University of Groningen

The Economic Impact of Local Government

Jong, Dylan

DOI:
[10.33612/diss.155033813](https://doi.org/10.33612/diss.155033813)

IMPORTANT NOTE: You are advised to consult the publisher's version (publisher's PDF) if you wish to cite from it. Please check the document version below.

Document Version
Publisher's PDF, also known as Version of record

Publication date:
2021

[Link to publication in University of Groningen/UMCG research database](#)

Citation for published version (APA):

Jong, D. (2021). *The Economic Impact of Local Government*. [Thesis fully internal (DIV), University of Groningen]. University of Groningen. <https://doi.org/10.33612/diss.155033813>

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The Economic Impact of Local Government

This research was conducted at the Urban and Regional Studies Institute, Faculty of Spatial Sciences, University of Groningen.

ISBN: 978-94-6416-324-7

Cover design: Renée de Leau | www.reneedeleau.com

Lay-out: Publiiss | www.publiiss.nl

Print: Ridderprint | www.ridderprint.nl

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university of
 groningen

The Economic Impact of Local Government

PhD thesis

to obtain the degree of PhD at the
University of Groningen
on the authority of the
Rector Magnificus Prof. C. Wijmenga
and in accordance with
the decision by the College of Deans.

This thesis will be defended in public on

Thursday 28 January 2021 at 14.30 hours

by

Dylan Maikel Oliver Jong

born on 3 May 1992
in Alkmaar

Supervisor

Prof. dr. P. McCann

Co-supervisor

Dr. V.A. Venhorst

Assessment Committee

Prof. dr. M.A. Allers

Prof. dr. F.G. van Oort

Prof. dr. S. Sheppard

Abstract

This dissertation studies the relationship between local governments and their local economic system. It is motivated by the increased transfer of power from central and regional government to local governments. The economic effects of this increase in local governmental power remain highly debated and the empirical evidence is still mixed. This dissertation adds new insights to the debate on the economic impacts of local governments by taking a detailed empirical approach. The main research question is:

To what extent, and in what ways, do local governments contribute to local economic development?

Answers to the research question are provided through four chapters, which seek to empirically examine, in great and novel detail, how the structure and fiscal composition of local governments affect local economic performance.

The empirical analyses start by entering the debate on decentralization, shedding a light on the economic effects of the increased transfer of power to local governments through detailed analyses. It makes the argument that the economic effects of decentralization are contingent on the quality of local governments, as well as the opposite argument, that the economic effects of the quality of local government is contingent on the degree of decentralization. Empirical analyses on European cities show that cities with high local autonomy, high quality of government, and low horizontal fragmentation are best performing. Furthermore, empirical analyses show that *organizational autonomy*, *policy scope*, *discretion* and *vertical autonomy* are most important for generating positive economic effects.

Given the potential for local governments to positively affect economic performance, the dissertation continues in analyzing how these positive effects may be achieved. It does so by taking a detailed full local public fiscal composition approach to empirically estimate the economic effects of separate fiscal components. Analyses on US cities show that the economic impacts of fiscal components depend on how they are “financed”. For example, increasing taxes only negatively affects economic growth when used to fund non-productive expenditures. When used to fund productive expenditures, increasing taxes may actually enhance economic growth. Relative productive expenditures are public welfare, highways, utilities, and commercial activities.

Given that it is not the sole purpose of local governments to enhance economic growth, the dissertation uses similar empirical estimations to explore how local governments may enhance well-being. In line with literature, well-being is inferred from population growth, using a Tiebout-Rosen-Roback style estimation strategy. Empirical analyses on US cities show that cities may attract population through increased expenditures and investments into infrastructure, such as highways, parking, and air transit. Furthermore, expenditures on

housing and community development and investments in higher education attract population.

Finally, the local public fiscal effects of an economic shock to the system are examined through a case study on the shock of the fracking-boom in Texas. Empirical analyses use a detailed, full local public fiscal composition approach. Results show that the positive economic effects of fracking result in higher housing prices and thus, higher property tax. Given that county governments and school districts are the main beneficiaries of property tax, these experience a growth in their budgets. County governments use the additional local public revenues mostly to deal with the negative externalities of the fracking-boom through increased highway, judicial administration, and police expenditures. School districts use the additional funds to increase elementary and secondary education expenditures to cope with the influx of children coming along with the influx of workers. The chapter concludes with a discussion on the policy implications of the results, concluding that the fracking-boom creates winners and losers. The results suggest that the losers are not compensated much for the negative externalities. Higher compensation may be achieved through impact fees, or in-kind-transfers.

Together, these four chapters introduce new ideas on how local governments affect their local economic system and how the local economic system may affect them. Each chapter has its own value, both to the academic literature, as well as to policymakers. The main novelty of the dissertation is found in the level of detail given to the separate topics. It makes the case for more detail as a means to enhance our understanding of the economic effects of local governments.

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Overview of chapters

Chapter 2 - Local autonomy, fragmentation and quality of government: The urban productivity effects of local governments.

Chapter based on: Jong, D.M.O. (2019). Urban productivity effects of decentralization and quality of government. NARSC Conference, 13th – 16th November, Pittsburgh, PA, USA.

Chapter 3 - How does the local public fiscal composition affect local economic growth? Insights from US cities.

Chapter based on: Jong, D.M.O., McCann, P., & Venhorst, V.A. (2019). Local public fiscal composition and economic growth. RSAI-BIS Conference, 16th – 18th July, Cambridge, UK.

Chapter 4 - A pure empirical application of local expenditures: 'Voting with your feet' and the provision of US urban services.

Chapter based on: Jong, D.M.O., McCann, P., & Venhorst, V.A. (2019). Local public finance and revealed preferences: well-being in US cities. NARSC Conference, 13th – 16th November, Pittsburgh, PA, USA.

Chapter 5 - Local public fiscal effects of fracking: The case of Texas.

Chapter based on: Jong, D.M.O., & Craig, S.G. (2020). Local public fiscal effects of fracking: The case of Texas. NARSC Conference 9th – 13th November, virtual conference.

CHAPTER 1

INTRODUCTION

1.1 Introduction to the topic

This dissertation studies the relationship between local governments and their local economic system. The aim is to explore the economic impact of local governments. This is done through four empirical analyses. First, the importance of the autonomy, structure and quality of local governments for their economic impact is explored. Subsequently, the economic and well-being effects of the local public fiscal composition are analyzed. The local public fiscal composition represents the composition of local public expenditures and revenues. Thus, how much is spent on what, and how is it financed. Finally, the reversed relationship is analyzed through a case study on the fracking-boom in Texas. The local public fiscal effects of the fracking-boom shock to the local economic system are analyzed in order to better understand the consequences of such a shock for local governments.

This dissertation is motivated by the increasing transfer of power from central governments to subnational governments, which is part of the ‘silent revolution’ of increased decentralization (OECD, 2019). Although the decentralization trend describes the increase in power of subnational governments, this dissertation focuses specifically on local governments. This is motivated by the fact that every country has local governments, whereas various countries do not have regional/state level governments (OECD, 2019). Furthermore, local governments are generally comparable across countries, whereas regional/state level governments may differ distinctly in their responsibilities, e.g. provinces in the Netherlands and states in the United States.

This transfer of power to local governments is driven by arguments that there are heterogeneous preferences, and that local governments have a better understanding of the specific local needs (Klugman, 1994; Oates, 1999; Tiebout, 1956). This trend of increased decentralization has also been accompanied by an increasing focus on regional and local policy-making in the form of place-based policies (Barca, 2009; Barca, McCann, & Rodríguez-Pose, 2012), and smart specialization (Foray, 2014; McCann & Ortega-Argilés, 2014). Furthermore, insufficient focus on local issues has been linked to the growing geography of discontent (McCann, 2020) and revenge of places that don’t matter (Rodríguez-Pose, 2018).

However, the empirical evidence on the economic effects of decentralization is mixed (Baskaran, Feld, & Schnellenbach, 2016; Carniti, Cerniglia, Longaretti, & Michelangeli, 2019). Moreover, there are numerous arguments in favor of a more centralized governmental system, arguing that there are universal needs which central government is more efficient at dealing with (Prud’homme, 1995), and arguments that subnational governments may lack the capacity, resources and expertise to deal with a great number of activities (Ahrend, Farchy, Kaplanis, & Lembocke, 2017; Prud’homme, 1995; Rodríguez-Pose & Gill, 2004). The debate on the optimal degree of decentralization is therefore still far from being solved (Carniti et al., 2019).

Given the increased power transferred to local governments, and aware of the debate that exists on this trend, this dissertation explores the relationship between local governments and their economic system. I find that there is a need for detailed study on how local government contributes to local economic development through their organizational structure, and through their local public fiscal composition. This is therefore translated into the following research question:

To what extent, and in what ways, do local governments contribute to local economic development?

This dissertation includes four chapters which seek to empirically examine, in great and novel detail, to what extent, and in what ways, local governments contribute to local economic development. This starts by exploring the importance of the organizational structure and quality of local governments for local governments to enhance local economic development. The analyses enter the debate on decentralization, shedding a light on the economic effects of the increased transfer of power to local governments. It makes the argument that cities with high local autonomy, high quality of government, and low horizontal fragmentation are best performing. Furthermore, it goes into more detail as to the specific dimensions of local autonomy that generate these positive effects. Building on that, I explore how the composition of local public finance contributes to local economic development. Will this be through traditionally accepted growth enhancing expenditures such as education and infrastructure, or do we find different patterns for local governments? Given that economic growth is not the only, or even the most important, goal of local governments, I also explore how local governments may enhance well-being. Finally, as a case study, the shock of the fracking-boom in Texas is used to examine the effects of an economic shock to the fiscal health and revenue and expenditure patterns of local governments.

Together, these four chapters introduce new ideas on how local governments affect their local economic system and how the local economic system may affect them. Each chapter has its own value, both to the academic literature, as well as to policymakers. The first chapter provides new insights into the complexity of decentralization. With the current debate stuck, this may create an opening for future research. It also presents new nuances to policymakers on when and how to decentralize power to local governments. The second and third chapter provide a new level of detail to the debate on how local governments affect economic growth and well-being. Both chapters may help structure debates on local public fiscal compositions. Furthermore, policymakers may find the results helpful to use in deciding on budgeting decisions. Finally, the detailed analyses on the local public fiscal effects of the fracking-boom, including the extended discussion of the results, brings new valuable insights into how the fracking-boom has affected the local communities, and whether or not a community should restrict fracking.

A novelty in this dissertation is the level of detail given to the separate topics. The economic effects of decentralization are explored using seven dimensions of local autonomy, three quality of government dimensions, and horizontal fragmentation. The economic growth and well-being effects of local governments are analyzed by taking a full compositional approach, considering separate expenditure and revenue components, and decomposing expenditures into capital outlay and current operations expenditures. Finally, the fracking-boom effects on local public finance again use the full composition, with a further decomposition into the four types of local governments in Texas. This dissertation and its results make the case for more detail as a means to enhance our understanding of the economic effects of local governments.

However, before delving into the chapters, this introduction first provides some background on what local governments actually are, what they do, and how they have developed over the past decades. The decentralization section shows that local governments have increasingly gained more power and responsibilities, thereby increasing the importance and relevance of local governments. Subsequently, the specific revenue and spending patterns of local governments are explored in order to explore the activities of local governments across various countries. Given that three of the four chapters in this dissertation are focused on local governments in the US, section 1.4 further explores the specific context of local governments in the US. With the background information covered, section 1.5 briefly summarizes the four studies this dissertation includes.

1.2 Decentralization

This section explores the decentralization trend of the transfer of power to local governments. The numerous arguments in favor of decentralization, as well as against, are discussed in chapter 2 of this dissertation, and will be ignored for now. Instead, this section presents a descriptive overview of the differences in degree of decentralization to local governments across countries, and the trend of increased decentralization over time. This helps to get a sense of this overall trend of decentralization, and thereby the increasing trend of the importance of local governments¹.

The past 50 years have shown a trend of increased decentralization all over the world (OECD, 2019). The OECD defines decentralization as the: “*transfer of powers and responsibilities*

¹ One distinction that is not explored in the chapters included in this dissertation, but that may be interesting to note, is that between unitary states and federal countries. The distinction lies in that in federal countries, the federal government shares sovereignty with the subnational/regional entities, meaning they share power, and all have their own parliament, government, and usually constitution (OECD, 2019). Unitary countries on the other hand, have one centralized government, which may delegate powers to subnational levels of government, but remains sovereign by itself regardless of this (OECD, 2019). Examples of federal countries are Australia, Belgium, Canada, Germany, and the United States. Examples of Unitary countries are the UK, France, Japan, Italy and the Netherlands. Some countries are somewhat in between and therefore dubbed by the OECD as quasi federal states are South Africa and Spain (OECD, 2019). One could thus say that, *ceteris paribus*, federal countries are more decentralized. However, decentralization is more complex than that as will be outlined below and especially in chapter 2 of this dissertation.

from the central government level to elected authorities at the subnational-level (regional governments, municipalities etc.” (OECD, 2019). This trend of increased decentralization has increased the importance of subnational governments. It is also reflected in the increasing academic focus on regional/local differences, and the need for specific policy reflecting these differences. For this, one could think of the place-based policies (Barca, 2009; Barca et al., 2012) and smart specialization (Foray, 2014; McCann & Ortega-Argilés, 2014). Such need for policies to be reflecting the regional/local needs, is also argued to be a relevant factor to combat phenomena of the geography of discontent (McCann, 2020), or the revenge of the places that do not matter (Rodríguez-Pose, 2018).

While the commonly observed decentralization trend describes the increasing transfer of power and responsibilities to subnational governments, both regional and local, this dissertation focuses specifically on local governments. The focus on local governments is motivated by the fact that every country has local governments, whereas various countries do not have regional/state level governments (OECD, 2019). Furthermore, local governments are generally comparable across countries, whereas regional/state level governments may differ distinctly in their responsibilities, e.g. provinces in the Netherlands and states in the United States. The OECD defines local government units as: “*units whose fiscal, legislative, and executive authority extends over the smallest geographical areas distinguished for administrative and political purposes*” (OECD Glossary of Statistical Terms source publication: *SNA 4.128.*). Generally, local governments are municipalities, but the types of local governments may differ across countries.

Fiscal decentralization is probably the most common way to capture decentralization. It is measured as the share of subnational/local governmental expenditures/revenues relative to the total governmental expenditures/revenues. It therefore captures the degree of *fiscal* decentralization. The benefit of using fiscal decentralization is data availability and data variance. Most countries have data available on how much of their governmental expenditures and revenues are spent/sourced at the subnational level, allowing one to calculate these fiscal decentralization measures. Furthermore, these fiscal decentralization measures will naturally differ somewhat over time and across regions, allowing for more complex econometric methods. The OECD has some cross-sectional data on the degree of local public fiscal decentralization. Figure 1.1 below shows four local fiscal components measured as the share of the same transaction by the general (total) government. It thus captures the degree of local fiscal decentralization².

Figure 1.1: Local public fiscal decentralization

Source: own visualization using data from the Subnational government structure and finance, OECD Regional Statistics (database). Note, data on debt are missing for Mexico and Australia.

The figure is sorted from high to low expenditures. It shows that the EU28-total have the highest fiscal decentralization of expenditures to local governments at around 23%. The country with the lowest fiscal decentralization in the data available is Australia at around 6.5%. Local revenues generally follow a similar pattern although it is generally slightly higher than the share of local expenditures. The graph shows that the share of investments spent by local governments is especially high, going from around 25% up to more than 40%. Given that investments are a major factor in which government may foster economic performance, the high share of investments done by local governments shows the importance of local governments for economic performance. Finally, the share of debt is generally smaller than that of expenditures and revenues, except for Switzerland.

However, as has been pointed out (OECD, 2019), fiscal decentralization does not capture the full complexity of decentralization. It may be that subnational governments simply execute orders given by the central government, without any authority or autonomy in deciding how the money is spent. In this case, the money shows up at the subnational government account, suggesting a degree of decentralization, while the power is actually not really in the hands of the local governments. Furthermore, I would argue that the fiscal decentralization variance is mostly the outcome variance in economic performance, both across regions as well as across time, rather than capturing the actual degree of power a particular regional or local government has. Therefore, I include the Local Autonomy Index (LAI) development below. The LAI

captures the degree of power local governments have for a large set of European countries (Ladner & Keuffer, 2018; Ladner, Keuffer, & Baldersheim, 2015, 2016). It is measured using expert surveys with a detailed codebook and consists of seven dimensions, which in turn depend on multiple factors. Chapter 2 of this dissertation discusses these dimensions in more detail. The dimensions are summarized into one index through the use of different weights. The index is normalized, running from zero (low local autonomy) to one-hundred (high local autonomy). The LAI development is plotted for the period 1992-2014 in figure 1.2.

Figure 1.2: Local Autonomy Index development (1992-2014)

Source: own visualization using data from the Local Autonomy Index (Ladner et al., 2015). The line represents where LAI 1992 equals LAI 2014. Countries included in the graph are: Albania, Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Georgia, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Liechtenstein, Lithuania, Luxembourg, Macedonia, Moldova, Netherlands, Norway, Poland, Portugal, Romania, Serbia, Slovak Republic, Slovenia, Spain, Sweden, Switzerland, Turkey, Ukraine, and the United Kingdom.

The figure shows that most countries have higher LAI values in 2014 than they did in 1992. Thus, local autonomy has increased in most countries. The biggest increases are visible in: Albania, Romania, Slovenia, Macedonia, Bulgaria, and Poland. A notable decrease in LAI may be found in Luxembourg, Spain and Hungary.

The trend of increased decentralization has been going hand-in-hand with a trend of decreased horizontal fragmentation. Horizontal fragmentation commonly refers to the

number of municipalities/local governments per capita. Thus, while local governments have increased in autonomy, they also increased in size through mergers, thereby decreasing in number. Figure 1.3 below, shows the development of horizontal fragmentation for 1992-2014. Horizontal fragmentation is captured here as the number of municipalities per one-million citizens.

Figure 1.3: Horizontal fragmentation development (1992-2014)

Source: own visualization using data from the Local Autonomy Index (Ladner et al., 2015). Horizontal fragmentation captures the number of municipalities per one-million citizens. The line represents where fragmentation 1992 equals horizontal fragmentation 2014. Countries included in the graph are: Albania, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Netherlands, Norway, Poland, Portugal, Slovak Republic, Slovenia, Spain, Sweden, Switzerland, Turkey, and the United Kingdom.

1.3 What do local governments do?

In order to identify what local governments actually do, the revenue and spending patterns of local governments across various countries are examined. The OECD has cross-sectional data on the spending patterns of local governments for a number of countries. First, the composition of local public expenditures is shown in figure 1.4. The figure shows the shares of each expenditure category. Thus, the combined categories add up to 100%.

The figure shows quite some variation in the expenditure composition across countries. Switzerland has a relative high share of expenditures on education, Germany on social protection, Austria on health, and Spain on general public services. Furthermore, the figure is sorted by local public expenditures as a share of total public expenditures, in line with figure 1.1 of the decentralization section (1.2). It therefore also shows that the countries with a relatively lower share of decentralization in local public expenditures, use relatively large shares of their expenditures for “other” than those outlined below.

Figure 1.4: Local public expenditure compositions

Source: own visualization using data from the subnational government structure and finance, OECD Regional Statistics (database). Note that the countries are sorted by local public expenditures as a share of total public expenditures, in line with figure 1.1.

Figure 1.5 shows a similar plot, but now for the share of investments. The graph shows that most investments generally go to economic affairs, although “other” is also relatively high, as well as general services in some countries. Finally, figure 1.6 shows how local governments source their revenues. It shows that local governments generally source their revenues through grants and subsidies, as well as taxes, followed at a distance by tariffs and fees. Property income and social contributions are relatively low for these countries.

Figure 1.5: Local public investment compositions

Source: own visualization using data from the subnational government structure and finance, OECD Regional Statistics (database). Note that the countries are sorted by local public expenditures as a share of total public expenditures, in line with figure 1.1.

Figure 1.6: Local public revenue compositions

Source: own visualization using data from the subnational government structure and finance, OECD Regional Statistics (database). Note that the countries are sorted by local public expenditures as a share of total public expenditures, in line with figure 1.1.

This section shows the cross-country variability in the fiscal responsibilities of local governments. This alone, already suggests that there is still a discussion on the optimal structure of local governmental responsibilities. If the optimal structure would have already been defined, one would expect local governments to have similar structures across countries. The variability in the structure of the spending and revenue patterns across countries, combined with the increasing debate on the optimal decentralization structure, are the main motivation to take a detailed look at how local governments interact with their local economic systems. The aim is to establish new insights and clarity into the debate on the power structure of local governments and the structure of local public fiscal compositions.

1.4 Local governments in the United States

Given that three out of the four chapters are on US local governments and that the US has a particularly complex system of local governments, the structure of US governments is discussed more in detail below. The structure of the local governments within the US, as in most countries, may be divided into three levels: federal, state, and local governments. An overview of the levels of government may be found in table 1.1.

Table 1.1: US levels of government

	General-purpose	Special-purpose
Country-level	Federal government	
State-level	State government	
Local-level	Counties	School districts
	City/Municipalities	Special districts
	Towns/Townships	

Source: author's own visualization of the types of government within the United States.

There is one federal government and there are 50 state governments. Every state is divided into counties with, on average, around 100.000 people per county, going from around 10 million in Los Angeles County (California), to less than 100 in Kalawao County (Hawaii)³. These counties may include multiple city governments/municipalities or townships/towns to deal with the specificities of that region, city or town. These governments are all general-purpose governments, and variations of these are generally found in any country.

The complexity of the US structure is found in the special purpose governments, which are found at the local level. These governments are created to deal with a specific special purpose. Given that (historically) most of these are responsible for schools, a distinction is made between school districts and special districts. The special purpose of the special districts can be nearly anything. Given the general lack of requirements, they are therefore also notorious to being misused to circumvent regulations (Goodman & Leland, 2019)⁴. The trend in the composition of local governments is visualized in figure 1.7. It shows that the number of school districts has dramatically declined, whereas the number of special districts

has been increasing. The general-purpose governments have generally remained the same over time, showing little to no general-purpose government mergers.

Figure 1.7: Trends in US local governments

Source: own visualization using data from the Census of Governments, US Census Bureau.

Now that the specific types of local governments that exist within the US are known, their relative size can be examined. Figure 1.8 shows the total revenues and expenditures for the three levels of government, with revenues subdivided into *non-transferred (own source)*, *federal intergovernmental transfers*, *state intergovernmental transfers*, and *local intergovernmental transfers*. The figure shows that the federal government is the biggest, both in terms of revenues, as well as expenditures. The state governments are slightly bigger than the local governments although, when deducting intergovernmental transfers from the expenditures, local governments become bigger than state governments. In percentages, the federal, state and local government source around 42%, 32%, and 25% of total revenues respectively. Looking at own-source revenues, this changes to around 51%, 29%, and 21% respectively. The intergovernmental transfers generally go down in level, from the federal government to the states, and from the states to the local governments. The total expenditure shares per level of government are 48%, 28%, and 24% for the three levels of government respectively. Deducting intergovernmental transfers, results in 47%, 25%, and 28% respectively.

Figure 1.8: Aggregated size US governmental levels (2017)

Source: own visualization using data from the US census Bureau, *Annual Survey of State and Local Government Finances*. The data are in trillions of USD, for the year 2017. Note, there may be slight discrepancies between total the transfer values of the revenue and expenditure-side. This is because the US Census data has minor discrepancies between these values, where for example, total spending on intergovernmental transfers from local governments to local governments is slightly lower than the total revenues on intergovernmental transfers from local governments. These discrepancies are small however, as becomes clear from the figure.

Figures 1.9 and 1.10 show the local public revenues and expenditures for the US. It shows that cities/municipalities are the largest by revenues and expenditures, followed by school districts, counties, special districts, and finally towns/townships. Figure 1.9 shows that most revenues are sourced through intergovernmental transfers and property tax. Cities/municipalities and special districts also source a major share of revenues through utilities. Sales and gross receipts tax revenues are sourced by counties and cities/municipalities. Figure 1.10 shows the composition of expenditures across the five types of local government. It naturally shows that most education expenditures are spend by the school districts. It is also the only thing school districts are responsible for, except a share of “other” expenditures. The size of the education expenditures also shows that it is by far the biggest expenditure category for the local governments combined. Infrastructural expenditures are also quite large, with most of them being spend by cities/municipalities and special districts. Similarly, cities/municipalities show the highest expenditures on public safety. County governments are mostly responsible for welfare and health.

Figure 1.9: Decomposition of US local public revenues (2017)

Source: own visualization using data from the US census Bureau, Annual Survey of State and Local Government Finances. The data are in billions of USD, for the year 2017.

Figure 1.10: Decomposition of US local public expenditures (2017)

Source: own visualization using data from the US census Bureau, Annual Survey of State and Local Government Finances. The data are in billions of USD, for the year 2017. Note: welfare and health includes expenditures on public welfare, health, and hospitals. Infrastructure includes expenditures on highways, sea and port, air transit, parking, and utilities. Public safety includes expenditures on police, fire protection, correctional facilities, and inspection and regulation. Community includes expenditures on housing and community development, parks and recreation, waste management, and sewerage. Other expenditures include expenditures on natural resources, commercial activities, public buildings, interest on debt, liquor stores, and employee and retirement trust funds.

1.5 Brief overview of the chapters included

This section briefly introduces the specific chapters included in the dissertation. The order of the chapters follows a similar structure as the background information in that it starts with a chapter on the increasing transfer of power to local governments, followed by analyses on the local public fiscal compositions.

The second chapter of this dissertation explores the economic implications of the complex structure and quality of local governments. It starts with a literature overview on the discussion of the economic effects of decentralization. While the topic has received a lot of attention over the past few years, there is still a lot we do not know, resulting in an unsolved debate on the economic effects of decentralization (Carniti, Cerniglia, Longaretti, & Michelangeli, 2019). The complexity of decentralization is linked to the mixed empirical economic effects of decentralization and the unresolved debate on the topic. The complexity of decentralization is described using definitions by the OECD establishing three decentralization dimensions: *political*, *administrative*, and *fiscal* (OECD, 2019). It is argued that there has been a heavy focus on only the *fiscal* decentralization dimension, arguably due to the data availability and variance. Therefore, there is a need for a better understanding of the economic implications of the full complexity of decentralization. The argument is made that the economic effects of decentralization are contingent on the quality of local government, as well as the opposite argument, the quality of local government effects are contingent on the degree of decentralization. The Local Autonomy Index (LAI) and horizontal fragmentation are used to capture the full complexity of decentralization. A mixed-multilevel model approach is used to estimate urban productivity in European Functional Urban Areas through information on the degree of local autonomy given in each country, combined with the quality of (local) government, and degree of horizontal fragmentation. Novel insights and nuances on the economic effects of local governments are gained through the use of separate decentralization and quality of government dimensions. Results show that local governments only (positively) affect urban productivity when quality of government is high, local autonomy is high, and horizontal fragmentation is low. A detailed decomposition of the results shows that this holds true for all three quality of government dimensions: corruption (inversed), quality of public services, and impartiality. Furthermore, a detailed decomposition of the local autonomy dimensions shows that the positive quality of government effects are best captured in a context of low horizontal fragmentation and high *organization autonomy*, *policy scope*, *discretion*, and *vertical autonomy*.

With the understanding that a high quality of local government in the right context may enhance local economic performance, the third chapter looks at how local governments may achieve this. This is done through a detailed analysis of the local public fiscal compositions of local governments in US cities, including a distinction between current operations expenditures and capital outlay. The chapter briefly summarizes the large bundle of literature

on the relationship between public finance and economic growth. Subsequently, it highlights that while we know a lot about this relationship, we know relatively little on the specific relationship between local public finance and local economic growth. The argument is made that local governments have distinctly different responsibilities. Therefore, the overall conclusions of the literature on public finance and economic growth cannot simply be translated 1:1 to the situation of local governments. Furthermore, given there is less research on the relationship between local public finance and local economic growth, there is even less research considering the full composition of local governments. Commonly, empirical research focuses on one type of local public expenditure, such as education. We argue however, that all fiscal decisions are relative, in that every expenditure needs to be financed through increased revenues, or a decrease in another expenditure component. These constraints, as well as the budget constraints are considered in the chapter, resulting in a new level of detailed understanding on the relationship between local public finance and local economic growth. Estimations are performed for 119 of the biggest US cities. The results show that the interpretation of the fiscal components indeed depends on how they are financed. For example, increasing revenues/taxes does not necessarily negatively affect economic growth. It only shows negative effects when used to finance non-productive expenditures. When used to fund productive expenditures, the increase in tax may actually have positive economic growth effects. Thus, there is a relative component to the interpretation of each fiscal component. Expenditures on public welfare are found to be relatively productive, as are capital outlay on highways, utilities, and commercial activities. Relatively unproductive expenditures are those on public safety, health, parks and recreation, public buildings, and interest on general debt.

The fourth chapter continues the line of reasoning set in the second chapter to estimate population growth effects associated with the composition of local public finance. This follows the line of reasoning as established by Tiebout (Tiebout, 1956) through the famous concept of 'voting with your feet'. However, instead of looking at the sorting of people into local communities within a city or region, the chapter looks at how central cities in general may attract people. The analysis includes Rosen-Roback controls in the form of housing prices and personal income (Roback, 1982; Rosen, 1979). The chapter discusses existing empirical evidence, showing that, like with local public finance and local economic growth, existing literature often focuses on one or two expenditure components rather than considering the full local public fiscal composition. Detailed overlapping dynamic five-year averaged estimations are performed in order to derive which local public expenditures may attract people to move to the US cities. The results first of all show that a bigger local government (higher taxes) hampers population growth. Controlled for government size, we find that shifting expenditures towards infrastructure indeed enhances population growth. Growth enhancing expenditures are expenditures on airports parking, and highways. Furthermore, we show that increasing the living conditions may also attract people to move to the city,

through increased expenditures on higher education, hospitals, and parks and recreation. In line with work previous work (Faggian, Olfert, & Partridge, 2012; Goetzke & Islam, 2017), we cautiously infer well-being effects from these population growth effects. Thus, it is argued that shifting expenditures towards infrastructure, and higher education, hospitals, and parks and recreation enhances well-being.

The fifth chapter includes a case study on the local public fiscal health and composition effects of a shock to the local economic system in the form of the fracking-boom. There is a lot of debate on the implications of fracking on the local communities, with some US states going as far as completely banning fracking activities in their jurisdiction (Bartik, Currie, Greenstone, & Knittel, 2019; Zwick, 2018). The benefits of fracking are economic (Bartik et al., 2019). However, it has also been shown to come with negative externalities through various environmental effects and social impacts associated with the large sudden influx of (mostly young-male) workers (Zwick, 2018). Furthermore, there is a debate on how the fracking activities affect local public fiscal health (Zwick, 2018). On the one hand, fracking activities result in increased economic output, meaning higher wages and housing values, and thus, higher local public revenues. At the same time, it is argued that fracking leads to a short-term increase in expenditures associated with the influx of new workers, dealing with the environmental and social impacts of fracking, and the need for investment in roads in order to facilitate the increase of heavy trucks working in the gas and oil industry. While there is some indication that the fracking-boom has been largely budget neutral for local governments (Bartik et al., 2019; Newell & Raimi, 2015), we do not know how the effects develop over time, how different types of local governments are affected, and to what extent neighboring counties are affected. The chapter presents a detailed analysis of the local public fiscal effects for local governments. The case study is on Texas because Texas is one of the US states that is most severely affected by the fracking-boom, and because it has detailed data on the development of the creation of gas and oil wells and gas and oil production. The estimation strategy includes difference-in-difference estimations, as well as models using spatial econometrics. The results confirm findings of previous work in that the fiscal effects have been largely budget-neutral (Bartik et al., 2019; Newell & Raimi, 2015). Furthermore, results show that the increase in revenues is mostly due to an increase in property tax. County governments and school districts are the main types of government sourcing property tax. It is therefore in line with expectations that these are found to increase in revenues per capita. The question then is, whether these funds are used to cope with the negative externalities of fracking, or if the increased revenues are also used to invest or give back to the community. We find that county governments mostly increase spending to deal with the negative externalities through increased spending on highways, police, and judicial administration. However, there is also a slight increase in per capita spending on parks and recreation. The school districts spend their increased funds on elementary and secondary education, while actually lowering spending on higher education. The increase in spending on elementary and

secondary education partly has to do with an increase in students. However, spending per student also goes up, be it only weakly significant. The chapter ends with a discussion on whether or not local communities should welcome the fracking activities, concluding that there may be winners and losers in the local community, but that as a whole, the benefits do not seem to outweigh the negative externalities. Local communities could be compensated more for the negative externalities associated with fracking through impact fees or in-kind-transfers.

The sixth chapter concludes the dissertation. It highlights the main findings of the work and discusses the theoretical and policy implications of these findings. Furthermore, it uses the novel insights gained through this work to present ideas for future work through which we may continue to push the knowledge on the topic of the economic impact of local government. Finally, a brief epilogue is included on how we may use the novel insights gained through this work to think about the current Covid-19 crisis, including suggestions for future work.

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CHAPTER 2

LOCAL AUTONOMY, FRAGMENTATION AND QUALITY OF GOVERNMENT:

THE URBAN PRODUCTIVITY EFFECTS
OF LOCAL GOVERNMENTS

Abstract

Over the past few decades, a “silent revolution” of decentralization has been observed, with increased policy power going to regional and local governments. The general assumption is that local governments have a better understanding of the local needs and can therefore better tailor the public services accordingly, resulting in economic benefits. However, empirical evidence on the economic effects of decentralization is mixed. This chapter argues that the economic effects of decentralization may be contingent on the quality of government, but also, that the economic effects of quality of government may be dependent on the degree of decentralization. Instead of using fiscal decentralization to measure the degree of decentralization at the local level, the Local Autonomy Index and horizontal fragmentation are used to capture the full complexity of decentralization. The combined urban productivity effects of local autonomy, horizontal fragmentation and quality of government are examined for European cities over 2003-2014. While the work is descriptive and exploratory in nature, support is provided that the positive association of quality of government is contingent on the degree of local autonomy and horizontal fragmentation. The positive quality of government effects are capitalized most when there is a high degree of local autonomy and a low degree of horizontal fragmentation. Similarly, I only find a positive association for increased local autonomy in a context of high quality of government and low horizontal fragmentation. The results are similar for the three quality of government dimensions: corruption (inversed), quality of public services, and impartiality. The local autonomy results are especially driven by organizational, policy scope, discretion, and vertical autonomy.

Keywords: Productivity; Local autonomy; Fragmentation; Quality of government

JEL classification: H11, H77, O47

2.1 Introduction

The positive effect of the quality of government on economic performance is well documented, both at the national-level (e.g. Acemoglu, Johnson, & Robinson, 2005; Barro, 1997; La Porta, Lopez-de-Silanes, Shleifer, & Vishny, 1999) and, more recently, at the regional level (Rodríguez-Pose & Ketterer, 2020). Similarly, the relation between decentralization and economic performance has (recently) received a lot of attention (Baskaran, Feld, & Schnellenbach, 2016; Martínez-Vázquez, Lago-Peñas, & Sacchi, 2017). However, the empirical evidence on the economic effects of decentralization is mixed (Baskaran et al., 2016). The debate on the economic effects of transferring power to subnational governments is therefore still far from being solved (Carniti, Cerniglia, Longaretti, & Michelangeli, 2019; Hooghe et al., 2016; Rodríguez-Pose & Ezcurra, 2011; Rodríguez-Pose & Gill, 2005).

The main argument presented for the remaining controversiality in the relationship between decentralization and economic performance is that decentralization is a complex and multifaceted concept with various dimensions (commonly grouped into political, administrative, and fiscal) (Carniti et al., 2019; OECD, 2019). Given the commonly acknowledged complexity surrounding the concept of decentralization, it is interesting to find that most empirical attempts at deciphering the relationship between decentralization and economic performance, capture decentralization only through one of its dimensions: fiscal. Instead, this chapter uses the detailed information on the separate decentralization dimensions to disentangle the relationship between decentralization and economic performance.

Furthermore, I argue that the economic effects of decentralization may be contingent on the quality of government. The argument is that, in order to reap the positive effects of decentralization one needs to have a high quality of government. This angle has been largely ignored except for recent work by Muringani, Fitjar, and Rodríguez-Pose (2019). Furthermore, I explore the opposite argumentation: in order to reap the benefits of a high (local) quality of government, local government needs to be sufficiently decentralized. In a highly centralized context, regional differences in subnational government quality should translate less into regional differences in economic performance, simply because subnational governments have less autonomy to affect the economic performance of the region.

The research differs from the work by Muringani *et al.* (2019), in that it focuses specifically on the local level instead of regions. This is because most subnational governmental activities are taking place at the local level, instead of a regional level (OECD, 2019). Furthermore, the (commonly) used European Quality of Government Index (EQI) (Charron, Dijkstra, & Lapuente, 2014, 2015), uses survey questions that specifically focus on the quality of local governments, hence, better match data on the autonomy of local governments.

The combined effect of quality of government and decentralization is analyzed through the geographical level of European Functional Urban Areas (FUAs) over 2003-2014. Whether

looking at FUAs, metropolitan areas or cities, urban areas have for some time now been the drivers of economic growth and their relative importance continues to grow (Dobbs et al., 2011). The share of people living in metropolitan areas is steadily growing and the OECD metropolitan areas record a GDP growth that is 32% higher than in the rest of the OECD countries since 2000 (OECD, 2018). Given the relative importance of urban areas as drivers of economic growth, it is important to understand the role of institutions for urban areas. The focus on FUAs specifically ensures a common typology of urban form across regions and countries, as defined by the European Union and the OECD (Dijkstra, Poelman, & Veneri, 2019). Furthermore, it allows us to include horizontal fragmentation in the hypothesized interaction effects (Ahrend, Farchy, Kaplanis, & Lembeke, 2017). The Local Autonomy Index (LAI) (Ladner & Keuffer, 2018; Ladner, Keuffer, & Baldersheim, 2015, 2016) and horizontal fragmentation (Ahrend et al., 2017) are used to capture the degree of decentralization experienced in cities. Together with the EQI (Charron et al., 2014; Charron, Dijkstra, & Lapuente, 2015), these capture the combined effect of quality of government and decentralization on the productivity in cities.

Economic performance is captured through GDP per worker, thereby essentially capturing labor productivity, in line with similar work by Ahrend *et al.* (2017). However, I also estimate the effects in terms of GDP per capita, which is found to yield similar results and may be found in the robustness section (2.5.6).

The chapter is descriptive and exploratory given the nature of the limited variability in the variables of interest. This limits the possibilities of causal estimation strategies and interpretations, something that is unfortunately common in the decentralization literature (Carniti et al., 2019). Nevertheless, I argue that the combined decentralization and quality of government literature benefits from such a descriptive and exploratory approach in enhancing the understanding of the interaction associations of quality of government and decentralization. Its novelty in (1) its specific focus on local governments, (2) interaction of local autonomy, horizontal fragmentation, and quality of government, and (3) the new level of depth put forward by the detailed analysis of the separate local autonomy and quality of government dimensions, push the knowledge frontier on the economic effects of decentralization forward.

This chapter continues with a brief discussion on the literature of quality of government and decentralization, where I argue for a combined approach. Subsequently, the data section describes the sources and structure of the data used. Section 0 discusses the estimation strategy, after which the estimation results are presented. Finally, the results and relevance of the research are summarized and discussed.

2.2 Decentralization and quality of governments

This section starts with an extended discussion on the concept of decentralization, followed by brief discussion of the quality of government literature. Subsequently, arguments are presented why it is important to look at the interaction effect of these two concepts.

2.2.1 Decentralization literature

More and more work is being published on the issue of decentralization. Decentralization refers to: *“the transfer of powers and responsibilities from the central government level to elected authorities at the subnational level (regional governments, municipalities, etc.) and that have some degree of autonomy”* (OECD, 2019). Over the past decades, many (OECD) countries have decentralized power to local governments, sometimes called the “silent” revolution (Ladner et al., 2015; OECD, 2019). The general assumption behind this trend is that local governments have a better understanding of the local needs (Klugman, 1994; Oates, 1999; Tiebout, 1956). This argument has also developed into the concepts of place-based policies (Barca, 2009; Barca, McCann, & Rodríguez-Pose, 2012) and smart-specialization (Foray, 2014; McCann & Ortega-Argilés, 2014).

Decentralization is argued to foster policy innovation through policy competition (Justman, Thisse, & Van Ypersele, 2002; Martinez-Vazquez & McNab, 2003; Oates, 1972; Rose-Ackerman, 1980; Tiebout, 1956). This competition also allows one to benchmark the performance of local politicians through increased transparency (Belleflamme & Hindriks, 2005; Besley & Case, 1995), which may result in increased participation and accountability (Ebel, 2002; Putnam, 1993; Seabright, 1996). Furthermore, it may result in better sorting through consumer-voters *voting with their feet*, where in equilibrium, consumer-voters sorted in the jurisdiction with lower per capita fees may increase their incentive to save, thereby promoting growth (Brueckner, 2006). Tax competition may also lower tax burden, increasing capital accumulation through savings and thereby economic growth (Koethenbueger & Lockwood, 2010). Decentralization may also lead to shorter supply chains and less inefficient bureaucracies resulting in reduced costs (Carniti et al., 2019; Ezcurra & Pascual, 2008; Klugman, 1994). Finally, there are arguments related to opportunities for reducing regional inequality through increased (fiscal) decentralization (Carrascal-Incera, McCann, Ortega-Argilés, & Rodríguez-Pose, 2020; Ezcurra & Pascual, 2008; McCann, 2018; Rodríguez-Pose & Ezcurra, 2011).

However, there are also plenty of arguments in favor of more centralized governments. Subnational governments may lack the capacity, resources and expertise to tackle major projects (Ahrend et al., 2017; OECD, 2015a; Prud’homme, 1995; Rodríguez-Pose & Gill, 2004, 2005). Prud’homme (1995) argues that government should only provide basic universal needs which do not differ much across regions. It is therefore more efficient to have centralized governments responsible for these activities (Goodman, 2019). Increased decentralization

may also increase the complexity of the local public system, decreasing public understanding of the system, resulting in decreased political participation and accountability mechanisms (Goodman, 2019). Furthermore, increasing (fiscal) decentralization may actually result in higher regional inequalities when interregional fiscal stabilizers are insufficiently established (Bartolini, Stossberg, & Blöchliger, 2016; Blöchliger, Bartolini, & Stossberg, 2016). Local elites may also find it easier to capture local governments' interest, resulting in corruption or inequalities (Bardhan & Mookherjee, 2000; Bischoff & Krabel, 2017; Jia & Nie, 2017; Storper, 2006). Finally, subnational governments may be misused to circumvent limits on debt or expenditures (Faulk & Killian, 2017).

The debate on the economic effects of decentralization is still ongoing (Carniti et al., 2019; Hooghe et al., 2016; Rodríguez-Pose & Ezcurra, 2011; Rodríguez-Pose & Gill, 2005). Nelson and Foster describe these opposing views on decentralization as Centrist and Polycentrist and I will continue to use these terms in the remainder of this chapter to identify the opposing views (1999). A literature survey on the impact of decentralization may also be found by Martínez-Vázquez *et al.* (2017).

While the arguments in favor and against decentralization all relate to decentralization in general, each of them captures certain specific aspects of decentralization. Decentralization is a complex concept, consisting of various dimensions depending on one's definition. The OECD suggests three dimensions: *political*, *administrative*, and *fiscal decentralization* (OECD, 2019). The *political* dimension sets the legal basis of decentralization by describing how subnational administrators are selected, by appointment or through elections (OECD, 2019). The *administrative* dimension relates to the transfer of planning, financing and management decisions on some public functions to lower levels of government (OECD, 2019). Lastly, the *fiscal* dimension describes the taxing and spending responsibilities of subnational tiers of government.

2.2.2 Capturing the complexity of decentralization and empirical evidence

Given the complexity of decentralization scholars have come up with multiple ways of capturing the degree of decentralization to some level. This section describes various ways in which decentralization is captured and their implications.

2.2.2.1 Fiscal decentralization

Probably the most popular measure of decentralization is through fiscal decentralization. This is measured as the share of expenditures/revenues spent/extracted at a subnational level. Empirical evidence on the economic effects of fiscal decentralization are mixed (Baskaran et al., 2016). The outcomes are shown to be dependent on the measurements empirical specification, sample, decentralization measure, and level of spatial aggregation (Baskaran et al., 2016; Iimi, 2005; Martínez-Vázquez et al., 2017).

Single country studies show a positive relationship between fiscal decentralization and growth in China (Feltenstein & Iwata, 2005; Lin & Liu, 2000; Qiao, Martinez-Vazquez, & Xu, 2008), although it is found to be bad for inflation and therefore stability (Feltenstein & Iwata, 2005). Xie, Zou and Davoodi (1999) find no significant relationship for the United States between 1951-1992. In a cross-country setting, Davoodi and Zou find insignificant fiscal decentralization effects on economic growth for developed and developing economies (Davoodi & Zou, 1998), whereas Iimi (2005) finds positive effects for a variety of countries for 1997-2001.

Empirical work by the OECD suggests a positive correlation between fiscal decentralization and economic growth, productivity, and human capital (Blöchliger & Égert, 2013), as well as higher levels of interregional convergence (Blöchliger et al., 2016). It is also found that alignment between the revenues sourced locally, and local public expenditures, generates greater returns to public investments, as there is more pressure to “better design” local economic development policies (Bartolini et al., 2016; Blöchliger et al., 2016).

Another group of empirical papers suggest a bell shaped curve relationship between fiscal decentralization and economic growth, finding neither extreme fiscal decentralization (Rodríguez-Pose & Ezcurra, 2011), nor extreme centralization (Thiessen, 2003) to positively affect economic growth, but rather, that optimal decentralization is somewhere in between. Carniti *et al.* (2019) suggest that this bell-shaped relationship stems from the bell-shape relationship between government size and economic growth, suggesting that the decentralization effect on economic growth runs through its effect on government size. While Carniti *et al.* (2019) find a bell-shaped curve for expenditure decentralization and economic growth, they show that investment decentralization actually shows an inverted bell-shaped curve, suggesting that the positive effects of investment decentralization only really come through after a certain threshold.

2.2.2.2 *Indices*

However, fiscal decentralization only captures one dimension of the OECD definition of decentralization and misses the *political* and *administrative* dimensions. Scholars have acknowledged that there may be a discrepancy between which governmental entity spends/extracts the money and which governmental entity holds power or authority over it and argue that there should be “*no fiscal decentralization without political and administrative decentralization*” (OECD, 2019). If subnational government is bound by a large body of rules from central government resulting in hardly any power or authority to decide for themselves how to distribute its budget, fiscal decentralization alone does not provide the full picture of decentralization.

In order to capture the *political* and *administrative* dimensions of decentralization, scholars

have come up with surveys to determine per country, to what extent subnational governments have power, responsibility and autonomy. The surveys result in multiple dimensions, which together make up one index. Examples include the Regional Authority Index (Hooghe et al., 2016), the Local Autonomy Index (LAI) (Ladner & Keuffer, 2018; Ladner et al., 2015, 2016) and work by the OECD (Dougherty & Phillips, 2019). These indices capture decentralization as a matter of how much authority or autonomy a particular subnational level of government has, mostly at the country level.

The observation by Baskaran *et al.* (2016), that papers are more likely to find positive decentralization effects in single-country studies because of the presence of a common institutional framework is precisely why I would argue that the structure of most administrative, political, and also fiscal institutional framework is decided at the country-level, ironically, by the central government. Therefore, I would argue in favor of leveraging these country level differences. Furthermore, the RAI and LAI allow for a detailed analysis of the economic effects of the specific decentralization dimensions on which the indices are built.

In terms of empirical evidence, it has been shown that the interaction between RAI and quality of governments is positively associated with economic growth (Muringani et al., 2019). Furthermore, Filippetti and Sacchi (2015) interact fiscal decentralization with RAI, finding tax decentralization to have higher rates of economic growth in a context of high administrative and political decentralization.

However, this chapter uses the LAI (Ladner & Keuffer, 2018; Ladner et al., 2015, 2016) instead of the RAI because: (1) most subnational governmental activities are taking place at the local level, instead of the regional level (OECD, 2019). Furthermore, (2) the quality of government index (Charron et al., 2014; Charron, Dijkstra, & Lapuente, 2015) included in the interaction uses survey questions that focus on the quality of local governments specifically, hence, better match data on the autonomy of local governments. Finally, (3) focusing on the local level allows for the inclusion of horizontal fragmentation in the model, thereby capturing a distinct feature in the organization of local governments (more on this below). To the best of my knowledge, this is the first time that LAI is used to measure the effect of decentralization on economic performance.

2.2.2.3 *Fragmentation*

Besides these decentralization measures capturing some degree of local power, it is also argued that the degree of fragmentation captures aspects of decentralization (Stansel, 2005). Fragmentation may be either horizontally or vertically (Goodman, 2019). Horizontal fragmentation refers to the number of units within the same tier of local government. Vertical fragmentation refers to the market share and distribution of responsibilities of those units within the same tier, meaning that there may be multiple layers of local government

(Goodman, 2019). The decentralization trend of a transfer in power occurred in combination with a decrease in horizontal fragmentation driven by policies encouraging or imposing mergers or cooperation between local governmental entities.

Commonly, empirical focus is put on horizontal fragmentation (Ahrend et al., 2017; Goodman, 2019; Ladner et al., 2015; Stansel, 2005). The OECD labels it *administrative fragmentation* and measures it as the number of local governments within a FUA (Ahrend et al., 2017). Empirical evidence on the relation between horizontal fragmentation and urban productivity premiums is mixed. Stansel (2005) finds that horizontal fragmentation is positively associated with long-run income growth. Similarly, Goodman (2020) finds a positive association between horizontal fragmentation and long-run population growth. Furthermore, Goodman (2020) shows that an increase in special districts per municipality is associated with larger population growth. However, Grassmueck and Shields (2010) find horizontal fragmentation to be negatively associated with income and employment growth. Similarly, Hammond and Tosun (2011) find a negative association between horizontal fragmentation and population and employment growth.

Nelson and Foster (1999) also take into account vertical fragmentation, showing that income growth is highest in the presence of large suburban municipalities, with few elected special service district officials, and an overseeing metropolitan governance structure which may coordinate decisions among local governments. Similarly, Ahrend *et al.* (2017) find that the presence of a governance body mitigates the negative effect of horizontal fragmentation. Given the lack of data on vertical fragmentation, the more commonly used horizontal fragmentation is included in the models to capture this specific aspect of decentralization.

2.2.3 Quality of Government

Quality of government has been described as reflecting the extent to which governments act impartial, efficient, and non-corrupt (Charron et al., 2014; Charron, Dijkstra, Lapuente, Rodríguez-Pose, & di Cataldo, 2015). Literature describes various ways in which the quality of government affects regional economic performance (Charron et al., 2014; Rodríguez-Pose & Ketterer, 2020). Putnam (1993) already showed the importance of the quality of government in the case study on the differences between Northern and Southern Italian regions. Since then, quality of government has been shown to be a driver of economic performance through shaping regional diversification (Cortinovis, Xiao, Boschma, & van Oort, 2017), regional competitiveness (Annoni & Dijkstra, 2013) and regional potential for innovation (Rodríguez-Pose & di Cataldo, 2015). Higher quality of government is also associated with lower interregional inequalities (Ezcurra & Rodríguez-Pose, 2014), and less dominance from any particular city or region (OECD, 2015b). Furthermore, Rodríguez-Pose and Garcilazo (2015) show how the quality of government shapes the returns of European cohesion policies. The types of public good investments in infrastructure are also influenced

by the quality of government, thereby affecting the returns on investment (Crescenzi, Di Cataldo, & Rodríguez-Pose, 2016). While the quality of government has been argued to be based on history (Charron & Lapuente, 2013), and path dependent (Rodríguez-Pose & Ketterer, 2020), it is found to be possible for regions to increase their quality of government (Rodríguez-Pose & Ketterer, 2020). Such relative improvements in quality of government are a powerful driver of development, especially in low income countries (Rodríguez-Pose & Ketterer, 2020).

2.2.4 A combined approach

Given the complexity of decentralization, the plentiful Centrist and Polycentrist arguments, and the mixed empirical evidence on the economic effects of decentralization, this chapter argues that the economic effects of decentralization may be contingent on the quality of government. To see why, it helps to look again at the Centrist/Polycentrist arguments. Polycentrist arguments claiming decentralized governments to be able to better tailor their activities in line with the specific local needs (Tiebout, 1956), may implicitly assume a high quality of local government. In case of a low quality of subnational government, these subnational governments may not be able to translate their power into the hypothesized benefits of increased decentralization. In that case, it may be that the Centrist arguments become stronger relating to the economies of scale (Prud'homme, 1995) or corruption (Bardhan & Mookherjee, 2000; Bischoff & Krael, 2017; Jia & Nie, 2017; Storper, 2006).

This chapter therefore explores the interaction effect between decentralization and quality of government. Decentralization is captured through two variables. First of all, the LAI (Ladner & Keuffer, 2018; Ladner et al., 2015, 2016) is used to capture the degree of autonomy given to local governments. This variable is captured at the country level, given that the degree of local autonomy is often decided at the country level. Secondly, horizontal fragmentation is used to capture the structure of the local governments (Ahrend et al., 2017). This is measured through the number of local governmental entities within a FUA. Together, these two variables tell us how much autonomy local governments have and how fragmented they are.

The hypotheses are subsequently as follows. In line with previous research, I expect EQI to have a positive direct effect on labor productivity, whereas LAI is expected to have an insignificant direct effect (Ezcurra & Rodríguez-Pose, 2013; Muringani et al., 2019). Furthermore, I expect the interaction between EQI and LAI to be positive, in line with the work by Muringani *et al.* (2019). There are two arguments for this. First of all, I expect LAI to have a positive effect when EQI is high. The argument is that one needs high quality of government in order to reap the benefits of increased decentralization in terms of policy competition, transparency, accountability and the effectiveness of local governments to adjust their policies to the specific local needs. At the same time, I expect the positive interaction effect because the positive EQI effect is likely to be higher as LAI increases. In case of

low local autonomy, regional differences in quality of government should matter less, given that local governments have limited ways in which to influence labor productivity, and vice versa. Similarly, the effect of a low quality of government (e.g. corruption) should be more effectively translated into lower economic performance in case of a higher LAI context.

I extend this hypothesis by introducing fragmentation. Following the work of Ahrend et al. (2017), I expect cities with a high degree of horizontal fragmentation to be less capable of tackling bigger projects and therefore being less effective in their undertakings. Thus, the positive effect of EQI in decentralized countries (high LAI) will diminish as the cities become more fragmented. Therefore, I expect the biggest positive labor productivity effect to be found in a high EQI, high LAI, and low horizontal fragmentation context. A discussion on the expectations for the separate LAI dimensions is included in the “unpacking LAI” section (2.5.5).

2.3 Data

This section describes the data sources and structure, starting with a description of the LAI, followed by horizontal fragmentation. Subsequently, the quality of government data, labor productivity and control variables are described.

2.3.1 Local Autonomy Index

The LAI has been introduced by the European Commission and consists of panel data for EU countries running from 1990 till 2014 (Ladner et al., 2015). It was specifically created to closely resemble the Regional Authority Index (Hooghe et al., 2016), with the difference of capturing the specific characteristics of local government. It is created through a network of experts on local government, assessing the autonomy of local government of their respective countries based on a common codebook. Eleven variables have been identified which have been grouped into seven autonomy dimensions: *legal autonomy*, *organizational autonomy*, *policy scope*, *effective political discretion*, *financial autonomy*, *central or regional control and vertical influence*⁵. The autonomy dimensions are normalized from 0-100, after which they are combined using various weights based on judgements of the country group coordinators to form the LAI, running from zero (no local autonomy) to 100 (full local autonomy score). Table 2.1 at the end of section 2.3.4 includes summary statistics for all variables included in the estimations. It shows that LAI runs from 44.71 – 75.96, for the sample of countries, with LAI dimensions ranging from 12.89 – 100.

Figure 2.1 shows the LAI values over time. Germany shows a noticeable downward spike for the year 2011 in a number of its LAI dimensions, resulting in the LAI downward spike as found in figure 2.1. Other than that, most developments are only happening slowly. In line with the common observation of increased decentralization over the past decades, I find

⁵ Please find a detailed description on the measurement and definitions of the LAI and its dimensions in the official document (Ladner et al., 2015).

increased LAI values for 9 out of 14 countries. However, 4 countries actually show a decline, with Hungary and Spain showing a bigger decline than any increase shown in the sample. Finland remains the same level over time.

Figure 2.1: LAI values over time (2003-2014)

Source: own visualization using data from the Self-rule Index for Local Authorities (Release 1.0) by the European Commission (Ladner et al., 2015).

2.3.2 Horizontal fragmentation

Data on horizontal fragmentation is created using data on the number of local governmental organizations within the FUAs from the OECD Metropolitan database. Although the data is fixed in time, coming from the 2001-2011 census, the differences across cities within the same country are assumed to be relatively stable. Thus, there are no within horizontal fragmentation effects, only between.

While horizontal fragmentation is commonly defined as the number of administrative units per capita (Stansel, 2005), I expect a nonlinear relationship to be present, where city size does not grow in a 1:1 relationship with the number of administrative units. The reasoning is that one may expect any metropolitan area to need a certain number of administrative units. As the metropolitan area becomes bigger, one may assume a certain degree of economies of

scale, where larger cities need less administrative units per capita. Normalizing horizontal fragmentation per capita would then result in most big cities showing relatively low horizontal fragmentation, which I would argue is not a sign of low horizontal fragmentation, but rather a gimmick for its city size. Therefore, instead of simply dividing the number of local governmental organizations by the population size, the relationship between the two is predicted, after which the errors are used as horizontal fragmentation measures⁶.

Given that I only have data on horizontal fragmentation that is fixed in time, I include the interaction with time to make sure that I (mostly) capture *between* population variance, not *within* population variance. Given that population is mostly growing in the FUAs during the observation period, not doing so would mean that horizontal fragmentation is underestimated in the earlier years and overestimated in the later years simply due to the development of population. This yields the following:

$$(2.1) \text{Fragmentation}_{f,t} = \alpha + \beta_t \text{population}_{f,t} * \text{time}_t + \varepsilon_{f,t},$$

Where, $\text{Fragmentation}_{f,t}$ captures the natural log of the number of local governmental entities in FUA f , at time t , $\text{population}_{f,t}$ captures the natural log of population, and time is a dummy for each year. The $\varepsilon_{f,t}$ is subsequently used as a population independent indicator of horizontal fragmentation:

$$(2.2) \widehat{\text{Fragmentation}}_{f,t} = \varepsilon_{f,t},$$

The horizontal fragmentation estimation result is included in the appendix 2.A. It shows a population size coefficient of 0.649 for the population size in 2003, going down to 0.646 in 2014, showing that for every 1% increase in population, the number of local governmental entities grow by around 0.65%. The appendix also includes plots for the number of governmental entities per capita and population size, as well as the natural log of both, showing that if one where to measure horizontal fragmentation as such, horizontal fragmentation would decrease as cities become bigger.

The horizontal fragmentation values are plotted in figure 2.2, with the LAI values of the countries plotted on the x-axis. The figure shows the average, minimum and maximum horizontal fragmentation values for the countries in the sample, combined with the LAI values. Together, these two capture decentralization in the estimation strategy. I find low horizontal fragmentation and low LAI in the UK and high horizontal fragmentation and high LAI in Denmark. No country shows a similarly low level of LAI as the UK. Relatively low LAI and high horizontal fragmentation are found for FUAs in Hungary, the Czech Republic

⁶ I also explored the possibility of a nonlinear relationship by including the natural log of population squared. However, I found that this added little to no explanatory power, and was turning the coefficients of both population variables insignificant. The appendix (table 2.17) also includes fragmentation measured as the errors from the prediction using a combination of population density and FUA area size, as well as simply the natural log of the number of governmental entities present in the FUA. Both result in similar estimation results as those found in the paper.

and Slovak Republic. High LAI and low horizontal fragmentation is found for Finland, Poland and a share of German cities. Germany shows the largest difference between the highest and lowest horizontal fragmentation for Neubrandenburg and Wuppertal respectively.

Figure 2.2: Horizontal fragmentation and LAI

Source: own visualization using data from the Self-rule Index for Local Authorities (Release 1.0) by the European Commission and the Metropolitan Areas database by the OECD. This figure plots the average horizontal fragmentation value per country as identified by the dots and country labels. Furthermore, the minimum and maximum horizontal values for the specific countries are indicated. The horizontal axis captures the average LAI value for the countries over the years 2003-2014.

2.3.3 Quality of government

The University of Gothenburg has developed the most extensive (subnational) quality of government database on European data, bundled together in the European Quality of Government Index (Charron et al., 2014; Charron, Dijkstra, & Lapuente, 2015). It is one of the most commonly used indices to capture (regional) quality of government (e.g. Cortinovis et al., 2017; Crescenzi et al., 2016; Rodríguez-Pose & Di Cataldo, 2015; Rodríguez-Pose & Ketterer, 2019). The EQI is created through extensive surveys at the individual level, thus a perceived quality of government measure. The survey questions ask specifically about the quality of government in the (local) area of the individual, thereby measuring the quality of local government. The individual data is aggregated up to NUTS2 regions, thereby capturing the average perceived quality of government in that NUTS2 region. The

EQI has data for the years 1996-2017. Three pillars are identified: corruption, quality of public services, and impartiality, with corruption naturally being inversely incorporated in the EQI. The identification of these three pillars are straightforward in line with what their names suggest. The three pillars, as well as the combined EQI index, are standardized with a standard deviation of 1. A detailed description of the survey questions and methodology used may be found in the codebook (Charron et al., 2014; Charron, Dijkstra, & Lapuente, 2015).

Figure 2.3 shows the minimum, maximum and average EQI values for each country, plotted against the LAI values. I find the UK and Poland to be somewhat outliers, showing high EQI and low LAI (UK) or high LAI and low EQI (Poland). The remaining countries somewhat show a development of a positive association between EQI and LAI, with Denmark, Finland and Germany being high-high. While Hungary and the Slovak Republic are relatively low-low. However, I also find a great number of countries with values somewhere in the middle, and quite some variation within countries.

Figure 2.3: EQI and LAI

Source: own visualization using data from the European Quality of Government Index (Charron et al., 2014; Charron, Lapuente, & Annoni, 2019; Charron, Dijkstra, Lapuente, et al., 2015), and the Metropolitan Areas database by the OECD. This figure plots the average EQI value per country over the years 2003-2014, as identified by the dots and country labels. Furthermore, the minimum and maximum (2003-2014) EQI values for the specific countries are indicated. The horizontal axis captures the average LAI value for the countries over the years 2003-2014.

In order to explore the dynamic trend over the period 2003-2014, I also plot the 11-year difference for EQI and LAI in figure 2.4. Here I clearly find two countries (Spain and Hungary) that have been decreasing in quality of government (with quite some within country variation for Spain), while at the same time decreasing in local autonomy. Especially, the decline in LAI sets them apart from the rest of the countries, which are generally clustered together.

Figure 2.4: Difference in EQI and LAI (2003-2014)

Source: own visualization using data from the European Quality of Government Index (Charron et al., 2014, 2019; Charron, Dijkstra, Lapuente, et al., 2015), and the Metropolitan Areas database by the OECD. This figure plots the average ΔEQI value per country over the years 2003-2014, as identified by the dots and country labels. Furthermore, the minimum and maximum (2003-2014) ΔEQI values for the specific countries are indicated. The horizontal axis captures the average ΔLAI value for the countries over the years 2003-2014.

2.3.4 Labor productivity and controls

The OECD Metropolitan database has data on OECD Functional Urban Areas (FUAs) from 1990 till 2016. After it was recently updated to include smaller metropolitan areas, it now consists of over 600 urban areas. Besides data on horizontal fragmentation, I use data on GDP, number of workers, population size, population density, FUA area size, elderly dependency ratio and youth dependency ratio. Labor productivity is measured as real GDP per worker at purchasing power parity.

The robustness section (2.5.6) also includes estimations using GDP per capita, to capture economic performance. FUAs with missing data are dropped to ensure a balanced dataset. This yields 242 FUAs across 151 regions in 14 European countries over the period 2003–2014. Figure 2.5 presents an overview of the number of metropolitan areas per country. Furthermore, table 2.1 presents the summary statistics for the data used.

Figure 2.5: Overview of the share of FUAs per country

Source: own visualization of the data used in the estimations. Data on FUAs comes from the Metropolitan Areas database by the OECD.

Table 2.1: Summary statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
ln(GDP p.w. at real PPP)	2,904	11.19	0.20	10.23	11.70
ln(pop density)	2,904	5.87	0.75	3.85	7.90
ln(area)	2,904	7.38	0.82	4.93	9.77
ln(population)	2,904	13.25	0.77	12.29	16.29
Elderly dep. ratio	2,904	26.37	5.02	14.20	46.50
Youth dep. ratio	2,904	24.13	4.08	14.20	36.70
Fragmentation	2,904	0.00	1.49	-3.11	2.87
<i>EQI</i>	2,904	0.42	0.67	-2.23	1.81
Corruption	2,904	-0.46	0.75	-1.86	2.51
Quality of public services	2,904	0.44	0.64	-2.20	1.89
Impartiality	2,904	0.46	0.76	-2.37	2.10
<i>LAI</i>	2,904	61.46	9.48	44.71	75.96
Legal	2,904	71.49	14.09	33.33	100.00
Organizational	2,904	63.60	20.81	25.00	100.00
Policy scope	2,904	68.12	19.86	32.90	87.50
Discretion	2,904	52.99	15.32	24.68	78.13
Financial	2,904	61.39	14.00	28.00	80.00
Centre/regional	2,904	61.53	10.76	12.89	71.43
Vertical	2,904	59.40	18.54	33.33	100.00

Note: summary statistics for the data used in the estimations. Data comes from the Metropolitan Areas database by the OECD, the European Quality of Government Index (Charron et al., 2014, 2019; Charron, Dijkstra, Lapuente, et al., 2015), and the Self-rule Index for Local Authorities (Release 1.0) by the European Commission.

2.4 Estimation strategy

The available data presents multiple geographical levels: LAI at the country-level, EQI at the regional level, and labor productivity, horizontal fragmentation and control variables at the FUA-level. In order to account for the nature of the data, I use multilevel modelling. This allows us to link concepts relating to the structure and quality of subnational governments at different geographical hierarchies to the labor productivity of FUAs. The argument is that the productivity of an FUA interacts with the context of government structure and quality in which it operates. Through multilevel modelling, I hypothesize that the productivity of FUAs is hierarchically nested into subnational regions, within countries, and are influenced by the context and properties in which it operates. FUAs within the same context are expected to be more similar in productivity than FUAs in other contexts. Thus, I create a three-level estimation with FUAs nested in EQI regions, nested in countries, using random intercepts for the countries and regions. This controls for the assumption of independence of observations in grouped data. Not controlling for this may violate the assumption of independence of the residual error terms, resulting in large errors and too liberal significance levels (Barcikowski, 1981).

First, I explore the direct effects of EQI, LAI, and horizontal fragmentation. This yields the following equation:

$$(2.3) \quad LP_{c,r,f,t} = \alpha + \beta_1 EQI_{c,r,t} + \beta_2 LAI_{c,t} + \beta_3 \widehat{fragmentation}_{c,r,f,t} + \beta_{k+3} X_{c,r,f,t} + \omega_t + u_{0c} + u_{1r} + \varepsilon_{c,r,f,t},$$

where, $LP_{c,r,f,t}$ represents labor productivity in FUA f , of region r , in country c , at time t . $EQI_{c,r,t}$ denotes the quality of government, $LAI_{c,t}$ represents the local autonomy index, and $\widehat{fragmentation}_{c,r,f,t}$ captures the degree of horizontal fragmentation. $\beta_k X_{c,r,f,t}$ represents the k -number of control variables. u_{0c} and u_{1r} represent the random intercepts for the countries and regions, respectively. Finally, time fixed effects are included, represented by ω_t . Subsequently, an interaction between EQI and LAI is introduced:

$$(2.4) \quad LP_{c,r,f,t} = \alpha + \beta_1 EQI_{c,r,t} + \beta_2 LAI_{c,t} + \beta_3 \widehat{fragmentation}_{c,r,f,t} + \beta_4 EQI * LAI_{c,r,t} + \beta_{k+4} X_{c,r,f,t} + \omega_t + u_{0c} + u_{1r} + \varepsilon_{c,r,f,t},$$

Finally, including horizontal fragmentation in the interactions results in a number of additional interactions:

$$(2.5.) \quad LP_{c,r,f,t} = \alpha + \beta_1 EQI_{c,r,t} + \beta_2 LAI_{c,t} + \beta_3 \widehat{fragmentation}_{c,r,f,t} + \beta_4 EQI * LAI_{c,r,t} + \beta_5 EQI * \widehat{fragmentation}_{c,r,f,t} + \beta_6 LAI * \widehat{fragmentation}_{c,r,f,t} + \beta_7 EQI * LAI * \widehat{fragmentation}_{c,r,f,t} + \beta_{k+7} X_{c,r,f,t} + u_{0c} + u_{1r} + \omega_t + \varepsilon_{c,r,f,t},$$

The multilevel structure may result in a correlation between the lower level explanatory variables and higher level error terms (Snijders & Berkhof, 2007). I remove this correlation through the use of the Mundlak (1978) correction, by including country- or region-level means of the lower level explanatory variables. Multilevel models may be estimated using full maximum-likelihood (FML) or restricted maximum-likelihood (RML). RML takes into account the uncertainty in the fixed parameters when estimating the random parameters, which is theorized to result in better estimates of the variance components (Raudenbusch & Bryk, 2001).

2.5 Estimation results

The estimation results are divided into six sections. First, I estimate the direct effects of the variables of interest. Subsequently, an interaction effect is introduced between LAI and EQI. The third section explores the full estimation model with the full interactions of EQI, LAI, and horizontal fragmentation. Section four subsequently decomposes the EQI into its three pillars. Section five does the same for the seven dimensions of LAI. Finally, the robustness section discusses some of the robustness checks.

2.5.1 Direct effects

First, I estimate the direct effects of the three variables of interest: quality of government, local autonomy, and horizontal fragmentation. While the three-level mixed-effects estimation is argued to be best suited given the three geographical levels in the data, I also include estimations using pooled OLS with time fixed effects, and fixed effects. This allows for a general insight into the correlations between the variables of interest. The results are shown in table 2.2.

EQI is significant and positive in line with previous literature (Rodríguez-Pose & Ketterer, 2020). In line with the work by Muringani *et al.* (2019) on regional authority, I find LAI to be insignificant in the pooled OLS estimations. However, as I introduce fixed effects or the multilevel model, I find a negative local autonomy effect. This suggests that countries with higher local autonomy tend to have lower labor productivity. I will further explore this through the hypotheses on the interaction effects. Finally, horizontal fragmentation is found to be positive in the OLS estimation, but insignificant in the mixed multilevel estimation.

Table 2.2: Base model exploring the direct effects of EQI, LAI and horizontal fragmentation

Variables	OLS	OLS	FE	Mixed
ln(pop density)	0.0948*** (0.0191)	0.154*** (0.0210)		0.0767*** (0.00430)
ln(area)	0.0768*** (0.0173)	0.0460*** (0.0157)		0.0554*** (0.00307)
ln(population)			0.0546 (0.131)	
Elderly dep. ratio	0.0128*** (0.00383)	0.00916*** (0.00339)	0.000389 (0.00209)	-0.00335*** (0.000577)
Youth dep. ratio	0.0101*** (0.00368)	0.00882** (0.00352)	-0.00345 (0.00395)	-0.00182** (0.000916)
EQI		0.102*** (0.0250)	0.0440** (0.0169)	0.0498*** (0.00713)
LAI		-0.000175 (0.00220)	-0.00225*** (0.000594)	-0.00246*** (0.000548)
Fragmentation		0.0616*** (0.0135)		0.00402 (0.00434)
Constant	9.472*** (0.294)	9.436*** (0.292)	10.63*** (1.682)	10.48*** (3.724)
<i>Random effects</i>				
Country-level variance				0.0346 (0.0199)
Region-level variance				0.0109 (0.0014)
Residual variance				0.0035 (0.0001)
Time FE	Yes	Yes	Yes	Yes
Fixed effects	No	No	Yes	No
Mundlak correction	No	No	No	Yes
R-squared	0.193	0.383	0.282	
Log restricted-likelihood				3669.139
# of countries	14	14	14	14
# of regions	151	151	151	151
Observations	2,904	2,904	2,904	2,904

Note: standard errors in parentheses (*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$). FUA area and horizontal fragmentation disappear when including fixed effects. Therefore, I also exclude population density and use population instead. Standard errors for the pooled OLS, and two-way fixed effects estimations are clustered at the NUTS2-level (the same level as the EQI data). The multilevel mixed-effects estimations are fitted with restricted maximum likelihood. The variance-covariance structure is unstructured, where all variances and covariances are distinctly estimated.

Table 2.3: Base model exploring the interaction effects of EQI and LAI

Variables	OLS	FE	Mixed
EQI	-0.432** (0.169)	-0.266*** (0.0592)	-0.218*** (0.0381)
LAI	-0.00471 (0.00287)	-0.00534*** (0.00106)	-0.00515*** (0.000660)
Fragmentation	0.0479*** (0.0109)		0.00323 (0.00430)
EQI*LAI	0.00834*** (0.00264)	0.00523*** (0.00108)	0.00449*** (0.000628)
Constant	9.761*** (0.322)	10.89*** (1.577)	10.86*** (3.615)
<i>Random effects</i>			
Country-level variance			0.0324 (0.0187)
Region-level variance			0.0112 (0.0014)
Residual variance			0.0034 (0.0001)
FUA controls	Yes	Yes	Yes
Time FE	Yes	Yes	Yes
Fixed effects	No	Yes	No
Mundlak correction	No	No	Yes
R-squared	0.415	0.324	
Log restricted-likelihood			3688.015
# of countries	14	14	14
# of regions	151	151	151
Observations	2,904	2,904	2,904

Note: standard errors in parentheses (*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$). FUA area and horizontal fragmentation disappear when including fixed effects. Therefore, I also exclude population density and use population instead. The FUA controls include population density, FUA area size, and the elderly and youth dependency ratios. The fixed effects estimation includes population instead of population density and FUA area size. Standard errors for the pooled OLS, and two-way fixed effects estimations are clustered at the NUTS2-level (the same level as the EQI data). The multilevel mixed-effects estimations are fitted with restricted maximum likelihood. The variance-covariance structure is unstructured, where all variances and covariances are distinctly estimated.

2.5.2 Exploring the interaction effects of EQI and LAI

In this section I introduce the interaction between EQI and LAI. Previous research has found a positive interaction effect (Muringani et al., 2019). Similarly, I expect a positive interaction coefficient. This is because I anticipate increased local autonomy to have a (more) positive effect in areas with high EQI, but also because I expect the positive EQI effect to be stronger in countries with higher local autonomy. The results are shown in table 2.3.

We find the positive interaction effect for all three estimations. The interaction effect is visualized in margins-plots, plotting the marginal effects of EQI and LAI (figure 2.6), based on the estimation results of mixed multilevel estimation. These plots allow us to explore both arguments for the positive interaction effect: a more positive LAI effect in high EQI

regions, and a higher EQI effect in high LAI countries. The left-hand side of figure 2.6 shows that the positive effect of increased EQI is only significant as LAI becomes higher, and subsequently grows as LAI becomes higher. Thus, the positive EQI effects are only significant in countries with medium to high local autonomy, and are best captured in countries with high local autonomy. The right-hand side of figure 2.6 shows the negative effect for LAI I found in table 2.2, which becomes less negative (or even positive) as EQI increases. This suggests that increased LAI is generally related to lower labor productivity. Only in case of a very high EQI, is increased LAI associated with higher labor productivity.

Figure 2.6: Margins-plots showing the marginal effects of EQI and LAI

Note: these plots show the marginal effects of EQI (left) and LAI (right), given certain values of LAI and EQI. The plots show the marginal effects captured from the mixed multilevel estimation in table 2.3.

2.5.3 Adding horizontal fragmentation

While, LAI captures a major part of decentralization, it does not account specifically for the degree of horizontal fragmentation. Therefore, horizontal fragmentation is added to explore the possibility of it affecting the positive EQI effect. Table 2.4 shows the estimation results. Again, I find the simple pooled OLS and fixed effects results to be relatively similar to the multilevel model. The number of interactions make the results difficult to interpret. Therefore, the marginal effects are plotted. Figure 2.7 shows the marginal effects of EQI for the OLS, FE, and mixed multilevel estimations.

Table 2.4: Exploring the interaction effects of EQI, LAI and horizontal fragmentation

Variables	OLS	FE	Mixed
EQI	-0.192 (0.152)	-0.299*** (0.0600)	-0.235*** (0.0395)
LAI	-0.00553** (0.00274)	-0.00603*** (0.000976)	-0.00632*** (0.000670)
Fragmentation	-0.0534 (0.116)		-0.219*** (0.0286)
EQI*LAI	0.00499** (0.00238)	0.00604*** (0.00108)	0.00505*** (0.000649)
EQI*Fragmentation	0.359*** (0.124)	0.149*** (0.0376)	0.123*** (0.0272)
LAI*Fragmentation	0.00167 (0.00188)	0.00231*** (0.000670)	0.00384*** (0.000470)
EQI*LAI*Fragmentation	-0.00591*** (0.00193)	-0.00303*** (0.000720)	-0.00260*** (0.000472)
Constant	9.874*** (0.279)	9.887*** (1.572)	11.16*** (3.852)
<i>Random effects</i>			
Country-level variance			0.0371 (0.0210)
Region-level variance			0.0111 (0.0014)
Residual variance			0.0033 (0.0001)
FUA controls	Yes	Yes	Yes
Time FE	Yes	Yes	Yes
Fixed effects	No	Yes	No
Mundlak correction	No	No	Yes
R-squared	0.451	0.353	
Log restricted-likelihood			3708.8292
# of countries	14	14	14
# of regions	151	151	151
Observations	2,904	2,904	2,904

Note: standard errors in parentheses (*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$). FUA area and horizontal fragmentation disappear when including fixed effects. Therefore, I also exclude population density and use population instead. The FUA controls include population density, FUA area size, and the elderly and youth dependency ratios. The fixed effects estimation includes population instead of population density and FUA area size. Standard errors for the pooled OLS, and two-way fixed effects estimations are clustered at the NUTS2-level (the same level as the EQI data). The multilevel mixed-effects estimations are fitted with restricted maximum likelihood. The variance-covariance structure is unstructured, where all variances and covariances are distinctly estimated.

Figure 2.7: Margins-plots showing the marginal effects of EQI

A, Pooled OLS estimation

B, Two-way Fixed effect estimation

C, Mixed-multilevel estimation

Note: these plots show the marginal effects of EQI for the pooled OLS, two-way-fixed effects and mixed-multilevel estimations as estimated in table 2.4. $\ln_fua_e$ represents the estimated horizontal fragmentation error.

The margins-plots show the importance of the interactions. Furthermore, the plots show the similarity in marginal effects the three types of estimations. I find that the positive EQI effect is best captured in a high local autonomy and low horizontal fragmentation context. The significant positive effect becomes smaller as local autonomy declines, turning insignificant when local autonomy is low. Similarly, the positive EQI effect declines as horizontal

fragmentation increases. The results are very similar for the three estimations, although the multilevel model shows smaller confidence intervals resulting in more significant differences between the low, medium and high LAI groups identified.

Figure 2.8 shows the resulting marginal effects of LAI and horizontal fragmentation as measured through the mixed-multilevel estimation. The results generally show a negative effect for increased local autonomy. This effect is mitigated by increased EQI and horizontal fragmentation. However, the only instance where increased local autonomy yields positive labor productivity effects, is when quality of government is high and horizontal fragmentation is low, although it is insignificant in the multilevel model. I anticipated the positive interaction effect between EQI and LAI as discussed before. However, the interaction effect of horizontal fragmentation is interesting, given that it is positive when the overall LAI effect is negative, but negative when the overall LAI effect is positive. It therefore seems to mitigate whatever effect is visible, both positive and negative, suggestive of a general decrease in governmental effectiveness as horizontal fragmentation increases. The marginal effects of horizontal fragmentation simply show the inverse picture of the marginal effects for EQI.

Figure 2.8: Margins-plots showing the marginal effects of LAI and horizontal fragmentation

A, Marginal effect of LAI

B, Marginal effect of horizontal fragmentation

Note: these plots show the marginal effects of LAI and horizontal fragmentation for the mixed-multilevel estimation from table 2.4. $\ln_fua_e$ represents the estimated horizontal fragmentation error.

2.5.4 Unpacking EQI

The EQI index consists of three pillars: corruption, quality of public services, and impartiality. While the three pillars are highly interrelated and commonly behave in similar ways, there may still be differences in outcomes when focusing on a specific pillar. Especially corruption may mean that increased decentralization allows local (powerful) interest groups to capture the interest of local government (Bardhan & Mookherjee, 2000; Bischoff & Krabel, 2017; Jia & Nie, 2017; Storper, 2006). For the sake of preserving space, the estimation results and related margins-plots are included in the appendix 2.B.

The results show that the positive effect of the quality of public services and impartiality is mostly captured in decentralized contexts with low horizontal fragmentation. I only include the corruption pillar margins-plot (figure 2.9) given that its effect is inversed, as corruption is a negative indicator of quality of government. The margins-plot shows that negative effects of corruption are mostly captured in a context of decentralized power with low horizontal fragmentation. While this result may be partly due to the fact that corruption is highly inversely correlated with the quality of public services and impartiality, it may also suggest that corruption is most damaging when there is a high context of decentralization of power, with low horizontal fragmentation, making local governmental entities big and strong enough to have a negative economic impact. With power decentralized, and low quality of government (e.g. corruption) local elites may find it easier to capture local the interest of local governments (Bardhan & Mookherjee, 2000; Bischoff & Krabel, 2017; Jia & Nie, 2017; Storper, 2006).

Figure 2.9: Margins-plots showing the marginal effects of corruption, LAI, and horizontal fragmentation

Note: the margins-plot shows the marginal effect of corruption as estimated in table 2.6. $\ln_fua_e$ represents the estimated horizontal fragmentation error.

2.5.5 Unpacking LAI

Similar to unpacking the EQI index, I also explore which LAI dimensions are driving the results. Before delving into the estimation results, short descriptions of the seven LAI dimensions are presented in order to have a better understanding of the meaning of the results.

Legal autonomy, describes the legal protection given to local governmental entities, in the form of constitutional clauses or through recourse to the judicial system to settle disputes with higher authorities (Ladner et al., 2015). High legal autonomy may protect local governments from being misused to circumvent limits on debt or expenditures (Faulk & Killian, 2017), but rather remaining autonomous and effective entities.

Organizational autonomy “measures the extent to which local authorities are able to decide aspects of their political system and their own administration” (Ladner et al., 2015). This goes from local executives directly being appointed by higher levels of government, to them being elected directly by the citizens through a system designed by the local governmental entity itself. Furthermore, it describes the extent to which local governmental entities may hire their own staff or create their own legal entities. Increased *organizational* autonomy, should allow local public organizations to better reflect the local preferences, thereby having a better understanding of the local needs (Klugman, 1994; Oates, 1999; Tiebout, 1956) and operating accordingly. This allows citizens to have more direct control into the organizational structure and should also allow citizens to benchmark the performance of local politicians and voting according to their preferences (Belleflamme & Hindriks, 2005; Besley & Case, 1995), resulting in increasing participation and accountability (Ebel, 2002; Putnam, 1993; Seabright, 1996). However, it may also increase the risk of local elites capturing the local public interest (Bardhan & Mookherjee, 2000; Bischoff & Krabel, 2017; Jia & Nie, 2017; Storper, 2006).

Policy scope captures “the range of functions or tasks where municipalities are effectively involved in the delivery of services, be it through their own financial resources and/or through their own staff” (Ladner et al., 2015). The range of functions measured are: education, social assistance, health, land-use, public transport, housing, police, and caring functions (Ladner et al., 2015). The general proposed benefit of decentralization should therefore be visible through this dimension, in that local governments with high policy scope autonomy should be better able at providing the services specific to the local needs. The shorter supply chains may also result in reduced costs (Ezcurra & Pascual, 2008; Klugman, 1994). However, local governmental entities may also lack the capacity, resources and expertise needed for bigger projects, such as major public transportation projects (Ahrend et al., 2017; OECD, 2015a; Prud’homme, 1995; Rodríguez-Pose & Gill, 2004, 2005).

Effective political discretion is measured through a combination of institutional depth and effective political discretion, “describing the range of tasks over which local government effectively has a say and whether it enjoys a general competence clause (Ladner et al., 2015). This dimension is related to the *policy scope*. However, it differs in that this captures the extent to which local governments are free to take on any new tasks not assigned to other levels of government, and to what extent it has real authoritative decision-making power in the previously named range of functions: education, social assistance etc.

Financial autonomy describes the ability of local governments to borrow and raise local public revenues in order to influence their own budget (Ladner et al., 2015). The possibility to set the base or rate of local taxes should in theory result in more competition between local governments, which may foster policy innovation (Martinez-Vazquez & McNab, 2003; Rose-Ackerman, 1980; Tiebout, 1956).

The final two dimensions capture the extent to which local governments work together with higher level governments. *Central or regional control* describes the extent to which local authorities are consulted by higher level governments in their policy making (Ladner et al., 2015). Whereas, *vertical influence* “measures the extent to which municipalities are able to influence political decisions on higher levels” (Ladner et al., 2015). The question that may arise here, is whether specific regional governments may be more capable of capturing the interest of higher levels of government, resulting in regional inequality (Liu, Martinez-Vazquez, & Wu, 2017).

Referring back to the three decentralization dimensions as set by the OECD (OECD, 2019), I would label *legal* and *organizational* autonomy as *political decentralization*. *Administrative decentralization* would encompass *policy scope*, and *effective political discretion*. *Financial* autonomy would be categorized as *fiscal decentralization*. Furthermore, I would add another decentralization dimension which captures how local government supports higher levels of government (upward autonomy) with the LAI dimensions: *central or regional control*, and *vertical influence*.

The estimation results for the LAI dimensions are included in appendix 2.C. The margins-plots include plots exploring the two argumentations given with respect to the interaction between EQI and LAI: the positive effect of EQI will be higher in a high LAI context, and increased LAI will enhance the effect (positive/negative) of EQI.

The figures show notable differences in the effect of EQI for the various LAI dimensions. The positive EQI effect is especially found in a context of low horizontal fragmentation and high *organizational*, *policy scope*, *discretion*, and *vertical* autonomy. Other dimensions generally show a positive EQI effect, but no significant differences between the various LAI dimensions values. Therefore, the overall LAI effect is driven by the *organizational*, *policy scope*, *discretion*, and *vertical* autonomy dimension. Based on the grouping of the decentralization dimensions into the three OECD decentralization dimensions, the results would indicate that the one out of four *political decentralization* dimensions, and 2 out of 2 *administrative decentralization* dimensions, are driving the positive EQI effect, exemplifying the importance of the policy scope and discretion of local governments. Furthermore, *upward autonomy* shows one significant dimension out of two.

When looking at the labor productivity effects of the LAI dimensions itself, I naturally find a similar pattern. I find that the negative effect for an increase in autonomy in a low EQI and low horizontal fragmentation context is found for *organizational*, *policy scope*, *discretion*, *financial*, and *vertical* autonomy. The positive autonomy effect for high EQI and low horizontal fragmentation, is only found for *organizational* autonomy. I find no significant differences in effects across the levels of EQI for *legal*, *financial*, and *central/regional* autonomy.

2.5.6 Robustness

In order to check to what extent these results are driven by a single country, the full interaction estimations are performed leaving out one country at a time. The estimation results are included in appendix 2.D. The results are robust, showing little variation. I also performed jackknife and bootstrap estimations, clustered at the FUA level and at the regional level. These robustness checks again confirm the robustness of the estimations and may also be found in the appendix.

Furthermore, the appendix includes estimations exploring the effects over time (appendix 2.E). First, I perform cross-sectional estimations for each separate year. I find that the significance disappears, thus suggesting that the estimation results are derived from the development over time. This is in line with the fixed effects estimation results in this chapter and how similar they are to the mixed multilevel estimation model.

Appendix 2.E also includes estimations exploring the effects before and after the financial crisis. I find no significance in the pre-crisis (2003-2007) estimation, with all the significance coming from the slow growth post-crisis era (2008-2014). This suggest that the positive high quality of government, high local autonomy, and low horizontal fragmentation FUAs are most resilient to adverse economic shocks (Carrascal-Incera et al., 2020; Fratesi & Rodríguez-Pose, 2016; Kitsos, Carrascal-Incera, & Ortega-Argilés, 2019). Only these FUAs are able to quickly respond to the changing environment created by the crisis.

Appendix 2.F includes estimations using GDP per capita as the dependent variable instead of GDP per worker. GDP per worker may have the issue, especially during the financial crisis, that productivity goes up simply because employment (the denominator) goes down. GDP per capita does not have this issue. The estimation results show that the story remains the same however; The positive EQI effect is highest for high LAI and low horizontal fragmentation.

We also checked the robustness of the horizontal fragmentation measure, by using the natural log of the number of local governmental entities directly, and by estimating an alternative horizontal fragmentation measure using a combination of population density and FUA area size, instead of population. This yields the following:

$$(2.6) \quad \widehat{Fragmentation}_{f,t} = \alpha + \beta_1 Pop\ density_{f,t} * time_t + \beta_2 FUA\ area$$

The results are again similar, suggesting a robust association.

Finally, I performed dynamic estimations in order to explore any labor productivity growth effects. I do this by lagging all explanatory variables and including the lagged dependent variable. This creates the following equation:

$$(2.7) \quad \Delta LP_{c,r,f,t} = \alpha + \beta_1 LP_{c,r,f,t-1} + \beta_2 QoG_{c,r,t-1} + \beta_3 LAI_{c,t-1} + \beta_4 FRAG_{c,r,f,t-1} + 5QoG * LAI_{c,r,t-1} + \beta_6 EQI * FRAG_{c,r,f,t-1} + \beta_7 LAI * FRAG_{c,r,f,t-1} + \beta_8 EQI * FRAG_{c,r,f,t-1} + \beta_{k+8} X_{c,r,f,t-1} + u_{0c} + u_{1r} + \omega_t + \varepsilon_{c,r,f,t},$$

The estimation results are presented in appendix 2.H. Without any interactions, I find EQI to be positive and significant. I no longer find a significant interaction between EQI and LAI when introducing the interaction. I do find the significant negative interaction between EQI and horizontal fragmentation (figure 2.10). Finally, when using the full interaction model, I find that EQI is only positive and significant for FUAs with low horizontal fragmentation, located in countries with high LAI (figure 2.11). However, it should be mentioned that while EQI is only positive and significantly different from zero in this context, it is not significantly different from the marginal EQI effect in low LAI countries.

Figure 2.10: Marginal effects for EQI for certain horizontal fragmentation values

Note: the margins-plot shows the marginal effect of EQI as estimated in estimation “EQI*Frag” of table 2.18: Dynamic estimations in appendix 2.H. Leqi represents lagged EQI. Lln_fua_e represents the lagged estimated horizontal fragmentation error.

Figure 2.11: Marginal effects for EQI for certain horizontal fragmentation values, given high or low LAI

Note: the margins-plot shows the marginal effect of EQI as estimated in estimation “Full” of table 2.18: Dynamic estimations in appendix 2.H. Leqi represents lagged EQI. Lln_fua_e represents the lagged estimated horizontal fragmentation error.

2.6 Conclusion

This chapter continues on the literature of Murginani *et al.* (2019) by arguing for possible interaction effects between decentralization and EQI and investigates such effects in terms of local labor productivity for EU cities over time. The argument is made that the productivity effects of EQI may be dependent on the degree of local autonomy. At the same time, the productivity effects of local autonomy may be dependent on EQI. Furthermore, continuing on the literature by Ahrend *et al.* (2017) the degree of horizontal fragmentation is included and hypothesized to have a negative effect on the positive productivity effects of EQI. The limited data availability and variance in decentralization data, make it difficult to establish causal relationships. However, through three-level mixed-effects estimations on EU cities over time, this chapter is able to disentangle significant associations between the decentralization dimensions and urban productivity. The robustness of the results shows that these associations are robust in various contexts.

The results provide support of the importance of local governments. EQI is found to have a positive effect on labor productivity, in line with findings of previous literature (Rodríguez-Pose & Ketterer, 2020). Furthermore, the mixed-multilevel model shows a negative effect for LAI. No significant direct effect is found for horizontal fragmentation. When introducing the interaction between LAI and EQI, a positive interaction effect is found. This means that the positive effect of EQI increases as LAI increases. Similarly, the negative effect of LAI decreases as EQI increases. The positive interaction effect is in line with the expectations and with a similar previous empirical attempt by Muringani *et al.* (2019). However, the overall negative LAI effect differs from the insignificant Regional Authority Index result found in the paper of Muringani *et al.* (2019). Only in a context of high EQI and low horizontal fragmentation, do I find a small positive effect for LAI. This may suggest that generally, the Centrist arguments are stronger than the Polycentrist arguments, except in those cases where the quality of government is high and horizontal fragmentation is low. The general picture is thus in line with the expectations, with the notable difference that the overall LAI effect is more negative than anticipated.

The subsequent introduction of horizontal fragmentation into the interactions shows that increased horizontal fragmentation lowers the positive EQI effect and mitigates the largely negative effects of LAI. In line with the expectations, the results show that FUAs with high EQI, high LAI, and low horizontal fragmentation are estimated to have the highest labor productivity. The story remains roughly the same when using various EQI dimensions. This means that the positive effects of high quality of public services and impartiality translate best into high labor productivity, in a high LAI and low horizontal fragmentation context. Conversely, the negative corruption effects are most visible in a high LAI and low horizontal fragmentation context. The estimations using the separate LAI dimensions show that the results are especially driven by *organizational, policy scope,*

discretion, and *vertical* autonomy. Grouping these into the OECD (2019) dimensions of decentralization, means that the results are especially driven by the *administrative* dimension of decentralization, and to a lesser extent the *political* dimension and the “new” *upward autonomy*, with no significance for the *fiscal* dimension. This provides further support for the OECD acknowledgment of the importance of capturing *political* and *administrative* decentralization, besides the more commonly used *fiscal* decentralization (OECD, 2019).

The robustness analysis omitting one country at a time, shows that the results are robust across country sample selections. Moreover, the jackknife and bootstrap estimations confirm the robustness of the estimation coefficients, as do the alternative horizontal fragmentation estimation results. The robustness section also shows that the significant results are driven by the (post-)crisis period. This suggests that FUA with high local autonomy, high quality of government and low horizontal fragmentation are most resilient to adverse economic shocks. Finally, dynamic estimations show a similar story, although the significance of the coefficients declines. The results show that the positive EQI effect is only captured in a context of high LAI and low horizontal fragmentation.

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Appendix

Appendix 2.A: Prediction of fragmentation

Table 2.5: Prediction of fragmentation using population

Variables	Coefficients
2003b.year*ln(population)	0.649*** (0.0369)
2004.year*ln(population)	0.648*** (0.0368)
2005.year*ln(population)	0.648*** (0.0368)
2006.year*ln(population)	0.648*** (0.0368)
2007.year*ln(population)	0.648*** (0.0368)
2008.year*ln(population)	0.648*** (0.0368)
2009.year*ln(population)	0.647*** (0.0368)
2010.year*ln(population)	0.647*** (0.0368)
2011.year*ln(population)	0.647*** (0.0368)
2012.year*ln(population)	0.647*** (0.0368)
2013.year*ln(population)	0.647*** (0.0368)
2014.year*ln(population)	0.646*** (0.0367)
Constant	-5.193*** (0.480)
Observations	2,904
R-squared	0.100

Note: the estimation is performed using a pooled OLS. The dependent variable is the natural log of the number of local governments within an urban agglomeration. The difference between the actual and predicted values is used to capture horizontal fragmentation.

Figure A1: Scatterplot of the local governmental entities and population

Figure 2.12: Scatterplot of the local governmental entities and population

Note: this matrix plot shows the correlations between the number of governmental entities per capita (GovPC) and the population size T_T value.

Figure 2.13: Scatterplot of the natural log of local governmental entities and population

Note: this matrix plot shows the correlations between the natural log of the number of governmental entities per capita ($\ln_GovPC$) and the natural log of population size ($\ln_T_T$).

Appendix 2.B: Unpacking EQI

Table 2.6: Unpacking EQI estimation results

VARIABLES	Corruption	Quality	Impartiality
“EQI”	0.166*** (0.0358)	-0.192*** (0.0367)	-0.140*** (0.0334)
LAI	-0.00583*** (0.000668)	-0.00503*** (0.000634)	-0.00484*** (0.000641)
Fragmentation	-0.189*** (0.0297)	-0.174*** (0.0259)	-0.185*** (0.0267)
“EQI”*LAI	-0.00367*** (0.000574)	0.00402*** (0.000596)	0.00295*** (0.000534)
“EQI”*Fragmentation	-0.0450* (0.0247)	0.0920*** (0.0229)	0.0998*** (0.0222)
LAI*Fragmentation	0.00333*** (0.000492)	0.00304*** (0.000413)	0.00313*** (0.000423)
“EQI”*LAI*Fragmentation	0.00117*** (0.000421)	-0.00198*** (0.000404)	-0.00191*** (0.000368)
Constant	10.56*** (3.934)	11.66*** (3.582)	10.19** (4.115)
<i>Random effects</i>			
Country-level variance	0.0401 (0.0226)	0.0306 (0.0175)	0.0436 (0.0248)
Region-level variance	0.0108 (0.0014)	0.0109 (0.0014)	0.0119 (0.0015)
Residual variance	0.0034 (0.0001)	0.0034 (0.0001)	0.0034 (0.0001)
Time FE	Yes	Yes	Yes
FUA controls	Yes	Yes	Yes
Mundlak correction	Yes	Yes	Yes
Log restricted-likelihood	3696.3287	3696.3232	3670.3437
# of countries	14	14	14
# of regions	151	151	151
Observations	2,904	2,904	2,904

Note: standard errors in parentheses (*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$). The FUA controls include population density, FUA area size, and the elderly and youth dependency ratios. The multilevel mixed-effects estimations are fitted with restricted maximum likelihood. The variance-covariance structure is unstructured, where all variances and covariances are distinctly estimated. “EQI” represents the specific EQI pillar as indicated at the top of the estimation results (corruption, quality of public services, and impartiality).

Figure 2.14: Marginal effects for corruption

Note: the margins-plot shows the marginal effect of corruption as estimated in table 2.6 of appendix 2.B. $\ln_fua_e$ represents the estimated horizontal fragmentation error.

Figure 2.15: Marginal effects for quality of public services

Note: the margins-plot shows the marginal effect of quality of public services as estimated in table 2.6 of appendix 2.B. $\ln_fua_e$ represents the estimated horizontal fragmentation error.

Figure 2.16: Marginal effects for impartiality

Note: the margins-plot shows the marginal effect of impartiality as estimated in table 2.6 of appendix 2.B. $\ln_fua_e$ represents the estimated horizontal fragmentation error.

Appendix 2.C: Unpacking LAI

Table 2.7: Unpacking LAI estimation results

VARIABLES	Legal	Organizational	Policy scope	Discretion	Financial	Centre/ regional	Vertical
EQI	0.0221 (0.105)	-0.258*** (0.0266)	-0.0275 (0.0320)	-0.0354 (0.0320)	0.0770*** (0.0237)	0.0504* (0.0268)	-0.140*** (0.0192)
"LAI"	-0.00117 (0.00124)	-0.00282*** (0.000295)	-0.00188*** (0.000620)	-0.00185*** (0.000687)	-0.00168*** (0.000458)	-0.00207*** (0.000380)	-0.00374*** (0.000613)
Fragmentation	-0.101*** (0.0315)	0.0576*** (0.0136)	-0.1165*** (0.0188)	-0.113*** (0.0181)	-0.111*** (0.0222)	-0.00466 (0.0170)	-0.0887*** (0.0138)
EQI**"LAI"	0.000424 (0.00156)	0.00437*** (0.000360)	0.00147*** (0.000470)	0.00203*** (0.000590)	-0.000536 (0.000384)	-7.13e-05 (0.000400)	0.00339*** (0.000311)
EQI*Fragmentation	0.0672 (0.0514)	0.102*** (0.0180)	0.0556*** (0.0169)	0.0461** (0.0181)	0.00920 (0.0163)	0.0220 (0.0210)	0.0396** (0.0154)
"LAI"*Fragmentation	0.00154*** (0.000450)	-0.00105*** (0.000214)	0.00259*** (0.000267)	0.00279*** (0.000335)	0.00172*** (0.000331)	0.000149 (0.000262)	0.00196*** (0.000252)
EQI**"LAI"*Fragmentation	-0.00100 (0.000760)	-0.00137*** (0.000263)	-0.00135*** (0.000257)	-0.00154*** (0.000345)	-0.000316 (0.000282)	-0.000406 (0.000334)	-0.00114*** (0.000280)
Constant	11.07*** (3.847)	10.24*** (3.618)	10.43*** (3.850)	10.53*** (4.077)	9.809** (3.970)	10.75*** (3.452)	10.75** (4.343)
<i>Random effects</i>							
Country-level variance	0.0369 (0.0212)	0.0324 (0.0187)	0.0369 (0.0211)	0.0418 (0.0237)	0.0396 (0.0226)	0.0293 (0.0170)	0.0474 (0.0275)
Region-level variance	0.0107 (0.0014)	0.0110 (0.0014)	0.0115 (0.0015)	0.0111 (0.0014)	0.0110 (0.0014)	0.0109 (0.0014)	0.0117 (0.0015)
Residual variance	0.0035 (0.0001)	0.00324 (0.0001)	0.0034 (0.0001)	0.0034 (0.0001)	0.0034 (0.0001)	0.0035 (0.0001)	0.0032 (0.0001)
Log restricted-likelihood	3645.3172	3743.6894	3684.4789	3679.7195	3657.9133	3651.6108	3726.6891

Note: standard errors in parentheses (** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$). All estimations include time fixed effects, FUA controls, and the Mundlak correction. The FUA controls include population density, FUA area size, and the elderly and youth dependency ratios. The multilevel mixed-effects estimations are fitted with restricted maximum likelihood. The variance-covariance structure is unstructured, where all variances and covariances are distinctly estimated. "LAI" represents the specific LAI pillar as indicated at the top of the estimation results (legal, organizational, policy scope, discretion, financial, center/regional, and vertical).

Figure 2.17: Marginal EQI effects using the legal autonomy pillar

Note: the margins-plot shows the marginal effect of EQI as estimated in table 2.7 of appendix 2.C. Ln_fua_e represents the estimated horizontal fragmentation error.

Figure 2.18: Marginal EQI effects using the organizational autonomy pillar

Note: the margins-plot shows the marginal effect of EQI as estimated in table 2.7 of appendix 2.C. Ln_fua_e represents the estimated horizontal fragmentation error.

Figure 2.19: Marginal EQI effects using the policy scope autonomy pillar

Note: the margins-plot shows the marginal effect of EQI as estimated in table 2.7 of appendix 2.C. $\ln_fua_e$ represents the estimated horizontal fragmentation error.

Figure 2.20: Marginal EQI effects using the discretion autonomy pillar

Note: the margins-plot shows the marginal effect of EQI as estimated in table 2.7 of appendix 2.C. $\ln_fua_e$ represents the estimated horizontal fragmentation error.

Figure 2.21: Marginal EQI effects using the financial autonomy pillar

Note: the margins-plot shows the marginal effect of EQI as estimated in table 2.7 of appendix 2.C. Ln_fua_e represents the estimated horizontal fragmentation error.

Figure 2.22: Marginal EQI effects using the center/regional autonomy pillar

Note: the margins-plot shows the marginal effect of EQI as estimated in table 2.7 of appendix 2.C. Ln_fua_e represents the estimated horizontal fragmentation error.

Figure 2.23: Marginal EQI effects using the vertical autonomy pillar

Note: the margins-plot shows the marginal effect of EQI as estimated in table 2.7 of appendix 2.C. $\ln_fua_e$ represents the estimated horizontal fragmentation error.

Figure 2.24: Marginal effects for the legal autonomy pillar

Note: the margins-plot shows the marginal effect of legal autonomy as estimated in table 2.7 of appendix 2.C. $\ln_fua_e$ represents the estimated horizontal fragmentation error.

Figure 2.25: Marginal effects for the organizational autonomy pillar

Note: the margins-plot shows the marginal effect of organizational autonomy as estimated in table 2.7 of appendix 2.C. Ln_fua_e represents the estimated horizontal fragmentation error.

Figure 2.26: Marginal effects for the policy scope autonomy pillar

Note: the margins-plot shows the marginal effect of policy scope as estimated in table 2.7 of appendix 2.C. Ln_fua_e represents the estimated horizontal fragmentation error.

Figure 2.27: Marginal effects for the discretion autonomy pillar

Note: the margins-plot shows the marginal effect of discretion as estimated in table 2.7 of appendix 2.C. $\ln_fua_e$ represents the estimated horizontal fragmentation error.

Figure 2.28: Marginal effects for the financial autonomy pillar

Note: the margins-plot shows the marginal effect of financial as estimated in table 2.7 of appendix 2.C. $\ln_fua_e$ represents the estimated horizontal fragmentation error.

Figure 2.29: Marginal effects for the center/regional autonomy pillar

Note: the margins-plot shows the marginal effect of central and regional as estimated in table 2.7 of appendix 2.C. *Ln_fua_e* represents the estimated horizontal fragmentation error.

Figure 2.30: Marginal effects for the vertical autonomy pillar

Note: the margins-plot shows the marginal effect of vertical as estimated in table 2.7 of appendix 2.C. *Ln_fua_e* represents the estimated horizontal fragmentation error.

Appendix 2.D: Robustness

Table 2.8: Exploring the effects of leaving out one country at a time

Variables	Austria	Belgium	Czechia	Denmark	Finland	France	Germany
EQI	-0.234*** (0.0399)	-0.231*** (0.0399)	-0.248*** (0.0397)	-0.239*** (0.0398)	-0.235*** (0.0396)	-0.206*** (0.0421)	-0.358*** (0.0532)
LAI	-0.00626*** (0.000680)	-0.00627*** (0.000678)	-0.00655*** (0.000671)	-0.00634*** (0.000677)	-0.00630*** (0.000672)	-0.00617*** (0.000721)	-0.00672*** (0.00103)
Fragmentation	-0.219*** (0.0289)	-0.219*** (0.0289)	-0.219*** (0.0288)	-0.218*** (0.0289)	-0.220*** (0.0287)	-0.224*** (0.0305)	-0.333*** (0.0362)
EQI#LAI	0.00502*** (0.000656)	0.00499*** (0.000656)	0.00521*** (0.000651)	0.00511*** (0.000655)	0.00506*** (0.000652)	0.00463*** (0.000689)	0.00728*** (0.000862)
EQI#Fragmentation	0.123*** (0.0275)	0.124*** (0.0275)	0.121*** (0.0273)	0.120*** (0.0276)	0.125*** (0.0273)	0.105*** (0.0289)	0.0751** (0.0334)
LAI#Fragmentation	0.00385*** (0.000474)	0.00385*** (0.000474)	0.00386*** (0.000472)	0.00382*** (0.000474)	0.00386*** (0.000471)	0.00374*** (0.000505)	0.00576*** (0.000615)
EQI#LAI#Fragmentation	-0.00259*** (0.000477)	-0.00261*** (0.000477)	-0.00259*** (0.000474)	-0.00254*** (0.000478)	-0.00263*** (0.000474)	-0.00224*** (0.000506)	-0.00192*** (0.000604)
Constant	10.99*** (4.151)	13.69*** (4.175)	8.541** (4.108)	11.13*** (4.112)	12.61*** (3.064)	11.18*** (4.172)	12.36*** (4.740)
<i>Random effects</i>							
Country-level variance	0.4274 (0.0260)	0.0337 (0.0206)	0.0328 (0.0204)	0.0426 (0.0259)	0.0214 (0.0136)	0.0434 (0.0266)	0.0483 (0.0292)
Region-level variance	0.0114 (0.0015)	0.0112 (0.0014)	0.0111 (0.0014)	0.0113 (0.0014)	0.0113 (0.0015)	0.0129 (0.0018)	0.0096 (0.0014)
Residual variance	0.0034 (0.0001)	0.0034 (0.0001)	0.0033 (0.0001)	0.0033 (0.0001)	0.0033 (0.0001)	0.0036 (0.0001)	0.0024 (0.0001)
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
FUA controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Mundlak correction	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Log restricted-likelihood	3607.5020	3608.5086	3650.174	3628.6368	3658.1841	2980.3356	2969.6877
# of countries	13	13	13	13	13	13	13
# of regions	146	146	147	147	148	130	118
Observations	2,844	2,844	2,856	2,856	2,868	2,436	2,100

Table 2.8 continued

Variables	Hungary	Italy	Poland	Portugal	Slovakia	Spain	UK
EQI	-0.224*** (0.0515)	-0.183*** (0.0432)	-0.155*** (0.0406)	-0.239*** (0.0397)	-0.274*** (0.0395)	-0.192*** (0.0443)	-0.359*** (0.0472)
LAI	-0.00635*** (0.000774)	-0.00491*** (0.000764)	-0.00530*** (0.000677)	-0.00651*** (0.000675)	-0.00704*** (0.000671)	-0.00524*** (0.000774)	-0.00621*** (0.000692)
Fragmentation	-0.233*** (0.0345)	-0.191*** (0.0298)	-0.172*** (0.0287)	-0.225*** (0.0288)	-0.195*** (0.0286)	-0.189*** (0.0327)	-0.233*** (0.0325)
EQI#LAI	0.00493*** (0.000808)	0.00396*** (0.000722)	0.00323*** (0.000702)	0.00514*** (0.000652)	0.00567*** (0.000649)	0.00469*** (0.000711)	0.00686*** (0.000758)
EQI#Fragmentation	0.141*** (0.0356)	0.105*** (0.0283)	0.0797*** (0.0278)	0.128*** (0.0273)	0.100*** (0.0272)	0.149*** (0.0287)	0.293*** (0.0403)
LAI#Fragmentation	0.00406*** (0.000562)	0.00342*** (0.000491)	0.00295*** (0.000478)	0.00395*** (0.000473)	0.00343*** (0.000469)	0.00382*** (0.000517)	0.00403*** (0.000532)
EQI#LAI#Fragmentation	-0.00287*** (0.000593)	-0.00229*** (0.000493)	-0.00166*** (0.000494)	-0.00268*** (0.000474)	-0.00218*** (0.000472)	-0.00320*** (0.000497)	-0.00499*** (0.000646)
Constant	12.03*** (3.644)	9.883*** (3.256)	10.95*** (4.231)	9.026* (5.287)	9.985** (4.246)	11.08*** (4.300)	13.91*** (2.958)
<i>Random effects</i>							
Country-level variance	0.0319 (0.0197)	0.0251 (0.0157)	0.0438 (0.0265)	0.0410 (0.0249)	0.0398 (0.0240)	0.0412 (0.0251)	0.0178 (0.0117)
Region-level variance	0.0114 (0.0015)	0.0108 (0.0014)	0.0100 (0.0077)	0.0109 (0.0014)	0.0108 (0.0014)	0.0113 (0.0015)	0.0106 (0.0015)
Residual variance	0.0034 (0.0001)	0.0035 (0.0001)	0.0030 (0.0001)	0.0033 (0.0001)	0.0033 (0.0001)	0.0034 (0.0001)	0.0033 (0.0001)
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
FUA controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Mundlak correction	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Log restricted-likelihood	3622.1881	3353.8639	3609.1582	3656.0003	3708.3304	3267.6113	2994.0274
# of countries	13	13	13	13	13	13	13
# of regions	146	140	140	148	149	137	121
Observations	2,844	2,676	2,724	2,868	2,880	2,604	2,352

Note: standard errors in parentheses (*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$). The FUA controls include population density, FUA area size, and the elderly and youth dependency ratios. The multilevel mixed-effects estimations are fitted with restricted maximum likelihood. The variance-covariance structure is unstructured, where all variances and covariances are distinctly estimated.

Table 2.9: Jackknife estimation results

VARIABLES		
ln(pop density)	0.0788*** (0.0266)	0.0788*** (0.0221)
ln(area)	0.0590*** (0.0185)	0.0590*** (0.0158)
Elderly dep. ratio	-0.00262 (0.00241)	-0.00262 (0.00190)
Youth dep. ratio	-0.000252 (0.00526)	-0.000252 (0.00473)
EQI	-0.235*** (0.0646)	-0.235*** (0.0649)
LAI	-0.00632*** (0.00105)	-0.00632*** (0.00110)
Fragmentation	-0.219*** (0.0692)	-0.219*** (0.0559)
EQI*LAI	0.00505*** (0.00114)	0.00505*** (0.00113)
EQI*Fragmentation	0.123*** (0.0460)	0.123*** (0.0421)
LAI*Fragmentation	0.00384*** (0.00115)	0.00384*** (0.000887)
EQI*LAI*Fragmentation	-0.00260*** (0.000845)	-0.00260*** (0.000786)
Constant	11.16*** (1.798)	11.16*** (1.797)
<i>Random effects</i>		
Country-level variance	0.0371 (0.0100)	0.0371 (0.0095)
Region-level variance	0.0111 (0.0018)	0.0111 (0.0018)
Residual variance	0.0033 (0.0006)	0.0033 (0.0005)
Time FE	Yes	Yes
Mundlak correction	Yes	Yes
Jackknife cluster	FUA	Region
Log restricted-likelihood	3708.8292	3708.8292
# of countries	14	14
# of regions	151	151
Observations	2,904	2,904

Note: standard errors in parentheses (*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$). Standard errors for the pooled OLS and two-way fixed effects estimations are clustered at the NUTS2-level (the same level as the EQI data). The multilevel mixed-effects estimations are fitted with restricted maximum likelihood. The variance-covariance structure is unstructured, where all variances and covariances are distinctly estimated. The jack-knife estimations clustered at the FUA level use 242 replications. The jack-knife estimations clustered at the regional level use 151 replications.

Table 2.10: Bootstrap confidence intervals (clustered at the FUA level)

VARIABLE	Normal confidence interval		Percentile confidence interval		Bias-corrected confidence interval	
	Min	Max	Min	Max	Min	Max
ln(pop density)	0.0246	0.1330	0.0364	0.1384	0.0366	0.1457
ln(area)	0.0199	0.0981	0.0272	0.1090	0.0243	0.0987
Elderly dep. ratio	-0.0068	0.0016	-0.0061	0.0024	-0.0075	0.0005
Youth dep. ratio	-0.0076	0.0071	-0.0074	0.0072	-0.0069	0.0080
EQI	-0.3548	-0.1159	-0.3552	-0.1177	-0.3368	-0.0978
LAI	-0.0083	-0.0043	-0.0079	-0.0038	-0.0079	-0.0039
Fragmentation	-0.3291	-0.1088	-0.3023	-0.0789	-0.3382	-0.1435
EQI*LAI	0.0030	0.0071	0.0029	0.0071	0.0025	0.0068
EQI*Fragmentation	0.0405	0.2065	0.0480	0.2134	0.0428	0.2042
LAI*Fragmentation	0.0020	0.0057	0.0014	0.0051	0.0024	0.0062
EQI*LAI*Fragmentation	-0.0041	-0.0010	-0.0044	-0.0012	-0.0042	-0.0011
Constant	8.5505	13.7725	7.5542	13.1545	8.4564	13.9153
<i>Random effects</i>						
Country-level constant	-1.8696	-1.4233	-1.9271	-1.4971	-1.8086	-1.4688
Region-level constant	-2.3583	-2.1408	-2.3504	-2.1261	-2.3929	-2.1743
Residual constant	-2.9897	-2.7172	-3.1434	-2.8811	-2.8454	-2.8454

Note: the multilevel mixed-effects estimations are fitted with restricted maximum likelihood. The variance-covariance structure is unstructured, where all variances and covariances are distinctly estimated. The bootstrap estimation is clustered at the FUA level and uses 200 replications.

Table 2.11: Bootstrap confidence intervals (clustered at the regional level)

VARIABLE	Normal confidence interval		Percentile confidence interval		Bias-corrected confidence interval	
	Min	Max	Min	Max	Min	Max
ln(pop density)	0.0407	0.1169	0.0461	0.1259	0.0475	0.1275
ln(area)	0.0311	0.0869	0.0324	0.0845	0.0313	0.0840
Elderly dep. ratio	-0.0062	0.0009	-0.0063	0.0007	-0.0063	0.0007
Youth dep. ratio	-0.0084	0.0079	-0.0072	0.0084	-0.0080	0.0069
EQI	-0.3536	-0.1172	-0.3539	-0.1126	-0.3537	-0.1099
LAI	-0.0084	-0.0043	-0.0082	-0.0041	-0.0086	-0.0046
Fragmentation	-0.3298	-0.1081	-0.3345	-0.1211	-0.3598	-0.1260
EQI*LAI	0.0030	0.0071	0.0030	0.0070	0.0026	0.0070
EQI*Fragmentation	0.0369	0.2100	0.0542	0.2332	0.0331	0.2034
LAI*Fragmentation	0.0020	0.0057	0.0021	0.0058	0.0023	0.0059
EQI*LAI*Fragmentation	-0.0042	-0.0010	-0.0047	-0.0012	-0.0039	-0.0008
Constant	8.0455	14.2775	7.2586	13.6393	7.8783	14.1025
<i>Random effects</i>						
Country-level constant	-1.8764	-1.4165	-1.9652	-1.4927	-1.9459	-1.4823
Region-level constant	-2.3767	-2.1224	-2.3944	-2.1396	-2.3995	-2.1484
Residual constant	-3.0049	-2.7019	-3.0475	-2.7451	-2.9730	-2.6669

Note: the multilevel mixed-effects estimations are fitted with restricted maximum likelihood. The variance-covariance structure is unstructured, where all variances and covariances are distinctly estimated. The bootstrap estimation is clustered at the regional level and uses 200 replications.

Table 2.12: Estimation with crossed random effects for the years

Variables	
ln(pop density)	0.0790*** (0.00422)
ln(area)	0.0591*** (0.00305)
Elderly dep. ratio	-0.00241*** (0.000569)
Youth dep. ratio	-0.000323 (0.000915)
EQI	-0.241*** (0.0394)
LAI	-0.00642*** (0.000666)
Fragmentation	-0.220*** (0.0286)
EQI*LAI	0.00514*** (0.000647)
EQI*Fragmentation	0.123*** (0.0272)
LAI*Fragmentation	0.00385*** (0.000469)
EQI*LAI*Fragmentation	-0.00259*** (0.000471)
Constant	11.22*** (3.856)
<i>Random effects</i>	
Year-level variance	0.0004 (0.0002)
Country-level variance	0.0372 (0.0211)
Region-level variance	0.0111 (0.0014)
Residual variance	0.0033 (0.0010)
Mundlak correction	Yes
Log restricted-likelihood	3734.1739
# of countries	14
# of regions	151
Observations	2904

Note: standard errors in parentheses (*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$). The multilevel mixed-effects estimation is fitted with restricted maximum likelihood. The variance-covariance structure is unstructured, where all variances and covariances are distinctly estimated.

Figure 2.31: Marginal EQI effects using the estimation results of the crossed random effects for the years

Note: the margins-plot shows the marginal effect of EQI as estimated in table 2.12 of appendix 2.D. Ln_fua_e represents the estimated horizontal fragmentation error.

Appendix 2.E: Effects over time

Table 2.13: Cross-sectional estimations for each year

Variables	2003	2004	2005	2006	2007	2008
EQI	0.680* (0.377)	0.560 (0.366)	0.680* (0.387)	0.637* (0.383)	0.553 (0.391)	0.615 (0.397)
LAI	0.00922 (0.0122)	0.0104 (0.0118)	0.00814 (0.0124)	0.00822 (0.0125)	0.00806 (0.0122)	0.00786 (0.0124)
Fragmentation	-0.0918 (0.171)	-0.126 (0.169)	-0.153 (0.178)	-0.125 (0.178)	-0.180 (0.175)	-0.174 (0.170)
EQI#LAI	-0.0101* (0.00612)	-0.00777 (0.00594)	-0.00967 (0.00625)	-0.00888 (0.00619)	-0.00749 (0.00634)	-0.00831 (0.00642)
EQI#Fragmentation	0.0108 (0.183)	0.0553 (0.175)	0.0927 (0.185)	0.0234 (0.182)	0.114 (0.188)	0.103 (0.190)
LAI#Fragmentation	0.00180 (0.00268)	0.00244 (0.00267)	0.00280 (0.00283)	0.00225 (0.00284)	0.00329 (0.00279)	0.00330 (0.00272)
EQI#LAI#Fragmentation	-0.000637 (0.00294)	-0.00152 (0.00282)	-0.00192 (0.00296)	-0.000858 (0.00292)	-0.00253 (0.00300)	-0.00249 (0.00305)
Constant	9.772* (5.051)	9.129* (4.831)	9.376* (5.012)	8.871* (4.979)	9.307* (4.977)	9.518* (4.987)
<i>Random effects</i>						
Country-level variance	0.0632 (0.0426)	0.0570 (0.0384)	0.0617 (0.0415)	0.0603 (0.0410)	0.0606 (0.0407)	0.0610 (0.0406)
Region-level variance	0.0062 (0.0015)	0.0067 (0.0015)	0.0069 (0.0016)	0.0070 (0.0016)	0.0071 (0.0017)	0.0074 (0.0017)
Residual variance	0.0060 (0.0010)	0.0058 (0.0010)	0.0061 (0.0010)	0.0066 (0.0010)	0.0067 (0.0010)	0.0060 (0.0010)
FUA controls	Yes	Yes	Yes	Yes	Yes	Yes
Mundlak correction	Yes	Yes	Yes	Yes	Yes	Yes
Log restricted-likelihood	118.1249	117.1001	112.7254	107.2656	105.9992	111.6718
# of countries	14	14	14	14	14	14
# of regions	151	151	151	151	151	151
Observations	242	242	242	242	242	242

Table 2.13 continued

Variables	2009	2010	2011	2012	2013	2014
EQI	0.587 (0.397)	0.668* (0.382)	0.156 (0.399)	0.289 (0.387)	-0.157 (0.300)	-0.0570 (0.276)
LAI	0.0103 (0.0114)	0.0111 (0.0112)	0.0109 (0.00915)	0.00630 (0.00901)	0.00511 (0.00684)	0.00310 (0.00723)
Fragmentation	-0.0992 (0.169)	-0.130 (0.157)	0.0501 (0.173)	-0.0486 (0.140)	-0.0982 (0.125)	-0.123 (0.114)
EQI#LAI	-0.00817 (0.00643)	-0.00933 (0.00621)	-1.06e-05 (0.00655)	-0.00212 (0.00634)	0.00503 (0.00482)	0.00387 (0.00448)
EQI#Fragmentation	0.00523 (0.190)	0.0584 (0.183)	-0.153 (0.194)	-0.0744 (0.175)	0.0297 (0.140)	0.0654 (0.123)
LAI#Fragmentation	0.00191 (0.00271)	0.00246 (0.00254)	-0.000372 (0.00296)	0.00110 (0.00235)	0.00198 (0.00203)	0.00253 (0.00195)
EQI#LAI#Fragmentation	-0.000712 (0.00306)	-0.00160 (0.00295)	0.00167 (0.00325)	0.000415 (0.00289)	-0.00128 (0.00231)	-0.00177 (0.00206)
Constant	8.879* (4.546)	8.919* (4.560)	10.53*** (3.659)	10.13*** (3.934)	11.45*** (3.398)	11.41*** (3.671)
<i>Random effects</i>						
Country-level variance	0.0492 (0.0322)	0.0503 (0.0331)	0.0314 (0.0245)	0.0380 (0.0247)	0.0276 (0.0180)	0.0330 (0.0210)
Region-level variance	0.0072 (0.0016)	0.0068 (0.0016)	0.0059 (0.0015)	0.0050 (0.0013)	0.0048 (0.0013)	0.0055 (0.0013)
Residual variance	0.0055 (0.0010)	0.0060 (0.0010)	0.0061 (0.0010)	0.0057 (0.0010)	0.0066 (0.0010)	0.0055 (0.0010)
FUA controls	Yes	Yes	Yes	Yes	Yes	Yes
Mundlak correction	Yes	Yes	Yes	Yes	Yes	Yes
Log restricted-likelihood	118.3562	114.8083	121.3844	130.3684	121.8825	129.4658
# of countries	14	14	14	14	14	14
# of regions	151	151	151	151	151	151
Observations	242	242	242	242	242	242

Note: standard errors in parentheses (** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$). The FUA controls include population density, FUA area size, and the elderly and youth dependency ratios. The multilevel mixed-effects estimations are fitted with restricted maximum likelihood. The variance-covariance structure is unstructured, where all variances and covariances are distinctly estimated.

Table 2.14: Pre- and post-crisis estimations

Variables	2003-2007	2008-2014
ln(pop density)	0.0709*** (0.00662)	0.0833*** (0.00523)
ln(area)	0.0524*** (0.00480)	0.0632*** (0.00377)
Elderly dep. ratio	-0.00183** (0.000918)	-0.000725 (0.000662)
Youth dep. ratio	-0.0154*** (0.00159)	0.00793*** (0.00138)
EQI	0.0365 (0.154)	-0.255*** (0.0448)
LAI	0.0181** (0.00757)	-0.00608*** (0.000694)
Fragmentation	-0.335*** (0.0836)	-0.155*** (0.0333)
EQI#LAI	-0.000330 (0.00247)	0.00529*** (0.000746)
EQI#Fragmentation	0.0220 (0.0838)	0.101*** (0.0342)
LAI#Fragmentation	0.00511*** (0.00133)	0.00278*** (0.000558)
EQI#LAI#Fragmentation	-0.000320 (0.00135)	-0.00199*** (0.000597)
Constant	8.836* (5.150)	11.26*** (3.612)
<i>Random effects</i>		
Country-level variance	0.0671 (0.0413)	0.0323 (0.0186)
Region-level variance	0.0122 (0.0016)	0.0110 (0.0014)
Residual variance	0.0031 (0.0001)	0.0030 (0.0001)
Time FE	Yes	Yes
Mundlak correction	Yes	Yes
Log restricted-likelihood	1433.357	2138.7885
# of countries	14	14
# of regions	151	151
Observations	1210	1210

Note: standard errors in parentheses (*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$). The pre-crisis years are: 2003-2007. The post-crisis years are 2008-2014. The multilevel mixed-effects estimations are fitted with restricted maximum likelihood. The variance-covariance structure is unstructured, where all variances and covariances are distinctly estimated.

Figure 2.32: Marginal EQI effects for the pre-crisis years 2003-2007

Note: the margins-plot shows the marginal effect of EQI as estimated in table 2.14 of appendix 2.E. $\ln_fua_e$ represents the estimated horizontal fragmentation error.

Figure 2.33: Marginal EQI effects for the post-crisis years 2008-2014

Note: the margins-plot shows the marginal effect of EQI as estimated in table 2.14 of appendix 2.E. $\ln_fua_e$ represents the estimated horizontal fragmentation error. $\ln_fua_e$ represents the estimated horizontal fragmentation error.

Appendix 2.F: GDP per capita outcome

Table 2.15: Estimations using GDP per capita as dependent variable

Variables	OLS	FE	MIXED
ln(pop density)	0.204*** (0.0277)		0.120*** (0.00659)
ln(area)	0.0945*** (0.0256)		0.103*** (0.00477)
ln(population)		-0.839*** (0.135)	
Elderly dep. ratio	0.00574 (0.00566)	-0.00121 (0.00196)	-0.0120*** (0.000896)
Youth dep. ratio	-0.00393 (0.00505)	-0.00235 (0.00330)	-0.00951*** (0.00143)
EQI	0.00980 (0.233)	-0.104 (0.0747)	0.0559 (0.0616)
LAI	-0.00393 (0.00405)	-0.00285* (0.00146)	-0.00371*** (0.00104)
Fragmentation	-0.0436 (0.189)		-0.220*** (0.0448)
EQI*LAI	0.00382 (0.00357)	0.00388*** (0.00136)	0.00135 (0.00101)
EQI*Fragmentation	0.311 (0.208)	0.213*** (0.0554)	0.152*** (0.0426)
LAI*Fragmentation	0.00177 (0.00304)	0.00243** (0.00104)	0.00429*** (0.000734)
EQI*LAI*Fragmentation	-0.00562* (0.00317)	-0.00430*** (0.00105)	-0.00367*** (0.000737)
Constant	8.580*** (0.479)	21.65*** (1.739)	9.848** (4.091)
<i>Random effects</i>			
Country-level variance			0.0367 (0.0231)
Region-level variance			0.0348 (0.0044)
Residual variance			0.0081 (0.0002)
Time FE	Yes	Yes	Yes
Fixed effects	No	Yes	No
Mundlak correction	No	No	Yes
R-squared	0.432	0.493	
Log restricted-likelihood			2415.055

Note: standard errors in parentheses (*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$). FUA area and fragmentation disappear when including fixed effects. Therefore, I also exclude population density and use population instead. The FUA controls include population density, FUA area size, and the elderly and youth dependency ratios. The fixed effects estimation includes population instead of population density and FUA area size. Standard errors for the pooled OLS, and two-way fixed effects are clustered at the NUTS2-level (the same level as the EQI data). The multilevel mixed-effects estimations are fitted with restricted maximum likelihood. The variance-covariance structure is unstructured, where all variances and covariances are distinctly estimated.

Figure 2.34: Marginal EQI effects using GDP per capita as dependent variable

Note: the margins-plot shows the marginal effect of EQI as estimated in table 2.15 of appendix 2.F. $\ln_fua_e$ represents the estimated horizontal fragmentation error.

Appendix 2.G: Alternative fragmentation estimators*Table 2.16: Prediction of fragmentation using population density and FUA area size*

Variables	Coefficients
2003b.year*ln(pop density)	-0.0975*** (0.0376)
2004.year*ln(pop density)	-0.0975*** (0.0376)
2005.year*ln(pop density)	-0.0975*** (0.0376)
2006.year*ln(pop density)	-0.0974*** (0.0375)
2007.year*ln(pop density)	-0.0974*** (0.0375)
2008.year*ln(pop density)	-0.0973*** (0.0375)
2009.year*ln(pop density)	-0.0973*** (0.0375)
2010.year*ln(pop density)	-0.0973*** (0.0374)
2011.year*ln(pop density)	-0.0974*** (0.0374)
2012.year*ln(pop density)	-0.0973*** (0.0374)
2013.year*ln(pop density)	-0.0973*** (0.0374)
2014.year*ln(pop density)	-0.0971*** (0.0373)
ln(area)	1.165*** (0.0324)
Constant	-4.634*** (0.391)
Observations	2,904
R-squared	0.403

Note: the estimation is performed using a pooled OLS. The dependent variable is the natural log of the number of local governments within an urban agglomeration. The difference between the actual and predicted values is used to capture fragmentation.

Table 2.17: Estimations using alternative fragmentation measures

Variables	Number of local governments	Density & size fragmentation
ln(pop density)	0.0735*** (0.00408)	0.0740*** (0.00474)
ln(area)	0.0566*** (0.00472)	0.0597*** (0.00308)
Elderly dep. ratio	-0.00258*** (0.000563)	-0.00254*** (0.000577)
Youth dep. ratio	0.000314 (0.000906)	-0.000662 (0.000919)
EQI	-0.492*** (0.0777)	-0.183*** (0.0395)
LAI	-0.0196*** (0.00128)	-0.00513*** (0.000663)
Fragmentation	-0.231*** (0.0197)	-0.103*** (0.0281)
EQI*LAI	0.0105*** (0.00133)	0.00406*** (0.000646)
EQI*Fragmentation	0.0804*** (0.0215)	0.138*** (0.0272)
LAI*Fragmentation	0.00390*** (0.000315)	0.00180*** (0.000466)
EQI*LAI*Fragmentation	-0.00169*** (0.000352)	-0.00238*** (0.000466)
Constant	12.08*** (3.969)	11.53*** (3.371)
<i>Random effects</i>		
Country-level variance	0.0397 (0.0225)	0.0278 (0.0163)
Region-level variance	0.0113 (0.0014)	0.0115 (0.0014)
Residual variance	0.0032 (0.0001)	0.0034 (0.0001)
Time FE	Yes	Yes
Mundlak correction	Yes	Yes
Log restricted-likelihood	3771.1438	3682.8254
# of countries	14	14
# of regions	151	151
Observations	1210	1210

Note: standard errors in parentheses (*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$). The multilevel mixed-effects estimations are fitted with restricted maximum likelihood. The variance-covariance structure is unstructured, where all variances and covariances are distinctly estimated.

Figure 2.35: Marginal EQI effects using number of local governments to capture fragmentation

Note: the margins-plot shows the marginal effect of EQI as estimated in table 2.17 of appendix 2.G. $\ln_fua$ represents the natural log of the number of governmental entities.

Figure 2.36: Marginal EQI effects using the estimated error from the fragmentation predicted by FUA area size and population density

Note: the margins-plot shows the marginal effect of EQI as estimated in table 2.17 of appendix 2.G. $\ln_fua_e2$ represents the estimated horizontal fragmentation error using density and population size.

Appendix 2.H: Dynamic estimations

Table 2.18: Dynamic estimations

Variables	Base	Direct	EQI*LAI	EQI*Frag	Full
Labor productivity, t-1	-0.0214*** (0.00357)	-0.0245*** (0.00382)	-0.0246*** (0.00385)	-0.0264*** (0.00363)	-0.0268*** (0.00389)
ln(pop density), t-1	-0.000196 (0.00174)	0.000266 (0.00185)	0.000293 (0.00185)	0.000234 (0.00185)	0.000389 (0.00185)
ln(area), t-1	0.00124 (0.00123)	0.00137 (0.00132)	0.00139 (0.00132)	0.00142 (0.00132)	0.00144 (0.00132)
Elderly dep. ratio, t-1	-0.000206 (0.000246)	-0.000197 (0.000247)	-0.000182 (0.000248)	-0.000230 (0.000247)	-0.000209 (0.000249)
Youth dep. ratio, t-1	0.000668* (0.000395)	0.000720* (0.000396)	0.000739* (0.000397)	0.000729* (0.000396)	0.000781** (0.000397)
EQI, t-1		0.00398** (0.00192)	-0.00319 (0.0112)	0.00427** (0.00192)	-0.00271 (0.0111)
LAI, t-1		9.17e-05 (0.000152)	3.90e-05 (0.000176)	0.000266* (0.000136)	0.000188 (0.000167)
Fragmentation, t-1		0.000358 (0.00184)	0.000339 (0.00184)	0.00175 (0.00190)	-0.00567 (0.00803)
EQI*LAI, t-1			0.000118 (0.000181)		0.000128 (0.000177)
EQI*Fragmentation, t-1				-0.00254*** (0.000904)	0.00791 (0.00780)
LAI*Fragmentation, t-1					0.000124 (0.000126)
EQI*LAI*Fragmentation, t-1					-0.000172 (0.000128)
Constant	0.256*** (0.0900)	0.292*** (0.0980)	0.306*** (0.103)	0.292*** (0.0776)	0.343*** (0.0970)
<i>Random effects</i>					
Country-level variance	0.0000 (0.0000)	0.0000 (0.0000)	0.0000 (0.0000)	0.0000 (0.0000)	0.0000 (0.0000)
Region-level variance	0.0000 (0.0000)	0.0000 (0.0000)	0.0000 (0.0000)	0.0000 (0.0000)	0.0000 (0.0000)
Residual variance	0.0006 (0.0000)	0.0006 (0.0000)	0.0006 (0.0000)	0.0006 (0.0000)	0.0006 (0.0000)
Time FE	Yes	Yes	Yes	Yes	Yes
Mundlak correction	Yes	Yes	Yes	Yes	Yes
Log restricted-likelihood	6023.1616	5990.9444	5983.4481	5988.1072	5964.9924
# of countries	14	14	14	14	14
# of regions	151	151	151	151	151
Observations	2,662	2,662	2,662	2,662	2,662

Note: standard errors in parentheses (** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$). The FUA controls include population density, FUA area size, and the elderly and youth dependency ratios. The multilevel mixed-effects estimations are fitted with restricted maximum likelihood. The variance-covariance structure is unstructured, where all variances and covariances are distinctly estimated.

CHAPTER 3

HOW DOES THE LOCAL PUBLIC FISCAL COMPOSITION AFFECT LOCAL ECONOMIC GROWTH?

INSIGHTS FROM US CITIES

Abstract

The “silent trend” of increased decentralization has slowly shifted more power to local governments, in favor of more place-based policies. The broad argument is that local governments are more efficient at providing the specific local needs, thereby being better capable at enhancing economic performance and local well-being. However, while we know a lot about the relationship between public finance and economic growth, we argue in this chapter that there is still a lot to learn about how local governments may actually enhance economic growth. Therefore, this chapter aims to present a detailed analysis on how the local public fiscal composition affects economic growth. New data allows for an extensive analysis on the local economic growth effects of over 100 revenue and expenditure categories in United States cities, with a further distinction between capital outlay and current operations expenditures. The data also presents a solution to the local fiscal comparability issue. Furthermore, by focusing on the complete local public fiscal composition of cities, this chapter considers the constrained choice set policy makers face. Results show that local public revenues are only distortionary when used to fund non-productive expenditures. When used to fund productive expenditures, increased revenues may enhance actually economic growth. Relatively productive expenditures are public welfare, highways, utilities, and commercial activities. Unproductive expenditures are public safety, health, parks & recreation, public buildings and interest on general debt.

Keywords: economic growth; local public finance; local government; fiscally standardized

JEL classification: H70, R11, R51

3.1 Introduction

This chapter examines the economic growth effects of the local public fiscal composition. While the economic implications of public finance have been extensively investigated at the federal (Gemmell, Kneller, & Sanz, 2016; Kneller, Bleaney, & Gemmell, 1999), less attention has been paid to the implications of the composition of local public finance for local economic growth. Local public fiscal compositions differ from national fiscal compositions in that the responsibilities of local governments are different (e.g. more education instead of military). The goal of this chapter is to empirically analyze how the local public fiscal composition affects local economic growth. A better understanding of the economic effects of the local public fiscal composition may help local policymakers in their decision making. While maximizing gross regional product (GRP) may not be the sole, or most important objective of local governments, local public policy makers should be aware of the economic implications of their fiscal choices.

This work is novel in its level of detail, analyzing the local economic growth effects of the full local public fiscal composition, including a distinction between public investment and current operations expenditures. This is made possible by the highly detailed Fiscally Standardized Cities (FiSC) database (Langley, 2016; Lincoln Institute of Land Policy, 2019). By focusing on the complete local public fiscal composition, this research allows for the complexity that public policy makers face in making their decisions. For example, increased expenditures or investments on education have to be financed through lower expenditures in other categories, increased sourcing of revenues, or a lower budget balance. All expenditure, revenue and budget decisions are therefore part of a constrained choice set. This is accomplished by using an estimation strategy based on the work by Devarajan, Swaroop and Zou (1996) and Gemmell, Kneller and Sanz (2016). We use data on more than 100 expenditure and revenue components, guided by theoretical evidence, to better understand the specific fiscal drivers of local economic growth. Finally, given the complex system of local governments in the United States with county governments, city governments, school districts and special districts, one cannot simply compare the fiscal compositions of city governments or counties; The responsibilities of these may differ greatly across regions. This issue of fiscal incomparability is solved in the chapter through the use of fiscally standardized data.

The subsequent sections first describe the literature on the relationship between public finance and economic growth, followed by a specific focus on local governments and the budget constraint. Subsequently, the data section describes the data sources and provides descriptive overviews of the data. The empirical analysis section describes our model, with a focus on causality and overlapping data. Subsequently the results are presented, after which they are discussed in the discussion section. The chapter is concluded by a short conclusion of our findings with our main takeaways.

3.2 Local public finance and economic growth

Given that the literature on the relationship between governmental activities and economic growth is extensive, this section will briefly highlight some of the general empirical findings in order to position our work. First, a general overview of the relationship between public finance and economic growth will be presented. Subsequently, the current gap in the literature that this chapter tries to fill is described through a description of the specific role of local governments, and the importance and implications of the budget constraint.

3.2.1 Public finance and economic growth

Historically, neoclassical growth models argued that government spending and taxation do not affect long-run economic growth, but only the level of output through the savings rate (Solow, 1956; Swan, 1956). These short-term growth effects may last some years but eventually disappear. However, during the 1980s research showed how governmental activities and economic growth are potentially related in different ways, in which the nature of the relationship is unclear (David Alan Aschauer, 1989; Barro, 1990; Lucas, 1988; Romer, 1986).

Governmental activities are captured by public finance, consisting of various fiscal components which may be divided into revenues, expenditures and the budget balance. The empirical evidence for an influence of public finance on long-run economic growth is somewhat mixed (Nijkamp & Poot, 2004). Intergovernmental transfers are generally assumed to be an exogenous event on which the remaining tax structure is build (Holm-Hadulla, 2020). They are generally found to have positive growth effects (Cashin, 1995; Dawid, Harting, & Neugart, 2018) although there is also evidence for a negative effect (Churchill & Yew, 2017). Furthermore, another strand of literature focused on fiscal decentralization, often uses the share of own-source revenues (all revenues other than intergovernmental transfers) as an indicator of fiscal decentralization (Martinez-Vazquez, Lago-Peñas, & Sacchi, 2017). The share of intergovernmental transfers may therefore also be interpreted as the inverse indicator of fiscal decentralization. A clear consensus has not yet been reached on the economic growth effects of fiscal decentralization (Iimi, 2005; Martinez-Vazquez et al., 2017; Rodríguez-Pose & Ezcurra, 2011; Stansel, 2005; Xie, Zou, & Davoodi, 1999). Therefore, a negative effect for intergovernmental transfers may be indicative of a positive fiscal decentralization effect, and vice versa.

Taxes are generally expected to distort growth (Cashin, 1995; Romero-Ávila & Strauch, 2008). However, there is some discussion on the relative distortionary extent; Some claim property tax to be relatively distortionary (Barro, 1990; Helms, 1985; Kneller et al., 1999), while others argue that it actually is relatively non-distortionary (Arnold, 2008a; Holm-Hadulla, 2020). Similarly, sales and gross receipts tax is both found to be relatively distortionary (Mendoza, Milesi-Ferretti, & Asea, 1997) and non-distortionary (Arnold, 2008a; Barro, 1990; Kneller et al., 1999).

When looking at the economic growth effects of public expenditures, literature often either talks about public investment (Ansar, Flyvbjerg, Budzier, & Lunn, 2016; Bom & Ligthart, 2014; Liu, Park, & Zheng, 2002; Pereira, 2000), or public expenditures (David Alan Aschauer, 1989; Glaeser, Scheinkman, & Shleifer, 1995; Helms, 1985; Kneller et al., 1999; Sturm & de Haan, 1995). The specific definition used for public investments may differ, with papers sometimes using public investment and public expenditures somewhat interchangeably (David Alan Aschauer, 1989; Barro, 1990). The detailed dataset used in this chapter allows for a specific distinction between public investment and public expenditures, where public expenditures are divided into public investments and current operations expenditures. This enhances our understanding of the specific economic growth effects of public expenditures.

Typical growth enhancing public expenditures are education (Barro, 1990; Glaeser et al., 1995; Helms, 1985; Kneller et al., 1999; Nijkamp & Poot, 2004) and infrastructure (David A Aschauer, 1990; David Alan Aschauer, 1989; Bom & Ligthart, 2014; Cohen & Paul, 2004; Helms, 1985; Kneller et al., 1999; Nijkamp & Poot, 2004; Pereira, 2000). Although, there is some discussion as to whether education simply benefits individuals by giving them the right qualifications to get higher up, or whether there is an actual direct relationship between the amount of education in a society and its future growth rate (Wolf, 2002). Furthermore, the question may be to what extent education expenditures enhance general future growth rate (Wolf, 2002). In terms of infrastructure, there are also empirical examples finding little to no economic growth effects for additional public transportation investments (Ansar et al., 2016; Elburz, Nijkamp, & Pels, 2017; Holtz-Eakin & Schwartz, 1995). One of the reasons for this may be the current stock and quality of infrastructure. It is found that a higher stock and quality yields lower additional impacts (Romp & Haan, 2007).

There is also evidence for economic growth effects of other public expenditures. For example, housing investment shows a positive economic growth effect (Liu et al., 2002). Furthermore, Midgley (1999) describes how traditionally, the idea was that the resources generated through economic growth should/may be redistributed through social programs. Subsequently, the argument is made that social programs may actually serve as investments in people, yielding positive economic growth effects (Midgley, 1999; Sala-I-Martin, 1992, 1997).

Finally, the argument related to the creative class (Florida, 2002), city amenities (Glaeser, 2011; Glaeser, Kolko, & Saiz, 2001) and whether people follow jobs or jobs follow people (Hoogstra, van Dijk, & Florax, 2017; Storper & Scott, 2009) would suggest that public investments into the recreational sector may also enhance urban economic growth.

3.2.2 Local vs. (sub)national

Most aforementioned research has been on aggregated country or state-level data. There seems to be little analysis on economic effects of local public finance. Often, local governments are

merged with state governments (e.g. Helms, 1985). Other times research focuses only on public infrastructure investment (e.g. Duffy-Deno & Eberts, 1990; Eberts, 1986) or scholars are interested in other outcomes such as employment (Dalenberg & Partridge, 1995) or population growth (Glaeser et al., 1995).

The limited empirical analyses on the economic effects of local public finance is striking given the increased observed importance of local governments. Over the past decades, a global decentralization trend developed (Oates, 1999; OECD, 2019; Rodríguez-Pose & Ezcurra, 2011). The often-observed (fiscal) decentralization trend shows the increased importance of state and local governmental organizations relative to the federal government. Interestingly, looking closely at the share of local public finance out of total (Federal, State and local) public finance specifically, we find no such clear trend of fiscal decentralization (figure 3.1). This suggests that (urban) local governments have not increased in fiscal importance in recent decades. However, these local governments still make up a significant share of total government (around one-third in expenditures and a quarter in revenues), yet they are often overlooked in public finance debates. This is even more interesting given the general consensus that investments into education and infrastructure are the main ways in which government may affect economic growth: these are two domains in which local governments are major contributors.

Figure 3.1: Fiscal decentralization of local public finance

Source: authors own elaboration with data from the FiSC database and United States Census data. The share of local public finance is measured as the average local public fiscal component per capita in the 150 cities of the FiSC database, divided by the average total (Federal, State and local) public fiscal component per capita for the United States.

3.2.3 The budget constraint

Empirical literature at the U.S. state-and-local level⁷ suggests that the size of government is determined by the resource supply, consistent with the tax-and-spend hypothesis (Westerlund, Mahdavi, & Firoozi, 2011). This means that subnational levels of government determine their optimal revenue structure, after which they determine how to spend it. This is in line with the tight budget regulations often found at the local level of government (Mahdavi & Westerlund, 2011; Westerlund et al., 2011). Although, as becomes evident from figure 3.2, the tight budget restrictions seem to be let go during crises, such as the dot-com bubble and the financial crisis⁸.

Figure 3.2: Local public finance over time

Source: authors elaboration with data from the FiSC database and United States Census data. Note that unlike in figure 3.1, we now use total revenues instead of total own-source revenues. The difference is that total revenues includes intergovernmental transfers. This chapter uses data from 2001 onwards (indicated by the grey bar).

While, it is common to assume all revenues to either be distortionary or non-distortionary, and expenditures to either be productive or non-productive (Gemmell et al., 2016; Kneller et al., 1999), it is important to note that the relative distortionary/productive extent of a fiscal component depends on the fiscal component it is compared to (Bénassy-Quéré, Gopalraja, & Trannoy, 2007; Crafts, 2009), represented by the budget constraint; One cannot simply increase expenditures without increasing revenues or debt. For example, Crafts (2009) finds investment in productive government expenditures to be positively correlated with economic growth, unless it is financed through taxes on incomes in which case the positive effect turns negligible. Reed (2008) summarizes a lot of this literature (Bartik, 1992; Gabe & Bell, 2004; Helms, 1985; Philips & Goss, 1995) in a cautionary consensus that taxes used to fund general

expenditures have small negative effects, whereas the negative tax effects may vanish or turn positive when used to fund productive expenditures. Similarly, Abiad *et al* (2016) find public investment to be more effective when financed through debt (budget balance) instead of taxes. Only few papers take a full composition view in which the relative effects of all (aggregated) fiscal components are explored (Gechert, 2015; Gemmell et al., 2016; Kneller et al., 1999), and none of these focus on local governments specifically.

This brief literature overview shows that the literature on the relationship between governmental activities and economic growth is extensive. However, it also shows that only few papers take a specific focus on local governments. Similarly, only few papers explore the full composition, with the relative effects of all (aggregated) fiscal components. This paper is therefore novel in combining two approaches that have been underutilized: a focus on local governments, using a full composition approach. The data section further explores two other novelties of this paper: the fiscal comparability issue of local governments (Langley, 2016), and a new degree of detail in the fiscal components.

3.3 Data

This section first describes the sources and structure of the data after which descriptive overviews are presented.

3.3.1 Data

This paper uses the *Fiscally Standardized Cities* (FiSC) database by the Lincoln Institute of Land Policy (Lincoln Institute of Land Policy, 2019) to carry out an in-depth analysis of the economic effects of local public finance at the metropolitan-level. To our knowledge, this is the most extensive database to look at local public finance. The FiSC database consists of fiscally standardized panel data on: 150 of the largest United States cities; across more than 100 categories of revenues and expenditures; over the period 1977 – 2016. All fiscal data is gathered from this database, including controls for cash holdings, outstanding debt, student enrollment and city population. The database is constructed using the quinquennial Census of Government Finance and the Annual Surveys of State and Local Government Finance of the U.S. Census Bureau. Each expenditure and revenue category is measured as the amount of real (2016 inflation adjusted) US Dollars.

The FiSC database is unique in how it standardizes the fiscal data of local governments. The system of local governments is extremely complex in the US. Any specific place in the US is usually covered by multiple local governments (county government, city government, and various special districts) at the same time, each responsible for certain specific activities. Such interdependencies between the fiscal compositions of municipal governments, county governments and special districts are common, not only in the US (Aronsson, Lundberg, &

Wikström, 2000). Given that this system of local governments differs across cities, one cannot simply compare city governments or county governments. To solve this issue, one needs to fiscally standardize all local governments into one fiscally standardized local government. The FiSC database is the first database to have successfully done so at a national scale⁹.

Economic growth is measured in terms of growth in gross regional product (GRP). Data comes from the *Regional Data* of the Bureau of Economic Analysis (Bureau of Economic Analysis, 2019). The data runs from 2001-2016 and is measured at the Metropolitan Statistical Areas (MSA) level. MSAs are larger than the geographical city government structures used in the FiSC data. This means that the geographical scales of the local public finance data and the dependent economic growth variable do not match. Moreover, some of the cities from the FiSC data are within the same MSA. Therefore, these fiscal cities are merged together to form one bigger city. Figure 3.3 shows a histogram of the population share, measured by dividing the “FiSC population” by the “MSA population”. The average population share is 37.2% with a median of 37%, which should be enough to capture the importance of the cities. Estimations include a control variable for this population share (city pop/MSA pop) to control for the difference in geographical scales between the dependent and independent variable.

Figure 3.3: Histogram of the population share of FiSC population out of MSA population (City pop/MSA pop)

Source: authors own elaboration with data from the FiSC database and regional data from the Bureau of Economic Analysis.

Demographic data is used to create control variables for the share of working age population (age 15 – 65) and the share of non-white population. The data comes from the Surveillance, Epidemiology, and End Results Program of the National Cancer Institute (2017), which has detailed demographic data at the county-level. Data on the student enrollment, comes from the FiSC database (Lincoln Institute of Land Policy, 2019). Finally, a political control

dummy variable is included, capturing whether the city is located in a blue or red State. A State is considered blue if it voted Democrats in the (last) presidential election, and red if it voted Republican. The dummy is therefore time-variant, every four years.

Merging the cities results in 122 fiscal cities. Following the advice of the creators of the FiSC database, Washington D.C. is subsequently removed given that its local public activities are highly intertwined with federal governmental activities and can therefore not be compared to the other cities (Langley, 2016). Furthermore, the two cities from Alaska (Anchorage and Fairbanks) are removed due to missing data issues. This leaves 119 cities to be analyzed through the regressions (see table 3.16).

3.3.2 Summary statistics

This section presents a brief overview of the fiscal variables. Although we examine the economic growth effects of all fiscal components, we first use aggregated fiscal components (e.g. education) to establish the general effects, before digging deeper into the economic growth effects of specific disaggregated fiscal components (e.g. current operations expenditures on higher education).

The revenue components are categorized into four groups: (1) intergovernmental transfers, (2) property tax, (3) consumption tax, and (4) other revenues. The *consumption tax* includes sales and gross receipts, current charges and utilities. *Other revenues* include all remaining revenue sources, including individual income tax and corporation income tax. These are categorized as *other revenues* given that only few cities levy these taxes and they are both relatively small. The expenditures are divided into: (1) education, (2) public welfare, (3) health, (4) infrastructure, (5) public safety, (6) housing, and (7) other expenditures. *Health* includes hospitals and health. *Infrastructure* includes highways, parking, air transit, ports & sea, and transit. *Housing* includes expenditures on environment & housing, and all utilities expenditures except transit. All remaining expenditures are categorized as *other expenditures*.

Figure 3.4 depicts the separate revenue categories over time. It shows that the *intergovernmental transfers* and *consumption tax* are the biggest revenue sources, with *property tax* and *other revenues* at a distance. It also shows the downwards spikes during the dotcom bubble and financial crisis caused by a drop in employee retirement trust fund revenues.

Figure 3.4: Aggregated local public revenues sources

Source: authors own elaboration with data from the FiSC database and United States Census data. Note that this paper uses data from 2001 onwards (indicated by the grey bar).

Figure 3.5 presents an overview of the aggregated expenditures components. It shows that expenditures on *education* are the biggest, followed by expenditures on *housing*. Expenditures on *public safety*, *infrastructure*, and *health* are significantly lower and *public welfare* expenditures make up relatively the smallest portion. All other expenditures are summarized by *other expenditures*. Expenditures on *public welfare* is the only expenditure category that has not grown (actually shrunken a little) in real terms over time.

Figure 3.5: Aggregated local public expenditures

Source: authors own elaboration with data from the FiSC database and United States Census data. Note that this paper uses data from 2001 onwards (indicated by the grey bar).

3.4 Empirical analysis

This section first describes the model that we use. Subsequently, we describe how we tackle potential causality issues and issues stemming from using overlapping data.

3.4.1 Model

The estimation strategy follows similar work relating country-level public fiscal composition to economic growth (Gemmell et al., 2016; Kneller et al., 1999), and is based on the work by Devarajan *et al.* (1996). Following their work, we start with the following estimation:

$$(3.1) \quad g_{i,t} = \alpha + Y_{t-5} + \sum_k \beta_k \left(\frac{E_k}{Y} \right)_{i,t-5} + \sum_m \beta_m \left(\frac{R_m}{Y} \right)_{i,t-5} + \beta_3 \left(\frac{B}{Y} \right)_{i,t-5} + X_{i,t-5} + \mu_i + \omega_t + \varepsilon_{i,t}$$

Where $g_{i,t}$ is average annual GRP growth per capita in city i at time t , E is total expenditures per capita, R is total revenues per capita, B is the budget balance per capita, Y is total GRP per capita, E_k is the k th expenditure component, R_m is the m th revenue component, X consists of the control variables, μ_i and ω_t are the city and time fixed effects, and $\varepsilon_{i,t}$ is the error term. The fiscal components (expenditures, revenues and budget balance) are normalized by GRP per capita, in line with existing literature (Gemmell et al., 2016; Kneller et al., 1999), thereby automatically controlling for regional price differences.

The estimation is impossible to perform given that the equation represents a closed system: $B_{it} = R_{it} - E_{it}$, resulting in perfect multicollinearity (Gemmell, Kneller, & Sanz, 2011; Kneller et al., 1999). Therefore, at least one fiscal variable has to be left out of the estimation.

Subsequently, the interpretation of the variables that are left in, is that these are financed through the variable that is left out. For example, if we are to leave out the budget balance, the estimation changes into the following:

$$(3.2) \quad g_{i,t} = \alpha + Y_{t-5} + \sum_k (\beta_k - \beta_3) \left(\frac{E_k}{Y} \right)_{i,t-5} + \sum_m (\beta_m - \beta_3) \left(\frac{R_m}{Y} \right)_{i,t-5} + X_{i,t-5} + \mu_i + \omega_t + \varepsilon_{i,t}$$

This means that the standard hypothesis test $\beta_k = 0$ or $\beta_m = 0$, turns into the null hypothesis test that $(\beta_k - \beta_3) = 0$ or $(\beta_m - \beta_3) = 0$. This means that the coefficient for a specific expenditure component (e.g. education) captures the effect of increasing education expenditures financed through a decrease in the budget balance. Similarly, separate expenditure or revenue components may be left out of the estimation.

Controls are all lagged five years and include the natural log of city population, share of working age population, share of non-white population, share of the population enrolled as a student, a dummy if the city is located in a state that voted Democrats in the Presidential election, local public cash holdings, and local public outstanding debt. The summary statistics are shown in table 3.1.

Table 3.1: Summary statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Δ GRP	1,309	0.000	0.002	-0.005	0.009
Initial GRP	1,309	10.746	0.231	10.155	11.530
City population	1,309	12.554	1.023	10.381	15.943
% working age	1,309	0.686	0.022	0.629	0.758
% non-white	1,309	0.228	0.154	0.021	0.715
% enrollment	1,309	0.143	0.029	0.007	0.225
Cash holdings	1,309	0.137	0.082	0.010	0.448
Outstanding debt	1,309	0.135	0.072	0.008	0.431
Blue state	1,309	0.442	0.497	0.000	1.000
City pop/MSA pop	1,309	0.374	0.181	0.011	0.846
Intergov. transfers	1,309	0.044	0.022	0.011	0.134
Property tax	1,309	0.026	0.008	0.007	0.056
Consumption tax	1,309	0.041	0.028	0.003	0.179
Other rev	1,309	0.016	0.014	-0.100	0.082
Budget balance	1,309	-0.004	0.014	-0.138	0.036
Education	1,309	0.040	0.014	0.001	0.096
Public welfare	1,309	0.003	0.004	0.000	0.022
Health	1,309	0.009	0.017	0.000	0.159
Infrastructure	1,309	0.011	0.006	0.001	0.052
Public safety	1,309	0.015	0.005	0.005	0.037
Housing	1,309	0.031	0.021	0.004	0.143
Other exp	1,309	0.024	0.010	0.006	0.066

Note: the number of observations represents the number of observations as found in our overlapping five-year dynamic estimations: 119 cities * 11 time-periods = 1309 observations. These are the summary statistics for dependent variable, control variables, and aggregated fiscal components. The summary statistics for the disaggregated fiscal components may be found in appendices A5-A8.

3.4.2 Causality

In line with similar empirical work (Gennaioli, La Porta, Lopez De Silanes, & Shleifer, 2014; Kneller et al., 1999; Reed, 2008), five-year dynamic estimations are performed. This longer time period is warranted for two reasons: a lagged effect, and possible endogeneity/causality issues. In terms of the lagged effect, given that it may take some time before the local public fiscal composition translates into economic effects, a longer time period is needed. Furthermore, by using the initial expenditure composition to estimate the average annual growth in GRP over the next five years, there is a natural degree of (weak) exogeneity. Robustness checks are performed exploring other lag structures. Issues of causality may stem from business cycle effects. The five-year dynamic estimation structure should limit potential business cycle effects. Issues of causality may also follow from Wagner's law (Fournier, 2016). Wagner's law suggests that higher income brings increasing political pressure for social programs, thereby creating a positive link between social expenditures and growth. However, following the argumentation of Fournier (2016), given that US cities have reached comparable levels of development, it is likely that Wagner's law only plays a minor role in shaping the link between local public fiscal composition and growth. Furthermore, using the initial expenditure composition to estimate the subsequent growth in combination with our controls and city fixed effects, should naturally yield (weak) exogeneity. Therefore, the reverse causality bias is likely to be limited. Yet, in order to investigate and control for Wagner's law, we also use a two-step approach to estimate the fiscal effects; First, each fiscal component is predicted using all control variables (excluding the fiscal variables):

$$(3.3) \quad fc_{f,i,t} = \alpha + Y_t + X_{i,t} + \mu_i + \omega_t + \varepsilon_{i,t}$$

Where, $fc_{f,i,t}$ represents each type of fiscal component f , in city i , at time t . The resulting residuals represent the degree of relatively over/under spending. These adjusted fiscal components are subsequently used in the estimations as represented by equation 3.2.

The dynamic panel estimation strategy also encounters the issue of dynamic panel bias or Nickell bias (Nickell, 1981). Nickell shows that short dynamic panels with fixed effects create a Huricz (1950)-type bias of the estimated convergence term (Arellano & Bond, 1991). The Nickell bias is much larger than the convergence coefficient itself (Barro, 2015; Nickell, 1981). Furthermore, it is found to affect all other coefficient estimates correlated with the level of GRP (Nerlove, 2000). The estimation strategy therefore follows previous work (Barro, 2015; Fournier, 2016; Fournier & Johansson, 2016) to ensure an unbiased estimation of the convergence coefficient. First, in line with the work by Barro (Barro, 2015), estimations are performed with an ordinary least square estimator with year fixed effects, excluding city fixed effects. However, this may result in omitted variables bias given that it may incorrectly treat city specific effects representing differences in technology or tastes (Caselli, Esquivel, & Lefort, 1996). It therefore assumes that the omitted variable bias is small and sufficiently controlled

for through the control variables. Secondly, in line with the work by Fournier (2016), and Fournier and Johansson (2016), city fixed effects are added, while the convergence coefficient is constrained to be equal to the unbiased convergence coefficient estimate from the first step. This solves the issue of the fixed effects affecting the convergence coefficient.

3.4.3 Overlapping data

The five-year dynamic structure results in an issue of overlapping data. Overlapping estimations are generally not preferred given that they create a moving average error term, which results in inefficient parameter estimates and biased hypothesis tests (Hansen & Hodrick, 1980; Harri & Brorsen, 2009). A common solution is to use non-overlapping estimations (Harri & Brorsen, 2009). This yields unbiased and consistent parameter estimates, and valid hypothesis tests. However, it also means that one is throwing away a lot of information, thereby yielding inefficient estimates. Furthermore, given the limited time-span of our data, it means that there are only few time-periods in our data. There are also ways to solve the moving average error term, thereby yielding efficient unbiased hypothesis tests: (1) a heteroscedasticity and autocovariance consistent (HAC) estimator, and (2) GMM estimation. Given the number of regressors in our estimations, GMM estimation quickly increases the number of instruments resulting in overidentification. Approaches to limit the number of instruments have been explored, still leading to issues of overidentification and unstable GMM estimation results. We therefore give preference to using the HAC estimator.

HAC estimators account for heteroscedasticity and autocorrelation over a specified number of lags. This solves the issue of the moving average error term. The Newey-West estimator is a commonly used HAC estimator. The Driscoll-Kraay estimator is similar to Newey-West, but has the added benefit of allowing for fixed effects and accounting for cross-sectional dependence. Given the island-style nature of our data, we do not use spatial econometrics to estimate potential spillovers arising from tax competition (Agrawal, 2016; Baskaran, 2019; Hauptmeier, Mittermaier, & Rincke, 2012; Janeba & Osterloh, 2013; Peltzman, 2016) or expenditure spillovers (Kelejian & Robinson, 1992; Solé-Ollé, 2006). However, the control for cross-sectional dependence should help with potential cross-sectional dependence between cities. Therefore, the Driscoll-Kraay estimator is preferred and used. In order to account for the overlapping data issue for the dynamic five-year estimation strategy, a truncation lag has to be set. An arbitrarily set lag structure of six lags (five-year dimension of our data + 1) is used following previous work (Mark, 1995). Other Driscoll-Kraay lag structures yield similar results, such as the first step of the Newey-West plug-in procedure (Hoechle, 2007; Newey & West, 1994) which results in two lags (see table 3.9).

3.5 Results

The results section first shows the estimation results using various control strategies to solve the Nickell bias (Nickell, 1981), in line with previous work (Barro, 2015; Fournier, 2016; Fournier & Johansson, 2016). Furthermore, it shows the difference in estimation results when using the general fiscal components or the two-step fiscal component residuals. Setting out these different estimation results helps to understand how the fiscal effects behave and allow us to choose the optimal control strategy for the remainder of this paper. Given that one fiscal component has to be left out of the estimation at all times, *budget balance* is left out for now. Using the preferred estimations strategy, a matrix of aggregated fiscal component estimation results is shown. Subsequently, various lag structures are examined to determine the fiscal effects over time. Finally, disaggregated fiscal effects are estimated to explore what is driving certain results.

3.5.1 Baseline estimation results

The baseline estimation results are shown in table 3.2. The first three columns show the results using the one-step approach, whereas estimations 4 and 5 use the two-step (residuals) approach. Furthermore, estimations 1, 2 and 4 do not include fixed effects, whereas estimations 3 and 5 do, in combination with the constrained convergence coefficient. The first estimation does not include the city population/MSA population control variable in order to investigate whether it significantly (possibly worryingly) alters the results. We find no such worrying changes. The only major shift we find is that *other revenues* turn significant and negative. We do find major changes when including fixed effects (estimations 3 and 5) as may be expected (Barro, 2015; Fournier, 2016; Fournier & Johansson, 2016). In estimation 3, *property tax* turns significant and positive, as does *consumption tax*. Furthermore, we find a negative effect for *health* expenditures and a positive effect for *public safety*. Intuitively, the positive results for *property tax*, *consumption tax* and *public safety*, may not sit well. These are generally not expected to be growth-enhancing and may therefore fuel the idea that Wagner's law is indeed at play here, in that the local public fiscal composition is related to the level of development (or possibly the demographic structure of the city).

The two-step estimation controls for this by using the residuals of the estimated fiscal components (see table 3.8). Estimations 4 and 5 show that the two-step approach indeed changes the estimation results. In estimation five, we now find an insignificant effect for *property tax*, a (weakly) negative effect for *consumption tax*, and a negative effect for *public safety* expenditures. These results support us in the idea that the two-step approach better controls for possible reverse causality. Therefore, the remainder of this paper uses the two-step estimation approach.

Table 3.2: Baseline estimation results

VARIABLES	1	2	3	4	5
Initial ln(GRP)	-0.00127*** (0.000381)	-0.00152** (0.000537)	-0.00152 (0)	-0.000597* (0.000293)	-0.000597 (0)
Intergov. transfers	-0.0159* (0.00855)	-0.0163* (0.00863)	-0.0189** (0.00756)	-0.0163* (0.00863)	-0.0267*** (0.00615)
Property tax	-0.00357** (0.00159)	-0.00621** (0.00269)	0.0477*** (0.00480)	-0.00621** (0.00269)	-0.0130 (0.00742)
Consumption tax	-0.00837 (0.0130)	-0.00841 (0.0129)	0.0298*** (0.00344)	-0.00841 (0.0129)	-0.00814* (0.00407)
Other rev	-0.00326 (0.00207)	-0.00401** (0.00172)	-0.00130 (0.00212)	-0.00401** (0.00172)	-0.00375 (0.00295)
Education	-0.00675 (0.0155)	-0.00746 (0.0152)	0.0140 (0.0125)	-0.00746 (0.0152)	0.00257 (0.0124)
Public welfare	0.0669*** (0.0121)	0.0709*** (0.0147)	0.121*** (0.0269)	0.0709*** (0.0147)	0.0831*** (0.0258)
Health	0.00967 (0.0101)	0.0101 (0.0103)	-0.0425*** (0.0103)	0.0101 (0.0103)	-0.0273* (0.0131)
Infrastructure	0.00970 (0.00889)	0.00835 (0.00740)	0.0109 (0.0122)	0.00835 (0.00740)	0.0162 (0.0142)
Public safety	-0.0602*** (0.0169)	-0.0674*** (0.0201)	0.0360** (0.0143)	-0.0674*** (0.0201)	-0.102*** (0.00986)
Housing	0.000947 (0.0139)	0.000678 (0.0134)	-0.00210 (0.00352)	0.000678 (0.0134)	0.0104*** (0.00321)
Other exp	0.0176*** (0.00306)	0.0146*** (0.00299)	0.00874** (0.00375)	0.0146*** (0.00299)	0.00212 (0.00408)
City pop/MSA pop		-0.000655 (0.000509)	0.00810 (0.00497)	0.000181 (0.000692)	0.00683 (0.00449)
Controls	Yes	Yes	Yes	Yes	Yes
Fixed effects	No	No	Yes	No	Yes
Two-step fisc vars	No	No	No	Yes	Yes
Observations	1,309	1,309	1,309	1,309	1,309
(Within) R-squared	0.358	0.361	0.443	0.361	0.438
Number of groups	119	119	119	119	119

Note: the two-step fisc vars represents the estimations that use the two-step estimation approach as explained in section 3.4.2. The control variables are not shown here but they include: city population, % working age, % non-white, % enrollment, cash holdings, outstanding debt, a blue state dummy, and the constant. All estimations include time fixed effects and are estimated using the Driscoll-Kraay estimator with up to six-year lags. Robust standard errors in parentheses (***) $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table 3.3 shows the fiscal effects matrix. Given that the interpretation is relative to the fiscal component that is left out of the estimation, the results show a matrix of relative fiscal effects. Thus, the results above the diagonal are similar to those found under the diagonal, except that they are inverted when both fiscal components are revenues/expenditures.

Table 3.3: Fiscal effects matrix

VARIABLES	Intergov. transfers	Property tax	Consumption tax	Other rev	Budget balance
Intergov. transfers		-0.0135 (0.0101)	-0.0185* (0.00903)	-0.0229*** (0.00635)	-0.0267*** (0.00615)
Property tax	0.0138 (0.0101)		-0.00477 (0.00849)	-0.00924 (0.00938)	-0.0130 (0.00742)
Consumption tax	0.0186* (0.00903)	0.00503 (0.00849)		-0.00439 (0.00372)	-0.00814* (0.00407)
Other rev	0.0230*** (0.00635)	0.00945 (0.00939)	0.00449 (0.00371)		-0.00375 (0.00295)
Budget balance	-0.0268*** (0.00615)	-0.0132 (0.00742)	-0.00823* (0.00407)	-0.00376 (0.00294)	
Education	-0.0241*** (0.00708)	-0.0106 (0.0168)	-0.00565 (0.0147)	-0.00119 (0.0118)	0.00257 (0.0124)
Public welfare	0.0564 (0.0312)	0.0700** (0.0293)	0.0749** (0.0246)	0.0793** (0.0261)	0.0831*** (0.0258)
Health	-0.0540** (0.0185)	-0.0405** (0.0169)	-0.0354*** (0.0104)	-0.0310** (0.0124)	-0.0273* (0.0131)
Infrastructure	-0.0106 (0.0160)	0.00301 (0.0190)	0.00796 (0.0132)	0.0124 (0.0124)	0.0162 (0.0142)
Public safety	-0.129*** (0.00712)	-0.115*** (0.0126)	-0.111*** (0.0122)	-0.106*** (0.0105)	-0.102*** (0.00986)
Housing	-0.0164*** (0.00412)	-0.00278 (0.00792)	0.00220 (0.00547)	0.00664* (0.00350)	0.0104*** (0.00321)
Other exp	-0.0246*** (0.00396)	-0.0111 (0.00925)	-0.00610 (0.00663)	-0.00163 (0.00475)	0.00212 (0.00408)
Observations	1,309	1,309	1,309	1,309	1,309
Number of groups	119	119	119	119	119

Note: all estimations use the two-step estimation approach as explained in section 3.4.2. The control variables are not shown here but they include: constrained initial GRP, city population, % working age, % non-white, % enrollment, cash holdings, outstanding debt, a blue state dummy, city population/MSA population, and the constant. All estimations include two-way fixed effects and are estimated using the Driscoll-Kraay estimator with up to six-year lags. Robust standard errors in parentheses (*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$).

Education	Public welfare	Health	Infrastructure	Public safety	Housing	Other exp
-0.0241*** (0.00708)	0.0581* (0.0313)	-0.0538** (0.0185)	-0.0103 (0.0161)	-0.128*** (0.00710)	-0.0163*** (0.00411)	-0.0245*** (0.00396)
-0.0104 (0.0168)	0.0718** (0.0293)	-0.0401** (0.0169)	0.00335 (0.0190)	-0.115*** (0.0126)	-0.00256 (0.00790)	-0.0108 (0.00924)
-0.00549 (0.0147)	0.0767** (0.0246)	-0.0353*** (0.0104)	0.00821 (0.0133)	-0.110*** (0.0122)	0.00227 (0.00546)	-0.00595 (0.00662)
-0.00108 (0.0118)	0.0811** (0.0260)	-0.0308** (0.0124)	0.0126 (0.0125)	-0.105*** (0.0105)	0.00670* (0.00350)	-0.00154 (0.00474)
-0.00267 (0.0124)	-0.0848*** (0.0259)	0.0271* (0.0131)	-0.0164 (0.0142)	0.102*** (0.00984)	-0.0104*** (0.00321)	-0.00220 (0.00408)
	-0.0822** (0.0356)	0.0297 (0.0230)	-0.0138 (0.0182)	0.104*** (0.00814)	-0.00786 (0.0102)	0.000380 (0.00917)
0.0805** (0.0356)		0.110*** (0.0165)	0.0668** (0.0246)	0.185*** (0.0325)	0.0727** (0.0286)	0.0809** (0.0288)
-0.0299 (0.0230)	-0.112*** (0.0165)		-0.0436*** (0.0136)	0.0744*** (0.0205)	-0.0377** (0.0153)	-0.0295* (0.0160)
0.0135 (0.0181)	-0.0686** (0.0246)	0.0433*** (0.0136)		0.118*** (0.0163)	0.00574 (0.0144)	0.0140 (0.0156)
-0.105*** (0.00816)	-0.187*** (0.0325)	-0.0753*** (0.0205)	-0.119*** (0.0163)		-0.113*** (0.00792)	-0.105*** (0.00745)
0.00774 (0.0102)	-0.0744** (0.0286)	0.0375** (0.0152)	-0.00597 (0.0144)	0.112*** (0.00790)		0.00820*** (0.00253)
-0.000530 (0.00915)	-0.0827** (0.0289)	0.0292* (0.0159)	-0.0142 (0.0156)	0.104*** (0.00742)	-0.00832*** (0.00254)	
1,309 119	1,309 119	1,309 119	1,309 119	1,309 119	1,309 119	1,309 119

Starting with the revenue components, we find *intergovernmental revenues* to be most distortionary, evidenced by its negative effect relative to most fiscal components, except for *property tax*, *public welfare*, and *infrastructure*. The other revenue sources show no significant relative effects to each other. However, when looking at their relative effects when financing *intergovernmental revenues*, *budget balance*, or *housing* expenditures, we find that *other revenues* are relatively least distortionary, followed by *consumption tax*. Generally, increasing revenues to fund expenditures (or the budget balance) shows insignificant or negative effects. The only consistently positive expenditure category is expenditures on *public welfare*, although its effect is weak when funded through *intergovernmental transfers*. Expenditures on *housing* are productive when financed through increased *other revenues*, *the budget balance*, or less productive expenditures such as *health*, *public safety*, and *other expenditures*. The third most productive expenditure category is *infrastructure*, which is productive when financed through lower expenditures on *health*, and *public safety*. Expenditures on *education* are generally not productive, except when financed through lower expenditures on *public safety*. The least productive expenditure category is found to be expenditures on *public safety*.

3.5.2 Lag structures

As explained in the empirical analysis section, the five-year lag structure is commonly used to account for the potential lagged effect, and to assure a natural degree of (weak) exogeneity. However, in order to explore the fiscal effects over time, the estimations using lag structures 1-5 are shown below. *Budget balance* is omitted, meaning that the interpretation is relative to increasing the budget balance.

The results (table 3.4) show an initial positive effect for *intergovernmental transfers* which turns insignificant at three years and negative afterwards. *Property tax* shows an initial weak negative effect which turns strongest at three years. *Consumption tax* remains insignificant throughout the time periods, except for the weak negative effect found at five years. Similarly, *other revenues* show no significance, except a weak negative effect at four years. Expenditures on *education* are initially weakly significant and negative, after which it turns insignificant. The positive *public welfare* effects only turn significant after 4 years. *Health* expenditures are significant and negative over all years. Expenditures on *infrastructure* are insignificant across the time periods. *Public safety* expenditures show a negative effect across the time periods, although its coefficient becomes smaller with time. Expenditures on *housing* are insignificant across time, except at five years. Finally, *other expenditures* show no significance.

Table 3.4: Exploring the fiscal effects over time

# year dynamic structure	1	2	3	4	5
Intergov. transfers	0.0393*** (0.00882)	0.0256*** (0.00832)	0.00106 (0.00837)	-0.0195*** (0.00599)	-0.0267*** (0.00615)
Property tax	-0.0611* (0.0306)	-0.0397* (0.0216)	-0.0536*** (0.0117)	-0.0427*** (0.0102)	-0.0130 (0.00742)
Consumption tax	-0.00166 (0.0116)	0.00377 (0.00949)	0.00899 (0.00509)	-0.00107 (0.00431)	-0.00814* (0.00407)
Other rev	-0.00449 (0.00702)	-0.00597 (0.00641)	-0.00684 (0.00452)	-0.00746* (0.00364)	-0.00375 (0.00295)
Education	-0.0344* (0.0183)	-0.0259* (0.0125)	-0.0139 (0.00904)	0.000111 (0.0105)	0.00257 (0.0124)
Public welfare	0.0429 (0.0664)	0.0429 (0.0431)	0.0529 (0.0438)	0.0758** (0.0336)	0.0831*** (0.0258)
Health	-0.0315** (0.0142)	-0.0368** (0.0153)	-0.0463*** (0.0115)	-0.0350** (0.0126)	-0.0273* (0.0131)
Infrastructure	0.0206 (0.0185)	0.0172 (0.0214)	0.0279 (0.0227)	0.0240 (0.0213)	0.0162 (0.0142)
Public safety	-0.161*** (0.0226)	-0.143*** (0.0203)	-0.110*** (0.0112)	-0.107*** (0.00913)	-0.102*** (0.00986)
Housing	-0.00453 (0.0117)	-0.00586 (0.0102)	-0.00382 (0.00720)	0.00474 (0.00465)	0.0104*** (0.00321)
Other exp	0.00717 (0.0115)	0.00975 (0.00806)	0.0108 (0.00670)	0.00405 (0.00786)	0.00212 (0.00408)
Observations	1,785	1,666	1,547	1,428	1,309
Number of groups	119	119	119	119	119

Note: all estimations use the two-step estimation approach as explained in section 4.1. The control variables are not shown here but they include: constrained initial GRP, city population, % working age, % non-white, % enrollment, cash holdings, outstanding debt, a blue state dummy, city population/MSA population, and the constant. All estimations include two-way fixed effects and are estimated using the Driscoll-Kraay estimator with up to six-year lags. Robust standard errors in parentheses (*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$).

3.5.3 Disaggregated fiscal components

This section discusses the disaggregated fiscal components effects. Given that the matrix of relative effects would explode and the estimations would run out of degrees of freedom, if all disaggregated fiscal components (minus one) would be included in the estimations, a more summarized approach is taken. Estimations with the inclusion of an expenditure component, control for the revenues as before (and additionally for the budget balance), but do not include any expenditure components besides the one of interest. Thus, the effect is explored relative to all other expenditure components. Similarly, the inclusion of a revenue component means that all other revenue components are left out, resulting in the interpretation of the

specific revenue component relative to all other revenue components. A selection of the main disaggregated components is included in the paper (see appendices A3-A4 for the estimation results of all available fiscal components).

Table 3.5 shows the disaggregated revenue results. We find *federal transfers* to be the main driver of the negative effect found for *intergovernmental transfers*. In terms of the consumption revenues, we find negative effects for *charges*, and utility revenues related to *water* use, but positive effects for revenues related to *transit* use. *Other revenues*, shows negative effects for *finances & fees*, and positive effects for *corporate tax*.

Table 3.5: Estimates for disaggregated revenue components

Variable		Variable		Variable	
<i>Intergovernmental transfers</i>		<i>Consumption tax</i>		<i>Other revenues</i>	
Federal transfers	-0.0559*** (0.00910)	Tax sales gen.	-0.00125 (0.0129)	Misc interest	0.000283 (0.0185)
State transfers	-0.00693 (0.00720)	Tax sales select.	0.0152 (0.0341)	Misc fines & fees	-0.142*** (0.0221)
		Tax sales utility	0.0704 (0.0420)	Misc spec ass	0.0519 (0.0472)
		Charges	-0.0148* (0.00686)	Misc property sale	0.0166 (0.0263)
		Water	-0.0364* (0.0178)	Ind income tax	0.0185 (0.0459)
		Electricity	0.00333 (0.00560)	Corp income tax	0.197*** (0.0329)
		Gas	0.0617 (0.0573)	Employee retire trust	-0.00431 (0.00364)
		Transit	0.407*** (0.126)		

Note: even though the variables are shown below one-another, they are not included in the same estimations; each coefficient for each variable represents a separate estimation. All estimations use the two-step estimation approach as explained in section 3.4.2. The estimations also control for the budget balance and all expenditure components as found in previous estimations: education, public welfare, health, infrastructure, public safety, housing, and other expenditures. The omitted fiscal variable is all revenues but the specific revenue component. Thus, the interpretation is to increase the specific revenue component at the cost of all other revenue sources. Other control variables are not shown here but they include the same control variables as before: constrained initial GRP, city population, % working age, % non-white, % enrollment, cash holdings, outstanding debt, a blue state dummy, city population/MSA population, and the constant. All estimations include two-way fixed effects and are estimated using the Driscoll-Kraay estimator with up to six-year lags. Robust standard errors in parentheses (*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$).

Table 3.6 shows the results for the main disaggregated expenditure components. We find no significant effects for the *education* expenditures. The positive *public welfare* effect is found to be caused by *other welfare*. This expenditure category is defined as “*all expenditures for welfare activities not classified elsewhere*” (U.S. Bureau of the Census, 2006), which roughly translates into all additional/separate payments for welfare other than the Medicare/Medicaid programs, regulation of private welfare, children services (foster/day care etc.), social services for the physically disabled, services for the homeless, and welfare-related community action programs. *Health* expenditures are negative for both *hospitals*, and *health* in general. Infrastructural expenditures are positive for *highways*, and (weakly) for *parking*, whereas they are negative for *air transit*. This negative effect may explain the lack of positive significance for the aggregated *infrastructure* component. Expenditures on *public safety* are negative for all categories except for *inspection*. *Housing* expenditures are all insignificant except for the negative effect of *parks & recreation* and the positive utility effects. Finally, *other expenditures* include various expenditure components. We find a weak positive coefficient for *intergovernmental transfers*, and a stronger positive effect for *commercial activities*. Negative effects are found for *public buildings* and *interest on general debt*.

Table 3.6: Estimates for disaggregated expenditure components

Variable		Variable		Variable	
<i>Education</i>		<i>Public safety</i>		<i>Other expenditures</i>	
Higher education	-0.0443 (0.192)	Police	-0.0814*** (0.0192)	Intergovernmental	0.0736* (0.0339)
Elem & sec educ	0.00142 (0.0105)	Fire protection	-0.293*** (0.0447)	Financial adm	-0.0286 (0.0229)
Libraries	0.00235 (0.0144)	Correction	-0.182*** (0.0410)	Judicial adm	-0.0620 (0.111)
<i>Public welfare</i>		Inspection	0.157** (0.0635)	Public buildings	-0.0498*** (0.00734)
Cash assistance	0.0229 (0.0171)	<i>Housing</i>		Other adm	0.00698 (0.0268)
Vendor payments	0.0435 (0.0699)	Natural resources	0.0238 (0.0745)	General interest	-0.0607*** (0.0128)
Other welfare	0.0589*** (0.0166)	Parks & rec	-0.0526** (0.0175)	Commercial activities	0.105*** (0.0283)
<i>Health</i>		Housing & com dev	-0.0108 (0.0299)	Other gen spending	-0.00399 (0.00421)
Hospitals	-0.0347** (0.0142)	Sewerage	0.00849 (0.0165)	Employee retirement	0.0222 (0.0273)
Health	-0.0740*** (0.0214)	Waste mgmt	-0.0759 (0.0742)	trust	
<i>Infrastructure</i>		Water	0.0192*** (0.00531)		
Highways	0.0568*** (0.0154)	Electricity	0.0246*** (0.00407)		
Air transit	-0.0237** (0.00929)	Gas	0.0932* (0.0512)		
Parking	0.0808* (0.0426)				
Seaport	0.0176 (0.0294)				
Transit	0.0103 (0.0206)				

Note: even though the variables are shown below one-another, they are not included in the same estimations; each coefficient for each variable represents a separate estimation. All estimations use the two-step estimation approach as explained in section 3.4.2. The estimations also control for the budget balance and all revenue components as found in previous estimations: intergovernmental transfers, property tax, consumption tax, and other revenues. The omitted fiscal variable is all expenditures but the specific expenditure component. Thus, the interpretation is to increase the specific expenditure component at the cost of all other expenditures. Other control variables are not shown here but they include the same control variables as before: constrained initial GRP, city population, % working age, % non-white, % enrollment, cash holdings, outstanding debt, a blue state dummy, city population/MSA population, and the constant. All estimations include two-way fixed effects and are estimated using the Driscoll-Kraay estimator with up to six-year lags. Robust standard errors in parentheses *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Finally, we want to know whether an expenditure is considered an investment or simply an expenditure to keep the current operations running. This allows for a stock and flow comparison of the expenditures. For example, are the expenditures spend on building new highways (flow) or are they spend on the repairment of the current stock of highways. The FiSC database allows for such a distinction through capital outlay and current operations. The US census defines capital outlay as expenditures “for purchase or construction, by contract or government

employee, construction of buildings and other improvements; for purchase of land, equipment, and existing structures; and for payments on capital leases” (U.S. Bureau of the Census, 2006). All non-capital outlay expenditures are considered current operations expenditures. Note that the U.S. Census does not provide data on this distinction for every expenditure component.

Table 3.7 shows the estimation results for the capital outlay and current operations expenditure components. The results show no significant differences overall, nor for education. We do find that the negative *hospitals* effects are driven by current operations expenditures. Furthermore, the positive *highways* effect is caused by capital outlay on *highways*. We also find negative current operations effects for *correction* and *parks & recreation*. Positive current operations effects are found for *sewers*. Finally, *utility* expenditures are positive for both capital outlay and current operations.

Table 3.7: Estimates for disaggregated expenditure components divided into capital outlay and current operations expenditures

Capital outlay		Current operations	
Capital outlay	0.00358 (0.00623)	Current operations	-0.00480 (0.00369)
Higher education	-0.123 (0.254)	Higher education	-0.0270 (0.232)
Elem & sec educ	0.00890 (0.00690)	Elem & sec educ	-0.00404 (0.0167)
Hospitals	-0.0128 (0.0462)	Hospitals	-0.0428** (0.0141)
Highways	0.0686*** (0.0201)	Highways	-0.00538 (0.0152)
Correction	0.0309 (0.0344)	Correction	-0.360*** (0.0590)
Natural resources	0.0181 (0.0758)	Natural resources	0.100 (0.0756)
Parks & rec	-0.0275 (0.0194)	Parks & rec	-0.139*** (0.0195)
Sewers	-0.0194 (0.0149)	Sewers	0.143*** (0.0333)
Waste mgmt	-0.168 (0.131)	Waste mgmt	-0.0527 (0.0708)
Other general	-0.0121 (0.00713)		
Utility	0.0191*** (0.00545)	Utility	0.0287** (0.00942)

Note: even though the variables are shown below one-another, they are not included in the same estimations; each coefficient for each variable represents a separate estimation. All estimations use the two-step estimation approach as explained in section 3.4.2. The estimations also control for the budget balance and all revenue components as found in previous estimations: intergovernmental transfers, property tax, consumption tax, and other revenues. The omitted fiscal variable is all expenditures but the specific expenditure component. Thus, the interpretation is to increase the specific expenditure component at the cost of all other expenditures. Other control variables are not shown here but they include the same control variables as before: constrained initial GRP, city population, % working age, % non-white, % enrollment, cash holdings, outstanding debt, a blue state dummy, city population/MSA

population, and the constant. All estimations include two-way fixed effects and are estimated using the Driscoll-Kraay estimator with up to six-year lags. Robust standard errors in parentheses (***) $p < 0.01$, (**) $p < 0.05$, (*) $p < 0.1$).

3.6 Discussion

This paper presents an empirical analysis of how the local public fiscal composition affects local economic growth. This section will discuss our results and link it to existing literature.

3.6.1 Revenues

In line with the observation by Reed (2008) we find that taxes (or public revenues) have negative growth effects when used to fund general expenditures, but may turn positive when used to finance productive expenditures. Furthermore, we find public expenditures to be slightly more productive when financed through the budget balance, instead of increasing local public revenues in line with work by Abiad *et al.* (2016).

When looking at specific revenue components, our results show an initial positive growth effect for *intergovernmental transfers*, after which it turns negative. We find that this is due to *federal transfers*, not *state transfers*. While a positive effect is generally expected (Cashin, 1995; Dawid *et al.*, 2018), other papers also describe a negative effect (Churchill & Yew, 2017). Furthermore, a general negative effect associated with fiscal decentralization may take over as the initial positive effect dies out. Thus, cities that are more dependent on *intergovernmental transfers* are less decentralized. While the literature is not clear-cut yet on the growth impacts of fiscal decentralization, multiple papers suggest a positive relationship (Iimi, 2005; Stansel, 2005), in line with our findings here.

Existing literature furthermore suggests that *property tax* and *consumption tax* may both be distortionary, although it is unclear on which one is relatively more distortionary (Arnold, 2008b; Cashin, 1995; Helms, 1985; Holm-Hadulla, 2020; Kneller *et al.*, 1999; Mendoza *et al.*, 1997; Nijkamp & Poot, 2004; Romero-Ávila & Strauch, 2008). We find no clear significant differences between the two, although *property tax* is found to be more distortionary in the shorter-run (after three years instead of five years).

Given that *other revenues* consists of various revenue sources, it is difficult to set expectations. The disaggregated fiscal components help with that and show that *finances & fees* are relatively more distortionary, whereas *corporate income tax* is relatively less distortionary. Although only few cities source revenue through *corporate income tax*, this result may encourage more cities to do it.

3.6.2 Expenditures

Literature commonly suggests expenditures or investments made into education and infrastructure to be productive (Kneller *et al.*, 1999). In terms *education*, we do not find such

a positive effect, neither for *elementary & secondary education*, nor *higher education* or *libraries*. It is not uncommon to find no growth effects associated with education expenditures (Bonander, Jakobsson, Podestà, & Svensson, 2016; Wolf, 2002). Direct measures of education often better predict growth outcomes than education inputs in the form of public expenditures (Glaeser et al., 1995; Hanushek, 2016). Furthermore, the five-year time frame may simply be too short to capture the positive effect. Infrastructural expenditures do show positive growth effects, although it depends on the type of infrastructural expenditure. Expenditures on *highways*, or more specifically, capital outlay on *highways* show positive growth effects. However, expenditures on *air transit* shows negative growth effects ¹⁰.

The most productive expenditure component is *public welfare* and more specifically *other public welfare* consisting of additional/separate welfare expenditures designed at the city level. It is positive and significant in all estimations. This result is in line with the work by Sala-I-Martin and Midgley (Midgley, 1999; Sala-I-Martin, 1992, 1997). The positive result for *public welfare* expenditures is especially interesting given the observation made from figure 3.5, showing that *public welfare* is the only (aggregated) expenditure component that did not increase in real terms over time. This leads one to conclude that this decline in real and relative terms may possibly have been motivated from an economic standpoint, but has actually come at an economic cost.

The least productive expenditure component is found to be *public safety*, which is negative in all estimations and for all disaggregated components except for *inspection*. Robustness analyses including various crime controls still yields negative *public safety* effects further supporting the conclusion that the negative result is not simply due to its possible correlation with crime. Another unproductive expenditure component is *health*. Both expenditures on *health* as well as *hospitals* show negative effects ¹¹.

Expenditures on *housing* positively affect growth in the longer term (five years). We find that this is driven by expenditures on the utilities: gas, water and electricity. Expenditures on *parks & recreation* negatively affect economic growth¹².

Finally, expenditures categorized as *other expenditures* also show significant effects; *Commercial activities* are found to be growth-enhancing as may be expected given its commercial nature. These activities are often related to infrastructural projects and may therefore further point towards a positive infrastructural growth effect. Expenditures on *public buildings* and *interest on general debt* show relatively unproductive effects.

10 The appendixl will furthermore show that expenditures on transit are growth enhancing in blue states whereas expenditures on highways are mostly growth enhancing in red states. This may point to a difference in focus across cities, between transit and highways.

11 Additionally, the appendixl shows that *health* expenditures made during/after the financial crisis 2008-2010 were insignificant, instead of relatively unproductive.

12 The appendix shows that the positive *housing* effect is largely due to its positive effect for *housing* expenditures made during/after the crisis 2008-2010.

3.7 Conclusion

This paper examines to what extent the local public fiscal composition affects local economic growth. This paper is novel in combining a local governmental focus with a full composition approach. Furthermore, it is highly detailed by looking at all fiscal components, thereby distinguishing between current operations expenditures (stock) and capital outlay (flow).

The level of detail is one of the main benefits of this paper. However, it also means that there are a lot of results to digest. The main findings are highlighted as follows. We find public revenues to not be distortionary per se. Only when used to fund relatively unproductive expenditures do they show a distortionary effect. However, when used to fund productive expenditures public revenues turn positive. We do find expenditures financed through the budget balance to be slightly more productive. When looking at the relative degree of distortion of public revenues, we find *intergovernmental transfers* to be the most distortionary source of revenue in the longer term, although it has an initial positive growth effect. We find no clear significant differences between the *property tax* and *consumption tax*, although *property tax* is found to be more distortionary in the shorter-run (after three years instead of five years). Furthermore, *corporate income tax* is found to be relatively less distortionary than other revenue sources. The most productive expenditure component is found to be *public welfare*, which is all the more interesting given that it is the only (aggregated) fiscal component that has seen real and relative decline in size over time. Other productive expenditures are investments made into *highways*, *utilities*, and *commercial activities*. Relatively unproductive expenditures are *public safety*, *health*, *parks & recreation*, *public buildings*, and *interest on general debt*.

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Appendix

Appendix 3.A: Additional tables and figures

Table 3.8: Estimated fiscal components to derive their residuals

VARIABLES	Intergov. transfers	Property tax	Consumption tax	Other rev	Budget balance	Education
ln(GRP)	-0.0131*** (0.00251)	-0.0183*** (0.00124)	-0.0268*** (0.00257)	0.00470 (0.00393)	-0.0138*** (0.00205)	-0.00175*** (0.000437)
City population	-0.00951 (0.0114)	0.00582 (0.00561)	0.0151 (0.0117)	-0.0248 (0.0178)	0.0437*** (0.00931)	-0.00426** (0.00198)
% working age	-0.0119*** (0.00328)	0.000956 (0.00162)	-0.0201*** (0.00336)	-0.00407 (0.00514)	-0.0149*** (0.00268)	6.91e-05 (0.000571)
% non-white	-0.0327 (0.0253)	0.0580*** (0.0124)	-0.146*** (0.0259)	-0.00460 (0.0396)	-0.0212 (0.0207)	-0.0143*** (0.00440)
% enrollment	-0.0121 (0.0148)	-0.00155 (0.00731)	0.0376** (0.0152)	-0.0150 (0.0232)	-0.0117 (0.0121)	-0.000431 (0.00258)
Cash holdings	0.135*** (0.0138)	0.00303 (0.00681)	-0.0246* (0.0142)	-0.00599 (0.0216)	0.189*** (0.0113)	0.000772 (0.00241)
Outstanding debt	0.0255*** (0.00552)	0.0141*** (0.00272)	-0.0179*** (0.00566)	0.0619*** (0.00865)	0.0353*** (0.00452)	0.00143 (0.000962)
Blue state	0.00336 (0.00556)	0.00220 (0.00274)	0.0191*** (0.00569)	-0.00530 (0.00871)	-0.00980** (0.00455)	0.00190** (0.000968)
City pop/MSA pop	0.00135** (0.000555)	-0.000666** (0.000273)	-0.00183*** (0.000568)	0.00169* (0.000868)	0.000630 (0.000454)	-8.47e-05 (9.65e-05)
Constant	0.336*** (0.0531)	0.165*** (0.0262)	0.668*** (0.0543)	0.0267 (0.0831)	0.342*** (0.0434)	0.0320*** (0.00924)
Observations	1,904	1,904	1,904	1,904	1,904	1,904
R-squared	0.186	0.265	0.274	0.307	0.294	0.117
Number of id	119	119	119	119	119	119

Note: these estimations are not dynamic, thus not overlapping. Therefore, these estimations are performed using a simple two-way fixed effects approach. Robust standard errors in parentheses (*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$).

Public welfare	Health	Infrastructure	Public safety	Housing	Other exp
-0.00762*** (0.00200)	-0.00355*** (0.00119)	-0.0106*** (0.000698)	-0.0131*** (0.00264)	-0.0129*** (0.00189)	0.00971* (0.00513)
0.0125 (0.00906)	0.00443 (0.00538)	-0.0200*** (0.00317)	-0.0162 (0.0120)	-0.00887 (0.00856)	-0.0245 (0.0233)
-0.00850*** (0.00261)	-0.000366 (0.00155)	0.00168* (0.000912)	-0.00344 (0.00345)	-0.0102*** (0.00247)	0.000472 (0.00671)
-0.0533*** (0.0201)	-0.0495*** (0.0119)	0.0228*** (0.00703)	-0.0450* (0.0266)	0.114*** (0.0190)	-0.0803 (0.0517)
0.0494*** (0.0118)	-0.00590 (0.00701)	-0.0151*** (0.00413)	-0.0182 (0.0156)	-0.0365*** (0.0112)	0.0465 (0.0304)
0.0116 (0.0110)	-0.00626 (0.00653)	9.30e-05 (0.00385)	-0.0186 (0.0145)	0.0186* (0.0104)	-0.0877*** (0.0283)
-0.0134*** (0.00440)	0.00129 (0.00261)	0.00258* (0.00154)	0.00851 (0.00581)	0.0201*** (0.00416)	0.0277** (0.0113)
0.00182 (0.00443)	0.00939*** (0.00263)	0.00212 (0.00155)	0.0253*** (0.00585)	0.0246*** (0.00418)	-0.0359*** (0.0114)
-0.00146*** (0.000442)	-0.000156 (0.000262)	6.37e-05 (0.000154)	0.000612 (0.000583)	-0.00117*** (0.000417)	0.00210* (0.00113)
0.217*** (0.0423)	0.0856*** (0.0251)	0.101*** (0.0148)	0.251*** (0.0558)	0.213*** (0.0399)	-0.0440 (0.109)
1,904	1,904	1,904	1,904	1,904	1,904
0.081	0.077	0.278	0.132	0.232	0.264
119	119	119	119	119	119

Table 3.9: Robustness Driscoll-Kraay

VARIABLES	1	2	3
Initial ln(GRP)	-0.000597 (0)	-0.000597 (0)	-0.000597 (0)
Intergov. transfers	-0.0267* (0.0155)	-0.0267*** (0.00600)	-0.0267*** (0.00615)
Property tax	-0.0130 (0.0216)	-0.0130 (0.0122)	-0.0130 (0.00742)
Consumption tax	-0.00814 (0.0146)	-0.00814 (0.00622)	-0.00814* (0.00407)
Other rev	-0.00375 (0.00444)	-0.00375 (0.00426)	-0.00375 (0.00295)
Education	0.00257 (0.0150)	0.00257 (0.0141)	0.00257 (0.0124)
Public welfare	0.0831 (0.0811)	0.0831** (0.0353)	0.0831*** (0.0258)
Health	-0.0273 (0.0278)	-0.0273* (0.0128)	-0.0273* (0.0131)
Infrastructure	0.0162 (0.0165)	0.0162 (0.0168)	0.0162 (0.0142)
Public safety	-0.102*** (0.0376)	-0.102*** (0.0160)	-0.102*** (0.00986)
Housing	0.0104 (0.00887)	0.0104* (0.00533)	0.0104*** (0.00321)
Other exp	0.00212 (0.00860)	0.00212 (0.00577)	0.00212 (0.00408)
City population	-0.00197 (0.00353)	-0.00197 (0.00148)	-0.00197 (0.00144)
% working age	-0.0189 (0.0149)	-0.0189*** (0.00471)	-0.0189*** (0.00363)
% non-white	0.0156 (0.0128)	0.0156** (0.00581)	0.0156*** (0.00483)
% enrollment	-0.00919 (0.0109)	-0.00919 (0.00732)	-0.00919 (0.00629)
Cash holdings	-0.00260 (0.00234)	-0.00260 (0.00305)	-0.00260 (0.00281)
Outstanding debt	0.00798*** (0.00253)	0.00798*** (0.00233)	0.00798*** (0.00214)
Blue state	0.000307 (0.000300)	0.000307*** (8.54e-05)	0.000307*** (6.70e-05)
City pop/MSA pop	0.00683 (0.0103)	0.00683 (0.00533)	0.00683 (0.00449)
Constant	0.0403 (0.0461)	0.0403* (0.0185)	0.0403* (0.0181)
Driscoll-Kraay	NO	YES	YES
DK lags	N.A.	2	6
Observations	1,309	1,309	1,309
(Within) R-squared	0.438	0.438	0.438
Number of groups	119	119	119

Note: all estimations use the two-step estimation approach as explained in section 3.4.2. All estimations include two-way fixed effects. The errors in estimation 1 are clustered at the State-level. The other estimations use the Driscoll-Kraay estimator. The default lag structure for the Driscoll-Kraay follows the equation: $m(T) = \text{floor}[4(T/100)^{2/9}]$, yielding 2 lags. Robust standard errors in parentheses (*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$).

Table 3.10 Estimates for disaggregated revenue components

Revenue component	All	Revenue component	All	Revenue component	All
General	-0.0148*** (0.00416)	Corp income tax	0.197*** (0.0329)	Chg sewers	-0.0211 (0.0188)
Intergovernmental	-0.0239*** (0.00690)	Motor vehicle	0.104 (0.102)	Chg waste mgmt	-0.167* (0.0892)
Federal transfers	-0.0559*** (0.00910)	Other taxes	0.0281 (0.0179)	Chg other	0.00122 (0.0109)
State transfers	-0.00693 (0.00720)	Charges & misc.	-0.00678 (0.00799)	Misc gen rev	0.00506 (0.00863)
Own source	0.000562 (0.00792)	Charges	-0.0148* (0.00686)	Misc interest	0.000283 (0.0185)
Taxes	0.00769 (0.00873)	Chg educ	0.0492 (0.0972)	Misc fines & fees	-0.142*** (0.0221)
Property tax	-0.00353 (0.00713)	Chg higher educ	-0.174 (0.166)	Misc spec ass	0.0519 (0.0472)
Sales&gross rec.	0.00485 (0.00952)	Chg school lunch	0.980** (0.339)	Misc property sale	0.0166 (0.0263)
Tax sales gen.	-0.00125 (0.0129)	Chg hospitals	-0.00197 (0.0160)	Misc other	0.00395 (0.00795)
Tax sales select.	0.0152 (0.0341)	Chg highways	0.149* (0.0784)	Utility	0.00287 (0.00316)
Motor fuel	0.0824 (0.0926)	Chg air transit	-0.126*** (0.0214)	Water	-0.0364* (0.0178)
Alcohol	1.692*** (0.406)	Chg parking	-0.0666 (0.0391)	Electricity	0.00333 (0.00560)
Tobacco	-0.0522 (0.364)	Chg seaport	-0.300 (0.283)	Gas	0.0617 (0.0573)
Tax sales utility	0.0704 (0.0420)	Chg nat resources	-0.0793 (0.116)	Transit	0.407*** (0.126)
Tax sales other	0.000593 (0.0336)	Chg parks&rec	-0.140** (0.0485)	Liquor store	1.103*** (0.324)
Ind income tax	0.0185 (0.0459)	Chg House&com	0.120 (0.148)	Employee retire trust	-0.00431 (0.00364)

Note: even though the variables are shown below one-another, they are not included in the same estimations; each coefficient for each variable represents a separate estimation. All estimations include two-way fixed effects. The Driscoll-Kraay estimator includes up to six-year lags. GMM represents a difference-GMM estimation using PCA to limit the instruments. The estimations also control for the budget balance and all expenditure components as found in previous estimations: education, social services, infrastructure, public safety, Housing, and other expenditures. The omitted fiscal variable is all revenues but the specific revenue component. Thus, the interpretation is to increase the specific revenue component at the cost of all other revenue sources. Other control variables are also not shown here but they include the same control variables as found in estimation 2.5: Δ Population, Δ Working age population, Δ Non-white, Δ Enrollment, Initial enrollment, Initial GRP, Δ State GRP. Robust standard errors in parentheses (***) $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table 3.11: Estimates for disaggregated expenditure components

Expenditure component		Expenditure component		Expenditure component	
Intergovernmental	0.0736* (0.0339)	Highways	0.0568*** (0.0154)	Financial adm	-0.0286 (0.0229)
Direct	-0.00124 (0.00420)	Air transit	-0.0237** (0.00929)	Judicial adm	-0.0620 (0.111)
General	-0.0117** (0.00485)	Parking	0.0808* (0.0426)	Public buildings	-0.0498*** (0.00734)
Education services	0.00134 (0.0109)	Seaport	0.0176 (0.0294)	Other adm	0.00698 (0.0268)
Education	0.00131 (0.0109)	Public safety	-0.103*** (0.00906)	General interest	-0.0607*** (0.0128)
Higher education	-0.0443 (0.192)	Police	-0.0814*** (0.0192)	Misc	-0.00272 (0.00455)
Elem & sec educ	0.00142 (0.0105)	Fire protection	-0.293*** (0.0447)	Commercial activities	0.105*** (0.0283)
Libraries	0.00235 (0.0144)	Correction	-0.182*** (0.0410)	Other gen spending	-0.00399 (0.00421)
Social services	-0.0288* (0.0150)	Inspection	0.157** (0.0635)	Utility	0.0243*** (0.00339)
Public welfare	0.0959*** (0.0294)	Environment & housing	-0.00905* (0.00438)	Water	0.0192*** (0.00531)
Cash assistance	0.0229 (0.0171)	Natural resources	0.0238 (0.0745)	Electricity	0.0246*** (0.00407)
Vendor payments	0.0435 (0.0699)	Parks & rec	-0.0526** (0.0175)	Gas	0.0932* (0.0512)
Other welfare	0.0589*** (0.0166)	Housing & com dev	-0.0108 (0.0299)	Transit	0.0103 (0.0206)
Hospitals	-0.0347** (0.0142)	Sewerage	0.00849 (0.0165)	Liquor store	1.253*** (0.370)
Health	-0.0740*** (0.0214)	Waste mgmt	-0.0759 (0.0742)	Employee retirement trust	0.0222 (0.0273)
Transportation	0.0143 (0.0122)	Administration	-0.0154 (0.0186)		

Note: even though the variables are shown below one-another; they are not included in the same estimations; each coefficient for each variable represents a separate estimation. All estimations include two-way fixed effects. The Driscoll-Kraay estimator includes up to six-year lags. GMM represents a difference-GMM estimation using PCA to limit the instruments. The estimations also control for the budget balance and all revenue components as found in previous estimations: intergovernmental transfers, property tax, consumption tax, and other. The omitted fiscal variable is all expenditures but the specific expenditure component. Thus, the interpretation is to increase the specific expenditure component at the cost of all other expenditure components. Other control variables are also not shown here but they include the same control variables as found in estimation 2.5: Δ Population, Δ Working age population, Δ Non-white, Δ Enrollment, Initial enrollment, Initial GRP, Δ State GRP. Robust standard errors in parentheses (*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$).

Table 3.12: Summary statistics revenues

Variable	Obs	# zeroes	Mean	Std. Dev.	Min	Max
Total revenues	1309	0	0.127	0.044	0.047	0.350
General	1309	0	0.111	0.035	0.054	0.318
Intergovernmental	1309	0	0.044	0.022	0.011	0.134
Federal transfers	1309	0	0.007	0.004	0.001	0.046
State transfers	1309	0	0.037	0.021	0.007	0.122
Own source	1309	0	0.067	0.022	0.024	0.199
Taxes	1309	0	0.039	0.010	0.015	0.082
Property tax	1309	0	0.026	0.008	0.007	0.056
Sales&gross rec.	1309	90	0.009	0.007	0.000	0.037
Tax sales gen.	1309	347	0.006	0.006	0.000	0.035
Tax sales select.	1309	97	0.003	0.003	0.000	0.018
Motor fuel	1309	1156	0.000	0.000	0.000	0.002
Alcohol	1309	1034	0.000	0.000	0.000	0.002
Tobacco	1309	1203	0.000	0.000	0.000	0.001
Tax sales utility	1309	300	0.001	0.002	0.000	0.010
Tax sales other	1309	154	0.001	0.001	0.000	0.016
Ind income tax	1309	1071	0.002	0.005	0.000	0.025
Corp income tax	1309	1255	0.000	0.001	0.000	0.015
Motor vehicle	1309	631	0.000	0.000	0.000	0.003
Other taxes	1309	0	0.002	0.003	0.000	0.020
Charges & misc.	1309	0	0.027	0.018	0.005	0.162
Charges	1309	0	0.019	0.016	0.002	0.156
Chg educ	1309	5	0.001	0.001	0.000	0.004
Chg higher educ	1309	1124	0.000	0.000	0.000	0.003
Chg school lunch	1309	8	0.000	0.000	0.000	0.002
Chg hospitals	1309	756	0.004	0.015	0.000	0.141
Chg highways	1309	503	0.000	0.001	0.000	0.012
Chg air transit	1309	111	0.002	0.003	0.000	0.031
Chg parking	1309	161	0.000	0.001	0.000	0.008
Chg seaport	1309	918	0.000	0.000	0.000	0.003
Chg nat resources	1309	1044	0.000	0.000	0.000	0.003
Chg parks&rec	1309	20	0.001	0.001	0.000	0.004
Chg House&com dev	1309	60	0.001	0.001	0.000	0.003
Chg sewers	1309	5	0.004	0.002	0.000	0.013
Chg waste mgmt	1309	76	0.002	0.002	0.000	0.011
Chg other	1309	0	0.004	0.003	0.000	0.016
Misc gen rev	1309	0	0.008	0.004	0.001	0.028
Misc interest	1309	0	0.003	0.002	0.000	0.021
Misc fines & fees	1309	362	0.000	0.000	0.000	0.003
Misc spec ass	1309	176	0.001	0.001	0.000	0.008
Misc property sale	1309	73	0.000	0.000	0.000	0.003
Misc other	1309	0	0.003	0.002	0.000	0.013
Utility	1309	0	0.013	0.019	0.000	0.114
Water	1309	61	0.004	0.003	0.000	0.021
Electricity	1309	885	0.007	0.017	0.000	0.095
Gas	1309	1129	0.001	0.004	0.000	0.028
Transit	1309	114	0.001	0.001	0.000	0.007
Liquor store	1309	1265	0.000	0.000	0.000	0.003
Employee retire trust	1309	431	0.003	0.011	-0.109	0.044

Note: the number of observations represents the number of observations as found in our overlapping five-year dynamic estimations: 119 cities * 11 time-periods = 1309 observations.

Table 3.13: Summary statistics for expenditures

Variable	Obs	# zeroes	Mean	Std. Dev.	Min	Max
Total expenditures	1,309	0	0.132	0.046	0.050	0.371
Intergovernmental	1,309	292	0.001	0.002	0.000	0.016
Direct	1,309	0	0.131	0.045	0.050	0.369
General	1,309	0	0.110	0.036	0.048	0.327
Education services	1,309	0	0.040	0.014	0.001	0.096
Education	1,309	3	0.039	0.014	0.000	0.095
Higher education	1,309	1110	0.000	0.001	0.000	0.006
Elem & sec educ	1,309	3	0.039	0.014	0.000	0.092
Libraries	1,309	15	0.001	0.001	0.000	0.008
Social services	1,309	10	0.012	0.018	0.000	0.161
Public welfare	1,309	66	0.003	0.004	0.000	0.022
Cash assistance	1,309	914	0.001	0.002	0.000	0.011
Vendor payments	1,309	756	0.000	0.001	0.000	0.005
Other welfare	1,309	82	0.002	0.003	0.000	0.017
Hospitals	1,309	713	0.006	0.016	0.000	0.143
Health	1,309	20	0.003	0.003	0.000	0.018
Transportation	1,309	0	0.008	0.005	0.000	0.042
Highways	1,309	0	0.005	0.003	0.000	0.019
Air transit	1,309	92	0.003	0.004	0.000	0.040
Parking	1,309	219	0.000	0.001	0.000	0.006
Seaport	1,309	872	0.000	0.001	0.000	0.011
Public safety	1,309	0	0.015	0.005	0.005	0.037
Police	1,309	0	0.008	0.003	0.003	0.019
Fire protection	1,309	4	0.004	0.002	0.000	0.012
Correction	1,309	102	0.002	0.001	0.000	0.011
Inspection	1,309	146	0.000	0.001	0.000	0.008
Environment & housing	1,309	0	0.017	0.006	0.004	0.045
Natural resources	1,309	215	0.000	0.001	0.000	0.025
Parks & rec	1,309	0	0.004	0.002	0.000	0.016
Housing & com dev	1,309	1	0.006	0.004	0.000	0.022
Sewerage	1,309	3	0.005	0.003	0.000	0.019
Waste mgmt	1,309	1	0.002	0.001	0.000	0.009
Administration	1,309	0	0.006	0.003	0.001	0.030
Financial adm	1,309	0	0.002	0.001	0.000	0.008
Judicial adm	1,309	6	0.002	0.001	0.000	0.006
Public buildings	1,309	37	0.001	0.001	0.000	0.012
Other adm	1,309	0	0.002	0.002	0.000	0.018
General interest	1,309	0	0.005	0.003	0.000	0.023
Misc	1,309	0	0.008	0.006	0.000	0.048
Commercial activities	1,309	832	0.000	0.000	0.000	0.008
Other gen spending	1,309	0	0.008	0.006	0.000	0.048
Utility	1,309	2	0.016	0.019	0.000	0.128
Water	1,309	58	0.005	0.004	0.000	0.038
Electricity	1,309	853	0.007	0.017	0.000	0.109
Gas	1,309	1130	0.001	0.004	0.000	0.028
Transit	1,309	100	0.003	0.003	0.000	0.024
Liquor store	1,309	1265	0.000	0.000	0.000	0.002
Employee retirement trust	1,309	429	0.004	0.005	0.000	0.030

Note: the number of observations represents the number of observations as found in our overlapping five-year dynamic estimations: 119 cities * 11 time-periods = 1309 observations.

Table 3.14: Summary statistics for capital outlay

Variable	Obs	# zeroes	Mean	Std. Dev.	Min	Max
Capital outlay	1,309	0	0.020	0.010	0.001	0.076
Education	1,309	5	0.004	0.003	0.000	0.022
Higher education	1,309	1158	0.000	0.000	0.000	0.002
Elem & sec educ	1,309	5	0.004	0.003	0.000	0.021
Hospitals	1,309	884	0.000	0.001	0.000	0.013
Highways	1,309	41	0.002	0.002	0.000	0.016
Correction	1,309	384	0.000	0.000	0.000	0.009
Natural resources	1,309	638	0.000	0.001	0.000	0.025
Parks & rec	1,309	29	0.001	0.001	0.000	0.012
Sewers	1,309	49	0.002	0.002	0.000	0.016
Waste mgmt	1,309	258	0.000	0.000	0.000	0.003
Other general	1,309	0	0.006	0.005	0.000	0.042
Utility	1,309	71	0.003	0.004	0.000	0.035

Note: the number of observations represents the number of observations as found in our overlapping five-year dynamic estimations: 119 cities * 11 time-periods = 1309 observations.

Table 3.15: Summary statistics for current operations

Variable	Obs	# zeroes	Mean	Std. Dev.	Min	Max
Current operations	1,309	0	0.101	0.038	0.042	0.319
Education	1,309	3	0.035	0.013	0.000	0.084
Higher education	1,309	1110	0.000	0.001	0.000	0.005
Elem & sec educ	1,309	3	0.034	0.013	0.000	0.084
Hospitals	1,309	720	0.005	0.016	0.000	0.136
Highways	1,309	0	0.003	0.002	0.000	0.014
Correction	1,309	102	0.002	0.001	0.000	0.006
Natural resources	1,309	225	0.000	0.000	0.000	0.004
Parks & rec	1,309	0	0.003	0.001	0.000	0.009
Sewers	1,309	5	0.003	0.002	0.000	0.011
Waste mgmt	1,309	1	0.002	0.001	0.000	0.008
Utility	1,309	11	0.010	0.017	-0.008	0.103

Note: the number of observations represents the number of observations as found in our overlapping five-year dynamic estimations: 119 cities * 11 time-periods = 1309 observations.

Table 3.16: Overview of the 119 US cities

Metropolitan Statistical Area	Metropolitan Statistical Area
Birmingham-Hoover, AL	Springfield, MA
Mobile, AL	Worcester, MA-CT
Montgomery, AL	Detroit-Warren-Dearborn, MI
Phoenix-Mesa-Scottsdale, AZ	Flint, MI
Tucson, AZ	Grand Rapids-Wyoming, MI
Fort Smith, AR-OK	Minneapolis-St. Paul-Bloomington, MN-WI
Little Rock-North Little Rock-Conway, AR	Gulfport-Biloxi-Pascagoula, MS
Bakersfield, CA	Jackson, MS
Fresno, CA	St. Louis, MO-IL
Los Angeles-Long Beach-Anaheim, CA	Billings, MT
Modesto, CA	Missoula, MT
Riverside-San Bernardino-Ontario, CA	Lincoln, NE
Sacramento--Roseville--Arden-Arcade, CA	Omaha-Council Bluffs, NE-IA
San Diego-Carlsbad, CA	Las Vegas-Henderson-Paradise, NV
San Francisco-Oakland-Hayward, CA	Reno, NV
San Jose-Sunnyvale-Santa Clara, CA	Manchester-Nashua, NH
Stockton-Lodi, CA	Albuquerque, NM
Colorado Springs, CO	Las Cruces, NM
Denver-Aurora-Lakewood, CO	Buffalo-Cheektowaga-Niagara Falls, NY
Bridgeport-Stamford-Norwalk, CT	New York-Newark-Jersey City, NY-NJ-PA
Hartford-West Hartford-East Hartford, CT	Rochester, NY
New Haven-Milford, CT	Syracuse, NY
Dover, DE	Charlotte-Concord-Gastonia, NC-SC
Philadelphia-Camden-Wilmington, PA-NJ-DE-MD	Durham-Chapel Hill, NC
Jacksonville, FL	Greensboro-High Point, NC
Miami-Fort Lauderdale-West Palm Beach, FL	Raleigh, NC
Orlando-Kissimmee-Sanford, FL	Bismarck, ND
Tallahassee, FL	Fargo, ND-MN
Tampa-St. Petersburg-Clearwater, FL	Akron, OH
Atlanta-Sandy Springs-Roswell, GA	Cincinnati, OH-KY-IN
Columbus, GA-AL	Cleveland-Elyria, OH
Boise City, ID	Columbus, OH
Chicago-Naperville-Elgin, IL-IN-WI	Dayton, OH
Fort Wayne, IN	Toledo, OH
Indianapolis-Carmel-Anderson, IN	Oklahoma City, OK
Cedar Rapids, IA	Tulsa, OK
Des Moines-West Des Moines, IA	Eugene, OR
Kansas City, MO-KS	Portland-Vancouver-Hillsboro, OR-WA
Topeka, KS	Salem, OR
Wichita, KS	Pittsburgh, PA
Lexington-Fayette, KY	Providence-Warwick, RI-MA
Louisville/Jefferson County, KY-IN	Charleston-North Charleston, SC
Baton Rouge, LA	Columbia, SC
New Orleans-Metairie, LA	Rapid City, SD
Shreveport-Bossier City, LA	Sioux Falls, SD
Lewiston-Auburn, ME	Chattanooga, TN-GA
Portland-South Portland, ME	Knoxville, TN
Baltimore-Columbia-Towson, MD	Memphis, TN-MS-AR
Washington-Arlington-Alexandria, DC-VA-MD-WV	Nashville-Davidson--Murfreesboro--Franklin, TN
Boston-Cambridge-Newton, MA-NH	Austin-Round Rock, TX

Table 3.16 continued

Metropolitan Statistical Area	Metropolitan Statistical Area
Corpus Christi, TX	Virginia Beach-Norfolk-Newport News, VA-NC
Dallas-Fort Worth-Arlington, TX	Seattle-Tacoma-Bellevue, WA
El Paso, TX	Spokane-Spokane Valley, WA
Houston-The Woodlands-Sugar Land, TX	Charleston, WV
Lubbock, TX	Huntington-Ashland, WV-KY-OH
San Antonio-New Braunfels, TX	Madison, WI
Provo-Orem, UT	Milwaukee-Waukesha-West Allis, WI
Salt Lake City, UT	Casper, WY
Burlington-South Burlington, VT	Cheyenne, WY
Richmond, VA	

Appendix 3.B: Robustness checks including crime controls

The estimation results in the paper show significant negative effects for expenditures on *public safety* suggesting it to be relatively non-productive. However, one could argue that expenditures on *public safety* are correlated with crime and therefore simply capture the negative economic growth effect of crime. We therefore perform a robustness check with the inclusion of control variables for crime. The most extensive local level crime data is available through the *Uniform Crime Reporting Statistics* (U.S. Department of Justice / Federal Bureau of Investigation, 2018). However, while it is extensive, it does not have data on all our cities, resulting in the deletion of 235 observations.

The results in table 3.17 first show the estimation results without any crime control for all our observations. Subsequently, we perform the same estimation (no crime control) for all observations that have data on crime to check for whether any changes are due to the inclusion of the crime control or the change in sample. We find that the results remain similar. Subsequently, the violent rate, property rate, and murder rate are included as controls, followed by all three crime controls together. We find that the inclusion of these crime variables does not really change the effect found for *public safety* expenditures (or any other coefficients). Given that the inclusion of crime controls does not alter our estimation results, but does lower our number of observations, we decided to exclude the crime controls in our estimations used in the paper.

Table 3.17: Robustness using various crime controls

VARIABLES	1	2	3	4	5	6
Intergov. transfers	-0.0267*** (0.00615)	-0.00388 (0.0109)	-0.00332 (0.0112)	-0.00356 (0.0108)	-0.00370 (0.0110)	-0.00205 (0.0115)
Property tax	-0.0130 (0.00742)	0.00534 (0.00854)	0.00167 (0.00829)	0.00546 (0.00851)	0.00529 (0.00870)	0.000473 (0.00838)
Consumption tax	-0.00814* (0.00407)	-0.00291 (0.00306)	-0.00346 (0.00320)	-0.00321 (0.00307)	-0.00320 (0.00303)	-0.00474 (0.00342)
Other rev	-0.00375 (0.00295)	-0.00196 (0.00171)	-0.00150 (0.00169)	-0.00202 (0.00174)	-0.00188 (0.00171)	-0.00143 (0.00171)
Education	0.00257 (0.0124)	0.00669 (0.0131)	0.00650 (0.0129)	0.00657 (0.0131)	0.00653 (0.0132)	0.00601 (0.0127)
Public welfare	0.0831*** (0.0258)	0.0892** (0.0333)	0.0873** (0.0349)	0.0901** (0.0328)	0.0911** (0.0339)	0.0900** (0.0352)
Health	-0.0273* (0.0131)	-0.0706*** (0.0113)	-0.0743*** (0.0111)	-0.0708*** (0.0113)	-0.0704*** (0.0113)	-0.0764*** (0.0109)
Infrastructure	0.0162 (0.0142)	0.00742 (0.0176)	0.00387 (0.0176)	0.00767 (0.0176)	0.00667 (0.0179)	0.00288 (0.0179)
Public safety	-0.102*** (0.00986)	-0.0686*** (0.00698)	-0.0694*** (0.00657)	-0.0678*** (0.00659)	-0.0690*** (0.00713)	-0.0674*** (0.00607)
Housing	0.0104*** (0.00321)	0.0119*** (0.00317)	0.0119*** (0.00287)	0.0120*** (0.00326)	0.0120*** (0.00318)	0.0123*** (0.00292)
Other exp	0.00212 (0.00408)	-0.00481 (0.00636)	-0.00393 (0.00626)	-0.00494 (0.00651)	-0.00499 (0.00640)	-0.00406 (0.00685)
Violent rate			-0.0538** (0.0185)			-0.0761*** (0.0206)
Property rate				0.00395 (0.00272)		0.0120*** (0.00214)
Murder rate					-0.700** (0.278)	-0.276 (0.277)
Observations	1,309	1,074	1,074	1,074	1,074	1,074
Number of groups	119	101	101	101	101	101

Note: all estimations use the two-step estimation approach as explained in section 3.4.2. The control variables are not shown here but they include: constrained initial GRP, city population, % working age, % non-white, % enrollment, cash holdings, outstanding debt, a blue state dummy, city population/MSA population, and the constant. All estimations include two-way fixed effects and are estimated using the Driscoll-Kraay estimator with up to six-year lags. Robust standard errors in parentheses (*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$).

Appendix 3.C: Blue vs. red state

While we control for blue/red state in every estimation in the paper, we also investigated whether there are differences in the fiscal effects between cities located in blue or red states. As the paper describes, we include a political control dummy variable, capturing whether the city is located in a blue or red State. A State is considered blue if it voted Democrats in the (last) presidential election, and red if it voted Republican. The dummy is therefore time-variant every four years. The number of observations is relatively similar between the two, although blue states represent a smaller number of cities. The results are presented in table 3.18.

The results show that *consumption tax* and *other revenues* are highly negative in blue states whereas they are insignificant in red states. This suggests that there are cities in blue states that over-tax consumption, whereas cities in red states may actually increase their consumption tax without distorting the economy too much. Expenditures on *public welfare* are positive in both estimations, but more significant in blue states. Furthermore, we find expenditures on *health* to be only significant and negative in red states. Furthermore, the positive significance of *housing* and negative significance of *public safety* is only found for cities located in red states. There thus seems to be significant differences between cities located in blue/red states.

Table 3.18: Blue and red state comparison on fiscal effects

VARIABLES	R	D
Intergov. transfers	-0.0213* (0.0116)	-0.00110 (0.00351)
Property tax	-0.0120 (0.0101)	-0.00830 (0.00626)
Consumption tax	-0.00757 (0.00656)	-0.0159*** (0.00387)
Other rev	0.00735 (0.00770)	-0.00477*** (0.00133)
Education	-0.00269 (0.0189)	-0.0102 (0.00966)
Public welfare	0.0914* (0.0469)	0.0667*** (0.0163)
Health	-0.0506** (0.0170)	0.00964 (0.0106)
Infrastructure	0.0235** (0.00788)	0.0259** (0.0115)
Public safety	-0.141*** (0.0239)	-0.00366 (0.0189)
Housing	0.0131** (0.00483)	0.00721 (0.00649)
Other exp	-0.00395 (0.0114)	0.00341 (0.00264)
Observations	653	656
Number of groups	83	69

Note: all estimations use the two-step estimation approach as explained in section 3.4.2. The control variables are not shown here but they include: constrained initial GRP, city population, % working age, % non-white, % enrollment, cash holdings, outstanding debt, a blue state dummy, city population/MSA population, and the constant. All estimations include two-way fixed effects and are estimated using the Driscoll-Kraay estimator with up to six-year lags. Robust standard errors in parentheses (*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$).

The disaggregated analyses furthermore show an interesting divide in infrastructural effects (see table below). Cities located in red states show positive highway expenditures and negative transit expenditures, whereas cities in blue states show the opposite pattern with insignificant highway effects and positive transit effects, although investments made in highways is positive in blue states as well.

Table 3.19: Blue and red state comparison on highway and transit expenditures

Expenditure component	Expenditure		Capital outlay		Current operations	
	R	D	R	D	R	D
Highways	0.0999*** (0.0129)	0.0238 (0.0150)	0.0682*** (0.0188)	0.0721** (0.0279)	0.206*** (0.0360)	-0.0848*** (0.0261)
Transit	-0.0720** (0.0240)	0.0830*** (0.0243)				

*Note: even though the variables are shown below one-another, they are not included in the same estimations; each coefficient for each variable represents a separate estimation. All estimations use the two-step estimation approach as explained in section 3.4.2. The estimations also control for the budget balance and all revenue components as found in previous estimations: intergovernmental transfers, property tax, consumption tax, and other revenues. The omitted fiscal variable is all expenditures but the specific expenditure component. Thus, the interpretation is to increase the specific expenditure component at the cost of all other expenditures. Other control variables are not shown here but they include the same control variables as before: constrained initial GRP, city population, % working age, % non-white, % enrollment, cash holdings, outstanding debt, a blue state dummy, city population/MSA population, and the constant. All estimations include two-way fixed effects and are estimated using the Driscoll-Kraay estimator with up to six-year lags. Robust standard errors in parentheses (***) $p < 0.01$, ** $p < 0.05$, * $p < 0.1$).*

Appendix 3.D: Fiscal effects over time

While the paper explores the lagged effect, it does not explore whether the results have changed over time. Our time-period of interest includes a time before, during, and after the financial crisis. To what extent are these periods driving our results? Literature suggests bigger growth effects associated with fiscal policies when there is considerable economic slack (Melo, Graham, & Brage-Ardao, 2013; Owyang, Ramey, & Zubairy, 2013; Ramey & Zubairy, 2018). In order to explore this, cross-sectional estimations are performed. Given the observed importance of the city fixed effects, the city fixed effects coefficients as estimated in the panel estimation (table 3.2, estimation 5 in the paper), are included as a variable with a coefficient constrained to equal 1. Similarly, the convergence coefficient is constrained to be the same as found in table 3.2, estimation 5 of the paper. The resulting coefficients (and standard errors) are plotted over time in figure 3.6 and figure 3.7 below. The coefficients represent the effects of the specific fiscal component made in that specific year on the subsequent average annual five-year GRP growth. The estimation results are also included in table form in table 3.20.

In figure 3.6, we find *intergovernmental transfers* to mostly be insignificant. *Property tax* is initially negative, subsequently turning insignificant. *Consumption tax* is mostly insignificant, except for revenues raised during the financial crisis (2008-2009), where it shows a significant negative effect. Finally, *other revenues* show a general upward trend. The spike in 2009 is likely due to the impact of the financial crisis in *employee retirement trust revenues*.

Figure 3.7 shows the expenditure results. Expenditures on *education* start insignificant or negative, but turn positive between 2006-2009. Expenditures on *public welfare* are positive throughout time, although its effect is declining. *Health* expenditures are mostly negative, except for an upward spike in 2009. Expenditures on *infrastructure* move around insignificant and positive over quite constantly over time. Public safety expenditures are negative with a negative trend over time. Expenditures on housing show an interesting result where they are mostly insignificant or slightly positive, but highly significant and positive during the crisis (2008-2009). Finally, *other expenditures* show no clear significance over time.

The negative spike for *consumption tax* and positive spike for *housing* expenditures during the crisis suggests a potential way for local governments to respond to future housing-crises; Lower *consumption taxes* and increase public *housing* expenditures.

Figure 3.6: Estimated revenue coefficients over time

Note: these figures are representations of the estimation results as included in table 3.20 of this document. The figures show the coefficient for each fiscal component for a given year, with its 95% confidence interval. The years represent the year in which the fiscal component was made, thus $T-5$.

Figure 3.7: Estimated expenditure coefficients over time

Note: these figures are representations of the estimation results as included in table 3.20 of this document. The figures show the coefficient for each fiscal component for a given year, with its 95% confidence interval. The years represent the year in which the fiscal component was made, thus T-5.

Table 3.20: Estimated coefficients that go with figure 3.6 and figure 3.7

Time-period	2001	2002	2003	2004	2005
	2006	2007	2008	2009	2010
Intergov. transfers	-0.0257* (0.0150)	-0.0191 (0.0150)	0.00363 (0.0124)	-0.0283** (0.0128)	-0.0296* (0.0150)
Property tax	-0.0362* (0.0203)	-0.0351* (0.0189)	-0.00549 (0.0125)	0.000846 (0.0145)	-0.00333 (0.0161)
Consumption tax	0.00149 (0.0113)	-0.0119 (0.0135)	0.00993 (0.0103)	0.0218* (0.0116)	-0.00275 (0.0146)
Other rev	-0.0183 (0.0156)	-0.0342** (0.0159)	-0.00583 (0.00785)	-0.00401 (0.0208)	0.00142 (0.0152)
Education	-0.00541 (0.0177)	-0.0375** (0.0160)	-0.0513*** (0.0146)	-0.00973 (0.0135)	0.0160 (0.0182)
Public welfare	0.108** (0.0441)	0.0779** (0.0325)	0.0545** (0.0243)	0.0908*** (0.0340)	0.0658** (0.0281)
Health	-0.0344*** (0.0106)	-0.0230* (0.0129)	-0.0475*** (0.0119)	-0.0517*** (0.0147)	-0.0338** (0.0149)
Infrastructure	0.0215 (0.0258)	0.0298 (0.0207)	0.0296 (0.0246)	-0.00282 (0.0163)	0.0220 (0.0217)
Public safety	-0.0671 (0.0492)	-0.0362 (0.0408)	-0.0627* (0.0367)	-0.0820*** (0.0304)	-0.0588 (0.0378)
Housing	0.00998 (0.0120)	0.0170 (0.0172)	-0.00620 (0.0123)	-0.0241** (0.00962)	-0.00242 (0.0152)
Other exp	-0.00231 (0.0187)	0.00413 (0.0134)	-0.00270 (0.0156)	0.00808 (0.0158)	0.0294* (0.0166)
Observations	119	119	119	119	119

Note: all estimations use the two-step estimation approach as explained in section 3.4.2 of the paper. The control variables are not shown here but they include: constrained initial GRP, city population, % working age, % non-white, % enrollment, cash holdings, outstanding debt, a blue state dummy, city population/MSA population, and the constant. All estimations include two-way fixed effects and are estimated using the Driscoll-Kraay estimator with up to six-year lags. Robust standard errors in parentheses (*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$).

2006	2007	2008	2009	2010	2011
2011	2012	2013	2014	2015	2016
-0.0329**	-0.0304**	-0.0349***	-0.0372***	-0.0234*	-0.0148
(0.0142)	(0.0144)	(0.0120)	(0.0108)	(0.0131)	(0.00995)
0.0145	-0.00350	-0.00734	-0.0215	-0.00408	0.0104
(0.0160)	(0.0176)	(0.0148)	(0.0160)	(0.0197)	(0.0150)
0.0101	0.00605	-0.0278**	-0.0467***	-0.0134	-0.00773
(0.0112)	(0.0100)	(0.0123)	(0.0147)	(0.0130)	(0.0110)
0.0301**	0.0311**	0.0101	-0.00403	0.0260**	0.0391***
(0.0152)	(0.0153)	(0.0116)	(0.00772)	(0.0126)	(0.0128)
0.0456***	0.0359**	0.0531***	0.0268**	0.00236	0.00110
(0.0160)	(0.0173)	(0.0158)	(0.0128)	(0.0147)	(0.0146)
0.0536*	0.0729**	0.0803***	0.0953***	0.0485**	0.0315
(0.0281)	(0.0347)	(0.0214)	(0.0212)	(0.0234)	(0.0260)
-0.0547***	-0.0426***	-0.0141	0.0113	-0.0167	-0.0238**
(0.00998)	(0.0112)	(0.0121)	(0.0146)	(0.0142)	(0.0104)
0.0221	0.00865	0.0313*	0.0236	0.00722	-0.00977
(0.0165)	(0.0192)	(0.0164)	(0.0162)	(0.0220)	(0.0168)
-0.117***	-0.129***	-0.147***	-0.128***	-0.134***	-0.106***
(0.0315)	(0.0391)	(0.0342)	(0.0289)	(0.0267)	(0.0254)
-0.0116	-0.00680	0.0344***	0.0497***	0.0185	0.0114
(0.0135)	(0.0103)	(0.0116)	(0.0145)	(0.0126)	(0.0123)
-0.00858	-0.0125	-0.0173	0.000878	-0.0308*	-0.0393**
(0.0117)	(0.0168)	(0.0177)	(0.0123)	(0.0180)	(0.0156)
119	119	119	119	119	119

CHAPTER 4

A PURE EMPIRICAL APPLICATION OF LOCAL EXPENDITURES:

'VOTING WITH YOUR FEET' AND THE PROVISION
OF US URBAN SERVICES

Abstract

The famous concept of ‘voting with your feet’ is attributed to the 1956 Tiebout paper: “A pure theory of local expenditures”. This work goes back to that original idea by empirically examining the relationship between local public expenditures and the movement of people. However, instead of focusing on the movement between local communities within cities or regions, it focusses on how the combined local governments in central cities may attract people to move to their jurisdiction. The research is novel in that it (1) examines the complete local public fiscal composition, considering the constrained choice set, in which each expenditure decision affects the rest of the fiscal composition. Furthermore, (2) the chapter makes a distinction between capital outlay (flows) and current operations expenditures (stock), allowing for a more detailed analysis. Finally, (3) it uses fiscally standardized data for local governments in cities, thereby allowing for a direct comparison between cities. Empirical estimations are performed using a five-year dynamic model with overlapping Driscoll-Kraay estimations. Results show that cities may attract population through increased expenditures and investments into infrastructure, such as highways, parking and air transit. Furthermore, expenditures on housing and community development and investments in higher education attract population. The analysis is extended into inferring well-being effects.

Keywords: Tiebout, local public expenditures, well-being, population growth

JEL classification: H70, I31, R51

4.1 Introduction

The seminal paper “A pure theory of local expenditures” by Tiebout (1956) established the concept widely known as ‘voting with your feet’. The concept of ‘voting with your feet’ is used in popular culture and academic work to express the action of people to move to, remain, or leave a specific entity based on their preferences. The original Tiebout paper relates this concept of ‘voting with your feet’ to the composition of local public expenditures, and others have subsequently built on these arguments (Roback, 1982; Rosen, 1974, 1979). The argument is that citizens may sort themselves into the local communities that best reflect their preferences in local public spending. Instead, we move the focus from local communities within an area towards the importance of central cities, arguing that central cities are competing with one another as well as with their surrounding suburbs to attract population (workers, investors and talent) through investments in infrastructure and living conditions (The Economist, 2020b).

Papers using the Tiebout-model often focus on testing one of its assumptions, or use the theory to identify the revealed preference for a certain type of amenity, or tax competition (Dowding, John, & Biggs, 1994). Instead, in this chapter we go back to the original idea of the full expenditure composition. We use the ideas articulated in the Tiebout-Rosen-Rosen (1982) type of schema to examine US mobility in the context of urban public expenditures. Although the paper by Tiebout also briefly mentions the local public revenue composition, the paper is focused on the expenditures. Similarly, this chapter is also focused on the implications of the local public expenditure composition. However, it does consider of the constrained choice set, meaning that expenditures need to be financed, either through increased local public revenues, debt, or by lowering other expenditures. Furthermore, in line with existing literature (Faggian, Olfert, & Partridge, 2012; Goetzke & Islam, 2017), we infer well-being effects from these US mobility patterns.

While previous empirical applications have examined the Tiebout-type effects associated with migration, population growth or housing prices, and of various different types of local expenditures and the provision of services, this research is novel in that (1) it uses a public composition estimation model to derive the population growth effects, taking into account the constrained choice set, in which each expenditure decision affects the rest of the fiscal composition (Gemmell, Kneller, & Sanz, 2016; Kneller, Bleaney, & Gemmell, 1999). Furthermore, (2) we solve the fiscal comparability issue by using fiscally standardized local public fiscal data (Langley, 2016; Lincoln Institute of Land Policy, 2019). Finally, (3) we make a distinction between capital outlay (flows) and current operations expenditures (stock), allowing for a more detailed analysis.

The Fiscally Standardized Cities Database (FiSC) (Lincoln Institute of Land Policy, 2019) is used to examine the population effects of the local public expenditure composition. This

database consists of fiscally standardized local public fiscal data at the city government level. A dynamic panel structure is used for the estimations. Given the probable lagged expenditure effects and possible endogeneity issues, five-year dynamic estimations are performed in line with similar empirical applications relating public fiscal compositions to economic growth (Gemmell et al., 2016; Kneller et al., 1999). The five-year dynamic estimations create the issue of overlapping data. Therefore, we use overlapping estimations with the Driscoll-Kraay estimator, which solves the issue of the moving average error term. Each expenditure category is measured as the share of total expenditures, while accounting for the size of local government and the budget balance.

One could argue that the expenditure components do not necessarily capture the quality of public services all that well. Taking the case of education for example, direct measures of education quality have often been found to better predict Tiebout effects than public education expenditures (Bonilla-Mejía, Lopez, & McMillen, 2020; Fack & Grenet, 2010; Gibbons, Machin, & Silva, 2013). However, this is exactly the point of this chapter. The attempt here, is not to capture the relationship between the quality of a public service and its Tiebout effects. The aim of this chapter is to find the relationship between local public spending and its Tiebout effects. One would expect local public governments to enhance living standards through, for example, increased spending on education, thereby enhancing education quality, and thus making the place more attractive. However, instead of looking at the effects of local government spending on education quality, or education quality on living standards, this chapter aims to empirically explore if we find any relationship between spending and the Tiebout effects. If one argues that local public spending does not necessarily increase education quality, we should not find any positive effects and thus empirically show that simply increasing education expenditures does not attract population.

The remainder of this chapter is structured as follows. First, the core idea of the Tiebout-model and its underlying assumptions are discussed. This helps to position some of the choices made for this chapter, such as the choice for the US. Secondly, existing empirical evidence is examined in order to position the chapter in the existing empirical literature. Thirdly, the data and estimation strategy are described, after which the empirical results are shown and briefly described. Subsequently, the discussion section discusses the empirical results into more detail using existing theoretical evidence to guide the discussion. Furthermore, it uses literature to extend the argument of revealed preferences into inferred well-being effects and discusses the possible implications. Finally, the conclusion summarizes the importance of the chapter and its main findings.

4.2 Voting with your feet

It is argued that one of the advantages of a decentralized governmental system is that it leads to policy innovation due to policy competition (Tiebout, 1956). Local governments

are competing to attract people and businesses to move to their cities by providing the best amenities they can. In this concept, the people are assumed to be consumer-voters in the sense that they move to the region which local government best satisfies his or her preferences (Tiebout, 1956). By moving, these consumer-voters reveal their preferences for a specific type of local public fiscal composition. While the paper by Tiebout is focused on the sorting of 'consumer-voters' into the local communities that best reflect their preferences, we argue that central cities are in a particular competition with one another. A recent special report by the Economist (The Economist, 2020b) articulates this argument for the Midwest. The argument is made that for the region to prosper, the bigger cities must flourish. This may be achieved by attracting investors, workers and talent through investments in infrastructure and increasing livability in the cities. Success is subsequently captured by population growth. We use this same line of reasoning and apply it to 150 of the biggest US cities. Subsequently, we test whether investments into infrastructure indeed increases population growth. Furthermore, we explore how the local public expenditure composition may enhance livability through its effects on population growth.

The implications of the concept of 'voting with your feet' are founded on seven assumptions (Tiebout, 1956). The first assumption is that (1) consumer-voters are fully mobile. Although it has been pointed out that people are not footloose moving across local jurisdictions, the question is if people are sufficiently mobile for the Tiebout-argument to work (Oates, 1981). People within the US are fully mobile to move within and across states, evidenced by a higher spatial mobility in the US compared to the EU (Broersma & Van Dijk, 2002). While Europeans are also mobile to a large degree, the cultural and language differences may form barriers to move freely across countries. Similarly, Chinese migration may be limited to some extent due to the *hukou* system (Gu, Jie, Li, & Shen, 2020). Therefore, it may follow that the US presents a good case where this concept of 'voting with your feet' and revealed preferences may work well, compared to Europe (Faggian et al., 2012), China, or other parts of the world.

The second assumption of Tiebout is that (2) consumer-voters have full knowledge of the differences of revenue and expenditure patterns across regions. While today's age with internet and transparency should allow one to compare tax and spending decisions across local governments to some extent, one may wonder if consumer-voters actually do that. Furthermore, the complex system of local governments, with special districts in the US may make it increasingly difficult. Thus, one may wonder to what extent consumer-voters have full knowledge of the revenue and expenditure patterns. Bickers and Stein (1998) agree that consumer voters are not aware of specific revenue and expenditure patterns. However, they argue that consumer-voters use informational heuristics and proxies to locate the jurisdictions with their preferred levels of collective goods. With the assumption that such proxies are affected by local public revenue and expenditure compositions, consumer-voters thus have sufficient knowledge to sort themselves into the jurisdiction with their preferred local public fiscal composition.

Assumption number three (3) states that there is a large set of regions for consumer-voters to choose from. Obvious favorable case studies to examine the Tiebout model are therefore big countries such as the US or China, or a big union of countries with free movement of people, such as the European Union.

Another assumption by Tiebout is that (4) restrictions due to employment are not considered. People tend to be “sticky”, be it for their job, house, family, friends or something else (Venhorst, 2013). This does not have to be a problem for the model to work as long as there are enough consumer-voters that are mobile (Oates, 1981). However, it does become an issue if the “stickiness” of people is not random. This chapter therefore controls for the demographic composition of the cities, including student enrolment given that students are found to be more spatially mobile (Venhorst, Van Dijk, & Van Wissen, 2010).

The fifth assumption of Tiebout is that (5) there are no spatial spillovers resulting from the local public services supplied. This assumption may be tested and controlled for using spatial econometrics (Elhorst, 2014). Given that we only have fiscal data on 150 of the biggest US cities with no data on what is happening in between these cities, it is impossible to control for spatial spillovers to these cities’ direct surroundings. The city government geographical scale of the data used in this chapter also means that interlinkages between the commuting zones are ignored. However, the estimations account for cross-sectional dependence by using the Driscoll-Kraay estimator (Driscoll & Kraay, 1998; Hoechle, 2007).

The final two assumptions are related to the optimum population size: (6) for every pattern of community services there is an optimal community size, and (7) regions below the optimum population size seek to increase their population to lower their average costs, while regions with above optimum size try to keep their population constant. This is in line with literature on agglomeration economies and congestion.

The Tiebout argument assumes that there is heterogeneity in preferences (Tiebout, 1956), because if preferences would be universal, the local public expenditure composition would be the same across all cities. The local public expenditure composition is shaped by the current citizens and subsequently attracts consumer-voters with similar preferences (Tiebout, 1956). Aware of such heterogeneous preferences, the focus of this chapter is to examine the effect on total population growth. More detailed population data would be needed to analyze the revealed preferences of various heterogeneous population groups.

While the local public expenditure composition may attract consumer-voters to move to a specific place, the attractiveness of a place is also dependent on housing prices. Housing prices will rise as more people move to a specific city. Furthermore, (expected) wages affect how much consumer-voters can afford to live in the specific area. Thus, both wages and housing prices affect the attractiveness of a city and must therefore be considered in the

estimations of this chapter. Using work by Rosen (1974, 1979) on hedonic prices, wages and quality of life, Roback (1982) extended the consumer-side focused theory of Tiebout (1956) by including wages and rents. In their papers, Rosen and Roback used the system of wages, rents, and amenities to infer quality of life indices for cities through hedonic prices (Roback, 1982; Rosen, 1979). The land price gradient reveals the marginal social value for each amenity to the community.

Faggian *et al.* (2012) take a similar approach using population growth, to infer well-being. The argument remains the same as the original idea by Tiebout, in that people will move to the location that they perceive will maximize their utility/well-being. If we assume that consumer-voters decide to move to a region if they believe it will enhance their overall well-being, then one can infer revealed well-being effects from migration data. This assumption is supported by empirical evidence which finds that happier regions experience higher population growth rates (Goetzke & Islam, 2017). The argument of inferred well-being, which is consistent with the original Tiebout logic, also allows us to link utility/well-being to the provision of local public services, again in accordance with the Tiebout-type logic. This means that local public expenditures affect population growth, because they affect inferred well-being associated with living, working and consuming in a particular city. Therefore, and in line with the work of Faggian *et al.* (2012), we also use population growth to capture the revealed preferences and to infer well-being from these revealed preferences.

4.3 Existing empirical evidence

Various papers have set out to test the specific implications of the Tiebout-model. In a paper by Dowding *et al.* (Dowding *et al.*, 1994), the seven implications of Tiebout are extended into eleven testable implications. Through a survey of over 200 papers, they conclude that *“an impressive array of evidence suggests that the Tiebout family of models holds a number of important truths about urban politics”*. While this is important for our understanding of the workings of the Tiebout model, it does not tell us which local public expenditures actually attract consumer-voters to move. Such attempts are usually targeted at attempting to decipher the revealed preferences for one or two of the amenities under control of local governments (Edel & Sclar, 1974; Fox, Herzog, & Schlottman, 1989). An early attempt looking at a number of local public expenditures is undertaken by Murray (1969), who looks at the effect of central city expenditures per capita on out-migration to the fringe, by income groups. The empirical application includes expenditures on police, fire protection, highways, parks & recreation, health & hospital, public welfare, and housing & community development. It concludes that the expenditures on police and fire protection are significant for all income groups, with police expenditures being positively associated to outward-migration and fire protection negatively associated. Expenditures on highways and public welfare were positively associated with outward-migration for the middle-income groups.

Fox et al. (1989) examine the migration effects of expenditures on education, welfare, police & fire protection, and parks & recreation. Their results suggest that out-migration is lowered through expenditures on education, police, and fire protection. Furthermore, they find that people prefer to live in a metropolitan area with parks and recreation, but to be located outside of the community actually financing it (Fox et al., 1989).

Other papers relate local public expenditures to housing prices, for example through tax capitalization (Oates, 1969), suggesting a negative relationship between housing prices and the effective tax rate, and a positive relationship between education expenditures per pupil and the housing prices. A paper by Welch, Carruthers, and Waldorf (2007) looks at municipal public expenditures in the US and its effect on housing value and rental value. It finds that expenditures on capital facilities, education, housing & community development, libraries, parks, police, roadways, and trash collection to positively affect housing value. Rental value is positively affected by capital facilities, fire protection, libraries, parks, police protection, and sewerage. Another paper looks at the effects of local public spending on housing prices in Barcelona (García, Montolio, & Raya, 2010). It looks at expenditures on personnel, purchases of goods & services, payment of interest, current transfers, real investment, capital transfers, variations in financial assets, and variations in debt, finding a positive effect for real investments.

Most empirical papers focus on the Tiebout-effects of one local public expenditure component. Initial attempts using the Tiebout-model to explore the effects of local public expenditures typically focused on welfare (Dowding et al., 1994). Empirical results suggest different effects across various demographic groups (Aronson & Schwartz, 1973; Brehm & Saving, 1964; Cebula, 1974; Enchautegui, 1997; Pack, 1973), resulting in mixed or insignificant results for the total population (Brueckner, 2000; Day, 1992; Giuliatti & Wahba, 2013; Pena, 2014). The Tiebout-effects of education expenditures show similar mixed results (Cebula & Alexander, 2006; Cebula & Clark, 2013; Edel & Sclar, 1974; Fox et al., 1989; Heinberg & Oates, 1968; Mcdougall, 1976; Meadows, 1976; Pack, 1973; Pollakowski, 1973). Generally, direct measures of education such as education quality, the presence of schools, or proximity to schools, better predict Tiebout-effects (Bonilla-Mejía et al., 2020; Fack & Grenet, 2010; Gibbons et al., 2013). One may therefore wonder to what extent local public expenditures on education translate into the quality and/or presence of schools. Expenditures on transportation also show mixed empirical results for expenditures on highways (Edel & Sclar, 1974; Mikelbank, 2005) and transit (Gonzalez-Navarro & Turner, 2018; Li, Chen, & Zhao, 2019; Zhang, Liu, Hang, Yao, & Shi, 2016). Papers looking at the Tiebout-effects of public safety expenditures such as police and fire protection expenditures also show mixed results (Koven & Shelley, 1989; Mcdougall, 1976). Similar mixed results are found for expenditures on parks & recreation (Fox et al., 1989; Mcdougall, 1976).

4.4 Data and estimation strategy

This section describes the database that is used and shows descriptive overviews of the data. Subsequently, the estimation strategy is outlined.

4.4.1 Data

The US has a complex system of local governmental organizations. There are five types of local governmental organizations: county government, city/municipal government, town/townships, special districts, and school districts. The responsibility and authority of these organizations is different in every city and often overlaps multiple governmental organizations. This means that one cannot simply compare the expenditures and revenues of city governments across cities. In one city, city government may be responsible for expenditures on education, while another city has a special school district which takes care of these expenditures. Therefore, all local governmental organizations within city boundaries have to be fiscally standardized in order to perform meaningful analyses. This is exactly what the FiSC database by the Lincoln Institute of Land Policy has done. The FiSC database is constructed using data for individual local governments from the U.S. Census Bureau's quinquennial Census of Government Finance and the Annual Surveys of State and Local Government Finance. These data are used to create fiscally standardized cities. This, allows for in-depth analysis and comparison of local public finance at the city level. The FISC database consists of fiscally standardized panel data on 150 of the largest US cities, across more than 120 categories of revenues, expenditures, debt, and assets, over the period 1977 – 2016. The fiscally standardized cities are captured at the geographical scale of city governments. Each expenditure category is measured by the amount of real (2016 inflation adjusted) US Dollars.

Figure 4.1 shows the development in total local governmental revenues and expenditures. Accounting for inflation, it can be seen that local governmental expenditures and revenues have increased over the years. On average, the expenditures and revenues stay close to each other, which is expected considering the tight budget constrictions local governmental organizations are often facing (Mahdavi & Westerlund, 2011; Westerlund, Mahdavi, & Firoozi, 2011). The effects of the dot.com bubble and the financial crisis are mostly visible through the governmental revenues.

Figure 4.1: Total weighted average local public revenues and expenditures per capita in major US cities

Source: authors elaboration using data from the FiSC database (Langley, 2016).

Figure 4.2 shows the development of the expenditures. Given that not all expenditure components can be included in the graph, the biggest expenditure component, *education*, is included together with a combination of other aggregated fiscal components. Nearly all expenditures on *education* come from expenditures on *primary & secondary education* (not shown here). The combined fiscal component of *housing, utilities, and transportation* shows a slightly bigger size than expenditures on *education*. The combination of *social services*, and *public safety* is much smaller. All expenditure components show an upward trend, although there is some variation over time.

Figure 4.2: Overview local public expenditures development over time

Source: authors elaboration with data from the FiSC database (Langley, 2016), showing the biggest expenditure category (education) together with combined main aggregated expenditure categories. Please find an overview of all fiscal components via: <https://www.lincolnst.edu/research-data/data-toolkits/fiscally-standardized-cities>, or refer to the U.S. Census Bureau's Government Finance and Employment Classification Manual, available at: <http://www.census.gov/govs/classification/>.

Since the data availability on net migration is rather limited we use population change instead of net migration in line with previous work (Faggian et al., 2012). This should not lead to major complications since the correlation between the two is very high (Partridge & Rickman, 2003). Under the reasonable assumption of high substitutability (Borjas, 2006), population growth may actually be preferred over net migration. Under that assumption, high (low) rates of natural population growth may be offset by low (high) rates of net domestic migration (Faggian et al., 2012). In addition, domestic net migration data often misses net international migration flows, which are captured in population change (Faggian et al., 2012). One issue related to using population change may be that these are highly affected by natural population change: people dying and people being born. Therefore, this is controlled for by having control variables for the percentage of the population aged above 65 and the percentage of people aged between 18 and 40. Another demographic control variable is added in the form of the share of population that is non-white. Finally, data on student enrolment is used to capture the percentage of students in a city. These demographic variables also automatically control for specific degrees of stickiness associated with the demographic composition of a city.

The city population data is also taken from the FiSC database, which has constructed city population estimates using decennial, intercensal, postcensal and recent population census

estimates (Langley, 2016). Data on the demographics comes from the Surveillance, Epidemiology, and End Results Program of the National Cancer Institute (2017), except for the data on student enrolment, which comes from the FiSC database (Lincoln Institute of Land Policy, 2019). Data on (pre-tax) personal income per capita is gathered through the Bureau of Economic Analysis (2019). Both the demographic and personal income data are at the county-level (except for student enrolment), which means that they do not fully match the fiscal data that we have. Furthermore, demographic data is missing for New York for 1977-1979.

There are three cities that show issues concerning their population data in which they double or shrink by half in size in one year (see figure 4.3). Therefore, these cities are dropped from the estimations. The remaining cities show no major population shocks. Following the advice of the Lincoln Institute of Land Policy, Washington D.C. is dropped from the estimations given its incomparable local public fiscal system. The same is done for Alaskan cities, which leaves 144 cities in the final estimations.

In order to derive a variable for housing prices, data by the National Association of Realtors (NAR) (National Association of Realtors, 2019) and the Federal Housing Finance Agency (FHFA) (Federal Housing Finance Agency, 2019) are combined. The NAR has data on the *Median Sales Price of Existing Single-Family Homes for Metropolitan Areas*. These data are used to create the cross section of housing prices for the years 2014 and 2015. Subsequently, these data are merged with data by the FHFA, which has data on average annual change in housing prices at the county level. Due to missing data for quite a few US cities, a panel of 102 cities is left when controlling for the housing prices. Unemployment data comes from the Bureau of Labor Statistics. It is captured through the *Smoothed Seasonally Adjusted Metropolitan Area Estimates*. Data starts from 1990 onwards, meaning that estimations including unemployment only capture 1990-2017.

We are also interested to know if an expenditure is an investment (flow) or it is simply an expenditure to keep the current system running (stock). Taking expenditures on *highways* as an example, the stock would be the current system of *highways* and the flow would be additional new *highways*. Thus, the expenditures on the current stock of *highways* (e.g. for repairment) would be the non-capital outlay (current operations) expenditures and the additional *highways* would be the flow, the capital outlay. The FiSC database allows one to look at the capital outlay of specific expenditure categories specifically. It defines capital outlay as expenditures “*for purchase or construction, by contract or government employee, construction of buildings and other improvements; for purchase of land, equipment, and existing structures; and for payments on capital leases*”(U.S. Bureau of the Census, 2006). All non-capital outlay expenditures are considered current operations expenditures. Note that the US Census from which the FiSC database is constructed, does not have data on capital outlay and current operations for all separate expenditure categories.

Given the large number of expenditure categories, a selection has to be made to be included in this chapter. This selection is guided by existing empirical theory (Fox et al., 1989; Murray, 1969; Welch et al., 2007). However, separate estimations are also performed for each expenditure category separately. These estimations may be found in the appendices B-D.

Table 4.1 presents an overview of the descriptive data. Note that there is also a column counting the number of zeroes. These are not missing values, but simply observations where a city has not recorded any expenditures in that specific category. *Higher education* is a category that shows a lot of zeroes, meaning there are few cities where local public finance is actually directed to *higher education*. Furthermore, some expenditure categories have a distinction between capital outlay and current operations expenditures.

Table 4.1: Descriptive data

Variable	Obs	# zeroes	Mean	Std. Dev.	Min	Max
$\Delta \ln(\text{population})$	5,040	0	0.042	0.070	-0.164	0.392
$\ln(\text{population})$	5,040	0	12.332	0.952	9.709	15.919
% pop. > 65	5,037	0	0.113	0.025	0.041	0.288
% pop 18 - 40	5,037	0	0.369	0.043	0.250	0.509
% pop nonwhite	5,037	0	0.190	0.139	0.004	0.715
% student	5,038	0	0.152	0.035	0.000	0.361
$\ln(\text{total exp})$	5,040	0	0.130	0.041	0.046	0.429
$\ln(\text{budget balance})$	5,040	0	-0.001	0.013	-0.192	0.263
$\ln(\text{personal income p.c.})$	5,040	0	10.542	0.228	9.802	11.872
$\Delta \ln(\text{personal income p.c.})$	5,040	0	0.062	0.072	-0.332	0.596
$\ln(\text{housing prices})$	3,632	0	12.225	0.324	11.629	13.856
$\Delta \ln(\text{housing prices})$	3,632	0	-0.002	0.197	-1.023	0.679
Unemployment %	3168	0	0.057	0.024	0.014	0.169
Δ Unemployment %	3168	0	0.000	0.027	-0.086	0.097
Cap higher education	5,040	4,558	0.000	0.001	0.000	0.022
Cur higher education	5,040	4,397	0.002	0.008	0.000	0.191
Cap elementary & sec educ	5,040	20	0.026	0.021	0.000	0.208
Cur elementary & sec educ	5,040	4	0.277	0.081	0.000	0.608
Libraries	5,040	75	0.008	0.005	0.000	0.071
Public welfare	5,040	278	0.027	0.033	0.000	0.237
Cap hospitals	5,040	2,846	0.002	0.008	0.000	0.238
Cur hospitals	5,040	2,237	0.030	0.050	0.000	0.412
Health	5,040	88	0.020	0.017	0.000	0.134
Cap highways	5,040	128	0.018	0.017	0.000	0.157
Cur highways	5,040	2	0.025	0.014	0.000	0.108
Transit	5,040	737	0.020	0.023	0.000	0.205
Air transit	5,040	507	0.019	0.026	0.000	0.391
Parking	5,040	833	0.003	0.006	0.000	0.063
Sea and ports	5,040	3,355	0.003	0.009	0.000	0.216
Police	5,040	0	0.060	0.017	0.007	0.145
Fire protection	5,040	4	0.035	0.012	0.000	0.091
Cap parks & rec	5,040	132	0.009	0.013	0.000	0.337
Cur parks & rec	5,040	0	0.023	0.012	0.000	0.155
Housing & comm dev	5,040	51	0.040	0.031	0.000	0.342

Note: capital outlay is abbreviated by *Cap*, and current operations expenditures is abbreviated by *Cur*. Furthermore, all non-differenced data is lagged by five years, meaning that it runs from 1977 – 2011.

4.2 Estimation strategy

Influenced by work on the economic effects of public finance (Devarajan, Swaroop, & Zou, 1996; Gemmell et al., 2016; Kneller et al., 1999) a dynamic estimation strategy is proposed to analyze the effect of local public finance on population growth:

$$(4.1) \quad \Delta P_{i,t} = \alpha + \beta_1 P_{i,t-5} + \beta_2 \left(\frac{E}{Y}\right)_{i,t-5} + \beta_3 \left(\frac{R}{Y}\right)_{i,t-5} + \beta_4 \left(\frac{B}{Y}\right)_{i,t-5} + \sum_k \beta_k \left(\frac{E_k}{E}\right)_{i,t-5} + X_{i,t-5} + \mu_i + \omega_t + \varepsilon_{i,t}$$

Where $P_{i,t}$ is the population in city i at time t , E is total expenditures, R is total revenues, B is the budget balance, Y is total personal income, E_k is the k th expenditure component, X consists of the control variables, μ_i and ω_t are the city and time fixed effects, and $\varepsilon_{i,t}$ is the error term.

Including all expenditure components would be impossible to estimate given the full system it presents: $\sum_k \beta_k \left(\frac{E_k}{E}\right) = 1$. Therefore, a selection of expenditure components is made, guided by empirical theory. The coefficients of the expenditure components capture the local economic growth effects of increasing the share of total expenditures spend on the specific expenditure component, at the cost of all expenditure components that are not included in the estimation. Estimations are also performed for all expenditure components separately, including those not selected for the estimations in the chapter. This means that k -number of estimations are performed, one for each expenditure component. These estimations results may be found in appendices B-D. Estimations using multiple expenditure components in the same regression are preferred given that they control (to some extent) at which “cost” the expenditure component is financed, which other expenditure component is lowered because of it. Estimations using only one expenditure component show similar results.

The fiscal variables (*total expenditures/revenues* and *budget balance*) are normalized by taking them as shares of personal income. Estimations in which the normalization is done through per capita data are also performed yielding similar results for the separate expenditure categories (see table 4.10). Normalization through total personal income is preferred as this captures a normalization for the share of government expenditures as part of the total local economy, thereby accounting for regional price differences.

One remaining issue, is that the equation still represents a closed system: $B_{it} = R_{it} - E_{it}$ (Gemmell, Kneller, & Sanz, 2011; Kneller et al., 1999). In order to solve this issue, either total expenditures, total revenues, or the budget balance needs to be left out of the estimation. Given that we are interested in the expenditures, total expenditures will be left in. Since total revenues and total expenditures are highly correlated it leads to complications if we are to leave total revenues in as well. Therefore, we include the budget balance. This leads to the following expression:

$$(4.2) \quad \Delta P_{i,t} = \alpha + \beta_1 P_{i,t-5} + (\beta_2 - \beta_3) \left(\frac{E}{Y}\right)_{i,t-5} + (\beta_4 - \beta_3) \left(\frac{B}{Y}\right)_{i,t-5} + \sum_k \beta_k \left(\frac{E_k}{E}\right)_{i,t-5} + X_{i,t-5} + \mu_i + \omega_t + \varepsilon_{i,t}$$

The equation shows that the interpretation of total expenditures and the budget balance is contingent on the missing total revenues. This means that the interpretation of the coefficient of total expenditures is that an increase of total expenditures is financed through total revenues. Controlling for the budget balance, it follows that total expenditures captures the same thing as total revenues. Therefore, the coefficient may be simply interpreted as an increase in local government size. The budget balance captures the effect of an increase in the budget balance financed through more local public revenues.

4.4.2 A lagged effect and endogeneity

The estimations are performed using five-year dynamic estimations. This longer time-period is necessary for two reasons: (1) a lagged effect, and (2) endogeneity issues. It may take some time before a change in the expenditure composition results in informational heuristics that cause higher/lower population growth. Secondly, the five-year lag is used to ensure a degree of exogeneity. It is likely that population growth affects local public expenditure patterns. By using the initial expenditure composition to estimate the subsequent five-year population growth, there is a degree of natural (weak) exogeneity. While it is common to use five-year periods (Kneller et al., 1999), other lag structures are also investigated, yielding similar results

The five-year time-span means that there is an issue of overlapping data. Overlapping estimations are generally not preferred because they create a moving average error term resulting in inefficient parameter estimates and biased hypothesis tests (Hansen & Hodrick, 1980). Harri and Brorsen (2009) discuss multiple ways in which to deal with overlapping data. The most common solution is using non-overlapping estimations (Harri & Brorsen, 2009). While this yields unbiased and consistent parameter estimates, and valid hypothesis tests, it is not efficient as it throws away a lot of information. Another option to solve the moving average error term issue is to use overlapping data and account for the moving average term using heteroscedasticity and autocovariance consistent (HAC) estimators (Harri & Brorsen, 2009). A popular HAC estimator is Newey-West (Whitney K. Newey & West, 1987), which accounts for heteroscedasticity and autocorrelation of a moving average over a specified period of lags. The Driscoll-Kraay estimator expands on this estimator by also accounting for cross-sectional dependence (Driscoll & Kraay, 1998; Hoechle, 2007). This estimator therefore also accounts for the fifth assumption of Tiebout related to spatial spillovers. A test for cross-sectional dependence (De Hoyos & Sarafidis, 2006; Pesaran, 2004) is performed to decide which of the two estimators is used. Pesaran's test of cross-sectional independence is significant with a value of -3.207 and a p-value of 0.0013. Therefore, the Driscoll-Kraay estimator is preferred and used for the overlapping estimations. The Driscoll-Kraay estimator requires setting the truncation lag. The lag structure is arbitrarily set at six to account for the five-year lagged data setting, following previous work (Mark, 1995). Another option is to use the first step of the Newey-West plug-in procedure (Hoechle, 2007; W. K. Newey & West, 1994), setting the lag $m(T)$ at:

$$(4.3) \quad m(T) = \text{floor}[4(T/100)^{2/9}]$$

However, this simple rule tends to choose an $m(T)$ that is often a bit small (Hoechle, 2007). Using this lag-setting yields similar estimation results that are slightly more significant. Therefore, the more cautionary lag settings results are included in this chapter and the results from the lag setting using the Newey-West formula are included in the appendix (table 4.10). The appendix also includes a five-year dynamic estimation with errors clustered at the State-level (table 4.10).

Finally, given the dynamic structure, there is the issue of the dynamic panel bias, also known as the Nickell bias (Nickell, 1981). The paper by Nickell shows that dynamic panel estimations using fixed effects result in biased results due to the demeaning process thereby creating a correlation between regressor and the error term. A common solution is to use GMM estimation to solve this issue. GMM estimation uses the first difference of the estimation in order to remove the constant and the individual effect. This still leaves a correlation between the differenced lagged dependent variable and the disturbance process, which may then be instrumented for using the individual fixed effects (Arellano & Bond, 1991; Caselli, Esquivel, & Lefort, 1996). However, as T becomes larger, the dynamic panel bias becomes insignificant. Furthermore, the number of instruments tend to explode (Roodman, 2009), which in practice may lead to highly unstable GMM estimates over alternative instrument sets (de Vos, Everaert, & Ruysen, 2015). Therefore, the Driscoll-Kraay estimator is preferred over GMM estimations.

Using the estimation strategy as just described, there may still be issues of endogeneity or reversed causality given that all the processes are essentially simultaneous. Even the lag structure may not really solve this as long as the past trends are the same as the current one. While we argue that our estimation strategy is the best option available to derive causal relationships, we may need to use some caution in interpreting the relationships as absolutely causal, and instead may interpret them as strong associations.

4.5 Results

The results section starts with the estimation results using various control-variable-strategies. Based on these results, a preferred control strategy is chosen after which it is used to explore the effects using different lag-structures.

4.5.1 General results

Table 4.2 shows the estimation results using various control-variable-strategies. There is evidence for dynamic linkages between population growth, personal income, and housing prices; First of all, cities with a higher personal income per capita attract more people to come. Furthermore, higher initial housing prices yield lower population growth (housing

prices estimation). However, at the same time, population growth and growth in housing prices go hand in hand (dynamic estimation). This intuitively makes sense, as housing prices would go up, driven by the increased demand of the population growth. While these dynamics are interesting in their own right, this is not the focus of the chapter. The idea for controlling for housing prices is that they may negatively affect population growth as it becomes more expensive to live somewhere. The results in table 4.2 show that this is best controlled for including lagged personal income, housing prices, and unemployment, without the dynamic controls (Unemployment estimation). The difference in housing prices (dynamic estimation) is positively correlated with population growth and would therefore partly capture our variable of interest. This would lead to an underestimation of our expenditures of interest. Furthermore, the dynamic personal income and unemployment are insignificant. Therefore, the estimation strategy as used in the estimation including unemployment is the preferred estimation strategy (the *unemployment* estimation from table 4.2).

With this in mind, we can look at the results for the fiscal variables. Total expenditures shows a significant negative effect. A 1% increase in total expenditures lowers population growth by 0.325%. This suggests that a relatively large local government (higher local public expenditures/revenues) negatively affects the attractiveness of the city. This is in line with previous research which finds negative migration effects for local public taxes (Cebula & Alexander, 2006; Cebula & Clark, 2013; Dowding & John, 1996). Estimations using total expenditures per capita, rather than total expenditures per total personal income have also been performed yielding similar results (see table 4.10). The budget balance shows negative significance in our preferred estimation, meaning that an increase in the budget balance as financed through increased revenues has a negative effect.

Table 4.2: Driscoll-Kraay estimator overlapping estimation results

Control structure	Population	Personal Income	Housing prices	Unemployment	Dynamic
ln(total exp), t_{-5}	-0.433*** (0.105)	-0.322*** (0.0760)	-0.337*** (0.0674)	-0.325*** (0.0843)	-0.223*** (0.0747)
ln(budget balance), t_{-5}	-0.0461 (0.0523)	-0.0166 (0.0508)	-0.0745 (0.0732)	-0.173** (0.0617)	-0.153*** (0.0485)
Cap. Higher education, t_{-5}	1.445* (0.788)	1.351* (0.791)	1.655** (0.615)	1.752*** (0.342)	1.890*** (0.429)
Cur. Higher education, t_{-5}	0.0209 (0.0612)	0.0290 (0.0605)	-0.169** (0.0667)	0.121 (0.131)	0.0964 (0.145)
Cap. Elementary & sec. educ, t_{-5}	0.144** (0.0536)	0.137** (0.0538)	0.114* (0.0578)	0.0215 (0.0354)	0.0545 (0.0438)
Cur. Elementary & sec. educ, t_{-5}	-0.0867*** (0.0292)	-0.0745*** (0.0251)	-0.0543** (0.0254)	-0.0632*** (0.0206)	-0.0559*** (0.0178)
Libraries, t_{-5}	0.230 (0.149)	0.242 (0.145)	0.0353 (0.151)	-0.398** (0.153)	-0.317*** (0.0849)
Public welfare, t_{-5}	0.00301 (0.0690)	0.0301 (0.0713)	-0.0896 (0.0701)	0.0200 (0.0642)	0.0962 (0.0624)
Cap. Hospitals, t_{-5}	-0.0378 (0.0555)	-0.0477 (0.0580)	-0.0744 (0.0567)	-0.126 (0.115)	-0.157 (0.105)
Cur. Hospitals, t_{-5}	0.00301 (0.0236)	-0.00105 (0.0215)	0.0142 (0.0217)	0.0238 (0.0174)	0.0356*** (0.0124)
Health, t_{-5}	0.0541 (0.0762)	0.0646 (0.0742)	0.113 (0.0745)	0.176* (0.0880)	0.173* (0.0929)
Cap Highways, t_{-5}	0.165*** (0.0366)	0.157*** (0.0346)	0.223*** (0.0417)	0.246*** (0.0415)	0.202*** (0.0439)
Cur Highways, t_{-5}	-0.166* (0.0962)	-0.167* (0.0890)	-0.246** (0.102)	0.0431 (0.0840)	0.0630 (0.0665)
Transit, t_{-5}	-0.0792 (0.0621)	-0.0495 (0.0529)	-0.108 (0.100)	-0.193* (0.108)	-0.223** (0.0905)
Air transit, t_{-5}	0.0873 (0.0636)	0.0709 (0.0587)	0.109*** (0.0334)	0.0386** (0.0177)	0.0139 (0.0180)
Parking, t_{-5}	0.360*** (0.101)	0.340*** (0.0951)	0.438*** (0.108)	0.702*** (0.106)	0.579*** (0.103)
Sea & ports, t_{-5}	-0.0841 (0.0876)	-0.112 (0.0915)	0.00117 (0.0734)	-0.0103 (0.0907)	0.0251 (0.0929)
Police, t_{-5}	-0.172 (0.115)	-0.140 (0.114)	-0.274** (0.127)	-0.0467 (0.0956)	-0.00292 (0.112)
Fire protection, t_{-5}	-0.141 (0.0901)	-0.0450 (0.119)	-0.0280 (0.0860)	-0.165** (0.0675)	-0.0129 (0.0618)
Cap. Parks & rec, t_{-5}	0.0398 (0.0605)	0.0329 (0.0604)	0.0533 (0.0573)	-0.0861** (0.0380)	-0.0283 (0.0239)
Cur. Parks & rec, t_{-5}	0.426*** (0.0833)	0.420*** (0.0836)	0.405*** (0.124)	0.274*** (0.0907)	0.325*** (0.111)
Housing & comm. Dev, t_{-5}	-0.0767** (0.0356)	-0.0807** (0.0355)	0.00395 (0.0318)	0.0540** (0.0191)	0.0709*** (0.0157)

The estimation results continue on the next page with the results for the control variables. Please find the notes for this table at the end of estimation results (next page).

Table 4.2: Driscoll-Kraay estimator overlapping estimation results continued

Control structure	Population	Personal Income	Housing prices	Unemployment	Dynamic
Ln(population), $t-5$	-0.157*** (0.0133)	-0.154*** (0.0129)	-0.134*** (0.0154)	-0.198*** (0.00447)	-0.205*** (0.00956)
% aged > 65, $t-5$	-0.0594 (0.166)	-0.0675 (0.167)	-0.0186 (0.160)	-0.120 (0.149)	-0.297* (0.149)
% aged > 18 & < 40, $t-5$	0.284** (0.125)	0.252** (0.120)	0.510*** (0.150)	0.179 (0.129)	0.136 (0.111)
% non-white, $t-5$	-0.316*** (0.0549)	-0.313*** (0.0579)	-0.372*** (0.0599)	-0.102** (0.0380)	-0.0772 (0.0500)
% student, $t-5$	0.292*** (0.0554)	0.289*** (0.0570)	0.492*** (0.0845)	0.273* (0.141)	0.171 (0.135)
ln(personal income p.c.), $t-5$		0.0474** (0.0184)	0.0795*** (0.0245)	0.0235* (0.0117)	0.0153 (0.0136)
ln(housing prices), $t-5$			-0.0439*** (0.0115)	-0.0456** (0.0173)	0.0231 (0.0199)
Unemployment %				-0.402*** (0.118)	-0.291*** (0.101)
Δ ln(personal income p.c.)					0.000897 (0.0145)
Δ ln(housing prices)					0.0722*** (0.0103)
Δ Unemployment %					-0.0484 (0.0391)
Constant	1.928*** (0.158)	1.395*** (0.208)	1.232*** (0.301)	2.797*** (0.267)	2.161*** (0.354)
Observations	5,035	5,035	3,632	2,288	2,288
Number of groups	144	144	104	104	104

Note: all explanatory variables are lagged five years. The top signals the control structure. The estimations include two-way fixed effects. The Driscoll-Kraay estimator includes up to six-year lags. Robust standard errors in parentheses (*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$).

The expenditure component results start with five variables capturing education. *Capital outlay on higher education* shows a significant positive effect when controlling for housing prices. The interpretation of the coefficient is tricky here; Increasing the share of expenditures spend on *capital outlay on higher education* with 1%, increases population growth by 1.75%. This is a 1% increase in the absolute share of expenditures on the expenditure component, not the relative share. Thus, moving the share of expenditures on this component from 0% to 1%, or 0.5% to 1.5%, would result in 1.75% population growth. *Current operations expenditures on higher education* is insignificant in our preferred estimation (including unemployment). *Capital outlay on elementary & secondary education* is insignificant when controlling for unemployment whereas, *current operations expenditures on elementary & secondary education* is significant and negative. Expenditures on *libraries* show no significant negative effects.

Four variables capture the expenditures on social services: *public welfare*, *capital outlay on hospitals*, *current operations on hospitals*, and *health*. Expenditures on *public welfare*

and *capital outlay on hospitals* show no significant results across the estimations. *Current operations expenditures on hospitals* are insignificant, except when the dynamic controls are included. Finally, *health* expenditures show weakly significant positive effects.

Transportation is captured through six expenditure components. *Capital outlay on highways* is positive and significant throughout all estimations. *Current operations expenditures on highways* are negative and turn insignificant when including unemployment. Expenditures on *transit* show the opposite result, turning weakly significant and negative once unemployment is included. Expenditures on *air transit* are positive and significant in our preferred estimation structure. *Parking* is significant and positive throughout all estimations. Finally, expenditures on *sea & ports* are insignificant.

The variables capturing public safety are expenditures on *police*, and *fire protection*. In our preferred estimation, *police* expenditures are insignificant and expenditures on *fire protection* are negative. Both show no significant effects. *Capital outlay on parks & recreation* is also negative in our preferred estimation whereas, *Current operations expenditures on parks & recreation* are significant and positive throughout all estimations. Finally, expenditures on *housing & community development* are significant and positive in nearly all estimations, including our preferred estimation.

4.5.2 Lag structures

In order to explore the sensitivity to the lag-structure of five years, other lag structures are explored. This also allows one to explore potential short-term effects. table 4.3 includes estimations using the control-variable-strategy as found in estimation *unemployment* from table 4.2. However, it uses lag structures going from one lag up to five lags. The results for the five-year lag estimation in table 4.3 are thus the same as those found in the estimation including *unemployment* of table 4.2.

Most results remain similar across the various lag structures, suggestive of consistent and robust results. We find that *total expenditures* remain significant and negative across all lag structures. Furthermore, capital outlay on *higher education*, and *highways*, expenditures on *air transit*, *parking*, and *housing & community development*, and current operations expenditures on *parks & recreation* remain significant and positive in (nearly) all lag structures. Similarly, the negative effects for expenditures on *libraries* and *fire protection* are pretty consistent. When looking at the *budget balance*, we find that it turns (weakly) significant and negative between lag three and five. *Current operations expenditures on elementary & secondary education* are (weakly) significant and negative between lag two and five. Finally, there is only a minor suggestion of positive effects for expenditures on *health*, capital outlay on *elementary & secondary education*, and current operations expenditures on *higher education*. Minor suggestions of negative effects are found for expenditures on *transit*, *police*, capital

outlay on *parks & recreation*, and current operations expenditures on *highways*.

Table 4.3: Driscoll-Kraay estimator overlapping estimation results with different lag structures

Lags	1	2	3	4	5
ln(total exp)	-0.0731*** (0.0164)	-0.147*** (0.0336)	-0.214*** (0.0518)	-0.274*** (0.0680)	-0.325*** (0.0843)
ln(budget balance)	-0.0311 (0.0211)	-0.0680 (0.0430)	-0.101* (0.0559)	-0.151** (0.0604)	-0.173** (0.0617)
Cap. Higher education	0.273** (0.132)	0.538* (0.282)	1.029*** (0.339)	1.521*** (0.330)	1.752*** (0.342)
Cur. Higher education	0.0285 (0.0393)	0.0601 (0.0750)	0.0589 (0.0979)	0.0678 (0.113)	0.121 (0.131)
Cap. Elem. & sec. educ	0.0187* (0.0109)	0.0290 (0.0201)	0.0254 (0.0278)	0.0247 (0.0335)	0.0215 (0.0354)
Cur. Elem. & sec. educ	-0.00421 (0.00474)	-0.0154* (0.00879)	-0.0319** (0.0147)	-0.0482** (0.0187)	-0.0632*** (0.0206)
Libraries	-0.0658** (0.0284)	-0.158*** (0.0386)	-0.241*** (0.0598)	-0.299*** (0.0998)	-0.398** (0.153)
Public welfare	-0.0148 (0.0114)	-0.0198 (0.0261)	-0.0224 (0.0418)	-0.00549 (0.0532)	0.0200 (0.0642)
Cap. Hospitals	-1.40e-05 (0.0339)	-0.0657 (0.0511)	-0.131 (0.0960)	-0.149 (0.123)	-0.126 (0.115)
Cur. Hospitals	0.000216 (0.00481)	0.00445 (0.00709)	0.00515 (0.00952)	0.00862 (0.0127)	0.0238 (0.0174)
Health	-0.00742 (0.0224)	0.0160 (0.0445)	0.0478 (0.0732)	0.111 (0.0875)	0.176* (0.0880)
Cap Highways	0.0324** (0.0125)	0.0755*** (0.0241)	0.135*** (0.0323)	0.194*** (0.0362)	0.246*** (0.0415)
Cur Highways	0.00697 (0.0253)	0.0248 (0.0434)	0.0350 (0.0596)	0.0531 (0.0752)	0.0431 (0.0840)
Transit	-0.0352* (0.0206)	-0.0590 (0.0469)	-0.0721 (0.0700)	-0.126 (0.0824)	-0.193* (0.108)
Air transit	0.0353** (0.0135)	0.0398** (0.0171)	0.0533*** (0.0186)	0.0502*** (0.0173)	0.0386** (0.0177)
Parking	0.148*** (0.0476)	0.304*** (0.0719)	0.474*** (0.0659)	0.603*** (0.0755)	0.702*** (0.106)
Sea & ports	0.00188 (0.0314)	-0.0182 (0.0426)	-0.0221 (0.0637)	-0.0300 (0.0779)	-0.0103 (0.0907)
Police	-0.0334* (0.0178)	-0.0460 (0.0445)	-0.0493 (0.0669)	-0.0520 (0.0867)	-0.0467 (0.0956)
Fire protection	-0.00710 (0.0276)	-0.0703* (0.0386)	-0.114*** (0.0309)	-0.136*** (0.0416)	-0.165** (0.0675)
Cap. Parks & rec	-0.00255 (0.0106)	-0.0128 (0.0216)	-0.0469 (0.0313)	-0.0782* (0.0378)	-0.0861** (0.0380)
Cur. Parks & rec	0.0585** (0.0234)	0.128*** (0.0389)	0.198*** (0.0509)	0.247*** (0.0702)	0.274*** (0.0907)
Housing & comm. Dev	0.0180 (0.0115)	0.0344* (0.0195)	0.0448** (0.0195)	0.0501** (0.0184)	0.0540** (0.0191)
Observations	2,704	2,600	2,496	2,392	2,288
Number of groups	104	104	104	104	104

Note: all explanatory variables are lagged by the number given at the top of the column in number of years. The control variables are not shown here but they include the same control variables as found in our preferred

*estimation: % aged > 65, % aged > 18 & < 40, % non-white, % student, ln(personal income p.c.), ln(housing prices) and unemployment %. All estimations include two-way fixed effects. The Driscoll-Kraay estimator includes up to six-year lags. Robust standard errors in parentheses (*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$).*

4.5.3 Robustness

As described before, robustness checks are also performed for through estimations for each expenditure component separately, including those expenditure components that were omitted from the full estimation model. The interpretation thus changes from the relative effect of increasing the share of expenditures on the specific expenditure component relative to the **omitted** expenditure components, towards the relative effect of increasing the share of expenditures on the specific expenditure component relative to **all other** expenditure components. The results are included in the appendix (table 4.7 - table 4.9) and show similar effects for the expenditure components included in our full estimation model. Interestingly, we also find positive effects for administrative expenditures (driven by financial administration, and other administration). While one would not expect these expenditures to attract population, we would argue that these expenditures are relatively fixed, meaning that a high share of administrative expenditures simply represents low expenditures. The result therefore is in line with the negative effect found for total expenditures. Similarly interesting, we find intergovernmental transfers to be positive. Here we would make the same argument, but also, that well performing cities are likely to have higher intergovernmental transfers.

The appendix also includes estimations using state-clustered errors, Driscoll-Kraay lags set through the first step of the Newey-West plug-in procedure, and total expenditures and the budget balance captured per capita instead of per personal income (table 4.10). The results remain robust across the various estimation procedures, although the negative budget balance effects disappears when captured per capita instead of per personal income.

As a robustness check, we also extend the estimation equation by including the lagged population growth (table 4.11). While the fixed-effects capture the average growth over the entire time-period, the lagged population growth controls for the previous population growth period, thereby capturing potential positive/negative population effects from a previous fast/slow growing/declining period. Given that Tiebout (1956) is silent on this subject, we state not prior expectations for this control variable.

$$(4.4) \quad \Delta P_{i,t} = \alpha + \beta_1 P_{i,t-5} + \beta_2 \Delta P_{i,t-5} + (\beta_3 - \beta_4) \left(\frac{E}{Y}\right)_{i,t-5} + (\beta_5 - \beta_4) \left(\frac{B}{Y}\right)_{i,t-5} + \sum_k \beta_k \left(\frac{E_k}{E}\right)_{i,t-5} + X_{i,t-5} + \mu_i + \omega_t + \varepsilon_{i,t}$$

The estimations results are also included in the appendix (table 4.11), yielding similar results for the expenditure components. Furthermore, it shows a weakly significant positive effect for the lagged population growth, suggesting positive population effects from the previous population growth period.

4.6 Discussion

This section first discusses the results using existing empirical literature. Subsequently, our findings are discussed in the light of inferred well-being.

4.6.1 General discussion

The estimation results confirm the “pure theory of local expenditures” of Tiebout in that local public expenditures indeed seem to affect population growth. Total government size captured through total expenditures shows significant negative effects, suggesting that more local public expenditures, and thus more local public revenues, negatively affect population growth. This is in line with the body of literature finding negative population effects for local taxes (Cebula & Alexander, 2006; Cebula & Clark, 2013; Dowding & John, 1996).

However, given the overall negative local public government size effect, local governments can attract population by shifting their expenditures towards attractive expenditure categories. Although the population effects of expenditures on education have been extensively investigated, those analyses have been mostly performed on an expenditure per capita level, for education overall. Our analysis goes into more detail by examining the share of expenditures on education, thus accounting for the constrained choice set and possible regional price differences. Furthermore, education is split into *higher education*, *elementary & secondary education*, and *libraries*, with a further distinction between capital outlay and current operations. Our distinction between capital outlay and current operations expenditures shows that *current operations expenditures elementary & secondary education* is (weakly) significant and negative. Similarly, expenditures on *libraries* are significant and negative. *Capital outlay on higher education* has a significant positive effect. These results may indicate that investing in new high schools may have positive effects through its increase in the proximity to schools (Sah, Conroy, & Narwold, 2016). At the same time, current operations expenditures possibly do not affect the quality of the schools sufficiently to have a positive effect, resulting in a relative negative effect.

Expenditures on social services are analyzed through *public welfare*, *hospitals*, and *health*. Expenditures on *public welfare* show no significant results, which is in line with previous findings (Brueckner, 2000; Day, 1992; Pena, 2014). Previous empirical research indicates that heterogeneous preferences such as personal income, ethnicity or gender (Aronson & Schwartz, 1973; Brehm & Saving, 1964; Cebula, 1974; Enchautegui, 1997; Pack, 1973), may be the reason for insignificant total population effects (Brueckner, 2000; Day, 1992; Giulietti & Wahba, 2013; Pena, 2014). Expenditures on *hospitals* do not show clear effects. Finally, *health* expenditures are weakly significant and positive.

Five infrastructural expenditures are examined: *highways*, *transit*, *air transit*, *parking*, and *sea & port*. Positive population effects are found for capital outlay on *highways*. This is in

line with work by Baum-Snow (Baum-Snow, 2019; Hamersma, Tillema, Sussman, & Arts, 2014). Current operations expenditures on *highways* show no significant effect on population growth. Thus, investments made into new, additional highways attracts people to a city, whereas, expenditures on the maintenance of the highways or the stock of the highways does not affect population growth. We are not the first to arrive at this finding. Mikelbank (2005) finds the same phenomenon and offers the interpretation that there is an initial period of positive anticipation impact, which is followed by induced travel and a return to equilibrium.

Expenditures on *transit* show are insignificant or (weakly) significant and negative. This is in line with the insignificant effects found for subways in other work (Gonzalez-Navarro & Turner, 2018; Zhao, Lou, Fonseca, Feiock, & Shen, 2020). However, positive Tiebout-effects are also commonly found for *transit*, especially in China (Dai, Bai, & Xu, 2016; Li et al., 2019; Zhang et al., 2016). One possible explanation for the largely insignificant results may be that the Tiebout-effect of public expenditures on transit is dependent on the degree to which the city is pedestrian-oriented or car-oriented. It has been shown that positive Tiebout-effects for *transit* are only found when the area is pedestrian-oriented (Bartholomew & Ewing, 2011; Duncan, 2011). One may wonder to what extent US cities are pedestrian oriented, also given the positive effects found for capital outlay on *highways*, and the positive effects for expenditures on *parking*. Perhaps one would find different outcomes for European or Chinese cities. Expenditures on *air transit* show a significant positive effect, although this may simply capture the positive effects of having an airport in your city. Expenditures on *sea & ports* are insignificant.

Police expenditures show no significant results. Expenditures on *fire protection* suggest a negative effect. Investments made into *parks & recreation* are negative. However, current operations expenditures on *parks & recreation* are significant and positive. Finally, expenditures on *housing & community development* show positive effects.

The results provide evidence for the line of reasoning by the Economist, in that investments in infrastructure indeed attract population. Furthermore, we find that local governments may enhance living standards through investments in higher education, and expenditures on housing and community development and parks & recreation.

4.6.2 Inferring well-being

Economists are more and more arguing for a shift from focus on GDP to a new measure of economic welfare (Stiglitz, Fitoussi, & Durand, 2018; Stiglitz, Sen, & Fitoussi, 2009). While GDP presents an 'easy' measure of economic welfare, it neglects a broader social aspect that one would like to be captured in economic welfare measures (Stiglitz et al., 2018). Scholars have put forward multiple measurements or indicators of this broader sense of well-being. Various Quality of Life (QoL) indexes were created consisting of various measurements

deemed relevant for one's quality of life (Boyer & Savageau, 1985; Cheshire, 1995; Faggian & Royuela, 2010; Hagerty et al., 2001; Roback, 1982). One issue such indexes have is that it is difficult to determine weights for each component of the index (Douglas & Wall, 1993; Mulligan, Carruthers, & Cahill, 2004). As a response to this issue, recently, economists are arguing for a set of indicators that are small enough to be comprehensible, but large enough to capture the concept sufficiently (OECD, 2017; Stiglitz et al., 2018).

In line with work by Rosen (1979) and Roback (1982), Faggian *et al.* (2012) argue that one can better infer well-being from net migration or population growth as people “vote with their feet”. Assuming consumer-voters decide to move to a region if they believe it will enhance their well-being, one can infer revealed well-being effects. This argument is not uncommon and the link between population growth and city performance is also made by the Economist (The Economist, 2020a). Evidence suggests that population growth is indeed a good indicator of happiness (Goetzke & Islam, 2017). Arguments against using population growth as a good indicator of happiness also exist. The argument is that data suggests that cities are increasingly unhappy, but also increasingly growing in population (Glaeser, Gottlieb, & Ziv, 2016). Thus, individuals do not seek to maximize happiness alone, but rather, are “*willing to sacrifice happiness or life satisfaction if the price is right*” (Glaeser et al., 2016). One could have a philosophical discussion on whether that actually mean that the preference for the financial incentives actually makes someone happier or increases well-being.

However, even if people are less happy in cities, and simply accept it for economic reasons, we actually control for this through personal income, housing prices, and unemployment. Furthermore, any natural amenities effects (Mueser & Graves, 1995) are controlled for by the fixed effects. Thus, we argue that one may indeed infer well-being effects from the population growth patterns. Using this argument of inferred well-being, we argue that the local public expenditure results of this chapter may be interpreted in terms of well-being enhancing. This means that local public expenditures affecting population growth, thereby also affect inferred well-being. Thus, leading to the conclusion that shifting local public expenditures away from current operations expenditures on *elementary & secondary education, libraries*, and capital outlay on *parks & recreation*, towards capital outlay on *higher education*, capital outlay on *highways, air transit, parking*, current operations expenditures on *parks & recreation*, and *housing and community development* expenditures, would enhance the well-being of citizens.

4.7 Conclusion

This chapter uses the argument made by Tiebout (1956) in his seminal paper, by examining the local public expenditure composition effects on population growth. This work is novel in that it (1) examines the local public fiscal composition, considering the constraint choice set, in which each expenditure decision affects the rest of the fiscal composition. Furthermore, it (2) examines the local public expenditure composition into much greater detail by looking at all expenditure categories, divided into capital outlay and current operations. Finally, (3) this chapter solves the issue of fiscal comparability by using fiscally standardized data.

Results show that a larger local government (higher taxes) negatively affects population growth. Furthermore, results show that expenditures on *air transit*, *parking* and *housing and community development* positively affect population growth. Shifting expenditures towards capital outlay on *higher education*, and *highways* also attracts consumer-voters to the city. Furthermore, shifting current operations expenditures towards *parks & recreation* also positively affects population growth. Negative expenditure effects are found for current operations expenditures on *elementary & secondary education*. Following the argumentation of Faggian *et al.* (2012), supported by the empirical evidence of Goetzke & Islam (2017), these results suggest that local public policy makers could enhance the well-being of its citizens by shifting the expenditure composition away from current operations expenditures on *elementary & secondary education*, towards expenditures on *air transit*, *parking* and *housing and community development*, capital outlay on *higher education*, and *highways*, and current operations expenditures towards *parks & recreation*.

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Appendix

Appendix 4.A: Summary statistics

Figure 4.3: Cities that are dropped from the estimations due to sudden population spikes

Table 4.4: Summary statistics for all expenditure components

Variable	Obs	# zeroes	Mean	Std. Dev.	Min	Max
Direct expenditures	5,040	0	0.995	0.012	0.813	1.000
General expenditures	5,040	0	0.856	0.114	0.272	1.000
Education services	5,040	0	0.314	0.088	0.013	0.639
Education	5,040	4	0.305	0.087	0.000	0.638
Higher education	5,040	4,393	0.002	0.009	0.000	0.211
Elementary & sec educ	5,040	4	0.303	0.086	0.000	0.638
Libraries	5,040	75	0.008	0.005	0.000	0.071
Social services	5,040	41	0.080	0.067	0.000	0.450
Public welfare	5,040	278	0.027	0.033	0.000	0.237
Cash assistance	5,040	3,021	0.009	0.020	0.000	0.142
Vendor payments	5,040	2,433	0.003	0.007	0.000	0.114
Other welfare	5,040	315	0.015	0.017	0.000	0.107
Hospitals	5,040	2,203	0.032	0.054	0.000	0.412
Health	5,040	88	0.020	0.017	0.000	0.134
Transportation	5,040	0	0.067	0.037	0.005	0.412
Highways	5,040	1	0.043	0.025	0.000	0.203
Air transit	5,040	507	0.019	0.026	0.000	0.391
Parking	5,040	833	0.003	0.006	0.000	0.063
Sea and ports	5,040	3,355	0.003	0.009	0.000	0.216
Public safety	5,040	0	0.112	0.028	0.034	0.236
Police	5,040	0	0.060	0.017	0.007	0.145
Fire	5,040	4	0.035	0.012	0.000	0.091
Correction	5,040	379	0.014	0.009	0.000	0.115
Inspection	5,040	350	0.004	0.003	0.000	0.045
Environment & housing	5,040	0	0.132	0.048	0.032	0.460
Natural resources	5,040	874	0.003	0.008	0.000	0.258
Parks & recreation	5,040	0	0.032	0.020	0.000	0.372
Housing & comm dev	5,040	51	0.040	0.031	0.000	0.342
Sewerage	5,040	15	0.039	0.026	0.000	0.334
Waste mgmt	5,040	68	0.018	0.012	0.000	0.194
Administration	5,040	0	0.049	0.017	0.011	0.144
Financial adm	5,040	0	0.014	0.006	0.002	0.072
Judicial adm	5,040	410	0.013	0.009	0.000	0.066
Public buildings	5,040	133	0.009	0.009	0.000	0.095
Other adm	5,040	0	0.014	0.010	0.001	0.123
General interest	5,040	0	0.046	0.029	0.002	0.302
Miscellaneous	5,040	7	0.056	0.038	0.000	0.377
Commercial activities	5,040	3,966	0.000	0.002	0.000	0.066
Other gen spending	5,040	7	0.056	0.038	0.000	0.377
Utilities	5,040	22	0.118	0.114	0.000	0.727
Water	5,040	279	0.042	0.031	0.000	0.427
Electricity	5,040	3,609	0.049	0.109	0.000	0.715
Gas	5,040	4,515	0.007	0.026	0.000	0.256
Transit	5,040	737	0.020	0.023	0.000	0.205
Liquor store	5,040	4,903	0.001	0.004	0.000	0.057
Employee retirement	5,040	1,434	0.020	0.024	0.000	0.162
Intergovernmental	5,040	1,205	0.005	0.012	0.000	0.187
Current operations	5,040	0	0.757	0.073	0.395	0.979
Interest on debt	5,040	0	0.056	0.032	0.003	0.305
Insurance	5,040	1,434	0.020	0.024	0.000	0.162
Wages	5,040	0	0.398	0.073	0.011	0.661

Table 4.5: Summary statistics for all capital outlay components

Variable	Obs	# zeroes	Mean	Std. Dev.	Min	Max
Capital outlay	5,040	0	0.152	0.064	0.001	0.478
General	5,040	0	0.125	0.055	0.000	0.461
Construction	5,040	0	0.118	0.060	0.001	0.449
Other	5,040	0	0.034	0.024	0.000	0.363
Education	5,040	18	0.026	0.021	0.000	0.208
Higher education	5,040	4,558	0.000	0.001	0.000	0.022
Elementary & sec educ	5,040	20	0.026	0.021	0.000	0.208
Hospitals	5,040	2,846	0.002	0.008	0.000	0.238
Highways	5,040	128	0.018	0.017	0.000	0.157
Correction	5,040	963	0.001	0.004	0.000	0.094
Natural resources	5,040	2,327	0.001	0.007	0.000	0.258
Parks & rec	5,040	132	0.009	0.013	0.000	0.337
Sewerage	5,040	264	0.018	0.022	0.000	0.311
Waste mgmt	5,040	927	0.002	0.005	0.000	0.159
Other general	5,040	2	0.047	0.033	0.000	0.391
Utilities	5,040	303	0.027	0.033	0.000	0.393

Table 4.6: Summary statistics for all capital outlay components

Variable	Obs	# zeroes	Mean	Std. Dev.	Min	Max
Education	5,040	4	0.279	0.081	0.000	0.608
Higher education	5,040	4,397	0.002	0.008	0.000	0.191
Elementary & sec educ	5,040	4	0.277	0.081	0.000	0.608
Hospitals	5,040	2,237	0.030	0.050	0.000	0.412
Highways	5,040	2	0.025	0.014	0.000	0.108
Correction	5,040	382	0.012	0.008	0.000	0.054
Natural resources	5,040	907	0.002	0.003	0.000	0.056
Parks & rec	5,040	0	0.023	0.012	0.000	0.155
Sewerage	5,040	21	0.021	0.012	0.000	0.091
Waste mgmt	5,040	79	0.016	0.010	0.000	0.103
Utilities	5,040	100	0.071	0.098	-0.129	0.717

Appendix 4.B: Estimations for all available fiscal components*Table 4.7: Estimations for all available expenditure components*

EXP of interest	Population	Personal income	Housing prices	Unemployment	Dynamic
Direct expenditures, $t-5$	0.00717 (0.116)	0.0132 (0.128)	0.0551 (0.102)	-0.118*** (0.0390)	-0.0928** (0.0329)
General expenditures, $t-5$	-0.0247* (0.0146)	-0.0167 (0.0148)	-0.0489** (0.0205)	-0.0413*** (0.0131)	-0.0143 (0.0157)
Education services, $t-5$	-0.0287 (0.0272)	-0.0174 (0.0254)	-0.0215 (0.0344)	-0.0446*** (0.00571)	-0.0370*** (0.00925)
Education, $t-5$	-0.0305 (0.0272)	-0.0198 (0.0253)	-0.0216 (0.0337)	-0.0390*** (0.00557)	-0.0325*** (0.00992)
Higher education, $t-5$	0.144 (0.0878)	0.142 (0.0918)	-0.0409 (0.117)	0.419*** (0.138)	0.411*** (0.124)
Elementary & sec educ, $t-5$	-0.0344 (0.0266)	-0.0237 (0.0248)	-0.0202 (0.0344)	-0.0467*** (0.00520)	-0.0400*** (0.00835)
Libraries, $t-5$	0.193 (0.147)	0.245 (0.145)	0.0389 (0.154)	-0.413** (0.163)	-0.332*** (0.104)
Social services, $t-5$	0.0123 (0.0238)	0.00914 (0.0216)	-0.00955 (0.0251)	0.0162 (0.0135)	0.0233 (0.0149)
Public welfare, $t-5$	0.0211 (0.0813)	0.0589 (0.0811)	-0.0735 (0.0619)	0.0211 (0.0415)	0.0801** (0.0354)
Cash assistance, $t-5$	0.210 (0.213)	0.244 (0.211)	-0.0389 (0.181)	0.129 (0.118)	0.353*** (0.0682)
Vendor payments, $t-5$	0.0486 (0.117)	0.106 (0.127)	0.0971 (0.155)	0.383 (0.227)	0.273* (0.158)
Other public welfare, $t-5$	-0.255** (0.0971)	-0.230** (0.0925)	-0.188*** (0.0529)	-0.163 (0.100)	-0.175** (0.0713)
Hospitals, $t-5$	0.00530 (0.0258)	-0.00643 (0.0209)	-0.00185 (0.0168)	-0.00359 (0.0135)	-0.00480 (0.0122)
Health, $t-5$	0.0578 (0.0744)	0.0665 (0.0739)	0.0886 (0.0663)	0.172** (0.0733)	0.140* (0.0801)
Transportation, $t-5$	0.107** (0.0394)	0.0865** (0.0341)	0.115*** (0.0174)	0.119*** (0.0135)	0.0898*** (0.00832)
Highways, $t-5$	0.0997** (0.0405)	0.0900** (0.0380)	0.0903* (0.0445)	0.196*** (0.0509)	0.166*** (0.0382)
Airports, $t-5$	0.101 (0.0630)	0.0744 (0.0562)	0.0992*** (0.0325)	0.0293 (0.0179)	0.00400 (0.0216)
Parking, $t-5$	0.386*** (0.0985)	0.352*** (0.0855)	0.484*** (0.0832)	0.672*** (0.108)	0.568*** (0.0990)
Sea & ports, $t-5$	-0.110 (0.0699)	-0.142* (0.0814)	-0.0312 (0.0766)	-0.00936 (0.0648)	0.0159 (0.0701)
Public safety, $t-5$	-0.0869 (0.0646)	-0.0183 (0.0552)	-0.0922 (0.0679)	-0.0653 (0.0598)	-0.0108 (0.0665)
Police, $t-5$	-0.237* (0.128)	-0.155 (0.117)	-0.276* (0.136)	-0.0297 (0.0934)	0.0266 (0.112)
Fire protection, $t-5$	-0.244* (0.132)	-0.0857 (0.138)	-0.136 (0.107)	-0.116 (0.119)	0.0518 (0.118)

Please find the notes at the end of the table.

Table 4.7 continued

EXP of interest	Population	Personal income	Housing prices	Unemployment	Dynamic
Correction, $t-5$	0.263** (0.128)	0.282** (0.126)	0.148* (0.0822)	-0.129*** (0.0380)	-0.129*** (0.0356)
Inspection, $t-5$	-0.0513 (0.309)	-0.0161 (0.300)	0.364 (0.317)	-0.0460 (0.360)	0.0716 (0.256)
Environment & house, $t-5$	-0.0154 (0.0200)	-0.0227 (0.0190)	-0.0128 (0.0223)	-0.00669 (0.0111)	0.00798 (0.00996)
Natural resources, $t-5$	0.233* (0.130)	0.220* (0.125)	0.0885 (0.104)	0.0227 (0.0395)	0.0851 (0.0565)
Parks & recreation, $t-5$	0.130** (0.0624)	0.121* (0.0617)	0.153*** (0.0426)	0.0164 (0.0245)	0.0639** (0.0250)
Housing & comm dev, $t-5$	-0.0723* (0.0426)	-0.0810* (0.0444)	-0.00297 (0.0442)	0.0686*** (0.0213)	0.0839*** (0.0199)
Sewerage, $t-5$	-0.0688** (0.0316)	-0.0719** (0.0299)	-0.114*** (0.0288)	-0.104*** (0.0327)	-0.119*** (0.0310)
Waste mgmt, $t-5$	0.0863 (0.0541)	0.0885 (0.0536)	0.158*** (0.0502)	0.00708 (0.116)	-0.0503 (0.102)
Administration, $t-5$	-0.132 (0.0987)	-0.116 (0.0919)	-0.169 (0.127)	0.135*** (0.0454)	0.175*** (0.0378)
Financial adm, $t-5$	-0.231 (0.214)	-0.178 (0.201)	-0.104 (0.250)	0.458*** (0.141)	0.510*** (0.124)
Judicial adm, $t-5$	-0.377** (0.181)	-0.214 (0.200)	-0.418 (0.251)	-0.936*** (0.257)	-0.557** (0.200)
Public buildings, $t-5$	-0.145* (0.0792)	-0.156** (0.0760)	-0.193 (0.124)	0.108 (0.119)	0.130 (0.116)
Other adm, $t-5$	0.0313 (0.116)	0.00448 (0.127)	-0.0598 (0.156)	0.231*** (0.0800)	0.213*** (0.0686)
General interest, $t-5$	-0.0247 (0.0215)	-0.0204 (0.0246)	-0.0502** (0.0184)	-0.0844*** (0.0194)	-0.104*** (0.0154)
Miscellaneous, $t-5$	-0.00565 (0.0149)	-0.00603 (0.0143)	-0.0157 (0.0119)	-0.0300*** (0.0105)	-0.0276** (0.0132)
Commercial activities, $t-5$	0.102 (0.159)	-0.0250 (0.132)	0.0182 (0.184)	0.0514 (0.0839)	-0.0435 (0.0944)
Other gen spending, $t-5$	-0.00610 (0.0143)	-0.00593 (0.0139)	-0.0158 (0.0113)	-0.0305** (0.0111)	-0.0273* (0.0137)
Utilities, $t-5$	0.0283 (0.0197)	0.0176 (0.0196)	0.0444 (0.0285)	0.0107 (0.0190)	-0.00305 (0.0181)
Water, $t-5$	-0.0305 (0.0268)	-0.0377 (0.0275)	0.00450 (0.0258)	0.00563 (0.0450)	-0.000253 (0.0445)
Electricity, $t-5$	0.0565*** (0.0200)	0.0418** (0.0188)	0.0601*** (0.0213)	0.0518 (0.0382)	0.0415 (0.0349)
Gas, $t-5$	0.111*** (0.0350)	0.0941** (0.0369)	0.118** (0.0457)	0.0514 (0.0572)	-0.00707 (0.0476)
Transit, $t-5$	-0.102 (0.0649)	-0.0634 (0.0586)	-0.122 (0.105)	-0.226** (0.0823)	-0.269*** (0.0670)

Please find the notes at the end of the table on the next page.

Table 4.7 continued

EXP of interest	Population	Personal income	Housing prices	Unemployment	Dynamic
Liquor store, t_{-5}	-1.390*** (0.402)	-1.203*** (0.405)	-0.878** (0.339)	-2.960* (1.624)	-3.672 (2.147)
Employee retirement, t_{-5}	0.0438 (0.0459)	0.0689 (0.0414)	0.219*** (0.0487)	0.238*** (0.0521)	0.105** (0.0493)
Intergovernmental, t_{-5}	-0.00877 (0.116)	-0.0147 (0.128)	-0.0551 (0.102)	0.118*** (0.0390)	0.0927** (0.0330)
Current operations, t_{-5}	-0.0789*** (0.0171)	-0.0654*** (0.0157)	-0.0525*** (0.0162)	-0.0198 (0.0124)	-0.0234* (0.0129)
Interest on debt, t_{-5}	0.0149 (0.0252)	0.0100 (0.0248)	-0.0194 (0.0279)	-0.106*** (0.0209)	-0.113*** (0.0156)
Insurance, t_{-5}	0.0438 (0.0459)	0.0689 (0.0414)	0.219*** (0.0487)	0.238*** (0.0521)	0.105** (0.0493)
Wages, t_{-5}	-0.0689** (0.0302)	-0.0536* (0.0285)	-0.0347 (0.0292)	0.0212 (0.0143)	0.0115 (0.0149)
Capital outlay, t_{-5}	0.0736*** (0.0254)	0.0572** (0.0237)	0.0570** (0.0225)	0.0222* (0.0124)	0.0291* (0.0148)
Observations	5,035	5,035	3,632	2,288	2,288
Number of groups	144	144	104	104	104

Note: even though the variables are shown below one-another, they are not included in the same estimations; each coefficient for each variable represents a separate estimation. Control variables are not shown, but they include the same as those found in table 4.2. The top signals the control structure as defined in table 4.2. Thus, population includes $L5.(population)$, $L5.\% \text{ aged} > 65$, $L5.\% \text{ aged} > 18 \text{ \& } < 40$, $L5.\% \text{ non-white}$, $L5.ln(\text{total exp})$, $L5.ln(\text{budget balance})$. Personal income adds $L5.ln(\text{personal income p.c.})$. Housing prices adds $L5.ln(\text{housing prices})$. Unemployment adds $L5.unemployment \%$. Finally, Dynamic adds $\Delta \ln(\text{personal income p.c.})$, $\Delta \ln(\text{housing prices})$, and $\Delta \text{unemployment} \%$. All estimations include two-way fixed effects. The Driscoll-Kraay estimator include up to six-lags. Robust standard errors in parentheses (***) $p < 0.01$, (**) $p < 0.05$, (*) $p < 0.1$).

Table 4.8: Estimations for all available capital outlay components

CAP of interest	Population	Personal income	Housing prices	Unemployment	Dynamic
General, $t-5$	0.0670** (0.0281)	0.0511** (0.0245)	0.0452* (0.0232)	0.0187 (0.0166)	0.0281 (0.0181)
Construction, $t-5$	0.0557* (0.0288)	0.0396 (0.0265)	0.0344 (0.0241)	0.00506 (0.0130)	0.00306 (0.0133)
Non-construction, $t-5$	0.0720* (0.0374)	0.0656* (0.0359)	0.0856** (0.0351)	0.0515*** (0.0149)	0.0802*** (0.0169)
Education, $t-5$	0.157** (0.0619)	0.141** (0.0600)	0.115* (0.0664)	0.0203 (0.0398)	0.0416 (0.0507)
Higher education, $t-5$	1.537* (0.806)	1.433* (0.804)	0.909 (0.805)	2.139*** (0.480)	2.233*** (0.453)
Elementary & secondary, $t-5$	0.154** (0.0622)	0.138** (0.0603)	0.113 (0.0674)	0.0152 (0.0392)	0.0362 (0.0499)
Hospitals, $t-5$	-0.0217 (0.0590)	-0.0515 (0.0613)	-0.0749 (0.0476)	-0.0886 (0.107)	-0.123 (0.101)
Highways, $t-5$	0.181*** (0.0402)	0.165*** (0.0384)	0.215*** (0.0473)	0.240*** (0.0517)	0.192*** (0.0500)
Correction, $t-5$	0.134 (0.225)	0.129 (0.212)	-0.0891 (0.122)	-0.173 (0.161)	-0.173 (0.154)
Natural resources, $t-5$	0.138 (0.111)	0.122 (0.106)	0.0216 (0.0848)	-0.0572*** (0.0158)	-0.00494 (0.0264)
Parks & recreation, $t-5$	0.0522 (0.0593)	0.0349 (0.0570)	0.0736 (0.0559)	-0.0660** (0.0297)	-0.0258 (0.0177)
Sewerage, $t-5$	-0.0202 (0.0297)	-0.0308 (0.0279)	-0.0872*** (0.0267)	-0.0914*** (0.0265)	-0.0961*** (0.0285)
Waste mgmt, $t-5$	0.236** (0.0907)	0.231** (0.0913)	0.252*** (0.0622)	0.122 (0.153)	0.0732 (0.145)
Other general, $t-5$	0.0104 (0.0304)	-0.00239 (0.0280)	0.0198 (0.0197)	0.0178** (0.00810)	0.0255** (0.0120)
Utilities, $t-5$	0.0492 (0.0328)	0.0373 (0.0337)	0.0490 (0.0323)	0.0233 (0.0189)	0.0156 (0.0168)
Observations	5,035	5,035	3,632	2,288	2,288
Number of groups	144	144	104	104	104

Note: even though the variables are shown below one-another, they are not included in the same estimations; each coefficient for each variable represents a separate estimation. Control variables are not shown, but they include the same as those found in table 4.2. The top signals the control structure as defined in table 4.2. Thus, population includes $L5.(population)$, $L5.\% \text{ aged} > 65$, $L5.\% \text{ aged} > 18 \text{ \& } < 40$, $L5.\% \text{ non-white}$, $L5.\ln(\text{total exp})$, $L5.\ln(\text{budget surplus})$. Personal income adds $L5.\ln(\text{personal income p.c.})$. Housing prices adds $L5.\ln(\text{housing prices})$. Unemployment adds $L5.\text{unemployment \%}$. Finally, Dynamic adds $\Delta \ln(\text{personal income p.c.})$, $\Delta \ln(\text{housing prices})$, and $\Delta \text{unemployment \%}$. All estimations include two-way fixed effects. The Driscoll-Kraay estimator include up to six-lags. Robust standard errors in parentheses (***) $p < 0.01$, (**) $p < 0.05$, (*) $p < 0.1$.

Table 4.9: Estimations for all available current operations expenditure components

CUR of interest	Population	Personal income	Housing prices	Unemployment	Dynamic
Education, $t-5$	-0.0919** (0.0350)	-0.0739** (0.0293)	-0.0687** (0.0313)	-0.0672*** (0.0210)	-0.0677*** (0.0189)
Higher education, $t-5$	0.128 (0.0859)	0.129 (0.0893)	-0.0683 (0.117)	0.427*** (0.131)	0.411*** (0.116)
Elementary & secondary, $t-5$	-0.0963*** (0.0348)	-0.0784** (0.0291)	-0.0661** (0.0321)	-0.0755*** (0.0228)	-0.0756*** (0.0203)
Hospitals, $t-5$	0.00807 (0.0282)	-0.00319 (0.0233)	0.00409 (0.0180)	-0.00145 (0.0170)	-0.00181 (0.0142)
Highways, $t-5$	-0.187* (0.0980)	-0.172* (0.0904)	-0.300** (0.121)	0.00388 (0.0835)	0.0383 (0.0691)
Correction, $t-5$	0.395* (0.229)	0.441* (0.221)	0.393* (0.224)	-0.0680 (0.159)	-0.0684 (0.168)
Natural resources, $t-5$	1.146*** (0.296)	1.143*** (0.283)	0.904** (0.396)	1.392*** (0.343)	1.656*** (0.398)
Parks & recreation, $t-5$	0.355*** (0.0979)	0.375*** (0.0937)	0.334** (0.140)	0.259*** (0.0817)	0.322*** (0.103)
Sewerage, $t-5$	-0.419*** (0.0844)	-0.371*** (0.0898)	-0.322*** (0.0929)	-0.174** (0.0835)	-0.235*** (0.0761)
Waste mgmt, $t-5$	-0.0232 (0.0665)	-0.0160 (0.0695)	0.0836 (0.0879)	-0.102* (0.0493)	-0.158*** (0.0401)
Utilities, $t-5$	0.0202 (0.0218)	0.00677 (0.0207)	0.0559* (0.0286)	0.0309 (0.0364)	0.0188 (0.0332)
Observations	5,035	5,035	3,632	2,288	2,288
Number of groups	144	144	104	104	104

Note: even though the variables are shown below one-another, they are not included in the same estimations; each coefficient for each variable represents a separate estimation. Control variables are not shown, but they include the same as those found in table 4.2. The top signals the control structure as defined in table 4.2. Thus, population includes $L5.(population)$, $L5.\% \text{ aged} > 65$, $L5.\% \text{ aged} > 18 \text{ \& } < 40$, $L5.\% \text{ non-white}$, $L5.ln(\text{total exp})$, $L5.ln(\text{budget surplus})$. Personal income adds $L5.ln(\text{personal income p.c.})$. Housing prices adds $L5.ln(\text{housing prices})$. Unemployment adds $L5.unemployment \%$. Finally, Dynamic adds $\Delta ln(\text{personal income p.c.})$, $\Delta ln(\text{housing prices})$, and $\Delta unemployment \%$. All estimations include two-way fixed effects. The Driscoll-Kraay estimator include up to six-lags. Robust standard errors in parentheses (***) $p < 0.01$, (**) $p < 0.05$, (*) $p < 0.1$.

Appendix 4.C: Robustness

Table 4.10: Driscoll-Kraay estimator overlapping estimation results

Variables	State clus	2 lags	6 lags	Per cap
Cap. Higher education, t_{-5}	1.752*** (0.599)	1.752*** (0.364)	1.752*** (0.342)	1.792*** (0.348)
Cur. Higher education, t_{-5}	0.121 (0.255)	0.121 (0.113)	0.121 (0.131)	0.127 (0.123)
Cap. Elementary & sec. educ, t_{-5}	0.0215 (0.0604)	0.0215 (0.0370)	0.0215 (0.0354)	0.0250 (0.0375)
Cur. Elementary & sec. educ, t_{-5}	-0.0632* (0.0364)	-0.0632*** (0.0176)	-0.0632*** (0.0206)	-0.0667** (0.0254)
Libraries, t_{-5}	-0.398* (0.211)	-0.398*** (0.129)	-0.398** (0.153)	-0.388** (0.152)
Public welfare, t_{-5}	0.0200 (0.143)	0.0200 (0.0609)	0.0200 (0.0642)	0.0198 (0.0646)
Cap. Hospitals, t_{-5}	-0.126 (0.144)	-0.126 (0.111)	-0.126 (0.115)	-0.116 (0.120)
Cur. Hospitals, t_{-5}	0.0238 (0.0518)	0.0238 (0.0210)	0.0238 (0.0174)	0.0255 (0.0151)
Health, t_{-5}	0.176 (0.136)	0.176* (0.0893)	0.176* (0.0880)	0.155* (0.0886)
Cap Highways, t_{-5}	0.246*** (0.0628)	0.246*** (0.0427)	0.246*** (0.0415)	0.246*** (0.0402)
Cur Highways, t_{-5}	0.0431 (0.183)	0.0431 (0.0756)	0.0431 (0.0840)	0.0248 (0.0744)
Transit, t_{-5}	-0.193 (0.155)	-0.193* (0.0946)	-0.193* (0.108)	-0.206* (0.118)
Airports, t_{-5}	0.0386 (0.0521)	0.0386* (0.0220)	0.0386** (0.0177)	0.0321* (0.0161)
Parking, t_{-5}	0.702*** (0.258)	0.702*** (0.138)	0.702*** (0.106)	0.710*** (0.108)
Sea & ports, t_{-5}	-0.0103 (0.0382)	-0.0103 (0.0948)	-0.0103 (0.0907)	-0.00568 (0.0968)
Police, t_{-5}	-0.0467 (0.147)	-0.0467 (0.0874)	-0.0467 (0.0956)	-0.0588 (0.102)
Fire protection, t_{-5}	-0.165 (0.229)	-0.165** (0.0731)	-0.165** (0.0675)	-0.171** (0.0707)
Cap. Parks & rec, t_{-5}	-0.0861 (0.0836)	-0.0861* (0.0491)	-0.0861** (0.0380)	-0.0753* (0.0391)
Cur. Parks & rec, t_{-5}	0.274* (0.141)	0.274*** (0.0967)	0.274*** (0.0907)	0.276** (0.0981)
Housing & comm. Dev, t_{-5}	0.0540 (0.0533)	0.0540* (0.0276)	0.0540** (0.0191)	0.0513** (0.0188)

Note: Table continues on the next page.

Table 4.10 continued

Variables	State clus	2 lags	6 lags	Per cap
$\ln(\text{total exp})_{t-5}$	-0.325** (0.128)	-0.325*** (0.0709)	-0.325*** (0.0843)	
$\ln(\text{budget balance})_{t-5}$	-0.173** (0.0814)	-0.173** (0.0744)	-0.173** (0.0617)	
$\ln(\text{total exp per capita})_{t-5}$				-0.0465*** (0.0146)
$\ln(\text{budget balance per capita})_{t-5}$				-0.000449 (0.000292)
Driscoll-Kraay lag	N.A	2	6	6
State clustered errors	YES	N.A	N.A	N.A

Note: $\ln(\text{total exp})$ and $\ln(\text{budget balance})$ are normalized through dividing it by total personal income, in line with all estimations of this chapter. The additional $\ln(\text{total exp per capita})$ and $\ln(\text{budget balance per capita})$ are normalized per capita. The results remain similar. All explanatory variables are lagged five years. The control variables are not shown here but they include the same control variables as found in the unemployment estimation of Table 4.2 with lagged: population, % aged > 65, % aged > 18 & < 40, % non-white, % student, $\ln(\text{personal income p.c.})$, $\ln(\text{housing prices})$, and unemployment %. All estimations include two-way fixed effects. Robust standard errors in parentheses (*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$).

Table 4.11: Estimations including lagged population growth

Regression number	Population	Personal income	Housing prices	Unemployment	Dynamic
$\Delta \ln(\text{population})_{t-5}$	0.156** (0.0568)	0.150** (0.0568)	0.163*** (0.0573)	0.0935* (0.0516)	0.109* (0.0533)
$\ln(\text{total exp})_{t-5}$	-0.338** (0.128)	-0.281*** (0.0928)	-0.339*** (0.0974)	-0.316*** (0.0865)	-0.209** (0.0763)
$\ln(\text{budget balance})_{t-5}$	-0.0198 (0.0722)	-0.00547 (0.0689)	-0.129 (0.0816)	-0.168*** (0.0588)	-0.146*** (0.0440)
Cap. Higher education, $t-5$	1.251 (0.749)	1.205 (0.770)	1.413*** (0.456)	1.653*** (0.370)	1.778*** (0.433)
Cur. Higher education, $t-5$	0.00213 (0.103)	0.00943 (0.101)	-0.162 (0.101)	0.0999 (0.124)	0.0739 (0.148)
Cap. Elementary & sec. educ, $t-5$	0.0215 (0.0293)	0.0189 (0.0292)	0.00357 (0.0407)	0.00461 (0.0363)	0.0352 (0.0388)
Cur. Elementary & sec. educ, $t-5$	-0.0829** (0.0341)	-0.0786** (0.0314)	-0.0917*** (0.0318)	-0.0682*** (0.0227)	-0.0611*** (0.0201)
Libraries, $t-5$	0.0357 (0.185)	0.0381 (0.179)	-0.244 (0.144)	-0.440** (0.182)	-0.362*** (0.121)
Public welfare, $t-5$	0.0460 (0.0660)	0.0591 (0.0663)	0.0305 (0.0422)	0.0338 (0.0596)	0.114* (0.0600)
Cap. Hospitals, $t-5$	-0.273** (0.106)	-0.274** (0.106)	-0.265 (0.167)	-0.119 (0.114)	-0.151 (0.103)
Cur. Hospitals, $t-5$	0.00682 (0.0353)	0.00452 (0.0337)	0.0526*** (0.0135)	0.0268 (0.0194)	0.0400*** (0.0131)
Health, $t-5$	-0.000846 (0.0896)	0.00184 (0.0854)	0.0745 (0.0973)	0.181** (0.0869)	0.180* (0.0917)
Cap Highways, $t-5$	0.154*** (0.0346)	0.150*** (0.0333)	0.181*** (0.0538)	0.231*** (0.0393)	0.184*** (0.0439)
Cur Highways, $t-5$	-0.0788 (0.105)	-0.0869 (0.0985)	-0.145 (0.0999)	0.0606 (0.105)	0.0850 (0.0898)
Transit, $t-5$	-0.0960 (0.0578)	-0.0769 (0.0491)	-0.122 (0.0891)	-0.168* (0.0920)	-0.195** (0.0746)
Air transit, $t-5$	0.0503 (0.0518)	0.0404 (0.0459)	0.0806*** (0.0224)	0.0315 (0.0203)	0.00453 (0.0222)
Parking, $t-5$	0.249* (0.124)	0.245* (0.120)	0.467*** (0.106)	0.666*** (0.108)	0.536*** (0.0994)
Sea & ports, $t-5$	-0.0379 (0.0672)	-0.0481 (0.0641)	-0.00834 (0.0665)	-0.0286 (0.0833)	0.00430 (0.0833)
Police, $t-5$	-0.0282 (0.110)	-0.00828 (0.0989)	-0.0616 (0.0665)	-0.0176 (0.0827)	0.0328 (0.100)
Fire protection, $t-5$	-0.0496 (0.0914)	-0.00221 (0.115)	-0.126 (0.0931)	-0.182** (0.0690)	-0.0323 (0.0644)
Cap. Parks & rec, $t-5$	-0.0374 (0.0289)	-0.0396 (0.0290)	0.00402 (0.0508)	-0.0878** (0.0383)	-0.0288 (0.0238)
Cur. Parks & rec, $t-5$	0.327** (0.152)	0.324** (0.151)	0.464*** (0.131)	0.213** (0.102)	0.256** (0.122)
Housing & comm. Dev, $t-5$	-0.00393 (0.0274)	-0.00629 (0.0277)	0.0429 (0.0319)	0.0560*** (0.0195)	0.0740*** (0.0166)

Note: control variables are not shown, but they include the same as those found in table 4.2. The top signals the control structure as defined in table 4.2. Thus, population includes $L5.(\text{population})$, $L5.\% \text{ aged} > 65$, $L5.\% \text{ aged} > 18 \text{ \& } < 40$, $L5.\% \text{ non-white}$, $L5.\ln(\text{total exp})$, $L5.\ln(\text{budget surplus})$. Personal income adds $L5.\ln(\text{personal income})$

*p.c.). Housing prices adds $L5.\ln(\text{housing prices})$. Unemployment adds $L5.\text{unemployment \%}$. Finally, Dynamic adds $\Delta \ln(\text{personal income p.c.})$, $\Delta \ln(\text{housing prices})$, and $\Delta \text{unemployment \%}$. All estimations include two-way fixed effects. The Driscoll-Kraay estimator include up to six-lags. Robust standard errors in parentheses (***) $p < 0.01$, ** $p < 0.05$, * $p < 0.1$).*

CHAPTER 5

LOCAL PUBLIC FISCAL EFFECTS OF FRACKING:

THE CASE OF TEXAS

Abstract

This chapter extensively analyzes the local public fiscal effects of the fracking boom. It does so by analyzing the effects over time, exploring a potential boom-bust structure and fiscal health implications associated with it. Furthermore, it decomposes the effects into the effects for the different types of local governments (county, municipality, special district, and school district). Additionally, the chapter investigates potential spatial interaction effects, where counties are affected by the fracking-boom activities in a neighboring county. The results show that local public revenues and expenditures per capita grow by about the same, with no clear signs of fiscal health issues. Affected counties experience a growth in *property tax* revenues, used for increased spending on *highways, police, parks and recreation, and judicial administration*. Affected school districts also experience an increase in *property tax* revenues, which they use to increase *elementary and secondary education* spending per capita, and, with weaker significance, per student. No clear fiscal effects are found for municipalities and special districts. The effects for counties and school districts are most visible after around five years. Positive spatial effects are found for oil and gas production value on neighboring *sales and gross receipts tax* revenues. Positive spatial effects for new active wells are found for neighboring *health and highways* expenditures. The results are used to discuss the benefits and issues for local communities associated with fracking.

Keywords: Fracking, local public finance, fiscal health, diff-in-diff, Spatial Durbin Model

JEL classification: H7, L71, Q35, R51,

5.1 Introduction

From 2000 onwards, the United States has experienced a “fracking boom”. The fracking boom is the result of a combination of two novel methods: horizontal drilling and hydraulic fracturing (Jackson et al., 2016; Zwick, 2018). The new technology was first used to re-drill older vertical wells to extract remaining oil, but starting in 2009, new well designs were created (Zwick, 2018). While there are economic benefits associated with fracking (Fetzer, 2014; Feyrer, Mansur, & Sacerdote, 2017; Weber, 2014), it is not without controversy as local communities may bear the costs related to environmental risks (Zwick, 2018). These are among the reasons the production and use of shale gas wells is restricted across numerous States in the US (Zwick, 2018).

If the necessary local public expenditures/costs are higher than the increased revenues in the long-run, this poses an issue on how to finance the increased expenditures. There may also be a discrepancy between the increased local public revenues and expenditures, where expenditures are needed beforehand or during the fracking boom whereas the increased revenues may lag months or years behind (Zwick, 2018). A major budget deficit may put local governments in a dilemma between underinvestment or being overleveraged (Zwick, 2018). It is therefore argued by some that local governments bear a disproportionate share of the expenses in relation to the revenue that they receive, posing possible fiscal health issues (Zwick, 2018). However, evidence thus far seems to find fracking to be largely budget neutral, or even positive, with slightly higher positive revenue effects than expenditure effects (Bartik, Currie, Greenstone, & Knittel, 2019; Newell & Raimi, 2015). Although, rural Colorado and Wyoming show some initial fiscal issues in managing the oil and gas booms (Newell & Raimi, 2015).

While Bartik *et al.* (2019) provide an excellent overview of the welfare effects associated with the fracking-boom, we argue that the specific local public fiscal effects deserve a more detailed exploration of their specific effects and what this means to the local communities. We still do not know how the local public fiscal effects developed over time, if there is a sign of a boom-bust structure, to what extent the different types of local governmental entities are affected differently, and how counties are affected by the fracking activities of neighboring counties. Furthermore, we further decompose some of the fiscal components, through which we show that the effects on education are not insignificant, but rather negative for higher education, while being positive for elementary and secondary education. This has major implications for our understanding of the effects of the fracking-boom. Answers to these questions should bring us closer to understanding the effects the fracking-boom have on the local community and whether or not local communities should be welcoming of major fracking activities.

This chapter thus extends our current knowledge on the fiscal effects of fracking in four ways. First, we analyze the development of the fiscal effects of fracking over time, thereby analyzing the development of the local public fiscal effects. Furthermore, we use a longer time period. This allows us to identify the potential end of the fracking boom and possible start of a bust. Secondly, we decompose the fiscal effects into the effects on the four types of local governments: county, municipalities, special districts, and school districts in order to derive which types of local governments have been most affected by the fracking boom¹³. Thirdly, we estimate spatial interaction effects associated with fracking, as we anticipate counties to be affected by the fracking activities of their neighboring counties. Finally, we use more detailed fiscal components to explore potential adverse effects within grouped fiscal components (e.g. education). The first two novel insights are established through a diff-in-diff approach. The third is gained through five-year average differenced estimations with spatial lags, and the final novelty may be found in both types of estimations.

The case of Texas is used, given that it is one of the most affected states and because of the detailed data availability for Texas. The diff-in-diff estimations are guided by existing empirical work of Bartik *et al.* (2019), making use of their Rystad identification. The spatial econometric model uses data on the location and production value of oil and gas wells from the Railroad Commission of Texas (Railroad Commission of Texas, 2019).

This chapter continues with a description of the literature on the effects of fracking, subdivided into the effects on local public revenues, local public expenditures, potential local public fiscal health issues, and local public spatial effects associated with fracking. Next, a description of the data is presented for the diff-in-diff estimations and the spatial estimations. Subsequently, the diff-in-diff estimation strategy is presented followed by the estimation results. After that, the spatial estimation strategy is described, followed by the estimation results. The discussion section brings all the results together in a discussion on the local public fiscal effects associated with fracking. Finally, the conclusion presents a short conclusion to the chapter.

5.2 Effects of fracking

The fracking is the combination of using horizontal drilling with hydraulic fracturing (Jackson *et al.*, 2016; Zwick, 2018). These novel technologies were development through a combination of private investments and US government funded R&D programs in the late 1970s, early 1980s as a response to a gas shortage at the time (Wang & Krupnick, 2015). The new technologies opened up the opportunity of accessing previously unreachable oil and gas minerals¹⁴.

¹³ Note that some states also include townships as a separate type of local governmental entity. Given that Texas does not have townships, this type of governmental entity is not listed in this chapter.

¹⁴ Besides fracturing oil and gas, the new technology also opened up new opportunities sand mining. This is not part of our analysis. However, another paper found that it is associated with lower population growth, positive

The fracking-boom terminology already suggests a boom-bust cycle associated with it. This is substantiated by the structure of the fracking activities. The creation of a well takes between three to six months on average, during which, at peak time, around 900 workers are needed for only a short period of time, resulting in only around 13 full-time employees for a year (Zwick, 2018). Once the well is constructed, a small number of workers can service the wells. Some argue that the boom-bust cycle associated with fracking is harmful for municipal fiscal health (Zwick, 2018). Although, evidence thus far seems to suggest fracking to be largely budget neutral (Bartik et al., 2019).

While fracking has come with a lot of economic benefits (Fetzer, 2014; Weber, 2014), it is also associated with negative externalities, such as decreased livability (Zwick, 2018), water safety issues, wastewater disposal and air quality concerns (Jackson et al., 2016; Zwick, 2018), traffic (Bartik et al., 2019), noise pollution (Bartik et al., 2019; Zwick, 2018), and minor man-made earthquakes (Goho, 2012; Zwick, 2018). Furthermore, fracking locations often struggle with issues of declines in health, depression, family stress, addiction, and crime, including violence towards women (Bartik et al., 2019; Jacquet, 2009; Shandro, Veiga, Shoveller, Scoble, & Koehoorn, 2011; Zwick, 2018). For these reasons, some states have prohibited fracking (Zwick, 2018).

On the other hand fracking increases fracking jobs and also jobs in related and unrelated industries (Christopherson & Rightor, 2014; Fetzer, 2014; Feyrer et al., 2017; Weber, 2012). Each million dollar of new production is estimated to create \$80,000 in wage income and \$132,000 in royalty and business income within a county (Feyrer et al., 2017). The restriction of fracking in some states may therefore impose significant opportunity costs. Bartik *et al.* (2019) estimate the willingness-to-pay for negative externalities of fracking at around \$2,500, although it is heterogenous running from practically \$0 to \$10,000.

Besides various environmental and social issues, and the positive economic effects of fracking, it is also argued to increase local public spending and revenues (Christopherson & Rightor, 2014). However, there is a debate on which is increased more and if this potentially leads to fiscal health issues over the longer term (Zwick, 2018). Below, these arguments are further explored.

5.2.1 Revenues

Property tax is the main source of revenue for local governments, and may increase as a result of increased property value (Weber, Burnett, & Xiarchos, 2016). Although there is also evidence of negative property value effects from fracking due to the risk of groundwater contamination (Boxall, Chan, & McMillan, 2005). Muehlenbachs, Spiller, and Timmins (2016) find small positive house price changes within two kilometers of a well, but a negative

income effects, and no employment growth effects (Deller & Schreiber, 2012).

effect if the house is dependent on well water. Property taxes may also increase due to a reclassification from agricultural land, which often has a low tax rate, to industrial land, which has a higher tax rate (Bamberger & Oswald, 2015). However, county governments may take years to reassess property values thereby creating a lag between drilling activity and reassessment (Zwick, 2018). This means that most value may already be extracted before the property is properly reassessed.

The estimated population growth effect associated with fracking also mean that local public revenues may increase due to an increased tax base (Christopherson & Rightor, 2014; Newell & Raimi, 2015), although this does not have to translate into increased per capita revenues. Fracking may also result in increased sales tax revenues from the fact that landowners receive royalty payments through which they have extra money to spend (Christopherson & Rightor, 2014; Newell & Raimi, 2015). Furthermore, State government may give more aid to local governments to mitigate the negative externalities from fracking (Newell & Raimi, 2015; Zwick, 2018), and local governments may also collect mineral royalties on their lands (Newell & Raimi, 2015; Zwick, 2018) or receive in-kind contributions from gas and oil companies (Newell & Raimi, 2015).

Through extensive interviews with local governmental officials, Newell and Raimi (2015) show that the local public revenue effects of fracking may differ across states. For Texas, they find no severance tax, impact fee, or in-kind-transfers from the oil and gas companies. They do find that affected counties in Texas profit from increased property taxes, and affected municipalities source more sales tax, and fee-for-service or lease revenues. Bartik *et al.* (2019) show that the fracking boom increased property tax revenues, and sales tax revenues.

5.2.2 Expenditures

The increased population resulting from the fracking-boom may mean that local governments are forced to increase their spending on providing services and infrastructure needed to support the increase of population and industry (Newell & Raimi, 2015; Zwick, 2018). Abramzon *et al.* (2014) estimated that each hydraulically-fractured well in Pennsylvania was responsible for damage to local roads between \$13,000 and \$23,000. In order to combat some of these costs, local governments may negotiate Road Use and Maintenance Agreements (RUMAs) with fracking companies in which fracking companies bear some of the costs. Taking into account such RUMAs, Abramzon *et al.* (2014) still find road damage of between \$5,000 - \$10,000 per well.

Local public expenditures are argued to increased due to an increase in need for public services (Christopherson & Rightor, 2014; Newell & Raimi, 2015). Furthermore, there is a need for additional administrative capacity meaning increased staffing levels, buying equipment and hiring outside expertise (Christopherson & Rightor, 2014; Newell & Raimi, 2015; Zwick,

2018). The increase in (especially young male population) is argued to also increase needed spending on public safety (Jacquet, 2009; Zwick, 2018). In line with those arguments is the finding that fracking increases sex ratios due to male in-migration resulting in an increase in the use of prostitution markets and enhanced gonorrhea transmission effects (Cunningham & DeAngelo, 2020).

It is also hypothesized that there are local public judicial administrative costs associated with fracking. The initial reaction of local governments to the fracking boom has sometimes been to ban fracking, perhaps because smaller municipalities lack the administrative capacity to regulate new environmental issues (Hanna, 2005; Miller et al., 2009; Wilson, 2006; Zwick, 2018). But local fracking bans have been struck down by state courts and pre-empted by state legislatures (Zwick, 2018). These procedures also come at administrative and staff costs to local public governments.

It is unclear what the relationship between fracking and education expenditures should be. On the one hand, increased revenues may free up money to invest in education. Furthermore, the influx of workers may mean an influx of children along with them, although this should not necessarily increase education expenditures per capita. On the other hand, the literature on the resource curse shows how there may be a negative relationship. The observation of countries or regions that are rich in natural resources, showing relatively lower economic growth is known as the resource-curse and has been well documented (Weber, 2014). Typically, empirical studies on the resource curse use cross-country studies (Auty, 2001; Sachs & Warner, 2001; Van Der Ploeg, 2011), but there is also growing within-country evidence (A. James & Aadland, 2011; Papyrakis & Gerlagh, 2007). One of the ways in which the resource curse is created, is through a decline in educational attainment (Weber, 2014). The argument here is that resource industries may increase wages of low-skilled workers relatively more than high-skilled workers, thereby decreasing the incentive for the local population to invest in education (Weber, 2014). Thus, as the local population is less incentivized to invest in education, local public education expenditures may simply decline as a result of a decline in demand.

Finally, there may be a temporary element to the increase in revenues related to the fracking-boom. Once the fracking activities decline in intensity or in need of employment, the local public fiscal effects may also decline. For this reason, we would expect the additional funds to be mostly used for investments through capital outlay instead of structural changes in spending through current operations expenditures.

In their interviews, Newell and Raimi (2015) find that affected counties in Texas increased spending on roads and staff, while affected municipalities in Texas increased spending on sewerage and water, and staff. Through a diff-in diff approach, Bartik *et al.* (2019) show that the fracking boom increased expenditures on public safety and infrastructure and utilities. They find no significant effects on welfare and hospitals, and education expenditures.

5.2.3 Spatial effects

The fiscal effects of fracking are likely to not be constrained by county borders. Incoming workers may choose to reside in a neighboring county, or to a nearby metropolitan area with better services, infrastructure and future job opportunities (Zwick, 2018). Surrounding counties may also experience increased business upstream and downstream supply linkages (Zwick, 2018). Negative externalities may be experienced in the form of road damage from through traffic.

The risks of fracking are often localized and long lasting (Brasier et al., 2011; Perry, 2012), whereas the benefits may be more regional in the form of increased investment and jobs (Christopherson & Rightor, 2014). This means that the benefits of fracking may be disproportionately distributed relative to the risks. Given the unevenly distributed fiscal benefits and costs, it is important for local governments to work together to solve the spatial fiscal issues (Zwick, 2018). The fiscal impacts of fracking are likely to be regionally, rather than locally, also affecting nearby cities and counties (Christopherson & Rightor, 2014).

In their response to a paper by Feyrer *et al.* (2017), James and Smith (2020) address the importance of accounting for spatial affects, arguing that “fracking counties” tend to be clustered and receive inward spillovers from neighboring counties. Without controlling for such spatial interactions, the effects of fracking are overestimated (A. G. James & Smith, 2020). This may be either using spatial lags up to a certain distance (Allcott & Keniston, 2018; Richter, Salanguit, & James, 2018), or through the use of contiguous counties (Weber, 2014; Weinstein, Partridge, & Tsvetkova, 2018). Given our fiscally standardized county system, we opt for the latter.

As highlighted in the introduction of this chapter, we set out to analyze roughly two aspects associated with fracking and local public finance. First, we establish a new level of detail in the long-run fracking effects on local public finance through the use of a diff-in-diff structure, with a decomposition into the four different types of governmental entities. Secondly, we explore the spatial effects associated with fracking through a contemporaneous five-year average estimation approach, using a spatial lags.

5.3 Data

The fracking-boom describes the boom in horizontal-hydraulically fractured oil, and gas wells. The fracking-boom is evidenced by the growth in the share of horizontal wells as shown in figure 5.1. Non-horizontal wells show no increase over the period 2000-2018, whereas horizontal wells increase dramatically. This also increased horizontal wells as the share of total wells from around 4% up to over 20% from 2000 till 2018.

Figure 5.1: Hydraulically fractured horizontal wells accounted for most new oil and natural gas wells in Texas

Authors own elaborations using data from the Texas Commission on Environmental Quality (U.S. Energy Information Administration, 2019).

The diff-in-diff estimations uses the Rystad identification as developed by Bartik *et al.* (2019). The identification comes from the Rystad Energy prospectivity index, which “captures the potential productivity of different portions of shale plays based on a nonlinear function of the different geological inputs” (Bartik *et al.*, 2019). Bartik *et al.* (2019) aggregate the Rystad prospectivity index up to the county level and subsequently divide the counties in each shale play into Rystad score quartiles. This identification has the benefit of ensuring exogeneity as it is constructed from the geological features of the area. The identification as used by Bartik *et al.* (2019) may be found in figure 5.2.

Figure 5.2: County Prospectivity Score Classifications as identified by Bartik et al. (2019)

Note: The prospectivity score classification comes from Bartik et al. (2019). The authors of this chapter created this map with the prospectivity score classifications just for Texas for the sake of this chapter.

The spatial lag models use data on the oil and gas production value and number of active oil and gas wells in Texas. While the direct effects of these fracking variables on the fiscal components may not be exogenous, the spatially lagged fracking variables, our variables of interest, are exogenous. We use data on the location of oil and gas wells from the Railroad Commission of Texas (Railroad Commission of Texas, 2019). It includes data on the well distribution per Texas county in February and September for the years 2000-2019. Besides containing information on the total number of oil/gas wells, it also has information on the number of wells that are regular producing wells, inactive wells, and the number of wells (capable of) injecting fluid into a productive formation. The regular producing and injection wells are combined to create the number of active wells. The number of active wells are normalized per capita before entering the estimations.

Data on the oil and gas production also comes from the Railroad Commission of Texas (Railroad Commission of Texas, 2020). Oil production is measured in BBL and gas production is measured in MCF. The production value is measured by multiplying the oil production with the global price of WTI crude (Federal Reserve Bank of St. Louis, 2020),

and multiplying the gas production by the Texas Natural Gas Industrial Price (U.S. Energy Information Administration, 2020). The production value is in one-million USD per capita in real 2015 USD.

Data on the fiscal components comes from the quinquennial Census of Government Finance and the Annual Surveys of State and Local Government Finance, of the US Census Bureau. This has local public fiscal data for independent local governmental entities. Given the complex system of local governmental entities in the US, we fiscally standardize counties in line with the work on Fiscally Standardized Cities Database by the Lincoln Institute of Land Policy (Langley, 2016) and Bartik *et al.* (2019). This means that we collapse all local governmental entities (county, municipality, special districts, and school districts) into one fiscally standardized county. Intergovernmental transfers between local governments are deducted from total revenues, total expenditures and total intergovernmental transfers in order to avoid double counting. The fiscal components are measured in \$1000 per capita.

Any missing data values are interpolated for the individual governmental entities before summing up all values into fiscally standardized counties. Additionally, we explore which types of local governmental entities are most affected by the fracking-boom. We do this by summing up the local public finance data for each specific type of local governmental entity in a given county. Thus, we create total public finance for municipalities, special districts, and school districts in a given county, as well as county government itself.

A selection of fiscal components is made based on our expectations from the literature. For example, instead of including public safety as a group of fiscal components (including the fire department, correction facilities, and inspection and regulation), we only include police expenditures as we expect it to best capture the hypothesized crime and public safety effects. The appendix includes diff-in-diff estimations for all available fiscal components, including those omitted from the chapter (table 5.16 - table 5.20).

The relative importance of the four different types of local government becomes apparent through their share of revenues and expenditures as visualized in figure 5.3 below. School districts make up the largest share of total revenues and expenditures at around 45%. Second, are the municipalities at around 30%, followed by counties at 15% and special districts at around 10%. However, school districts do not source any sales and gross receipts tax revenues. Instead it sources nearly all its revenues through property tax. Property tax revenue makes up the largest share of total local public revenues (not shown here), as does expenditures on education (not shown here), which naturally follows from the relative size of school districts.

Figure 5.3: Share of total Texas fiscal components by type of governmental entity

Source: authors own elaboration using the data from the US Census Bureau. The data represents total 1997-2017 fiscal components for local governments in Texas. The colors represent the following: blue = county, red = municipality, grey = special district, and yellow = school district.

Texas is home to some of the least populous counties in the country, such as Loving County, and King County which only have populations of around 100 and 300 respectively. Similar to Feyrer *et al.* (2017) we exclude the least populated counties because the results are sensitive to the inclusion of these counties. Especially Loving County is found to be an outlier affecting our results¹⁵. However, instead of using the 2% threshold like Feyrer *et al.* (2017), we use a threshold of a population of 1000 (in the year 2000) as to exclude McMullen county which is also found to be an outlier heavily affecting the results. Our threshold means that we exclude 7 out 254 counties, or around 2.75%. Figure 5.4 shows the population per county in 2000, as well as the counties that are excluded from the estimations.

Figure 5.4: Population per county and counties excluded from the estimations

Source: authors own elaboration using population data from the Bureau of Economic Analysis. Left shows the population per county in the year 2000. Right shows the counties that are excluded for having a population of less than 1000.

15 Loving County has a big oil industry, which appears to have been affected by the fracking-boom. Total revenues per capita increased from around 15 thousand real USD per capita in 2000 to around 55 thousand in 2008, which has been slowly declining ever since.

The appendix includes summary statistics on the data used for the diff-in-diff and spatial estimation models (table 5.14 and table 5.15). It also includes information on student enrollment taken from the NCES (National Center for Educational Statistics, 2020), which is used to capture expenditures per student instead of per capita.

5.4 Difference in difference

5.4.1 Estimation strategy

For the longitudinal effects, we follow the estimation strategy as set out by Bartik *et al.* (2019). In their paper, Bartik *et al.* (2019) estimate the welfare effects of fracking, where welfare effects are captured through various economic estimators. The authors use an extensive diff-in-diff approach with annual data. However, in their estimations exploring the fracking effects on local public finance, they use a more limited diff-in-diff approach with only two time periods (2002 - 2012 in the paper and 1997 – 2012 in the appendix). We extend this analysis by using annual data from 1997 – 2017, using the more extended (time-series) diff-in-diff approach used by Bartik *et al.* (2019) for their other welfare measures. The annual data allows us to explore the fracking effects over time. Furthermore, given that data is now available until 2017, it allows us to explore a longer time period, thereby checking for a possible (boom-)bust effect.

The estimations follow the work of Bartik *et al.* (2019). This means that we start with the following equation for outcome fiscal component y , in county c , shale play p , and year t :

$$(5.1) \quad y_{cpt} = \mu_{pt} + \gamma_c + \delta(1[Post - fracking]_{pt} * 1[Rystad\ top\ quartile]_c) + \epsilon_{cpt}$$

The equation includes year-by-play fixed effects (μ_{pt}) and county fixed effects (γ_c). *Post-fracking* equals 1 in the year that fracking initiated and all subsequent years. The *Rystad top quartile* is the identification as used by Bartik *et al.* (2019). It has a value 1 when the maximum prospectively value within county c , is in the top quartile for counties in shale play p .

Given that fracking was initiated at different points in time in the various shale plays, there is a difference in the number of years pre- and post-fracking for the shale plays. This means that a county located in a shale play which initiated fracking in 2000, has 3 years pre-fracking and 17 years post-fracking in our dataset. However, counties where fracking initiated in 2008, show 11 years pre- and 9 years post-fracking. This creates an unbalanced dataset and means that we have a balanced dataset for 3 years pre-fracking, and 9 years post-fracking. An indicator is included for the observations that fall outside this time-frame:

$$(5.2) \quad y_{cpt} = \mu_{pt} + \gamma_c + \delta_1(1[Post - fracking]_{pt} * 1[Rystad \text{ top quartile}]_c) + \delta_2(1[Unbalanced \text{ sample}]_{ct} * 1[Post - fracking]_{pt} * 1[Rystad \text{ top quartile}]_c) + \epsilon_{cpt}$$

As Bartik *et al.* (2019) point out, this estimation has two limitation. First, δ_1 may confound any treatment effect with differential pre-trends in the in the Rystad top-quartile counties. Secondly, the equation assumes fracking to affect only the level of the local public fiscal component, ignoring possible growth rate effects. These limitations are solved in our estimation procedure exploring the fracking-effects over time. Here, we adjust the equation (5.1) by replacing *post-fracking* for *event-year* indicators, where the *event-year* indicators are defined as the calendar year minus the year in which fracking was initiated in the specific shale play:

$$(5.3) \quad y_{cpt} = \mu_{pt} + \gamma_c + \delta_1(Event \text{ year}_{pt} * 1[Rystad \text{ top quartile}]_c) + \epsilon_{cpt}$$

This also means that the indicator for the unbalanced data is no longer needed, as long as we only look at the balanced event years (minus 3 - 9). We set year zero, when fracking is initiated, as the control group, from where the pre- and post-fracking effects are estimated.

5.4.2 Diff-in-diff results

First, the standard diff-in-diff estimation is performed (equation 5.2), in order to explore general diff-in-diff effects for the local public fiscal components. Three control strategies are used. The results are summarized in table 5.1 below.

We find the diff-in-diff results for *total revenues* and *expenditures* to both be positive and significant, with total revenues being slightly higher, although not significantly different from total expenditures. *Outstanding debt* is insignificant and *cash holdings* significantly increase. Thus, we find no clear indication of any fiscal health issues associated with fracking. If anything, fracking seems to increase *total revenues* slightly more than *total expenditures*, with the additional sourced revenues potentially being invested/stored into *cash holdings*.

The decomposition of the expenditures by character shows that all types of expenditures increase. We find that *capital outlay* significantly increases whereas *current operations* expenditures turns insignificant once the play-year fixed effects are introduced. This is in line with our expectations that the additional revenues are especially used to increase investments instead of structural changes in the *current operations* expenditures. The appendix also includes a decomposition of the *capital outlay* effects, showing no clear significance across the components (table 5.19). This suggests that there is a heterogeneity in the type of capital outlay that the additional funds are used for. Results furthermore show that *interest on general debt* and *salaries and wages* only show weak significance.

Table 5.1: Diff-in-diff estimation results

Variable	2.1		2.2		2.3	
	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.
<i>Fiscal health components</i>						
Total revenues	1.677***	(0.426)	1.690***	(0.420)	1.252***	(0.364)
Total expenditures	1.532***	(0.413)	1.542***	(0.407)	1.093***	(0.367)
Budget balance	0.130	(0.0912)	0.148	(0.107)	0.159	(0.119)
Outstanding debt	0.366	(0.386)	0.407	(0.386)	0.572	(0.374)
Cash holdings	0.657	(0.435)	0.722*	(0.431)	0.800**	(0.353)
<i>Expenditures by character</i>						
Current operations	0.604*	(0.312)	0.593*	(0.306)	0.351	(0.232)
Capital outlay	0.351***	(0.0941)	0.382***	(0.0990)	0.290***	(0.0962)
Interest on general debt	0.0233	(0.0144)	0.0256*	(0.0144)	0.0324*	(0.0166)
Salaries/wages	0.161	(0.107)	0.141	(0.0992)	0.155*	(0.0856)
<i>Revenue components</i>						
Intergovernmental	-0.0291	(0.100)	-0.0254	(0.104)	-0.00424	(0.101)
Property tax	1.488***	(0.371)	1.499***	(0.367)	1.138***	(0.375)
Sales and gross receipts	0.0361*	(0.0211)	0.0469**	(0.0217)	0.0319	(0.0217)
Utilities	-0.0313	(0.0225)	-0.0293	(0.0219)	-0.0343	(0.0313)
<i>Expenditures by function</i>						
Higher education	-0.0397***	(0.0121)	-0.0394***	(0.0118)	-0.0563**	(0.0268)
Elem. & sec. education	0.634***	(0.191)	0.633***	(0.185)	0.401**	(0.198)
'' per student	2.951***	(0.875)	2.962***	(0.847)	1.724*	(0.921)
Public welfare	-0.00359	(0.0188)	-0.00194	(0.0187)	-0.0117	(0.0270)
Hospitals	0.0378	(0.118)	0.0294	(0.117)	-0.0743	(0.118)
Health	-0.000735	(0.00990)	0.000325	(0.0100)	-0.00504	(0.0118)
Highways	0.0519*	(0.0287)	0.0538*	(0.0294)	0.0491	(0.0320)
Police	0.0150	(0.0168)	0.0146	(0.0173)	0.0338**	(0.0149)
Natural resources	0.00605	(0.00748)	0.00539	(0.00772)	0.00260	(0.00943)
Parks & recreation	0.0194*	(0.0114)	0.0191*	(0.0113)	0.0187*	(0.0105)
Housing & comm. dev.	0.000757	(0.0108)	-0.000473	(0.0115)	-0.00111	(0.0131)
Financial administration	0.0123	(0.0117)	0.0105	(0.0123)	0.0178	(0.0130)
Judicial administration	0.0487***	(0.0173)	0.0489***	(0.0172)	0.0494***	(0.0157)
Utilities	-0.0476	(0.0323)	-0.0377	(0.0327)	-0.0541	(0.0465)
Time FE	Yes		Yes		No	
County FE	No		Yes		Yes	
Play-year FE	No		No		Yes	

Note: robust standard errors in parentheses: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. All three estimations use equation 5.2. The errors are clustered at the county level. Even though the coefficients are shown below one another, they represent separate estimations. "Per student" represents expenditures on elementary and secondary education per student instead of per capita.

The decomposition of the revenue sources shows that the significant increase in revenues is mainly due to a significant increase in *property tax*. We also find an indication of an increase in *sales and gross receipts tax*, although its significant disappears as play-year fixed effects are introduced. *Intergovernmental revenues* and *utility revenues*, show no significant effects.

Finally, the decomposition of expenditures by function shows increases in expenditures on *elementary and secondary education*, *police*, *judicial administration*, and a minor increase in *parks and recreation* expenditures. The results for *elementary and secondary education* expenditures are shown in per capita, as well as per student. We find that the increase per student is higher but less significant. Furthermore, we find a negative effect for expenditures on *higher education*. Expenditures on *highways* show a weak positive effect, which disappears once play-year fixed effects are introduced. Other expenditure components show no significant effects: *Hospitals*, *public welfare*, *health*, *natural resources*, *housing and community development*, *financial administration*, and *utilities*.

The same estimations are performed for the four different types of local governmental entities separately. These results are shown in table 5.2 below. The results show that most of the overall diff-in-diff significance comes from counties and school districts. Both show increases in *total expenditures* and *total revenues*, with school districts also showing increases in *outstanding debt* and *cash holdings*. When looking at expenditures by character, we find significant diff-in-diff effects for all expenditures in counties, except for *interest on general debt*. School districts show no significant effects for *current operations* and *wages and salaries*. The significant *property tax* diff-in-diff effects are also found in counties and school districts. Additionally, there are some weak differences in *intergovernmental transfers*, suggesting that counties receive more *intergovernmental transfers* at the cost of other local governmental entities. Finally, the expenditures by function decomposition shows that the significant education effects are found in the school districts. The remaining significant effects mostly come from the counties in the form of higher expenditures on *highways*, *police*, *parks and recreation*, and *judicial administration*. Municipalities also show a weak positive effect for *judicial administration*. Negative health effects are found in the *special districts*.

Table 5.2: Diff-in-diff estimation results per type of local governmental entity

Variable	County		City		Special district		School district	
	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.
<i>Fiscal health</i>								
Total revenues	0.551***	(0.186)	-0.00693	(0.0499)	-0.0289	(0.123)	0.748**	(0.338)
Total expenditures	0.450***	(0.171)	-0.0124	(0.0501)	-0.113	(0.126)	0.780**	(0.338)
Budget balance	0.102	(0.0627)	0.00543	(0.0207)	0.0845	(0.0611)	-0.0313	(0.0438)
Outstanding debt	0.0730	(0.0997)	-0.115	(0.122)	-0.0821	(0.196)	0.700**	(0.293)
Cash holdings	0.161	(0.107)	-0.119	(0.0995)	-0.0742	(0.134)	0.838***	(0.281)
<i>Expenditures</i>								
Current operations	0.317**	(0.139)	-0.0135	(0.0364)	-0.0827	(0.114)	0.139	(0.157)
Capital outlay	0.0992*	(0.0506)	-0.00300	(0.0178)	-0.0205	(0.0279)	0.216***	(0.0758)
Interest on gen. debt	0.00731	(0.00666)	0.000384	(0.00686)	0.00246	(0.0106)	0.0226**	(0.0110)
Salaries/wages	0.145***	(0.0534)	0.00236	(0.0205)	-0.0378	(0.0528)	0.0477	(0.0309)
<i>Revenue</i>								
Intergovernmental	0.169**	(0.0849)	-0.0334**	(0.0157)	-0.0389*	(0.0217)	-0.102	(0.0638)
Property tax	0.257***	(0.0917)	0.0124	(0.00941)	0.0227	(0.0331)	0.848**	(0.348)
Sales & receipts	0.0174	(0.0146)	0.0195	(0.0141)	-0.000543	(0.00272)	0	(0)
Utilities	0.000888	(0.00112)	-0.0267	(0.0231)	-0.00600	(0.0228)	0	(0)
<i>Expenditures by function</i>								
Higher education	-9.43e-08	(1.01e-07)	0	(0)	0	(0)	-0.0563**	(0.0268)
Elem. & sec. educ	0.000799	(0.00203)	1.23e-05	(2.83e-05)	0	(0)	0.401**	(0.199)
<i>'' per student</i>								
Public welfare	-0.00292	(0.0256)	0.000330	(0.000384)	-0.00914	(0.00915)	0	(0)
Hospitals	-0.0310	(0.0531)	-0.00106	(0.00140)	-0.0423	(0.118)	0	(0)
Health	0.00865	(0.00789)	0.00297	(0.00456)	-0.0162**	(0.00817)	0	(0)
Highways	0.0616**	(0.0306)	-0.000779	(0.00892)	-0.0111	(0.00911)	0	(0)
Police	0.0287**	(0.0134)	0.00662	(0.00759)	-4.54e-07	(4.60e-07)	0	(0)
Natural resources	0.00336	(0.00366)	-7.81e-05	(0.000220)	-0.000699	(0.00974)	0	(0)
Parks & recreation	0.0228**	(0.00914)	-0.00384	(0.00414)	-3.43e-05	(0.000125)	0	(0)
Housing & comm. dev.	-0.00175	(0.0108)	0.00136	(0.00213)	-0.000635	(0.00907)	0	(0)
Financial adm	0.0196	(0.0128)	-0.00199	(0.00485)	0	(0)	0	(0)
Judicial adm	0.0403**	(0.0157)	0.00982*	(0.00569)	0	(0)	0	(0)
Utilities	0.00109	(0.00238)	-0.0177	(0.0237)	-0.0353	(0.0375)	0	(0)

Note: robust standard errors in parentheses: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. All estimations use equation 5.2. Even though the coefficients are shown below one another, they represent separate estimations. The errors are clustered at the county level. All estimations include county fixed effects and play-year fixed effects. "Per student" represents expenditures on elementary and secondary education per student instead of per capita.

5.4.3 Results over time

The effects are explored over time through the use of an event-study type of analysis, estimated using equation 5.3. The results for the fiscal health components are shown in table 5.3. The results show that *total revenues* and *total expenditures* are higher and increasing. However, the standard error and the negatively associated significance also quickly goes up after around five years, resulting in increasingly less significant results from around five years onwards. *Outstanding debt* and *cash holdings* are only briefly and weakly significantly different at around three years.

Table 5.3: Diff-in-diff estimation results over time for the fiscal health components

Year	Total revenues	Total expenditures	Budget balance	Outstanding debt	Cash holdings
-3	-0.170 (0.123)	-0.0851 (0.127)	-0.0852 (0.0587)	0.256 (0.297)	0.154 (0.233)
-2	-0.166* (0.0867)	-0.0768 (0.0996)	-0.0889 (0.0740)	0.0968 (0.200)	0.0225 (0.169)
-1	-0.148** (0.0731)	-0.0618 (0.0622)	-0.0858 (0.0743)	-0.0264 (0.0750)	-0.0848 (0.132)
0 = Reference					
1	0.113 (0.108)	0.186 (0.125)	-0.0721 (0.0826)	0.115 (0.164)	0.153 (0.148)
2	0.300* (0.179)	0.347* (0.204)	-0.0463 (0.108)	0.631 (0.399)	1.369* (0.720)
3	0.398** (0.182)	0.494** (0.245)	-0.0960 (0.134)	0.722** (0.360)	0.718* (0.393)
4	0.446* (0.254)	0.723* (0.384)	-0.277 (0.209)	0.685 (0.498)	0.438 (0.395)
5	0.719*** (0.272)	0.915*** (0.318)	-0.196 (0.201)	0.655 (0.504)	0.215 (0.321)
6	1.319*** (0.403)	1.114*** (0.364)	0.205 (0.147)	0.970 (0.589)	0.715 (0.580)
7	1.797*** (0.542)	1.404** (0.613)	0.393 (0.294)	0.949 (0.668)	0.998 (0.634)
8	1.737*** (0.622)	1.584** (0.718)	0.153 (0.351)	0.539 (0.656)	0.373 (0.512)
9	1.501** (0.588)	1.477** (0.626)	0.0242 (0.276)	0.903 (0.664)	0.756 (0.634)
Constant	3.965*** (0.101)	4.062*** (0.116)	-0.0977* (0.0573)	3.124*** (0.249)	2.723*** (0.241)
Observations	5,187	5,187	5,187	5,187	5,187
R-squared	0.617	0.609	0.067	0.207	0.138
# Counties	247	247	247	247	247

Note: robust standard errors in parentheses: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Even though the coefficients are shown below one another, they represent separate estimations. The errors are clustered at the county level. All estimations include county fixed effects and play-year fixed effects.

The results for expenditures by character are included in table 5.4. The results show no significant increases in *current operations*. *Capital outlay* is most significant and positive after around five years. *Interest on general debt* turns most significant one or two years later. *Salaries and wages* are mostly insignificant.

Table 5.4: Diff-in-diff estimation results over time for expenditures by character

Year	Current operations	Capital outlay	Interest on general debt	Salaries/wages
-3	-0.134 (0.108)	0.0472 (0.0478)	0.00360 (0.0105)	-0.119** (0.0461)
-2	-0.103 (0.0788)	0.0249 (0.0498)	-0.00151 (0.00811)	-0.0874** (0.0341)
-1	-0.0702 (0.0574)	0.00633 (0.0293)	-0.00316 (0.00537)	-0.0546** (0.0263)
0 = Reference				
1	0.0970 (0.0904)	0.0950 (0.0780)	-0.000433 (0.00425)	0.0171 (0.0214)
2	0.166 (0.151)	0.183* (0.101)	0.0145 (0.0107)	0.0206 (0.0392)
3	0.228 (0.150)	0.280** (0.136)	0.0304 (0.0196)	0.0311 (0.0462)
4	0.180 (0.209)	0.538** (0.230)	0.0318 (0.0248)	0.0119 (0.0532)
5	0.272 (0.223)	0.629*** (0.200)	0.0490* (0.0254)	0.0512 (0.0528)
6	0.343 (0.246)	0.316** (0.138)	0.0522** (0.0236)	0.103* (0.0590)
7	0.133 (0.352)	0.306 (0.197)	0.0636** (0.0298)	-0.00386 (0.118)
8	0.144 (0.268)	0.376 (0.276)	0.0509* (0.0287)	-0.0365 (0.117)
9	0.196 (0.233)	0.477** (0.188)	0.0499* (0.0257)	0.00518 (0.0666)
Constant	3.107*** (0.0708)	0.500*** (0.0513)	0.127*** (0.00992)	1.490*** (0.0351)
Observations	5,187	5,187	5,187	5,187
R-squared	0.601	0.226	0.151	0.230
# Counties	247	247	247	247

Note: robust standard errors in parentheses: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Even though the coefficients are shown below one another, they represent separate estimations. The errors are clustered at the county level. All estimations include county fixed effects and play-year fixed effects.

The revenue component results are shown in table 5.5. *Intergovernmental revenues* are negative between 5-7 years, suggesting that the increased own-sourced revenues mean that the local governments receive less *intergovernmental revenues*. *Property tax* is significantly higher at around 5-8 years, after which it slowly comes back down. *Sales and gross receipts* show no real significance over time. Revenues sourced through *utilities* are weakly significant and lower after some years.

Table 5.5: Diff-in-diff estimation results over time for the revenue components

Year	Intergovernmental	Property tax	Sales & receipts	Utilities
-3	0.0175 (0.0343)	-0.101 (0.0729)	-0.0107 (0.00686)	0.000259 (0.0122)
-2	0.000994 (0.0269)	-0.107* (0.0598)	-0.00482 (0.00510)	-0.00217 (0.00985)
-1	0.000679 (0.0192)	-0.105* (0.0594)	-0.00161 (0.00356)	-0.00437 (0.00893)
0 = Reference				
1	-0.0260 (0.0362)	0.0860 (0.0858)	0.00152 (0.00346)	-0.000772 (0.00446)
2	-0.0571 (0.0382)	0.192 (0.151)	0.000827 (0.00690)	-0.00607 (0.00916)
3	0.0287 (0.0599)	0.222* (0.127)	0.00582 (0.0107)	-0.00439 (0.00845)
4	-0.0586 (0.0765)	0.355 (0.222)	0.0120 (0.0138)	-0.0188* (0.0113)
5	-0.166* (0.0883)	0.702*** (0.256)	0.0191 (0.0157)	-0.0328 (0.0218)
6	-0.265** (0.106)	1.380*** (0.442)	0.0259 (0.0187)	-0.0433* (0.0249)
7	-0.242** (0.118)	1.830*** (0.591)	0.0285 (0.0221)	-0.0491* (0.0260)
8	0.0814 (0.250)	1.728*** (0.665)	0.0327 (0.0238)	-0.0560** (0.0268)
9	0.156 (0.254)	1.455** (0.575)	0.0432* (0.0258)	-0.0879** (0.0400)
Constant	1.044*** (0.0270)	1.571*** (0.0729)	0.154*** (0.00564)	0.288*** (0.0222)
Observations	5,187	5,187	5,187	5,187
R-squared	0.508	0.457	0.063	0.184
# Counties	247	247	247	247

Note: robust standard errors in parentheses: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Even though the coefficients are shown below one another, they represent separate estimations. The errors are clustered at the county level. All estimations include county fixed effects and play-year fixed effects.

Finally, the expenditures by function show where the increased expenditures are going. These are shown in table 5.6 below. We find that the negative effect for *higher education* loses its significance, likely due to the low number of counties with *higher education* expenditures, and thus low number of observations for each year (see summary statistics in the appendix, table 5.14 and table 5.15). *Elementary and secondary education* is mostly positive and weakly significant, with most significance at around 5 years. Expenditures on *highways* are higher after around 7 years. Expenditures on *police* are higher after around 5 years, and remain apparently stable at a higher rate after that. Expenditures on *parks and recreation* only show a weak increase after around 3-5 years. Finally, we find higher *judicial administration* expenditures, still visibly significant after 9 years.

Table 5.6: Diff-in-diff estimation results over time for the expenditures by function

Year	Higher education	Elem & sec education	Highways	Police	Parks & recreation	Judicial administration
-3	0.00819 (0.00922)	0.0752 (0.0665)	-0.00905 (0.00891)	-0.00990 (0.00730)	-0.0118 (0.00882)	-0.0162* (0.00830)
-2	0.00324 (0.00771)	0.0623 (0.0555)	-0.00771 (0.00616)	-0.00757 (0.00511)	-0.0117 (0.00783)	-0.0116** (0.00584)
-1	0.00834* (0.00445)	0.0128 (0.0355)	-0.000620 (0.00496)	-0.00161 (0.00264)	-0.00591 (0.00390)	-0.00566* (0.00310)
0 = Reference						
1	-0.00562 (0.00522)	0.172* (0.103)	0.00674 (0.00441)	0.00594 (0.00370)	0.00638 (0.00446)	0.00682* (0.00347)
2	-0.00987 (0.00791)	0.283* (0.171)	0.00912 (0.00705)	0.00833 (0.00689)	0.0116 (0.00846)	0.0131* (0.00724)
3	-0.0254* (0.0153)	0.403* (0.207)	0.0143 (0.00993)	0.0131* (0.00773)	0.0103* (0.00625)	0.0162* (0.00912)
4	-0.0156 (0.0158)	0.612* (0.359)	0.0142 (0.0187)	0.0175* (0.00948)	0.00946* (0.00493)	0.0261** (0.0110)
5	-0.0277 (0.0176)	0.713** (0.304)	0.0271 (0.0216)	0.0255** (0.0110)	0.0132* (0.00764)	0.0334*** (0.0121)
6	-0.0356 (0.0220)	0.454* (0.269)	0.0434* (0.0258)	0.0312** (0.0134)	0.00814 (0.00898)	0.0365** (0.0149)
7	-0.0370 (0.0260)	0.509* (0.289)	0.0755** (0.0369)	0.0402** (0.0161)	-0.00223 (0.0143)	0.0496*** (0.0174)
8	-0.0366 (0.0280)	0.528* (0.277)	0.0678 (0.0565)	0.0393** (0.0158)	0.00424 (0.0128)	0.0484*** (0.0159)
9	-0.0373 (0.0341)	0.514** (0.232)	0.0626 (0.0775)	0.0413** (0.0178)	0.00675 (0.0132)	0.0491*** (0.0170)
Constant	0.0848*** (0.0112)	1.722*** (0.0478)	0.172*** (0.0179)	0.139*** (0.00541)	0.0350*** (0.00192)	0.0735*** (0.00272)
Observations	5,187	5,187	5,187	5,187	5,187	5,187
R-squared	0.088	0.456	0.231	0.240	0.239	0.567
# Counties	247	247	247	247	247	247

Note: robust standard errors in parentheses: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Even though the coefficients are shown below one another, they represent separate estimations. The errors are clustered at the county level. All estimations include county fixed effects and play-year fixed effects.

5.4.4 Results across shale plays

In order to investigate which shale plays are driving the positive diff-in-diff results, we estimate the effects for each play separately. By analyzing the effects over time, we are also able to distinguish between calendar years and years since fracking initiated. Figure 5.5 below shows the map of the five shale plays, with the top quartile Rystad counties. The figure shows that Granite Wash does not have a top quartile Rystad county, while Haynesville only has one.

Figure 5.5: Shale plays and Top Quartile counties

Note: the prospectivity score and shale play classification comes from Bartik et al.(2019). The author of this chapter created this map with the prospectivity score and shale play classifications just for Texas for the sake of this chapter.

We use estimation (3) as described in the estimation strategy, but a dummy for each shale play:

$$(5.4) \quad y_{cpt} = \mu_{pt} + \gamma_c + \delta_1(\text{Shale play}_p * \text{Event year}_{pt} * \mathbf{1}[\text{Rystad top quartile}]_c) + \epsilon_{cpt}$$

Where *Shale play_p* are indicators for the type of shale play. The results are plotted in figure 5.6 and figure 5.7. We find no diff-in-diff effects for Barnett and Haynesville, neither in terms of revenues nor expenditures. The Permian play initiated fracking in 2005, which is shown to result in increased revenues and expenditures. However, the expenditures go down in 2009 whereas the revenues still slowly increase. From 2013 onwards, total revenues and expenditures show a major increase again. This falls around the same time when Eagle Ford shows a massive increase in total revenues and expenditures. After showing no fiscal effects for around 4 years after fracking was initiated, there is a major increase. It appears that the financial crisis period from around 2008-2012 has postponed some of the fracking effects. Another interesting thing to note is that the Eagle Ford shows a larger increase in total expenditures than revenues, whereas our overall results as well as the Permian result shows a bigger increase in total revenues.

Figure 5.6: The total revenues diff-in-diff effect per shale play

Note: the figure shows the total revenues diff-in-diff coefficient results for each shale play separately using equation 5.4. The year in which a line starts is the year in which fracking was initiated in that specific shale play. Note, confidence intervals are not plotted as to not clutter the figure.

Figure 5.7: The total expenditures diff-in-diff effect per shale play

Note: the figure shows the total expenditures diff-in-diff coefficient results for each shale play separately using equation 5.4. The year in which a line starts is the year in which fracking was initiated in that specific shale play. Note, confidence intervals are not plotted as to not clutter the figure.

5.5 Spatial interactions

As explained in the theoretical section (5.2.3), one may also expect spatial interaction effects associated with the fracking boom. In this section we explore such spatial interactions.

5.5.1 Estimation strategy

The results in our diff-in-diff estimations show that the fracking effects generally turn most significant at around 5 years, after which the standard errors increase and the result turns less significant. In order to accommodate this lagged effect, we use five-year time periods for our spatial estimations. This has the additional positive effect of mostly using the more detailed quinquennial Census of Government Finance, fiscal data which is published every five years. The detailed fiscal data are available every five years, starting in 1977. Given the detailed oil and gas data is available from 2000 onwards (more on this below), we therefore use fiscal data for the years 2002, 2007, 2012, and 2017.

Fracking intensity is captured through two measures: the number of active wells, and the production value. While these are related, they may capture differences in terms of public revenues and expenditures. For example, the creation of a new well is argued to be associated with short employment booms and possible public investments, whereas the production value may be more reflected in public revenues through increased tax revenues such as property tax revenues. Separate estimations are performed for these two fracking variables, as well as a combined estimation.

We perform the estimations in first difference to tease out any fixed effects. All variables capture the five-year average annual difference in the fiscal component or fracking variable respectively. This first results in the following equation:

$$(5.5) \quad \Delta y_{cpt} = \beta_1 \Delta production_{ct} + \beta_2 \Delta wells_{ct} + \omega_{pt} + \epsilon_{cpt}.$$

Where, $\Delta y_{c,t}$ represents the fiscal component in county c at time t , $\Delta production_{c,t}$ represents the production value in one-million USD per capita in real 2015 USD, $\beta_2 \Delta wells_{ct}$ captures the number of active wells per capita, and ω_{pt} captures the play-year fixed effects. The fiscal components are measured in \$1000 per capita. Thus, the ratio between production value and the fiscal components is 1000:1.

Given the likelihood of spatial spillovers relating to the dependent variables (fiscal competition (Blöchliger & Pinero, 2011)) as well as the explanatory variables (e.g. influx of workers due to fracking activities in a neighboring county), there is a clear argument for spatial spillover effects. Spatial econometric estimations are performed to estimate and control for these spatial spillover effects. Spatial Autoregressive Model (SAR) and Spatial Durbin Model (SDM) estimations are performed, where the SAR includes spatial lags of the dependent variable and the SDM additionally includes spatial lags for the explanatory

variables. The SDM estimation formula therefore takes the following shape:

$$(5.6) \quad \Delta y_{c,t} = \rho W \Delta y_{i,t} + \beta_1 \Delta production_{c,t} + \beta_2 W \Delta production_{c,t} + \beta_3 \Delta wells_{c,t} + \beta_4 W \Delta wells_{c,t} + \omega_t + \epsilon_{c,t}$$

Where, $\rho W \Delta y_{i,t}$ captures the spatial interaction in the dependent variable (fiscal competition), and $\beta_1 W \Delta fracking_{c,t}$ captures the spatial effect of the fracking variable. The SAR estimation only includes the spatial interaction in the dependent variable, whereas the SDM estimation includes both.

5.5.2 Results

First, we explore the direct and spatial effects of total revenues and expenditures to get an idea of the total fiscal effects. The results are shown in table 5.7 below. Four estimations are performed for both fiscal components: an OLS, SAR, and two SDM models, where the second model includes play-year fixed effects, instead of simply time fixed effects. The results show positive direct effects for the production value as well as the number of active wells. We find that the positive production value is higher for total revenues, than total expenditures, whereas the number of active wells is higher for total expenditures than for total revenues. Given that production naturally follows the creation of the wells, this result suggests that the creation of the wells is associated with a bigger increase in expenditures than revenues, which is subsequently offset once the wells go into production, which have a larger positive impact on total revenues. We do not find any spatial effects from our production value or number of active wells. However, we do find a positive spatial effect for the dependent variable shown by the positive rho, suggestive of fiscal competition. However, this positive effect disappears when play-year fixed effects are included. The inclusion of the play-year fixed effects naturally captures a similar spatial effect, which makes it likely for the spatial effects to disappear or decline.

For the sake of conciseness, the remainder of this section only shows and discusses those fiscal components which show significant spatial effects for the production value or number of active wells¹⁶. While the direct effects are also interesting, these follow similar patterns as found in the diff-in-diff estimation. Furthermore, they may not be considered fully exogenous. Similarly, the spatial lag of the dependent variable is interesting from a fiscal competition point of view, but this is not the focus of our analysis. However, the appendix includes an overview of the SDM estimation results, both year fixed effects and play-year fixed effects (table 5.21 - table 5.24). Furthermore, the discussion section subsequently also takes into consideration some of the direct effects estimation results, as well as any insignificant spatial effects.

Table 5.7: Total revenues and total expenditures

Variables	Total revenues				Total expenditures			
	OLS	SAR	SDM	SDM	OLS	SAR	SDM	SDM
Δ Prod. value	7.380*** (1.289)	7.154*** (1.348)	7.032*** (1.410)	7.225*** (1.356)	5.472*** (2.067)	5.109** (2.085)	4.515** (1.916)	4.814** (2.014)
$W*\Delta$ Prod. value			1.087 (2.308)	1.956 (2.625)			5.183 (5.636)	5.258 (6.032)
Δ Wells	3.406*** (1.007)	3.350*** (0.977)	3.358*** (0.993)	3.095*** (0.894)	4.850*** (1.401)	4.820*** (1.322)	4.842*** (1.424)	4.580*** (1.222)
$W*\Delta$ Wells			-0.623 (2.488)	-1.483 (2.648)			-2.881 (4.365)	-2.931 (4.534)
Rho		0.0968** (0.0474)	0.0932** (0.0472)	0.00646 (0.0498)		0.125** (0.0522)	0.111** (0.0539)	-0.0126 (0.0637)
Constant	0.249*** (0.0123)			0.227*** (0.0174)	0.226*** (0.0140)			0.201*** (0.0191)
Year FE	Yes	Yes	Yes	No	Yes	Yes	Yes	No
Play-year FE	No	No	No	Yes	No	No	No	Yes
Observations	741	741	741	741	741	741	741	741
R-squared		0.252	0.253	0.312		0.174	0.183	0.234
# counties	247	247	247	247	247	247	247	247

Note: robust standard errors in parentheses: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. The errors are clustered at the county level. The W -matrix is a row-normalized queen contiguity matrix.

Our fiscal components grouped as “fiscal health”, do not show any significant spatial production value or active wells coefficients. The expenditures by character do show a significant spatial effect for *interest on general debt*. The results are shown in table 5.8. We find that the creation of new active wells is associated with a weak increase in *interest on general debt*, which disappears as rho is included. However, this positive effect is stronger and remaining significant for the creation of new active wells in neighboring counties. This suggest that the counties may also need to make investments when their neighboring counties are creating new active wells. We also find a minor suggestion that the debt is decreasing as these new active wells start to produce, evidenced by the weakly significant negative effect for the spatially lagged production value.

From the four revenue components, we only find significant spatial effects for the *sales and gross receipts tax* revenues. In line with what one may expect, these spatial effects are significant in the form of positive spatial production value effects (table 5.9). Thus, as a neighboring county increases its production value, the population from the neighboring county is likely to spend some of that increased income in your county, thereby increasing the sales and gross receipts tax. Interestingly, no significant direct effects are found.

Table 5.8: Interest on general debt

Variables	OLS	SAR	SDM	SDM
Δ Prod. value	0.140 (0.140)	0.141 (0.140)	0.112 (0.145)	0.107 (0.141)
$W*\Delta$ Prod. value			-0.352* (0.196)	-0.335 (0.230)
Δ Wells	0.122* (0.0643)	0.117* (0.0642)	0.0789* (0.0437)	0.0724 (0.0481)
$W*\Delta$ Wells			0.672*** (0.240)	0.598** (0.258)
Rho		0.0269 (0.0294)	-0.00265 (0.0220)	-0.0410* (0.0219)
Constant	0.00775*** (0.00291)			0.00995* (0.00532)
Year FE	Yes	Yes	Yes	No
Play-year FE	No	No	No	Yes
Observations	741	741	741	741
R-squared		0.009	0.024	0.043
# counties	247	247	247	247

Note: robust standard errors in parentheses: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. The errors are clustered at the county level. The W -matrix is a row-normalized queen contiguity matrix.

Table 5.9: Sales and gross receipts tax

Variables	OLS	SAR	SDM	SDM
Δ Prod. value	0.0135 (0.0830)	0.0124 (0.0832)	-0.0436 (0.0715)	-0.0353 (0.0696)
$W*\Delta$ Prod. value			0.273*** (0.0878)	0.241** (0.106)
Δ Wells	0.0289 (0.0248)	0.0288 (0.0248)	0.0157 (0.0278)	0.0200 (0.0259)
$W*\Delta$ Wells			0.0109 (0.124)	0.0676 (0.132)
Rho		0.0136 (0.0512)	-0.00636 (0.0511)	-0.0571 (0.0502)
Constant	0.00858*** (0.000551)			0.00731*** (0.000777)
Year FE	Yes	Yes	Yes	No
Play-year FE	No	No	No	Yes
Observations	741	741	741	741
R-squared		0.002	0.014	0.059
# counties	247	247	247	247

Note: robust standard errors in parentheses: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. The errors are clustered at the county level. The W -matrix is a row-normalized queen contiguity matrix.

Finally, in the expenditures by function, we find spatial effects for *higher education* (table 5.10), *health* (table 5.11), *highways* (table 5.12), and *natural resources* (table 5.13). Starting with *higher education*, we find that weakly significant negative effects for the production value and more significant negative effects for the spatially lagged number of active wells. The negative relationship between resource dependency/activity and education has been

discussed in the relation to the resource curse. This negative relationship may therefore suggest such underlying mechanisms to be present. The spatially lagged variable may show higher significance, simply because only few counties have *higher education* expenditures. Thus, one is more likely to have a neighbor with *higher education* expenditures than oneself is. However, the resource curse argumentation remains the same. As there are good job-opportunities in the oil and gas industry, especially for lower skilled workers, the local population may be less inclined to invest in their own education. It is therefore also unsurprising that the negative effect is shown for the number of active wells, given that these especially require a lot of employment, whereas the subsequent production is less labor demanding. It has to be noted however, that only few counties have *higher education* expenditures, making it more prone to random trends and events.

Table 5.11 shows the effects on health expenditures. Here we find positive effects for the spatially lagged number of active wells. The definition of *health* expenditures is the following: “*Provision of services for the conservation and improvement of public health, other than hospital care, and financial support of other governments’ health programs*” (U.S. Bureau of the Census, 2006). This includes expenditures on a list of health activities, such as health-related inspections, community health care programs, and regulation of air and water quality. Especially the regulation of air and water quality may be expected to go up in response to creation of the active wells.

Table 5.10: Higher education

Variables	OLS	SAR	SDM	SDM
Δ Prod. value	-0.0150* (0.00789)	-0.0354*** (0.0121)	-0.0303* (0.0172)	-0.0186* (0.0108)
W* Δ Prod. value			0.0441 (0.0712)	0.0189 (0.0627)
Δ Wells	-0.0112 (0.00754)	-0.0282 (0.0174)	-0.0219 (0.0140)	-0.0104 (0.00835)
W* Δ Wells			-0.0954*** (0.0336)	-0.119** (0.0539)
Rho		-0.149*** (0.0233)	-0.154*** (0.0242)	-0.0828*** (0.0173)
Constant	0.00493*** (0.00102)			0.00610*** (0.00173)
Year FE	Yes	Yes	Yes	No
Play-year FE	No	No	No	Yes
Observations	741	741	741	741
R-squared		0.002	0.003	0.008
# counties	247	247	247	247

Note: robust standard errors in parentheses: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. The errors are clustered at the county level. The W-matrix is a row-normalized queen contiguity matrix.

Table 5.11: Health

Variables	OLS	SAR	SDM	SDM
Δ Prod. value	-0.0876* (0.0515)	-0.0871* (0.0519)	-0.0978* (0.0510)	-0.0972** (0.0477)
W* Δ Prod. value			-0.0251 (0.0592)	-0.0678 (0.0712)
Δ Wells	0.0157 (0.0240)	0.0191 (0.0275)	0.0109 (0.0237)	0.0177 (0.0216)
W* Δ Wells			0.107** (0.0483)	0.133** (0.0522)
Rho		-0.0360 (0.0298)	-0.0401 (0.0291)	-0.0844*** (0.0326)
Constant	0.00157** (0.000735)			0.00156 (0.00107)
Year FE	Yes	Yes	Yes	No
Play-year FE	No	No	No	Yes
Observations	741	741	741	741
R-squared		0.005	0.008	0.029
# counties	247	247	247	247

Note: robust standard errors in parentheses: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. The errors are clustered at the county level. The W -matrix is a row-normalized queen contiguity matrix.

The expenditure component with significant spatially lagged fracking variables, is expenditures on *highways* (table 5.12). Expenditures on *highways* are generally expected to go up with fracking activities. However, we do not find this to be the case for the non-spatially lagged fracking variables. We do find this positive effect for the spatially lagged number of active wells. The significance disappears once the year fixed effects are replaced by the play-year fixed effects. This suggests that the entire play increases its *highways* expenditures as a response to the fracking-boom.

Finally, we find a lot of significance for the *natural resources* fracking variables (table 5.13). The explanatory power is also high relative to the other expenditure components, which may natural follow from how directly related it is to the oil and gas industry. The definition reads: “*Conservation, promotion, and development of natural resources (soil, water, energy, minerals, etc.) and the regulation of industries which develop, utilize, or affect natural resources*”(U.S. Bureau of the Census, 2006). The interpretation of the fracking variables are difficult however. The production value and active well variables show opposite effects, as do the spatially lagged variables. Again, we find the significance of the spatially lagged variables decreasing as the play-year fixed effects are introduced.

Table 5.12: Highways

Variables	OLS	SAR	SDM	SDM
Δ Prod. value	-0.229* (0.132)	-0.229* (0.133)	-0.287** (0.139)	-0.272* (0.143)
W* Δ Prod. value			0.00504 (0.329)	-0.00102 (0.361)
Δ Wells	0.154 (0.191)	0.155 (0.191)	0.122 (0.178)	0.105 (0.169)
W* Δ Wells			0.380** (0.178)	0.297 (0.216)
Rho		-0.0148 (0.0254)	-0.0296 (0.0277)	-0.0911*** (0.0325)
Constant	0.00667*** (0.000891)			0.00733*** (0.00115)
Year FE	Yes	Yes	Yes	No
Play-year FE	No	No	No	Yes
Observations	741	741	741	741
R-squared		0.006	0.012	0.044
# counties	247	247	247	247

Note: robust standard errors in parentheses: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. The errors are clustered at the county level. The W -matrix is a row-normalized queen contiguity matrix.

The next section will further discuss these results by also including the diff-in-diff estimation results, thereby presenting our full interpretation of the results.

Table 5.13: Natural resources

Variables	OLS	SAR	SDM	SDM
Δ Prod. value	0.348* (0.179)	0.348** (0.177)	0.369** (0.183)	0.373** (0.180)
W* Δ Prod. value			-0.221** (0.110)	-0.196* (0.115)
Δ Wells	-0.258*** (0.0725)	-0.261*** (0.0716)	-0.267*** (0.0636)	-0.274*** (0.0599)
W* Δ Wells			0.171*** (0.0597)	0.119* (0.0702)
Rho		0.103 (0.0898)	0.147 (0.0960)	0.0978 (0.0992)
Constant	0.000783 (0.000534)			0.00165*** (0.000639)
Year FE	Yes	Yes	Yes	No
Play-year FE	No	No	No	Yes
Observations	741	741	741	741
R-squared		0.207	0.219	0.269
# counties	247	247	247	247

Note: robust standard errors in parentheses: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. The errors are clustered at the county level. The W -matrix is a row-normalized queen contiguity matrix.

5.6 Discussion

This discussion presents a discussion of our interpretation of the estimation results. The discussion is divided into four sections: fiscal health, revenues, expenditures, and policy implications. In these subsections, the fiscal components are separately discussed, combining the diff-in-diff results, with the spatial estimation results. Note that we also touch upon some of the direct effects from the spatial estimations when deemed relevant, even though these are not the focus of the chapter and may have endogeneity issues.

5.6.1 Fiscal health

One of the main concerns related to fracking and local public finance is that the fracking-boom may negatively impact the fiscal health of local governmental entities (Zwick, 2018). We find no clear indication of such fiscal health issues. We find both revenues and expenditures to be positively affected by the fracking-boom, with the revenues being more affected than the expenditures, although the difference is not significant. These results are in line with previous empirical work (Bartik et al., 2019; Newell & Raimi, 2015). Being identified as a fracking county adds around \$1250 revenues and \$1100 expenditures per capita annually, with around 60% of that going to school districts and the remaining to county governments.

We do find a minor indication of increased debt in school districts, also evidenced by the increase in *interest on general debt* expenditures, but this quickly disappears and is also associated with increased cash holdings. The increase in total revenues and expenditures is found for the county governments and school districts. Furthermore, we find that the positive effect for the production value is higher for the revenues than for expenditures, whereas the change in active wells is higher for expenditures than revenues. This again indicates that there may be some short-term costs associated with building the new wells. This is further evidenced by the significant positive effect between new active wells and *outstanding debt*, while at the same time a positive effect for production value on *cash holdings* (both results in the appendix, table 5.21).

The initial increase in expenditures followed by the increase in revenues may naturally follow from the expenditures necessary for the creation of the wells, followed by the revenues that come from the subsequent production of these wells. However, one could also argue that the revenues follow the expenditures simply because of strict budget requirements that are common for local governments (Mahdavi & Westerlund, 2011; Westerlund, Mahdavi, & Firoozi, 2011). This relates to the debate whether governments tax-and-spend, or spend-and-tax (Anderson, Wallace, & Warner, 1986; Chang, Liu, & Caudill, 2002; Westerlund et al., 2011). In this case, it may be that tax rates (e.g. property tax) are increased in order to source more property taxes.

In terms of the boom-bust structure, there are also no clear signs of a nearing bust. Our dataset includes up to 9 years after the introduction of fracking in the specific shale-plays found in Texas. After 9 years, we still find total revenues and expenditures to be higher in the counties associated with the fracking-boom, with the positive revenue effect remaining higher than the expenditure effect, although not significantly different. We do find the positive revenue and expenditure effects to decrease in significance. When looking at the diff-in-diff effects for each shale play separately, we find that the positive diff-in-diff effect of Eagle Ford are declining, and the Permian Basin is no longer increasing.

The spatially lagged estimations show no spatially lagged effects for the fracking variables. We do find an indication of spatial clusters in the development of total expenditures and revenues as evidenced by the significant spatially lagged dependent variable, which disappears once the play-year fixed effects are included.

5.6.2 Revenues

Nearly all positive revenue effects stem from increased property tax revenues, in line with previous work (Bartik et al., 2019; Newell & Raimi, 2015). These positive effects are therefore found in the government types that source most property tax revenues: counties and school districts. Being identified as a fracking county adds around \$1150 in property taxes. The positive effect turns significant after around 5 years, and remains significant for the remaining years. The long-run diff-in-diff results show that *intergovernmental* revenues and *utility* revenues actually decrease a little bit. The *intergovernmental* transfers between 5-7 years after fracking initiated, which may relate to the decreased need for such revenues given the increase in *property taxes*. We also find a shift in *intergovernmental* revenues, moving away from municipalities and special districts towards county governments. The *utility* revenues are lower from 6 years onwards, which may also relate to a decrease in need of such taxes (tax cuts), although the decrease is only minor.

The spatial effects show an increase in *sales and gross receipts tax* revenues. Thus, the neighboring counties profit from the population and income growth, which is spent in their counties. An increase in production value of one-million USD, increases *sales and gross receipts tax* revenues in neighboring counties by around \$240. Interestingly, and contrary to previous empirical work (Bartik et al., 2019; Newell & Raimi, 2015), we do not find any increase in *sales and gross receipts tax* revenues in the fracking county itself when controlling for the play-year fixed effects, neither in the diff-in-diff estimations, nor the spatial estimations. It therefore seems likely that the increase in *sales and gross receipts tax* revenues are spread out across the region or play instead of being localized in the specific fracking county. Finally, we find evidence of revenue clusters, with significant rho coefficients for *intergovernmental transfers* and *property tax* revenues.

5.6.3 Expenditures

The increased revenues are accompanied by increased *current operations* expenditures for county governments and increased *capital outlay* for school districts, and to a lesser extent county governments. Furthermore, we find *interest on general debt* to increase for school districts as observed before, as well as increased *salaries and wages* for county governments in line with the work by Newell and Raimi (2015).

With school districts being one of the main beneficiaries of the increased revenues, through their sourcing of *property tax*, the additional funds are invested into *elementary and secondary education*, while expenditures on *higher education* actually go down. These opposing findings may point to why Bartik *et al.* (2019) find no significant effects for total education expenditures (elementary and secondary, and higher education). The decline in *higher education* links well with the resource curse literature. The increase in lower-skilled jobs associated with the fracking boom may increase the opportunity costs of going to higher education instead of working in the fracking industry, with the consequence of less high school students and less funds going to *higher education*. We find that neighboring counties experience this drop in *higher education* expenditures, likely for similar reasons. However, it has to be noted that only few counties actually have expenditures on *higher education*, making the result more prone to random events.

Counties spend their increased public funds on *highways, police, parks & recreation*, and *judicial administration*. The increased highways expenditures are needed given the road damage that is likely to be associated with increased use of the road network by the gas and oil industry trucks. The result is also in line with previous work (Bartik *et al.*, 2019; Newell & Raimi, 2015), although the effect is weak over time. The spatial estimations furthermore show that this is also the case for neighboring counties or counties located in the same play.

The increased police expenditures are also in line with the work by Bartik *et al.* (2019). The increased police expenditures remain relatively robust over time, still clearly visible 9 years after fracking initiated. Expenditures on *parks and recreation* on the other hand, are only briefly significant between years 3-5. Finally, we find positive effects for *judicial administration* which links well with the argumentation of the administrative capacity needed to regulate the new environmental issues (Hanna, 2005; Miller *et al.*, 2009; Wilson, 2006; Zwick, 2018), also evidenced by the increase in *salaries and wages*.

No significant effects are found for *public welfare* and *hospitals*, in line with the work by Bartik *et al.* (2019). We do find expenditures on *health* to decrease in special districts. Similarly, it is negatively associated with production value. However, we find a stronger opposing effect for the spatially lagged active wells. It is likely that the increase in *health* expenditures is used for healthcare programs specific to the fracking industry, such as the regulation of air and water quality (Jackson *et al.*, 2016; Zwick, 2018).

5.6.4 Policy implications

With all fracking-boom effects in mind, should local communities be welcoming of the fracking-boom and fracking activities? From a policymaker perspective, that is ultimately the question. While it is difficult to answer that question, and preferences may be heterogeneous, we may philosophize somewhat about the results ultimately mean for local communities in our opinion.

It may be important to keep in mind that Texas has a lot of small, thinly populated counties in general, and that the “fracking counties” are generally even smaller. Seventy-five percent of the “fracking-counties”, as identified through the top quartile of Bartik *et al.* (2019), have a population of less than 23 thousand. So, what happens to these communities?

First, local communities may experience negative environmental impacts, such as water safety issues, wastewater disposal and air quality concerns (Jackson *et al.*, 2016; Zwick, 2018), traffic (Bartik *et al.*, 2019), noise pollution (Bartik *et al.*, 2019; Zwick, 2018), and minor man-made earthquakes (Goho, 2012; Zwick, 2018). These all result in decreased livability (Zwick, 2018). The fracking-boom attracts workers, generally young-male, coming into their local communities, with various sorts of potential issues, such as depression, family stress, addiction, and crime, including violence towards women (Bartik *et al.*, 2019; Jacquet, 2009; Shandro *et al.*, 2011; Zwick, 2018).

This increase in workers increases housing values (Bartik *et al.*, 2019), through which the local government sources increased property tax, which is the main way in which local public revenues increase. There is also some indication that the Texas State transfers more funds to the counties affected, but at the same time, transfers less to municipalities and special districts, creating a net insignificant result. Furthermore, there is only a very weak indication of increased revenues sourced through sales and gross receipts tax.

The main increase in local public revenues per capita sourced through increased property tax means that the home-owners of the local community benefit by an increase in wealth. The question is however, who exactly benefits? Probably big property owners, which could sell property for a much higher value than they bought it at initially. However, most households with just one property cannot access the additional wealth, unless they sell their property. In that case however, they will probably need to move out of their county as the other houses in their county also increased in price. Renters also do not benefit as they will see their rents going up (Bartik *et al.*, 2019).

However, while only a minor share of the local community may actually benefit from the increase in housing prices, the increase in local public funds could be given back to the local community in the form of investments in better healthcare, education, parks and recreation, social benefits and more. The question then becomes, do we find this in our results? Or do we find that the additional funds are mostly used to cope with the increase in population and fracking activity? Our results suggest a little bit of both.

We find that the main beneficiaries of the increased property tax revenues are the county government and school districts. The county government uses the increased per capita funds mostly to deal with the negative externalities of fracking by increasing per capita spending on police, highways, and judicial administration. However, they also give back to the community by increasing expenditures on parks and recreation. The school districts spend their increased funds on elementary and secondary education. The per capita increase could suggest more students per capita, but also more expenditures per student. The expenditures per student results show that these go up, although its significance decreases. This suggests that school districts indeed use part of the additional funds to invest in school quality, although it is weak in significance. We do not find any per capita increases in health, hospitals, or public welfare however. The health expenditures of special districts actually go slightly down. Furthermore, expenditures on higher education go down, possibly suggestive of the resource curse.

The main benefit for local communities is probably the increase in employment and wages. However, if this means that educational attainment goes down, one may wonder what the long-term effects will be once the fracking-boom turns into a bust. Furthermore, as a large share of these new jobs are taken by the population influx, one may wonder how much the local community actually benefits.

Finally, there our spatial estimations show the potential effects for neighboring counties, adding insights to the public finance spillover effects. We find that neighboring counties benefit from increased sales and gross receipts tax per capita associated with the fracking production value increase. Total revenues and expenditures do not increase with the fracking activities, although there is a positive spatial interaction in the dependent variable, meaning that the increase in revenues and expenditures in the fracking county may affect revenues and expenditures in the neighboring county through policy competition. We find the same negative higher education effect, suggesting that the hypothesized resource curse affects a wider region. Furthermore, we find a positive spatial correlation for the production of new wells and interest on general debt, which may relate to the increase in expenditures on highways. Thus, neighboring counties may experience a decrease in higher education quality/quantity, and increased highway costs and interest on debt payments, which seem to be covered by the increase in per capita sales and gross receipts tax. These spillover effects may also point to the need for good governance and coordination in the event of such major economic shocks, given that these also affect neighboring counties.

With all results in mind, do the local communities actually benefit from the fracking-boom? The answer is mostly likely that there are winners and losers, making the question a political one. However, the fact that the fracking companies do not seem to pay impact fees, or in-kind-transfers in Texas (Newell & Raimi, 2015), instituting such transfers may allow for more compensation to “losers” of the local communities. We find that such transfers are instituted in other states such as Arkansas, Colorado, Montana, North Dakota, and

Pennsylvania (Newell & Raimi, 2015). Instituting such transfers may help prevent big oil and gas companies extracting most of the value, by transferring a share of the value back to the local communities.

5.7 Conclusion

This chapter attempts to enhance our understanding of the local public fiscal effects associated with the fracking boom, using the case of Texas. A diff-in-diff analysis is presented where we estimate the fracking effects over time for the four different types of local government (county, municipality, special district, and school district). The results show increased revenues and expenditures for county governments and school districts. No clear signs of fiscal health issues are found, nor do we find a clear indication that the increased local public revenues per capita are used to give back to the local community. Rather it seems most of it is used to cope with the negative externalities associated with fracking. Instituting impact fees and/or in-kind-transfers like we find in other states may help compensating local communities more for the negative externalities.

The increase in county government revenues is sourced through increased intergovernmental transfers (excluding other local governments), and property tax. These increased revenues are spent on highways, police, parks and recreation, and judicial administration. School districts increase their revenues through increased property tax revenues, which they spend on elementary and secondary education. Expenditures on higher education actually go down, indicative of the resource curse. Positive spatial effects are found for the oil and gas production value on the sales and gross receipts tax revenues of neighboring counties. New active wells show positive spatial effects on the expenditure side, through health and highways expenditures.

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Appendix

Appendix 5.A: Summary statistics

Table 5.14: Summary statistics for the DID estimations

Variable	Obs	# zeroes	Mean	Std. Dev.	Min	Max
<i>Fiscal health components</i>						
Total revenues	5,187	0	3.70	2.41	0.34	33.00
Total expenditures	5,187	0	3.71	2.48	0.31	33.30
Budget balance	5,187	0	-0.01	0.65	-15.04	10.89
Outstanding debt	5,187	19	2.92	4.85	0.00	101.16
Cash holdings	5,187	0	2.80	5.34	0.14	102.97
<i>Expenditures by character</i>						
Current operations	5,187	0	3.12	1.77	0.29	22.64
Capital outlay	5,187	1	0.44	0.56	0.00	10.35
Construction	5,187	21	0.34	0.52	0.00	10.14
Interest on general debt	5,187	14	0.12	0.18	0.00	4.54
Salaries/wages	5,187	0	1.53	1.08	0.20	39.24
<i>Revenue components</i>						
Intergovernmental	5,187	0	1.05	0.62	0.07	8.17
Property tax	5,187	0	1.46	1.76	0.15	30.91
Sales and gross receipts	5,187	42	0.14	0.24	0.00	16.08
Utilities	5,187	41	0.24	0.31	0.00	7.12
<i>Expenditures by function</i>	5,187		0.08	0.28	0.00	3.17
Higher education		4,290				
Elementary & secondary education	5,187	0	1.77	1.20	0.19	16.05
'' per student	5,187	0	9.22	5.59	2.70	84.54
Public welfare	5,187	550	0.03	0.21	0.00	6.13
Hospitals	5,187	2,420	0.37	0.74	0.00	17.28
Health	5,187	354	0.05	0.09	0.00	1.41
Highways	5,187	4	0.15	0.14	0.00	4.33
Police	5,187	4	0.14	0.14	0.00	5.33
Natural resources	5,187	81	0.02	0.05	0.00	0.82
Parks & recreation	5,187	133	0.03	0.04	0.00	0.62
Housing & community development	5,187	829	0.04	0.05	0.00	0.50
Financial administration	5,187	0	0.06	0.06	0.00	1.41
Judicial administration	5,187	1	0.07	0.05	0.00	0.58
Utilities	5,187	41	0.26	0.46	0.00	19.82
<i>DID dummies</i>						
Rystad top quartile	5,187	NA	0.08	0.27	0	1
Post-fracking	5,187	NA	0.05	0.22	0	1
Event-year	5,187	NA	1.48	5.24	-11	17
Unbalanced sample	5,187	NA	0.21	0.40	0	1

Note: all fiscal variables are in one-thousand real 2015 US Dollars, per capita. "Per student" represents expenditures on elementary and secondary education per student instead of per capita.

Table 5.15: Summary statistics for the spatial estimations

Variable	Obs	# zeroes	Mean	Std. Dev.	Min	Max
<i>Fiscal health components</i>						
ΔTotal revenues	741	0	4.75	2.56	0.81	22.32
ΔTotal expenditures	741	0	4.78	2.80	0.78	25.02
ΔBudget balance	741	0	-0.03	1.03	-15.04	10.89
ΔOutstanding debt	741	2	4.15	5.96	0.00	76.05
ΔCash holdings	741	0	3.99	6.78	0.56	95.23
<i>Expenditures by character</i>						
ΔCurrent operations	741	0	4.00	2.11	0.70	22.64
ΔCapital outlay	741	0	0.55	0.69	0.00	10.35
ΔConstruction	741	5	0.43	0.66	0.00	10.14
ΔInterest on general debt	741	2	0.16	0.21	0.00	2.88
ΔSalaries/wages	741	0	1.86	1.62	0.39	39.24
<i>Revenue components</i>						
ΔIntergovernmental	741	0	1.31	0.72	0.17	8.17
ΔProperty tax	741	0	1.92	1.87	0.41	20.20
ΔSales and gross receipts	741	7	0.18	0.12	0.00	0.96
ΔUtilities	741	9	0.31	0.37	0.00	5.12
<i>Expenditures by function</i>						
ΔHigher education	741	612	0.10	0.34	0.00	3.04
ΔElementary & secondary education	741	0	2.20	1.45	0.39	15.91
ΔPublic welfare	741	105	0.05	0.34	0.00	6.13
ΔHospitals	741	373	0.51	1.16	0.00	17.28
ΔHealth	741	94	0.06	0.11	0.00	1.41
ΔHighways	741	2	0.19	0.21	0.00	4.09
ΔPolice	741	2	0.19	0.22	0.00	5.33
ΔNatural resources	741	15	0.03	0.06	0.00	0.82
ΔParks & recreation	741	40	0.04	0.06	0.00	0.62
ΔHousing & com dev	741	152	0.05	0.06	0.00	0.50
ΔFinancial administration	741	0	0.07	0.07	0.00	1.41
ΔJudicial administration	741	1	0.09	0.07	0.00	0.58
ΔUtilities	741	9	0.33	0.42	0.00	4.52
<i>Fracking</i>						
ΔProd. Value	741	NA	0.00	0.01	-0.08	0.19
ΔWells	741	NA	0.00	0.02	-0.04	0.40

Note: all fiscal variables are in one-thousand real 2015 US Dollars, per capita. The production value is in one-million USD per capita in real 2015 USD. Active wells is the number of active wells per capita.

Appendix 5.B: Diff-in-diff estimations for all available fiscal components

Table 5.16: Revenues

Variable	Coef.	Std. Err.	Variable	Coef.	Std. Err.
Total	1.252***	(0.364)	Higher educ chg	-0.0234	(0.0154)
General	1.275***	(0.361)	School lunch chg	-0.000958	(0.00123)
Intergovernmental	-0.00424	(0.101)	Hospitals chg	-0.0363	(0.0913)
Federal transfer	0.0159	(0.0608)	Highways chg	0.00414	(0.00408)
State transfer	-0.0201	(0.0993)	Air transit chg	-0.000692	(0.000878)
Local transfer	-0.00839	(0.0127)	Parking chg	0.000260	(0.000291)
Own source	1.288***	(0.355)	Sea and port chg	-0.000317	(0.000321)
Taxes	1.174***	(0.377)	Nat res chg	-0.0100*	(0.00539)
Property tax	1.138***	(0.375)	Parks & rec chg	-0.00259**	(0.00111)
Sales & gross rec.	0.0319	(0.0217)	House comm dev	0.00636*	(0.00328)
General sales	0.0331	(0.0219)	Sewers chg	0.0173	(0.0178)
Selective sales	-0.00120	(0.00397)	Waste mgmt chg	0.000904	(0.00652)
Motor fuel	1.63e-05	(1.58e-05)	Other chg	0.117	(0.0996)
Alcohol	-7.96e-05	(0.000104)	Misc general	0.0357	(0.0304)
Tobaco	4.65e-05	(4.96e-05)	Misch interest	0.0123	(0.0105)
Utility	0.00128	(0.00305)	Misc spec ass	-0.00163*	(0.000899)
Other sales tax	-0.00305	(0.00291)	Utilities	-0.0343	(0.0313)
Indiv income tax	-9.07e-08	(1.15e-07)	Water	0.00884	(0.0179)
Corp income ta	0	(0)	Electricity	-0.0470**	(0.0238)
Motor vehicle	0.000483	(0.00336)	Gas	0.00567	(0.00376)
Charges & misc	0.114	(0.171)	Transit	-0.00182	(0.00143)
Charges	0.0784	(0.149)	Liquor store	0	(0)
Education chg	-0.0178	(0.0152)	Empl retirement	0.00205	(0.00239)

Note: robust standard errors in parentheses: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. All estimations use equation 5.2. Even though the coefficients are shown below one another, they represent separate estimations. The errors are clustered at the county level. All estimations include county fixed effects and play-year fixed effects.

Table 5.17: Expenditures

Variable	Coef.	Std. Err.	Variable	Coef.	Std. Err.
Total	1.093***	(0.367)	Police	0.0338**	(0.0149)
Intergovernmental	0.476*	(0.259)	Fire protection	0.0110	(0.00926)
Local transfer	0.000884	(0.00332)	Correction	0.149	(0.136)
Direct	0.596**	(0.232)	Inspection	-0.000549	(0.000987)
Current operations	0.351	(0.232)	Natural resources	0.00260	(0.00943)
Capital outlay	0.290***	(0.0962)	Parks & rec	0.0187*	(0.0105)
Construction	0.258***	(0.0839)	House comm dev	-0.00111	(0.0131)
Assistance	2.09e-05	(0.000116)	Sewerage	0.00529	(0.0157)
Debt interest	0.0324*	(0.0166)	Waste mgmt	0.00387	(0.00707)
Insurance	0.000270	(0.000997)	Financial adm	0.0178	(0.0130)
Wages	0.155*	(0.0856)	Judicial adm	0.0494***	(0.0157)
Education	0.345*	(0.197)	Public buildings	0.00151	(0.00818)
Higher education	-0.0563**	(0.0268)	General interest	0.0305*	(0.0167)
Elem sec educ	0.401**	(0.198)	Commercial act	0.000260	(0.000810)
Libraries	0.00227	(0.00144)	Property sale	-2.62e-05	(0.00116)
Public welfare	-0.0117	(0.0270)	Utilities	-0.0541	(0.0465)
Cash assistance	-6.19e-05	(0.000101)	Waste mgmt	-0.000226	(0.0366)
Hospitals	-0.0743	(0.118)	Electricity	-0.0427*	(0.0223)
Health	-0.00504	(0.0118)	Gas	0.00430	(0.00431)
Highways	0.0491	(0.0320)	Transit	-0.0155	(0.0104)
Air transit	0.00483	(0.00364)	Liquor store	0	(0)
Parking	0.000266*	(0.000158)	Empl retirement	0.000270	(0.000997)
Sea and port	-0.000477	(0.000504)			

Note: robust standard errors in parentheses: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. All estimations use equation 5.2. Even though the coefficients are shown below one another, they represent separate estimations. The errors are clustered at the county level. All estimations include county fixed effects and play-year fixed effects.

Table 5.18: Direct expenditures

Variable	Coef.	Std. Err.	Variable	Coef.	Std. Err.
Education	0.134*	(0.0749)	Police	0.0330**	(0.0146)
Higher educ	-0.0500**	(0.0240)	Fire protection	0.0106	(0.00922)
Elem & sec educ	0.184**	(0.0728)	Correction	0.147	(0.135)
Libraries	0.00202	(0.00144)	Inspection	-0.000748	(0.000854)
Public welfare	-0.0116	(0.0269)	Natural resources	0.00203	(0.00777)
Hospitals	-0.0709	(0.114)	Parks & rec	0.0176*	(0.0102)
Health	-0.00494	(0.0114)	House comm dev	-0.00132	(0.0131)
Highways	0.0477*	(0.0282)	Sewerage	0.00831	(0.0143)
Air transit	0.00153	(0.00250)	Waste mgmt	0.00216	(0.00677)
Parking	0.000263*	(0.000155)	Financial adm	0.0175	(0.0130)
Sea and port	-0.000397	(0.000422)	Judicial adm	0.0499***	(0.0156)

Note: robust standard errors in parentheses: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. All estimations use equation 5.2. Even though the coefficients are shown below one another, they represent separate estimations. The errors are clustered at the county level. All estimations include county fixed effects and play-year fixed effects.

Table 5.19: Capital outlay

Variable	Coef.	Std. Err.	Variable	Coef.	Std. Err.
Education	0.0783	(0.0513)	Natural resources	-0.00167	(0.00104)
Higher education	-0.00381**	(0.00193)	Parks & rec	0.0104	(0.00708)
Elem & sec educ	0.0821	(0.0513)	House comm dev	-0.00139	(0.00222)
Libraries	0.000215	(0.000318)	Sewerage	0.00690	(0.0123)
Public welfare	-0.00146	(0.00128)	Waste mgmt	-0.000369	(0.00283)
Hospitals	-0.00419	(0.00724)	Financial adm	0.000705	(0.000704)
Health	0.00488	(0.00311)	Judicial adm	0.00208	(0.00154)
Highways	0.00723	(0.0106)	Public buildings	-0.00346	(0.00392)
Air transit	0.000308	(0.00203)	Commercial act	1.40e-05	(2.75e-05)
Parking	-3.03e-06	(6.30e-05)	Utilities	0.0120	(0.0146)
Sea & port	-2.54e-05	(2.67e-05)	Water	0.0159	(0.0147)
Police	-0.00160	(0.00184)	Electricity	-0.00249	(0.00189)
Fire protection	0.00350	(0.00331)	Gas	-0.000516	(0.000517)
Correction	0.0110	(0.0157)	Transit	-0.000915*	(0.000525)
Inspection	0.000586	(0.000461)	Liquor store	0	(0)

Note: robust standard errors in parentheses: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. All estimations use equation 5.2. Even though the coefficients are shown below one another, they represent separate estimations. The errors are clustered at the county level. All estimations include county fixed effects and play-year fixed effects.

Table 5.20: Budget, debt and assets

Variable	Coef.	Std. Err.	Variable	Coef.	Std. Err.
Budget balance	0.159	(0.119)	Cash holdings	0.800**	(0.353)
Outstanding debt	0.572	(0.374)	Empl retirement	-0.000652	(0.0151)
Short-term debt	0.0396	(0.0318)	Other	0.801**	(0.352)
Long-term debt	0.532	(0.359)	Other offsets	-0.0886	(0.108)
Private purp debt	-0.0765	(0.102)	Other bonds	0.312**	(0.129)
Issued debt	0.0693	(0.127)	Other other	0.578**	(0.223)
Retired debt	0.133*	(0.0708)			

Note: robust standard errors in parentheses: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. All estimations use equation 5.2. Even though the coefficients are shown below one another, they represent separate estimations. The errors are clustered at the county level. All estimations include county fixed effects and play-year fixed effects.

Appendix 5.C: Overviews of the spatial estimation results

Table 5.21: Fiscal health and expenditures by character estimation results with time fixed effects

Fiscal component	Δ Prod. value	$W^*\Delta$ Prod. value	Δ Wells	$W^*\Delta$ Wells	Rho
<i>Fiscal health components</i>					
Total revenues	7.032*** (1.410)	1.087 (2.308)	3.358*** (0.993)	-0.623 (2.488)	0.0932** (0.0472)
Total expenditures	4.515** (1.916)	5.183 (5.636)	4.842*** (1.424)	-2.881 (4.365)	0.111** (0.0539)
Budget balance	2.510 (2.397)	-4.229 (6.211)	-1.478* (0.765)	2.176 (5.676)	0.0992** (0.0444)
Outstanding debt	1.508 (4.557)	-5.624 (6.490)	3.222*** (1.223)	10.46 (6.461)	-0.0296 (0.0302)
Cash holdings	8.294** (4.206)	-2.744 (7.865)	-0.315 (1.099)	0.242 (4.701)	0.0280 (0.0240)
<i>Expenditures by character</i>					
Current operations	6.003** (2.456)	6.917 (7.189)	-3.445** (1.668)	-8.218 (6.376)	0.167* (0.0906)
Capital outlay	-0.309 (0.564)	-0.101 (2.003)	1.703*** (0.398)	3.533 (2.561)	-0.272*** (0.0675)
Interest on general debt	0.112 (0.145)	-0.352* (0.196)	0.0789* (0.0437)	0.672*** (0.240)	-0.00265 (0.0220)
Salaries/wages	-0.0514 (0.576)	-1.371* (0.764)	0.267 (0.383)	0.720 (0.661)	0.228** (0.0989)

Note: robust standard errors in parentheses: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. The errors are clustered at the county level. The W -matrix is a row-normalized queen contiguity matrix. The estimations should be read left to right, instead of up/down. All estimations include time fixed effects.

Table 5.22: Revenue and expenditure components estimation results with time fixed effects

Fiscal component	Δ Prod. value	$W^*\Delta$ Prod. value	Δ Wells	$W^*\Delta$ Wells	Rho
<i>Revenue components</i>					
Intergovernmental	1.752 (1.392)	-0.681 (1.326)	-0.537* (0.321)	-0.0519 (0.752)	0.152** (0.0620)
Property tax	5.793*** (1.063)	0.256 (1.458)	3.975*** (0.597)	-2.866 (2.029)	0.349*** (0.0525)
Sales and gross receipts	-0.0436 (0.0715)	0.273*** (0.0878)	0.0157 (0.0278)	0.0109 (0.124)	-0.00636 (0.0511)
Utilities	-0.0508 (0.137)	0.103 (0.208)	-0.0196 (0.0375)	0.227 (0.183)	0.0182 (0.0455)
<i>Expenditures by function</i>					
Higher education	-0.0303* (0.0172)	0.0441 (0.0712)	-0.0219 (0.0140)	-0.0954*** (0.0336)	-0.154*** (0.0242)
Elem. & sec. education	5.862*** (1.217)	-0.140 (1.711)	-1.406 (1.108)	-1.795 (1.645)	0.437*** (0.0644)
Public welfare	0.0220 (0.0638)	0.248 (0.234)	0.0330 (0.0639)	-0.155 (0.112)	-0.0115 (0.0135)
Hospitals	1.152 (1.178)	7.047 (5.813)	-0.776 (0.476)	-4.973 (4.835)	-0.150* (0.0866)
Health	-0.0978* (0.0510)	-0.0251 (0.0592)	0.0109 (0.0237)	0.107** (0.0483)	-0.0401 (0.0291)
Highways	-0.287** (0.139)	0.00504 (0.329)	0.122 (0.178)	0.380** (0.178)	-0.0296 (0.0277)
Police	-0.322* (0.166)	-0.00463 (0.234)	0.0762 (0.0847)	0.0931 (0.133)	0.000146 (0.0129)
Natural resources	0.369** (0.183)	-0.221** (0.110)	-0.267*** (0.0636)	0.171*** (0.0597)	0.147 (0.0960)
Parks & recreation	0.00935 (0.0255)	0.0939 (0.0764)	-0.00909 (0.00956)	-0.0476 (0.0439)	0.0598 (0.0392)
Housing & comm. dev.	-0.0575 (0.0374)	-0.00254 (0.0563)	-0.000601 (0.0170)	-0.0450 (0.0539)	0.0487 (0.0572)
Financial administration	-0.0372 (0.0426)	-0.110* (0.0657)	-0.00970 (0.0210)	0.0535 (0.0495)	-0.0147 (0.0295)
Judicial administration	-0.137 (0.112)	-0.0566 (0.0664)	0.0645 (0.0570)	0.0111 (0.0674)	0.222** (0.101)
Utilities	0.0144 (0.270)	-0.236 (0.545)	-0.0377 (0.0951)	0.635 (0.716)	0.0589* (0.0304)

Note: robust standard errors in parentheses: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. The errors are clustered at the county level. The W -matrix is a row-normalized queen contiguity matrix. The estimations should be read left to right, instead of up/down. All estimations include time fixed effects.

Table 5.23: Fiscal health and expenditures by character estimation results with play-year fixed effects

Fiscal component	Δ Prod. value	W* Δ Prod. value	Δ Wells	W* Δ Wells	Rho
<i>Fiscal health components</i>					
Total revenues	7.225*** (1.356)	1.956 (2.625)	3.095*** (0.894)	-1.483 (2.648)	0.00646 (0.0498)
Total expenditures	4.814** (2.014)	5.258 (6.032)	4.580*** (1.222)	-2.931 (4.534)	-0.0126 (0.0637)
Budget balance	2.424 (2.404)	-3.173 (6.556)	-1.499* (0.822)	1.533 (6.083)	0.00780 (0.0575)
Outstanding debt	1.804 (4.344)	-2.784 (7.054)	2.751** (1.273)	7.344 (6.870)	-0.0678** (0.0302)
Cash holdings	8.523** (4.266)	-1.328 (9.794)	-0.466 (1.245)	-0.516 (5.771)	0.0100 (0.0226)
<i>Expenditures by character</i>					
Current operations	6.282*** (2.405)	6.523 (7.515)	-3.749** (1.479)	-8.871 (6.567)	0.0311 (0.102)
Capital outlay	-0.372 (0.605)	-0.745 (2.092)	1.741*** (0.396)	3.727 (2.633)	-0.310*** (0.0661)
Interest on general debt	0.107 (0.141)	-0.335 (0.230)	0.0724 (0.0481)	0.598** (0.258)	-0.0410* (0.0219)
Salaries/wages	-0.108 (0.492)	-2.368* (1.316)	0.386 (0.340)	1.524* (0.884)	0.220** (0.0977)

Note: robust standard errors in parentheses: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. The errors are clustered at the county level. The W-matrix is a row-normalized queen contiguity matrix. The estimations should be read left to right, instead of up/down. All estimations include play-year fixed effects.

Table 5.24: Revenue and expenditure components estimation results with play-year fixed effects

Fiscal component	Δ Prod. value	W* Δ Prod. value	Δ Wells	W* Δ Wells	Rho
<i>Revenue components</i>					
Intergovernmental	1.866 (1.317)	0.295 (1.556)	-0.725* (0.379)	-1.182 (1.084)	0.0873 (0.0557)
Property tax	5.904*** (1.118)	0.997 (1.574)	3.945*** (0.533)	-2.274 (2.084)	0.234*** (0.0525)
Sales and gross receipts	-0.0353 (0.0696)	0.241** (0.106)	0.0200 (0.0259)	0.0676 (0.132)	-0.0571 (0.0502)
Utilities	-0.0379 (0.110)	0.323 (0.282)	-0.0525 (0.0594)	0.0226 (0.184)	-0.100 (0.0754)
<i>Expenditures by function</i>					
Higher education	-0.0186* (0.0108)	0.0189 (0.0627)	-0.0104 (0.00835)	-0.119** (0.0539)	-0.0828*** (0.0173)
Elem. & sec. education	5.862*** (1.172)	-0.329 (1.743)	-1.370 (0.988)	-1.331 (1.716)	0.293*** (0.0640)
Public welfare	0.0202 (0.0656)	0.166 (0.236)	0.0471 (0.0587)	-0.0614 (0.0694)	-0.0205 (0.0182)
Hospitals	1.411 (1.334)	7.468 (6.140)	-1.122** (0.538)	-6.439 (5.100)	-0.251** (0.103)
Health	-0.0972** (0.0477)	-0.0678 (0.0712)	0.0177 (0.0216)	0.133** (0.0522)	-0.0844*** (0.0326)
Highways	-0.272* (0.143)	-0.00102 (0.361)	0.105 (0.169)	0.297 (0.216)	-0.0911*** (0.0325)
Police	-0.318** (0.158)	-0.0456 (0.281)	0.0914 (0.0831)	0.204 (0.130)	-0.00617 (0.0156)
Natural resources	0.373** (0.180)	-0.196* (0.115)	-0.274*** (0.0599)	0.119* (0.0702)	0.0978 (0.0992)
Parks & recreation	0.00914 (0.0304)	0.0815 (0.0981)	-0.00796 (0.0117)	-0.0375 (0.0571)	0.0381 (0.0393)
Housing & comm. dev.	-0.0551 (0.0400)	3.66e-05 (0.0801)	-0.00176 (0.0196)	-0.0465 (0.0738)	0.0228 (0.0570)
Financial administration	-0.0371 (0.0437)	-0.0993 (0.0865)	-0.00752 (0.0221)	0.0645 (0.0511)	-0.0396 (0.0274)
Judicial administration	-0.146 (0.109)	-0.186* (0.0986)	0.0742 (0.0546)	0.0769 (0.0899)	0.160* (0.0897)
Utilities	0.0242 (0.268)	-0.109 (0.533)	-0.0326 (0.0941)	0.647 (0.721)	0.00464 (0.0425)

Note: robust standard errors in parentheses: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. The errors are clustered at the county level. The W-matrix is a row-normalized queen contiguity matrix. The estimations should be read left to right, instead of up/down. All estimations include play-year fixed effects.

CHAPTER 6

CONCLUSION AND DISCUSSION

6.1 Introduction

This dissertation pushes forward the knowledge frontier on the economic impact of local governments through detailed analyses of the relationships between local governments and their economic system. The study is motivated by the increasing transfer of power from higher level governments to the local government and the discussions surrounding this trend. Before writing this work, much remained unclear on when to decentralize power to local governments, and how local governments may use their increased power to enhance economic performance and well-being. These questions are bundled in the research question:

To what extent, and in what ways, do local governments contribute to local economic development?

This study sheds a light on the extent and ways in which local governments contribute to local economic development through detailed empirical analyses on four sub-questions. The analyses describe which decentralization dimensions are important in order to reap the benefits of a high-quality local government. Furthermore, the detailed analyses of the local public fiscal compositions show the economic and well-being effects of separate fiscal components, as well as how they are affected by the economic shock in the form of the fracking-boom. The level of detail provided in the analyses creates new insights into the economic impact of local government.

This chapter first includes a brief summary of the main findings of the four studies. This is followed by a discussion on the main theoretical and policy implications of the work.

6.2 Summary of the main findings

This section briefly highlights the relevance and main findings of the four empirical chapters included in this dissertation.

6.2.1 Local autonomy, fragmentation and quality of government: The urban productivity effects of local governments

The second chapter of this dissertation provides new insights into the urban productivity effects of the decentralization of power to local governments. This topic is extremely relevant, as we have seen an increase in the transfer of power to local governments, while there remains a debate on whether this is actually the right thing to do (Carniti, Cerniglia, Longaretti, & Michelangeli, 2019). Arguments exist for both sides, and thus far, empirical evidence is mixed (Baskaran, Feld, & Schnellenbach, 2016; Carniti et al., 2019). This chapter brings new insights under which conditions the decentralization of power to local governments brings economic benefits.

The chapter describes the arguments in favor and against decentralization in more detail. What

stands out is that the arguments often relate to very specific dimensions of decentralization. This is in line with the common observation that decentralization is a very complex concept (Carniti et al., 2019; OECD, 2019). It is exactly this complexity, that scholars argue to be the main reason why there still is no consensus on the economic effects of decentralization (Carniti et al., 2019; OECD, 2019). The debate is still ongoing and currently seems far from being solved (Carniti et al., 2019).

The OECD broadly defines three dimensions of decentralization: *political*, *administrative*, and *fiscal* (OECD, 2019). The *political* dimension deals with the legal basis through which subnational governmental officials are selected. The *administrative* dimension describes to what extent planning, financing and management decisions are taking place in subnational levels of government. Finally, *fiscal* decentralization captures the share of expenditures, revenues and investments taking place at the subnational level.

Interestingly, while the complexity of decentralization is argued to be main reason for the lack of consensus, scholars have mostly been using only one dimension of decentralization to capture and understand the economic effects of decentralization, namely: *fiscal* decentralization. In order to better capture the full complexity of decentralization, through its various dimensions, the Regional Authority Index (RAI) (Hooghe et al., 2016) and Local Autonomy Index (LAI) (Ladner & Keuffer, 2018; Ladner, Keuffer, & Baldersheim, 2015, 2016) are created. These indices consist of various dimensions capturing detailed specific aspects of decentralization based on expert surveys.

Previous work has interacted the RAI with quality of government (Muringani, Fitjar, & Rodríguez-Pose, 2019), and fiscal decentralization (Filippetti & Sacchi, 2015) in order to bring more clarity into the complexity of the economic effect of decentralization, finding positive interaction effects for RAI and quality of government, as well as tax decentralization and RAI. I opt to use LAI over RAI as (1) most subnational governmental activities take place at the local level instead of the regional level, with various countries not even having a regional or state government (OECD, 2019). Furthermore, (2) the quality of government index uses survey questions that specifically target the perceptions on the quality of local government. Even though the quality of government data is subsequently averaged up into bigger (mostly NUTS2) regions, it still captures the perceptions on the quality of local government.

In line with work by Muringani *et al.* (2019), I argue that the economic effects of decentralization are contingent on the (local) quality of government, as well as the economic effects of the (local) quality of government are contingent on the degree of power local governments have. However, in addition, I argue that fragmentation is also a factor in the effect of decentralization, in line with work by Ahrend *et al.* (2017). The biggest novelty however, is the analysis of which specific local autonomy dimensions drive the positive interaction effects between quality of government and local autonomy.

Estimations are performed on European Functional Urban Areas using mixed-multilevel models, thereby accounting for the hierarchical structure of the data. The results provide robust evidence that the context in which local governments operate is significantly associated with urban productivity. The results first confirm the positive quality of government and LAI interaction effect on urban productivity, previously found for quality of government and RAI. The chapter extends this finding by showing that quality of government has the most positive effect in a context of high local autonomy and low fragmentation. As local autonomy decreases, or fragmentation increases, the positive effect of the quality of government disappears. Evidence is provided that the results hold true for all three quality of government dimensions: corruption (inversed), quality of public services, and impartiality. The analyses of the separate local autonomy dimensions show that the positive quality of government effect is captured when fragmentation is low and there is high *organizational autonomy*, *policy scope*, *discretion* and *vertical autonomy*.

6.2.2 How does the local public fiscal composition affect local economic growth? Insights from US cities

The third chapter closer at how local governments may actually affect economic performance. This is done through very detailed analyses of the local public fiscal compositions. The chapter looks specifically at how local public fiscal compositions affect local economic growth in US cities.

The rich literature relating public finance and economic growth has established some generally accepted growth promoting public expenditures, such as education and infrastructure, as well as generally accepted distortionary ways of sourcing revenues for governments, usually various types of tax. However, the empirical evidence for such an influence of public finance on economic growth is mixed (Nijkamp & Poot, 2004). We highlight debates on the economic effects of intergovernmental transfers, to what extent property tax and sales and gross receipts tax are distortionary, as well as the productiveness of public expenditures in general, and specific public expenditures, concluding in line with Nijkamp and Poot (2004) that results are mixed.

These debates describe the overall situation. However, we find that most such papers only look at the national or state level, ignoring the specific context of local governments. Local government are generally responsible for distinctly different activities than the central government. Given the increasing transfer of power to local governments, together with their distinctively different responsibilities, we argue for a need to analyze the relationship between local public finance and local economic growth.

Furthermore, instead of focusing on few hypothesized fiscal components, we analyze the full local public fiscal composition. We find that there are generally few papers looking at how

the full composition of government affects economic growth, and even less is known about how local public fiscal compositions affect economic growth. We argue that there is a high need of such a comparable analysis of how local governments source their revenues, and where to spend their budget on.

The chapter is novel in its level of detail, analyzing the fiscal components separately, for both capital outlay, as well as current operations expenditures, while controlling for the full composition. Existing academic work relating economic performance to public expenditures or revenues generally focuses on one or two expenditure or revenue components relevant to their specific research question. We argue that there is a need for full compositional analyses, as this considers the constrained choice set local policy-makers face, and how the economic effects of the local fiscal decisions are all relative. Given that one fiscal component needs to be left out at a time to avoid a perfect system of collinearity, a matrix of relative effects is established. This allows one to see the economic growth effect of for example, increasing expenditures on highways at the cost of increasing property tax, or through a decrease in expenditures on health. Furthermore, the distinction between capital outlay and current operations expenditures allows us to infer interpretations on stock vs. flow, or maintenance and investment.

The chapter uses data from the Fiscally Standardized Cities Database of the Lincoln Institute of Land Policy. The database has detailed local public finance data on 150 of the largest US cities over the period 1977-2016, combining all types of US local governments into one fiscally standardized city entity. The estimation strategy is based on the work by Devarajan *et al.* (1996) and Kneller *et al.* (1999) and uses an overlapping five-year dynamic structure.

In the interpretation, we follow the literature of defining public revenues either as distortionary or non-distortionary, and expenditures as either productive or non-productive. We find that an increase in local public revenues only hampers growth when used to fund non-productive expenditures. The negative effect disappears when used to fund productive expenditures, although expenditures are more productive when financed through the budget balance. We find no significant differences between revenues sourced through property tax or consumption tax. The most productive public expenditure are expenditures on public welfare, followed by investments made into highways, utilities, and commercial activities. Relatively unproductive expenditures are those on public safety, health, parks and recreation, public buildings, and interest on general debt.

6.2.3 A pure empirical application of local expenditures: 'Voting with your feet' and the provision of US urban services

The fourth chapter goes back to the original idea of Tiebout (Tiebout, 1956), establishing the famous concept of 'voting with your feet'. The chapter describes the importance of local

governments and how citizens may sort themselves into local communities which best reflect their preferences in local public spending. As an example, it describes the case of a city resident that wants to move to the suburbs. If the city is big enough, the resident will have plenty of suburbs to choose from, all with their own local governmental entities and local public fiscal compositions.

However, we move away from the focus on local communities within an area, but rather use the concept to establish the performance of central cities. The argument follows the line of reasoning found in a recent Economist article (The Economist, 2020). The Economist article describes the importance of cities for economic performance and growth. It shows that US cities in the Midwest are competing with one another for investors, talent, and workers, and captures the success of the city by its population growth. Furthermore, it finds that the two main ways of achieving this success are by (1) creating appealing living conditions and (2) investing in the redevelopment and better public transport. This chapter uses the same lines of argumentation and explores how the local public expenditure composition may increase population. How do local governments use their fiscal compositions to enhance living conditions, and do we indeed find that investments made into infrastructure attract people to move to the city.

The chapter presents a brief literature overview of the Tiebout hypothesis. It shows that most papers exploring the Tiebout effects of local public expenditures focus on one or two expenditure components. This chapter instead uses the full expenditure composition in order to estimate relative population growth effects for the separate expenditure components. We argue that this helps to create some clarity in the, generally, mixed results found thus far in the literature.

The chapter uses fiscally standardized cities data on US cities from the Lincoln Institute of Land Policy (Langley, 2016). The estimation strategy is guided by previous work on similar topics (Devarajan et al., 1996; Gemmell, Kneller, & Sanz, 2016; Kneller et al., 1999). The full fiscal expenditure composition is included in the estimation, and is being regressed on population growth. Rosen-Roback controls are included in the form of housing prices and personal income (Roback, 1982; Rosen, 1974, 1979). The chapter uses five-year dynamic overlapping estimations in an attempt to alleviate reversed causality issues, and discusses why we think this is the best option.

The results show that generally, a larger government (higher taxes) negatively affects population growth. In line with the piece by The Economist (The Economist, 2020), we indeed find that investments made into infrastructure yield positive population growth effects, in the form of expenditures on airports, and parking, and capital outlay on highways. Furthermore, we find that investments into higher education, and current operations expenditures on hospitals, and parks and recreation also positively enhance population growth. Negative effects are found

for current operations expenditures on elementary and secondary education. In line with the work by Faggian *et al.* (Faggian, Olfert, & Partridge, 2012) and Goetzke and Islam (Goetzke & Islam, 2017), we infer well-being effects from these population growth effects. Thereby, we conclude in line with the findings of the Economist, that local public policymakers may indeed enhance population growth in the city by enhancing the livability and infrastructure in the city. Livability may be enhanced through investments into higher education and current operations expenditures on hospitals and parks and recreation.

6.2.4 Local public fiscal effects of fracking: The case of Texas

While the chapters thus far focused on how local governments may affect their local economic system and well-being, the final chapter takes the reverse approach, by looking at how a shock to the local economic system may affect the local community. The shock that we use is the fracking-boom in Texas., which, in a short time, drastically increased oil and gas production in Texas. While Texas is not the only state that has been affected by the fracking-boom, it is one of the most affected states and has detailed data availability on the creation of new wells and oil and gas production value at the county level. The chapter uses fiscally standardized counties to examine the local public fiscal effects associated with the fracking-boom.

The chapter briefly describes the technological advances that catalyzed the fracking-boom. Subsequently, the effects of the fracking-boom are described. The increased oil and gas production naturally come with certain economic gains. However, there are also numerous negative externalities resulting in a controversy surrounding fracking, with some states even completely ban fracking. On the environmental side, it has been shown that fracking may be associated with water safety issues, wastewater disposal and air quality concerns (Jackson *et al.*, 2016; Zwick, 2018), traffic (Bartik, Currie, Greenstone, & Knittel, 2019), noise pollution (Bartik *et al.*, 2019; Zwick, 2018), and minor man-made earthquakes (Goho, 2012; Zwick, 2018). On the social side, the influx of (mostly young-male) workers, has been associated with declines in health and livability (Zwick, 2018), through depression, family stress, addiction, and crime, including violence towards women (Bartik *et al.*, 2019; Jacquet, 2009; Shandro, Veiga, Shoveller, Scoble, & Koehoorn, 2011; Zwick, 2018).

The fracking-boom has created a debate on the effects on local public finance. On the one hand, scholars argue that local governments benefit from increased property tax and other forms of income through the increased economic activity and influx of workers (Bartik *et al.*, 2019; Newell & Raimi, 2015; Zwick, 2018). On the other hand, scholars argue that the influx of workers and especially the heavy trucking needed for the oil and gas production, creates a major short-term need for increased local public expenditures and investments (Bartik *et al.*, 2019; Newell & Raimi, 2015; Zwick, 2018), for which local governments may need to take on increased levels of debt, with potentially problematic long-term effects (Zwick, 2018).

There is some existing empirical work relating the fracking-boom to local public finance (Bartik et al., 2019; Newell & Raimi, 2015). It finds that expenditures and revenues both go up, but that the increase is budget neutral, concluding no significant fiscal health issues. We extend the existing analyses in three ways. First, we examine the effects over time using diff-in-diff estimations, thereby allowing for the possibility of short-term fiscal health issues, which may ease out over time. The time period of analysis is also longer, making it more likely to spot the end of the fracking-boom and potentially the start of the fracking-bust. Secondly, more detailed effects are captured by using more detailed fiscal components, e.g. using higher education and elementary and secondary education separately instead of the combined education form. This has major implications for our findings as well. It shows that education is not insignificant as previous work suggested (Bartik et al., 2019). Rather, expenditures on higher education go down while expenditures on elementary and secondary education go up. Thirdly, we identify how the different types of local governments are affected by the fracking-boom, and how this affects their subsequent fiscal response.

In line with previous research (Bartik et al., 2019; Newell & Raimi, 2015), we find a comparable increase in total revenues and total expenditures per capita, resulting in a budget neutral increase in the size of local governments. The increase in revenues is mainly due to an increase in housing prices resulting in higher property tax per capita. County governments and school districts are the main beneficiaries of property tax and are therefore found to increase in size. County governments mainly use their increased funds for dealing with the negative externalities associated with fracking through increased spending on highways, judicial administration, and police. However, there is also a slight increase in spending on parks and recreation. School districts use their increased funds to increase spending on elementary and secondary education. However, this is partly due to an increase in students per capita. When looking at elementary and secondary education expenditures per student, the increase turns only weakly significant. Interestingly, despite the increase in funds for school districts, spending on higher education goes down. The decline in higher education expenditures suggests potential long-term harm in line with the theory on the resource curse.

The spatially lagged dependent variables suggest fiscal competition effects to be present. Furthermore, the spatially lagged results show that neighboring counties increase sales and gross receipts tax revenues per capita. Finally, we show that the resource curse may extend the county borders in finding negative spatially lagged effects for higher education spending.

The policy implications of the results are extensively discussed. While it remains difficult to establish a conclusive answer on whether or not the fracking-boom has been a positive development for the affected counties, the discussion section sheds a light on what we believe the results tell us. It concludes that there are winners and losers in the local community, and that the fracking activities may prove to not be beneficial to the local communities in the long-term. Local communities could be compensated more for the negative externalities

associated with fracking through impact fees or in-kind-transfers, similar to what other states impose.

6.3 Theoretical and policy implications

This dissertation is a detailed and focused attempt at enhancing our understanding of the relationship between local governments and their economic system. It explores to what extent, and in what ways, local governments contribute to local economic development. The analyses show the importance of the organizational structure and local public fiscal compositions of local governments to contribute to local economic development.

The level of detail had led to new insights in the debate on decentralization. It calls for a more holistic approach where the various dimensions of decentralization are considered rather than focusing solely on fiscal decentralization. The findings in this dissertation show that local government is only effective when it has sufficient autonomy and low fragmentation. This may serve as a further motivation for highly centralized governments to decentralize power to local governments (Carrascal-Incera, McCann, Ortega-Argilés, & Rodríguez-Pose, 2020). Taking the example of the UK, the high quality of government and low degree of fragmentation provide the excellent context to reap the benefits of such increased decentralization. This increased transfer of power should be achieved through an increase in organizational autonomy, policy scope, discretion, and vertical autonomy. This could mean that local authorities may hire their own staff, and create their own legal entities. Furthermore, local authorities could be more effectively involved in the delivery of services through their own financial resources and through their own staff. The range of tasks over which local governments have effective political discretion could also be enhanced. Finally, there may be more vertical influence, meaning that local authorities are able to influence higher level policy.

The findings of this dissertation also provide evidence on the relative economic, population and well-being effects of the various fiscal components. The novel level of detail enhances our academic understanding of the relationship between the local public fiscal composition and economic growth, population growth, and well-being. The level of detail also means that the results are easily translatable into policy implications. Although more research is highly recommended to further test the robustness of our findings, the results already suggest which public expenditures may be overrepresented and which could be enhanced to improve economic growth and well-being. Shifting expenditures towards investments made into infrastructure may enhance economic growth and well-being. Furthermore, shifting expenditures towards public welfare and commercial activities may enhance economic growth, while increased expenditures on higher education, hospitals, and parks and recreation may enhance well-being. Note, that while increasing taxes generally negatively impacts economic growth, it does not when used to fund productive expenditures.

I believe future research may combine the novel insights into the effects of decentralization and local public finance in order to get an even better understanding of how to optimally structure local governments. The argument has been that power should be transferred to local governments as they better understand the specific local needs (Klugman, 1994; Oates, 1999; Tiebout, 1956). Furthermore, in line with the argumentation by Tiebout (Tiebout, 1956), local public governments should have distinctly different revenue and expenditure patterns, so that consumer-voters may sort themselves into their preferred pattern. I believe there may a lot of ground to gain in understanding which local public fiscal patterns may be optimal under which circumstances and for which set of preferences. Future research should focus on the relationship between the local autonomy dimensions and fiscal composition patterns, and how these together affect economic performance and well-being. There exists information on the degree of decentralization for specific activities such as healthcare, and education. Can we find relationships between the degree of autonomy of local governments in such domains and their spending patterns in such domains? Could we translate these into economic and well-being impacts? Or could we relate them to the overall perceived quality of government in these domains? I think there is a lot of potential in better understanding these relationships for local governments which should help us creating better local public policies.

I would also highly recommend the creation of a cross-country public finance database, with data on each level of government. This dissertation has benefited greatly from the detailed subnational public finance data available in the US, through the Quinquennial Economic Census and the Annual Survey of State and Local Government Finances of the US Census Bureau. It also means that the dissertation has been heavily focused on the US. Future research may highly benefit from cross-country comparisons in the economic effects of local public finance. Would we for example, find very different results for the local public fiscal composition effects in the highly centralized UK? There is still a lot of ground to be gained in this field of local governments, or the broader subject of subnational governments.

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Epilogue (Covid-19)

The Covid-19 pandemic has generated an urgent crisis with a vital need for quick, adaptive and thorough governance. The geography of the pandemic also shows the importance and relevance of the decentralization of power, and local (and regional) governments. The localized clusters of the pandemic require a place-based approach that specifically targets the needs of the area affected. In my home country (the Netherlands), there initially was a very centralized approach to the pandemic (NOS, 2020d). Rules were established for the entire country. We do not really know why this was the case. It may have been because we did not know enough of the virus to establish more regional or local approaches. Perhaps it was also to establish unity in the country and make everyone aware of the seriousness of the pandemic. Or perhaps it was simply because the country was unprepared to take a more regionalized/localized approach. Subnational governmental organizations frequently criticized policy decisions made by the central government arguing for more place-based approaches (NOS, 2020e, 2020c). After some time, the localized clusters motivated a more regional and local approach to the pandemic (NOS, 2020d). Furthermore, there are now local experiments in Covid-19 measures (NOS, 2020b, 2020a).

The regional and local approach has put power in municipalities and overseeing “safety regions” (veiligheidsregio’s). There are 25 safety-regions (more than double the number of provinces) (NOS, 2020d). These were established in response to the firework disaster in Enschede (2000) and the new year’s eve fire in Volendam (2001) (NOS, 2020d). This pandemic has been one of the first serious tests of the organizational structure of the safety-regions. Thus far, it has led to a lot of critique on the legitimacy of the safety-regions given that these public officials are not democratically chosen (NOS, 2020d). This creates tension between the safety-regions and the democratically chosen municipal councils (NOS, 2020d). The safety-region may decide on strict pandemic policies, cancelling local events, much to the dismay of municipal councils who may argue that for their specific municipality, there is a low risk and different preferences.

Reading the news, I find that it shows the importance and relevance of the studies included in this dissertation, especially the second chapter, by enhancing our understanding in how to best organize our local governments. The second chapter also shows that the economic performance effects are driven by the crisis period, suggesting that it is the resilience of the organization that is important. Given the specific nature of this pandemic crisis, I believe research is needed to specifically look at how the construction of power between the various levels of government may affect the speed, adaptivity, thoroughness, and public acceptance of the government response. Can we find evidence in the initial structure of government and the effectiveness of government response to the pandemic across countries? Would the Netherlands have benefited from a more regional/local approach from the beginning? I would expect cross-country studies to be very helpful in preparing us for crises such as this in the future.

Besides the organizational structure point of interest in this crisis, the pandemic also has major public fiscal health implications. The decrease in economic output and increase in unemployment means decreased public revenues and increased social security expenditures. Furthermore, there are significant health and operational costs associated with the crisis. We see that central governments have no choice but to finance many of these activities through debt, which may be especially worrying for those countries which already had high levels of debt. While the focus has been mainly put on the debt levels of central governments, the Economist documented that the pandemic has also created a “cash crunch” for US local governments, which may be found to have severe long-term effects (The Economist, 2020a, 2020b). For future research, I would therefore also recommend analyzing the local public fiscal health effects of Covid-19. While the shock has been very different than the one found in the fracking-boom, we may benefit from the methodology and findings there to establish a strategy for estimating the local public fiscal effects of the pandemic.

Utrecht, August 2020

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Nederlandse samenvatting

De Economische Impact van Lokale Overheden

Deze dissertatie onderzoekt de relatie tussen lokale overheden en hun lokale economische systeem. De motivatie hiervoor ligt in de toegenomen verschuiving van macht van centrale en regionale overheden, naar lokale overheden. Er heerst een sterk debat over de economische gevolgen van deze toegenomen macht van lokale overheden. Empirisch onderzoek geeft tot dusver geen uitsluitsel over de economische gevolgen van deze verschuiving in macht. Deze dissertatie voegt nieuwe inzichten aan het debat toe door middel van een zeer gedetailleerde en empirische aanpak. De hoofdonderzoeksvraag is:

Hoe, en in welke mate, dragen lokale overheden bij aan de lokale economische ontwikkeling?

Antwoorden op deze vragen worden geleverd middels vier hoofdstukken, welke op een vernieuwende en gedetailleerde wijze empirisch onderzoeken hoe de structuur en financiële compositie van lokale overheden de economische prestatie van de regio beïnvloeden.

De empirische analyses beginnen bij het debat over decentralisatie met het leveren van nieuwe inzichten in de economische gevolgen van de toegenomen verschuiving in macht naar lokale overheden, middels gedetailleerde analyses. Het argument wordt gemaakt dat de mate van de economische effecten van decentralisatie afhangen van de kwaliteit van de lokale overheid, maar ook, dat de economische effecten van de kwaliteit van de lokale overheid afhangen van de mate van decentralisatie. Middels empirisch onderzoek naar Europese steden wordt er aangetoond dat steden met een hoge autonomie, hoge kwaliteit van overheid, en lage mate van horizontale fragmentatie het beste presteren. Verder tonen empirische analyses aan dat *organiserende autonomie*, *beleidsgebied*, *beleidsdiscretie*, en *verticale autonomie* het meest belangrijk zijn voor het creëren van positieve economische effecten.

Gegeven de mogelijkheid voor lokale overheden om de lokale economie positief te beïnvloeden, gaat de dissertatie verder met het onderzoeken hoe lokale overheden deze positieve effecten precies kunnen creëren. Dit wordt gedaan middels een gedetailleerde analyse van de economische effecten van de volledige financiële compositie van uitgaven en inkomsten van lokale overheden in Amerikaanse steden. Er wordt aangetoond dat de mate van economische effecten van individuele lokale financiële componenten afhangt van de manier waarop zij gefinancierd worden. Zo heeft een belastingtoename enkel een negatief economisch effect wanneer het gebruikt wordt voor het financieren van niet-productieve uitgaven. Echter, wanneer een belastingtoename gebruikt wordt om productieve uitgaven te financieren, kan de belastingtoename zelfs een positief economisch effect hebben. Relatief productieve uitgaven zijn uitgaven aan sociale voorzieningen, wegen, nutsvoorzieningen, en commerciële activiteiten.

Gegeven dat lokale overheden niet enkel bezig zijn met het stimuleren van de economie, maar ook met het welzijn van haar burgers, wordt er in het derde onderzoek op een vergelijkbare manier als het tweede onderzoek gekeken naar hoe lokale overheden het welzijn van haar burgers kunnen stimuleren. In navolging van de literatuur, wordt populatiegroei gebruikt om welvaartseffecten te meten, gebruikmakend van een Tiebout-Rosen-Roback type analyse op Amerikaanse steden. De resultaten tonen aan dat steden mensen aantrekken middels uitgaven en investeringen in infrastructuur, zoals wegen, parkeergelegenheid, en vliegvelden. Daarnaast, zorgen ook uitgaven aan huisvesting en scholen voor een groei in populatie.

Tot slot worden de lokale publieke financiële effecten van een economische schok in het system geanalyseerd, door middel van een casus naar de *fracking-boom* in Texas. Gedetailleerde analyses worden uitgevoerd middels de volledige lokale publieke financiële compositie. De resultaten tonen aan dat de positieve economische effecten van de *fracking-boom* voor hogere huizenprijzen zorgen, en daarmee ook voor hogere belastinginkomsten uit onroerende goederen. Aangezien met name *county governments* en *school districts* onroerend goed belasting heffen, profiteren zij vooral in de vorm van toegenomen budgetten. De *county governments* gebruiken het toegenomen budget vooral voor de negatieve neveneffecten van de *fracking-boom*, middels uitgaven aan wegen, gerechtelijke administratie, en politie. De *school districts* gebruiken het toegenomen budget voor extra geld naar basis en middelbare scholen om te voldoen aan het toegenomen aantal kinderen welke mee zijn gekomen met de toename in werknemers. Een discussie over de beleidsgevolgen van de *fracking-boom* concludeert dat deze winnaars en verliezers heeft opgeleverd. Echter, de resultaten suggereren dat de verliezers nauwelijks gecompenseerd worden voor de negatieve neveneffecten waarmee zij te maken hebben gekregen. Een hogere compensatie zou mogelijk zijn via impactvergoedingen of overdrachten in natura van de olie- en gasbedrijven.

Acknowledgments

The past four years have been extremely energizing, educative and overall rewarding. I can honestly say I had the time of my life working on this project, and I have many people to thank for that.

When applying for the PhD position, I was still in Shanghai finishing my master's degree. Given that the internet connection on campus was sometimes shaky, I decided to book a meeting room at one of the best hotels close to campus. The service was of unnecessary high quality. However, the internet was not up to the restrictions China is notorious for putting in place during the discussions of the Chinese five-year plan. Skype only worked for a few minutes after which I was completely unable to reconnect. Luckily, Philip called me straightaway telling me that the hiring committee had no issues doing the interview over the phone. I am still very thankful for that because it was the start of an amazing four years.

I would like to express my gratitude to Philip and Viktor for all their excitement, energy and insights. From the first meeting we had, up to now, I always leave our meetings feeling more excited about our work, and full of new ideas to explore. In my opinion, this is the ultimate task of one's supervisors and Philip and Viktor have been more than excellent at it.

When Philip moved back to the UK early on in my PhD, he promised me that it would not affect me. He was right. He regularly visited Groningen, we met at conferences, and we stayed in touch through email, phone calls, text messages and skype. I knew he would always instantly reply or call me whenever I would put "urgent" in any email title. Philip always made sure we were on track.

Viktor was a true daily supervisor in the sense that he was always in his office and he would help me with anything I needed, or was just available for a simple chat about nothing. During the meetings with Philip, he would also take notes which we would discuss afterwards, and used to set up a plan for the coming weeks. Similarly, he was at every conference presentation he could, taking notes on the feedback and comments I received in order to discuss them with me afterwards. During the final year, my weekly meetings with Viktor helped me coordinating the work, staying focused, and remain optimistic about finishing on time. In my opinion, Philip and Viktor perfectly complement each other as supervisors and I cannot think of any better supervision.

I would also like to thank my office mates Fikri, Richard, Dani, Carmelina, Moises, Fieke, Titissari and Niels. Great thanks also to all my other colleagues and friends at the Faculty: Lili, Elda, Sergi, Suzan, Steven, Song, Gwenda, Laura, Lara, Michiel, Marten, Luise, Thanasis, Rik, Anna, Sander, Samira, Angelica, Eva, Felix, Mufty, Nina, Rozanne, Roselinde, Julia, Franziska and many more. Thanks also to Jouke, Jeannet, and everyone else at the Economic Geography department for creating such a fun workplace.

I would also like to thank everyone at the OECD for making my time in beautiful Trento a wonderful and productive experience: Joaquim, Rudiger, Alexander, Alessandra, Alexandra, Roberto, Francesca, Andrea, Elisa, Mattia, Paolo, and Valentina. I would especially like to thank Nikos, who I bumped into at every corner of my PhD as a neighbor, office mate (sorry again for being a noisy co-worker), roommate, and friend.

Great thanks to Steve Craig for his insightful feedback and comments in our work on chapter 5. Great thanks also to Guus Brinkhof for transposing the oil and gas well data and to Yu-Hsin (Annie) for her work on the local public finance of Texas. Thanks also to the many people attending the numerous conferences, summer schools, winter schools, and workshops for providing valuable feedback.

This book was written to the music of several of my favorite artists, to whom I air-drummed on a daily basis while working: Sigur Rós, the Mars Volta, Steven Wilson, Faithless, Sufjan Stevens, the Notwist, Big Thief, Leftfield, Oceansize, Radiohead, Moderat, Suuns, I Am Kloot, JPEGMafia, Burial, Brand New, Interpol, Destroyer, The Antlers, GSYBE!, Patrick Watson, Grandaddy, Nils Frahm, and many more. Thanks also to Seats2Meet Utrecht CS for providing a great workspace when I was working from Utrecht.

I would like to thank my parents for giving me all the tools I need in life, and always supporting me in every decision I make. This thanks also goes out to the rest of my family and friends who have supported me along the ride. A very special thanks also to Wade, Rodrigo, Orsa, Emma, Nora, Kevin, Brian, and all those amazing people I met at conferences, for making my time as a PhD even more unforgettable. Major thanks also to Pim and Slav for the weekly insightful discussions over drinks and Olaf for welcoming me to Utrecht the way he did.

Finally, I would like to thank Leonoor for all your support. From the moment we met, your enthusiasm and interest in economics and research have been infectious. While you initially may have briefly distracted me somewhat from my work, you gave me so much energy and joy, making work much easier and productive in the end. Your numerous visits to Trento will always remain special, as will the experience of us both working in our small, amazing apartment during the final months of finishing this work.

Utrecht, December 2020