THE IMPORTANCE OF INSTITUTIONAL ARRANGEMENTS FOR
DEVELOPMENT: A STUDY OF THE RELATIONSHIP
BETWEEN DECENTRALIZED GOVERNANCE AND THE PROVISION OF
PUBLIC EDUCATION

by

Ramziya K. Shakirova
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Committee:

_____   Andrew Hughes Hallett, Chair

_____   Kingsley E. Haynes

_____   A. Lee Fritschler

Roger D.Congleton, External Reader

_____   James P. Pfiffner, Program Director

_____   Mark J. Rozell, Dean

Date: _____   Summer Semester 2013
George Mason University
Fairfax, VA

The Importance of Institutional Arrangements for Development:
A Study of the Relationship between Decentralized Governance
and the Provision of Public Education

A dissertation submitted in partial fulfillment of the requirements for the degree of
Doctor of Philosophy at George Mason University

By

Ramziya K. Shakirova
Candidate of Economic Sciences
Kazan Institute of Finance and Economics, 1996

Director: Andrew Hughes Hallett, University Professor
School of Public Policy

Summer Semester 2013
George Mason University
Fairfax, VA

DEDICATION

This dissertation is dedicated to my beloved parents, Faniya and Kamil Shakirov.

Кадерле әнием белән әтиемә багышлана.

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ABSTRACT

THE IMPORTANCE OF INSTITUTIONAL ARRANGEMENTS FOR
DEVELOPMENT: A STUDY OF THE RELATIONSHIP
 BETWEEN DECENTRALIZED GOVERNANCE AND THE PROVISION OF
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Ramziya Shakirova, PhD

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Dissertation Director: Dr. Andrew Hughes Hallett

This dissertation explores the possibility of improving the provision of public education

through decentralizing decision-making, taxation and public spending to the level of

regional governments. It develops a theoretical framework to analyze the impact of fiscal

decentralization on the provision of public education and uses quantitative analysis to

empirically evaluate the impact. The effects of other major socio-economic, political and

demographic variables on public education spending and education outcomes were also

examined. The analysis using cross-sectional time series data for 33 developed and

transitional countries over the 1997-2006 period revealed that institutional arrangements

in the form of decentralization of governance to the regional level have the potential to

significantly improve public education.

CHAPTER 1

INTRODUCTION

The purpose of this dissertation is to investigate empirically the impact of

decentralization on providing public education as a type of regional public good.

Particularly, the dissertation examines the impact of fiscal federalism on financing of

education and the quality of education quality. The dissertation intends to explore

theoretical mechanisms explaining the impact and to test the theory using a sample of 33

countries that includes developed and transitional countries.

There are two research questions addressed in this dissertation. The first research

question "Whether public spending on education is higher in countries with a greater

level of fiscal decentralization (higher regional fiscal autonomy)?" intends to investigate

the impact of fiscal decentralization on public financing of education. The second

question "Whether higher public spending on education results in better outcomes?"

explores the relationship between public spending on education and the educational

quality and, thereby evaluate the direct and indirect impact of fiscal decentralization on

educational outcomes.

The objective of these research questions is to improve our general understanding about

fiscal decentralization's impact on providing public goods and services. Public education

was chosen as a typical type of regional public good, which gives us an opportunity to

test the linkage of decentralization to economic development since education leads to the development of human capital and to economic growth. The dissertation uses quantitative methods of analysis of time series cross sectional data to answer these research questions.

This dissertation contributes to academic literature in several ways.

First, it systematizes the existing literature and modifies the theoretical approaches through critical analysis of models offered by different schools of thought. It argues that a theoretical framework should be based on theories with the possibility of testing the impact of each factor /theory separately. The decentralization theorem is seen as most powerful among existing theories. I also discuss the assumptions that underlie the cases in which the decentralization theorem (based on heterogeneity of tastes and preferences) works.

Second, this dissertation brings into discussion the optimal levels of decentralization in any government and the necessity for correcting decentralization measures for asymmetric assignments of the power. It suggests that fiscal decentralization at regional (intermediate between central and municipal) levels may be more beneficial for improving the provision of local public goods because they have more fiscal and administrative capacities.

Furthermore, this dissertation is based on the approach that the impact of decentralization on each category of public good should be studied separately because the differences exist not only between regional and national public goods but also between different categories of regional public goods. In this dissertation I focus on only one type of public

good, the provision of public education; the study of the other categories is left for future research.

This dissertation also contributes to the academic literature by developing approaches that may be used to study the relationship between public spending on education and education outcomes, thus exploring the direct and indirect impacts of decentralization on education outcomes.

Next, this research contributes to both the theoretical and empirical literature on economic development by showing the link of decentralization to human capital development through education. Decentralization's impact on the economic development of countries is not well understood in the literature, since it is not clear what links decentralization to economic growth. My research attempts to fill that gap in the understanding of the mechanisms that underlie that impact.

Beyond Chapter 1's Introduction, the dissertation is organized as follows. Chapter 2 surveys the existing theoretical literature and provides an understanding of major theoretical schools and models of fiscal decentralization. Chapter 3 develops a theoretical-methodological approach to the problem by analyzing the literature on factors that influence the outcomes of decentralization and public spending budget formulation, as well as the approaches to measuring decentralization and by discussing their shortcomings. By identifying the major concepts, relationships and variables, and revealing the gaps in the literature, this survey helps develop a theoretical model for empirical research. Chapter 4 presents details about the data and methods of time series cross sectional data analysis selected to answer the research questions and describes

variables used in empirical analysis. Chapter 5 presents the regression models developed to answer each research question and diagnostic tests for the models and discusses the research findings. Chapter 6 presents the policy relevance and implications of the research findings. Chapter 7 concludes the dissertation by summarizing findings of theoretical and empirical analyses.

This dissertation and its findings will be useful for the academic community and local and central policy makers, as well as for non-profit organizations and citizens concerned with improvement of public education and local governance. Further it will provide insights for those concerned with problems of regional autonomy and fiscal federalism. The results can be used as reference points when developing more efficient public policies and policies more responsive to local needs.

CHAPTER 2

LITERATURE REVIEW

This study is at the edge of several disciplines: public economics and political economy, regional economics and public choice. In this chapter I provide a review of classical theories and recent schools of thought on decentralization and fiscal federalism. First, I discuss the basic features, principles and nature of federalism as a form of government. Although a thorough consideration of institutional and political federalism goes beyond this study, the reasons why countries decentralize their governments may be similar to why they choose federalism, so it will help to better understand what outcomes they expect from the decentralization and fiscal federalism.

The nature of federalism

Countries choose the federal form of government mainly for economic and political reasons. (Filippov et al (2004)). The economic justification of federalism is based on the fact that "Government (i.e., coercive) action may be required to resolve market failures associated with informational asymmetries, externalities, and wholly decentralized decision making over public goods. However, public goods in particular vary in their characteristics, which, in turn, may require different treatments by different levels of government. ….The ideal federalism …is one that allocates the responsibilities of the state across levels of government according to rational criteria…" (p. 2)

The political justifications for federalism may include various reasons like "allowing minorities – ethnic, religious, linguistic, or otherwise – the autonomy they often demand as 'payment' for their acquiescence to the coercive powers of the national government" (p. 2). As noted by Filippov et al, "in theory at least federalism allows individuals to join those with whom they share similar tastes for government services, thus opening the door to a general level of welfare – and, presumably, a degree of satisfaction with political institutions – unavailable to a unitary state" (p. 2) . Federalism also helps to resolve or decentralize conflicts.

Inman and Rubinfeld (1997) identify the following three reasons why federalism is valued: "it encourages an *efficient* allocation of national resources; it fosters *political participation* and a sense of the democratic community; and it helps to protect basic *liberties and freedoms*." (pp. 44-45)

The theory of federalism from a public finance point of view is discussed in Musgrave (1959). He discusses the model of pure federalism, which assumes that "state governments…possess full autonomy. They differ from the central government only in area covered." In this model, he says, "the principle of equal treatment of equals does not apply to total (state plus central) taxes on a nationwide level" (p.179), but "this is nothing to object to. Indeed, it is as it should be. The very purpose of fiscal federalism, according to this approach, is to permit different groups living in various states to express different preferences for public services; and this, inevitably, leads to differences in the levels of taxation and public services." (pp. 179-180)

Musgrave suggests that "the policies of the Allocation Branch should be permitted to differ between states, depending on the preferences of their citizens. The objectives of the Distribution and Stabilization Branches, however, require primary responsibility at the central level." (Musgrave 1959, 181-182)

After discussing pure federalism, he moves to a more practical view of federalism and discusses the necessity of transfers to guarantee a minimum level of public services. "If any one state is too poor to provide this minimum level, even though a required minimum degree of tax effort is made, the federation steps in. It calls for a transfer from wealthy states where the minimum level of public services is provided while tax rates are below the stipulated minimum level. If, however, the citizens of any one state fall short of the required tax effort, no claim for support can be established"(p.183).

However, Musgrave does not discuss whether the mentioned minimum level and having taxes lower than some minimum level is the result of preference or insufficient tax "capacity." Although, it is difficult to distinguish between these two, it would be useful to do so in future empirical studies because these two would require two different strategies for remedies. In my opinion, it would be possible to distinguish them by controlling for tax base/tax capacity of the regions (or by using proxies to control for this factor if such data is not available).

Musgrave recognizes the complexity of federalism and notes that the problems of fiscal federalism are complicated if: 1) the levels of government are expanded beyond two; 2) overflows of public services from one state to another are allowed; and 3) the possibility

of minimal taxation (domestic tariffs) is considered. (p.183). He also writes: "The choice between the various …approaches as well as other patterns is not a matter of fiscal analysis only. It is basically a matter of how to interpret the nature of the federation, thus involving political no less than economic considerations." (p.183)

Musgrave, however, does not focus on the relationship between fiscal federalism and the level and quality or efficiency of the provision of public goods.

Classical Theory

Classical theory that looks at the impact of fiscal decentralization on the provision of public goods and services was developed by Tiebout (1956) and Oates (1972). In this framework fiscal decentralization guarantees an efficient provision of public goods because local preferences are better satisfied than in the case of centralization. It assumes a benevolent government.

C.M. Tiebout's article "A pure theory of local expenditures" (1956), one of the best known and most cited works in the literature of fiscal federalism, argues that decentralization can be seen as a model of intergovernmental competition, where in an urban context consumers "vote with their feet." This generates Pareto efficient patterns of local services and taxes. Consumers choose to live in that locality that provides the fiscal package for them according to their preferences and tastes. He notes that in earlier public finance theories "no 'market type' solution exists to determine the level of expenditures on public goods. Seemingly, we are faced with the problem of having a rather large

portion of our national income allocated in a "non-optimal" way when compared with the private sector" (p. 416), and inefficiencies result.

Wildasin (1987) notes, "Tiebout's article was a direct response to Samuelson's classic 1954 and 1955 papers on public expenditure theory, in which it was claimed that there exists no market or other mechanism that would provide proper incentives for the efficient provision of public goods." (p. 1161)

The mechanism described in Tiebout's article can be considered as a market solution to the problem of producing efficient levels of output of some public goods.

This model is based on the following assumptions:

1) Consumers are mobile (i.e., cost of mobility is very low);

2) They have a full knowledge of revenue and expenditure patterns of communities;

3) There is a large number of communities to choose from;

4) Restrictions due to employment are not considered;

5) Public Goods do not spill over in terms of benefits/costs from one community to the next;

6) There is an optimal size of communities for each pattern of community services;

7) Communities try to achieve "optimal size."

The assumptions are criticized in the literature (Bardhan 2002, 188-190), but despite this, Tiebout's model is influential and continues to serve as a starting point in most empirical research.

The theory of fiscal federalism and decentralization was further developed in Wallace E. Oates's book "Fiscal Federalism" (1972). Oates offers an economic definition of federalism as "a public sector with both centralized and decentralized levels of decision-making in which choices made at each level concerning the provision of public services are determined largely by the demands for these services of the residents of (and perhaps others who carry on activities in) the respective jurisdiction" (p.17). He also offers a decentralization theorem, which argues that "For a public good – the consumption of which is defined over geographical subsets of the total population, and for which the costs of providing each level of output of the good in each jurisdiction are the same for the central or the respective local government – it will always be more efficient (or at least as efficient) for local governments to provide the Pareto-efficient levels of output for their jurisdiction than for the central government to provide any specified and uniform level of output across all jurisdictions" (p.35).

Oates also point out that when "…the welfare gain from the decentralized provision of a particular local public good becomes greater as the diversity in individual demands within the country as a whole increases and as each geographical grouping of consumers becomes more homogeneous in terms of their demands for the good" (p.37).

Oates' theory assumes that governments are benevolent, i.e., operate in order to maximize social welfare and that in case of centralization there is a uniform provision of public goods.

As additional benefits from decentralization Oates sees the possibility of "greater experimentation and innovation in the production of public goods" (p.12) and "more efficient levels of public output, because expenditure decisions are tied more closely to real resources costs" (p.13).

In "An Essay on Fiscal Federalism," (1999), Oates further develops the discussion of federalism. In this article, he reviews traditional theories of fiscal federalism and provides a survey of new developments in this area: laboratory federalism, interjurisdictional competition and environmental federalism, the political economy of fiscal federalism, market-preserving federalism, and fiscal decentralization in developing and transitional economies.

Decentralization also has limits; not all government functions can be decentralized. For example, from Oates' view, such functions as macroeconomic stabilization and economic distribution of income should be performed by the central government because "in the absence of monetary and exchange-rate prerogatives and with highly open [regional] economies that cannot contain much of the expansionary impact of fiscal stimuli, provincial, state, and local governments simply have very limited means for traditional macroeconomic control of their economies. Similarly, the mobility of economic units can seriously constrain attempts to redistribute income…" (Oates 1999, p.1121)

Decentralized levels of government, according to Oates, "have their raison d'etre in the provision of goods and services whose consumption is limited to their own jurisdictions. By tailoring outputs of such goods and services to the particular preferences and

circumstances of their constituencies, decentralized provision increases economic welfare above that which results from the more uniform levels of such services that are likely under national provision" (pp.1121-1122)

Oates also discusses Tiebout's model and says that decentralization leads to an increase of efficiency even "if there were absolutely nothing mobile—households, factors, or whatever" - as "the efficient level of output of a 'local' public good, as determined by the Samuelson condition that the sum of the marginal rates of substitution equals marginal cost, will typically vary from one jurisdiction to another" (p.1124)

The Second Generation Models

Ideas about federalism were further developed in so-called second generation federalism, as Qian and Weingast (1997) called their work. They write that traditional theories of federalism point out two sources of benefits from decentralization:

> First, Hayek (1945) suggested that, because local governments and consumers have better information than the national government about local conditions and preferences, they will make better decisions. Second, Tiebout (1956) argued that competition among jurisdictions allows citizens to sort themselves and match their preferences with a particular menu of local public goods. In this spirit, Musgrave (1959; see also Oates, 1972) showed how the appropriate assignment of jurisdictions over public goods and taxes can increase welfare. (p.83)

At the same time, they note that earlier economic theories "ignore the problem of why government officials have an incentive to behave in the manner prescribed by the theory." (p. 83) Qian and Weingast (1997) attempt to answer to the question: "How do governments commit to providing efficient public goods and preserving market incentives?" They say that "the answer lies in the governance structure of the state

(Williamson, 1996). Preserving markets requires that the state be effective yet limited. Several mechanisms are known to further this objective, such as the rule of law, horizontal separation of powers (for example, into the executive, judiciary and legislative branches), and democracy, but all such mechanisms are imperfect" (p.83-84). Qian and Weingast suggest that federalism provides another solution.

They argue "that the appropriate political institutions [will] align incentives of political officials and citizen welfare" (p. 84). For markets to work effectively,

> the state must maintain 'positive' market incentives that reward economic success. When the government is tempted to take away too much income and wealth generated by the future success, individuals have no incentives to take risks and make effort today. …The state must also commit to 'negative' market incentives that punish economic failure; if the [central] government is tempted to bail out failed projects or continue costly, inefficient public programs, individuals have no incentives to avoid mistakes and waste. In the terms of Kornai (1986), this is the 'soft budget constraint' problem. (p.84)

Sinha (2005) writes that "The second generation of research on fiscal federalism puts forward more nuanced arguments by analyzing the pattern and nature of decentralization rather than decentralization per se... The theory of market preserving federalism incorporates a more realistic assumption about rulers; strong central states, it argues, hold the potential to subvert the beneficial effects of market-oriented growth. Local governments, in contrast, subject to the pressures of interjurisdictional competition, respond to citizens' functional needs as well as check …central power effectively" (p. 337). However, he notes that despite these insights, the empirical evidence is controversial.

Public Choice

The theory of decentralization of governance was further developed in public choice and political economy models. It is one of the central problems discussed in public choice literature[1]. For example, Mueller (2003) writes "a superior institutional arrangement to having the quantities of both G_l [local public goods] and G_f [national public goods] decided by the larger community is to assign the authority to decide G_f to the larger community, and the authority to decide G_l to the …smaller ones. Having done so, one has created a federalist state" (p. 210). He writes that "a federalist state has two salient properties: (1) separate and overlapping levels of government exist and (2) different responsibilities are attached to the different levels of government. The polar case of a federalist system would have specific authorities for different activities assigned to each level of government, with each level able to determine both the expenditure levels for the activities assigned to it, and the taxes to cover these expenditures." (p.210). However, he notes in practice no federal country fits this polar case, but will it "exhibit these two salient features to some degree" (p. 210). He sees the federalist state as an institutional arrangement to optimize transaction costs.

Mueller also discusses federalism with geographic representation, considering representative government at a higher level of government. He argues that under at-large representation of geographically dispersed preferences, discrimination may occur against some groups, depending on how coalitions are formed. (p.214)

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[1] See, for example, the special issue of *Public Choice Journal* on local government setting Public Choice (2011), also Feiock (2007).

Mueller also discusses the effects of intergovernmental grants on local governments' spending and notes that the empirical literature finds, that "money from the central government transferred to a local government largely 'sticks where it lands' – in the local governments' budget. So consistent is this result that it has acquired its own name: the flypaper effect." (Mueller 2003, 221)

As separate and overlapping levels of government where different responsibilities are attached to the different levels of government are mentioned, we also need to discuss vertical competition, which occurs between different levels of government. Such analysis and definition of vertical competition is provided by Breton (2006).

Breton notes that there are two ways to approach decentralization: "that of welfare economics and public choice economics" (p.89). He notes that " if one chooses the first of these, then there are no intrinsic virtues to decentralization since a government that maximizes a social welfare function, while it may face informational constraints, will always strive to address all the problems that arise in the entirety of the country" (p.89). "Those in the welfare economics tradition who attach virtues, such as 'closeness to the people', 'risk reduction in socio-political experimentation and innovation', or 'the promotion of liberty,' to decentralization are logically inconsistent because a social-welfare-function-maximizing institution always strives to be close to people, always tries to experiment and innovate at minimum risk, and always toils to promote liberty" (pp.89-90). However, this assumes that government maximizes social welfare or is benevolent. If we drop the assumption of benevolent governments (as I do in my research), the "closeness to the people" still matters.

16

Breton continues that in case of the public choice economics approach, "these virtues are simply that an ideal decentralized institutional structure may possess the 'balance' needed to make effective 'checking' possible. The checks (and the balance) are a manifestation of competition. The case for decentralization is that it produces competition and, by virtue of that competition, a degree of control over the office-holders who, the approach assumes, seek to maximize their own interest. If competition is strong enough, separate reference to subsidiary, to experimentation and innovation, and to liberty is redundant…" (p.90) However, competition alone may not be enough to control for self-interest maximizing office-holders. This is why I think the electoral accountability assumption is critical and has to be included in a theoretical model. Also Breton's opinion that competition can solve all other problems (including experimentation, innovation and liberty) is too optimistic and will not always work in practice. Also, I will show later that competition does not always work.

Breton writes that "a governmental system is decentralized when checks and balances, and therefore vertical competition is, are present." He states that if "checks and balances and vertical competition are absent, decentralization… will not support an automatic mechanism operating to assign powers" (p. 90)

He analyzes a horizontal competition described in Salmon (1987) and continues this discussion to vertical competition. He writes that "one virtue of that mechanism – not shared by a mechanism based on fiscal mobility – is that it can provide a rationale for vertical competition whenever citizens use the performance of governments located at other jurisdictional tiers as benchmarks to evaluate what their own government is doing"

(p. 92) He argues that this mechanism helps "to shape the assignment of powers" (p. 92)
Vertical competition is based on the fact that "assignments, like contracts, are always
incomplete.." and vertical competition leads "to a new (static) permanent division of
powers between jurisdictional tiers" (p. 94) According to Breton "it generates
reassignment of powers that reflect the comparative advantage of governments at
different tiers.." (p. 95)

Breton states that "vertical competition is an important (and to date the only known)
automatic mechanism that contributes to the determination of equilibrium assignments of
powers or of their division among governments located at different jurisdictional levels."
(p. 95) However, he recognizes that the operation of vertical competition "is conditioned
by what are in effect institutional constraints." (p. 95) He suggests that the following
institutional constraints are the most important: federal or unitary character of the
governmental system, initial conditions and path dependence, dynamic instability (or
"race to the bottom"), decision-making influence of constitutional courts and the division
of revenue powers between jurisdictional tiers. (pp. 95-101)

Another important contribution of public choice literature to decentralization theory is
Brennan and Buchanan's (1980) Leviathan hypothesis (called also "the competition
thesis" (Busemeyer 2007, 6) This literature sees fiscal decentralization as a mechanism
for constraining the expansionary tendencies of governments. Under this approach,
central governments do not maximize social welfare and operate like monopolists (or
leviathans) in order to increase their control over the economy's resources and to
maximize the revenue (Brennan 1980, 29) As Busemeyer notes, "To Buchanan, the

growth of the public sector in the second half of the twentieth century is indicative of a process he calls 'politics for profit' (Buchanan 1977, 13), in which politicians expand public spending to maximize their 'political income' and increase their chances of re-election." Busemeyer also notes that in democracies "the electoral process should be a sufficient restraint on government, but fiscal constraints can substitute as efficient restraints on the power of government to tax in a less-than-ideal setting (p. 8) Fiscal federalism in a decentralised polity can be seen as 'market analogy' (Buchanan 1995, 21), introducing interstate competition and effectively limiting the power of constituent governments to raise spending." (Busemeyer 2007, 6)

The thesis that decentralization serves as a fiscal constraint on the central government's taxing power was also supported by some empirical literature (Nelson, 1987, Marlow, 1988, Grossman, 1989, Grossman and West, 1994, Feld et al., 2003, Fiva, 2005, Ebel/Yilmaz 2004). However, some found no robust impact of decentralization on spending (Oates 1985; Zax 1989; Anderson 1998; Kirchgaessner 2001).

The most recent public choice literature (Rodden (2003), Busemeyer (2007)) argues that Leviathan hypothesis may not always hold. Rodden (2003) argues that if decentralization is provided by grants from general to local governments (or through expenditure decentralization) the expected outcome should be a larger public sector. When the general government decentralizes fiscal revenues, the effect on total public sector might be negative. As Busemeyer (2007) notes "The fact that decentralized systems with a high degree of vertical imbalance between delegated spending and revenue authority spend

more emerges as one of the few robust findings" (Grossmann 1989; Grossmann/West 1994; Stein 1999; Jin/Zou 2001; Rodden 2003) (p.8)

Busemeyer (2007) finds that the impact varies and can be positive or negative; instead of decreasing spending, fiscal decentralization can increase aggregate spending, depending on the respective type of spending. He also argues that the impact of fiscal decentralization on the provision of Regional Public Goods (RPG) is not well understood yet (p.12) He points out that all studies of the relationship between decentralization and public spending focused at total spending and ignored the fact that fiscal decentralization may affect different types of spending differently, and it might be related to the fact that some of public goods are national public goods and some are regional public goods. "In contrast to NPGs, RPGs are usually provided by localities or regional governmental bodies, and there is a greater variety in terms of quality and general levels of spending." (Busemeyer 2007, p. 9) He defines regional public goods as "those spending items or programmes where the spending authority lies with the local or regional level of government." (p. 9) At the same time, he acknowledges that some degree of interdependence between different levels of government may exist for all types of spending.

Busemeyer notes that the public choice literature sees this problem from two angles: from the point of view of the decentralization thesis (based on Oates' view) and the competition thesis (pp. 5-6).[2] Busemeyer also notes that "more recent models try to

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[2] In fact, Busemeyer refers to the Kirchgassner (2001) saying the terminology 'competition thesis' and 'decentralisation thesis' is taken from Kirchgassner (2001).

integrate the welfare economics and the public choice perspectives of the decentralization and competition theses" (p. 7) and "a sound theoretical concept of a *positive* relationship between fiscal decentralization and spending is missing." (p. 8). He says there are two perspectives: Rodden's and Grossmann's public choice perspective, assuming self-interested politicians and voters, and Oates' argument that "higher spending can actually reflect preferences for higher spending and not externalities of the actions of purely self-interested political actors."(p. 8)

Busemeyer argues that the assumption that "voters care mostly, or even solely, about lower tax rates and/or lower spending"(p.12) is not totally correct, because "it is also possible (and maybe more realistic) to assume …that voters face a tradeoff between welfare losses due to higher taxation and welfare gains due to the increased provision of public goods. ..Thus, voters are not looking for the lowest tax rates, but the best combination of a public good and its tax price."(p.13)

The competition is not based solely at the level of taxes (he notes that now "corporate tax competition takes place between nations and not between communities" (p.13). Communities, according to him, mainly compete for consumer-voters (citizens). Communities also "have an incentive to attract consumer-voters to spread the costs of providing a given public good over a larger number of taxpayers." (p.13)

According to Busemeyer, the consumer-voters value "the concrete benefit of being able to consume certain public goods" more than the "the relatively abstract benefit of a slightly lower tax rate." (p.14) And the "competition between subnational units are not

(only) lower tax rates, but better schools, better hospitals, nicer swimming pools, a safer neighborhood, etc.," in other words, for better provision regional public goods.

And as a result, such a 'race to the top' at the local level increases levels of spending on regional public goods in decentralized systems. (p. 14).

However, it should be mentioned that having a trade-off between lower taxes and lower public goods implies that only one mechanism - competition - cannot fully explain how decentralization works. We also need to complete the theoretical model with other mechanisms. I will discuss this in the next chapter.

Busemeyer empirically shows that "the logic of a local 'race to the top' holds even when fiscal decentralisation is measured in terms of revenue autonomy."(p. 15) It was shown earlier by Rodden (2003) that "the delegation of spending autonomy alone leads to increased spending because lower levels of government have an incentive to free-ride," and by Volden (2005), that when "different levels of government are jointly responsible for the provision of a given public good, the resulting 'horizontal' competition will lead to overspending" (Busemeyer 2007, 14)

Salmon (2009) called second generation models and early public choice models "an *ademocratic* political economy theory of federalism because …no particular attention given to democratic processes…" (pp. 2-3)

Salmon (2009) also points out that there are some objections to the regional competition thesis in the literature:

> The possibility that, from the start, some regions have a natural advantage or disadvantage of some kind and thus that competition among regions may be unbalanced – so much so that some regions may even decide not to participate in it – is a major objection to the approach (Cai and Treisman 2005). A second objection is that not only bad policies may be eroded by mobility-based competition, but also 'good' ones (the 'race to the bottom' possibility) or, at any rate, policies to which the population is strongly attached. As a consequence, in democracies the *ademocratic* characteristic of the second approach may well turn out to be unsustainable. (p. 3)

Lockwood (2006) distinguishes between the "'standard' or traditional approach to the study of fiscal federalism, which treats each level of government as a benevolent social planner, maximizing the welfare" (p. 33) and the political economy approach, which is better to able to explain two key benefits – preference-matching argument and the accountability of government – and can address shortcomings of standard approach. In Lockwood's opinion, a key part of political economy perspective is that political institutions determine the choice between centralization and decentralization (p.35)

Recently, the theories of decentralization were substantially developed. And most of the recent literature considers governments and politicians as self-interested actors, thus departing from the normative approach and benevolent government assumption of earlier theories. These recent approaches are called a political economy approach. They emphasize "the importance of institutional arrangements, including the legal, political and administrative aspects, and information flows to ensure that there are appropriate incentives and sanctions to generate good governance."(Ahmad and Brosio 2006, 1)

Recent Models

Earlier political economy models of decentralization assumed that governments maximize their own objective function. Recent political economy models of

23

decentralization place the accent on the electoral accountability of office-holders. (Salmon, 2009)

The recent political economy models may also be subdivided into two streams (Porcelli 2009). The first is "a political economy model like direct democracy where the decision-making process is implemented via majority voting over alternative levels of public good provision." (Porcelli 2009, 3-4). These models are also called "legislative decision making" (Lockwood, 2006). In this case, the decentralization theorem continues to hold if preferences of the median voter are equal to the average preferences; centralized decision-making process produces the inefficient outcome, for example through cost-minimization.

The second stream is a "principal agent model of electoral accountability model." (Porcelli 2009, 5) From this point of view, decentralization is preferred. Porcelli comments about Oates saying "a centralised system takes the form of a single agent (elected public official) who serves the whole population, while decentralization consists of one agent in each jurisdiction" (Oates (2005). Porcelli further notes "Fiscal decentralization stimulates political accountability; a positive effect on government efficiency can be observed also in the case of perfect homogeneity of preferences across local jurisdictions." (p. 5)

So, decentralization, through tax or yardstick competition can help to reduce the information asymmetry and also increase electoral accountability.

Salmon notes that competition between jurisdictions may be mobility-based or may happen without any mobility when it takes a form of yardstick competition. But he notes that a large part of the literature assumes that the horizontal competition is mobility based (Salmon 2006, 62).

As Salmon explains "yardstick competition," "Office-holders want to be re-elected." (Salmon 2009, 4). Citizens vote depending on their perception of government's performance, but they do not have full information ("information asymmetry"). However, they can compare performance of their own local government with the performance of governments in other regions, and office holders "want to be judged as performing comparatively well." (p.4) Thus, "yardstick competition" among governments "may strengthen in governments (not only politicians in office) the right kind of incentives." (p. 4) For this mechanism to work, there should be several governments, and "federalism and political decentralization imply such coexistence and consequently offer a way to make office-holders more accountable." (p.4)

There is another reason for yardstick competition— to be promoted (Salmon 2006, 74-75)[3]. This may be more applicable to countries with no electoral accountability but where local governors are accountable to central power.

Salmon also mentions that yardstick competition may be powerful in a non-democratic context (Salmon 2006, 77).

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[3] Salmon refers to Rose-Ackernam and Strumpf, who noted that a successful office holder in a subcentral jurisdiction may seek a reward in the form of an office higher up in the governmental system.

Salmon also notes that the assumption that mobility is costless is not correct, and he mentions that we can divide factors among those who are mobile and those who are not. He mentions that in Europe labor is not mobile across member countries (Salmon 2006, 69).

Provision of Local Public Goods

There is extensive empirical literature that discusses the impact of federalism on economic growth,[4] but the research on its impact on local public goods provision is limited.

As for the impact of federalism on education, Bruekner (2006) and Cerniglia and Longaretti (2008) deserve attention, although they discuss total (not only public) investment in human capital. Brueckner (2006) in his model drops Tiebout's assumption that demand and consumption of the public good are homogeneous in communities. Young and old people in his model choose different communities better tailored to their needs. This results in a differentiated public good consumption, which affects saving incentives. Savings in federal systems, according to Brueckner, will be higher than under unitary regimes because young people invest in human capital and consume less public goods (not related to education). And higher investment in human capital affects economic growth positively, as it was illustrated by endogenous growth models.

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[4] For example, Feld et al (2007) review and discuss six cross-country studies, including Davoodi and Zou (1998) (46 developing and developed countries), Woller and Philipps (1998) (23 developing countries), Yilmaz (2000) (17 unitary States, 13 federal countries from among the Newly Industrialized Countries and developed countries), Enikolopov and Zhuravskaya (2003) (21 developed and 70 developing and transition countries), Thießen (2003) (21 developed countries), Thießen (2003a) (26 countries). They also provide a survey of nine single country studies (for China, Ukraine, the U.S. and Germany).

Cerniglia and Longaretti (2008) modified Brueckner's analysis and assumed "that i) the public good enhances the human capital; ii) human capital is heterogeneously distributed across individuals."(Cerniglia and Longaretti 2008, 2) They also found that "federalism, which allows education-related public good levels to be tailored on the human capital of heterogeneous agents, increases human capital accumulation. This in turn leads to higher rates of growth. The benefits of federalism are stronger the larger the intra-jurisdiction variance of agents' human capital" (p.1).

Although these two studies find a positive relationship between federalism and investments in human capital, they do not focus on public provision of education.

There are some studies that discuss how fiscal federalism and decentralization in general may affect the provision of public goods. For example, Martinez-Vazquez and McNab note that "in fact, subnational governments can be more efficient than the central government even if all individuals have identical preferences or if they lack mobility. Central governments may have a greater tendency to spend funds, for example, on national defense when the priorities of taxpayers may be better reflected, for example, by greater expenditures on education and sanitation." (Martinez-Vazquez and McNab 2003, 1604)

They also point out that "decentralization may lead to greater producer efficiency in that it fosters experimentation and innovation in the provision of goods and services." (p.1604)

Discussing local service delivery, Ahmad et al (2006) point out the importance of relationships of accountability between the actors in a service delivery chain. They look at relationships between citizens and policy makers, between policy makers and service providers, and also between local and central policy makers. Ahmad et al say that "the accountability between central and local policy makers - its fiscal, financing, regulatory and administrative dimensions - can have an important bearing on the incentives facing service providers and therefore on service delivery outcomes. Sound design and implementation of these aspects of decentralization is the starting point for improving local service delivery" (Ahmad et al. 2006, 245). They note that "the assignment of expenditure and financing responsibility between different tiers of government can have a direct impact on service delivery" (p. 245)

The following statement particularly deserves an attention. "The accountability of lower-level governments to local clients is enhanced if subnational governments have access to own-taxes with the right to adjust tax rates. Indeed, the service delivery incentives facing subnational governments may improve if, at the margin, they have to raise their own revenues through tax increases rather than relying on central transfers or bailouts that soften the budget constraint." (p. 246)

There are not many empirical studies that look at outcomes of decentralization for education. For example, Jean-Paul Faguet and Fabio Sánchez (2008) compare the case of Bolivia with the case of Colombia to explore decentralization's effects on public education outcomes. They tested the link between decentralization and specific policy outcomes (enrollment rates). They found that "in Colombia, decentralization of education

finance improved enrollment rates in public schools. In Bolivia, decentralization made government more responsive by re-directing public investment to areas of greatest need. In both countries, investment shifted from infrastructure to primary social services." (Faguet and Sánchez 2008, 1294) Fiske (1996) also analyzes the case of Colombia and concludes that "In short, the decentralization effort in Colombia was successful in providing legitimacy to the government and improving education, but its impact was severely limited by the failure to obtain consensus and the support of important players…." (p. 14)

Generally speaking, the results of empirical studies on the relationship between fiscal decentralization and provision of public goods are inconclusive so far. One possible explanation of such inconclusiveness may be that researchers use different measures to measure the level of decentralization. I discuss this problem later in Chapter 3.

There are some studies that find a negative relationship between decentralization and provision of public goods. For example, Akin et al (2005) find decentralization results in fewer funds for public goods provision as local planners allocate "declining proportions of their budgets to public goods activities." (p. 1417) They also find that spillover effects "lead to free riding by districts on the health budgets of their neighbors." (p.1437)

De Mello (2000) points out the coordination failures in intergovernmental fiscal relations and that these coordination failures may induce subnational governments to spend inefficiently and beyond their means.

Some researchers note that decentralization's impact is unclear, and it depends on the income level of countries (Khaleghian, 2004) or it may have a different impact on

different public services (Busemeyer, 2007). Treisman (2000) finds that decentralization results in greater perceived corruption, and there is weak evidence that countries with more tiers of government offer a lower quality of health. He finds that the effect of decentralization on education is rarely significant, but in the case of federal countries the effect seems to be positive and significant.

Some researchers report a positive impact of decentralization. Adam et al (2008) find that government efficiency increases with the degree of fiscal decentralization. Lockwood and Barankay (2006) find that more decentralization is associated with higher educational attainment.

There is also a debate about the relationship between decentralization and corruption, and how it affects economic growth. (Martinez-Vazquez and McNab 2003, pp.1606-1607) Hanka (2008) note that "some scholars have highlighted the danger that decentralization, far from enhancing accountability, may simply serve as a vehicle for strengthening the powers of regional elites (Smoke 2006; Azfar et al. 2004; Bardhan and Mookherjee 2001; von Braun and Grote 2002)..…For subnational democracy and accountability to exist care must be taken that lower-tier governments truly represent all of their constituents…" (pp. 4-5)

The literature also discusses the possibility of an unequal distribution of public resources as a result of decentralization. There are arguments on both sides of this question, although as yet without any resolution through empirical tests (Martinez-Vazquez and

McNab 2003, pp.1605-1606). I will return to the equity problem and how I can control for this in empirical research in the next chapter.

The next chapter will provide the critical analysis and summary of the findings from the literature, which will help to define and shape a theoretical approach to the analysis of the problem. I will also discuss the factors that may influence public spending and the provision of public education, so it will help to identify major control variables and theoretically justify a model to study the relationship between fiscal decentralization and public education provision. I will also discuss in more detail how decentralization is measured in the literature.

CHAPTER 3

A METHODOLOGICAL APPROACH TO MEASURING THE ADVANTAGES OF

FISCAL DECENTRALIZATION

This chapter continues the literature review and gives an analytical overview of the

problem as a whole. It defines the different theories explaining why decentralization

should bring gains, and defines the four different kinds of decentralized regimes that I

will look at in my analysis. At the end of this section I will propose an agenda for

conducting the empirical part of the research.

First, I briefly review the literature that discusses factors and conditions that may affect

outcomes of decentralization. Second, I analyze the literature that discusses the factors of

public spending and budget formation because these factors will correlate and determine

how much and to what degree fiscal decentralization may affect public spending after

controlling for other important factors. Third, I review and discuss existing approaches to

define and measure decentralization. This will help to identify what kind of measure I

need to use to capture the level of fiscal decentralization in my study and avoid the

shortcomings of previous studies. Fourth, I summarize findings from the review of the

theoretical literature and the empirical research addressed in the previous chapter with the

purpose of developing my own theoretical framework. I analyze the aspects that are still

not getting enough attention or are missing in the current literature, and I identify ways to overcome these shortcomings. Based on this analysis I develop the theoretical analytical framework to study the impact of decentralization on public financing of the public education and on the outcomes of public education services.

Factors influencing the outcomes of decentralization

The literature review in the previous chapter shows that the decentralization of government has a significant impact on public goods provision; it makes public goods and services provision more efficient and better tailored to demand and local conditions. However, outcomes of decentralization may vary depending on initial conditions, on economic and political environment, on institutional constraints, etc. Differences in institutions between developing and developed countries, institutional context, the structure of incentives and organization, fiscal and political factors are among the factors that may alter and affect the efficiency of decentralization (Escobar-Lemmon 2001, Bardhan 2002 Rodden and Wibbels 2002).

Many authors (Escobar-Lemmon 2001, Manor 1999, Shah 2003, Eckardt 2002, Bardhan 2002, Parker and Thornton, 2006) emphasize the importance of local governance capacity and institutional structures. Eckardt notes that in the literature the skepticism about decentralization is based on the fact that "several externality problems deriving from common pool problems, inter-jurisdictional spillovers, and soft budget constraints can result in efficiency losses associated with decentralization." (Eckardt 2002, 13) Finding the right division of responsibilities and functions between central and lower

governments is important and that "the governance outcomes of decentralization depend in large parts on the design of a policy mix including fiscal, administrative and political decentralization."(p. 14).

Hankla (2008) points out the importance of local governance capacity, especially for developing countries "…Even if subnational authorities have sufficient revenue streams, they may not possess the administrative resources necessary for effective governance. Many regional governments lack sufficient numbers of trained civil servants to carry out their policies, and this problem is especially acute in developing countries." (Hanka 2008, 4) However, in my view, the problem of quality of local government officials is solvable through training and education and through practice because they cannot gain administrative experience if they are not given enough authority and the possibility of gaining experience through actual work.

Another problem, the lack of trained civil servants, might be relevant when decentralization occurs at the lowest (municipality) level. Municipalities or counties with small populations may not have enough educated and capable human resources to perform administrative functions properly, while at regional/state level with larger economies and larger population, the situation may be different. To the best of my knowledge, these differences are not discussed in the existing literature.

As noted in the literature, both financial and decision-making autonomy are important in making decentralization work. Eckardt writes that "Imbalanced assignment of expenditures and revenues results in overburdening of sub-national governments and

leads to undersupply in public goods." (Eckardt 2002, 18) Durability of the rules over time is also important. "Lower tier governments face no incentives to broaden the tax base and are not expected to engage in growth enhancing policies if they perceive that future fiscal benefits might be divested by the federal level." (p. 18)

Among the factors that may affect the outcomes of decentralization Larson and Ribot (2004) list such factors as "local capacities; incentive structures; ideologies; political and social histories; forms of local social organization; degrees of local stratification; unresolved land and forest tenure relations; failure to account for time and insecurities (and often retrenching) produced by change; the strength and manipulations of elite actors; state and government resistance; and government, NGO and development agency commitment to 'traditional' or private and third-sector institutions over democratic authorities.." (p. 8)

Other interesting points that Larson and Ribot bring to the discussion address the concern about central governments. First they discuss accountability of central governments saying that "…downward accountability of local authority is not the only accountability relation that matters. Central government must be downwardly accountable to local elected authorities for effective decentralizations. Local governments need services from central government – such as expertise, heavy machinery, financial support and market access. Central government also has responsibility for clarifying laws, mediating major disputes, and providing guidelines and means to assure the inclusion of marginal groups. There must be mechanisms for local representatives to hold higher-level bureaucrats accountable to them." (p. 6)

They then note that "decentralization should strengthen both central and local government….For the state to play a supportive role, central government also needs to be strong…. there is no contradiction between a strong state and decentralization… It is not about dismantling the state in order to replace it with local democratic sovereigns... Decentralization is about bringing the state back in, but this time as a positive and legitimate democratic institution." (p. 7)

Some researchers discuss the role of political centralization and find that the outcomes of governance and public services depend on the strength of national party system, and whether local and state executives are appointed or elected. (Enikolopov and Zhuravskaya, 2003). Enikolopov and Zhuravskaya (2003) also point out that the effect of decentralization depends on political and economic incentives of local public officials. These observations point to the critical importance of electoral accountability, and that the theoretical model should include an assumption of accountability. In practice, it suggests that fiscal decentralization cannot be successful without electoral liberty or democratic/political decentralization and accountability.

Public Spending Budget Formation

The goal of this research is to explore how fiscal decentralization affects public spending on education and education outcomes. At the same time, public spending on education depends not only on decentralization, but it may be a function of many other determinants. In empirical research we have to control for such factors.

36

This section surveys the literature on public spending determinants to identify the most important factors.

Political science literature suggests that the role of political institutions, especially the role of competitive and collective veto points, is significant for public spending (Tsebelis's 1999, Crepaz and Moser 2004). "Fundamental to the theory of veto points is that, the more of them that exist, the more difficult it is to change policy" (Crepaz and Moser 2004, 259). Degrees of federalism also "represents levels of veto points as well as whether countries are unicameral, bicameral, or have very weak upper houses, such as the United Kingdom." (p. 259)

Some authors (Tabellini 2000, Milesi-Ferretti, Perotti, and Rostagno 1999) found that "social security and welfare spending is larger in proportional systems than in countries ruled by majoritarian elections" (Tabellini 2000, 13). Persson and Tabellini (2001) found that presidential regimes lead to a smaller size of government than parliamentary regimes, and that majoritarian elections lead to smaller welfare programs.

Some studies find that political variables such as democratization, which is also a characteristic of a political system, may affect educational outcomes (Brown 1999, Lake and Baum 2001, Baum and Lake 2003, Deacon 2003, Pinto and Timmons 2005, Stasavage 2005). Another factor that is discussed in the literature is globalization, although empirical research is still inconclusive about its role.

Careja and Emmenegger (2009) explore the effects of government composition, globalization, political institutions, and socioeconomic factors on total public, public

social and public educational expenditures in 12 Central and Eastern European countries. They find that, similar to Western countries, the party composition of government has the most robust effect and "that left incumbency is positively correlated with total public and social expenditures." (p. 177). However, their research does not support the hypothesis about the effects of globalization on public spending. Careja and Emmenegger note that globalization has conflicting effects on the governments. "On one hand, they should increase spending on education, while simultaneously cutting total public and public social expenditures to attract investors who seek a qualified workforce and low taxes, and on the other hand, they should downsize public expenditure as response to pressure from international financial institutions." (p. 178) They find two arguments in the literature: the compensation thesis and the efficiency thesis. The compensation thesis argues that globalization, or "trade integration leads to higher social and public expenditures to compensate the public for the heightened economic insecurity." (p. 171) The efficiency thesis argues that it forces countries to scale back social and public expenditures to remain competitive in internationalized markets."(p. 171) This means that the sign of the impact is not clear.

Dion (2008) analyzes social spending changes in 49 mostly non-European middle-income countries. She finds that political institutions, not economic globalization, are a better determinant for annual change in social spending (p. 16). And if globalization has an effect, it will affect public spending through domestic political institutions.

In sum, the literature suggests that political institutions (party system, veto points, democratization, local accountability, and so on) affect public spending; the role of

globalization is debated and there is no agreement on its effect. This discussion suggests

that in the empirical part of the research I have to control for political institutions. I will

also control for globalization to see if it has any impact on public spending on education.

I will discuss the choice of variables to control for those factors later in this chapter.

Decentralization: Alternative Definitions and Measures

There is still no agreement in the literature about the precise definition of decentralization

of government and how to measure it. This causes problems with the comparability and

interpretation of the results of empirical studies.

Decentralization may be effective or procedural, based on how it was done, whether it is

based on giving real autonomy with powers to collect its own revenue and make its own

decisions on spending or whether it is delegating some spending autonomy or

administrative functions without providing fiscal autonomy.

Thornton (2007) notes that

> Much of the literature on the macroeconomic impact of fiscal decentralization has not
> distinguished appropriately between administrative and substantive decentralization
> in that it has failed to recognize that high sub-national government revenue and
> expenditure shares do not necessarily indicate high local autonomy. In particular,
> recent studies on the relation between fiscal decentralization and economic growth
> generally have failed to take account of the extent of the independent taxing powers
> available to sub-national governments in measuring revenue decentralization and, as a
> result, have substantially overstated revenue decentralization in practice. (p. 69)

Bardhan (2002) distinguishes "decentralization in the sense of devolution of political

decision-making power from such mere administrative delegation of functions of the

central government to local branches" (p. 186). He writes that "we should also separate

the political and administrative aspects of decentralization from those of fiscal

decentralization and, in the latter, the more numerous cases of decentralization of public expenditure from those involving decentralization of both tax and expenditure assignments... Not all these aspects of decentralization operate simultaneously in any particular case, and it is quite possible that a given economy may be decentralized in some respects, not in others." (p. 186).

He also notes that the territorial domain of subnational governments may vary significantly. And taking into account that the "typical province in India or China is larger in population than most countries in the world, and so federalism in the sense of devolution of power to the provincial state governments may still keep power over [many] people pretty centralized...." (Bardhan 2002, 86-187). This is an important point, suggesting that in empirical studies we should use the measure of decentralization that could be comparable across countries from two points of view. First the indicator should measure decentralization at the same level of government in all countries, and second those levels of government should be comparable by population size.

Martinez-Vazquez and McNab's point of view is that "although there are several ways to describe the process of fiscal decentralization, its essence is captured by the two related processes of either 'delegation' or 'devolution' of fiscal authority. In either case, decision-making power on the composition of expenditures and often on the composition and level of revenues is shifted to separately elected subnational governments." (Martinez-Vazquez and McNab 2003, 1598).

Larson and Ribot (2004) distinguish between administrative and political decentralization:

> Administrative decentralization, or deconcentration, of public services – transfers of power to local administrative bodies – aims to help line ministries, such as health, education, public works and environment, to read the preferences of local populations and to better mobilize local resources and labor. Political or democratic decentralization integrates local populations into decision-making through better representation by creating and empowering representative local governments. Democratic decentralization is premised on new local institutions 1) being representative of and accountable to local populations and 2) having a secure and autonomous domain of powers to make and implement meaningful decisions... (p. 3)

They also note that "deconcentration is a weaker form of decentralization than is democratic decentralization since the mechanisms by which deconcentrated decision-makers are responsive and accountable to local populations are weaker [Ribot, 2002a]. If efficiency and equity benefits arise from the democratic processes which encourage local authorities to serve the needs and desires of their constituents [Smoke, 2000; Crook and Sverrisson, 2001], then democratic decentralization should be the most effective form of decentralization." (pp. 3-4)

Arzaghi and Henderson (2005) state that actual decentralization may/or may not be accompanied by a change of formal institutions. "A country which in the data has a formal federal structure may still be de facto highly centralized, in that the local or regional governments have little fiscal responsibilities; and a country with a formal unitary structure may be de facto highly decentralized fiscally" (Arzaghi and Henderson 2005, p. 1158)

Escobar-Lemmon (2001) points out the importance of fiscal decentralization. He writes that "fiscal decentralization is key in determining whether subnational governments can carry out expanded responsibilities. If subnational governments are obligated to provide additional services or are given the right to legislate in new areas without receiving sufficient resources from the national government, the result is not real decentralization but rather buck-passing." (p.41) According to her, fiscal decentralization enhances the authority of subnational governments, even in non-federal systems.

Rodden (2004) writes that the concepts of decentralization and federalism are "often assumed to be complementary or even interchangeable. The emerging view of decentralization shows an organic, intertwined transfer of political, fiscal, and policy autonomy." (p. 481).

At the same time, he points out that "questions about the design, content, and form of decentralization are glossed over …because more refined data are difficult to collect. The bluntness of these measures is often acknowledged but defended as the cost of achieving a large enough sample to make reliable inferences." (p. 482) The question is, however, "how high are these costs? Do the favored indicators of decentralization actually measure the concepts addressed in the relevant theories?" (p. 482)

Feld et al (2007) find that measurement problem may be the explanation of why empirical research results vary:

> The majority of the cross country studies interprets fiscal federalism as decentralized organization of government activities and measures decentralization by the fraction of sub-federal spending from total government spending. Using spending decentralization as a measure for fiscal federalism mainly allows for testing the

Tiebout thesis. But this particular measure is problematic: theoretical analyses presume autonomy of sub-federal decision-making on provision and financing of public goods, while spending decentralization might simply indicate the extent of administrative federalism with sub-federal jurisdictions providing public services according to federal mandates and financed by the federal government (Treisman 2002, Rodden 2004, Stegarescu 2005). (p. 116)

The measurement problem is noted also by Ebel and Yilmaz (2003), although they recognize that "Comparing the degree of fiscal decentralization across countries is a complex task that requires identification of sub-national autonomy and discretion over expenditure and revenue arrangements." (p. 6) They state that "most of the studies are cross-country analyses using the Government Finance Statistics (GFS) of the International Monetary Fund, and all describe the degree of fiscal decentralization as the sub-national share of total government spending/ revenue or of Gross Domestic Product (GDP)…"(p. 6)

Ebel and Yilmaz (2003) identify three major problems with the use of this data:

First, although GFS provides a breakdown of expenditures by function and economic type, it does not identify the degree of local expenditure autonomy. Thus, local expenditures that are mandated by the central government or are spent on behalf of the central government appear as subnational expenditure.

Second, GFS does not distinguish the sources of tax and non-tax revenues, intergovernmental transfers, and other grants. Hence, there is no information on whether revenues are collected through shared taxes, piggybacked taxes, or locally determined "own-source" revenues.

Third, GFS does not disclose what proportion of intergovernmental transfers is conditional as opposed to general-purpose, and whether transfers are distributed according to an objective criteria or a discretionary measure. (p. 6)

The use of this data, in their opinion, results in overestimation of the fiscal decentralization indicator, which "can be illustrated by analyzing the revenue structure of sub-national governments" (p. 7). They note, that "until recently, such a comparison was

impossible due to lack of data that would be both disaggregated and would fit what was identified as the essence of public sector decentralization--the ability of local governments to set the tax rate at the margin," (p. 7) but "such data are available now for a set of EU accession countries from the Organization for Economic Cooperation and Development (OECD)'s survey Fiscal Design Across Levels of Government (OECD, 2001)." (Ebel and Yilmaz 2003, 7) However, I cannot use this data because this survey was not continued, and it is available only for a short period of time for a limited sample of countries.

Kirchgassner (2001) also points out the measurement problem and writes that "the share of state expenditure (or revenue) of total state and local expenditure might be the wrong indicator because the decentralization hypothesis may still hold even if there is no significant positive relation between this variable and the size of the government as long as federal government expenditure is reduced to such an extent that even an increase of state and/or local expenditure in a federal system are overcompensated."(p.19) Busemeyer notes that "Early studies use spending shares of subnational governmental units to measure fiscal decentralisation. However, this neglects the fact that spending might be mandated by higher levels of government or funded through grants instead of own revenues"(Busemeyer 2007, 17). He also writes that "it is apparent that it is inadequate to measure fiscal decentralisation as spending shares of lower levels of government without taking revenue autonomy into account (Rodden 2003: 709–710). Secondly, the commonly used Government Finance Statistics provided by the IMF is criticised because of the sketchiness of its classification of 'own source' revenue

(Ebel/Yilmaz 2004: 6; Rodden 2003: 709) along with its misclassification of countries (Stegarescu 2004: Fn 15, 46)" (p.18) Busemeyer uses in his study Stegarescu's measure, which is "a measure of 'own tax revenue' of 'sub-central governments' (Stegarescu 2004: 6, 28)."(p.18). It should be noted, that Stegarescu considers localities in federal government "as an integral part of the intermediate level of government." (Stegarescu 2004, p. 7)

At the same time, the literature mostly ignores a variation of decentralization levels at cross-regional scale. I argue that decentralization should be measured by taking this variation or asymmetry into account.

Hooghe, Marks, and Schakel (2010)' approach to measure the decentralization is very close to my view of how decentralization should be measured, and in this research I have used their data. I will describe this approach and explain in Chapter 4 in more detail why I have decided to choose this data. I will describe the advantages of this data in comparison to other publicly available datasets, and how it correlates with my approach. However, in the future it might be worth further developing this approach to better correct for regional variations of decentralization and asymmetry. Also, measuring and coding of each component might be improved.

Summary

The analysis of the literature presented in previous sections and in the first chapter

suggests that decentralization has its positive and negative sides or limitations. I

summarize these findings in the following table:

Table 1. Positive and Negative Consequences of Decentralization according to schools of thought

The theory	Positive sides of decentralization	Shortcomings of decenralization/ limitations of the models
Classical Theory of Decentralization	local governments and consumers have better information than the national government about local conditions and preferences; competition among jurisdictions allows citizens to sort themselves and match their preferences with a particular menu of local public goods (Tiebout); decentralization increases the efficiency of government (Oates's decentralization theorem)	-Assumptions of the Tiebout model are not realistic (i.e. mobility) -Oates: diseconomies of scale may happen. -no particular attention given to democratic processes - the common resource problem might lead to an overuse of the tax base.
Second Generation	Preserving markets requires that the state be effective yet limited. Federalism-the appropriate decentralization from the central to local governments-provides a solution to this.	no particular attention given to democratic processes; - self interest of local officials is not discussed

Public Choice Literature on decentralization	-optimizes transaction costs, geographic representation at higher levels of government (Mueller); - Fiscal decentralization is a mechanism for constraining the expansionary tendencies of governments. (Leviathan hypothesis:Brennan and Buchanan's (1980). - introduces interstate competition (Salmon) and effectively limits the power of constituent governments to raise spending. - vertical competition is the mechanism of checks and balances and assigning of powers (Breton)	- If decentralization is in form of intergovernemental grants, ""money from the central government transferred to a local government largely "sticks where it lands" – in the local governments' budget. (flypaper effect) - Public choice literature does not discuss the difference in self-interest between local and central politicians: local politicians also may be interested in getting more control over local economy resources. In such cases, leviathan problem may not be resolved.
Political economy approach	Decentralization is preferred, because "a centralised system takes the form of a single agent (elected public official) who serves the whole population, while decentralisation consists of one agent in each jurisdiction"(Oates (2005). "Fiscal decentralisation stimulates political accountability; a positive effect on government efficiency can be observed also in the case of perfect homogeneity of preferences across local jurisdictions". By other words, electorate can increase their control over the politicians.	If governments maximize their own objective function/(self-interest), they may not respond effectively to population' needs. In countries with weak institutions and developing countries this argument may not hold.

As this table and the analysis of the literature indicates, the recent state of the literature is not conclusive about the exact mechanism of decentralization's operation or the impact of decentralization on the quantity and quality of the provision of public goods and services.

There is no consensus on the expected consequences of decentralization of governments because it may vary depending on many factors, such as culture, institutional constraints, etc. Until now, as Busemeyer (2007) notes "a sound theoretical concept of a *positive* relationship between fiscal decentralization and spending is missing." (p. 8)

Thus, it is necessary to develop a general theoretical framework that would explain all links from decentralization of government to changes in public goods provision. It should explain when and for what types of public goods each mechanism works better. There is no such framework yet because different schools of thought and strands of the literature focus on only one aspect and deny other mechanisms or ignore other aspects. For example, Breton says "if competition is strong enough, separate reference to subsidarity, to experimentation and innovation, and to liberty is redundant." (Breton 2006, 90) Also, the literature is mostly normative.

At the same time, no single theory can explain all of decentralization's impact; rather, we need to incorporate several theories into one framework to explain all possible variations of how decentralization may impact the public good provision.

In my opinion, a sound theoretical framework should include at least four major theories offered to date by the literature: (1) the decentralization/ efficiency theory offered by

classical theory (but we need to relax the assumption of benevolent governments and assume that they are not benevolent); (2) horizontal competition; (3) vertical competition offered by public choice literature (again, we need to accept that competition theories have their own shortcomings and are not capable of explaining decentralization's impact just alone for the reasons discussed above); and (4) a political economy approach. We need to accept that politicians are self-interested and they have to be accountable to the electorate.

Thus, this general theoretical approach is based on two major assumptions. First, governments are not benevolent (in contrast with classical theory). Second, office holders are accountable to electorates. I assume that when democracy/elections exist, politicians will be interested in being reelected, which means they will be more responsive to local needs. I also argue that mobility assumption should be relaxed, as it does not always work. I also argue that the competition/ fragmentation thesis does not always work, and the decentralization/or efficiency thesis is more powerful than horizontal competition.

When we have assumptions of non-benevolent governments and electoral accountability of self-interested politicians, then the decentralization/efficiency thesis and competition theses can explain why and how decentralization of government may affect local public goods provision positively.

Ideally, we need to control for all of these mechanisms (or effects) in empirical research. However, in practice, the data are not always available to control for all effects. In my empirical work I use a sample of democratic countries and assume that in all countries

politicians are accountable to the electorate. I assume that decentralization's impact is caused mainly by differences in preferences (or decentralization/efficiency thesis), but to measure the effect of this mechanism, ideally, I need to control for effects of horizontal and vertical competition as they also may affect education financing. I will discuss specific variables and models later in Chapter 4.

In fact, the effects of competition and decentralization theses may overlap. To attract more population, regions will increase spending on education and also provide more public goods to respond to the local population's demands, tastes and preferences. These two effects may occur simultaneously. However, the difference between these two mechanisms is that even if there is no mobility, or benchmarking by citizens of governments against other governments, decentralization thesis will still work, because it is based on differences of local tastes and preferences that affect structure and quantity of demand for public goods. It may also affect the requirements for its quality.

I argue that the competition thesis may not always properly work. For example, if population mobility is very low for historical, cultural or other reasons, or if the population does not have an opportunity to influence politicians because there are no elections or other mechanism influencing local politicians, then even if they benchmark their own government with neighbor governments or upper level governments, there will be no practical effect.

As mentioned in the literature, the competition thesis may be weak not only because mobility may be low, but also "that, from the start, some regions have a natural advantage

or disadvantage of some kind and thus that competition among regions may be unbalanced – so much so that some regions may even decide not to participate in it – is a major objection to the approach (Cai and Treisman 2005). A second objection is that not only bad policies may be eroded by mobility-based competition, but also "good" ones (the "race to the bottom" possibility) or, at any rate, policies to which the population is strongly attached." (Salmon 2009, 3)

In my theoretical framework, I also assume that the impact of decentralization of government on the provision of different regional public goods may vary depending on the type of public good. That is why the relationship between decentralized government and the provision of each type of public goods should be studied separately. In this research, I am focusing only on public education (more specifically, on primary and secondary education).

The empirical literature focuses mostly on spending and still does not address the quality of public goods particularly of public education. The reason for this is probably that it is not easy to measure the quality of education and difficult to find comparable across countries reliable data on quality of education. That is why this research also looks at how decentralization affects the quality of education. I argue that increased levels of spending on education affect the quality of education positively, and that is why decentralization of governance positively affects not only educational funding but also education outcomes.

As for practical aspects, such as how to measure decentralization in an empirical study, I will provide more detail in Chapter 4, but I support measuring fiscal decentralization by revenue autonomy, because spending in accordance with local preferences may become possible only if regions have taxing power and are not restricted only to intergovernmental grants as their financial means.

Measuring Decentralization

Besides of the lack of a solid theoretical framework to explain decentralization's impact on public goods provision in the literature, there are also other problems that are not receiving enough attention in the current literature and need to be addressed. In this section I discuss the two problems that I find most important and that affect the results and the accuracy of the empirical research. They are (1) possible asymmetries in decentralization, which means that the levels and degree of decentralization vary not only across countries but also across regions; and (2) optimal levels of government for decentralization. Or, put differently, at what levels – regional or municipal- fiscal decentralization should exist and be measured.

Asymmetry

There is an increasing interest in asymmetric federalism in theoretical literature (see, for example, Congleton (2006) and Congleton et al (2003)). Congleton et al (2003) explain how asymmetric decentralization emerges as the result of bargaining between different levels of governments. However, empirical studies usually do not take asymmetry into consideration. It is difficult to obtain reliable data on such detailed regional levels, but

this aspect should be taken into account in empirical research, and decentralization measures should be corrected for possible asymmetries.

Most decentralization theories are based on spatial heterogeneity and differences in tastes and preferences, but the heterogeneity is often viewed only from one side – from the point of view of variation of demand for public services. However, supply of public goods and services also may vary because different regions may have different authority. This aspect or the variation in levels of regional authority is often ignored. Mostly, it is assumed that all regions will have the same level of fiscal or administrative authority, but their policies and actions vary only because demand varies as a result of differences in tastes. At the same time, the demand for regional authority may vary also because of spatial differences related to culture, language, economy, etc.

This ignorance of asymmetric demand for regional authority may stem from the fact that "the modern state....built on the principle of individualism and equal citizenship, is inherently incapable of dealing with ethnic and social diversity that characterizes most countries." (Ghai 2002, 141) And also, "constitutionalism is not primarily concerned with the relations of groups to the state, or relations between groups" (p. 141).

At the same time, ethnically or religiously diverse groups that seek recognition of their cultural diversity do not want to be assimilated, and want to keep "their culturally diverse ways of thinking, speaking, and acting," and they want "to rule themselves in accordance with their customs and ways (Tully 1995:4)." (p.141). However, the constitutions of most governments "are based on a homogeneous culture", which in practice often results in

excluding or assimilating other cultures. (p.141) In such cases, symmetries of power, institutions, and laws may not be consistent with the diversity of forms of self-government necessary in multi-ethnic states. (p.142)

Also, traditional electoral systems "are not conducive to minority representation" (p. 145) In such cases "territorial autonomy is a device to allow ethnic or other groups claiming a distinct identity to exercise direct control over affairs of special concern to them while allowing the larger entity to exercise those powers which cover common interests." (p. 155)

Ghai gives the following definition of asymmetry: "Federal systems where one or more regions are vested with special powers not granted to other provinces are known as 'asymmetrical' (Stevens 1977, Watts 1994, Agranoff 1994, Boase 1994, Brown-John 1994)." (p.155) Most of the multi ethnic countries in the world have asymmetric federalism.

In some cases, if there are only one or two minority groups, the federal model may be unnecessary. (p. 155) In these situations "special powers may be devoted only to a part of the country where the minority constitutes a majority; these powers are exercised by regional institutions. Normally very significant powers are devolved, and the region, unlike in a federation, plays relatively little role in national government and institutions. This kind of autonomy is sometimes referred to as regional autonomy (Heintze 1998:10-11) or federacy (Stevens 1977, Elazar 1987:7)." (p.156) Such regions exist in many countries, e.g., Finland (Aland Islands), Italy (South Tyrol), US (Puerto Rico), Denmark

(Greenland and Faroes), UK (Scotland) and in others. As Ghai notes "by its nature, this kind of autonomy is asymmetrical." (p.156)

Asymmetric federalism is mostly a feature of multi ethnic countries, and in such cases "the division of powers is likely to be more focused on cultural matters, like education, religion and arts; and the normal tensions of federalism, like fiscal redistribution or regional influence, take on an ethnic dimension and become aggravated." (pp. 157-158)

In sum, the importance of the asymmetry problem is recognized and theoretically discussed in political science and public choice literature. However, fiscal federalism and decentralization literature, and especially empirical studies that look at the relationship between decentralization and education, mostly ignore that regional powers may be asymmetrical. Also, most empirical studies use decentralization measures that do not capture asymmetric arrangements between the central government and regions.

It is not easy to measure asymmetry, and the financial spending measures widely used to measure the level of decentralization are calculated as an average for the country. Even if some regions have more taxing or spending power or have special relations with the center, it is difficult to collect such data over time across all regions of all countries. There are two possible ways of dealing with this problem: 1) control for asymmetry using categorical variable, or 2) correct the financial autonomy variable, e.g., taxing power, using weighted averages. For example calculate taxing power as the weighted average for the country by looking at variation of taxing power across regions for each country.

Optimal Levels of Governance for Decentralization

In my research I found little discussion in the decentralization literature of what levels of government should be decentralized and up to what degree. Some insights are provided in Oates (1972) and Kirchgassner (2001). This aspect is often ignored also in the empirical literature, and the inconsistency of approaches (how researchers measure the decentralization, at what level) affects the validity and comparability of results and findings.

Decentralization may occur at regional (intermediate between federal and municipal) or/and at the municipal level. In the decentralization indices used in the empirical research, "local government" is defined very loosely. In some cases it may mean "municipal or county level," and in some cases it means "state or regional level." This causes inconclusiveness in the empirical research.

This is not only a matter of comparability and consistency of measuring decentralization in different countries. It is also an important theoretical problem because different levels of governance may have different economies of scale, as well as different fiscal capacity and local governance/administrative capacity. Therefore decentralization's impact on provision of public goods might be different at different government levels (on regional or municipal levels). This is true especially for regional public goods, for example for primary and secondary education.

The problem is discussed to some degree in regional economics literature from the fairness of public spending point of view. For example, Ross and Yinger (1999) note that

"When local governments have considerable autonomy, as in the US, and sorting occurs, some jurisdictions have much higher incomes and tax bases than others and end up with much higher quality public services. This effect is magnified by environmental factors; high income jurisdictions tend to have favorable environments for providing public services and hence relatively low public service costs. Moreover, some jurisdictions have extensive commercial and industrial property, which lowers their tax price and thereby raises the quality of public services voters select." (p. 2049)

However, they notice that "higher levels of government bear ultimate responsibility for the nature of this system" as usually "the system of local governments is established by higher levels of government" (p.2049). Thus, higher levels of governments, e.g., states in the US, concerned with variation in local public goods and services "may want to compensate local governments for unfavorable fiscal factor that are largely outside their control, such as a low tax base, high input prices, or a harsh environment" (p.2049). As Ross and Yinger note, "[t]his compensation by a state can take the form of intergovernmental aid programs that account for tax base and cost differences across communities," (Bradbury et al., 1984) or of institutional changes, such as regional tax base sharing or allowing cities to tax suburban communities (Reschovsky, 1980; Ladd and Yinger, 1991)." (p.2049)

It follows from this (and as the practice shows), intermediate or regional levels of government have more fiscal and administrative capacity. Of course, the number of tiers depends on individual characteristics of the countries, and first of all, the country's size

(can be measured by territory or population). But if we can control for this factor(s), it would be more reasonable to explore decentralization's impact at intermediate level.

Even if there are variations (for example, some countries may have only two levels of government, not three), in general, there should be some consensus in the literature about which level is optimal for fiscal decentralization. This is important because of economies/diseconomies of scale and/or fiscal capacity of the different government units may vary. Also, this affects comparability of decentralized units across countries in cross-country empirical research.

As was noted, these issues were mentioned earlier by Kirchgassner (2001). He also refers to Oates, who "mentions the possibility" that decentralisation is expensive because of the loss of potential economies of scale (1972, p. 209). It might also be the case that "since individuals have more control over public decisions at the local than at the state or national level they will wish to empower the public sector with a wider range of functions and responsibility where these activities are carried out at more localised levels of government." (Kirchgässner 2001, p. 17) Thus, even if total government spending is reduced, it might be increased at the lower governmental levels. (p. 17) However, this diseconomy of scale may not happen if decentralization occurs at higher levels of government.

Framework for Empirical Research

To sum up, I argue that a theoretical framework to explain decentralization's impact on public goods provision should combine the decentralization thesis (Oates'), horizontal

competition (services and /or tax competition), vertical competition and self-interested politicians with the assumptions of non-benevolent governments and electoral accountability of politicians.

However, I argue that, among all these theories, the decentralization or efficiency thesis will be a more powerful theory that works even if the governments are non-benevolent.

The assumption of electoral accountability is critical for this theoretical framework. If there is no electoral accountability (which is a restricting mechanism for self-interested local elites), it may result in increased corruption and local elites' misuse of power.

Competition theory, in contrast to efficiency theory, may not always work because in most cases it is based on labor mobility, and mobility (labor or businesses mobility) in some countries or in some regions may be very low for historical, political, cultural or other reasons. Also, the assumption that all regions are willing to participate in the competition is not correct. The existence of intergovernmental grants (or vertical competition) also affects the horizontal competition; however, there is no agreement in the literature on the direction of that effect. Some authors argue that if intergovernmental grants are assured, then some regions will choose not to spend on education above a certain level; some researchers argue that it may result in overspending. So, the horizontal or vertical competition theses may not be as powerful as the decentralization/efficiency thesis in explaining decentralization's impact on public spending for public education.

In this dissertation, we need to differentiate between several mechanisms of how fiscal decentralization may impact the provision of public goods. These mechanisms (horizontal or "yardstick" competition, vertical competition, effectiveness [or "decentralization thesis"], and self-interest of political actors) should be captured and controlled by different variables in empirical models, so we can measure the impact and significance of each of them separately. To control for horizontal competition, the best control variable is internal/regional mobility, but in practice it is not always possible to find detailed and reliable data on regional mobility. Such data may exist in developed countries, and probably, such research can be performed for a smaller set of countries. To control for vertical competition, we can examine what level of government is responsible for provision of certain public goods. In my research on educational outcome models, I control for regional responsibility for education. To control for self-interested politicians, we can control for local elections, assuming that politicians are interested in being re-elected. In non-democratic countries probably we need to control for corruption or choose another control variable to capture self-interest of politicians, if there is no electoral accountability. But in my research, I use the sample of democratic countries, and they all have electoral accountability although, the level or degree of that accountability will vary by country.

In next chapter I will discuss the data and variables and the methods I use to test my theory and hypotheses in the empirical part of the research.

CHAPTER 4

RESERACH QUESTİONS, HYPOTHESES, AND METHODOLOGY

This study explores the impact of fiscal decentralization on provision of public education. This topic can be divided into two research questions:

The first research question is " Whether public spending on education is higher in countries with a higher level of fiscal decentralization (higher regional fiscal autonomy)?"

The second research question is "Whether higher public spending on education results in better education outcomes?"

These two research questions follow from the discussion of the role of decentralization in providing public goods examined in Chapters 2 and 3. It was shown that the empirical literature is still inconlusive about both the direction of such impact and the mechansims of how decentralization affects the provision of public goods. Also, it was shown that most of the literature does not differentiate between types of public goods, while the impact of decentralization on public spending may differ for different types of public goods and services. There is some recent research (for example, Busemeyer, 2007) in this direction, but more empirical stuides are needed. Also it is neccessary to study not only

changes in spending but also the changes in the outcomes of the provision of public goods. In other words, how does decentralization affect the quality of such services?

In chapters 4 and 5 I explore these questions empirically. I investigate whether the decentralization/ efficiency thesis combined with the political economy thesis about self-interested politicians, works in the case of such regional public goods as public education.

As explained in previous chapters, my theoretical approach relaxes an assumption of benevolent governments, and I assume that politicians are self-interested. I also add an electoral accountabilty assumption to control for possible negative outcomes such as corruption and regional elites' power abuse, when they maximize their own utility function instead of responding to local preferences and needs. The mechanism that explains why decentralization works is based on the decentralization/effectiveness thesis combined with an assumption of electoral accountability or democracy. I find that the thesis based on differences in preferences is a more powerful explanation of the impact of fiscal decentralization on the provision of public goods than the more widely accepted competition thesis in the literature. I assume, however, that in some cases competition also works.

As discussed in the previous chapter, the horizontal competition thesis may not serve as the main explanation for how the decentralization mechanism works in all cases. First, some regions may have a natural disadvantage in the specific sector and may choose not participate in yardstick competition. Second, internal labor mobility may not be sufficient

or exist at all. (This may happen for many reasons: cultural, climatic, historical, etc). In the former Soviet Union and European countries, for example, mobility is typically not as high as in the United States (Gakova and Dijkstra (2008); Fidrmuc (2005)). However, the decentrlaization thesis (or the so-called effectiveness or diversity theory) works even if there is no mobility or no competition because it is based on differences in tastes and preferences and on better tailoring of spending on regional public goods to local needs. In Oates' words, "By tailoring outputs of such goods and services to the particular preferences and circumstances of their constituencies, decentralized provision increases economic welfare above that which results from the more uniform levels of such services that are likely under national provision." (Oates 1999, 1121-1122).

We also need to control (in an ideal world) for vertical competition because federal/central governments may also participate in public education financing. In many countries this is an area of shared responsibilities. It should be noted that vertical competition is also not a powerful enough thesis to explain all the motivations to increase spending and the quality of public goods and services of a decentralized operation. However, both vertical competition and horizontal competition should be contolled (ideally) in models exploring the role of the decentralization/effectiveness thesis.

This relationship can be presented as follows:

| Fiscal Decentralization (measured by regional fiscal autonomy index) | → | Public spending on education (% GDP) | → | Education quality (measured by international test scores) |
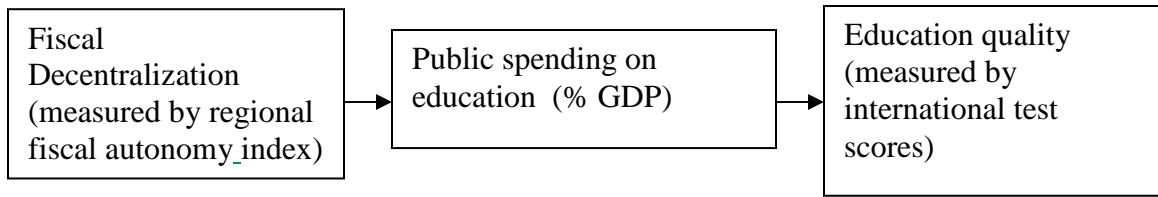
Figure 1. The relationship between decentralization and public education

The theoretical framework of this research that expalins the relationship can be presented as follows:

Horizontal competition		Effectiveness/decentralization		
Fiscal decentralization (measured by regional fiscal autonomy index)		Public spending on education (% GDP)		Education quality (measured by international test scores)
Self-interest of politicians		Vertical competition		
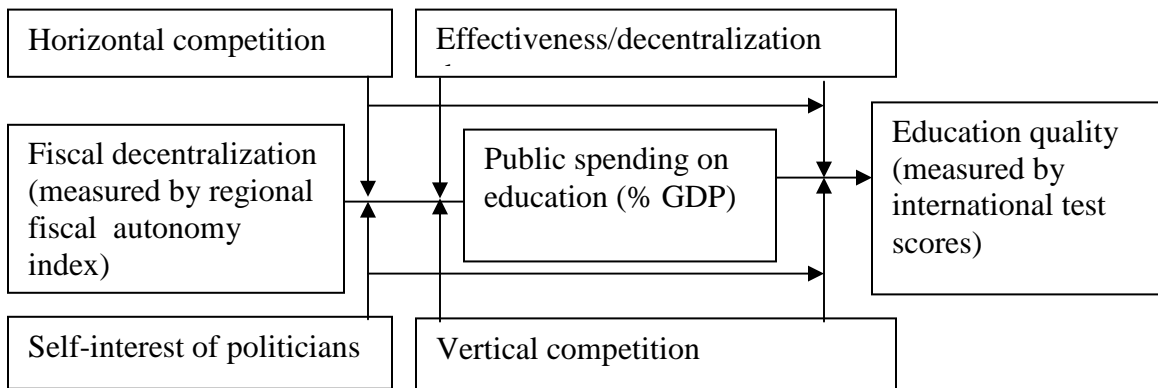
Figure 2. Conceptual model of the relationship between fiscal decentralization, public spending on education and education oucomes.

Accordingly, there are two hypotheses to be investigated and tested in this paper, corresponding to the two research questions.

H1: Fiscal Decentralization increases public spending on education

 As discussed earlier, I expect that decentralization positively affects public spending on education. Although the decentralization/effectiveness theory is my main theoretical

64

explanation of this relationship, horizontal competition may also expain some part of the relationship, as regions may compete for human capital and businesses (through mobility-based and yardstick competition), especially in an era of globalization. However, it is very difficult to find reliable regional level time series data on internal mobility for all countries in my sample. I have tried to use a proxy for internal mobility by controlling for economic growth, assuming that countries with higher interregional competition will also have higher economic growth. However, this variable has not worked (the sign was negative, and it was not significiant in all models). While it is theoretically possible that in some countries mobility-based or yardstick competition explains a significant part of decentralization's impact on public good provision, the data on regional mobility for most countriesis are not available, and it was not possible to find an appropriate alternative measure for that for my sample. In the future this research can be undertaken for some countries at the regional level (using decentralization measures at regional level as well). For example, reliable data of good quality for regional mobility can be found in the US.

In this research I control for effects of vertical and horizontal competition using the best available data. I used federal binary variable (for vertical competition) and regional inequality and regional responsibility for education (to control for horizontal competition).

As mentioned above, I assume that the positive link from decentralization to effective public service provision may be explained by several mechanisms that may work simultaneously. My main hypothesis is that biggest portion of this impact is explained by

the decentralization/effectiveness theory, working simultaneously with electoral accountability and politicians'self-interest in being re-elected. If local/regional governments have fiscal autonomy, as well as spending and decision-making autonomy, they may spend more on public goods and services because this will help them in re-elections. I do not control for electoral accountability in all models because my sample contains democratic and quasi-democratic (transitional) countries, and I assume that to some degree electoral accounability exists in all countries of my sample. Nevertherless, in some models I have been able to include local election variables directly.

The main theoretical explanation behind my empirical models is that the populations in different regions may have different tastes and preferences, and this affects the parameters of local demand for public goods and services. Although populations in all regions want their children to be well educated and some universal standards for the quality of education or how it should be provided may exist, regional differences may also exist related to both expenditure stucture and teaching curricula. These differences may be caused by or related to several factors. The differences in tastes and preferences for public goods and services may be explained by linguistic/ ethnic/ cultural/ historical differences, or be related to the regional economy, or to climatic differences, median age differences, and so on. As a result, some regions may spend more on education. For example, regions with a high linguistic heterogeneity may request education to be provided in different languages of instruction. They may also have different preferences on school cirrucula or textbooks (for example, there are might be different understanding of the local history, or the role of religion, or different prefences over which foreign

languages should be taught). Regions with relatively younger populations may value

educational services more than the regions with aging populations. Schools in cold

climates may need to spend more on elecricity, gas or other school-related expenditures.

I test this hypothesis using a sampe of democratic (or quasi-democratic) countries for 33

developed and tranistional countries for 1997-2006.

H2: Higher public spending on education as a result of higher regional fiscal autonomy improves education outcomes

This hypothesis tests the existence and the significance of the link between spending and

outcomes. There is limited literature on this relationship. Some scholars (Kirchgassner,

2001) suggest that a relationship exists between spending on public goods and the quality

of those public goods. Baker states: "Balanced-budget rules and limitations of

expenditure, taxes, and deficits, have in most cases proved to be effective in cutting down

public expenditure, revenue, and debt. However, at least in some cases this leads to a

deterioration of the quality of the publicly provided services, especially with respect to

schooling." (Baker 2012, 21) In his study Baker also finds that money does matter for

education outcomes.

 As these studies suggest a positive link between spending and educational outcomes, it

means that increasing public spending on education is important. Total national public

spending on education increases when each region spends more or spends higher

proportions of their budget on education. According to my hypothesis and findings of the

above-mentioned scholars, this increase in spending should result in improving the

quality of education. Below I will explain in more detail the mechanism supporting this. This positive link also raises some concerns about a deterioration of public education services if regions do not have a large enough tax base to provide adequate educational services. I will discuss this aspect later as well.

 In my empirical research I expect that higher levels of public spending on education have a positive effect on education outcomes. This is based on my assumptions that: (1) Increased spending on teachers' salaries and benefits helps to attract better teachers. Further it increases teachers' motivation toward those outcomes (regions may finance part or all of teacher salaries). (2) Higher spending on technical and informational support, such as spending on equipment, labs, internet, textbooks, multimedia, and so on, also results in a higher quality of education services. (3) Increased extra-curricular activities, financed by regions, may inspire and support students' interest in science, art, languages, etc. This can also include international exchange programs (financed by regional governments). (4) Regions may compete for better textbooks and curricula (assuming that the regions have autonomy to control/develop their own educational policies). (5) In ethnically heterogeneous countries, increased funding may result in better educational outcomes, through providing equal access to high quality education for all linguistic and religious groups (through financing textbooks and/or schools for all groups in the population).

Some authors warn that decentralization (with more tiers of government) may increase opportunities for corruption (Treisman 2002), and misuse of funds or overspending. This concern highlights the importance of electoral accountability for local (and central)

government officials. The correlation between spending and educational outcomes is expected to be positive. However corruption, lack of accountability or bad decision-making may alter the sign. That is why, in some models, I have included corruption to control for this factor.

There is also a concern in the literature that in cases of regional inequality, or in poor regions, eductional services will be financed below the optimal level if there is fiscal decentralization.

However, as discussed in Chapter 3, this problem is partially related to the fact that often the decentralization of government is measured at municipal or county levels.These levels of government may not always have enough fiscal capacity, and hence their funding capacity may vary significantly. If decentralization is measured at the state or regional level, then those levels of goverment will be more or less equal in terms of tax capacity, as they have command over larger economies and a larger tax base to collect sufficient revenues. For the remaining inequality, it is often suggested that poor regions should set the development of human capital as a first priority and then spend more on education if they want to catch up and develop the regional economy. At the same time, they have to be given adequate fiscal and spending autonomy so that they will have the opportunity to set and implement these priorities. Also, it is important to remember that increased fiscal autonomy does not necessarily mean that the federal or central government does not participate in setting educational standards and financing for education. In many cases, there is also vertical competition, and educational services may be funded by both regional and central governments. To contol for this factor, and also

for vertical competition, I have included binary variables for a region's responsibility for educational financing in education quality models. However, this aspect (the role of the federal government in providing education, or the optimal division of financing for education between federal and regional governments) goes beyond the scope of this research, and requires a separate study on this topic, as it will depend on so many other factors (historical, political, economic, etc.). However, it should also be noted that in my sample, there are only a few countries (Belgium, Spain) where regions are responsible for more than 75% of primary and secondary educational expenses, and in no case are the regions (or local governments) responsible for 100% of the expenses. In most of the sample, the central government has the right to control educational standards, so a minimum level of educational services will be assured for all the population.

Since there are concerns about equity, I control for regional inequality in the countries as well as for the level of regional responsibility for public educational financing (or for horizontal competition). I will discuss these variables and how they are coded in more detail in the control variables section.

There is also a possibility that decentralization affects education outcomes not only through spending but also through other channels, for example, through policy regulation of public education or through lowering transaction costs. As these effects will not always be captured by the spending variable, there is a need to control for this possible direct effect of decentralization, so model 2 includes such a control variable (as measured by local elections and federalism).

The structure of this chapter is as follows. First, I will discuss the data and sample selection. Second, I will introduce and discuss the methodology and dependent, independent and control variables. Then I will discuss the methods for testing each of the hypotheses in more detail, as well as diagnostic tests. The results of the econometric estimation and discussion of policy implications of empirical research will be presented in Chapter 5.

Data

The data sample used in this dissertation includes 33 countries; 27 are OECD members and 5 are non-OECD member countries. Eleven countries of the 33 in the sample are post-socialist countries. The OECD countries include: Australia, Austria, Belgium, Bulgaria, Canada, the Czech Republic, Denmark, Finland, France, Estonia, Hungary, Germany, Greece, Italy, Ireland, Latvia, Lithuania, Poland, Portugal, Russia, Romania, Slovakia, Slovenia, Sweden, Switzerland, Turkey, the UK, and the USA. Countries vary in GDP, size of territory, and institutional characteristics. However, the countries in this subsample are all democracies or quasi-democracies, which means that the political systems of these countries are comparable. Also, most of the countries are members of the OECD or the EU[5].

At the same time, there are very significant differences in the levels of decentralization in these countries and how the provision of education is organized, which makes the use of

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[5] Of the 5 non-OECD countries, four (Bulgaria, Romania, Latvia and Lithuania) are EU members, and Russia is a candidate for membership in the OECD

statistical analysis appropriate. Table 2 presents the variation in variables of our research

interest.

Table 2. Descriptive Statistics

Variables	obs	Mean	Std. Dev.	Min	Max
Fiscal Autonomy	330	1.633318	1.659198	0	4.79
Public Education expenditure in GDP, %	330	5.0935	1.211666	2.58992	8.438
Public Education expenditure in total government expenditure, %	330	12.4962	2.593138	6.2	21
GDP growth rate, %	330	3.673057	2.636972	-6.103	12.233
GDP per capita (PPT, log)	330	9.887105	.532463	8.48872	10.88354
Population (log)	330	16.50477	1.32581	14.07788	19.51929
Education expectancy	330	16.49655	2.193759	9.5	22.2
PolCONIII Index	330	.7078788	2.840448	0.13	0.37
Languages per 100000 population	330	.2882024	.2792266	.0123077	1.384615
Tertiary Enrollment, %	330	55.58993	15.45276	19.52	94.89
Internet Users per 1000 population	330	32.27386	23.05157	.44	85.8996
Government expenditures in GDP, %	330	41.83612	7.092111	28.85	58.284

In 48 % of the sample, regional governments and regional budgets are responsible for more than 50% of provision of primary and secondary education. This 50% also includes the countries where primary education is funded from municipal budgets, but the municipalities depend on regional budgets for grants and subsidies as they do not have sufficient revenues on their own. It also includes the cases where education is funded through municipal budgets, and regional governments are responsible for developing and implementing education policies.

Time Period

The empirical part of this research comes in two parts: (1) testing the hypothesis about the effect of decentralization on public spending on education, and (2) testing the hypothesis about the effect of decentralization on education outcomes. Thus, these two models allow testing for indirect (through funding) and direct effects of decentralization on education outcomes.

For the first part of the research – exploring the relationship between regional autonomy and public spending on education – the data was analyzed from 1997-2006. (A measure of fiscal autonomy from the RAI dataset (Hooghe et al 2010) used in this study was available only up to 2006). As many of the former socialist countries did not exist as separate self-governing entities before the 1990s and were newly established in the early 1990s and had to go through a transition period, the sample period began in 1997.

For the second part of the research – exploring the relationship between public spending on education and educational outcomes, the data was analyzed from 2003-2009, as OECD Programme for International Student Assessment (PISA) scores are available only

for the years 2003, 2006, and 2009. In this part, to control for direct effects of

decentralization not captured by the funding variables, I use regional autonomy in

educational spending and local elections.

Data sources and Data accuracy

The empirical data to test the hypotheses was taken from OECD sources, UNESCO's

Statistics Institute, the World Bank, the IMF publications, and countries' statistical

agencies. Although recognizing that data may not be very accurate, they are officially and

universally used international data sources for research of this kind. In the cases where

data is missing, I applied the commonly used data filling techniques, such as interpolating

averages between years and in some cases previous years, to estimate recent data.[6] Also, I

tested for the robustness by comparing my results to regressions obtained using

alternative measures for decentralization and the dependent variable and a variety of

model specifications and methods of estimation, to exclude the possibility of spurious

correlations.

Methodology

Model

I use a comparative quantitative analysis to estimate the relationships between

decentralization in governance and the provision of public education and education

quality. I analyze this relationship from two perspectives. From the spending and

education outcomes point of view, there are two models to be estimated: (1) Public

spending on education as a function of the degree of decentralization, and (2) Education

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[6] For example, public spending on education as percent of GDP and total government spending for most
countries was available only for 2008, and I used these data to estimate data for 2009.

outcomes (measured by international test scores) as a function of public spending on education. I control for the direct effect of decentralization, which may occur not through spending but through other channels.

The models to be estimated are specified as follows (control variables were chosen based on the analysis in previous chapters, but I discuss them in more detail below):

 1) Public Spending on Education = F(Decentralization; Political institutions; Demographic variables, School Expectancy, Socio-Economic Factors; Technological Development)+error term,

 2) Education Outcomes = F(Public spending on Education; Direct Effect of Decentralization; Regional Responsibility for Education; Families' Socio-Economic Status; Regional Inequality; Educational environment and resources of the country; Linguistic Diversity)+ error term

In model1, the "Decentralization" variable is assumed to capture/explain the work of decentralization in response to differences in tastes and preferences (as explained by the decentralization/effectiveness thesis), and it may capture partially the work of horizontal and vertical competition theories as well. Ideally, and in order to differentiate between these three theories, we need to control for horizontal and vertical competition using separate control variables. In my empirical research I was not able to find a good measure to control for horizontal competition because of lack of data. (It might be a task for future research to use only one or two countries where such data can be easily found at the regional level and data is of good quality.) I used regional inequality to control for horizontal competition. The proxy variable of economic growth was also tested,

assuming that faster growing economies have higher yardstick competition. But that variable was not significant in most models. The vertical competition aspect was controlled by using the federalism binary variable.

Dependent and Explanatory Variables

Fiscal Autonomy Index

 The difficulty of measuring of regional autonomy/fiscal decentralization and problems of data availability on measures is widely discussed in the literature, and I reviewed major approaches to measure the level of decentralization earlier in chapter 3. According to my approach, the real level of decentralization should be measured by real fiscal autonomy or powers to collect necessary revenue; powers to be able to react to local demand adequately and in a timely manner; and powers to decide how to spend money. We need also to capture possible unevenness or asymmetry in levels of autonomy across regions of the countries. Also, decentralization measures across countries should be comparable in the sense that they capture the same levels of government (ideally, regional or intermediate) and for approximately equal sized populations.

Thus, I consider a taxing power or fiscal autonomy index to be a measure of real regional autonomy. I decided to employ the fiscal autonomy sub-index from the regional authority index (RAI) dataset developed by Hooghe, Marks, and Schakel (2010) to measure decentraliation in my sample. I also test for the robustness of my findings by using the following alternative measures of decentralization:

- Tax revenue decentralization – from Stegarescu (2004), available for 1997-2001 for 21 of the countries in my sample.

- Federalism - dummy variable (0 – if the country is not federal (by constitution), and 1 – if the country is federal). Although federalism does not necessarily mean fiscal decentralization, it may approximate the level of regional autonomy, and it was used as one of measures to check the robustness of findings. In some models, particularly, in the education outcome models, I use this variable to control for the direct effect of decentralization.

- Local Elections (executive and local parliament, coded by the author, varies from 0.5 to 3) - were used as an alternative measure for decentralization. Also, this variable was used as a variable to capture the direct effect of decentralization on education quality.

More specifically, a local election (executive and/or local parliament) index was coded as:

 0.5 if there were no regional elections (at the sub-national level), but there were elections at the municipal level, and the municipal level had taxing power or regional councils were elected from town or municipal council members[7] and/or there is no intermediate (or regional tier) government or it is ruled by a head appointed from the center (as are county governors in Lithuania);

 0 – if there are no regional and municipal elections, and if there are municipal elections but municipalities have no taxing power;

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[7] For example in Latvia, "regional (district) councils. . . are not elected directly, but are formed by chairmen (heads) of councils of urban and rural municipalities."

1- if regions can elect regional legislative parliaments, but the head of the region is appointed by the center;

2- if the region has elections to a parliament, and the head of the region is chosen from the elected council members;

3 – if a country has regional parliamentary elections, and the head of the government is elected locally by direct popular regional vote.

This variable should have a positive coefficient. The theroretical literature suggests that decentralization may result in better education outcomes through increased accountability (Ahmad et al 2006) **and** through timely decision making on adminsitrative or financial issues related to education (regional autonomy on education spending and desicion making). It may also result through lower corruption.

My approach to estimating the impact of decentralization on public goods differs from others in the existing empirical literature in the following ways:

1) I focus on the regional (or intermediate or sub-national) level between the national level and municipalities, using data that allows me to compare regions across countries.

2) By using the fiscal autonomy measure from RAI dataset, which is calculated as a weighted average for existing asymmetric regional powers, I take into account any existing asymmetric arrangements in the regions.

3) I explore the decentralization's impact not only on public spending on education, but also on education outcomes.

4) I control for the division of the responsibilities in providing education (using a "regional responsibility for education" variable), and control for regional inequality and school resources.

As noted earlier, I use a Fiscal Autonomy variable as my main explanatory variable for the first part of the research, as calculated by Hooghe, Marks, and Schakel (2009) using the folowing methodology. For regions of the countries, it varies from 0 to 4.

- It is equal to 0 if the central government sets the base and rate of all regional taxes.

- It equals 1 if the regional government sets the rate of minor taxes.

- It is 2 if the regional government sets the base and rate of minor taxes.

- It is 3 if the regional government sets the rate of at least one major tax: personal income, corporate, value added or sales tax.

- And it is 4 if the regional government sets the base and rate of at least one major tax: personal income, corporate, value added or sales tax.

These regional measures are aggregated by the authors at the country level, using weighted averages, and by taking into account any asymmetrical financing arrangements.[8]

I use a Fiscal Autonomy index from the RAI dataset as a main indicator to measure decentralization in my study for the following reasons:

1) To the best of my knowledge, this is the only available data set that differentiates between local governments (or municipal governments) and regional governments. Different countries may define local governments very differently, and for most studies that use local government definitions ranked by country, the measures based on these definitions may not be comparable across countries. Moreover, this RAI index has a cut-off point for measuring a region at a population of 150,000. The authors of the index describe a region and regional government in the following way:

> A region has the following characteristics:
> a territory having a single, continuous, and non-intersecting boundary
> a set of legislative and executive institutions responsible for authoritative decision making intermediate between local and national government an average population of minimal 150,000.

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[8] Here is how the authors explain the aggregation process: "The unit of analysis is a country in a given year of evaluation. Country scores aggregate scores for each regional tier and individual regional governments in a country.

    The more regional tiers a country has, the higher is the country score, all other things equal. Where there is variation among regions at a given tier, scores are weighted by population. The following aggregation rules are employed:

    Horizontal asymmetry: Where a tier is composed of regions with different scores, an average score for that tier is calculated by weighting each region's score by its population.

    Vertical asymmetry: Where lower-level regions exist only in some higher-level regions or where scores for lower-level regions vary between higher-level regions, the lower-level scores are weighted by the population of the higher-level regions of which they are part

    Special autonomy: special autonomous regions are weighted by their population relative to that of the national population." (Hooghe et al 2009, p. 48)

150,000 is the dividing line between regional and local government in the *nomenclature d'unite´s territoriales statistiques*, which is a geocode standard for referencing the administrative divisions of countries for statistical purposes in the European Union and the Council of Europe.

A regional government, then, is the government of a coherent territorial entity of a certain size situated between local and national levels with capacity for authoritative decision making. (Hooghe et al 2008, 1)

2) To the best of my knowledge, the RAI provides the only indicator among the other available measures that takes into account the asymmetry in levels of autonomy in different regions. This is how the authors describe units of analysis:

The standard unit of analysis is a regional tier in a given year of evaluation: Spanish *Comunidades* in 1981; *Comunidades* in 1982; . . . *Comunidades* in 2006. The unit of analysis is an individual region in a given year of evaluation if a region's authority is different from the authority of the standard unit. This is so either because the region has an asymmetrical arrangement—it falls under a country-wide constitutional structure, but enjoys different (usually greater) authority—or because it is a special autonomous region (it has a *sui generis* statute)….

To measure the authority of an asymmetrical region, the same criteria are applied as for standard regions. For a special autonomous region, the criteria for measuring institutional depth, policy scope, fiscal autonomy, and representation are the same. But those for shared rule are adjusted to tap the extent to which a special autonomous region influences national legislation with respect to its territory, rather than for the country as a whole."(Hooghe et al 2008, 1-2)

3) The fiscal autonomy measure, in my view, captures genuine decentralization, not only procedural decentralization. (The distinction between these two was discussed in chapter 2.)

In my study, I use the RAI measures aggregated to the country level; the data are available also at the regional level. But, since they are aggregated while accounting for existing asymmetries, they measure existing levels of decentralization more accurately.

Dependent variables: Public Spending on Education

In regression models for exploring the impact of fiscal autonomy on public education funding (model 1), I use gross public spending on education as a dependent variable. This variable is also used as an explanatory variable in models of education outcomes (model 2).

Public spending on education is measured using public expenditure on education as a percentage of GDP. This is a main indicator of public funding of education used in this research. However, for checking the robustness of models and results, I have also used an alternative measure - public expenditures on education per student (log transformed), calculated by author by dividing total public spending on education into total enrollment (at all levels of education and for all ages).

The use of the share of public education expenditure in GDP as a measure of public funding of education is common in the literature. This index measures how a country prioritizes education in relation to its overall allocation of resources. Public expenditure on education includes "spending on schools, universities and other public and private institutions involved in delivering or supporting educational services. Expenditure on educational institutions is not limited to expenditure on instructional services but also includes public expenditure on ancillary services for students and families, where these services are provided through educational institutions..."[9] In other words, it also includes expenditure on educational institutions and subsidies for students' living costs and for

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[9] From the OECD Social Policy Division's definition of public education spending: http://www.oecd.org/dataoecd/45/48/37864432.pdf

other private expenditures outside institutions. It also captures all education-related public expenditures, including ministries other than the ministry of education, local and regional governments and other public agencies. It therefore includes both current and capital public expenditure on education.

Dependent variables: PISA scores as measure of education quality

PISA scores (mathematics and reading) were used as dependent variables in the models for evaluating the impact of public education spending on educational outcomes. Educational outcomes and educational quality are difficult to measure, especially across countries. However, international test scores, such as PISA, can be used for cross-country comparisons of educational quality. In this study I used PISA math and reading scores (mean scores for each country) for 2003, 2006, 2009. (A longer series of historical data is not yet available.)

The Programme for International Student Assessment (PISA) was started in 1997 by the OECD. It "aims to evaluate education systems worldwide by testing the skills and knowledge of 15-year-old students. Since the year 2000, every three years, a randomly selected group of fifteen-year-olds take tests in the key subjects: reading, mathematics and science, with focus given to one subject in each year of assessment."[10]

Control Variables: Model 1

The choice of the control variables is based on a critical analysis of the existing literature discussed in the second and third chapters, as well as on my own assessment of what is

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[10] http://www.oecd.org/pisa/aboutpisa/   Accessed August 28, 2012

missing in the literature and what factors may impact the change of public education spending and public education quality.

As presented in the beginning of this chapter, my hypothetical (theoretical) model takes public spending on education as a function of following factors:

Public Spending on Education = F(Fiscal Autonomy; Political institutions; Demographic variables, School Expectancy, Socio-Economic Factors; Technological Development)+error term   (1)

To empirically estimate this model and account for the factors listed above I used the following control variables:

Political institutions

First, following my theoretical model, I control for political institutions and any veto structure. The political economy literature suggests the importance of veto players in public spending (Crepaz and Moser, 2004). As Busemeyer notes, "a measure of the veto player density in political institutions …controls for that part of the restraining impact of the constitutional veto structure that is unrelated to fiscal decentralisation (Leibfried/Castles/Obinger 2005)." Busemeyer (2007) found that "The veto index is negatively associated with social spending and total public spending, but positively associated with spending on pensions and health care."(p. 22)

To measure Political institutions, I employ Henisz' Political Constraint Index. This index is coded annually for 140 countries and "captures the feasibility of a change in policy given the structure of a nation's political institutions (the number of veto points [number of independent branches with veto power]) and the preferences of the actors that inhabit

them (the partisan alignment of various veto points and the heterogeneity or otherwise of the preferences within each branch)."(Henisz and Zelner 1999, 13) The index also captures differences in presidential/parliamentary systems.

The literature on social spending finds also that the legislative composition (i.e., left versus right), as well as coalitions, affect the level of public funding on social expenditures. However, the data on these particular variables were not available, and the Political Constraint Index, as it captures fractionalization of legislatures, is supposed to account for these aspects as well.

I expect that this index will have a positive sign as countries with more stable political institutions (with more checks and balances) tend to spend more on human capital development and create innovative ways for economic development. The existence of political constraints affects the social spending positively because unconstrained choices by politicians would not reflect their constituents' interests.

Demographic variables

Second, I control for demographic factors. Demographic variables are assumed to control or at least influence the demand for education. I tested several control variables for demographic factors: total enrollment, the share of young people in the total population, and the population growth rate. The expectation is that they will all have a positive sign; as demand increases the funds made available.

School Expectancy

Third, I also control for the variability of educational policy in my sample, using a school expectancy variable. School expectancy is expected to have significant positive impact on

education funding because this is a variable that reflects the demand side;–the longer the schooling, the more resources a government needs to spend to fund education-related expenses. But this is not the demand by the population; this is a variable that captures educational standards set by central governments. I found that school expectancy positively and closely correlates with the GDP per capita.

Socio-Economic Factors

Fourth, I control for socio-economic factors. This is a big group of factors, and I have tested many control variables to capture these factors. First, I tried to capture the level of economic development, using (in different specifications) such control variables as GDP per capita (PPP), annual economic growth (GDP per capita growth) and household consumption per capita. The expectation is that educational spending will increase with increased levels of development. However, it is possible that less developed countries will spend more on education with the hope of increasing human capital and catching up. Thus the expected sign is not clear.

I also control for total public budget size using Total Public Expenditures as a % of GDP, assuming that countries with larger public budgets will spend more on education. The literature also points out that "[s]tates with a large public sector will exhibit higher spending levels in different subcategories as well, because of intrinsic cross-country differences in the division of labor between the state and markets in the provision of (semi-) public goods."(Busemeyer 2007, 19)

I also control for regional inequality, as there are concerns in the literature that regional inequality may affect the quality of social and educational services in the regions. I use

the measure of inequality based on the weighted average of income variation in the country, provided by Lessman (2012). It is very difficult to find good data to measure regional inequality (especially for non-EU members), and I used Lessman' data as a proxy. This measure is a weighted average level of variation of income for 1980-2000 for each country. His data set contains almost all countries in my data set except Estonia. Although recognizing that this data does not capture variation over time (it is an average level for period of time), and ideally it would be better to capture the effects of inequality changes over time, this data still can be used as a proxy because it captures variation in inequality levels among countries (as a cross-sectional feature).

I also control for the size of the country, using population as a measure, and I expect that this variable will have a negative impact on spending when controlling for other factors (as a result of economies of scale). At the same time, it is possible that with large distances, more schools (and more money) will be needed, so the expected sign of the effect is in fact not clear.

I also control for linguistic diversity using the number of languages per capita (log). It is expected that in countries with higher ethnic and linguistic diversity, spending on education will be higher because each group will demand schools and teaching in their own languages.

I have considered including the share of tertiary enrollment in total enrollment as an indicator of how education is valued/prioritized in the society (a cultural factor). This factor might be correlated with development level as well. However, it is possible that in ex-socialist countries, even if they have low income levels as a result of past socialist

economies and traditions, higher education might be highly valued, and this may result in higher expectations and standards for primary and secondary education.

Technological Development

Fifth, I think that technological development should be controlled and for this purpose I used the number of internet users per 1000 population. Technological development serves as a demand factor for educated people and increases the value of education, as well as facilitating education. It is expected that this variable will have a positive sign.

I have also tested whether certain variables can be used to distinguish the horizontal and vertical competition effects discussed earlier. For horizontal competition I tried the regional economic growth variable as data on interregional mobility was not available. For vertical competition I used the federal binary variable and also tested regional responsibility for the education variable. The sign for these variables is not clear, but based on the past literature these variables should have a positive effect. However, in most models these variables were not statistically significant.

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Control Variables: Model 2

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My hypothesis is that the theoretical model of relationship between educational funding and education outcomes is described as follows:

Education Outcomes = F(Public spending on Education; Direct effect of Decentralization; Educational environment and resources of the country; Regional Inequality; Families' socio-economic status; Regional Responsibility for Education; Linguistic Diversity)+ error term (2)

In this model, first I control for the direct impact of decentralization, which may have an impact on the quality of education, not through funding, but through other channels as described earlier. Such effects may occur naturally when regions select and decide for themselves on textbooks or curricula, when regions develop their own educational policies, or when they have authority to control local schools, etc. At the stage of implementing policies and spending money efficiently, other dimensions of regional autonomy may be more important than taxing powers. We need to control for this possibility in the education outcome model. Mainly, local accountability, the accountability of regional policy makers to local population, is becoming more important, as well as expenditures and educational policy making authority.

In countries with local elections, where citizens directly elect local parliament or the heads of local governments, local governments may be more motivated to improve public services. And as a result of increased accountability and better control of local resources, the performance of the providers of education may improve. This impact is not related to educational funding. The sign and significance of this variable are not clear, but it is usually assumed to have a positive effect.

Second, I control for the Educational environment and resources, which clearly vary across the countries in the sample. To capture this factor I employ an index of the quality of educational resources from the PISA web-site. This index is defined as the answer to a question by the school's principal in the PISA questionnaire.

Third, I control for regional inequality in the country. I use a measure of inequality based on weighted average variation of income in the country, provided by Lessman (2012). It

is expected that regional inequality has a negative effect on average education outcomes in total, although within country the outcomes may vary between regions. Unfortunately, there is no possibility to test the relationship between regional level educational performance and the regions' well-being. We can only use average test scores for countries. This may be a research task in the future for each country, assuming that data becomes available.

 Fourth, a factor that should be controlled is families' socio-economic status or wealth. To capture this factor I use household consumption per capita data from World Bank Data. It is expected that this variable has a positive effect on a child's performance at school.

 I also control for a region's responsibility for financing secondary and primary education, using a binary (dummy) variable. This is needed because when a majority of educational expenditures are financed through grants from the federal center, or the federal center is responsible for providing education, regions may choose a free ride even if they have taxing power or revenue authority. In other words, this variable in fact controls for vertical competition as discussed in the previous chapter. This variable is coded by the author as 0, if education financing is centralized and 1 if more than 50% of education expenditures is financed from regional budgets. In cases where primary and secondary education was financed from municipal budgets, I have examined how municipal budgets are financed. If they receive educational grants or a significant part of their revenues come from regional budgets, and regions are responsible for educational policies, it was coded as 1. But if the regions are responsible only for spending federal

funds and do not have decision-making authority in regards to providing education or educational policies, it was coded as 0. This index (coded as a dummy variable) is based on information provided by the websites of the countries' ministries of education or by local official web-sites, and the literature on power sharing. I have also validated my coding by looking at the shares of educational spending at regional and local (municipal) levels (from World Bank data).

Further, I control for linguistic diversity using the number of languages per capita (log transformed), to capture differences in cultural environment. The expected sign of the factor is not clear, as heterogeneity may affect education outcomes negatively. For example, if some students' native languages are different from the instructional language, it may affect students' understanding of the academic material. Alternatively heterogeneity may affect educational outcomes positively. There is some research that shows the benefits of bilingualism and that multilingualism may create a positive impact on the performance of bilingual children in schools. (Bankston III and Zhou, 1995)

Methods of Estimation and Diagnostic Tests

The data used in this dissertation consists of pooled time series cross-sectional data. For the first model N=33, T=10; for the second model N=33, T=3, where N= the number of countries and T= the number of time periods. To empirically estimate the models 1 and 2, theoretically specified as above, I use methods of statistical estimation designed for this type of data.

In this section, I describe existing methods and approaches in the literature to estimate models using pooled time series cross-sectional data. I discuss the problems related to

such data and possible ways of overcoming such difficulties. Also, I explain my choice of the methods for my case and describe diagnostic tests needed to test the appropriateness of the selected estimation techniques and the accuracy of the results obtained.

As Beck and Katz (1995) note "The critical assumption of TSCS [Time series cross sectional] models is that of "pooling"; that is, all units are characterized by the same regression equation at all points in time." (p. 636). They also point out that "The error process of such models may be more complicated than is typical of either time-series or cross-sectional models. Different assumptions about this error process lead to different preferred methods of estimation." (p. 636)

 General discussion of specifics of estimating of pooled time series cross sectional data

There is no agreement on what the data that combines time and cross-sectional dimensions should be called (Worall 2007, 233) They may be called "panel data," "time-series cross section," "pooled time series and cross-section," or "multiple time series." There is a view that "in political science, when T is large relative to N the data are referred to as *time-series cross-section* data." (Frees 2004, 286) As Beck and Katz (1995) state "Time-series cross-section data are characterized by having repeated observations on fixed units, such as states or nations. The number of units analyzed would typically range from about 10 to 100, with each unit observed over a relatively long time period (often 20 to 50 years)." (p. 634).

However, regardless of the number of units and time periods in the dataset, they all have the same methodological issues and concerns. (Worall 2007, p. 233) These methodological problems and concerns include the following pooling problems:

1. Autocorrelation.

2. Panel heteroskedasticity, where the variance of the error process differs from unit to unit (Beck and Katz 1995, 636). "Adding a time dimension magnifies the effect of the heteroskedasticity." (Worall 2007,p. 234)

3. Heterogeneity. There might be time related (when errors across each unit will be correlated due to some event) or time-stable differences between units. (Worall 2007, p. 234)

4. Spatial correlation

As Beck and Katz note "Both the temporal and spatial properties of TSCS data make the use of ordinary least squares (OLS) problematic." (p.634) They also state that "TSCS errors to be contemporaneously correlated in that large errors for unit i at time t will often be associated with large errors for unit j at time t. This is likely in the cross-national context, where the economies of, say, the Netherlands and Belgium are linked... These contemporaneous correlations may differ by unit…" (p. 636)

The errors also may show temporal dependence.

Beck and Katz state further that "Time series cross-section analysts …put some structure on the assumed error process. In particular, they assume that for any given unit, the error

variance is constant, so that the only source of heteroscedasticity is differing error variances across units. Analysts also assume that all spatial correlation both is contemporary and does not vary with time. The temporal dependence exhibited by the errors is also assumed to be time-invariant and may also be invariant across units." (p.636) These assumptions are based on the panel nature of the data, and Beck and Katz call them "the *panel error assumptions*." (p. 636)

These problems are violations of OLS assumptions and have to be adequately addressed. The diagnostic tests after estimation are important to verify that these problems are addressed and the methods and results are appropriate.

Worall specifies "five key estimation issues associated with fixed effects regression models… (1) heterogeneity; (2) dynamics; (3) panel heteroskedasticity and contemporaneous correlation; (4) stationarity; and (5) trends." (Worall 2007, p. 233)

Most researchers use fixed effects or random effects methods for panel data. The fixed effects model is the most popular method, but it has several disadvantages. As Worall (2007) comments, "it removes any of the average unit-to-unit variation from the analysis", or "ignores the possibility that unit-to-unit variation sheds light on the relationship between x and y." (p. 235) Another disadvantage is that there are "three types of "problematic" predictors that limit its use" (p. 235): a predictor that does not vary over time ("it will be perfectly collinear with dummies for each unit"); predictor that model some events that each unit experiences at same time (perfectly collinear with time dummies), predictors that change a little over time. (p.235)

As Plumper and Troeger (2004) state, "contrary to a cross-section or a pure time-series panel data analyses allow controlling for unit fixed-effects that – as most researchers believe – capture the systematic influences from omitted variables."(p. 2) However, they point out that this is potentially misleading, "since unit fixed effects do not eliminate all kinds of omitted variable bias. Time-variant omitted variables may still bias the estimates. Thus, one danger of fixed effects models is that many researchers believe that the inclusion of unit dummies precludes problems with omitted variables." (p. 2)

Busemeyer (2007) comments that the use of fixed effects model in case when main explanatory variable (decentralization) for most countries is time invariant is not considered as appropriate. (p. 19) He also remarks that there is a trade-off between elimination of cross-sectional variance with inclusion of fixed effects, and absorption of largely time invariant variables by country-specific fixed effects and the risk of omitted variable bias and biased conclusions when fixed effects are not included. (p. 19).

Random effects estimation also has limitations. It "assumes that the error term is not associated with any of the predictor variables" or "the predictor variables are not correlated with unobserved unit-specific effects," (Menard 2007, 235) which is not always true. Random effects estimation also assumes that random error terms, that are unique to each unit, do not change over time. (p. 235) Random effects are also preferable in comparison with fixed effects because, as Hoechle says, "Assuming that the residuals are correlated both within groups as well as between groups would often be more natural." (Hoechle 2007, 283)

To estimate the coefficients of my models I chose Driscoll-Kraay and Newey-West standard errors estimation as main methods, as I need to deal with autocorrelation, heteroscedasticity and in some cases spatial dependence problems. These estimators are the most robust to specification errors, and I will discuss this later. However, I used random effects estimation as an alternative method to test the robustness of my findings[11]. To deal with omitted variable bias problem, which was discussed above, I considered most of the variables that could affect the differences among individual countries. I have also tested regressions for omitted variable bias.

In next section I discuss Panel Corrected Standards Errors method, Driscoll-Kraay Standard Errors and Newey-West estimations in more detail.

Feasible GLS, Panel-corrected standard errors, Newey-West and Driscoll-Kraay standard errors

After Beck and Katz (1995, 1996) suggested the use of panel corrected standard errors model for time series cross sectional data, it has become one of widely used methods in the relevant literature (see, for example, Busemeyer, 2007).

Earlier, another popularly used method was Feasible Generalized least squares method, or the Parks method; however, Beth and Katz (1995) criticized this method. Beck and Katz (1995) noted that the method produces accurate standard errors instead of OLS errors; their idea was "to retain OLS parameter estimates but replace the OLS standard errors with *panel-corrected standard errors*." (p. 634)

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[11] The testing random effects versus fixed effects using the Hausman test shows that random effects are preferable for my data.

Beck and Katz showed "that the generalized least squares approach of Parks produces standard errors that lead to extreme overconfidence, often underestimating variability by 50% or more."(p. 634) They reviewed several articles in political science, which used "the generalized least squares (GLS) method first described by Parks (1967), a method designed to deal with some common problems that occur in TSCS data," and showed that "that the Parks method produces dramatically inaccurate standard errors." (p. 634)

They explained that GLS has optimal properties for TSCS data, but in practice we do not have knowledge about the error process: "Thus analysts use not GLS, but feasible generalized least squares (FGLS)... The FGLS formula for standard errors, however, assumes that the error process is known, not estimated. In many applications this is not a problem because the error process has few enough parameters that they can be well estimated. Such is not the case for TSCS models, where the error process has a large number of parameters."(p. 634)

Hoechle (2007) also supports the view that Park's FGLS method is not always appropriate. He notes that proposed by Parks (1967) a feasible generalized least-squares (FGLS)-based algorithm that Kmenta (1986) made popular, was "an early attempt to account for heteroskedasticity as well as for temporal and spatial dependence in the residuals of time-series cross-section models" (p. 284). However, he notes that this method "is typically inappropriate for use with medium- and large-scale microeconometric panels for at least two reasons. First, this method is infeasible if the panel's time dimension, T, is smaller than its cross-sectional dimension, N, which is almost always the case for microeconometric panels. Second, Beck and Katz (1995) show

97

that the Parks-Kmenta method tends to produce unacceptably small standard error estimates." (Hoechle 2007, 284)

Petersen (2009) notes that there is no single approach to the estimation of panel data. He points out that in finance, while many researchers use panel data, used approaches to address the problem of possible biases in standard errors vary. He writes that

> In recently published finance papers, which include a regression on panel data, 42% of the papers did not adjust the standard errors for possible dependence in the residuals. Approaches for estimating the coefficients and standard errors in the presence of the within-cluster correlation varied among the remaining papers. Thirty-four percent of the remaining papers estimated both the coefficients and the standard errors using the Fama-MacBeth procedure (Fama and MacBeth, 1973). Twenty-nine percent of the papers included dummy variables for each cluster (e.g., fixed effects or within estimation). The next two most common methods used OLS (or an analogous method) to estimate the coefficients but reported standard errors adjusted for the correlation within a cluster (e.g., within a firm or industry). Seven percent of the papers adjusted the standard errors using the Newey-West procedure (Newey andWest, 1987) modified for use in a panel data set, while 23% of the papers reported clustered standard errors (Liang and Zeger, 1986; Moulton, 1986; Arellano, 1987; Moulton, 1990; Andrews, 1991; Rogers, 1993; and Williams, 2000), which are White standard errors adjusted to account for the possible correlation within a cluster. (pp. 435-436)

Hoechle (2007) notes that "[t]o ensure validity of the statistical results, most recent studies which include a regression on panel data therefore adjust the standard errors of the coefficient estimates for possible dependence in the residual". (p. 281) It is common to rely on "robust" standard errors. "Probably the most popular of these alternative covariance matrix estimators has been developed by Huber (1967), Eicker (1967), and White (1980). …standard errors which are obtained by aid of this estimator are consistent even if the residuals are heteroscedastic…" (p. 283)

Hoechle writes that "[a]nother approach to obtain heteroscedasticity and autocorrelation (up to some lag) consistent standard errors was developed by Newey and West (1987). Their generalized method of moments - based covariance matrix estimator is an extension of White's estimator; the Newey-West estimator with lag length zero is identical to the White estimator. Although Newey-West standard errors have initially been proposed for use with time series data only, panel versions are available."(p. 283) At the same time, he also notes that while "most empirical studies now provide standard error estimates that are heteroscedasticity and autocorrelation consistent, cross-sectional or "spatial" dependence is still largely ignored." (p. 281)

As Petersen explains, the Newey-West standard errors method: "...was initially designed to account for a serial correlation of unknown form in the residuals of a single time series…The Newey-West method for estimating standard errors has been modified for use in a panel data set by estimating only correlations between lagged residuals in the same cluster (see Brockman and Chung, 2001; MacKay, 2003; Bertrand, Duflo, and Mullainathan, 2004; and Doidge, 2004). The problem of choosing a lag length is simplified in a panel data set, since the maximum lag length is one less than the maximum number of years per firm" (Petersen 2009, pp.435-436). He also writes that "having a lag length of less than the maximum $(T - 1)$ will cause the Newey-West standard errors to underestimate the true standard error when the firm effect is fixed." He also notes that "in a panel setting, the Newey-West standard error formula is identical to the clustered standard error formula except for the weighting function."(pp. 475-476)

Based on this review of methods I can conclude that panel corrected standard errors and Newey-West standard errors estimations could be the most appropriate methods to estimate coefficients of regression models in my research. However, in some models I have spatial correlation, and in such cases, i.e., in panel data models with autocorrelation, heteroskedasticity and spatial correlation, the use of Driscoll-Kraay standard errors is recommended (Hoechle 2007, 306-308).So I used this method in cases with spatial dependence. I also show robust regressions with White errors, and in model 2 I included time dummies to adjust for contemporaneous correlation. In that case, the time period is too short to use Driscoll-Kraay Standard Errors.

As Hoechle (2007) writes, "assuming that the disturbances of a panel model are cross-sectionally independent is often inappropriate." (p.282) He notes, "Provided that the unobservable common factors are uncorrelated with the explanatory variables, the coefficient estimates from standard panel estimators, e.g., fixed effects (FE) estimator, random-effects (RE) estimator, or pooled ordinary least-squares (OLS) estimation, are still consistent (but inefficient). However, standard error estimates of commonly applied covariance matrix estimation techniques, e.g., OLS, White, and Rogers or clustered standard errors, are biased, and hence statistical inference based on such standard errors is invalid. Fortunately, Driscoll and Kraay (1998) propose a nonparametric covariance matrix estimator that produces heteroskedasticity- and autocorrelation-consistent standard errors that are robust for general forms of spatial and temporal dependence." (p. 282) Driscoll and Kraay (1995) note

Economists are frequently faced with the problem of drawing inferences from data sets which combine cross-sectional and time-series data. In such situations, it has become standard practice to base inferences on techniques which pool the cross-sectional and time-series dimensions in some way. For such techniques to be valid, it must be the case that the error terms are not correlated across different cross-sectional units, either contemporaneously or at leads and lags. This condition is directly analogous to the usual requirement that the residuals from different observations in a single cross-sectional regression be independent of each other. (p. 1)

As Driscoll and Kraay (1995) point out "if this condition is not met, estimates of standard errors will be inconsistent, and will not be useful for inference" (p.1). However in many cases, "especially in macroeconomics and international economics, the assumption of independent cross-sectional units is inappropriate." (p.1)

Driscoll and Kraay (1998) proposed "a simple modification of the standard nonparametric time series covariance matrix estimator which remedies the deficiencies of techniques which rely on large-T asymptotics" (p. 550). They write:

…a simple transformation of the orthogonality conditions which identify the parameters of the model permits …to construct a covariance matrix estimator which is robust to very general forms of spatial and temporal dependence as the time dimension becomes large. The consistency result holds for any value of N, including the limiting case in which N →∞ at any rate relative to T. By relying on nonparametric techniques, we avoid the difficulties associated with misspecified parametric estimators. Moreover, since we do not place any restrictions on the limiting behavior of N, the size of the cross-sectional dimension in finite samples is no longer a constraint on feasibility, and we can be confident of the quality of the asymptotic approximation in finite samples in which N and T are of comparable size, or even if N is much larger than T, provided that T is sufficiently large. (p. 550)

I use Driscoll-Kraay and Newey-West Standard Errors to estimate model 1 and Newey-West standard errors as the main method to estimate model 2. I also report robust regression estimations (White Standard Errors) and other alternative estimations.

<center>**Diagnostic tests**</center>

To ensure that regression results are reliable and accurate and interpretations based on these estimations are correct, and the chosen estimation methods are appropriate, I performed diagnostic tests. These tests are needed because regression analysis and estimations are based on certain assumptions, and violation of those assumptions would result in inconsistency or inefficiency of estimations. Such assumptions for OLS (as both Newey-West and Driscoll-Kraay Standard Errors are based on OLS) and requirements for data include normality, homoskedasticity, stationarity (for time series), and no serial or spatial correlations, and no collinearatity. Also, as I use pooled time series data, the test of poolability (i.e., can we pool this data in one model or are several models needed for sub-parts of the data), as well as the test of parameter stability over time to insure that the results are statistically correct.

In this section I will describe the tests that I have conducted to verify that the empirical research is methodologically correct and results are statistically significant and reliable. First, I have tested the data for the presence of **heteroskedasticity**, using Breusch-Pagan / Cook-Weisberg test, and in all models the null hypothesis about constant variance was rejected. This suggests that errors are heteroskedastic and that methods with robust standard errors should be used.

Second, I tested data for **stationarity** (only for first part of the research, where T=10, because second model has T=3), using unit root test for variables.(Im et al, 2003) According to nharvey test, variables are stationary (for both constant and trend stationarity), although the Fisher test for panel unit root showed that public expenditure

<center>102</center>

as a percentage of GDP is non-stationary. However, as this is only one variable and the first test rejected non-stationarity, I did not use any transformations. All my models were tested using alternative measures of spending, and the results were similar.

Third, I have tested for **cross-sectional dependence**, using the Pesaran, Frees and Freidman tests. In cases where I found cross-sectional dependence, I have used robust methods. Particularly, cross-sectional dependence was found in some models for public educational expenditure as a function of decentralization, and in such cases I estimated it with Driscoll-Kraay Standard errors. I compared these estimations with robust panel estimations and presented alternative estimations as well. In the case of model 2, the PISA math models did not demonstrate spatial dependence. For models with alternative variables (with alternative measures for spending as public educational expenditures per student and PISA reading score as the alternative dependent variable) I have used time dummies to take into account spatial dependence. I have also presented several alternative estimations.

Fourth, to test for presence of multicollinearity I used VIF test.

Fifth, I have tested my models for **parameter stability** over the time period using the Chow test.

Sixth, as pooled TSCS data has to be corrected for the **autocorrelation** problem (was tested by using Wooldridge test and Arellano-Bond test), I used Driscoll-Kraay and Newey-West standard errors OLS estimations. In alternative specifications I included a lagged dependent variable into the models.

Next, as I use pooled time series cross section data, I need to perform the **poolability**

test. Baltagi (2005) notes, "The question of whether to pool or not naturally arises with

panel data. The restricted model is the pooled model…representing a behavioral equation

with the same parameters over time and across regions. The unrestricted model, however,

is the same behavioral equation but with different parameters across time or across

regions." (p.53) As Baltagi points out, in many economic studies researchers have large

number of observations on individuals, firms, regions, etc., but only a few time periods.

In such cases, the poolability of the data can be tested "for the case of pooling across

regions keeping in mind that the other case of pooling over time can be obtained in a

similar fashion."(p. 53) He explains the methodology of the poolability test as a

comparison of the restricted model with the unrestricted model: "For the unrestricted

model we have a regression equation for each region, and coefficients are different for

each regional equation." (p.53) To test poolability "we want to test the hypotheses H0: δ_i

$= \delta$ for all i." (p. 53) This can be done by using the Chow test. However, as Baltagi

shows, the Chow test is not always appropriate and the Roy-Zellner test is a better test for

poolability in most cases. (pp. 56-58)

Patuelli, Vaona and Grimpe (2008) also discuss the poolability test and write that "testing

for poolability is equivalent to testing for sub-sample stability of the estimated regression

coefficients. The question underlying the econometric procedures labeled as 'poolability

tests' is whether a single model can fit all the data we are analysing or it is better to

specify different models for different parts of the dataset." (p. 8) The idea is to test if the

vector of coefficients is the same for all units. "In other words, our null hypothesis is H_0:

$\beta_i = \beta$." (p. 8) They also note that the Chow tests and Roy-Zellner tests, and "two tests for poolability can be distinguished according to the assumptions regarding zero cross-correlations in the distribution of the errors. The Chow test assumes that $u_{ig} \sim N(0, \sigma^2)$; whereas, the Roy-Zellner test assumes $u \sim N(0, \sum)$." (p.9)

They mention other tests as well. "Ziemer and Wetzstein (1983) built a poolability test on the basis of the forecast risk performance of the pooled and unpooled estimators. Han and Park (1989) extended the test for structural change proposed by Brown et al. (1975) to a panel data setting, while Baltagi et al. (1996) proposed a nonparametric test for poolability. Finally, there exist also three mean squared error (MSE) criteria helping to choose on 'pragmatic grounds' between the pooled and unpooled estimators (Wallace 1972; McElroy 1977)." (p. 9) They note that the tests and the criteria above, however, rely on the assumptions of linearity of the model and normality of the errors. They used Watson and Westin (1975) and a likelihood ratio test (for unrestricted and restricted models) for poolability.

In my case, there are 33 countries ten years for model 1 (and T=3 for model 2), and the number of my variables varies in my main specifications from five to seven. I was not able to estimate unrestricted models, as I do not have enough observations to run the unrestricted model with large number of variables (I have to include 33 β_i coefficients). In such cases, when there is too little data to perform this test, researchers suggest using panel data, and test if it is appropriate.[12]

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[12] See for example http://stats.stackexchange.com/questions/6102/why-are-my-constraints-getting-dropped; http://www.stata.com/statalist/archive/2011-01/msg00281.html

Also, as in my case, since the fixed effects model is not significant (for either regional or time dimensions), I assume that there are no significant differences in parameters for regions, and data can be pooled.

I have also performed tests for functional form and normality to ensure that OLS based methods can be used to estimate the data.

For the **robustness check** I used alternative methods of estimation, i.e.,RE GLS regression with AR(1) disturbances (xtregar), Prais-Winsten estimation, as well as cross-sectional time-series FGLS regression with panel-specific AR1 (xtgls). I have also tested robustness of the results using alternative measures for decentralization and for public spending on education. For regressions on education outcomes the results were also tested for robustness, using different test scores (for reading) and different measures of spending.

All models also were tested also for robustness and the sensitivity of the results to including one country by dropping one country at time. The results showed that coefficient estimates do not change and are not driven by inclusion of some countries. In the next chapters, I discuss the results of econometric estimation of models and will also discuss public policy implications and limitations of the research.

CHAPTER 5

DISCUSSION OF THE EMPIRICAL RESULTS OF THE RESEARCH

In this chapter I present and discuss the results of the empirical research.

First, I discuss research findings from the empirical estimation of the model for public

spending on education. I also evaluate the robustness of this model using alternative

variables to measure public spending on education and decentralization. In addition, I

conduct and discuss diagnostic tests of the results.

 Second, I discuss the results of the empirical estimation of models of education

outcomes. I also address the main and alternative specifications, conduct diagnostic tests,

analyze effects and the significance of explanatory factors and discuss the robustness of

the results.

 Third, I summarize the findings from my analysis, the limitations of the data, and discuss

the opportunities for future research.

Regression models on relationship between decentralization and public spending on

education

 The model of the relationship between fiscal decentralization and public spending on

education was specified in the previous chapter as follows:

Public Spending on Education = F(Fiscal Autonomy; Political institutions; Demographic variables, School Expectancy, Socio-Economic Factors; Technological Development)+ error term (1)

My research goal is to determine whether decentralization has any effect on the provision of public education by examining funding and outcomes, controlling for other factors (institutional, demographic and socio-economic factors) that may affect these variables. My hypothesis is that this effect is significant and positive.

I measure public spending on education by its share of GDP, which shows how countries value and prioritize public education. I also test the robustness of the findings by employing another measure for public spending on education, i.e., public education expenditure per student (in constant US dollars).

As discussed in Chapter 4, I use time-series cross-sectional data for 33 countries in the period of ten years. However, during the model building process, after examining the diagnostic plots, one country – Turkey – was excluded as an outlier for one variable (the ratio of young population in total population). This affected the results of the specification tests. For this reason Turkey was excluded from the sample for model 1. In the future, however, if the research is repeated with more observations with similar ratios of young population to total population, it is possible to include such countries and use a control variable for those countries. It should be noted that exclusion/inclusion of Turkey affects only the coefficient for young population, and other regression coefficients in the model do not change significantly. Also, for Estonia a regional inequality measure was not available; thus, in final model 1 I have only 31 countries.

The methods used to estimate the coefficients of regression were chosen after a comprehensive analysis of the data in my sample and take into account specifics of the panel data.

Discussion of pre-estimation tests

The diagnostic tests show that data in my sample are heteroskedastic and autocorrelated, and in some cases have spatial dependence. The exception is for the model with an an alternative fiscal decentralization measure – Stegrescu's tax decentralization index used in models 1 and 2.

The hypothesis about constant variance in residuals was tested using the Breush/Pagan and White tests, and it found that the data is heteroskedastic, so robust methods had to be used.

The presence of autocorrelation and its lag structure was tested using the Arellano-Bond test (abar test), which revealed that the model has autocorrelation with up to nine orders.

The tests of spatial independence using the Pesaran, Frees and Freidman tests of spatial independence (xtcsd test) were conducted to find out if the residuals have contemporaneous correlation. In cases where such null hypotheses about the spatial independence were rejected, I estimated model1 with Driscoll-Kraay standard errors, which are robust to heteroskedasticity, autocorrelation and spatial dependence. I also report the Newey-West Standard Errors. This method is robust for heteroskedasticity and

autocorrelation but not for contemporary correlation. The coefficients are the same in

both cases, as both methods are based on pooled OLS.[13]

I also analyzed whether the lagged dependent variable should be included on the right

hand side of the model and explored such models using instrumental variables approach.

However, post estimation tests for omitted variables and model specification suggested

that there was no omitted variable bias in models without lagged dependent variables.

Most researchers dealing with panel data analysis use fixed effects or random effects

estimation. I have also attempted to use fixed effects to estimate this data and have

compared them with random effects using the Hausman test. This test was conducted for

models with fiscal autonomy index and with an alternative index for fiscal

decentralization (Stegarescu tax decentralization index). In addition I conducted the

version of this test suggested by Hoechle (2007), and both tests revealed that there are no

systematic differences in estimations. Therefore, random and Pooled OLS methods can

be used.[14]

Based on the results of these pre-estimation diagnostic tests and analyses of the data, as

well as econometric and empirical literature discussed in chapter 4, model 1, describing

the relationship between decentralization and public spending on education, should be

estimated by pooled OLS with Driscoll-Kraay standard errors. Furthermore, I examined

estimations using random effects GLS. However, this method can correct only

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[13] The poolability of the sample was tested using the Hausman test, which confirmed that there are no fixed effects, so it was decided that data can be pooled. The test results are described in table 1.
[14] I also should note that my main explanatory variable, fiscal autonomy, rarely changes over time (or time-invariant), which also makes the use of fixed effects problematic.

autocorrelation of the first order. In my case, the Arellano-Bond test shows the presence

of autocorrelation with up to nine lags, and that is why the results are not reliable.

Therefore the random effects method is eliminated. Also, random effects are not

suggested for use in the model that has a contemporaneous correlation. When I estimated

the model with random effects, which is not consistent in this case, most of regression

coefficients became insignificant. In panel data models with autocorrelation,

heteroskedasticity and spatial correlation, Driscoll-Kraay standard errors are

recommended (Hoechle 2007), so I used this method. However, I also present other

estimations to compare them.

 The robustness of the model and accuracy of specification was also tested by including

some additional variables to determine if coefficients change significantly when new

variables are added.

 The model was theoretically examined in earlier chapters, but I also analyzed the

potential links between variables and their possible effect on dependent variables by (1)

using correlation matrixes; (2) plotting chosen control variables against dependent

variable; and (3) using added variable plots during the model building process. I have

looked for outliers and patterns of the residuals after each specification as well.

 Formal specification tests, such as Ramseys' specification test and the Link specification

test, were used to verify that the model does not have an omitted variable bias and the

specification is correct. Also, these tests helped to identify whether the functional form of

the model is correct. Formal tests, such as the ladder test and skeweness/kurtosis test,

and the analysis of residual plots to check for patterns in residuals were used to identify

whether any transformations of variables are needed to avoid non-normality of residuals

and violations of OLS assumptions. As a result of these tests, I have decided to log

transform some of my variables. Specifically dependent variables and total government

expenditures in education, population, number of languages per capita, GDP per capita,

and surface/territory of the country were log transformed to fix non-linearity and non-

normality in residuals.

Table 3. Pre-estimation diagnostic tests

Test	Test results and significance	The findings
Pesaran's test of cross sectional independence	Pesaran's test of cross sectional independence = 2.852, Pr = 0.0043	The data is spatially correlated
Heteroskedasticuty: White's general test statistic	White's general test statistic : 244.5174 Chi-sq(76) P-value = 1.4e-19	The data is heteroskedastic
Breusch-Pagan / Cook-Weisberg test for heteroskedasticity	chi2(1) = 24.02 Prob > chi2 = 0.0000	The data is heteroskedastic
Arellano Bond test for autocorrelation	for AR(1): z = 14.68 Pr > z = 0.0000 for AR(2): z = 12.62 Pr > z = 0.0000 for AR(3): z = 11.33 Pr > z = 0.0000 for AR(4): z = 10.06 Pr > z = 0.0000 for AR(5): z = 8.50 Pr > z = 0.0000 for AR(6): z = 6.67 Pr > z = 0.0000 for AR(7): z = 5.22 Pr > z = 0.0000 for AR(8): z = 4.14 Pr > z = 0.0000 for AR(9): z = 2.81 Pr > z = 0.0055	The data has autocorrelation with up to 9 lags
Hausman Test	Test: Ho: difference in coefficients not systematic chi2(8) = (b-B)'[(V_b-V_B)^(-1)](b-B) = 10.80 Prob>chi2 = 0.2135	There are no fixed effects (random effects and Pooled OLS are consistent)
Test of overidentifying restrictions: fixed vs random effects (xtoverid test)	Sargan-Hansen statistic 13.605 Chi-sq(10) P-value = 0.1918	There are no fixed effects

Thus, the final model presents the optimal set of explanatory variables chosen on the basis of this analytical work. I have also analyzed the statistical significance of included variables and multicollinearity between variables. In addition, I have analyzed multicollinearity after each step by using VIF test, as the use of VIFs is considered to be the standard approach.[15] Some variables, discussed in theoretical chapters were not included in final model, as the analysis showed close correlation between control variables. For example, the tertiary enrollment ratio and internet users per capita closely correlate with school expectancy and with control of corruption index. For this reason they were not included in the final model.

Discussion of estimation results for the regression model of public spending on education

The results of the estimation of regression models show that fiscal decentralization has a significant positive impact on public spending on education while holding the impact of political institutions, socio-economic and demographic characteristics of the country constant. This finding is robust and consistent across different specifications (table 4 and table 5).

 Further, I will discuss the coefficients and their significance based on the estimated model 1. In addition, other models are presented to show that the results still hold when I use different measures for fiscal decentralization and for public spending on education. It should be noted that when I use log of public education expenditures per student (as an

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[15]See, for example: http://www.stata.com/statalist/archive/2011-08/msg01063.html; https://onlinecourses.science.psu.edu/stat501/node/83

alternative measure for dependent variable) the interpretation and meaning of some demographic coefficients changes. Specifically the interpretation of the urbanization rate and the ratio of people younger than 29 of total population, and linguistic diversity change, and this explains changes in sizes and signs (see below, p. 124). But the interpretation of other explanatory variables does not change.

 The coefficient for fiscal autonomy, which in the final model equals 0.0416469 (table 4), shows that countries with higher levels of regional fiscal autonomy have higher levels of public spending on education in GDP. They prioritize the funding for education more than other countries, and also they spend more public resources on education per student. When the fiscal autonomy index increases by one point, which means they have more taxing power, the share of public education spending in GDP increases by 4.16 percent.

 The finding about the positive impact of decentralization is also robust when alternative measure of decentralization, Stegarescu's tax revenue decentralization index (Stegarescu 2004) is used. The coefficient is also positive and significant although smaller. The difference in sizes of coefficients for these two measures of fiscal decentralization is explained by the fact that these indexes are constructed differently. In the case of the Stegarescu tax decentralization index, it is a share of the sub-central governments' own autonomous taxes (when sub-central government determines tax rate and tax base, or only tax rate or only tax base) in the consolidated general governments' total tax revenue. In the case of the fiscal autonomy measure index from the RAI data set, it is an ordinal variable of tax autonomy varying from 0 when central government sets the base and rate

114

for all regional taxes to 4 when the regional government sets the base and rate of at least one major tax: personal income, corporate, value added, or sales tax.[16]

When I use an alternative dependent variable (public spending on education is measured in dollars per student (log transformed)), the coefficient for fiscal autonomy is also positive and significant.

I have also tested if other decentralization measures, for example, local elections can be used instead of fiscal decentralization and if the results are similar. However, when I use local elections, the estimated coefficient, although positive, is not significant in all models. This means that local elections or political decentralization cannot replace fiscal decentralization, or that procedural decentralization is different from actual or effective decentralization, and regional taxing power is important for increasing the spending on public goods and services.

The findings about the positive and statistically significant effect of fiscal decentralization confirm my theoretical conclusions in previous chapters: fiscal decentralization through giving regions real power to respond to the demand of the population provides an opportunity to increase funding for public education through increased spending on schools, teacher salaries, technical equipment, textbooks, etc.

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[16] More detailed methodology on ranking of fiscal autonomy measure is as follows (Hooghe et al 2008, 129) : 0: the central government sets the base and rate of all regional taxes;
1: the regional government sets the rate of minor taxes;
2: the regional government sets the base and rate of minor taxes;
3: the regional government sets the rate of at least one major tax: personal income, corporate, value added, or sales tax;
4:the regional government sets the base and rate of at least one major tax: personal income, corporate, value added, or sales tax.

When regional governments are accountable to the local population, and regional authorities have a real ability (as they have financial flexibility) to respond to citizens' preferences by increasing funding on preferred expenditures, there is a high probability that they will spend more on social and particularly, educational categories. For example, regional authorities place a higher value on education than the expenditures on military or national security.

These findings were discussed with public officials in one of the central regions of Russia (in the Republic of Tatarstan). The interviews with public officials from the Ministry of Education and the Ministry of Finance of the Republic of Tatarstan and the Education Committee Chair of the regional parliament confirmed the findings. For example, they confirmed that local schools would not be closed in villages and small towns, if the region had its own financial sources to support them and had the right to make decisions. Centralized decisions on the optimization of the number of schools were made by introducing a school bus system and determining the number of buses needed to drive students to schools in larger villages and towns. This resulted in strong opposition from parents, as they were concerned about the safety, health and ineffective use of students' time. For example, parents complained that often old and improperly equipped buses were used, often without a heating system and not designed for carrying children. Often there was only one bus from one town serving kids of different grade levels or different schedules. The quality of roads is a concern for safety for parents, especially during Russian cold winters. The local officials also mentioned that in some villages, library, school and/or hospitals are all located in the same building for purposes of saving money,

although they understand that this is not optimal. They mentioned that all of these factors are related to the fact that the region no longer has any taxing power and does not have enough financial resources for flexible social spending. It should be mentioned that today no region has taxing power in Russia in contrast to the early 1990s. At that time, for instance, in Tatarstan many new schools were opened, including many schools using the Tatar language and other minority languages. Still, the regional parliament and government of the Republic of Tatarstan are now trying to finance programs (from the regional budget) to support teachers and education. In 2011 every high school teacher in Tatarstan received a free laptop from the regional government. The region also has several unique programs supporting education. Among them is Program "Algarysh" (translates as "progress") that funds study abroad programs. Local officials have stated publicly that education is a regional priority, although during the interviews some mentioned that the situation with local schools and the teaching of the Tatar language would improve if the region had fiscal power, and could decide what and how to teach.

Table 4. Regression models for the relationship between fiscal decentralization and public spending on education.

*** - significant at 0.001 level, **- significant at 0.05 level, * significant at 0.10 level

	Driscoll-Kraay standard errors, 9 lags (Dependent variable – log of public spending in GDP) Model 1	Newey-West standard errors, 9 lags (Dependent variable – log of public spending in GDP) Alternative estimation for Model 1, does not correct for spatial dependence	Newey-West Standard Errors, 4 lags (with Stegarescu Fiscal Decentralization index) Model 1_2	Driscoll-Kraay SE (Dependent variable – log of expenditure per student, 9 lags Model 1_3
Fiscal Autonomy	.0416469***	.0416469**		.0580161***
Stegarescu – decentralization measure			.002225**	
TotGovExpendit in GDP (log)	.1813808***	.1813808	.6589999 ***	
Population (log)			-.04082**	-.0711867***
Territory of the country (surface, log)	-.0296502***	-.0296502*		
PolCon Index (Polconiii)	.1260674***	.1260674		
Control of Corruption			.1752637***	.268826***
Urban population	.0022038***	.0022038	.0042419**	-.0086143***
Number of languages per capita (log)	.1031607***	.1031607***		-.0430474***
School expectancy	.0228518***	.0228518*		
Age ratio, under 29	1.922855***	1.922855**	3.000814***	-2.774856***
R&D in GDP	0.0626785***	0.0626785**		.0572425***
Federal/vertical competition	-.1581994***	-.1581994***	-.0235647	-.0739004**
Regional Inequality/Horizontal Competition	-.0334541	-.0334541		.4081599***
GDP PC (PPT, log)	0.0487908***	0.0487908***	.1670592***	1.433183***
R2	0.6473	0.6473	0.7350	0.9575
Significance test	F = 15429.37 Prob > F = 0.0000	F = 15.44 Prob > F = 0.0000	18.54 Prob > F = 0.0000	F= 1920398.07 Prob > F = 0.0000

Table 5. Alternative estimations for model1, describing the relationship between fiscal decentralization and public spending on education.

*** - significant at 0.001 level, **- significant at 0.05 level, * significant at 0.10 level

	Cross-sectional time-series FGLS regression, with heteroschedastic panels and common AR 1. Dependent variable – Public education expenditures in GDP, %	RE GLS regression with AR(1) disturbances Dependent variable – Public education expenditures in GDP, %	Instrumental variables (2SLS) regression Dependent variable - Public education expenditures in GDP, transformed	Driscoll-Kraay standard errors (with more explanatory variables) Dependent variable – Public education expenditures in GDP, log
Fiscal Autonomy	.0817691*	.0258553	.0059418*	.0313891***
One year lag of dependent variable			.8412081***	
TotGovExpendit in GDP	.0480757***	.0473133***		
TotGovExpendit in GDP, log			.0867897***	.4310343***
Population (log)			-.0088381	-.0867736***
Territory of the country (surface, log)	-.0939544**	-.1073285		
PolCon Index (Polconiii)	.5352255**	.974488**		.2489691***
PolCon index (log)			.0268357*	
Control of Corruption			.0046489	
Urban population	.0147018**	.0331389***		.0042442***
Number of languages per capita (log)	.4192073***	.1876752**		.0402396**
School expectancy	.0328594	.0436242*		.0107445**
Age ratio, under 29	8.032235***	5.593319*		1.578108***
R&D in GDP	.22139***	.0605319		.0798529***
Tertiary enrollment (log)			.0317165	
Gini coefficient				.0133422***
Diversity index (Ethnologie)			-.0563777***	
Federal/vertical competition	-.4285691**	-.3942766	.0198387	-.1297282***
Regional Inequality/Horizontal				-.0650787

Competition				
GDP PC (PPT, log)	.4092755**	.3363227		.056525**
R2		R-sq: within = 0.0930 between = 0.5896 overall = 0.5523	Centered R2 = 0.9476 Uncentered R2 = 0.9989	R-squared = 0.6841
Significance test	Wald chi2(11) = 296.44 Prob > chi2 = 0.0000	Wald chi2(12) = 81.74 Prob > chi2 = 0.0000	F= 911.60 Prob > F = 0.0000	F = 40231.48 Prob > F = 0.0000

Analysis of control variables in model1

As the regression results show, most of the coefficients for the control variables confirm my expectations about their signs and significance.

The impact of **political institutions** was controlled by 1) using Henisz's Political Constraint Index (PolconIII), and 2) the Control of Corruption index from the World Bank Governance database. The Political Constraints Index measures checks and balances in a political system and captures fractionalism in the legislature. The Political Constraints Index highly correlates with the Control of Corruption index, which confirms that they both reflect the institutional development level of the country. Both variables have the expected positive coefficient and significance in the models.

The regression coefficient for the Political Constraints Index in the final model is equal to 0.1260674, and shows that when this index's value is increased by one point (i.e., by 0.01), the share of spending on education is increased by 12.6 percent. Thus, this factor plays a significant role in explaining the variation of the dependent variables and controls in my sample for possible variations in parliament structure and types of governance. (This was explained in more detail in chapter 4.) Of course, as political and cultural

variables change slowly, it may take a long time to see this effect. (It might not be easy to generate a change of 0.01.) As explained in Chapter 4, this index determines the constraints faced by politicians desiring to change a status quo policy in a country in a given year. It uses quantitative data on the number of independent branches of administrative government with veto power over policy change and the distribution of preferences within those veto players, and analyzes this data in a simple spatial model of political interaction to assess the feasibility with which any one actor can secure a change in the status quo. In my sample, only ten of the 33 countries tested this index showed increases (only slightly) during 1997-2006 (in UK, Sweden, Slovakia, Romania, Lithuania, Germany, France, Austria, Canada, Bulgaria). In other 22 countries over the ten-year period, the Political Constraints Index value stayed stable or decreased.

The Control of Corruption's coefficient is significant and positive in alternative models. In models 1 2, with the Stegarescu Fiscal decentralization index, the regression coefficient for control of corruption equals 0.1752637 and is statistically significant at 0.99 significance level. In the model of 1-3, with the alternative dependent variable as expenditure per student, the coefficient for control of corruption equals 0.268826 and is also statistically significant. This is one of the most influential factors as well, as one point increase in the index results is about an 18% change in the share of public spending on education in GDP or about a 30% increase in expenditure per student.

 I anticipated **school expectancy** to be positively related to public funding, and it was indeed positive and significant. It is correlated with other variables, especially with the ratio of young population in total population, but Variance inflation factors (VIF test) are

still acceptable, so I decided to keep this variable in the final model.[17] Also, specification test results are improved when this variable is included. The regression coefficient for school expectancy equals 0.0228518, which means that when school expectancy increases by one year, the share of the country's GDP spent on public education increases by .2.28 percent.

Demographic variables' effect was tested using the share of young population (29 and younger in total population), population growth, total population (log transformed), and also by the ratio of urban population in total population. The results are mixed.

 The share of young population positively affects the share of public funding of education (coefficient is 1.922855 and the coefficient is statistically significant). It should be kept in mind that this interpretation assumes that all other factors are fixed or constant (or do not have an impact). Thus, this is one of the most influential factors and it is understandable as it controls for demographic demand. However, these changes are very difficult, almost impossible, to obtain in the aging societies of my sample. My sample shows that during these ten years the ratio of young population to the total population decreased in all countries. (Appendix 2)

 Population growth was not significant in explaining the variation of the share of public education expenditures in GDP.

The population variable (log transformed) is used to control for the **size of the country**. I have also used territory (surface) to measure this factor. The territory/size variable has a

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[17] Although, when this variable is excluded, only the regression coefficient for the ratio of young population is increased, while other variables do not change significantly.

negative sign, which can be explained by economies of scale. However, the effect is small – the coefficient for the territory is -.02965, meaning that when size of the country increases by 1%, public spending on education decreases by about 0.03 %. This means that in my sample, countries with larger territories prioritize spending on education less in comparison to other countries, while holding other factors constant. This can probably be explained by economies of scale, or by the fact that there is some level of optimal size of spending on education, and countries with larger populations do not necessarily spend higher proportions of GDP on education. I have also tested squared variable for population and the results are similar. In my opinion, it might be that the increase of population will not automatically result in policy change without proper institutions to lobby for that change (or to react to demand). Rather, it might be that the larger size of the country makes it difficult for authorities to reach every region and properly respond to their needs. Also the opposite may be true; larger territories make it more difficult for citizens to demand certain policy actions.

This conclusion is confirmed by the fact that urbanization rate has a positive impact. Concentration in urban centers makes it easier for the population to reach policy makers, so their voice and preferences can be heard. Policy makers in such cases are closer to people. The coefficient for the urbanization rate is 0.0022038, which means that every one point of increase in the urbanization rate increases the share of the public education expenditure in GDP by 0.2%. The urbanization rate is significant across all specifications.

Tertiary enrollment was tested as well. I expected that societies with higher tertiary enrollment rates will value and prioritize education expenditures more than others. However, this variable was positive but not significant and was not kept in the model. Also, the tertiary enrollment rate closely correlates with economic and political development as well as with technological development level of the country, and its inclusion increases multicollinearity in the model.

The signs and effects of some demographic variables change, however, when I use the expenditure on education per student as an alternative measure for public spending on education. The ratios of young population and urban population in this case have negative signs. In the case of the share of young population (which is a proxy for student population), this negative sign is explained by the existence of a logical relationship between the number of students and expenditure per student (increased number of students means less actual spending on each person, holding other things constant). In the case of urbanization, it might be explained by the effect of economies of scale. For example, there are might be fewer schools per capita, but several shifts (morning and afternoon classes) in each school.

Thus, we can say that when the share of public education expenditures in GDP is used as a dependent variable, the model describes how certain factors affect policy making or policy preferences (or prioritizing the education), while models with expenditure per student help to understand the factors of actual use of the money.

The other important demographic feature of the country is its **ethnic/linguistic diversity**. To test the impact of linguistic diversity on public spending on education, I used the

number of languages per capita. It was not possible to find diversity data for each year for each country, and also these are variables that change very slowly, so the variable is time invariant in my sample.

The variable for linguistic diversity in the model 1 has positive sign as expected and is significant and equals .1031607. As I expected it might be because different ethnic groups may request schools in different languages, thus increasing the total spending on education. Thus, a 1% increase in the number of languages per capita means a 0.1% increase in the share of public education expenditures in GDP. However, when the expenditure per student is used as a dependent variable, this variable behaves as demographic variables and has a negative sign since it also controls for the demand.

I have controlled for **socio-economic factors** using total public budget size and GDP per capita. They both have expected positive coefficients and are significant.

GDP per capita (measured as PPP; log transformed) has a coefficient equal to .0487908, meaning that every 1% of increase in GDP per capita will result in about a 0.05 % increase of the share of public education expenditure in GDP.

Total public budget size, or general government expenditures in GDP, also has a positive effect on public spending on education, and the effect is statistically significant (the coefficient is equal to .1813808). Every 1% increase of the share of general government expenditures in GDP increases the share of public education expenditures in GDP by about 0.18%.

I expected that the **technological development** of the country would have a positive

effect on pubic funding of education because technologically developed countries would spend more on education and science and in these countries demand for educated people will be higher. I tested this hypothesis using the following variables: Internet users per capita; R&D expenditures in GDP.

The research shows that R&D spending indeed has a positive and significant impact, while the internet variable was not significant. The coefficient for the R&D spending share in GDP, which equals 0.0626785, means that if the country increases the share of spending on R&D in GDP by one unit (by 0.01), a 6.3% change in the share of public education expenditures in GDP will result. Thus, this is one of the most significant factors influencing a priority of education spending in the country. This has important policy implications, too, as science and research based innovative growth policies have to be tied to education policies and education spending. This is especially important for the countries that choose innovative ways of development.

I have also included control variables for **horizontal and vertical competition**, as explained in previous chapters. To find and measure the effect of fiscal decentralization caused by different mechanisms (differences in tastes and preferences; horizontal competition, vertical competition, accountability/self-interest of politicians), we have to control for these different effects and estimate the impact of each of them separately. However, in practice it is neither easy nor always possible to control for all of these mechanisms due to limitations and quality of the data.

In this research I control for these effects using the best available data. I control for vertical competition by using federal dummy variable and for horizontal competition by

using regional inequality or regional responsibility for education. At the same time federalism may capture the effects of both vertical and horizontal competitions. The coefficients for both federalism and regional inequality variables are negative, but regional inequality is not statistically significant. The coefficient for the federalism variable equals -.1581994, which means holding other things constant, and controlling for regional fiscal autonomy, constitutional federalism makes it more difficult for federal countries to increase spending on public education. It increases the veto points in policy making, or in other words the expected geometric mean of the share of public spending on public education in GDP in federal countries will be about 15% lower than the expected geometric mean in non-federal countries[18]. This shows that financial or fiscal tools for regions (or real federalism) are more important in changing spending patterns than formal federalism. At the same time, constitutional federalism introduces vertical competition and that is what I want to control. Non-federal countries (assuming they do not have such vertical competition, and also have fewer veto points) would spend higher proportions of their GDP on education. However, this variable is not significant in all models.

As for regional inequality, although it has a negative impact in the model with the share of education spending in GDP (but not significant), the regression coefficient is positive and is statistically significant in the model with expenditure per student. This means in countries with higher levels of regional inequality on average spend more per student. The positive effect may be explained by the desire to get out of the "poverty" trap. This

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[18] For discussion of how to interpret dummy variables coefficient see
http://www.ats.ucla.edu/stat/mult_pkg/faq/general/log_transformed_regression.htm

confirms that horizontal competition works. However, these findings need to be tested for robustness in the future with different data sets and different measures. Although these variables may not be perfect to control for competition, their inclusion in the model is important. They help separate the impact of decentralization explained by competition and explain the rest of the variation by the decentralization /efficiency thesis based on differences in tastes and preferences. In the future labor/households mobility can be tested for horizontal competition if such data becomes available for all countries.

 To summarize, this research found that the major factors for the increase of spending on education are the share of R&D spending in GDP, fiscal regional autonomy, the urbanization rate and linguistic diversity. The ratio of young population is the most influential as it captures the demand factor. At the same time, federalism (control variable for vertical competition) and the size of the country are found as factors that negatively affect the share of public spending on education in GDP of the country.

Models with alternative variables

I have tested my hypothesis about the positive relationship between decentralization and public funding of education using alternative measures for dependent variable (public education expenditures per student, log transformed) and for the explanatory variable, decentralization (Stegarescu's tax decentralization index). This is also a robustness check for research findings after the estimation of the first model. These alternative models are presented in columns 3-4 in table 5.

 The positive sign and significance of Stegarescu's fiscal decentralization measure confirms my findings about decentralization: regional autonomy results in increased

levels of public funding of education. Stegarescu's index and the RAI fiscal autonomy index are both measures of taxing power. Although calculated by different methodologies, their interpretation is similar and it confirms the validity of the findings based on the fiscal autonomy measure. The hypothesis of independence of these two measures was tested using the Spearman rank correlation coefficient, and the null hypothesis of independence was rejected (Appendix 1).

I have also tested whether local elections can be used to measure fiscal autonomy, but I found that it cannot replace the fiscal decentralization measure. Although this variable was positive, it was not always significant. This is an important finding, which shows that taxing power or fiscal autonomy can not be replaced by political decentralization without providing fiscal powers.

The analyses of these alternative models show that the signs and the significance of the coefficients for most of my control variables (for political institutions, total public budget size, GDP per capita, urban population, technological development, size of the country) are consistent with those of the main model.

As for the model with an alternative dependent variable (expenditure per student), the findings about the impact of fiscal autonomy and the main control variables are consistent with the findings of the main model, so I conclude my findings are robust. As already mentioned, in this case there are differences only in signs and interpretations of demographic characteristics (the share of young population and urbanization rate and linguistic diversity of population). Regional inequality also becomes significant and positive in this case. Although horizontal competition/regional inequality may negatively

impact the priority of education (or policy preferences) in the country (as in model1), it may at the same time positively affect actual spending per student, as regions compete for human capital. The more inequality between regions, the more competition there is for human capital, as underdeveloped regions need to attract (or develop) human capital to catch up. In addition, developed regions will still need to increase spending on education to continue growth and retain human capital. However, this requires additional research, and confirmation is needed with other variables to test this effect of horizontal competition.

Post estimation diagnostic tests for model 1

The quality and reliability of regression models has to be evaluated with post estimation tests. I conducted such tests for each equation. Here I present the analysis of the diagnostic tests only for the main model, but diagnostic tests were conducted for the alternative models as well.

As the method of estimation is pooled OLS (with Newey-West or Driscoll-Kraay standard errors), I checked for violations of OLS assumptions, normality of residuals, and also conducted specification and parameter stability tests.

Some of violations of OLS assumptions were already checked in the pre-estimation step, which pointed to high orders of autocorrelation and heteroskedasticity. The plot of residuals versus fitted values after estimation still shows some heteroskedasticity, but as standard errors are robust to heteroskedasticity, it is not a problem for coefficients and inferences.

The tests for normality (statistical summary of residuals, histograms, Shapiro –Wilk test) presented in tables 6 and 7 and in figures 3 and 4 show that residuals are normally distributed.

Multicollinearity was tested using variance inflation factors (VIF), and this test confirms that multicollinearity in the final model is not a problem. The correctness of specification was tested using Ramsey's test and Link specification test. Their results are shown in tables 7 and 8. These tests verify that there are no specification errors due to omitted variable bias or due to functional form.

Normality tests for residuals

Table 6. Statistical summary of residuals for model 1

Percentiles	Smallest	Standard Deviation		
1%	-.297594	-.3588464	Observations	310
5%	-.2278247	-.3336871	Sum of Wgt	310
10%	-.1818416	-.3169124	Mean	7.69e-10
25%	-.0971028	-.297594	Std. deviation	.1369906
50%	.0007172		Variance	.0187664
	Largest		Skewness	-.0946496
75%	.0974778	.2829019	Kurtosis	2.392143
90%	.1761799	.2837062		
95%	.2176584	.3018756		
99%	.2829019	.3042048		
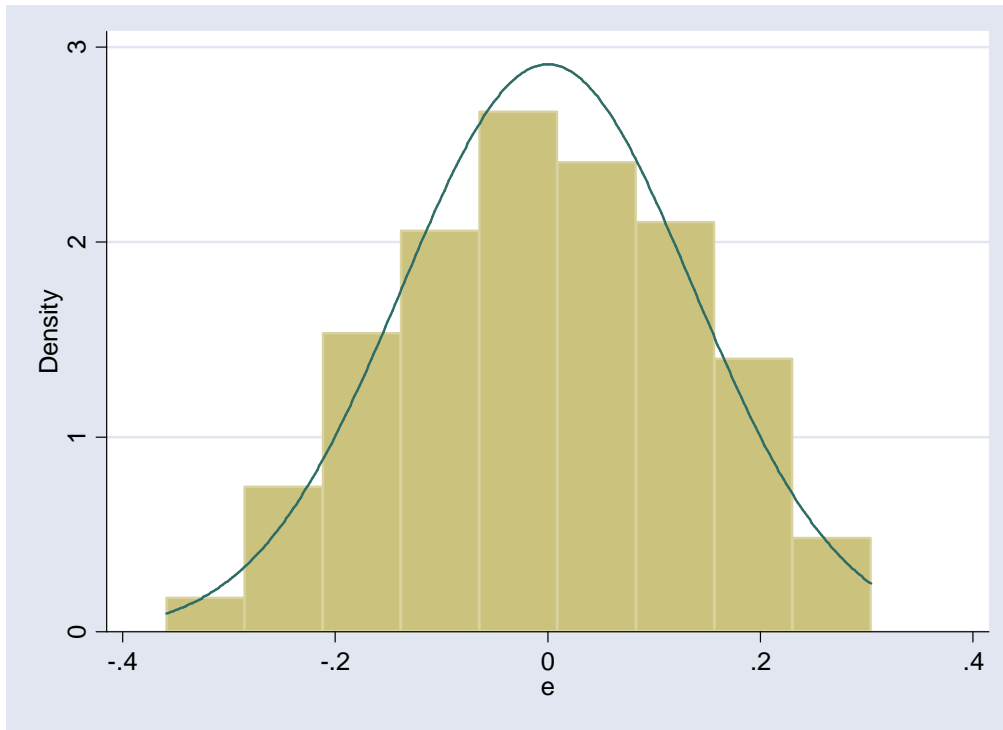
Figure 3. Histogram of residuals of regression model 1.

Table 7. Post –estimation diagnostic tests for model 1

Test	Test results	The findings
Shapiro-Wilk test for normal data	W=0.99123 V=1.923 Z=1.537 Prob>z = 0.06210	The residuals are normally distributed
Multicollinearity test with VIFs	Mean VIF = 2.57	There is no multicollinearity
Ramsey's specification test	F(3, 294) = 0.56 Prob > F = 0.6429	Model has no omitted variables
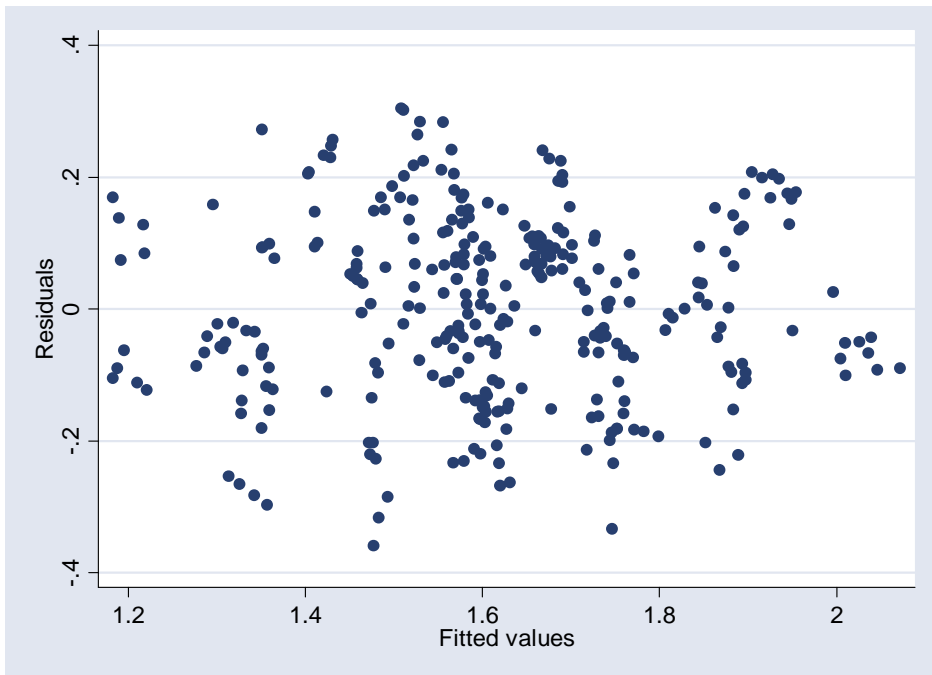
Figure 4. Residuals versus fitted values plot for regression model 1.

Table 8. Link specification test for model 1

```
      Source |       SS       df       MS              Number of obs =    310
-------------+------------------------------           F(  2,  307) =  282.62
       Model | 10.6552352      2   5.3276176           Prob > F      =  0.0000
    Residual | 5.78729497    307  .018851124           R-squared     =  0.6480
-------------+------------------------------           Adj R-squared =  0.6457
       Total | 16.4425302    309  .053212072           Root MSE      =  .1373


------------------------------------------------------------------------------
 logpubexpe~p |    Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       _hat |  1.421854   .5409485     2.63   0.009     .3574185    2.48629
      _hatsq | -.1307174   .1671123    -0.78   0.435    -.4595477    .198113
       _cons | -.3358667   .4347827    -0.77   0.440    -1.191398    .5196645
```

133

The above post-estimation tests validate that the results of the regression analysis are statistically correct and inferences are reliable.

In addition to these tests, a test for parameter stability over time was conducted using the Chow test, which confirmed there are no structural breaks. Structural stability was tested using midpoint in the time period, and F for the sample (1.2422) was less than F-critical (1.7547); thus, the null hypothesis is not rejected. The robustness of the coefficients was also tested by adding new variables (coefficients for rest of explanatory variables do not change significantly) and by dropping observations (countries) one by one. All tests confirm that results are reliable and robust.

Regression models on education quality

In this section I describe the results of empirical estimation of the model of relationship between public spending on education and education outcomes (model 2). My second research question was whether spending on education has a positive impact on education outcomes. This question has a huge practical importance, however, it has not been well explored in the literature so far.

As noted earlier, in this research I focus only on quality of primary and secondary education (leaving out quality of university education). As described in chapter 3, I use international test scores (PISA math and PISA reading scores for 15-year old students) to measure education outcomes.

The model was specified in previous chapter as follows:

Education Outcomes = F(Public spending on Education; Direct Effect of

Decentralization; Regional Responsibility for Education; Families' Socio-Economic

Status; Regional Inequality; Educational environment and resources of the country;

Linguistic Diversity)+ error term

In this model, I have data only for 2000, 2003 and 2006. Consistent data was not

available for subsequent years. I expected that autocorrelation would not be a problem, as

in the first part of the research. However, when I conducted formal tests, data showed the

presence of autocorrelation (Arrelano-Bond test). To obtain robust estimations I decided

to treat the data as a time series for consecutive years (to be able to use robust methods of

estimation). I plan to repeat this research in the future when the data for a longer time

period (more PISA results) is available.

I tested for homoskedasticity of residuals using the Breusch-Pagan / Cook-Weisberg test

and the White test, and the hypothesis about constant variance of residuals was rejected

in both cases. The LR test also showed that the model has heteroskedasticity, so I have

used robust methods of estimation.

I also performed the Hausman test to verify that I can use Pooled OLS. The Hausman

test confirms that there are no fixed effects. This means that both random effects and

pooled OLS coefficients will be consistent as the test does not reject null hypothesis that

there are no systematic differences. As I have heteroskedasticity, autocorrelation and

spatial dependence (in some models with alternative variables), I chose to use robust

pooled OLS estimation, although I show random effects estimation as an alternative.

As discussed earlier in Chapter 4, I use PISA math and readings scores (log transformed) to measure and compare education outcomes across countries in my sample. I ran regression models using both spending measures (the share of public spending on education in GDP and public education expenditure per student).

The results of estimation show that public spending on education (measured as a percentage of GDP (log transformed) and also as public education expenditure per student (log transformed) has a positive impact on PISA test scores. This finding is consistent across different specifications.

This result is obtained by controlling household consumption level. In alternative specifications with alternative measure of decentralization (as public education expenditures per student) I controlled for development using a transitional/developing dummy variable since household consumption level per capita and public educational expenditures per student closely correlate (correlation coefficient is 0.97), The transitional country variable, however, was not significant. The former socialist country dummy variable also was not significant. I also control for linguistic diversity (measured as languages per capita, log transformed), educational environment and resources of the country (measured by index of quality of school resources and in alternative models, with pupil to teacher ratio), as well as for population density. Population density controls for population concentration, which affects how the resources are distributed and used, and also how spillover effects of education and learning can be used[19]. In addition, I control

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[19] In some alternative models, I also tested the population variable (log transformed).

for local elections or for the direct effect of decentralization, which can occur through lower transaction costs and accountability of politicians to local population, for example. I have tested regional inequality and regional responsibility variables; however, in these models they were not significant. Also, these variables correlate closely with local elections, which I included to control for accountability and the direct effects of decentralization, so I did not keep them in the model.

The final models are presented in Table 9, and alternative models are presented in Table 12.

Table 9. Regression results for education outcome models (using PISA math scores) *** - significant at 0.001 level, **- significant at 0.05 level, * significant at 0.10 level

Dep var – PISA math scores (log)	Newey-West standard errors (Pooled OLS), two lags there is no spatial dependence model 2	White standard errors (pooled OLS regression)
Public Spending on Education in GDP	.080364**	.080364***
Number of languages Per Capita (log)	.035104***	.035104***
Population Density	.000097**	.000097***
Local elections	.0173592**	.0173592***
Household Consumption Per Capita (log)	.0131001	.0131001
Index of quality of school resources	.0158167	.0158167
Significance test	F(6, 86) = 14.02 Prob > F = 0.0000	F(6, 86) = 24.41 Prob > F = 0.0000
R-squared	0.6182	0.6182

Table 10. Diagnostic tests for model 2

Test	Test results	The findings
Pesaran's test of cross sectional independence	Pesaran's test of cross sectional independence = 0.484 Pr = 0.6285	The data is not spatially correlated
Heteroskedasticuty: White's general test statistic	69.59622 Chi-sq(27) P-value = 1.3e-05	The data are heteroskedastic
Breusch-Pagan / Cook-Weisberg test for heteroskedasticity	chi2(1) = 14.41 Prob > chi2 = 0.0001	The data are heteroskedastic
Specifcation tests: Ramsey RESET test using powers of the fitted values of logpisamath	F(3, 83) = 2.42 Prob > F = 0.0718	The model has no omitted variables
Shapiro-Wilk test for normality	z = 0.794 Prob>z =0.21353	The residuals are normally distributed
Multicollinearity test with VIFs		There is no multicollinearity

Table 11. Statistical summary of residuals for model 2

Percentiles	Smallest	Standard Deviation		
1%	-.101016	-.101016	Observations	93
5%	-.0742226	-.0972176	Sum of Wgt	93
10%	-.0561647	-.0835361	Mean	-5.13e-09
25%	-.0233173	-.0796156	Std. deviation	.0406962
50%	.0018678		Variance	.0016562
	Largest		Skewness	-.2906643
75%	.0277667	.074975	Kurtosis	2.81742
90%	.052011	.0765414		
95%	.0600672	.0772014		
99%	.0905027	.0905027		
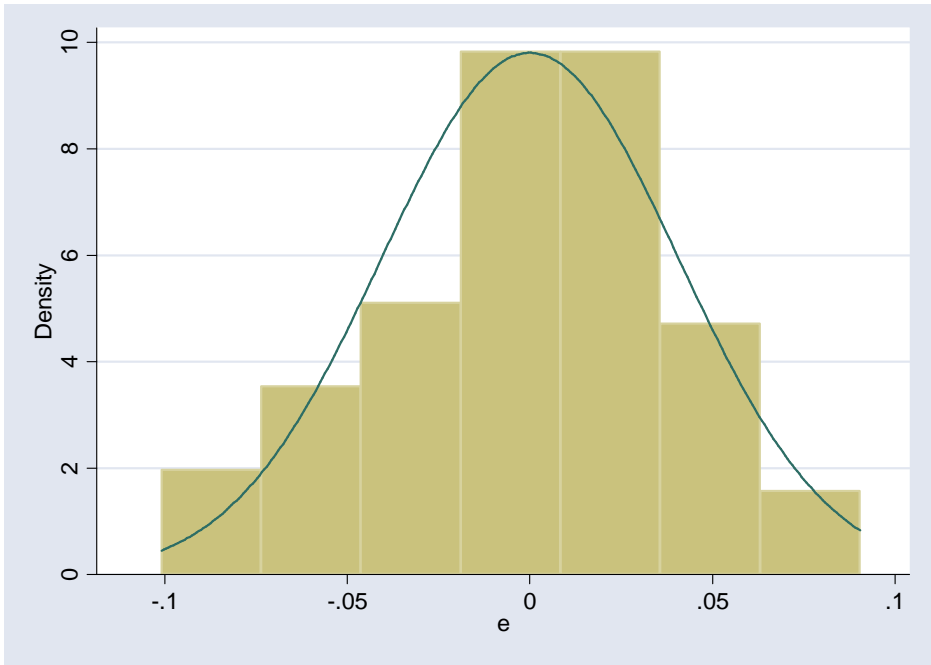
Figure 5. Histogram of residuals of regression model 2
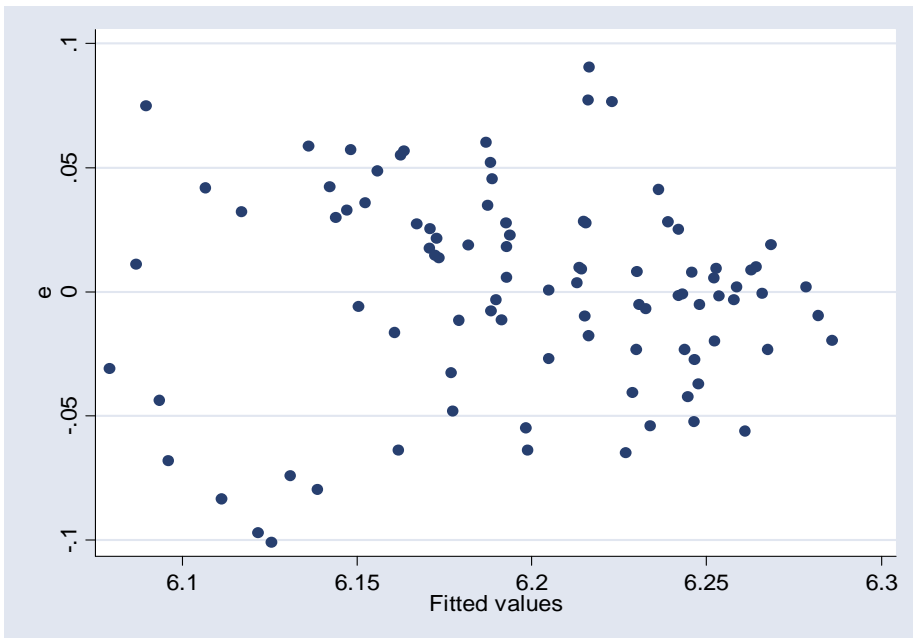
Figure 6.Residuals versus fitted values plot for regression model 2

Table 12. Regression results with alternative models (using education expenditure per student to measure public spending on education and PISA reading score as the dependent variable)

*** - significant at 0.001 level, **- significant at 0.05 level, * significant at 0.10 level

	Robust Regression (White standard errors) with time dummies	Driscoll-Kraay standard errors Dep var – PISA math score	Newey-West Standard Errors	Robust regression, Dep var – PISA reading score	Robust regression, Dep var – PISA reading score	Robust regression- Dep. Var- PISA reading score
Transition/developing country	.0284784	.0255004**	.0252294		.0056197	
Former socialist country						-.0060889
R&D in GDP	.0260845***	.0259161***	.0258676***			.0114886*
Education Expenditure Per Student (log transformed)	.0336239 ***	.0318409***	.0316916*		.0368028***	.0267665**
Public expenditure on education in GDP,				.1237805 ***		
Household consumption per capita (log)				.0337204 ***		
Number of languages Per Capita (log)	.0276798***	.0277123***	.0278642 ***	.0157292 **	.017493***	.0149651***
Local elections				.0064942	.0044209	
Population Density	.0001459***	.0001475***	.0001477 ***			
Surface (log)				-.0009103		
Population (log)					-0.002704***	-.003371
Year2003	-.0111739			-.0075633	-.0106506	-.0103489
Year2006	-.0092623			.0043633	-.0001291	-.0018046
Pupil/teacher ratio				-.0000991		
Index of quality of school resources					.0247919*	.0265347*
Significance test	F(7, 91) = 18.76 Prob > F = 0.0000	F(5, 2) = 71.47 Prob > F = 0.0139	F(5, 93) = 12.82 Prob > F = 0.0000	F(8, 69) = 13.46 Prob > F = 0.0000	F(7, 88) = 10.66 Prob > F = 0.0000	F(8, 87) = 9.05 Prob > F = 0.0000
R-squared	0.5889	0.5829		0.6206	0.5388	0.5494

All alternative regression models were also tested for OLS violations, and specifications presented above are chosen after careful examination of diagnostic tests and residuals. This means that the results are statistically reliable.

As the results of regression analysis show, the effect of the share of public spending on education in GDP, controlling for other factors, is significant and positive, and equals 0.080364 (in the model with PISA math). This can be interpreted as a 1% increase in the share of spending on education in GDP and results in a 0.08 % increase in the average PISA math score for the country. In case of PISA reading scores the effect is larger and equals 0.12% (also positive and statistically significant).

The effects of **linguistic diversity** and **population density** are also positive and significant, although small and practically close to zero. The coefficient for linguistic diversity (measured as number of languages in the country per capita, log transformed) is 0.0351, which means that every 1% of increase of number of languages per capita results in a 0.04% increase in average PISA math scores (in case of reading score in an increase of 0.0157%, as the coefficient is equal to 0.0157%).

The finding that diversity does not affect education quality negatively is an important finding because it has practical policy implications in an increasingly globalizing world. More research may be required in the future, but this finding confirms conclusions of some other researchers that bilingualism or multilingualism positively affects learning and students' performance in schools (Bankston III and Zhou 1995).

Population density has a coefficient of 0.0000978, which means that a 1% increase in population density results in an average PISA math score increase of 0.00978 or 0.01%.

It is a very small effect, but we need to control this factor as it is statistically significant in all models and captures the population's spatial characteristics which may affect the use of money and education outcomes.

In the alternative model, I controlled for the spatial factor using territory (size of the country) variable (log transformed). In this case its effect is similar to the effect in educational spending models; it is negative. The effect is also very small and is equal to 0.00009, showing that a 1% increase of the territory (which characterizes the size of the country) decreases average PISA reading scores by about 0.0001%, holding other factors constant.

Educational environment and resources of the country were controlled by using the index of the quality of school resources and, in some models, by using pupil-to-teacher ratio.

The index of quality of school resources (this variable is from PISA dataset, and reported by school principals), as expected, affects education quality positively. However, it was found that this variable is not significant (significant at 0.90 level only in alternative models with public educational expenditure per student). The pupil/teacher ratio in this sample was not significant in explaining the variation in PISA math or reading scores. However, I kept these variables in the model to control for these factors.

Local elections, a control variable for direct effects of decentralization, has a positive coefficient in both PISA math and reading models (0.01736 and 0.0065 respectively). In the PISA math model the coefficient is significant at the 0.99 significance level; in the PISA reading model the coefficient was not significant. However, the significant positive

effect on PISA math scores suggests that local accountability of politicians is important and may result in increased quality of public education services. This shows that local authorities are held responsible more for the quality of education than the funding. They are closer to schools and school administrations, and their re-election depends on how satisfied the local population is with the quality of education.

Household consumption level per capita has a positive impact on average PISA scores as expected (although in some models it is not statistically significant). The coefficient is equal to 0.013 in PISA math (not statistically significant) and 0.034 (significant at the 0.99 level) in PISA reading models. This suggests that a 1% increase in household consumption level per capita increases PISA reading test scores by 0.034%, but in case of the PISA math the result cannot be interpreted as the coefficient is not significant.

In alternative specifications I added transitional /developing and former socialist country dummy variables and the share of R&D in GDP into the model. Transitional/developing and former socialist country binary variables were found not statistically significant.

The share of R&D expenditures in GDP has a positive effect on test results in models with expenditure per student as a dependent variable for both the PISA math (the coefficient is 0.026, and the coefficient is significant at the 0.99 level of significance) and the PISA reading (the coefficient is 0.01; significant at the 0.90 level) models. This means, for example in case of PISA math scores, every 1% (or one unit) increase in the share of R&D expenditures in GDP increases the average PISA math scores in the country by 2.6%. This variable has a very significant effect and suggests that there is a

clear and strong link between science development and education quality in the country. In case of PISA reading scores the effect is smaller (1%), but also positive.

 The summary of findings and caveats on data quality

 This empirical research confirms findings of the theoretical analysis and research hypotheses that regional fiscal autonomy has significant positive effect on public education funding and on education outcomes. The findings are robust when tested by using alternative variables to measure regional autonomy, public spending on education and education outcomes.

These findings were obtained by controlling for the effects of major socio-economic, institutional and demographic factors in regression models. The methods for estimation of regression models were chosen after detailed analysis of the data and tests for violations of regression analysis assumptions (including tests for autocorrelation structure, spatial dependence, multicollinearity, homoskedasticity and normality of residuals). As cross-sectional time-series data was used, the appropriateness of random and fixed effects of estimation and Pooled OLS were tested by employing formal tests. The Hausman test does not reject the null hypothesis that there is no systematic difference between the two methods, so random effects (and pooled OLS) can be used. As the data is heteroskedastic, has autocorrelation with lag structure up to nine lags, and also has spatial dependence, the pooled OLS methods robust to these violations were used. The models were also constructed by using formal tests for specification errors and taking into account theoretical considerations about the necessity of including certain control variables.

The results and findings of the research are promising and have important practical significance for policy making. However, future research may be needed with larger samples and with alternative measures, especially for testing the hypothesis about the relationship between public spending on education (and fiscal decentralization) and education quality. This study used PISA math and reading scores to measure education outcomes, but in the future other measures can be used for education quality. Alternative variables can be also tested for some control variables, for example, for regional inequality or for measuring educational resources in the country.

All the conclusions are made while acknowledging that different data sources (such as special surveys or regional level data) may be used in the future. The education quality model (model 2) needs further testing with larger datasets, as only three rounds of PISA scores were available for countries in my sample. Because this is a developing area there is a hope that there are will be better PISA data in the future (as well as other international tests).

Also, in the future, more effort is required to test the hypotheses about the separate impacts of different theories to explain the work of decentralization. Particularly, to test the impact of horizontal competition, detailed data on internal/regional mobility is needed. Different control variables for vertical competition may be also used. In this research I used federalism (binary variable) for vertical competition, but federalism may also capture effects of horizontal competition.

This research can be continued in following directions:

1) Explore how education quality may be improved by looking at detailed cost accounts to identify how and where the money is spent, and further explore the effectiveness of spending on certain categories (such as teacher salaries or technical equipment, or textbooks, etc.);

2) Test the role and significance of some variables that were mentioned above when more data is available (horizontal competition by using regional mobility data, or regional equality by using different measures, etc);

3) This research focused on one type of public services (public education), but research hypotheses about the impact of decentralization on other types of public services, for example, public health services provision, can be tested in the future studies. As it was stated earlier, the provision of different types of public goods may react differently to fiscal autonomy, and in case of education, this impact is positive. In case of other public services and goods, decentralization of governance may have a different effect, and each type of public goods and services has to be studied separately.

CHAPTER 6

POLICY CONCLUSIONS

This research provides insights on possible effects of decentralization on the provision of

public education. Often, policy makers need to evaluate the consequences of their

policies, and what effect they have on citizen's well-being and on development of the

country. In this regard, the proposed research methodology and regression models and the

findings of this research can be a helpful tool for evaluating the effects of decentralization

of governance and the effects of public spending on education. This research is done at

the edge of several policy areas (such as decentralization or governance, or institutional

development and improvement of public services provision, and particularly public

education). It can thereby be helpful and applicable in all of these areas. Also, it can be

used in policy making at both central and regional governance levels.

 Recently, decentralization of governance and education are becoming an increasingly

popular topic in the policy agenda of many countries, which makes this research even

more valuable. It can help answer most recent political challenges. For example, there is

a growing demand for decentralization in regions of many European countries (such as

UK, Spain, etc.) and central authorities often do not know how to react or what the

consequences would be if demanded decentralization is provided. Also, often there are no

clear answers about what form the decentralization should be provided – in form of

political decentralization or providing taxing power, both, or just devolution of administrative powers of central agencies. This research attempts to answer these questions, as I test separately the effects of political decentralization (through local elections and formal federalism) and fiscal decentralization (through taxing power). While local elections are important for improving education quality, their effect is not as significant for public educational funding as the effect of fiscal decentralization. The effect of formal federalism (controlling fiscal autonomy effect separately) was negative in public education funding. This shows that there are many important institutional decisions to be made, and changes may be required to provide financial or real autonomy to regions. Only constitutional or formal federalism will not work as expected on its own. Political decentralization in the form of local elections is important for decentralization to work. However, it was found that without fiscal decentralization, elections cannot affect spending. Local elections and accountability are important for increasing the quality of public services by keeping politicians accountable.

This research emphasizes the role of taxing power and shows that countries need to provide regions taxing or revenue autonomy to benefit from decentralization. The devolution of only spending autonomy without taxing power will not provide the regions all the necessary financial resources and enough capacity to effectively respond to local demands. While administrative and political decentralization are equally important, the key factor to change policies and spending patterns is the regions' financial flexibility and sustainability, which can not be achieved without their fiscal autonomy.

This dissertation also explains why the positive effect of decentralization occurs in the case of public goods provision. It explores mechanisms behind the positive effects by separating the total effect into several sub-effects: the effect that occurs due to more efficient response to different tastes and preferences ("decentralization or efficiency thesis'), the effect of horizontal and vertical competitions ("competition thesis") and local elections ("self-interested politicians"). This is an important contribution to theoretical and empirical literature. While recognizing that there are might be several mechanisms and controlling for their effects, this dissertation explains the positive effect of fiscal decentralization by the ability of local politicians to effectively respond to the local differences and preferences of the population through having financial flexibility. This is an important research finding that has practical significance and shows that regional fiscal autonomy is a necessary policy tool for regional governments as local demand may vary and regions may need different tools and policies to respond. Without financial flexibility it is difficult to develop and implement effective policy actions.

In addition to testing the effect of decentralization (and explaining why this effect exists), there are other important findings that have practical policy implications as well. These are findings about the role of certain factors for public funding of education and for increasing the education quality.

For example, this research revealed the strong and statistically significant links between R&D funding and public educational funding. R&D or technological development has a large effect on educational funding and quality among other factors, by influencing a priority of education spending in the country. This has important policy implications as it

149

suggests that science and research based innovative growth policies have to be tied to educational policies and increased educational spending.

 The research also reveals that the urbanization rate has positive impact on the priority of educational spending (or on the share of public educational funding), while territory/size of the country has negative effect. This suggests the importance of population concentration and that urbanization may help the population to more actively lobby for their preferences (as well as more effectively use money). This finding supports urbanization policies and the importance of clustering in development.

 The research also confirms the importance of institutional factors: institutional development, checks and balances in the system, control of corruption. These factors have a significant positive impact on the results of decentralization. This is an especially important finding for developing and transitional countries. It suggests that to succeed in the education and development of human capital countries need to democratize, control corruption and develop checks and balances in the political system.

 Moreover, this research has policy implications for overall economic growth and economic development, as it shows the link of decentralization to education (and the link of education to economic growth is already proved by new growth theories in economic literature). Until now, decentralization's impact on economic development of countries is still not well understood in the literature, as it is not clear what links decentralization to economic growth. Thus, this research, by showing the positive link of decentralization to human capital, contributes to theoretical and empirical literature on economic development and can be used as a tool for development policies.

The findings about the positive effect of linguistic diversity also may find practical implications in education policy as well as in cultural and migration policies.

The findings from model 2 on education outcomes are especially important in practical policy-making. Not only citizens and parents, but also governments are interested in improving the quality of education, as education is a driving force for economic growth and development. Both sides (population and government) want to increase the effectiveness of the expenditures on education. That is why the question of how we can improve education outcomes or quality is an important policy question. Another important policy question is whether there is a relationship between the amount of money spent on schools and its effect on education outcomes.

The finding that there is a positive relationship between spending and education outcomes is probably one of most important findings of this dissertation. This finding has policy implications at both the central and regional levels of policy making. The research shows that while other factors (such as individual- specific factors, and/or family specific factors) may play a role in educational achievements, on average, the countries that spend more on education have better international test scores (controlling for household consumption levels, linguistic diversity, quality of school resources and population density). I also control for institutions and the presence of local elections (which control for accountability of politicians to population). These are important assumptions in forming conclusions about the effectiveness of spending.

Thus, this theoretical and empirical analysis suggests that with decentralization of government public services can be provided more efficiently, with higher quality, and in

accordance with local needs and local preferences. Although there is still a room for debate and there are might be some restrictions/limitations (as for example, this research is based on the assumptions of democracy and electoral accountability), this study suggests that fiscal decentralization has a positive impact on public spending on education and on education outcomes. At the same time, not only fiscal decentralization, but also political decentralization (the development of local democracy and accountability of governance to local people) is important for increasing the quality of public services. However, we need to emphasize that the sample was restricted to the sample of democratic and quasi-democratic countries with developed and transitional economies. In case of developing countries other factors may need to be controlled for (initial level of development, cultural factors, etc.).

CHAPTER 7

RESEARCH CONCLUSIONS

 To summarize, this dissertation explored the relationship between decentralization of

governance and its impact on public education provision.

A comprehensive analysis of the literature showed that the literature is inconlusive about

the direction of such impact and the mechansims of how decentralization can affect

public goods provision. Also, for the most part the literature does not differentiate

between types of public goods; meanwhile the impact of decentralization on public

spending may vary for different types of public goods and services (assymmetry of the

impact). It is also neccessary to study the impact not only on spending levels but also on

the outcomes of public goods provision. The empirical literature usually does not

account/adjust decentralization measures for assymmetric decentralization.

 The thorough analysis of theoretical and empirical literature allowed for conclusions and

formulation of my research questions:

 1. Is public spending on education higher in countries with a greater level of fiscal

decentralization (higher regional fiscal autonomy)?

 2. Do higher levels of public spending on education result in better education outcomes?

 I explored these questions empirically by using econometric analysis of the data for 33

countries. I tested whether the decentralization theorem/ efficiency thesis (which states

153

that regional/local governemnts react more effectively to local needs and local policies are better tailored to diverse needs of local population) in combination with the political economy thesis about self-interested politicians has an impact on funding and the quality of such regional public good as public education.

 In this approach I relax an assumption of benevolent governments in decentralization/efficiency theory and assume that politicians are self-interested. I also add an electoral accountabilty assumption to control for possible negative outcomes such as corruption and/ or regional elites' power abuse. Thus, I explain the mechanism behind decentralization's work mainly by the decentralization/effcency thesis, assuming that there is electoral accountability/democracy.

 I also control for vertical and horisontal competition mechanisms, as existing literature suggest that these mechansisms also may have impact on decentralization's results. In the future other control variables for competition can be tested. I recognize that horisontal competition can be better controlled with regional level labor/household mobility, but at this moment it was not possible to find such data for all countries in my sample.

 Theoretical framework of this research is presented in Figure 2 (p. 64)

Two research hypotheses were investigated and tested in this dissertation:

H1: Fiscal Decentralization increases public spending on education

 This hypothesis is based on the developed theoretical framework which sees the differences in tastes, preferences and, as a result, differences in regional demand for public goods and services as main explanation behind decentalization's work. In the case

of public education, although there can be some universal/national standards on the quality of public education or how it should be provided, there will always be some regional diffrences related to both preferred expenditure stucture (for example, related to climatic or geogaphic differences) and/or school curricula (for example, related to regional economy structure or linguistic preferences). The diffrences in tastes and preferences for public goods and services may be explained by linguistic/ ethnic/cultural/ / historical factors, as well as these by the specifics of regional economy, or climatic characteristics, median age differences, and so on.

 This hypothesis was tested using a sample of 31 democratic (or quasi-democratic) countries from 1997-2006. (I started with 33 countries, in the process of model building two countries were dropped, and the final models were built using the data for 31 countries).

 H2: Higher public spending on education as a result of higher regional fiscal autonomy improves education outcomes

 My second hypothesis tests the existence and the significance of the link between spending on public education and education outcomes. Total national public spending on education increases when each region spends more or spends higher proportions of their budgets on education. According to my hypothesis and findings from the literature review, the increase of spending should result in improved educational quality. This hypothesis was also confirmed by econometric analysis of the data. On average, and controlling for other major determinants, higher levels of public spending on education result in higher education quality (measured by PISA math and PISA reading scores).

However, I need to acknowledge that size of the sample was small as PISA scores were available only for three rounds for countries in my sample, and that this research needs to be tested with more data when it becomes available. With the data I have, the research revealed a positive impact of educational spending on international test scores.

To sum, the detailed econometric analysis using the data for 33 countries confirmed both of my research hypotheses and revealed that decentralization has a positive impact on public educational funding and on education outcomes. However, the assumptions are important. It was assumed that countries are democratic and local officials are accountable to population. With such assumptions it was showed that decentralization has a positive impact as a result of differences in tastes and preferences. When politicians are accountable to (or elected by) local population and regions have fiscal autonomy/taxing power, education becomes one of prioritized expenditure categories and funding of public education increases. This conclusion was confirmed by empirical analysis controlling for institutional, demographic and socio-economic factors, as well as other mechanisms of decentralization – horizontal and vertical competitions.

The finding that the increase of public funding of education has a positive impact on education outcomes (measured in this dissertation by PISA math and reading scores) is another major conclusion of the research (controlling for families socio-economic status, linguistic diversity, regional inequality and direct impact of decentralization).

These findings are robust when tested using alternative variables to measure regional autonomy and alternative measures for dependent variables. Thus, the findings and results of the research can be used in practical policy making to develop and correct

policies at both regional and federal levels to achieve better results in providing public

education and to promote overall economic growth.

APPENDIX

Rank correlation between Fiscal Autonomy (RAI) index and Stegarescu tax decentralization index

. spearman stegarescu_decentr fiscal_autonomy

Number of obs =   104
Spearman's rho =   0.6255

Test of Ho: stegarescu_decentr and fiscal_autonomy are independent
                 Prob > |t| =   0.0000

Fiscal decentralization measures' changes over time (fiscal autonomy rarely change over time):
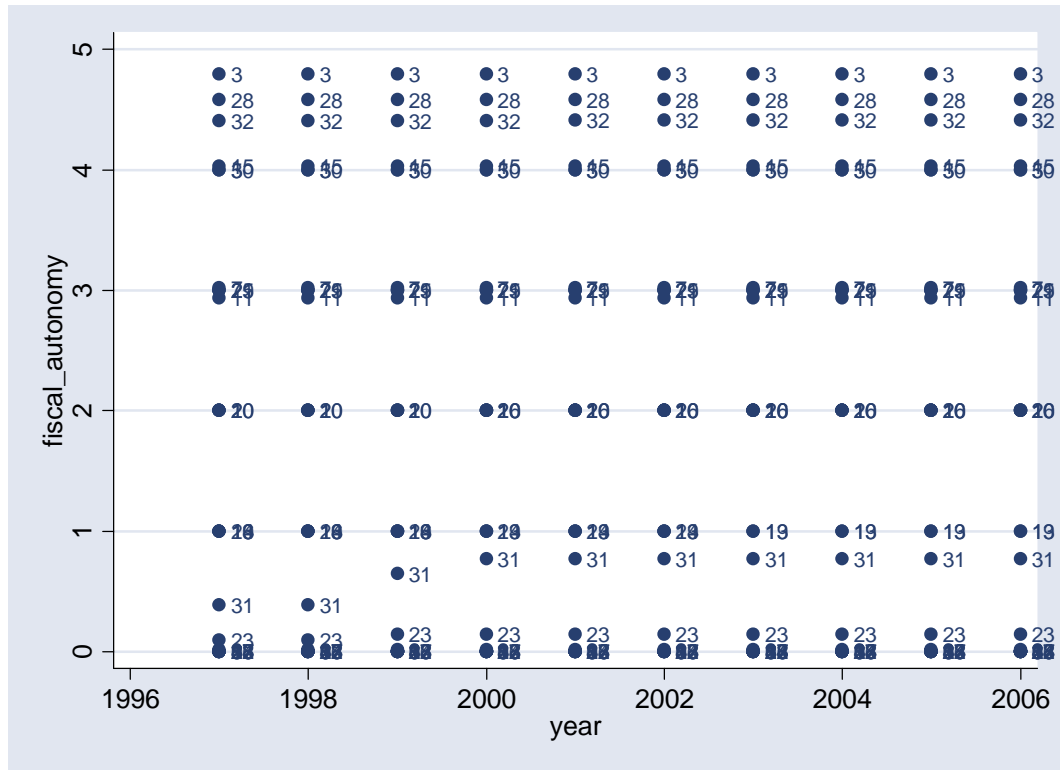
Figure 1. RAI Fiscal Autonomy index's changes over time (numbers present country ID)
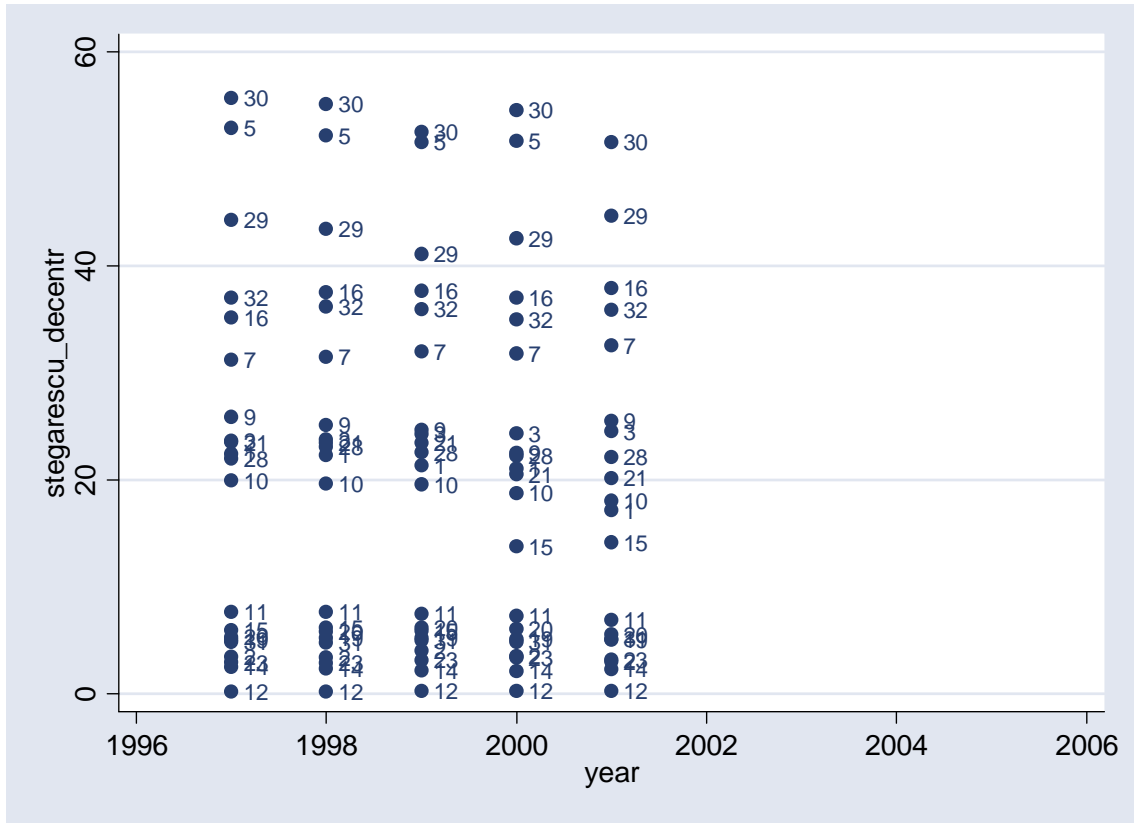
Figure 2. Stegarescu decentralization index's change over time

Ratios of young population in the sample

```
countryid = 1

      +-----------------+
      | year   _29age~o |
      |-----------------|
  1.  | 1997    .363816 |
  2.  | 1998    .360929 |
  3.  | 1999     .35812 |
  4.  | 2000    .355604 |
  5.  | 2001    .353271 |
      |-----------------|
  6.  | 2002    .350335 |
  7.  | 2003    .346796 |
  8.  | 2004    .343253 |
  9.  | 2005    .339829 |
 10.  | 2006    .337092 |
      +-----------------+

-> countryid = 2

      +-----------------+
      | year   _29age~o |
      |-----------------|
  1.  | 1997     .31909 |
  2.  | 1998    .313608 |
  3.  | 1999    .308737 |
  4.  | 2000    .304426 |
  5.  | 2001    .300501 |
      |-----------------|
  6.  | 2002    .297077 |
  7.  | 2003    .294279 |
  8.  | 2004    .291888 |
  9.  | 2005    .289749 |
 10.  | 2006    .288042 |

-> countryid = 3

      +-----------------+
      | year   _29age~o |
      |-----------------|
  1.  | 1997    .315452 |
  2.  | 1998    .313016 |
  3.  | 1999    .310446 |
  4.  | 2000    .307704 |
  5.  | 2001    .304792 |
      |-----------------|
  6.  | 2002    .302077 |
  7.  | 2003    .299772 |
  8.  | 2004    .297916 |
  9.  | 2005    .296721 |
 10.  | 2006    .295682 |
      +-----------------+

-> countryid = 4

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      | year   _29age~o |
      |-----------------|
  1.  | 1997     .34022 |
  2.  | 1998    .339019 |
  3.  | 1999    .335809 |
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  4. |  2000    .331559 |
  5. |  2001    .327303 |
     |-----------------|
  6. |  2002    .323009 |
  7. |  2003    .318132 |
  8. |  2004    .312506 |
  9. |  2005    .306852 |
 10. |  2006    .301318 |

-> countryid = 5

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     | year    _29age~o |
     |-----------------|
  1. |  1997    .342055 |
  2. |  1998    .340007 |
  3. |  1999    .337881 |
  4. |  2000    .335676 |
  5. |  2001    .333449 |
     |-----------------|
  6. |  2002     .33098 |
  7. |  2003    .328175 |
  8. |  2004    .325579 |
  9. |  2005    .322439 |
 10. |  2006    .319409 |
     +-----------------+

-> countryid = 6

     +-----------------+
     | year    _29age~o |
     |-----------------|
  1. |  1997    .360557 |
  2. |  1998    .359786 |
  3. |  1999    .358108 |
  4. |  2000     .35466 |
  5. |  2001    .349703 |
     |-----------------|
  6. |  2002     .34371 |
  7. |  2003    .336382 |
  8. |  2004    .327599 |
  9. |  2005    .318279 |
 10. |  2006    .309397 |

-> countryid = 7

     +-----------------+
     | year    _29age~o |
     |-----------------|
  1. |  1997    .312049 |
  2. |  1998    .309856 |
  3. |  1999    .308691 |
  4. |  2000    .307961 |
  5. |  2001    .306752 |
     |-----------------|
  6. |  2002     .30515 |
  7. |  2003    .303735 |
  8. |  2004    .302645 |
  9. |  2005    .301621 |
 10. |  2006    .301116 |
     +-----------------+

-> countryid = 8

     +-----------------+
     | year    _29age~o |
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162

```
      |----------------|
 1.   | 1997    .360506 |
 2.   | 1998    .35952  |
 3.   | 1999    .35616  |
 4.   | 2000    .351746 |
 5.   | 2001    .347655 |
      |----------------|
 6.   | 2002    .343412 |
 7.   | 2003    .338957 |
 8.   | 2004    .334815 |
 9.   | 2005    .330886 |
10.   | 2006    .32679  |
```

> countryid = 9

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      +----------------+
      | year    _29age~o |
      |----------------|
 1.   | 1997    .314453 |
 2.   | 1998    .312728 |
 3.   | 1999    .311627 |
 4.   | 2000    .311015 |
 5.   | 2001    .310403 |
      |----------------|
 6.   | 2002    .30996  |
 7.   | 2003    .309654 |
 8.   | 2004    .308908 |
 9.   | 2005    .307357 |
10.   | 2006    .305296 |
      +----------------+
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-> countryid = 10

```
      +----------------+
      | year    _29age~o |
      |----------------|
 1.   | 1997    .341991 |
 2.   | 1998    .338639 |
 3.   | 1999    .334865 |
 4.   | 2000    .330988 |
 5.   | 2001    .327042 |
      |----------------|
 6.   | 2002    .323057 |
 7.   | 2003    .319484 |
 8.   | 2004    .316667 |
 9.   | 2005    .314938 |
10.   | 2006    .314004 |
      +----------------+
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countryid = 11

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      +----------------+
      | year    _29age~o |
      |----------------|
 1.   | 1997    .297162 |
 2.   | 1998    .291192 |
 3.   | 1999    .285578 |
 4.   | 2000    .280871 |
 5.   | 2001    .277534 |
      |----------------|
 6.   | 2002    .275667 |
 7.   | 2003    .274945 |
 8.   | 2004    .274383 |
 9.   | 2005    .273724 |
10.   | 2006    .272601 |
      +----------------+
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163

-> countryid = 12

```
      +-----------------+
      | year   _29age~o |
      |-----------------|
  1.  | 1997    .33381  |
  2.  | 1998    .328046 |
  3.  | 1999    .322359 |
  4.  | 2000    .31687  |
  5.  | 2001    .311322 |
      |-----------------|
  6.  | 2002    .305867 |
  7.  | 2003    .300452 |
  8.  | 2004    .294938 |
  9.  | 2005    .289423 |
 10.  | 2006    .284088 |
```

-> countryid = 13

```
      +-----------------+
      | year   _29age~o |
      |-----------------|
  1.  | 1997    .349102 |
  2.  | 1998    .347939 |
  3.  | 1999    .346328 |
  4.  | 2000    .344448 |
  5.  | 2001    .341931 |
      |-----------------|
  6.  | 2002    .338633 |
  7.  | 2003    .334678 |
  8.  | 2004    .328749 |
  9.  | 2005    .320836 |
 10.  | 2006    .313055 |
      +-----------------+
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-> countryid = 14

```
      +-----------------+
      | year   _29age~o |
      |-----------------|
  1.  | 1997    .40996  |
  2.  | 1998    .405833 |
  3.  | 1999    .401109 |
  4.  | 2000    .395779 |
  5.  | 2001    .389729 |
      |-----------------|
  6.  | 2002    .384662 |
  7.  | 2003    .380493 |
  8.  | 2004    .376727 |
  9.  | 2005    .37311  |
 10.  | 2006    .369421 |
      +-----------------+
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-> countryid = 15

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      +-----------------+
      | year   _29age~o |
      |-----------------|
  1.  | 1997    .309647 |
  2.  | 1998    .303638 |
  3.  | 1999    .297416 |
  4.  | 2000    .29128  |
  5.  | 2001    .285052 |
      |-----------------|
  6.  | 2002    .279254 |
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164

```
      7. |  2003    .274071 |
      8. |  2004    .269341 |
      9. |  2005    .264677 |
     10. |  2006    .260316 |
         +-----------------+

-> countryid = 16

         +-----------------+
         | year   _29age~o |
         |-----------------|
      1. |  1997    .321255 |
      2. |  1998    .315859 |
      3. |  1999    .307531 |
      4. |  2000    .299344 |
      5. |  2001    .293631 |
         |-----------------|
      6. |  2002    .287809 |
      7. |  2003    .281781 |
      8. |  2004    .275614 |
      9. |  2005    .270408 |
     10. |  2006    .266387 |
         +-----------------+

-> countryid = 17

         +-----------------+
         | year   _29age~o |
         |-----------------|
      1. |  1997    .355925 |
      2. |  1998    .355575 |
      3. |  1999    .353621 |
      4. |  2000    .350473 |
      5. |  2001     .34568 |
         |-----------------|
      6. |  2002    .340333 |
      7. |  2003    .335072 |
      8. |  2004    .330503 |
      9. |  2005    .326461 |
     10. |  2006    .322247 |
         +-----------------+

-> countryid = 18

         +-----------------+
         | year   _29age~o |
         |-----------------|
      1. |  1997     .36984 |
      2. |  1998    .368712 |
      3. |  1999    .366201 |
      4. |  2000    .362537 |
      5. |  2001     .35833 |
         |-----------------|
      6. |  2002    .354091 |
      7. |  2003    .350058 |
      8. |  2004    .346331 |
      9. |  2005    .342386 |
     10. |  2006    .337706 |
         +-----------------+

-> countryid = 19

         +-----------------+
         | year   _29age~o |
         |-----------------|
      1. |  1997    .327539 |
```

165

```
 2. |  1998   .323368 |
 3. |  1999    .31881 |
 4. |  2000   .314101 |
 5. |  2001   .309949 |
    |-----------------|
 6. |  2002   .306663 |
 7. |  2003   .304416 |
 8. |  2004   .302965 |
 9. |  2005   .302208 |
10. |  2006   .301847 |
    +-----------------+

-> countryid = 20

    +-----------------+
    | year   _29age~o |
    |-----------------|
 1. |  1997   .372643 |
 2. |  1998   .368814 |
 3. |  1999   .363963 |
 4. |  2000   .359115 |
 5. |  2001   .355983 |
    |-----------------|
 6. |  2002   .354783 |
 7. |  2003   .353594 |
 8. |  2004   .351683 |
 9. |  2005   .349791 |
10. |  2006   .348404 |
    +-----------------+

-> countryid = 21

    +-----------------+
    | year   _29age~o |
    |-----------------|
 1. |  1997    .33411 |
 2. |  1998   .331661 |
 3. |  1999   .329173 |
 4. |  2000   .326824 |
 5. |  2001   .324583 |
    |-----------------|
 6. |  2002   .322417 |
 7. |  2003   .320415 |
 8. |  2004   .318889 |
 9. |  2005   .318001 |
10. |  2006   .317521 |
    +-----------------+
-> countryid = 22

    +-----------------+
    | year   _29age~o |
    |-----------------|
 1. |  1997   .383537 |
 2. |  1998   .383388 |
 3. |  1999   .382897 |
 4. |  2000   .381248 |
 5. |  2001    .37832 |
    |-----------------|
 6. |  2002    .37463 |
 7. |  2003    .36998 |
 8. |  2004   .364569 |
 9. |  2005   .358488 |
10. |  2006   .351684 |
    +-----------------+

-> countryid = 23
```

166

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        +----------------+
        | year   _29age~o |
        |----------------|
  1.    | 1997    .39724 |
  2.    | 1998   .388362 |
  3.    | 1999   .380334 |
  4.    | 2000   .373725 |
  5.    | 2001    .36831 |
        |----------------|
  6.    | 2002   .363858 |
  7.    | 2003   .359386 |
  8.    | 2004   .353593 |
  9.    | 2005   .346425 |
 10.    | 2006   .339043 |
        +----------------+
```

-> countryid = 24

```
        +----------------+
        | year   _29age~o |
        |----------------|
  1.    | 1997    .39724 |
  2.    | 1998   .388362 |
  3.    | 1999   .380334 |
  4.    | 2000   .373725 |
  5.    | 2001    .36831 |
        |----------------|
  6.    | 2002   .363858 |
  7.    | 2003   .359386 |
  8.    | 2004   .353593 |
  9.    | 2005   .346425 |
 10.    | 2006   .339043 |
        +----------------+
```

-> countryid = 25

```
        +----------------+
        | year   _29age~o |
        |----------------|
  1.    | 1997   .366573 |
  2.    | 1998   .365396 |
  3.    | 1999    .36375 |
  4.    | 2000   .361701 |
  5.    | 2001   .358689 |
        |----------------|
  6.    | 2002   .355062 |
  7.    | 2003   .350872 |
  8.    | 2004   .346598 |
  9.    | 2005   .341687 |
 10.    | 2006    .33679 |
        +----------------+
```
-> countryid = 26

```
        +----------------+
        | year   _29age~o |
        |----------------|
  1.    | 1997   .395799 |
  2.    | 1998    .39552 |
  3.    | 1999   .394411 |
  4.    | 2000   .391776 |
  5.    | 2001     .3881 |
        |----------------|
  6.    | 2002   .383565 |
  7.    | 2003   .377856 |
  8.    | 2004   .371006 |
```

167

```
 9. | 2005    .363308 |
10. | 2006    .355431 |
    +-----------------+

-> countryid = 27

    +-----------------+
    | year   _29age~o |
    |-----------------|
 1. | 1997    .343514 |
 2. | 1998    .338862 |
 3. | 1999    .334505 |
 4. | 2000    .330437 |
 5. | 2001    .326252 |
    |-----------------|
 6. | 2002    .321459 |
 7. | 2003    .316117 |
 8. | 2004      .3105 |
 9. | 2005    .304808 |
10. | 2006    .298779 |
    +-----------------+
-> countryid = 28

    +-----------------+
    | year   _29age~o |
    |-----------------|
 1. | 1997    .351425 |
 2. | 1998    .344754 |
 3. | 1999    .338207 |
 4. | 2000    .331418 |
 5. | 2001     .32451 |
    |-----------------|
 6. | 2002    .317891 |
 7. | 2003    .311348 |
 8. | 2004    .304615 |
 9. | 2005    .297969 |
10. | 2006    .291494 |
    +-----------------+

-> countryid = 29

    +-----------------+
    | year   _29age~o |
    |-----------------|
 1. | 1997    .313914 |
 2. | 1998    .314499 |
 3. | 1999    .314886 |
 4. | 2000    .314455 |
 5. | 2001     .31292 |
    |-----------------|
 6. | 2002    .310602 |
 7. | 2003    .307967 |
 8. | 2004    .305526 |
 9. | 2005    .303803 |
10. | 2006    .302658 |
    +-----------------+

-> countryid = 30

    +-----------------+
    | year   _29age~o |
    |-----------------|
 1. | 1997    .306904 |
 2. | 1998    .302988 |
 3. | 1999    .299694 |
 4. | 2000    .297352 |
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168

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     5. |  2001    .296936 |
        |------------------|
     6. |  2002    .297794 |
     7. |  2003    .298441 |
     8. |  2004    .298857 |
     9. |  2005    .299163 |
    10. |  2006    .298946 |
        +------------------+
-> countryid = 31

        +------------------+
        | year   _29age~o  |
        |------------------|
     1. |  1997    .31909  |
     2. |  1998    .313608 |
     3. |  1999    .308737 |
     4. |  2000    .304426 |
     5. |  2001    .300501 |
        |------------------|
     6. |  2002    .297077 |
     7. |  2003    .294279 |
     8. |  2004    .291888 |
     9. |  2005    .289749 |
    10. |  2006    .288042 |
        +------------------+

-> countryid = 32

        +------------------+
        | year   _29age~o  |
        |------------------|
     1. |  1997    .355997 |
     2. |  1998    .35579  |
     3. |  1999    .355042 |
     4. |  2000    .353662 |
     5. |  2001      .3515 |
        |------------------|
     6. |  2002    .349892 |
     7. |  2003     .34858 |
     8. |  2004    .347752 |
     9. |  2005    .346696 |
    10. |  2006    .346455 |
        +------------------+

-> countryid = 33

        +------------------+
        | year   _29age~o  |
        |------------------|
     1. |  1997    .501255 |
     2. |  1998    .497345 |
     3. |  1999    .493316 |
     4. |  2000    .489293 |
     5. |  2001    .485214 |
        |------------------|
     6. |  2002    .480997 |
     7. |  2003    .476665 |
     8. |  2004    .472244 |
     9. |  2005    .467794 |
    10. |  2006    .463385 |
        +------------------+
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BIOGRAPHY

Ramziya Shakirova received her Diploma of Specialist in Economics from the Kazan Institute of Finance and Economics, in Russia in 1993 and the Candidate of Economic Sciences degree from the Kazan Institute of Finance and Economics in 1996. She has worked at the Kazan Institute of Finance and Economics, Russia and at the Terrorism, Transnational Crime and Corruption Center at George Mason University's School of Public Policy. Currently, she is a research analyst at Independent Project Analysis, Inc.