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THE IMPACT OF EDUCATION DECENTRALIZATION ON EDUCATION OUTPUT: A CROSS-COUNTRY STUDY

BY

EUNICE HEREDIA-ORTIZ

A Dissertation Submitted in Partial Fulfillment
Of the Requirements for the Degree
of
Doctor of Philosophy
in the
Andrew Young School of Policy Studies
of
Georgia State University

GEORGIA STATE UNIVERSITY
2006

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ACCEPTANCE

This dissertation was prepared under the direction of the candidate's Dissertation Committee. It has been approved and accepted by all members of that committee, and it has been accepted in partial fulfillment of the requirements for the degree of Doctor of Philosophy in Economics in the Andrew Young School of Policy Studies of Georgia State University.

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ABSTRACT

THE IMPACT OF EDUCATION DECENTRALIZATION ON EDUCATION OUTPUT: A CROSS-COUNTRY STUDY

By

EUNICE HEREDIA-ORTIZ

November 2006

Committee Chair: Dr. Jorge L. Martinez-Vazquez

Major Department: Economics

This dissertation examines, both theoretically and empirically, the impact of expenditure decentralization and decision-making in education on education output measured through net enrollment rates, repetition rates, dropout rates, completion rates, and test scores in science at the primary school level. We develop a theoretical model based on a behavioral production function model that investigates the potential direct effects of education decentralization on output, and indirect effects of education decentralization through its impact on family, school and teacher inputs.

We develop an unbalanced panel data model of education decentralization by using various econometric estimators on a dataset of fifty nine countries, developed and developing countries, covering the period 1970-2004 in five-year intervals. The empirical analysis in this dissertation improves upon previous empirical studies of education decentralization by using up-to-date comparative international data over time on measures of education decentralization and various indicators of primary schooling.

We find empirical support that expenditure decentralization in education significantly improves repetition rates, dropout rates, completion rates and test scores at

the primary school level. We are unable to find a significant effect on primary net enrollment rates. Further, we find that decisions on education planning and personnel management have a greater influence on education output when taken at the intermediate level of government (states and provinces). At the same time we find that allocating decisions on education at the school level can also significantly improve education output.

Our empirical results support the hypothesized positive link between education decentralization and education outcomes. Additionally, this study is consistent with the recent trend towards decentralizing education around the world.

CHAPTER ONE

INTRODUCTION

This dissertation explores the impact of the decentralization of expenditure and decision-making authority in the area of education on the output of publicly provided primary education.[1] Decentralization in education can range from the deconcentration of administrative authority to more comprehensive regulatory and financial control, and it can extend across all education functions. In this study we define the term "education decentralization" to mean the process of devolution of fiscal and decision-making authority, from higher to lower levels of government and organizational units, affecting the way school systems make policy about resource generation and spending; organization of instruction (curricula, textbooks, teaching methods, schedule); personnel management (hiring/firing, pay scales, assigning teaching responsibilities, training); and planning and managing public schools.

A number of researchers suggest that human capital–in the form of quantity of schooling and quality–plays an important role in economic development and per capita income growth. Education not only helps to improve the income-earning potential but it also has the ability to empower individuals; education enables individuals to participate in local and national government, it provides skills and knowledge to improve quality of

[1] Chapter Three provides a more detailed discussion on the definition and measurement of education output.

life, and to become more productive (World Bank 1995a). Therefore, investigating whether education decentralization might improve the outcomes associated with the provision of education is of primary importance in order to obtain better governance, quality of life, and overall economic growth. Our model investigates the direct and indirect effects that decentralization of education expenditures and decision-making might have (positive or negative) on education services at the primary school level. Specifically, we investigate the direct effect of education decentralization on education output indicators and the potential indirect effects through family and school inputs. As we discuss throughout this dissertation, the findings could have significant policy implications since most countries are moving towards some form of decentralized delivery of education services.

Empirically, our model estimates the effects of education decentralization on primary education provision. We evaluate different indicators of primary education provision performance, namely we measure access to education through net enrollment rates; cohort flows through dropout and repetition rates, and completion rates; and student learning through test scores.[2] We estimate our model based on a panel data set of developed and developing countries for five-year intervals from 1970 to 2004.

We further investigate the effect of education decentralization for a sub sample of countries, mainly OECD countries, employing traditional measures of education decentralization (expenditure decentralization) versus a more comprehensive measure of education decentralization that includes measures of decision-making autonomy in the

[2] The literature has used different indicators for the performance of education systems. We evaluate the ones that have been most commonly used in the literature. The indicators most commonly criticized are repetition and dropout rates because they can be strongly influenced by variation in the promotion standards of education systems.

education process. Lastly, our goal is to provide a discussion on the policy implications of our empirical results.

Motivation

For many decades now, there has been a consensus on the importance of education in economic performance. Globally, education has gained attention due to the two Millennium Development Goals that are directly related to education (achieving universal primary education and promoting gender equality), and education is argued to also help promote achievement of several other MDG goals, such as reducing poverty, reducing child mortality, improving maternal health, lowering the prevalence of HIV/AIDS, and ensuring environmental sustainability (Birdsall 1993; Deny, Harmon, and Redmon 2000; Psacharopoulos and Woodhall 1985; Ranis, Stewart, and Ramirez 2000).

Despite the many advantages of education, including the potential to lift people out of poverty, in many countries education provision has failed in terms of affordable access, technical quality, client responsiveness, and output. Millions of children around the world fail to gain access to schooling, and an even larger number of those who enroll leave prematurely, dropping out before basic skills of literacy and numeracy are achieved (World Bank 2003). This will likely have negative implications to economic growth and development in a country.

While education continues to receive great attention in policy debates, reforming education to provide adequate access, equity, and quality education, involves redefining

the role of government in education management and finance. Proponents of fiscal decentralization and decentralized education argue that decision-making in the delivery of education services that are closer to the people, at lower levels of government, may translate into better education service delivery and improved output (Fiske 1996; Hanson and Ulrich 1994).

As a result of this apparent positive link between education decentralization and education output, international financial organizations, notably the World Bank and the United Nations, have facilitated efforts for decentralization reforms in developing countries. Over the past two decades, decentralization has moved to the forefront of policy discussions in developed, developing, and transitional countries. Decentralization of the provision of education, as a component of overall decentralization, has often been viewed as one of the first functions to be assigned to lower levels of government. In some instances, the decision to decentralize education is pursued for the wrong reasons. For example, central governments may impose unfunded mandates, which are expenditure requirements on sub-national governments arising from the absence of adequate funding or in order to meet deficit targets at the central level (Prud'homme 1995; Tanzi 1996). These unfunded mandates compromise the efficient provision of education services.

Our goal in this dissertation is to analyze, theoretically and empirically, the impact of education decentralization on education output. We believe that the course of research of this dissertation is timely and pertinent given the lack of consensus in the literature about the effect of education decentralization on education outputs. While there is a possibility that there is improvement in education outputs due to education

decentralization,[3] others argue that centralization of education systems should be preferred in developing countries where there is considerable instability, often immature democratic systems, and where weak fiscal and technical capacity of sub-national governments may hinder equitable and efficient provision of education services. Whether education decentralization has an effect on the performance of education systems and what is the magnitude of this effect are yet to be determined.

Furthermore, the literature is abundant with specific country case studies on the impact of education decentralization on education output, but there is less evidence, if any, on comparative studies of education decentralization across countries over time. Considering that no two countries are the same, it is essential that the literature provides evidence of this impact across countries and over time.

Understanding the factors that contribute to the production of education and exploring the link between education decentralization and the outcomes of this policy on the education system is important for the following reasons: (1) it will contribute to the literature explaining the effect of education decentralization on education output across countries and over time, and (2) from the policymakers' point of view, if education decentralization leads to improved outcomes of education provision in terms of greater access through higher enrollment rates; greater efficiency through lower repetition and dropout rates, as well as better student test scores, then international financial institutions, bilateral donors and governments should focus on decentralization reforms that enhance the responsibilities of sub-national governments in delivering education services. This

[3] See Lobo (1995), Lange (1988), and Sawada (2000).

would contribute, according to evidence, to the betterment of human capital and the improvement of economic performance.

The Need for Theoretical Analysis

Principal-agent models,[4] educational production functions,[5] teacher power and patronage models[6] have all been used to examine the question of education outputs and expenditures. Only recently, with the rise of decentralization reforms have these models began to incorporate education decentralization as a potential influencing variable with respect to education outputs. These models hypothesize that education outputs are influenced by school inputs; management structure; household inputs; community participation; and many other outside forces such as the political environment.

The production function models are widely used in more recent studies of education decentralization. There is a need to extend the existing theoretical models on education decentralization and education output in order to establish a firm basis for the empirical work such as that carried out in this dissertation. Most of the existing theoretical models have primarily examined the role of education decentralization reform and differences across regions in one specific country and do not account for the behavioral effects of the agents in the education process. The theoretical models in these studies were adapted to only one specific form of decentralization, leaving no room for

[4] For principal-agent models Holmes, DeSimone and Rupp (2003); Otsuka, Chuma, and Hayami (1992); and Sawada (2000).
[5] For production function models see: Hanushek (1995); Ozler (2001); Pritchett and Filmer (1997); and Sawada (2000).
[6] See Olson (1965) and Pritchett and Filmer (1997).

theoretical specifications that can account for different types of education decentralization across countries.[7]

Although specific country analysis of education decentralization can provide policymakers with significant insight on a type of reform and its influence on education outputs, cross-country studies can provide planners with guidance on a balance between centralized and decentralized decision-making of education functions. Examining the distribution of decision-making authority in different countries with respect to the educational functions can also help determine a plan about an optimal level of government decision-making power sharing that is best suited in any given set of circumstances based on countries' characteristics, experiences, and outputs of education. Although Lee and Barro (2001) developed a production function model to investigate the factors that affect education output across countries, their model does not incorporate education decentralization as a determinant of education output.

We argue that the failure to develop a model that is adaptable to different types of education decentralization and to include behavioral effects on the inputs of the education process has inhibited researchers' ability to perform cross-country comparative studies of decentralization's influence on education outputs. One of the objectives of this dissertation is to develop a theoretical model of decentralization that investigates the potential effect of education decentralization that is adaptable to different forms of education decentralization policies to take full advantage of cross-country experiences.

---

[7] Examples of studies that incorporate one type of decentralization are: Jimenez and Sawada (1999) and the EDUCO program of Community Participation and Teacher Effort in El Salvador; Prawda (1993a) and the implementation of a voucher program in Chile; and Hoxby (2000) and the increase in competition through local financing in the United States.

The theoretical model we present in Chapter Three of this dissertation extends previously developed production function models, and incorporates an education decentralization parameter which affects the production of education.

The Need for Additional Empirical Research

Numerous countries around the world are considering or are implementing education decentralization reforms, yet empirical knowledge of the relationship between education decentralization and education output remains ambiguous. The ambiguity could be the result of a number of measurement problems and the lack of international comparative data.

The focus of previous empirical research about the impact of education decentralization on education output has been on individual country analysis.[8] This approach makes sense; characteristics of education decentralization and the output of education are affected by social, cultural, economic, and political determinants which are country-specific. There remains a need to expand the possibility of generalizing results through comparative case studies. Studies have relied on cross-sectional data, even though education decentralization is an extensive process whose impact, we believe, is only quantifiable over time. In addition, measuring education output has been a controversial issue in the literature. Can education output be measured by the number of students enrolled in school, the number of students who graduate each year, the number of dropout students, the number of repeaters, or the results of test scores? Does

[8] See Galiani and Schargrodsky (2002); Lange (1988); Lobo et al. (1995); Ozler (2001); Prawda (1993b); and Sawada (2000).

decentralization influence the measures listed above differently? Recent studies have attempted to study the effect of education decentralization on education output measured via results in mathematics, science and language tests. However, these data are still very limited for international comparative studies.

This study extends the empirical literature on the relationship between education decentralization and education output. For instance, this study analyzes this relationship in the context of an international comparative study over time, using different measures of education output, and comparing results between using traditional measures of education decentralization and a more comprehensive measure of education decentralization that includes decision making autonomy across functions within the education system. To the best of our knowledge, this study is the first to use panel data for a large set of countries in examining the relationship between education decentralization and education output.

Overview of the Dissertation

The rest of the dissertation is organized as follows: Chapter Two provides definitions on education decentralization and education output, as well as a brief review of the empirical literature on education decentralization and education output. Individual country case studies on education decentralization reforms can be found in Appendix A. In Chapter Three, we develop a simple production function model of education that introduces education decentralization as a factor in the production of education output. The chapter concludes presenting the testable hypotheses derived from the theoretical

model concerning the relationship between education decentralization and its impact on education output. Chapter Four describes the empirical estimation methods and the data. Chapter Five presents and discusses the empirical results. Chapter Six concludes this dissertation providing a discussion on the policy implications based on the empirical results obtained in the previous chapter.

CHAPTER TWO

REVIEW OF THE LITERATURE

The apparent correlation between education decentralization and education output has generated numerous research studies and policy debates in the past decade. The existing literature on this relationship abounds with country specific studies, although cross-country comparative studies of this relationship are very limited. The literature is motivated by the importance of determining what influences the provision of education in order to improve education output. In this chapter, we provide a survey of some of the main findings emerging from some of these studies. We will discuss measures of education output used in the literature, and highlight some of the difficulties in measuring and assessing the impact of education decentralization, theoretically and empirically.

The rest of this chapter is organized as follows. In the first section we briefly review the definition of education output and the various indicators of education output that have been used in the literature. In the second section, we review the definition of education decentralization and the different measures of such that have been used by researchers in this area. In the third section, we review the theoretical links between education decentralization and education output as established in the literature. In the fourth section, we highlight the empirical literature on education decentralization and the

problems encountered in empirically measuring the true impact of education decentralization on education output. The last section presents a conclusion and the expected main contributions of this research study on the existing literature.

Defining and Measuring Education Output

The provision of education is a complex process and its goal is to help achieve a range of outcomes.[9] Education outputs themselves are affected by an array of education inputs including factors other than government activities, notably student and parent time, student ability, family, peer group, and other factors. We define educational output as what education systems and schools produce to contribute to education outcomes.

For many years, governments have sought to improve measures and indicators of government educational services. Measuring the output of government education is difficult, and the literature uses the terms output, outcomes, and output quality, interchangeably to refer to the same set of indicators. Measures of output in the publicly-funded education sector generally are divided into two components: the volume of output (pupil number and cohort flows) and the quality of output (achievement in test scores) (Atkinson 2005).

Because there is no consensus in the literature about the most appropriate measure of education output, we evaluate the commonly used proxies of education output in primary education. We consider that our measures of the completion of primary

[9] Broadly defined, education outcomes include the preparation of individuals (students) for participation in society and in the economy through the labor market.

education and test scores are better measures of education output, than some other indicators commonly used in the literature. These other indicators–enrollment rates, dropout and repetition rates–might not exactly capture the concept of education output, but we analyze them as well, as they might provide an understanding of the multiple purposes of education decentralization policies.

Access or the level of popular participation in the education sector is generally measured through enrollment rates. Literacy rates show the accumulated achievement of primary education and literacy programs in imparting basic literacy skills to the population. Another set of education output indicators are those related to cohort flows: repetition rates and dropout rates. Although these indicators are claimed to measure the internal efficiency of the education system, such indicators are also used in the literature as indicators of education quality (Lee and Barro 2001). Repetition rates are measured as the percentage of repeaters in the total number of students enrolled at a given level, and the dropout rate is measured as the proportion of pupils who start primary school but do not eventually attain the final grade of primary school. These measures are often criticized because they can be strongly influenced by variations in the promotion standards of education systems.[10]

A final type of education output indicator often used to monitor the quality of education output is test scores. These capture the level of knowledge of pupils. However, measuring and comparing the performance of students for a broad number of countries can be difficult and costly. A potential problem with international assessments is that

[10] For example, a country can mandate no repetition in primary grades. Hence, repetition rates in these countries should drop to zero.

student performance in specific areas reflects different national emphasis in school curricula. A further problem involves the difficulty in obtaining representative samples of pupils (Lee and Barro 2001). Fortunately, indicators of students' scores on international comparable tests have become more frequent in the last decade and they have begun to cover a broader number of countries.

To summarize, we evaluate education output as net enrollment rates, completion rates, repetition rates, dropout rates, and student test scores. Despite the weaknesses in some of these measures, all of the above education output indicators have been used in previous literature as proxies for education output. For example, see Lee and Barro (2001); Lobo et al. (1995); Mahal, Srivasta and Sanan (2000); and Prawda (1993b).

Defining and Measuring Education Decentralization

The literature on the decentralization of education presents a variety of definitions and ways that power is transferred via decentralization. Strictly speaking, we refer to decentralization in education as the devolution of authority from a higher to a lower level of authority. Devolution, which is often considered the strongest form of decentralization, is the permanent transfer of authority over financial, administrative, or pedagogical matters from higher to lower levels of government. Four possible levels of authority are considered in this dissertation: the central government; the intermediate level of government (provincial, state or regional governing bodies); local government (municipal, county or district governments); and schools.

Other definitions of education decentralization that the literature presents are deconcentration and delegation. Deconcentration is a process where there is a shift in management responsibilities to lower levels of government but central government is in control. This is the weakest form of decentralization. On the other hand, delegation is a more general approach to decentralization where the central government lends authority to lower levels of government or organizational units, with the understanding that the delegated authority can be withdrawn.[11]

The literature recognizes that given decentralization's multidimensional nature, measuring any decentralization policy is a difficult task. The fact has been commonly discussed in the fiscal decentralization literature, although at a much less extent in the education decentralization literature.[12] Just as fiscal decentralization is generally measured in the literature as the sub-national share of total government spending, education decentralization may also be measured in its fiscal dimension as the sub-national education spending share of total government spending in education. While this approach ignores the importance of measuring the level of decision making at which functions in education take place, given the lack of data to perform cross-country studies, the fiscal dimension measure of education decentralization may be the only proxy that would be consistent for a wider set of countries.

Education decentralization has been measured in different ways based on the variety of labels and strategies that it has taken. Differences in measuring education decentralization in the literature may explain the conflicting results in evaluations of

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[11] For a complete discussion on the differences between deconcentration, delegation, and devolution see Fiske (1996); Guess, Loehr and Martinez-Vazquez (1997); Hanson (1997); McGinn and Welsh (1999); and Rondinelli, Nellis, and Cheema (1984).

education decentralization policies. The variety of education decentralization strategies include policies of community and parental participation, school autonomy, school choice and voucher programs, charter schools, and sub-national and local resource management.[13] In this approach, education decentralization has been generally measured as dummy variables representing whether a school may be autonomous, or a chartered school, or a community school, or presence of *de jure* autonomy and decentralization, and so forth. This dummy variable approach is generally found in country case studies.

Where data are available, education decentralization has been measured as the differences in the management of schools with respect to how many decisions, which decisions, and to what degree decisions are being taken at a certain government level or organization level rather than some other level. According to OECD methodology, education decentralization can be measured on the basis of the location of decision-making affecting each of the four types of decisions in education systems: organization of instruction (curricula, textbooks, teaching methods, schedule); personnel management (hiring/firing, pay, assigning teaching responsibilities, training); planning and structures; and resources and spending (Organisation for Economic Co-operation and Development 1998). See Table 1 for a detailed description of decisions that may be decentralized. While OECD provides data on decision making for each of the above mentioned four types of decisions, these are only available for OECD countries for a limited period of time. However, this data represents a starting point for a more comprehensive measure of education decentralization in cross-country studies.

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[12] For examples see: Bird (2000); Guess, Loehr, and Martinez-Vazquez (1997); and Martinez-Vazquez and McNab (2003).

[13] See Appendix A for an overview of country case studies with different forms of education decentralization policies.

In sum, we can see that the multiple dimensions of education decentralization pose serious empirical challenges in investigating the true impact of education decentralization on education. Provided the limited data availability for a comprehensive measure of education decentralization for a large set of countries, in this dissertation we use the fiscal measure for education decentralization for developing and developed countries; and where data permits, we examine a sub sample of OECD countries for which a more comprehensive measure of education decentralization is feasible.

Table1. Types of decisions in education that may be decentralized

Organization of Instruction	Select School attended by student. Set instruction time. Choose textbooks. Define curriculum content. Determine teaching methods.
Personnel Management	Hire and fire school director. Recruit and hire teachers. Set or augment teacher pay scale. Assign teaching responsibilities. Determine provision of in-service training.
Planning and Structures	Create or close a school. Selection of programs offered in a school. Definition of course content. Set examinations to monitor school performance.
Resources	Develop school improvement plan. Allocate personnel budget. Allocate non-personnel budget. Allocate resources for in-service teacher training.

Source: Organisation for Economic Co-operation and Development (1998)

Theory of Education Decentralization and Education Service Delivery

There is currently a global trend towards the decentralizing of education systems. Most countries are experimenting or contemplating some form of decentralization.[14] Proponents of education decentralization claim that "reorganization will improve the quality of teaching and learning by locating decisions closer to the point at which they must be carried out and be energizing teachers and administrators to do a better job" (Fiske 1996, p. 24). Although the impact of education decentralization has been analyzed in the literature for nearly fifteen years, there is still no consensus on whether these policies positively impact education output and schooling.

Given that primary and secondary education are often considered a national priority both on efficiency and equity grounds, central government involvement in the financing and regulation of education (including determining curricula and setting educational standards) is generally universal, especially in developing countries. Conversely, in other countries, such as the case in the United States, these are responsibilities of sub-national governments. Nonetheless, in accordance with the subsidiarity principle, the actual provision or delivery of basic education is often characterized by decentralized provision, where local governments are responsible for assuring the actual provision of education. While there is no simple rule to follow when it comes to decentralizing education; the issue becomes one of finding a balance between degrees of centralized and decentralized decision-making of functions in education across different levels of government, given the education system objectives.

Assuming that the correct institutions are in place,[15] the potential gains in the framework of decentralized education service delivery found in the literature can be summarized as follows:[16]

i. *Better information and targeting.* Local governments have a more institutionalized linkage with beneficiary communities, improved information, and the incentive to use this information; therefore, local governments are better placed to identify the needs, to respect local social identities, and to respond more efficiently to local variations in conditions, tastes, standards, affordability, location requirements and so on for services or infrastructure. Community participation can improve the information flow leading to improved project performance and better targeting. Local governments are better informed not only about local preferences and politics but also about local variations and costs, so they can potentially allocate resources more efficiently than the central government.

ii. *Innovation and creative approaches*. Having many suppliers of education can lead to a wide variety of experiences and innovation through competition among sub-national governments. It also encourages providers to act to satisfy the wishes of the local community. Additionally, demand side inducements and choice, if well designed, can be very valuable for education improvement.

iii. *Cost/service link.* Improved efficiency levels of service provision are achieved when there is a link between costs and benefits. When local governments have autonomy to levy fees and local taxes, there is not only a great potential for improved revenue mobilization and increased resources available for redistribution and allocation of programs, but this also reinforces local accountability.

iv. *Improved efficiency.* This deals with how educational resources are used. It is argued that decentralization leads to more efficiency by eliminating bureaucratic procedures and motivating local officials to be accountable to citizens for resource allocation. In a centralized system, decisions are mostly made outside and far away from where the actual issue is located. Assuming that local government units are more informed about the specific needs of their communities, then allowing local governments to decide on resource allocation will result in better efficiency.

v. *Greater voice and participation.* Decentralization empowers citizens through the creation of institutions that promote greater voice and participation, and giving

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[14] A survey of developing and transitional nations by Dillinger (1994) indicates that out of 75 such economies with populations greater than 5 million, all but 12 have experienced some type of transfer of power to local governments.

[15] Underlying assumptions include (i) elected that officials are responsive to constituents, (ii) planning and budgeting allows for public involvement, and (iii) local bodies indeed have discretion in expenditure decisions.

[16] See Burki, Perry and Dillinger (1999); Fiske (1996); Oates (1972); Winkler and Gershberg (2000).

citizens a greater management role. The assumption is that decentralization works by enhancing citizen's political voice in a way that results in improved education services, however, this could go either way on both theoretical and empirical grounds. Although decentralization is no panacea, if correct institutions are in place, it can be very promising. While direct parental participation is considered a weak link to affect service delivery when there is no local autonomy to make changes, providing direct parent and community participation in schools can be a promising strategy for school improvement.

vi. *Strengthened accountability relationships.* Accountability relationships between local authorities, citizens, providers and the center are strengthened, as there is greater voice, information, responsiveness and monitoring.

Based on the above potential gains due to decentralized education delivery, moving decision-making closer to the needs of each school and finding the right balance of centralized and decentralized responsibilities will improve education provision by focusing more on cultural differences and learning environments. In addition, it will improve accountability by giving incentives for quality performance to teachers and school officials (Hanushek and Rivkin 2003). Similarly, closer parent-school partnership through decentralization can improve both the school and home environment to learning.

Recent studies argue that education decentralization influences the behavior of parents and school agents in the education process.[17] Education decentralization may influence household behavior including those related to the time each child spends in school and learning at home, time each adult spends helping with homework, choice of school, education related expenditures among others. Moreover, the argument that accountability relationships strengthen through decentralization are believed to improve education output by giving incentives for quality performance to education officials, teachers and schools themselves. Additionally, having many suppliers of education

[17] For examples see Behrman and King (2001); Filmer (2002); Jimenez and Paqueo (1996); Jimenez and Sawada (1999); Lobo et al. (1995); and Sawada (2000).

through education decentralization is argued to lead to increasing "competitiveness" of the system and encouraging providers to improve performance (Oates 1972).

However, the assumptions that education decentralization improves education output as presented above presume a world in which democracy works well, in which all externalities are captured locally, and sufficient institutional capacity is present to undertake responsibilities. The argument is only valid under the assumption that governance capacity of the receiving institution is at least as efficient as the central government to run the program, and that the central government is unable to match the preferences of the median-voter of each jurisdiction.[18] In the absence of these presumptions it is argued that decentralization in education may increase disparities in access, learning outputs, and disparities and inequality in expenditures (Elmore, Fuller, and Orfield 1996; Godwin and Kemerer 2002).

Studies such as Bahl and Nath (1986), Bahl and Linn (1992) and Prud'homme(1995) argue that efficiency gains due to decentralization are not significant in developing and transitional countries. Prud'homme (1995) and Tanzi (1996) argue that allocative gains arising from a better match to heterogeneous tastes in developing countries are minimal. Another argument states that developing countries may not gain allocative efficiency through school competition because their citizens may be too poor to "vote with their feet" (Davoodi and Zou 1998). Others argue that the central government is better able to attract better personnel and is able to bargain better wages and career

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[18] For examples of competition positively influencing education outcomes see Hoxby (1994); Hoxby (2000); and Ritzen, van Dommelen and De Vijlder (1997).

prospects. Moreover, it is argued that centralized provision of public goods should have the advantage of production efficiency over local governments due to economies of scale.

Despite the counterarguments for decentralization, education has not been the only public service to undergo decentralization reforms in the past years. Countries have implemented decentralization in health service delivery, transportation, road services and others. Preliminary studies show that there may be positive effects of decentralization in public service delivery. In the health sector, for example, Robalino, Picazo and Voetberg (2001) analyze the impact of fiscal decentralization on mortality rates in a panel data of low and high income countries. The authors find that higher fiscal decentralization is consistently and significantly associated with lower mortality rates, particularly for poor countries. However, there are studies that have found negative or no significant relationship between decentralization in service delivery and output of the service (Arredondo and Orozco 2006), reiterating that this effect remains an empirical question.

The Empirical Literature

The preceding section demonstrates that theoretical studies offer an ambiguous response to the question of the impact of education decentralization on education output. In fact, the theoretical literature supports two opposing arguments. One wave in the literature argues that education decentralization would improve education output through better knowledge of local environment, better voice and accountability relationships, and so on. The other wave disagrees and argues that education decentralization may likely

cause local elite capture, increase disparities in access, learning outputs, and disparities and inequality in expenditures.

While the question of the effect of education decentralization is strictly empirical, the current empirical literature is mixed and limited. Most investigations conclude that the effect depends on whether basic assumptions have been met and on the type of education decentralization policy that is implemented. As indicated earlier, education decentralization can take a myriad of forms, ranging from centralized provision, to provision by regional and local governments, to community-level or school-level control over service delivery. In addition, education decentralization is multi-dimensional in which it not only encompasses responsibility for resources but also the decision-making on specific functions in the education system (i.e., organization of instruction, management functions, and planning and structures). Consequently, it is reasonable to suspect that the different dimensions of education decentralization might have different impact on education service delivery, and on output depending on how it is measured. Hence there is a need for additional empirical investigations. We now explore some of the empirical work that has been done in this area and the limitations encountered in these studies.

As discussed previously, a big challenge in any empirical study involving education decentralization and education output is quantifying these two. The literature on education decentralization is growing but it is still mostly descriptive in nature. Empirical studies have generally suffered from weak baseline data. Indeed, there is no perfect measure of education decentralization as well as no perfect measure of education output. Numerous empirical studies have employed different indicators of both education

decentralization and education output. We will review various studies in the empirical literature according to the form of education decentralization policy that is evaluated.

Education Decentralization to Lower Levels of Government

The level of education decentralization varies widely from country to country. Based on Government Finance Statistics data, the share of sub-national spending on education is on average 51 percent of total education spending in 62 countries from 1970 to 2004. Additionally, an OECD survey on decision-making in education (based on decisions described in table 1) across 38 countries, mainly OECD, shows that 71 percent of decisions in education are taken at the sub-national level, of which 16 percent are taken at the regional level, 18 percent at the local government level, and 38 percent at the school level from 1990 to 2004.[19]

In many federal countries–Brazil, Canada, Germany, India–the states or provinces have constitutional responsibility for education, although the responsibility for primary and secondary education in many of these countries in turn is devolved to the local government level. Many other countries have devolved the responsibility for delivering primary and secondary education to local governments guided by the "subsidiarity principle" in devolving expenditure assignments between different government levels.[20]

In analyzing the impact of education decentralization on different education outputs, Winkler and Gershberg (2000) find that in Brazil, where most authority concentrates at the state government level, decentralization has increased enrollment rates but it has done little to improve on regional inequities in access to schooling and output

[19] See Chapter Four for a description of data sources and countries in the sample.

measured through test scores. Chile's experience, where decision-making authority has increasingly being transferred to municipalities, also suggests that decentralization does not by itself remove inequalities between localities. In particular, output measured through test scores in poorer communities continues to lag.

Burki, Perry and Dillinger (1999) in their analysis of education decentralization in Latin American countries suggest that transferring responsibility for primary education to local governments may not be sufficient. They argue that only when management is decentralized to community school boards and school directors that the positive impacts of decentralization appear. According to the authors, decentralizing education to state government as in Colombia and Mexico is unlikely to improve output. In contrast, efforts to shift management power to community groups and school directors as in special cases in Nicaragua, El Salvador, and Minas Gerais, Brazil, are likely to show results.

A study by Filmer (2002) of Argentina, where primary education is in the hands of the provinces, uses a production function model to examine the impact on student learning of school autonomy and parental participation. Their analysis describes autonomy as the extent to which the school itself may choose inputs, and parental participation as the kind of leverage parents (students and the local community) are given in school operations. The study utilizes a cross-sectional data set to analyze the impact of autonomy and parental participation on student language and math test scores in sixth and seventh grades, in urban public and private as well as rural public schools. This study derives an autonomy and parental participation index from a set of 12 variables that measure the degree of school autonomy in decision-making about teacher management

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[20] The subsidiarity principle suggests that government services should be provided at the lowest level of government that is capable of efficiently providing this good or service.

and organization; curricular and pedagogical matters; and relations with parents. Similarly, parental participation is derived from 16 variables that measure the degree of parental participation involvement in teachers' management and organization; curricular and pedagogical matters; parents' convocations; and participation in other matters. The results are that autonomy and participation are found to be positive and significantly related to learning in mathematics (not language). Moreover, the effect is stronger among the poorest schools and as strong for children of poorer households.

The major weakness in Eskeland and Filmer's study, however, is the possibility that the results of this study may be biased due to endogeneity between unobserved variables and autonomy and participation. Despite the richness of the dataset (over 24,000 observations at the student level) the lack of data forced the author to use weak instrumental variables, for example, excluding certain explanatory variables from the production function model and using them as instruments. Their results, however, may have relevance in the education decentralization literature in stressing that if responsibility is moved from the center to the regions or local government level, the results are beneficial if this raises autonomy and participation in schools.

On locally funded primary education, Jimenez and Paqueo (1996) investigate the impact of local contributions on efficiency through a cost function, using financial resources and student achievement data from Philippine primary schools. The authors measure the degree of decentralization as the proportion of school's total expenditures financed by local contributions, such as contributions from the local school board, municipal government, Parent Teacher Associations (PTA) and other local sources.

Jimenez and Paqueo estimate a simple double-log Cobb-Douglas cost function determined by two measures of school output, student enrollment and average score of fourth grade students in mathematics, English and Filipino. This study finds that schools which rely more heavily on local sources are more efficient, meaning that they have lower costs while holding constant for enrollment and test scores. "A 1 percent increase in the share of financing coming from local sources will lead to a decline in total costs of 0.135 percent, or about the cost of providing for a place for one more student" (Jimenez and Paqueo 1996).

Although the results of this study have constituted a great contribution to the literature on decentralization, the results yet have to be tested in a number of ways. As the authors state, the study needs to be further tested with more flexible functional forms of cost structure; however, such functional forms have been limited due to the limited number of observations and measures of input costs. In addition, the results from this study may not be generalized to other levels of schooling. For example, Lockheed and Zhao (1993) estimate the effect of variables such as the relative influence of the central authority compared to the school principal's on the school's organization; the principal's and teachers' influence on the curriculum and selection of students; and community involvement variables. They find that the extent of school decision-making has no positive effect on student learning in secondary schools in Philippines.

Studies on locally provided education in the United States have concentrated on the study of the impact of school choice on education outputs. Locally provided education in the United States has provided parents to be able to exercise school choice by moving into another school district or to private schools. This type of choice is often

referred to "voting with your feet" which substantially raises education productivity, according to recent studies. Hoxby (2000)[21] analyzes the effects of public school choice by looking at 6,523 metropolitan school districts in the United States. By looking at the "market concentration" in each metropolitan area and holding other factors constant, Hoxby intended to isolate the effect that public school choice had on school productivity. In order to test whether increased public school choice had any effect on school productivity, Hoxby used data from the U.S. Department of Education's "National Educational Longitudinal Survey," and the U.S. Department of Labor's "National Longitudinal Survey of Youth." The study finds that a statistically significant amount of the variation in American students' achievement is explained by Tiebout choice. In other words, if all other things were equal, students in areas with extreme Tiebout choice (i.e., Boston) would be expected to score one-quarter to one-half of a standard deviation higher on achievement tests than an identical student in an area with no Tiebout choice (i.e., Miami).

Given the different results of regional provision of education and school choice in the United States and other countries, the impact of decentralization of education to regional or local governments and whether it improves the output of education still remains an open empirical question. Most of the recent literature on education decentralization has gone beyond the study of education provided at the regional and local level, but instead has concentrated on the analysis of school-based management and community participation in management.

[21] For further studies on School Choice and Student Performance see Stevans and Sessions (2000).

Education Decentralization to the School Level–School-Based Management

School-based management is a management framework which devolves decision-making to schools to enable them to make school-based policies to better meet students' needs and to improve learning outcomes. The argument for school-based management states that actors who have the best information about schools needs are best able to make appropriate decisions about the use of resources and teaching methods. While the current literature abounds with empirical studies of school-based management, we review some of the most renowned case studies.

In Nicaragua, decentralization reform gives public schools greater autonomy by shifting responsibility for key areas of decision-making in education from the Ministry of Education directly to the schools themselves. The reform gives considerable decision-making power to participating schools in areas of administration, finance, and pedagogy. In 1991, councils were established in all public schools to ensure that the educational community, in particular parents, participate in making schools decision in different functions. Councils consisted of school principals, teachers, parents and students, and decisions were reached by voting.

King and Ozler (2000) examine the impact of Nicaragua's school autonomy reform on learning within an education production function approach. Controlling for school and household inputs, the authors estimate the effect of local power of autonomy (decisions made by a council of principal, teachers, and parents) on learning in math and languages at the primary and secondary levels. The empirical evaluation assumes a linear functional form explained by student characteristics, household characteristics, teacher characteristics, school characteristics, dummies for urban or rural areas, regional

dummies, and type of school (private or private subsidized). The measure of school autonomy is measured in two ways: one is a dummy variable representing *de jure* autonomy, whether a public school has officially signed a contract with the Ministry of Education transforming it school council into a *Consejo Directivo*. The authors argue that *de jure* autonomy does not necessarily translate into greater autonomy. Some traditional schools are as autonomous in practice as the so-called autonomous schools. Moreover, some schools that are supposed to be autonomous (*de jure*) remain centrally controlled as some traditional schools. In order to differentiate between these schools, the authors develop another measure of autonomy called *de facto.* This second measure of school autonomy indicates the percentage of key decisions made by the school council rather than the central or local government.

The variable of *de facto* autonomy is derived from a questionnaire about the locus of decision-making for 25 school decision areas given to school principals and random samples of council members and teachers for each school in the sample. The variable is constructed as an index according to the importance of the decision on improving school quality. Among these decisions areas are: curriculum, hiring and firing teachers, planning and preparing the budget, and other functions.[22] One of the major issues encountered in this study is the endogeneity of school participation in the decentralization reform and the endogeneity of the number of decisions being made at the school regardless of autonomy status granted by the Ministry of Education. The endogeneity in this study arises from the possibility that the decision of making a school autonomous may be simultaneously determined with student achievement. Due to the availability of quantitative and

[22] For more detail on constructing the *de facto* autonomy variable see Appendix A in King and Ozler (2000).

qualitative measure in this study, the authors find significant instruments that determined de jure and de facto autonomy including size of school, director's characteristics, enrollment rates, and municipality education indicators.

King and Ozler find that autonomous public schools in Nicaragua are making more decisions about pedagogical and personnel matters than traditional public schools. Their education production function estimates show that *de jure* autonomy (measured as a dummy variable), has no statistically significant impact on student achievement (measured by standardized test scores). On the other hand, *de facto* autonomy (measured as an index on the locus of 25 school decisions) is positively and significantly related with student performance in primary schools, in particular, decisions related to hiring and firing personnel and their compensation. Moreover, they find that decentralization of pedagogical methods and curricular choices has no effect on student achievement, nor do teacher's influence on these decisions. As in the case of the EDUCO program in El Salvador, the authors find that teacher attendance also increased significantly due to the decentralization reform.

School Based Management (SBM) in the United States has become popular in the last decade. Chicago, for example, adopted a structure-based educational reform focusing on governance in 1988 and a content based reform in 1995 that focused on improving student learning. These reforms created elected parent-led school councils with power to hire and fire the school director. In addition, the school director works closely with the council to prepare and monitor school development plans. Directors were delegated power to increase discretion in allocating the budget, and increased control over curriculum decisions. The mayor of the city was also given control over a central district

school board and a corporate-style management team. The mayor, along with the council, was given the power to impose a sanction on poorly performing schools, and evaluating and dismissing principals. Byrk (1998) evaluates the performance of the SBM in Chicago with longitudinal case study data on 22 schools, survey responses from principals and teachers in 269 schools, and supplementary system-wide administrative data. The authors identify four types of school politics in this study: strong democracy; consolidated principal power; maintenance; and adversarial. Their findings suggest that an increase in local democratic participation has an impact on elementary reading and math test scores which showed consistent gains over the years. [23] At the same time, Wong (1998) notes that graduation rates for high school seniors improved in 1997 after the reform in 1995.

In a similar manner, a content based educational reform was initiated in Memphis in 1995, where the city granted autonomy to individual schools. Each school formed an advisory school council integrated by the director, teachers, parents, and community members. Each council had the objective of diagnosing needs in the school, agreeing on reforms, and monitoring progress in student learning. According to Winkler and Gershberg (2000) each school was required to adopt a school-based reform from eight different school restructuring models.[24] A study of the Memphis Restructuring Initiative (MRI) confirmed the Chicago results by finding significantly higher student achievement gains in experimental schools (those which undertook school-based management) than a group of control schools. This new study analyzes academic achievement focusing on a measure of "value added" assessments after three years of the MRI.

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[23] For example, a 19 percent gain in achievement for fifth graders was reported between 1992 and 1996.

Robertson and Briggs (1998) examine the impact of School-Based Management on improving schools in several states of the United States and provinces in Canada. Using data from twenty-two case studies of schools in four North American school districts,[25] the analysis is guided by a non-mathematical theoretical model that describes the process through which SBM can lead to school improvement. The authors argue that the SBM process should firstly improve the decision-making process in schools which will consequently enable for strategic and operational changes that build effective school culture. Each school case study was coded to assess the amount of change occurring in the five variables in the model: decision-making process; strategic and operational changes; school culture; individual behavior; and school quality. These variables were then rated either "high" or "low" according to the evidence provided on improvement of each variable. The method used in this study is of coding and analysis.[26] The analysis indicates that schools in the sample most frequently exhibited positive changes in two areas, decision-making process and school culture. Moreover, strategic and operational changes and individual behavior were less likely to undergo positive changes. Although the authors support the validity of the model, there are many issues with the data and methodology used. Some of these issues include the lack of information regarding staff behavior change, the analysis used does not allow for causality tests, and the assumption that improvement in school culture necessarily translates into school improvement.

As shown in empirical studies, the impact of school-based management on education output through evaluations in Nicaragua, Chicago and Memphis provide strong

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[24] Among these models are: increased school autonomy (pedagogic matters); common vision in school goals in school development plans; performance targets set between school director and central administration; teacher development activities at the school level, and monitoring of progress.
[25] Includes school districts in California, Kentucky, Virginia, and Edmonton and Alberta in Canada.

evidence that educational decentralization can improve learning. We now turn to the last form of education decentralization that we will review, community participation.

Education Decentralization and Community Participation

This type of education decentralization is based on the premise that persons who are not education professionals can govern schools effectively. The argument is that community participation in reform implementation ensures that policies match with the local preferences. According to World Bank (1995b), education output can be improved when schools are able to allocate resources according to local conditions and become accountable to parents and communities through their participation in school management.

School-based management shifts responsibility and power not only to school actors (principals and teachers) but also to communities, parents, and even students. Berhman and King (2001) state that greater parental involvement through participation in financing or through participation in school management committees is associated with better performance in schools.

In El Salvador, community-managed schools emerged during the 1980s when public schools could not be extended to rural areas because of the country's civil war. In 1991, El Salvador's Ministry of Education decided to draw on this prototype to expand preprimary and primary education in rural areas through the EDUCO program (Educación con la Participación de la Comunidad). At present, EDUCO schools are each managed autonomously by a community education association (CEAs) elected from

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[26] For more details on the method used refer to pages 40-43 in Robertson and Briggs (1998).

among students' parents, who are mostly rural workers who receive training by supervisors. CEAs enter into a one year renewable contract with the ministry, and the agreement outlines rights, responsibilities, and financial transfers. With the money directly transferred to them, CEAs select, hire, fire, and monitor teachers, in addition to managing schools funds and raising additional resources.

A study by Jimenez and Sawada (1999) assesses the EDUCO ("Education with the Participation of the Community") experience by comparing teacher absenteeism and student achievement in math and language in third grade students in EDUCO schools with that of traditional schools. By estimating school production functions using three measures of education outputs, the study uses an OLS regression method on student level test scores and days missed due to teacher's absence as dependent variables, and explanatory variables on household characteristics, school inputs and a dummy variable equal to 1 if the school is EDUCO and 0 otherwise. The study controls for student characteristics and selection bias (since EDUCO schools were not randomly selected) using an exogenously determined formula for targeting EDUCO schools as an instrumental variable. Jimenez and Sawada find no effect on students test scores due to EDUCO programs; however, they find that EDUCO schools, with their close community monitoring of the school, had fewer days of teacher absenteeism than traditional schools. They also find positively and statistically significant EDUCO participation effects based on increased coverage of education in rural areas; increase in enrollment for preschools and grades 1 and 3; better teacher attendance, performance and commitment; and improved interrelationships between the Ministry, schools, international organizations and communities.

Another study in El Salvador by Sawada (2000) utilizes a principal-agent framework to show that the parental associations (principal) can affect not only teacher's (agent) efforts and performance by imposing an appropriate incentive scheme but also school-level input through delegated school management. Sawada replicates the production function model from Jimenez and Sawada (1999) with alternative set of variables. Sawada estimates a teacher compensation function, teacher effort function, and input demand functions, based on the theoretical implications of the principal-agent framework. Sawada also empirically examines the effect of parents and community involvement on two measures of education outputs, standardized test scores in mathematics and language among 594 third-grade students from EDUCO and Traditional schools in 1996. Sawada finds that student performance is positively and significantly related to the number of visits by CEAs. Sawada's empirical results indicate that the degree of community participation positively affects the slope of the teacher's wage equation. Hence, teacher's effort level in the traditional schools is consistently lower than that in the EDUCO schools. Parental Associations are found to affect not only teacher effort and their performance by imposing an incentive scheme but also school level inputs by decentralized school management (CEAs).

The empirical results from Jimenez and Sawada (1999) and Sawada (2000) support the view that decentralization of education system should involve delegation of school administration and teacher management to the community group. However, while the authors mention that test score measures may be unresponsive to short-run changes in school governance, they could have alternatively measured education output as school enrollment over time to capture not only changes in access to education but also any time

effects in the implementation of the EDUCO programs. After all, one of the principal objectives for implementing the EDUCO program is to increase educational supply. Moreover, a more comprehensive measure of education decentralization in addition to the EDUCO dummy variable, such as decision-making functions delegated to CEAs and parental associations would have provided more insight about what functions to delegate to schools and community groups in the education process in order to raise student achievement.

The EDUCO model has developed into a major schooling model in the country where traditional schools now have more parent participation in school governance and management, and are more autonomous with the supporting block financing.

Conclusion

Overall the empirical literature on the impact of education decentralization, in its various forms, on education output in countries around the world show that there is no consensus on this effect. Case studies such those in El Salvador, Nicaragua, Chicago and Memphis provide strong evidence that education decentralization can improve education outputs. At the same time, however, other studies find that education decentralization may have no significant impact on education output, or negative effects such as increasing inequalities.

Nevertheless, the current literature makes it clear that the effect of education decentralization may be different depending on the country, on the type of decentralization reform, and on the method of measuring education output.

In this dissertation, we will improve upon the studies surveyed in at least three ways. First, we develop a comparative empirical study about the impact of education decentralization and education outputs across different countries. Next, we use different measures of education output in order to compare how the impact of education decentralization may differ depending on the chosen output indicator. Finally, we compare different measures of education decentralization, one based on traditional measures of education decentralization through sub-national share of education spending and the other based on a more comprehensive measure including the locus of decision making across different levels.

The next chapter develops a production function theoretical model of education that examines the effects of education decentralization in the production of education.

CHAPTER THREE

A MODEL OF EDUCATION DECENTRALIZATION

In the previous chapter, we examined the current state of the literature and different country experiences with education decentralization. We noted that the literature consistently emphasizes the direct and indirect effects of education decentralization (economic efficiency, transparency, accountability, responsiveness to service provision, better input management) on education output; however, these have not been thoroughly incorporated in a theoretical model.[27]

Theoretically, the impact of education decentralization on education output has been represented through principal-agent models, for example Holmes, DeSimone, and Rupp (2003), Otsuka, Chuma, and Hayami (1992), and Sawada (2000), which only capture the behavioral effect of the policy and not the technical efficiency changes. Martinez-Vazquez and McNab (2003) argue that when analyzing decentralization,

[27] Ozler (2001) develops a production function approach to education decentralization for Nicaragua. However, the model does not explore theoretically the efficiency gains of the reform with the use of economic theory. Prichett and Filmer (1997) propose a new positive theory of education spending based on technical and behavioral effects, however, it does not include education decentralization. Lastly, Jimenez and Paqueo (1996) investigate local contributions on the efficiency of public schools concentrating on the Philippines case. It develops a cost-minimizing structure that does no allow for behavioral effects.

representative agent models suffer a common fault by assuming that the preferences of a single individual (the representative agent) proxy for the aggregated preferences of all agents in the economy. They further argue that from a policy perspective the approach is flawed since after a policy change, the representative agent model assumes that the choice of the representative agent continues to coincide with the aggregate choice of all the agents in the economy. From a fiscal decentralization perspective, the authors argue that representative agent models do not capture the most important argument for decentralization, the potential gains in allocative efficiency resulting from sub-national governments' more closely matching the heterogeneous preferences of jurisdictions.

Other studies such as Ozler (2001), Pritchett and Filmer (1997), and Sawada (2000) have employed a production function approach; nevertheless, these models have not been fully developed to include the array of effects (direct and indirect effects) of education decentralization in the education process. Previous attempts using production function approaches have not demonstrated through economic theory the potential technical efficiency gains of education decentralization as well as the behavioral and organizational effects on the production of education output. Moreover, most previous studies have analyzed education decentralization reform in one single country, that is, developing a theoretical model applicable to the specific reform in that country. As it has been discussed previously, no two countries have applied the same form of education decentralization reform, hence, the need for developing a theoretical model that is adaptable to a comparative study of education decentralization reforms across countries. The significant advantage of using the production approach instead of the principal-agent model is that it allows the inclusion of the indirect effects of education decentralization

on the education production process and thus it allows us to examine the technical efficiency gains due to the reforms while it does not constraint preferences to be uniform. With this in mind, we now turn to developing a theoretical model to investigate the impact of education decentralization on education output.

The objective of this chapter is to present a theoretical model for framing the question of what is the impact of education decentralization on the hypothesized education output. The chapter is organized as follows. In the next section, we develop a theoretical framework of education based on a production function approach which links education decentralization to the production of education output. The third section presents a hypotheses framework for examining the impact of education decentralization on education output. We conclude the section and the chapter by specifying the testable hypotheses that form the foundation of the estimation equations that are discussed in Chapter Four.

The Theoretical Model

The production of education output results from the interaction of the behaviors of various agents who take part in the schooling process such as students, parents, teachers, and administrators at various levels. Even if agents do not take part directly in the educational system, they may still affect education outputs if they influence the environment in which students learn. Following Ozler (2001), Pritchett and Filmer (1997) and Sawada (2000), we employ a behavioral production function model that adds behavioral effects of education decentralization to a conventional production function

model. We further assume that the production function meets the conditions of a quasi-concave function.

We augment the model by assuming that education decentralization can directly affect education output and indirectly affect it through the different input channels. We assume that a social planner attempts to maximize a production function[28] for education output $O_{i,t}$ in country *i* in time *t* given by:

$$O_{i,t} = f(X_{i,t}, S_{i,t}, E_{i,t}, D_{i,t}) \tag{1}$$

where $O_{i,t}$ is output, $X_{i,t}$ is a vector of student and household inputs, $S_{i,t}$ is a vector of school-related inputs, $E_{i,t}$ is a vector of teacher's effort, $D_{i,t}$ is the level of education decentralization which is bounded between 0 and 1. We further assume that $O'_X, O'_S, O'_E > 0$ and $O''_X, O''_S, O''_E < 0$. We do not assume a direction in the sign of the cross partial derivatives between the input vectors. The production function is a conventional production function that incorporates behavioral effects to the production of education output.

With respect to the input factors included in equation (1), we assume that these (student and household inputs, school related inputs, and teacher's effort) are functions of, among other things, education decentralization as follows:

$$X_{i,t} = g(D_{i,t}, Z^1{}_{i,t}) \tag{2}$$

$$S_{i,t} = h(D_{i,t}, Z^2{}_{i,t}) \tag{3}$$

$$E_{i,t} = i(w_{i,t}, D_{i,t}, a_{i,t}, Z^3{}_{i,t}) \tag{4}$$

[28] No specific production function is specified in this model. Each country may have a different production function model. In general, a Cobb-Douglas production function is used in education production.

where $Z^{j}_{i,t}$ (j=1,2,3) are vectors of exogenous variables explaining the behavior of the three variables of interest. Additionally, $w_{i,t}$ is teacher's salary, and $a_{i,t}$ represents teacher's altruism.

Our production function in equation (1) states that, at any time in country i, the output of education is dependent upon student and household inputs, school inputs, teacher's effort, and the direct and indirect effects of education decentralization. Education output can increase if the level or quality of inputs increase, or, assuming the joint effect of education decentralization is positive when the level of education decentralization increases. On the other hand, education output can decrease if the level or quality of inputs decrease, or assuming the joint effect of education decentralization is negative when the level of education decentralization increases.

We note that education decentralization may affect education output through two channels, a potential direct effect on output, and a series of potential indirect effects. Taking the first-order derivative of equation (1) with respect to education decentralization we obtain

$$\frac{\partial O}{\partial D} = O'_{X.} X'_{D} + O'_{S.} S'_{D} + O'_{E.} E'_{D} + O'_{D} \tag{5}$$

where the subscript refers to the first-order partial derivative of the variable with respect to education decentralization. For simplicity, we exclude the country and time subscripts. Equation (5) above represents the marginal product of education decentralization, the additional output that can be produced by employing one more unit of education decentralization while holding all other inputs constant. We can observe in the above equation that decentralization may affect education output directly and indirectly through the vectors of student and household inputs, school-related inputs, and teacher's effort.

Given that education decentralization is bounded between zero (complete centralization) and one (complete decentralization), the marginal product of education decentralization depends on how much of it is used in the production of education. With respect to the education decentralization input, given that it is bounded, it may be possible for a country to use complete decentralization (or complete centralization) while keeping the amount of other inputs fixed.

Following general production function theory, we hypothesize that the marginal product of education decentralization may be positive or negative, depending on the country. We do assume, however, that there is an optimal level of education decentralization for which education output reaches a maximum value. This may be anywhere between zero and one (including 0 and 1), and it is the goal of this dissertation to calculate it empirically. Following equation (5) the impact of education decentralization on education output depends on the sign and the magnitude of the direct effect of education decentralization on output given by $O_D^{'}$ and the indirect effect of education decentralization on output through X, S and E.

We now turn to explaining intuitively the potential indirect effects that education decentralization may have on education output through each of the inputs in the production function model.

Education Decentralization and Student and Household Inputs

In our model, the vector of inputs from student and household characteristics $X_{i,t} = g(D_{i,t}, Z^1{}_{i,t})$ is a function that is determined by education decentralization $D_{i,t}$ and a vector of exogenous variables $Z^1{}_{i,t}$. We hypothesize that the effect of education

decentralization on student and household inputs can be positive or negative, depending on the type of policy implemented and on the institutional condition of the country at the time the education decentralization policy is implemented.

Recent literature on education decentralization, such as Behrman and King (2001), Filmer (2002), Jimenez and Paqueo (1996), Jimenez and Sawada (1999), Lobo et al. (1995), and Sawada (2000), argues that education decentralization may have a positive effect on education output if the policy reform is based on local financing, community participation, school-based management and other decentralization policies affecting student and household inputs. It is hypothesized that these education decentralization reforms affect household behavior through voice, participation, and school choice. Greater community participation and closer parent-school partnership through decentralization makes citizens feel as if they part of the education process which can lead to improvements in the home environment to learning and the allocation of household resources for education including those related with the time each child spends in school and learning at home, time each adult spends helping with homework, choice of school, and education related expenditures among others. In addition, school choice and local financing provides households with the opportunity to choose the school that their children attend, thus, they would choose the community that offers services that better match their preferences in education.

All of the above assumptions would increase the quantity and quality of our vector of student and household inputs. However, the assumptions above presume a world in which democracy works well, and the existence of institutions that would allow consumers to participate in the education process. In the absence of these conditions we

may find that decentralization in education may have a negative effect by increasing disparities in learning outputs, and disparities and inequality in expenditures (Elmore, Fuller, and Orfield 1996; Godwin and Kemerer 2002).

Education Decentralization and School-Related Inputs

With respect to the vector of school-related inputs in our production function,[29] $S_{i,t} = h(D_{i,t}, Z^2_{i,t})$ is a function that is determined by education decentralization $D_{i,t}$ and a vector of exogenous variables $Z^2_{i,t}$. We hypothesize that the effect of education decentralization on school related inputs can be positive or negative depending on the type of policy implemented and on the quality of governance and institutional conditions of the country at the time the education decentralization policy is implemented.

The literature on education decentralization emphasizes its effect on school-related inputs in the production function. Education decentralization reforms characterized by local funding, greater voice and community participation, greater local or school autonomy, and greater competition between schools, are hypothesized to result in reallocation of resources and a change in school agents' behavior.[30] In a centralized system of governance, school administrators are accountable not to parents and students but to the ministries of education. Since the costs of monitoring, inspecting and enforcing detailed procedures are often high, these ministries set norms of budgetary allocation for teachers and inputs. If these norms do not match the school's needs or the community's

[29] School related inputs may be variables related to resources provided by schools such as spending per pupil, pupil-teacher ratio, number of school days, books, etc.
[30] To see examples of studies that have found a positive impact of local financing, participation, autonomy on education see Filmer (2002), Jimenez and Paqueo (1996), Jimenez and Sawada (1999), King and Ozler (2000), and Hoxby (1994).

preferences, school administrators do not have the decision-making power or the incentive to change them. Thus, education decentralization through greater school autonomy and greater community participation may improve school-related inputs such as student-teacher ratio, class size, infrastructure, maintenance, and books, by focusing in cultural differences and learning environments, to better matching the needs of their constituents. Moreover, overlays of bureaucratic procedure would be diminished or eliminated that would otherwise occur in a more centralized system of governance.

In addition, it is argued that greater community participation would encourage parents and the community to participate in the education process by monitoring school performance and thus increasing accountability. If school principals behave differently due to an increase in monitoring and accountability, then education inputs from teachers and organization will improve. Schools that are financially accountable to the communities they serve may be more responsive to their clients. School management would be accountable to school councils and parents on student performance, thus, affecting the quality of organization and management of schools.

Lastly, if education decentralization introduces competition between schools such that households can "vote with their feet" (Tiebout 1956) by selecting the community and school in which they live, the threat to move imposes competition on governmental units and schools. Theoretically, this competition forces them to be more efficient in supplying goods and services out of taxes. Thus, education decentralization would not only affect the quality of inputs, but it would also encourage for new innovative organizational and teaching methods provided in schools.

Nevertheless, the above arguments are based on the assumption that governance capacity of the receiving institution is at least as efficient as the central government to run the program, and that the central government is unable to match the preferences of the median-voter of each jurisdiction, and that citizens can easily move between localities.[31] In addition, if financial and administrative responsibility to local politicians or school administrators increases rent-seeking activities, or results in poor allocation of resources due to lack of institutional capacity, or externalities are spilled over, or there are diseconomies of scale, then education decentralization would adversely affect the allocation of school-related inputs.

Education Decentralization and Teacher Effort

In our model, teacher effort $E_{i,t} = i(w_{i,t}, a_{i,t}, D_{i,t}, Z^3{}_{i,t})$ is a function of teacher's salary $w_{i,t}$, teacher's altruism $a_{i,t}$, education decentralization $D_{i,t}$, and a vector of exogenous variables $Z^3{}_{i,t}$. We further hypothesize that education decentralization may have a positive or negative effect on teacher's effort.

Education decentralization that results in changes in management and organization, decision-making authority related to teachers, and voice and participation of parents and the community, is argued to affect teacher-related inputs in the education process. In a centralized system of education, the ministry of education determines teacher standards and qualifications, training programs, control recruitment, promotion, leave, transfers, discipline, and lines of communication among others. Yet, it can be very

[31] For examples of competition positively influencing education outcomes see Hoxby (1994), Hoxby (2000), Ritzen, van Dommelen, and De Vijlder (1997).

costly for the central government to provide pedagogical support, supervision, and teachers' recruitment that match the needs of a specific area or school; as well as to inspect and monitor teacher's performance, working conditions, promotions and discipline. Recent literature on education decentralization argues that teacher management and school autonomy that is closer to the schools and the community positively affects the level of teacher-related inputs.[32] Local governments and schools can be more responsive to the recruitment of teachers with certain qualifications required in a school. Moreover, teacher support and training can be targeted to fulfill those areas where there are known deficiencies in teachers' education and experience. Education decentralization may directly influence teacher inputs, such as imposing a mandatory training and rewarding education advancement. On the other hand, it is argued that some local governments and schools may be unable to hire qualified teachers in the local labor market, or are not capable to locally bargain teacher's salaries. In this case, greater decision-making on teacher management at the local level would not improve the level of teacher-related input. However, the argument is not about decentralizing all functions in the education process, but to find the right balance between centrally managed decisions and local autonomy.

Sawada (2000) finds that teacher's effort levels in the traditional centrally-managed schools are consistently lower than that in the community-managed EDUCO schools. A teacher that puts more effort into the learning process of students is more likely to improve his/her teaching methods, and in turn improve learning output. Ozler (2001) states that the promise to pay teachers a certain wage and to provide certain

[32] For reference related to teacher management and teacher incentive programs see Gaynor (1998), Jimenez and Paqueo (1996), King and Ozler (2000), and Sawada (2000).

benefits is legally enforceable, but the teacher's commitment to provide a certain level of effort is not. Therefore, teachers' effort depends on the different factors and incentives that affect their effort level. In our model, we assume that teacher's effort level is an increasing function of salary received, teacher's altruism, and other exogenous variables. First, teacher's effort level depends on the salary and payments received. Rewarding teachers for their work with a sufficient wage plays an important role in keeping teacher's motivated to do a good job. Wages should also be sufficient so that teachers would prefer to keep their jobs given the alternatives available. Recent studies argue that incentive payment schedules based on performance positively affect teacher's effort level.[33] Second, teacher's effort is a function of teacher's altruism, which is based on "personal responsibility." The greater teachers' own motivation and commitment to the learning process, the greater the quality of teacher-related inputs.

With respect to the effect of education decentralization on teacher's effort, we hypothesize that the impact may be positive or negative depending on whether certain conditions are met. Education decentralization that provides community and parental participation, school autonomy, and decision-making to hire and fire teachers to school directors are likely to affect the level of monitoring and thus affect teacher's effort level. When parents and local community become part of the education process, monitoring of teacher's performance increases. Teachers that are constantly monitored by parents and the community are more likely to become accountable for student's performance, thus, teachers would increase their effort level at improving their teaching quality. Moreover, if

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[33] Jacobson (1998) in a study in the United States concluded that the implementation of an incentive plan that monetarily rewarded high rates of teacher attendance was accompanied by a significant reduction in teacher absences.

local councils and school director have the decision-making power to hire and fire, teachers fear not having job stability and they similarly increase their effort level at improving their teaching quality.[34] In order for a system of monitoring to be successful, it should be credible (i.e., sanctions should be enforceable) and the information available regarding teacher productivity should be accurate. Thus, sanctions enforcement, performance monitoring, and community involvement determine whether education decentralization would positively affect teacher's effort level, which in turn affects teacher's direct input.

On the other hand, if schools and local community and parent's associations are not committed at monitoring teacher's performance, or if corruption converts the hiring and firing of teachers into a rent-seeking opportunity, then education decentralization would not be successful at improving teachers' effort levels and at improving the teacher-related inputs.

The Optimization Problem

The principal goal of the social planner is to find optimal levels of input variables and the level of education decentralization that maximizes education output given by:

$$O_{i,t} = f(X_{i,t}, S_{i,t}, E_{i,t}, \bar{D}) \tag{6}$$

[34] See Sawada (2000).

where we assume that each country has an initial level of education decentralization $\bar{D}$, and the problem is to maximize the input variables $X_{i,t}, S_{i,t}, E_{i,t}$ subject to a fixed budget constraint given by:

$$P_i(X_{i,t}, S_{i,t}, E_{i,t}) \leq \overline{B} \tag{7}$$

where we assume that costs are related to the input variables and there is no cost to adjust the level of education decentralization.[35] We set up the Lagrange expression as follows:

$$\text{L} = f(X_{i,t}, S_{i,t}, E_{i,t}, \bar{D}) + \lambda[\overline{B} - P_j(X_{i,t}, S_{i,t}, E_{i,t})] \tag{8}$$

setting the partial derivatives of L equal to zero, with respect to each of the variables we wish to optimize, namely $X_{i,t}, S_{i,t}, E_{i,t}$ (for simplicity we disregard the subscripts), yields the equations representing the necessary first order conditions for an interior maximum.[36] The first three of these imply:

$$\frac{O_X^{'}}{O_S^{'}} = \frac{P_X^{'}}{P_S^{'}} \tag{9}$$

$$\frac{O_X^{'}}{O_E^{'}} = \frac{P_X^{'}}{P_E^{'}} \tag{10}$$

$$\frac{O_S^{'}}{O_E^{'}} = \frac{P_S^{'}}{P_E^{'}} \tag{11}$$

Equations (9-11) are precisely the first-order condition for a constrained maximum, the critical point for the function L. When costs are at a minimum, the extra output obtained from the last dollar spent on an input must be the same for all inputs. Whenever the ratios of the marginal products to inputs prices differ across inputs, it will always be possible to

[35] Country experiences indicate that there may be significant costs related to initially implementing decentralization, and that it may be more expensive in developing countries. However, for simplicity, we assume that costs related to adjusting the level of education decentralization beyond some initial cost is zero.

make a cost-saving substitution in favor of the input with the higher marginal product per dollar ratio. We can make a similar interpretation by defining the ratios on the left-hand side of equations (9-11) as the marginal rate of technical substitution, which must be equal to the relative prices of inputs.[37]

The equations can be solved for X^*, S^*, E^*. Such a solution will have two properties: (i) the optimal values X^*, S^*, E^* will obey the budget constraint; and (ii) among the values of X^*, S^*, E^* that satisfy the constraint will make L (and hence $O_{i,t}$) as large as possible. Sufficient conditions for these equations to represent a relative maximum are that the second partial derivatives are less than zero, or negative. Assuming that the second-order conditions are met, the implicit function theorem applies and assures that each X^*, S^*, E^* is a function of the parameter $\bar{D}$. Therefore, we obtain:

$$X^*_{i,t} = X^*_{i,t}(D) \tag{12}$$

$$S^*_{i,t} = S^*_{i,t}(D) \tag{13}$$

$$E^*_{i,t} = E^*_{i,t}(D) \tag{14}$$

where X^*, S^*, E^* denote the minimum-cost optimal values of $X_{i,t}, S_{i,t}, E_{i,t}$ when D is given**.**

How does the optimal level of Education Decentralization affect Education Output?

Our model assumes that the parameter D, which is bounded between 0 (complete centralization) and 1 (complete decentralization) affects education both directly and

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[36] See theoretical Appendix B for a more detailed derivation of equations.
[37] Marginal Rate of Technical Substitution (MRTS) is the rate at which one input can be exchanged for another without altering the total level of output.

indirectly. Given an initial level of D, countries maximize output by choosing the optimal values X^*, S^*, E^*. By substituting these optimal values into our original objective function of education output (equation 6) yields an expression in which the optimal value of $O^*_{i,t}$ depends on the parameter D both directly and indirectly through the effect of D on the input variables X^*, S^*, E^*. Assuming that there is no cost to adjust the level of education decentralization, we have the following:

$$O_{i,t} = f(X^*_{i,t}(D), S^*_{i,t}(D), E^*_{i,t}(D), D_{i,t}) \tag{15}$$

Differentiating the above equation with respect to D yields:

$$\frac{dO}{dD} = \frac{\partial f}{\partial X^*} \cdot \frac{dX^*}{dD} + \frac{\partial f}{\partial S^*} \cdot \frac{dS^*}{dD} + \frac{\partial f}{\partial E^*} \cdot \frac{dE^*}{dD} + \frac{\partial f}{\partial D} \tag{16}$$

where changes in the value of O are brought about by changing the parameter D. For any change in the level of decentralization, the inputs $X_{i,t}, S_{i,t}, E_{i,t}$ are assumed to be adjusted to their optimal values. The expression in equation (16) indicates that a change in the level of decentralization affects education output through a direct effect given by $\frac{\partial f}{\partial D}$ and indirect effects given by all the other parameters, the sign and the magnitude of this effect and the indirect effect through each channel is unknown. Thus, the overall effect of a change in education decentralization is determined by the aggregate effect (both direct and indirect) of education decentralization on output.

As we indicated in the previous chapter, the goal is to find the optimal balance between centralized and decentralized responsibilities and decision-making that maximizes education output. Therefore, countries may adjust their level of decentralization over time as they learn by doing until they reach an optimal level of

decentralization that maximizes the output of education systems. Thus, we assume that there is an optimal level of D, say D^*, at which countries find the right balance of centralized and decentralized responsibilities across government, and where output reaches its maximal value, O^*, given by:

$$O^*_{i,t} = f[X^*_{i,t}(D^*), S^*_{i,t}(D^*), E^*_{i,t}(D^*), D^*] \quad (17)$$

In general, for any initial level of education decentralization $D^0_{i,0}$ such that $D^0_{i,0} \neq D^*_{i,t}$, the goal is to find the optimal level of education decentralization $D^*_{i,t}$ that provides the input combination that yields the highest possible output. We have assumed that technical efficiency is the social planner's objective regardless of the level of education decentralization. Therefore, when a country reaches the optimal level of education decentralization (the right balance of decision-making between levels of government and organizational units), output quantity will achieve its maximum value for a given fixed budget.

In the same manner, if education decentralization results in inefficient allocation of resources, rent-seeking activities, politically corrupt processes, local capture, or if a country changes the level of education decentralization away from the optimal level, then education decentralization may have a joint negative effect in the production process having a negative impact on output.

The Hypothesis Framework

We now develop the empirical hypotheses that will be tested in Chapter Four. The question of the relationship between education decentralization and education output is

based on a joint effect (direct and indirect) that arise from the direct relationship between education decentralization on education output and the indirect relationship between education decentralization and student and household inputs, school inputs, and teacher inputs. We develop the following hypotheses resulting from the theoretical framework developed in this chapter:

Hypothesis One: All else being equal, a change in the level of education decentralization $D_{i,0}^{O} - D_{i,t}^{1} \neq 0$ may lead to a change in the level of education output as measured by enrollment rates, dropout rates, repetition rates, completion rates and test scores.

Hypothesis Two: All else being equal, a change in the level of education decentralization $D_{i,0}^{O} - D_{i,t}^{1} \neq 0$ influences student and household characteristics, which in turn influence school output.

Hypothesis Three: All else being equal, a change in the level of education decentralization $D_{i,0}^{O} - D_{i,t}^{1} \neq 0$ influences school related inputs, which in turn influence school output.

Hypothesis Four: All else being equal, a change in the level of education decentralization $D_{i,0}^{O} - D_{i,t}^{1} \neq 0$ influences teachers' effort, which in turn influence school output.

We use the four testable hypotheses developed in this section to examine the effect of education decentralization on education output. Given that education decentralization may positively or negatively influence education output according to whether the system moves towards or away from the optimal level of education decentralization, we reserve this determination to the empirical analysis.

Concluding Thoughts from the Theoretical Analysis

In summary, we have determined that there potentially exists a direct and indirect effect of education decentralization on education output. The magnitude and the size of the total effect of education decentralization on education output in the long run is theoretically indeterminate due to some potential channels through which this effect is transmitted. In our model, we examined three potential transmission channels–student and household inputs, and school and teacher inputs. This theoretical ambiguity in the effect of education decentralization justifies the case for empirical analysis.

Further, we show that over time there is an optimal level of education decentralization that would maximize education output for given optimal levels of other education inputs. Therefore, there may be countries that are either above, below, or at the optimal level of decentralization. It is our goal to estimate the optimal level of education decentralization empirically.

Lastly, the literature suggests that there may be differences on the hypothesized impact of education decentralization on education output depending on the way that these are measured. We therefore test for the alleged differences in the effect by comparing different methods of measurement used.

In Chapter Four, we develop the empirical framework within which we will test the hypotheses developed in this chapter.

CHAPTER FOUR

EMPIRICAL METHODOLOGY

In Chapter Three we developed a behavioral production function model of education that included potential direct and indirect effects of education decentralization in the production of education. Based on this theoretical model, the objective of this chapter is to develop an empirical methodology for analyzing various aspects of the effect of education decentralization on education output. The objective is to analyze empirically the marginal impact of education decentralization on several indicators of education output. Using several indicators of education output allows us to examine whether there is an effect of education decentralization on each of these indicators, and what the magnitude of the effect is. If the empirical findings are consistent across different proxies for education output, then we have more evidence to support the effect.

Using both the traditional measure of education decentralization and a more comprehensive measure of education decentralization allows us to explore the influence of education decentralization through its fiscal dimension and its decision-making autonomy dimension. As previously indicated, we will do a sub-sample regression analysis for OECD countries where education decentralization is measured not only through its fiscal dimension but also through a measure of decision-making in education at various levels of government.

In the following section, we discuss the data sources that are used for the estimations reported in Chapter Five. In the third section of this chapter, we develop the empirical framework and specify the estimation equations that are used to test the hypotheses about the impact of education decentralization on education output developed in Chapter Three. In this section we discuss the two-way error components model for unbalanced panels as well as the fixed and random effects models. Then, we present the specification of the estimation equations that we will use in Chapter Five to estimate the influence of education decentralization on education output. We conclude the chapter by briefly discussing the potential econometric problems that may adversely affect the estimation of the testable hypotheses, and we introduce the instrumental variable/two-stage least-squares estimation approach.

Data Description and Sources

In our empirical estimation we employ an unbalanced panel data set of fifty nine countries covering the period 1970-2004 in five-year intervals. Details on data categories and sources are provided in the following subsections. The definitions and the summary statistics of all variables are presented in Appendix C.

Education Output Data

The measurement of education output continues to be a center of debate among researchers in the education and decentralization literatures. Various measures of education output have been used in comparative and specific country studies. Most of

these are driven by issues of data availability and international standard measures of education output. For years, studies have measured education output by the ratio of enrollment rates, dropout rates, repetition rates, completion rates, and test scores, all of which we use in this dissertation.[38] Data on dropout and repetition rates were obtained from Barro and Lee's *International Measures of Schooling Years and Schooling Quality Dataset*, for years 1965-2000, and updated by the World Bank's comprehensive *Online Database of Education Statistics* (EDStats).[39] Variables on net enrollment rates and completion rates were obtained from the *World Bank's World Development Indicators,* 2005 CD-ROM, and updated with the Organization for Economic Co-operation and Development (OECD) *Education Online Database,*[40] and the World Bank's comprehensive *Online Database of Education Statistics* (EDStats).

Often, education output has been measured by nationally administered test scores in mathematics, language, and science. If the purpose is to perform a comparative study across countries, data availability and standard examination of students is very limited. Since 1959, the International Association for the Evaluation of Educational Achievement (IEA), the International Study Center (ISC),[41] and the Organization for Economic Co-operation and Development (OECD)[42] have conducted comparative studies in educational achievement. These studies contain educational variables in different subjects (reading, math and science) and age groups (9-10, 13-14, and the last year of secondary school). Each test uses a common assessment questionnaire that reflects the curricula of

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[38] For an overview of these studies see Mahal, Srivasta and Sanan (2000); Lobo et al. (1995); Prawda (1993b).
[39] For Barro and Lee's data set see http://www.cid.harvard.edu/ciddata/ciddata.html and for World Bank's online data see http://www1.worldbank.org/education/edstats (accessed September 2006).
[40] See http://www1.oecd.org/scripts/cde/members/EDU_UOEAuthenticate.asp (accessed September 2006).
[41] For an overview of studies performed by IEA and ISC, see http://isc.bc.edu (accessed September 2006).
[42] For an overview of PISA surveys, see http://www.oecd.org (accessed October 2006).

all participating countries. While these data are very useful in educational research, they are very limited for comparative studies since not all the same countries have participated in all studies. Until 1995, from studies directed by IEA only two countries (England and the United States) had taken part in every large-scale comparison of achievement in mathematics and science.[43] New surveys from the International Association for the Evaluation of Educational Achievement (IEA) such as *Trend's in Mathematics and Science Study* (TIMSS) and OECD's *Program for International for International Student Assessment* (PISA) have been improved and will be repeated every three years. In this dissertation, we hope to evaluate a sub-sample of countries using test scores as a measure of output. Data on test scores was obtained from Barro and Lee's *International Measures of Schooling Years and Schooling Quality Dataset,* and updated with test score results from PISA and TIMSS recent survey results.[44] Considering that in this study we evaluate the outcomes of education decentralization on primary level education, we only evaluate test scores for 9 and 10 year-olds (age at the end of primary school). Considering that science tests have been most frequently performed in this age group, we evaluate science test scores for 9 and 10-year olds as follows: First International Science Study (FISS) for 1970; Second International Science Study (SISS) for 1985; International Association for the Evaluation of Educational Progress (IAEP 2) for 1990; Third International Mathematics and Science Study (TIMSS-95) for 1995; and the Trends in International Mathematics and Science Study (TIMSS-03) for 2004. Scales range from 0 to 1000, with a mean of 500 and standard deviation of 100. For comparability of data we transformed all data to percentage form.

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[43] See Appendix C, Table C.6 for a list of comparative international tests.

Education Decentralization Data

The measurement of decentralization of education continues to be a hot topic of debate among researchers. This debate is induced in part by the complexity of the concept but also by the lack of data necessary to develop a complete measure that would effectively capture all the decision-making functions, and the responsibility and authority of different government levels in the education system. In general, decentralization has been measured as the level of government at which revenue and expenditure responsibility in education occurs.[45] Alternatively, recent studies have measured different forms of education decentralization with dummy variables.[46] For example, they have measured education decentralization as dummy variable equal to 1 for schools with community participation, schools with voucher systems, charter schools, and others.[47]

Ideally, we would wish to construct a panel data measure of education decentralization that would effectively quantify the activities of sub-national governments resulting from independent decision making. For example, activities that are under the control of sub-national governments, even if funded by the central government, would be classified as a sub-national government activity. However, constructing such a measure would require information on grants and transfers between various levels of government, whether these grants and transfers are under the control of the central or recipient level of government, or if the grants are conditional, block, or lump-sum.

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[44] For PISA test results see http://www.pisa.oecd.org, for TIMSS test results see TIMSS and PIRLS International Study Center at http://timss.bc.edu (accessed June 2006).
[45] For an example see Thomas (2001).
[46] For example, Galiani and Schargrodsky (2002) measures decentralization as a dummy variable that equals unity if school j in period t is administered by the national government. Ozler (2001) measures education decentralization in Nicaragua as dummy equal to 1 if the school presents de facto decentralization.

Unfortunately, the primary data source for public sector revenues and expenditures, the International Monetary Fund' Government Finance Statistics (GFS), does not contain detailed information regarding grants and transfers to develop the ideal measure of education decentralization. This lack of available information leads to a fiscal dimension measure of education decentralization as the ratio of total sub-national expenditures in education to general government expenditures in education.[48] The IMF functional categories include consolidated education expenditures, state/regional education expenditure, and local government education expenditures.

The weakness in defining education decentralization as the ratio of sub-national government expenditures in education is that it does not capture the extent of sub-national government autonomy in decisions about expenditure in the delivery of education services. In order to fill this gap in our fiscal measure of education decentralization, we complement the fiscal dimension measure with a measure of decision-making autonomy of sub-national governments (state/regional and local) and organizational units (the schools), by the percentage of decisions in education functions that are taken at each level of government and the school level. This data, however, are only available for specific countries (mainly OECD) and for limited time spans. Yet, their use represents, we think, a positive contribution to achieving a better measure of decentralization in education.

Data on decision-making autonomy is available for fourteen countries in 1990-1992 from Meuret, Prod'hom, and Stocker (1995) and for thirty countries from the

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[47] See Jimenez and Sawada (1999).
[48] General government expenditures are equal to the expenditures of the consolidated central government (budgetary central government, extra-budgetary funds, and social security) and the expenditures of sub-national governments.

Organization for Economic Co-operation and Development publication, *Education at a Glance,* Annual Reports *1998 and 2003(Organisation for Economic Co-operation and Development 1998, 2004).* Because our input measures are available for five-year intervals, we matched the inputs measures with decision-making data to the nearest year to which it is available. Therefore, data from 1998 is matched with data in year 1995 and data from 2003 is matched with data in 2004. Due to limited data availability on decision-making in education functions, this dissertation tests the posed hypotheses by using a sub-sample of mainly OECD countries according to the availability of information. This approach, we believe, will provide some useful information regarding the effect of decision-making at different levels of government on education output.

Based on OECD methodology, our indicator of decision making in education functions are based on decisions on four domains or categories: organization of instruction, personnel management, planning and structures, and resources. Therefore, the percentage of decisions taken at a particular administrative level (central, intermediate, local or school) can be interpreted as a measure of the importance of that particular level for decision-making in that education function. Table 2 presents the percentage of decisions relating to public sector education taken at each level of government, where the sum of decision across levels sum to 100 percent.[49] From the table, we can see that central government is dominant in Portugal, Turkey and Uruguay; regional decision-making is predominant in India and Argentina; local decision-making is important in France and the United States; and the school level is particularly important in decision-making in Finland, New Zealand and Norway.

[49] In our dataset, when we refer to decisions taken at the sub-national level refers to decisions taken at levels other than the central government level.

Table 2. Percentage of decisions relating to public sector education taken at each level of government

	1990					1998					2003				
Country	**Cent**	**Int**	**Loc**	**Sch**	**Total**	**Cent**	**Int**	**Loc**	**Sch**	**Total**	**Cent**	**Int**	**Loc**	**Sch**	**Total**
Argentina	-	-	-	-		3	68	0	29	100	-	-	-	-	
Australia	-	-	-	-		-	-	-	-	-	0	76	0	24	100
Austria	28	26	8	38	100	35	18	22	25	100	0	76	0	24	100
Belgium	0	25	50	25	100	1	73	0	26	100	26	22	23	29	100
Chile	-	-	-	-	-	7	3	54	36	100	-	-	-	-	-
China	-	-	-	-	-	21	3	30	46	100	-	-	-	-	-
Czech Republic	-	-	-	-	-	17	21	10	52	100	0	57	0	43	100
Denmark	15	0	44	41	100	26	0	43	31	100	7	1	32	60	100
Finland	13	0	47	40	100	0	0	64	36	100	11	0	4	85	100
France	33	36	0	31	100	33	38	0	29	100	2	0	71	27	100
Germany	7	18	42	33	100	4	43	16	37	100	24	45	0	31	100
Greece	-	-	-	-	-	55	22	0	23	100	4	47	17	32	100
Hungary	-	-	-	-	-	0	0	35	65	100	80	4	3	13	100
Iceland	-	-	-	-	-	-	-	-	-	-	3	0	29	68	100
India	-	-	-	-	-	0	91	0	9	100	-	-	-	-	-
Indonesia	-	-	-	-	-	63	7	0	30	100	-	-	-	-	-
Ireland	19	0	8	73	100	47	0	0	53	100	-	-	-	-	-
Italy	-	-	-	-	-	39	25	3	33	100	25	0	50	25	100
Japan	-	-	-	-	-	-	-	-	-	-	23	16	15	46	100
Jordan	-	-	-	-	-	65	0	19	16	100	-	-	-	-	-
Korea, Rep.	-	-	-	-	-	37	38	0	25	100	12	21	44	23	100
Luxembourg	-	-	-	-	-	-	-	-	-	-	10	34	8	48	100
Malaysia	-	-	-	-	-	82	0	0	18	100	-	-	-	-	-
Mexico	-	-	-	-	-	-	-	-	-	-	66	0	0	34	100
Netherlands	-	-	-	-	-	24	0	3	73	100	31	47	0	22	100
New Zealand	29	0	0	71	100	34	0	0	66	100	0	0	0	100	100
Norway	23	0	45	32	100	36	0	55	9	100	25	0	0	75	100
Paraguay	-	-	-	-	-	67	0	0	33	100	-	-	-	-	-
Philippines	-	-	-	-	-	37	24	0	39	100	-	-	-	-	-
Portugal	57	3	0	40	100	69	7	0	24	100	31	0	32	37	100
Slovak Republic	-	-	-	-	-	-	-	-	-	-	51	8	0	41	100
Spain	33	13	26	28	100	3	56	0	41	100	33	2	15	50	100
Sweden	4	0	48	48	100	12	0	22	66	100	0	72	0	28	100
Switzerland	0	50	40	10	100	-	-	-	-	-	-	-	-	-	-
Thailand	55	0	0	45	100	55	-	-	45	100	-	-	-	-	-
Turkey	94	0	0	6	100	94	-	-	6	100	-	-	-	-	-
Turkey	-	-	-	-	-	-	-	-	-	-	17	0	36	47	100
United Kingdom	-	-	-	-	-	14.5	0	34.5	51	100	18	0	38	44	100
United States	0	3	71	26	100	0	2	69	29	100	-	-	-	-	-
Uruguay	-	-	-	-	-	100	0	0	0	100	-	-	-	-	-

OECD further provides data on decision making in education by domain. For example, we have data on the percentage of decisions taken at each level of government

for organization of instruction, personnel management, planning and structures, and resource, where the percentage of decisions across levels of government sum to 100 for each domain.

Other Explanatory Variables

On the basis of our theoretical model of the production function for education, it is necessary to identify and measure the education inputs that take part in the production of education. Since this dissertation is a comparative study across countries at the aggregate level, then we also need information at the aggregate level on countries' school resources, and household characteristics. We use input measures of school resources that include pupil-teacher ratios, real public educational spending per student, salaries of teachers, and length of the school year obtained from Barro and Lee's *International Measures of Schooling Years and Schooling Quality Dataset*, for years 1965-2000, and updated by the World Bank's comprehensive *Online Database of education statistics* (EDStats). Our measures of family factors include GDP per capita, as a proxy for parents' income; parents' education level measured through the average years of primary schooling in the population 25 and over; and fertility rate as a proxy for the average number of children in a household which proxies for the amount of time that parents would dedicate to their children. The data on GDP per capita and fertility were obtained from the *World Bank's World Development Indicators,* 2005 CD-ROM, and the proxy for parents' education was obtained from Barro and Lee's *International Data on Educational Attainment: Updates and Implications* dataset on education attainment across countries.[50]

[50] Data were obtained from http://www.cid.harvard.edu/ciddata/ciddata.html (accessed August 2004).

Additionally, we use demographic and governance control variables obtained from the *World Bank's World Development Indicators,* 2005 CD-ROM and Freedom House's *Survey of Freedom 2003,*[51] including population density, rule of law, political rights, civil liberties, and corruption. In analyzing education decentralization, it is important to consider governance indicators since the argument for decentralization presumes a world in which democracy works well, and in which all externalities are captured locally.[52]

Empirical Models

Empirical studies about education decentralization and education output in general have been country-specific examinations. Comparative studies across countries have not been common, except for studies that investigate schooling output without investigating the impact from decentralization.[53] In particular, we are not aware of any panel data study across countries in the literature that examines the impact of education decentralization on education outputs in various countries. Education decentralization and many other policies are processes that occur over time, results such as any improvement on education outputs may occur also only over time, and even some distance away from the time of reform implementation. Thus, we believe that the use of panel data is more appropriate to the question of the influence of education decentralization on education output, since cross-sectional analysis may result in incorrect inferences as to the nature of

[51] For an overview of the SOF, see http://www.freedomhouse.org/ratings/index.htm (accessed May 2006).
[52] Winkler and Gershberg (2000).
[53] Examples of panel data studies of schooling output include Heyneman and Loxley (1983), Hanushek (1995), Hanushek and Kimko (2000), and Lee and Barro (2001).

education decentralization. In this section we first discuss the general form of the two-way error components model, and we then develop the estimation equations for each of the testable hypotheses.

In our model of estimating the impact of education decentralization on education output, it is likely that numerous unobservable individual country factors will be present. These factors among others include student capacity, teachers' altruism, and parents' encouragement in a certain country, which significantly influence the education process of students. These unobservable factors can be classified as those that vary across countries but not across time, those that vary across time but not countries, and those that vary across countries and time. In addition, the data set is an unbalanced sample where the number of time-series observations for each country in the sample is less than or equal to *T*, where *T* is the maximum number of time-period observations in the sample.

Following Hsiao (1986) and Baltagi (1995), the general form of the unbalanced two-way error components panel data model is

$$Y_{i,t} = X_{it}^{'}\beta + u_{it} \qquad i = 1,...,N_t \qquad t = 1,...,T \tag{22}$$

where *i* denotes countries and *t* denotes time. If the sample were balanced, *i* would range from 1 to *N*, where *N* is the number of countries in the sample. However, the sample is unbalanced and *i* ranges from 1 to N_t, where ($N_t \leq N$) is the number of countries observed in year *t* and we can define the total number of observations as $n = \sum^t N_t$. Following Baltagi (1995), we can decompose the error term u_{it} as follows

$$u_{it} = \mu_i + \lambda_t + \nu_{it} \qquad i = 1,...,N_t \qquad t = 1,...,T \tag{23}$$

where μ_i denotes the unobservable country specific effect, λ_t is the unobservable time effect and ν_{it} is the remainder stochastic disturbance term. λ_t is country-invariant and it

accounts for any time specific effect that is not included in the regression. For example, it could account for any shock that occurs over time which could affect education output. If we explicitly assume that the country and time specific effects are jointly equal to zero, then the most efficient method of estimation is to pool all the countries in the sample. Additionally, we would assume that individual countries share the same intercept and slope terms. Under these assumptions, we would pool the observations and apply the Least Squares (LS) estimation methodology to estimate the impact of education decentralization.

However, the LS estimator is inefficient in the presence of unobserved individual specific effects and inconsistent if the individual effects are correlated with any of the regressors. Panel data methods such as fixed effects (FE) and random effects (RE) estimation procedures are designed to remedy some of these shortcomings.

Assume that the μ_i and λ_t are fixed parameters to be estimated; the v_{it} are identically independently distributed (IID) with zero mean and constant variance $(v_{it} \sim IID(0, \sigma_v^2))$; X_i represents the matrix of regressors, which are assumed independent of v_{it} for all *i* and *t*; and $y_{i,t}$ represents the dependent variable of interest. We can estimate the impact of education decentralization using a two-way fixed effects error components model using the dummy variable structure and the unbalanced two-way error components model.

When using a fixed effects approach, we need not assume that the $X_{i,t}$ are independent of the μ_i and λ_t, that is, we do not have to explicitly assume that the regressors are independent of the country specific or time specific effects. Inferences, however, are conditional on the *N* countries and *T* time periods observed in the sample.

The fixed effects model is costly in terms of degrees of freedom lost relative to the random effects approach.

The alternative to using a two-way fixed effects error components model is to use a two-way random effects error components model. In the case of the random effects approach, we assume that the country and time specific effects are randomly distributed and that the parametric function varies from country to country. Since the time specific and country specific effects are random variables that are independently, identically distributed with zero mean and constant variance, the random effects is more efficient in the absence of heteroscedasticity and serial correlation than the fixed effects model. The random effects model also allows the inclusion of time and country invariant regressors. However, the assumption that country and time specific effects are uncorrelated with the regressors may be strong when applied to the purpose of this study. If this assumption is violated, the random effects model would produce inconsistent estimates. If the assumption is not violated, the random effects model would be consistent and more efficient than the fixed effects model if the assumption of no serial correlation and homoscedasticity are valid in the model.

The Hausman (1978) specification test is used to compare the appropriateness of the fixed effects model relative to the random effects model. The test is based on the difference between RE and FE estimates. Under the null hypothesis, unobserved individual effects are uncorrelated with observed explanatory variables. Both the random effects and fixed effects are consistent but the random effect is efficient. Therefore, a statistically significant difference between the two estimators is evidence against the null of no correlation between the country-specific unobserved effects and the observed

explanatory variables as assumed by the random effects model (Wooldridge 2002). This would support the fixed effects model against the random effects.

If $\hat{\beta}_{FE}$ is an Mx1 vector of fixed effects estimates, and $\hat{\beta}_{RE}$ is an Mx1 vector of random effects estimates, then the Hausman statistic, H, can be computed as follows:

$$H = (\hat{\beta}_{FE} - \hat{\beta}_{RE})'[A\hat{V}ar(\hat{\beta}_{FE}) - A\hat{V}ar(\hat{\beta}_{RE})]^{-1}(\hat{\beta}_{FE} - \hat{\beta}_{RE})$$

and is asymptotically distributed as χ^2_M under the null hypothesis, where *A* var(.) denotes the asymptotic variance of the estimator.

We now proceed to the specification of the estimation equations that we will use in Chapter Five to test the hypotheses developed in Chapter Three.

Estimation Equations

The empirical education production function model that we estimate in this dissertation follows the production function model estimated by earlier researchers such as Lee and Barro (2001) with some extensions. Following the purpose of our study, we include indicators of decentralization as additional determinants in the production of education.

Many previous studies suggest that family background and socioeconomic factors are important determinants of schooling output, and in some cases they found that these are more important that school resources (Hanushek 1986, 1995). According to Psacharopoulos and Woodhall (1985), three key family input variables are family income, parents' education level, and father's occupation.

Similarly, there are some studies that show that school resources significantly determine schooling output. Conceptually, schooling output can be influenced by

resources available such as pupil-teacher ratios, expenditure per pupil, teacher salary and education level, availability of material, and others (Lee and Barro 2001). However, various studies have found no convincing evidence for a positive effect between school resources and output (Hanushek 1986, 1995, 2003). There is evidence to suspect that school resources have a much stronger effect on output in developing countries than in developed ones as evidenced by Heynemen and Loxley (1983).

The model we estimate in this study is within the framework of the previous production function models. In addition to the "traditional" determinants of education output, household characteristics and school-related inputs, we include indicators of education decentralization and additional control variables as determinants of variations in education output. Ideally, we would control for teacher's effort by including variables such as teachers' absenteeism rate; however, lack of data limits our model and disables us to control for teacher's effort. Therefore, the general education production equation we estimate can be expressed as follows:

$$O_{i,t} = \beta_0 + \beta_1 X_{i,t} + \beta_2 S_{i,t} + \beta_3 D_{i,t} + \beta_4 Z_{i,t} + \mu_i + \lambda_t + \nu_{it} \qquad (18)$$

where $O_{i,t}$ denotes education output (enrollment rates, repetition rates, dropout rates, completion rates, test scores) in country *i* in year t; $X_{i,t}$ is a vector of student and household characteristics (proxy for parents' income, education level, and average number of children in a household); $S_{i,t}$ is a vector of school and teacher related inputs (pupil-teacher ratio, expenditure per pupil, teacher's salaries, number of school days in a year), $Z_{i,t}$ is a vector of control variables (including population density and indicators of governance and quality of institutions). $D_{i,t}$ is an indicator of education decentralization

(ratio of sub-national expenditures in education to total expenditures in education, and level of decision-making in education functions).

A priori, we would expect that a positive relationship exists between household and school inputs, and education output. We cannot a priori sign the relationship between decentralization and education output, as it may be positive or negative depending on the minimum assumptions for decentralization discussed in Chapter Three.

We estimate equation (18) with different indicators of education output and different indicators of decentralization and analyze any common trend or difference in results. The basic econometric model, however, is the same, except for changes in the dependent variable of education output and changes in the variable of education decentralization. As mentioned before, to estimate the influence of decision-making in education functions, we use a sub-sample of countries where this data is available.
To this point we have examined the potential direct effect of education decentralization on education output. We now turn to examine the potential influence of education decentralization on output through household and school factors.

Education Decentralization and Household and School Factors

Based on our theoretical model developed in Chapter Three, we argue that there potentially exists an indirect relationship between education decentralization and education output through the effect of education decentralization on student and household characteristics, school-related inputs, and teachers' effort level. We further hypothesize that these effects may be positive or negative.

While theoretically we showed that education decentralization may indirectly influence education output, data limitations restrict us from testing this hypothesis by estimating separate equations on the influence of education decentralization on each of these input factors. Nevertheless, we make an attempt to investigate the impact of education decentralization on real government current educational expenditure per pupil at primary school (PPP-adjusted) controlling for student enrollment, population density, and GDP per capita and present estimation results in Table E.1 (Appendix E). We find that education decentralization positively affects spending per pupil at the 10 percent significance level, suggesting that there potentially exists a significant relationship between education decentralization and education spending per pupil at the primary level.

Based on the inability to estimate separate equations on the indirect effect of education decentralization for each input factor in our main model, we therefore explore interaction effects between education decentralization and household and school inputs. We test interaction effects to the model to test the joint effect of the input variables on education output over and above their separate effect.[54]

Based on the above discussion, the general form of the estimation equation with interaction effects is:

$$O_{i,t} = \beta_0 + \beta_1 X_{i,t} + \beta_2 (X_{i,t} * D_{i,t}) + \beta_3 S_{i,t} + \beta_4 (S_{i,t} * D_{i,t}) + \beta_5 D_{i,t} + \beta_6 Z_{i,t} + \mu_i + \lambda_t + \nu_{it} \quad (19)$$

In interpreting the results from equation (19), we say that if the coefficient of an interaction variable is positive then the higher the level of decentralization, the greater the effect of *X* or *S* on education output. On the contrary, a negative value for the interaction

[54] Note that interaction effects do not measure the indirect effect of education decentralization on education output. Instead, they allow us to make a more accurate estimation of the relationship between inputs and output and to explain more of the variation in the dependent variable.

term would imply that the higher the level of decentralization, the smaller the effect of *X* or *S* on education output.

Lastly, we suspect that there may exist a non-linear relationship between education decentralization and education output. Using a scatter plot diagram of the relationship between these two variables shows that there may be a non-linear relationship between decentralization and some of our education output indicators.[55] Therefore, based on this suspicion, we test whether education decentralization effects are non-linear. We capture the non-linear relationship by including the square of education decentralization to equation (19) above, to capture the quadratic fit suggested in the scatter plot figures, as follows:

$$Y_{i,t} = \alpha + \gamma_1 X_{i,t} + \gamma_2 D_{i,t} + \gamma_3 D_{i,t}^2 + \gamma_4 (X_{i,t} * D_{i,t}) + \gamma_5 (X_{i,t} * D_{i,t}^2) + \gamma_6 S_{i,t}$$
$$+ \gamma_7 (S_{i,t} * D_{i,t}) + \gamma_8 (S_{i,t} * D_{i,t}^2) + \gamma_9 Z_{i,t} + \mu_i + \lambda_t + \nu_{it} \qquad (20)$$

The marginal effect of education decentralization on education output in equation (20) is given by the

expression $\gamma_2 + 2\gamma_3 \overline{D}_{i,t} + \gamma_4 \overline{X}_{i,t} + 2\gamma_5 \overline{X}_{i,t} * \overline{D}_{i,t} + \gamma_7 \overline{S}_{i,t} + 2\gamma_8 \overline{S}_{i,t} * \overline{D}_{i,t}$, where

$\overline{X}_{i,t}, \overline{S}_{i,t}, \overline{T}_{i,t}, \overline{D}_{i,t}$ represent the mean values of the vector of inputs and education decentralization in our sample**.** Thus, the critical level of education decentralization (assuming that interaction variables are different from zero) beyond which the sign of the marginal effect is reversed is given by**:**

$$D_{i,t} = -\frac{(\gamma_2 + 2\gamma_4 \overline{X}_{i,t} + \gamma_7 \overline{S}_{i,t})}{2(\gamma_3 + \gamma_5 \overline{X}_{i,t} + \gamma_8 \overline{S}_{i,t})} \qquad (21)$$

Econometric Issues: Endogeneity

Before we move forward with the estimation of the testable hypothesis in Chapter Five, we test and control for potential econometric issues that could confound the estimates. We now briefly identify and discuss the potential problem as well as the possible methodology of controlling the issue, if present. In particular, in this section, we discuss the issue of endogeneity.[56]

Literature on education decentralization that investigates the impact on education output and quality often argue that there may potentially be a problem of endogeneity in the analysis (Filmer 2002; King and Ozler 2000). The problem of endogeneity, as suspected in the literature, potentially arises from the possibility that the decision of a country to decentralize education is a not a random event, but instead those countries that believe that decentralization will improve education output are those that may decentralize. In practice, the question of endogeneity has rarely been addressed in the education decentralization literature, mostly because of the lack of good instrumental variables. Other studies, such as King and Ozler (2000) have been able to address the issue through instrumental variables due to the richness of their data in examining education decentralization in Nicaragua.

Before being quick to claim that the analysis of education decentralization in this dissertation may present an econometric problem of endogeneity, we present a brief

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[55] See Appendix C for scatter plot figures that show the relationship between education output indicators and education decentralization.

[56] The potential issue of serial correlation in panel data is partially mitigated in our case by the fact that our dependent variable is measured using five-year averages. Additionally, using the Wooldrige (2002) autocorrelation test for panel data, we fail to reject the null hypothesis of no first-order autocorrelation at the 10% significance level. We performed this test in Stata using the user-written program, **xtserial**,

discussion on the choice of education decentralization in different countries and how endogeneity may actually not be an issue in our analysis. First, we argue that in most countries education decentralization is part of a broad political reform, where the choice to decentralize the education sector is part of an overall decentralization program to promote poverty reduction, better governance and economic growth in a country instead of a sector specific reform aimed solely at improving education outcomes, as evidenced in recent studies on education decentralization national strategies in countries around the world (UNESCO 2003, 2005; Winkler and Gershberg 2004).[57]

Second, we argue that even in countries where decentralization strategies are restricted to the education sector, the purpose is generally to reform the entire education system and not only to achieve improvement in education outcomes, such as diversification of financing, restructuring of the management and redistribution of political power, and improvement in the allocation of teaching resources (UNESCO 2005; World Bank 2000).

Third, we argue that the potential problem of endogeneity may be greater in country case empirical studies where the education decentralization strategy is not to decentralize all schools in the system, but instead to decentralize some districts or schools in the country (Filmer 2002; King and Ozler 2000). Then, the problem of endogeneity becomes severe where the decision of making a district or a school autonomous may not be random, but instead it may be simultaneously determined with indicators of education quality and student achievement.

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proposed by David Drukker. With regards to the possibility of heterocedasticity, we report robust standard errors in all estimations, Pooled OLS, fixed effects and random effects.

[57] The correlation index between education decentralization and fiscal decentralization (economy-wide decentralization) is 0.75.

Since every country has different reasons for and methods of decentralizing, there are wide variations in decentralization reforms across countries. While we have provided strong reasons about why we may not face the issue of endogeneity in our model, for completeness, we use the Hausman (1978) specification test to test the null hypothesis of exogeneity. We perform this test by regressing education decentralization (the potential endogenous regressor) using various instrumental variables such as total population, ethnic fractionalization, index of freedom, and a dummy variable equal to 1 if the country is a former British colony or 0 otherwise.[58] We conduct the endogeneity specification test for each of the output indicators with the instruments specified above and exogenous variables in the model. In the results chapter, Chapter Five, we report the results of endogeneity tests for each model estimated. If we reject the null hypothesis of exogeneity, then we consider that the Two-Stage Least Squares (2SLS) or instrumental variable (IV) estimation is the most appropriate estimation method to deal with the potential endogeneity problem of our data.[59]

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[58] Previous studies have related colonial heritage as a predictor of fiscal authority and organization. For example see Diaz-Cayeros (2004) who argues that former French colonies should be more centralized, while former British colonies are expected to be more decentralized. The author estimates centralization of government using information about colonial heritage as a predictor.

[59] See Appendix D for an explanation of the two-stage least-squares estimation technique and for regression results of instrumental variables and education decentralization.

CHAPTER FIVE

ESTIMATION RESULTS

In the previous chapter we presented the basic estimation equations and the empirical methodology for the analysis of the impact of education decentralization on education output that we will perform in this chapter. The main goal of this dissertation is to examine the impact of education decentralization on education outputs. To do this, in this chapter we compare the results about the influence of education decentralization on different measures of education output. An important reason to consider different indicators of education output is that this approach will provide a robustness test of the conclusions otherwise reached with any one of the models alone. Of course, it is possible that education decentralization may positively or negatively influence the different measures of education output. There is a higher chance that education decentralization will have different effects on the various output measures. Only the actual empirical analysis can provide more information about the relationship between different measures of education outputs.

In the first section of the chapter we report and discuss empirical findings derived from our testable hypothesis regarding the joint effects of education decentralization on education outputs for the entire sample of countries. For each education output indicator we estimate equations using Pooled LS estimation and panel data fixed effects (FE) an random effects (RE) approaches. Where necessary, we control for the endogeneity of education decentralization, reporting two-stage least-squares (2SLS)/instrumental

variable (IV) estimators.[60] In the second section, we report and discuss empirical findings of education decentralization using more disaggregated data on decision-making in education at different levels of government; because of data availability this is done only for a sub-sample of countries (mainly OECD). Appendix C presents data description, descriptive statistics, list of countries in each sample, as well as simple correlation between variables.

Education Decentralization and Education Output: All Countries

Here we analyze the question of whether education decentralization significantly influences education output indicators as measured by student repetition rates, dropout rates, net enrollment rates, completion rates, and test scores in science at the primary school level. We analyze and report the results separately for each indicator.

Education Decentralization and Primary Repetition Rate

The descriptive statistics in Table C.2 (Appendix C) show that primary repetition rates for the entire country sample period 1970-2004 ranges from zero to 15 percent, with a sample mean of 3.12 percent. Over time, the sample mean has decreased from 6.5 percent in 1975 to 1.6 percent in 2004. Countries that have achieved zero repetition rates are mainly European and Asian countries. In our sample, the highest repetition rate of 15 percent is found in India in 1975.

[60] When education decentralization fails to reject the null hypothesis of exogeneity, we report instrumental variable estimation.

We start our analysis with the question of whether education decentralization significantly influences repetition rates. Recall that in the previous chapter we discussed the adequacy of repetition rates as a measure of education output, and that analysis will not be repeated here.

Table 3. Fixed and Random Effects Estimation Results for all Sample Countries. Dependent Variable: Repetition Rate at the Primary Level

	One-Way FE	**One-Way RE**	**Two-Way FE**	**Two-Way RE**
Educ. Decent (Expenditure)	-0.139**	-0.102**	-0.136**	-0.096**
	(0.055)	(0.041)	(0.055)	(0.038)
Fertility Rate	0.019	0.028	-0.287	-0.286
	(0.569)	(0.162)	(0.562)	(0.174)
# of school days		-0.012		0.002
		(0.032)		(0.030)
Pop. Density	0.031		0.040	0.002
	(0.027)		(0.029)	(0.003)
Ratio of per pupil Exp. to GDP p.c.	-0.402***	-0.452***	-0.354**	-0.396***
	(0.151)	(0.113)	(0.134)	(0.109)
Adult Avg. years of schooling	0.196	0.490	1.031	0.987**
	(0.631)	(0.420)	(0.669)	(0.385)
Decent. x adult Schooling	0.007	-0.001	0.005	-0.002
	(0.009)	(0.006)	(0.009)	(0.005)
Decent. x educ Spending	0.004**	0.005***	0.004*	0.004***
	(0.002)	(0.002)	(0.002)	(0.002)
Log GDP p.c.	-0.504	1.671*	1.769	0.727
	(2.081)	(0.958)	(2.523)	(0.887)
Infant Mortality	0.220***	0.166***	0.195***	0.144***
	(0.070)	(0.052)	(0.066)	(0.048)
Observations	108	108	108	108
R-squared	0.56		0.64	
Countries	35	35	35	35

Note: Robust standard errors in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%.

As discussed earlier, the education decentralization variable may be endogenous which would cause estimates to be inconsistent; this problem would call for the use of an instrumental variable approach. In this case, the Hausman endogeneity test fails to reject the null hypothesis that education decentralization is exogenous with a p-value of 0.37, therefore here we report fixed and random effects estimators. The results in Table 3 indicate that the coefficients for education decentralization are negative and significant, indicating that an increase in the level of education decentralization significantly lowers repetition rates at the primary school level, ceteris paribus.

In comparing the appropriateness of fixed effects versus random effects estimation, we conducted the Hausman specification test of the null hypothesis of no correlation between the country unobserved fixed effects and the regressors with the result that we are able to reject the null with a p-value of 0.0237. This suggests that the fixed effects model is more appropriate. Thus, following the estimates of the fixed effects model, the magnitude of the total effect of education decentralization on the dependent variable is given by the sum of three terms:

[-.136 + 0.005 adult schooling + 0.004 per pupil spending].

Evaluating the marginal effect at the mean values for the explanatory variables we obtain a value of -0.0265. That is, a 10 percent increase in education decentralization is associated with a 0.265 percent reduction in the repetition rate, all else constant.[61]

As far as the effect of family inputs, we find that the effect of infant mortality is positive and significant at the 1 percent level, indicating that as the level of infant mortality increases so does the rate of repetition in primary school. The magnitude of the

[61] We obtain -0.0265 by substituting mean values for adult education and per pupil spending, as follows: -0.136+0.005*(7.88)+0.004*(17.53)

coefficient indicates that a 10 percent increase in infant mortality rate increases primary repetition rates by approximately 2 percent. The proxy for parents' education and income are found to be non significant.

With respect to the measure of school resources, we find that education spending per pupil relative to GDP per capita is negative and significant indicating that countries with higher spending per pupil achieve lower repetition rates. This is consistent with some of the education literature that finds a positive effect of education spending on education output.

Education Decentralization and Primary Dropout Rate

We now turn to examine estimation results when dropout rate at the primary school level is the dependent variable. In our sample, primary dropout rates range from zero to 41 percent, with a sample mean of 7.61 percent for the period 1975-2004. Over time, the sample mean decreased from 9.76 percent in 1975 to 5 percent in 2004. Countries that have achieved zero dropout rates at the primary school level are mainly European countries and Japan. The highest dropout rate at the primary school level of 41 percent is found for Paraguay in 1990.

When we performed the Hausman endogeneity test we reject the null hypothesis that education decentralization is exogenous with a p-value of 0.00004, therefore, we only report results for the 2SLS/IV estimations in Table 4. As described in Chapter Four, we instrument for education decentralization using total population, ethnic fractionalization, an index for quality of governance, and a dummy variable for whether the country is a former British colony. In order to choose between the fixed and random

effects estimators, we perform a Hausman specification test which fails to reject the null hypothesis of no correlation between the country observed fixed effects and the regressors with a p-value of 0.996. This suggests that using the random effects estimator is appropriate.

As illustrated in Figure C.3, the relationship between education decentralization and dropout rates may not be linear. To account for the quadratic fit suggested by Figure C.3, we include the square term of the instrumented education decentralization variable. Results in column 2 of Table 4 show a negative and statistically significant coefficient in the linear part while the sign on the quadratic term is positive and statistically significant at the 10 percent level. These findings confirm the U-shape pattern observed in the graphical illustration, which suggests that education decentralization is likely to improve dropout rates up to a certain critical level beyond which any increase in the share of sub-national expenditures in education may actually increase dropout rates. Specifically, an increase in expenditure decentralization in education beyond a critical threshold of approximately 62.25 percent would appear to lead to an increase in dropout rates.[62] We must note that most developing and developed countries are below this threshold, as the mean of expenditure decentralization in education is 48 percent and 53 percent, respectively. If we analyze mean values by regions, only South East Asia, represented by India in our sample, has a mean value of education decentralization greater than the threshold, at 89%.[63] The magnitude of the marginal effect of education decentralization is

[62] This critical decentralization level is obtained by setting the partial derivative of the estimation equation to zero and solving for education decentralization EducDec= - (β_1/ 2 β_2)=(1.245/(2*0.010))=. Solving for education decentralization using the estimated coefficients in column 2 of Table 4 yields the decentralization threshold of 62.25%.

[63] The high measure of expenditure decentralization in India has been highly criticized in the past since most expenditure in India is taken at the state level and little decentralization has occurred beyond this

given by [-1.245 + 0.020 education decentralization], where evaluated at the mean value results in a marginal effect of -0.2272. That is, a 10 percent increase in education decentralization is associated with a 2.28 percent reduction in the dropout rate, all else constant.[64]

Table 4. 2SLS/IV Estimation Results for all Sample Countries
Dependent Variable: Dropout Rate at the Primary Level

	IV Fixed Effects+	**IV Random Effects+**
Educ. Decent (Expenditure)	-1.226 (0.642)	-1.245* (0.748)
Square Educ. Decent (Expenditure)	0.005 (0.005)	0.010* (0.006)
Fertility Rate	1.115 (1.362)	-1.191 (1.095)
Pupil-teacher ratio	-0.243 (0.176)	0.119 (0.195)
Ratio of per pupil Exp. to GDP p/c	-0.175 (0.377)	-0.670 (0.458)
# of school days		-0.099 (0.185)
Observations	110	110
Number of countries	34	34

Note: Standard errors in parentheses. + Year dummies included.
* significant at 10%; ** significant at 5%; *** significant at 1%.

In addition to education decentralization, the input variables included in the regression are those that have been found to significantly impact education output in the previous literature. Variables such as pupil-teacher ratio and spending per pupil appear to have the correct sign but they are non-significant. The positive sign of the pupil-teacher

level. Considering that a state in India may in itself be the size of a country, decentralization to the state level in India may not mean genuine decentralization.

ratio coefficient indicates that as the classroom size gets larger the dropout rate increases. On the other hand, the negative sign in the ratio of spending per pupil to GDP per capita indicates that in countries with greater spending per pupil the dropout rate is lower. As far as the interaction variables in the equations with dropout rates, these were generally not significantly different from zero and therefore they were excluded in the final estimating equation.

Education Decentralization and Primary Net Enrollment Rate

We now turn to the estimation results when the dependent variable is the net enrollment rate at the primary school level. Descriptive statistics show that primary net enrollment rates range from 72 to 100 percent, with a sample mean of 94 percent for the period 1975-2004. Over time, the sample mean has remained in the 93 and 95 percent range. Most developed countries have achieved full enrollment at the primary level including some developing countries such as Albania, Argentina, Chile, Mexico, Russia and others. The lowest enrollment rate in our sample is found in Indonesia with 72 percent in 1975.

The estimation results in Table 5 suggest that education decentralization does not significantly influence student net enrollment rates over time. Only in the pooled LS estimation with fiscal decentralization (column 2) do we find that the variable of decentralization significantly influences net enrollment rates. However, when we use fiscal decentralization as a proxy for education decentralization in the panel data estimations, the coefficient of fiscal decentralization is also not significant.

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[64] We obtain -0.2272 by substituting the mean value for education decentralization as follows: -1.245 + 0.020 (50.89).

Table 5. Estimation Results for all Sample Countries:
Dependent Variable: Net Enrollment Rate at the Primary Level

	Pooled LS	**Pooled LS**	**One-Way FE**	**One-Way RE**	**Two-Way FE**	**Two-Way RE**
Educ. Decent	0.008		-0.037	0.012	0.003	0.015
(Expenditure)	(0.018)		(0.034)	(0.026)	(0.036)	(0.024)
Fiscal Decent.		0.144**				
(All Expenditure)		(0.067)				
Fertility Rate	-0.399	0.200	-3.349***	-0.950	-4.171***	-0.621
	(0.308)	(0.446)	(1.059)	(0.587)	(1.208)	(0.573)
Pupil-teacher	-0.302***	-0.838***	-0.006	-0.273***	0.081	-0.236***
Ratio	(0.081)	(0.140)	(0.147)	(0.083)	(0.170)	(0.077)
# of school days	-0.059	0.013		-0.154*	0.000	-0.037
	(0.052)	(0.055)		(0.088)	(0.000)	(0.080)
Pop. Density	0.005**	0.005	-0.014	0.001	-0.009	0.003
	(0.002)	(0.003)	(0.012)	(0.003)	(0.017)	(0.003)
Ratio of per pupil	-0.140	-0.518***	-0.037	-0.087	-0.071	-0.118
Exp. to GDP p/c	(0.104)	(0.155)	(0.103)	(0.091)	(0.089)	(0.086)
Observations	111	210	103	101	111	111
R-squared	0.23	0.36	0.35		0.41	
Countries			38	37	41	41

Note: Robust standard errors in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

A Hausman endogeneity test fails to reject the null that education decentralization is exogenous with a p-value of 0.7376. Table 5 presents pooled LS and fixed and random effect estimators. A Hausman specification fails to reject the null of no correlation between the country observed fixed effects and regressors with a p-value of 0.6825, suggesting that using the random effects estimation is appropriate. Thus, when examining the impact of other explanatory variables, we find that only the pupil-teacher ratio significantly influences net enrollment at the 1 percent level. The negative sign indicates that greater classroom density reduces the net enrollments.

Although the sign of the estimated coefficient for decentralization would indicate a positive relationship between education decentralization and net enrollment rates, the estimated coefficient for decentralization is never statistically significant. This may be the result of the low variability of net enrollments over time as many countries in the past 15 years have reached, or are close to reaching the full primary enrollment mark.

Education Decentralization and Primary Completion Rate

We now turn to estimating the hypothesized influence of education decentralization on primary completion rates. In our sample, primary completion rates range from 61 to 100 percent, with a sample mean of 95 percent for the period 1990-2004. Over time, the sample mean has increased from 93 in 1990 to 97 percent in 2004. The lowest completion rate of 61 percent in our sample is for Switzerland in 1990; however, in most recent years Switzerland has achieved the 100 completion rate mark.[65]

As far as the issue of endogeneity of education decentralization in the completion rates model, we fail to reject the null of exogeneity with a p-value of 0.69. Therefore, we report only the fixed and random effects estimators in Table 6. In this table, we report the fixed and random effects estimators for education decentralization in columns 1 and 2, and those using fiscal decentralization in columns 3 and 4. The estimation coefficients for both fixed and random effects suggest a positive influence of education decentralization on student completion rates. A Hausman specification test of the null hypothesis of no correlation between the country unobserved fixed effects and regressors suggests the fixed effects model is more appropriate with a p-value of 0.0391 for

[65] These changes in the data are quite likely the result of exogenous policies involving criteria of graduation and grade repetition in particular countries. These issues were discussed in the previous chapter.

education decentralization; however, the random effects model is more appropriate when fiscal decentralization is used as the explanatory variable with a p-value of 0.1154.

Table 6. Fixed and Random Effects Estimation Results for all Sample Countries: Dependent Variable: Completion Rate at the Primary Level

	One-Way FE	**One-Way RE**	**One-Way FE**	**One-Way RE**
Educ. Decent. (Expenditure)	0.141* (0.082)	0.016 (0.033)		
Fiscal Decent. (Expenditure)			0.382* (0.203)	0.344*** (0.097)
Log GDP p.c.	-2.679 (8.643)	2.525* (1.366)	7.477 (4.924)	5.555** (2.558)
Pupil-Teacher Ratio	0.195 (0.524)	-0.108 (0.175)	-0.017 (0.349)	-0.531* (0.289)
Ratio of per pupil Exp. to GDP p/c	0.134 (0.131)	-0.042 (0.108)	0.091 (0.116)	-0.138 (0.130)
Fertility Rate	-7.755** (3.692)	-0.050 (0.709)	-6.869*** (2.414)	-1.959** (0.951)
Observations	115	115	145	145
R-squared	0.23		0.33	
Countries	45	45	60	60

Note: Standard errors in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%.

The fixed effect estimator for education decentralization suggests that there is a positive and significant influence of education decentralization on completion rate at the 10% significance level. With respect to the magnitude of the effect, a 10% increase in the level of expenditure decentralization in education results in an increase of the student completion rate of approximately 1.4%, ceteris paribus. The random effect estimator for fiscal decentralization also suggests a positive and significant effect on completion rate,

where a 10% increase in fiscal decentralization will lead to an improvement of completion rate by 3.4%, ceteris paribus.

Turning to the other explanatory variables, based on the panel data estimations, we note the strong effects of family inputs on completion rates. The fertility rate is negative and statistically significant at the 5% level for each of the estimation models. As one might expect, these results suggest that countries where families have a greater number of children tend to experience lower student completion rates at the primary level. Additionally, the model with fiscal decentralization indicates a positive and significant influence of the proxy for parents' income on completion rates, meaning that in higher-income countries students tend to achieve higher completion rates at the primary level.

With respect to the measures of school resources, for the pupil-teacher ratio, as was the case for enrollment rates, the negative and significant coefficient indicates that the greater the classroom density the lower student completions rates. The ratio of spending per pupil to GDP per capita turns out to be insignificant for the panel data estimators.

Education Decentralization and Primary Students Test Scores in Science

Finally, we turn to examining the influence of education decentralization on student test scores in science at the primary school level. We choose to evaluate test scores in science because it is the subject that has been evaluated for more years for students at the primary level. Test scores in science for primary students are available for 1985, 1990, 1995 and 2004. Other subjects are available for a longer time series but they

evaluate students in lower secondary and secondary education levels. Despite our small sample size, we have decided to report the estimation results in the hope that in future years, with the increment of country participation in comparative achievement studies, the sample size of countries may improve and buttress our preliminary findings. This is our hope anyway considering that test scores may be one of the most important indicators of education performance.

The variable test scores ranges from 0 to 1000, with a mean of 500 and standard deviation of 100. For comparability of data we transformed all data to percentage form. In our sample, test scores range from 46.6 to 66.9 percent, where the lowest test score of 46.6 is achieved in Norway in 2004 and the highest of 66.9 is achieved in Italy in 1990.

A Hausman endogeneity test fails to reject the null hypothesis that education decentralization is exogenous with a p-value of 0.3737. Therefore, Table 7 presents the panel data fixed and random effect estimators for education decentralization and fiscal decentralization. The Hausman specification test fails to reject the null hypothesis of no correlation between the country unobserved fixed effects and regressors with a p-value of 0.6547. Thus, we focus our discussion on the estimation results for the random effects model (in columns 2 and 3 of Table 7). The estimated coefficients for education decentralization and fiscal decentralization suggest a positive and significant relationship between decentralization and student test scores. The magnitude of the effect of education decentralization indicates that a 10 percent increase in education decentralization is associated with approximately 1 percentage point increase in student test scores. Similarly, a 10 percent increase in fiscal decentralization is associated with a 1.7 percentage point increase in student test scores, all else constant.

Table 7. Fixed and Random Effects Estimation Results for all Sample Countries. Dependent Variable: International Test Scores in Science at the Primary Level

	One-Way FE+	**One-Way RE+**	**Two-Way RE**
Educ. Decent (Expenditure)	1.792 (0.863)	0.096** (0.044)	
Fiscal Decent (Expenditure)			0.172** (0.051)
Ratio of per pupil Exp. to GDP p/c	-0.618 (0.694)	-0.473** (0.219)	-0.018 (0.180)
Pupil-Teacher Ratio	0.239 (1.055)	-0.019 (0.232)	-0.414* (0.231)
Fertility Rate	24.060* (8.921)	-0.152 (0.701)	0.663 (0.352)
Pop. Density	0.181 (0.369)	0.014 (0.023)	
Infant Mortality	-0.726 (1.482)	-0.113 (0.191)	
Adult Avg. years of schooling	4.055 (2.587)	0.113 (0.832)	
Observations	27	27	39
Countries	16	16	24
R-squared	0.72		

Note: Standard errors in parentheses. +Robust standard errors where indicated.
* significant at 10%; ** significant at 5%; *** significant at 1%.

With respect to the other explanatory variables, the effects of family inputs on student achievement appear to be non significant. However, the positive sign in the proxy for parent's education suggest that countries where parents achieve greater years of schooling are likely to effect positively on the level of student achievement. The negative sign of infant mortality rate, once again suggests that countries with high infant mortality rates are likely to achieve lower test scores of student achievement.

With respect to the variables capturing school resources, pupil teacher ratio is negative and significant in column 3, while per pupil spending is not significant. In addition, the pupil teacher ratio is negatively related to test scores; thus, smaller class size appears to be associated with improved pupil achievement. The estimated coefficients for the interaction variables between education decentralization and other education inputs were generally not significantly different from zero and were therefore excluded from the final estimations.

Education Decentralization and Decision-Making: An Analysis with a Sub-sample of Countries

We now turn to estimating the effects of education decentralization when this key explanatory variable is measured in a finer way than expenditure decentralization through what decisions on education are actually taken at different levels of government. Examining the impact of education decentralization when this is measured via indicators for the level of decision-making in different education functions may provide us with better information on the relationship between decentralization and education outcomes. This type of analysis may also help us understand what form of decentralized decisions may have the strongest impact on education output.

Based on data from OECD, we have indicators for decision-making authority in four categories of education systems: organization of instruction, personnel management, planning and structures, and resources.[66] We measure three decentralized levels at which decisions in each of these four categories may be taken: the intermediate level (regions

[66] See Table 1 for a detailed description of the types of decisions in education that may be decentralized in each of the four categories we present in this study.

and provinces), local level (municipalities), and school level. When we refer to sub-national decision-making, we denote decisions taken at all levels below the central government level.

The main disadvantage of our analysis of education decentralization through decision-making is the low number of observations, which does not allow us to perform fixed and random effects estimations. Therefore, we confine our discussion to the results obtained from the pooled LS regressions. First, we explore the effect of sub-national decision-making (aggregate measure including intermediate, local and school level) on each of the output indicators. The results are mixed. We find that sub-national decision-making is significant only when we try to explain performance in terms of test scores and repetition rates (as dependent variables.) Based on these results, we concentrate our discussion on test scores and repetition rates by further exploring the significance of sub-national decision-making by analyzing the disaggregated effect of sub-national decision-making for each level of government.

Table 8 reports the estimation results when the dependent variable is science test scores. All estimating equations (the different columns) present a positive and significant effect of expenditure decentralization on education, which is consistent with our results found in the previous section. Column 1 of Table 8 shows the results of the effect of education decisions taken at the intermediate level. The effect is positive and significant at the 1% significance level, implying that decentralized decisions on education taken at the intermediate level of government improve test scores.

Table 8. Estimation Results for Sub-Sample of Countries. Dependent Variable: International Test Scores in Science at the Primary Level[+]

	Pooled LS	**Pooled LS**	**Pooled LS**

Educ. Decent (Expenditure)	0.028* (0.015)	0.047** (0.021)	0.047** (0.018)
% Decisions at Intermediate level	0.200*** (0.058)		
% Decisions at Local level		0.025 (0.043)	
% Decisions at School level			-0.021 (0.030)
Fertility Rate	1.061*** (0.263)	0.489 (0.566)	0.718 (0.475)
Ratio of per pupil Exp. to GDP p/c	-0.069 (0.108)	0.003 (0.208)	-0.008 (0.201)
Pupil-Teacher Ratio	-0.203 (0.139)	0.152 (0.184)	0.077 (0.113)
Population Density	-0.005** (0.002)	-0.001 (0.002)	-0.001 (0.001)
Observations	22	22	22
R-squared	0.85	0.76	0.77

Note: Robust standard errors in parentheses. + Year Dummies included.
* significant at 10%; ** significant at 5%; *** significant at 1%

As far as the magnitude of the effect, we can say that a 10 percent increase in decisions taken at the intermediate level of government improves test scores in science by 2 percentage points. When we disaggregate the effect of intermediate decisions into decisions about planning, organization, personnel, and resources, we find a positive and significant effect of personnel and planning decision on test scores, while decisions about resources and organization were also positive but not significant. These results suggest that an increase in decision-making at the intermediate level in personnel management and planning will raise student achievement.

As far as the effect of decisions taken at the local and school level on test scores, column 2 of Table 8 shows a positive although not significant effect of decision-making at the local government level on test scores. Column 3 of Table 8 shows a negative but again not significant effect of decision-making at the school level on test scores.

Table 9. Estimation Results for Sub-Sample Countries. Dependent Variable: Repetition Rate at the Primary Level+

	Pooled LS	**Pooled LS**	**Pooled LS**
Educ. Decent (Expenditure)	-0.032*** (0.009)	-0.032*** (0.010)	-0.027** (0.011)
% Decisions at School level	-0.043** (0.018)		
% Decisions at Intermediate level		0.020 (0.014)	
% Decisions at Local level			0.013 (0.019)
Ratio of per pupil Exp. to GDP p/c	-0.201*** (0.044)	-0.151*** (0.047)	-0.186*** (0.050)
Fertility Rate	-0.286 (0.178)	-0.297 (0.195)	-0.386* (0.183)
Freedom	-0.019 (0.221)	0.246 (0.209)	0.258 (0.280)
Observations	22	22	22
R-squared	0.76	0.74	0.72

Note: Robust standard errors in parentheses. + Year Dummies included.
* significant at 10%; ** significant at 5%; *** significant at 1%

With respect to the effect of decentralized decision-making on repetition rates, Table 9 reports the estimation results where decision-making at the school level is found to have a negative and significant effect on repetition rates at the 5% significance level (column 1). As far as the magnitude of the effect, we can say that a 10 percent increase in

"decisions taken at the school level" improves repetition rates by 0.43 percentage points. When we disaggregate the effect of school decisions on repetition rates into decisions about planning, organization, personnel, and resources, we still find a negative effect for each of these on repetition rates, although the disaggregated effects are not significant. These results suggest that an increase in decision-making in each category (planning, organization, personnel and resources) by itself may not lead to an improvement in repetition rates, while an increase in all of these categories together will improve outcomes regarding repetition rates.

For the effects of decision making at the intermediate and local levels on repetition rates, column 2 of Table 9 shows a positive but not significant effect for decision-making at the intermediate level, while column 3 shows a positive and not significant effect for decision-making at the local level.

In summary, we find some interesting results when we measure the effect of education decentralization through the percentage of decisions in education taken at different sub-national levels. The results are quite different depending on the dependent variables being evaluated. More decision-making power at the intermediate level of government appears to improve student test scores; more specifically, these results are present for decision-making about planning and personnel management. In addition, the presence of more decision making authority in education at the school level is found to significantly improve repetition rate outcomes. The estimation results also show that larger decision making authority at the intermediate level positively affects completion rates and enrollment rates.

As mentioned throughout this dissertation, the purpose of education decentralization generally is not to decentralize all expenditures and decisions to one sole level of government or organizational unit; instead the purpose may be to find a balance in the decision making authority that should be allocated to each level of government. Our results suggest that decisions on planning and personnel management have a greater influence on education output when taken at the intermediate level of government (states, provinces, etc.). At the same time we find that decisions at the school level can also significantly improve education output. However, we find that decentralizing decisions solely to the school level may not lead to improvements in education output. These results contrast quite significantly with those found by (Burki, Perry, and Dillinger 1999) for Latin America. Clearly, further analysis will be necessary to have a more definite answer to the questions posed here; in particular, we will need a bigger sample of countries for which indicators of decision-making in education are available.

CHAPTER SIX

CONCLUSION

In this dissertation, we have explored the impact of expenditure decentralization and decision-making authority in the area of education on the outputs of publicly provided primary education. We started by reviewing the literature on education decentralization in Chapter Two where we presented results from various country case studies on the direct and indirect effects that education decentralization may have on education output. While the potential relationship between education decentralization and its outcomes on education is still ambiguous in the literature, we determined there is a need for additional theoretical and empirical research for exploring the alleged relationship.

In Chapter Three, we developed a theoretical production function model that incorporates behavioral effects of the agents in the education process. We illustrated how education decentralization may directly and indirectly affect education output through its influence in student and family inputs, school resources, and teachers' effort. From the theoretical model, we developed four testable hypothesis concerning the relationship between education decentralization and education output.

After discussing our data sources and empirical methodology in Chapter Four, in Chapter Five we explored empirically the effect of education decentralization on education output using a panel data set from a sample of developed and developing

countries for five-year intervals during the period 1970-2004.[67] We employed pooled LS, fixed and random effects estimators, as well as two-stage least-squares estimators to deal with some of the common problems associated with studies of education output and education decentralization, namely unobserved effects and endogeneity. We analyzed multiple indicators for education output in order to explore a range of possible effects of education decentralization on repetition rates, dropout rates, net enrolment rates, completion rates, and international comparative student test scores in science at the primary school level.

Summarizing, our empirical findings support the existence of the hypothesized positive effects of education decentralization on education output. With respect to the influence of expenditure decentralization on education output we find empirical support for the proposition that education decentralization may significantly improve repetition rates, dropout rates, completion rates, and test scores in science at the primary school level, everything else constant. With respect to the effect on net enrollment rates, although the regression coefficients are positive, we were unable to find a significant effect of education decentralization.

With regard to the effect of measures of family and school inputs on education output, our results are mixed. We used different measures of family inputs such as proxies for family size, family income, education of parents, and health of children. Measures of school and teacher inputs include spending per pupil as a percentage of GDP per capita, pupil-teacher ratio, and the number of school days in a year. Our empirical findings suggest that infant mortality significantly affects repetition and completion rates.

[67] The sample size is smaller in some regressions depending on data availability.

We also found a negative and significant effect of family size and a positive and significant effect of parents' income on completion rates. Lastly, the proxy for class size, the pupil-teacher ratio, was found to negatively and significantly affect net enrollment rates and completion rates, all else constant.

With respect to the influence of decentralized decision-making in education, we find that both decision taking at the intermediate and school levels significantly improve education output. Specifically, our results suggest that decisions on planning and personnel management have a greater influence on education output when taken at the intermediate level of government (states, provinces, etc.). At the same time we find that decisions at the school level can also significantly improve education output. However, we also find that allocating a portion of decisions for a sole category of education decisions may not lead to improvements in education output.

Our results have a number of implications regarding decentralization policy. While many cross-sectional country case studies have not been able to find any significant effect of education decentralization on education output, it might help to evaluate decentralization policies with a panel data set where observation are allowed to vary over time; our results reaffirm the conjecture of the superiority of panel data estimation. Second, our empirical evidence suggests that education decentralization may have different effects depending on the indicator chosen for schooling performance. For example, our findings show that when education output is measured through enrollment rates, we fail to find any significant effect of education decentralization. Third, our empirical results support the efforts of international financial institutions, bilateral donors and many governments around the world that have embarked on the decentralization of

education decisions to levels of government below the central level in order to improve education output. Lastly, given that educational attainment and human capital is considered to be a key determinant in reducing poverty and improving economic performance, policy-makers may want to consider education decentralization as a tool to influence education indicators to ultimately fight poverty and achieve economic growth.

We believe that the inclusion of additional explanatory variables and the balancing of the panel data set with additional observations, as they become available, will significantly improve our empirical knowledge about the impact of education decentralization on education outputs. Additionally, it will be useful to examine the indirect effects of education decentralization on education output and further explore the effect of corruption in the model as data becomes available. Furthermore, it will be necessary to examine the effect of education decentralization on performance at other levels of education, especially secondary education.

APPENDIX A

COUNTRY EXPERIENCES WITH EDUCATION DECENTRALIZATION

In Chapter Two of this dissertation, we examined the current state of the literature of the impact of education decentralization on education output in terms of theoretical modeling and empirical methodology. This appendix extends the examination of education decentralization by taking a deeper look at the design of education decentralization reforms in different countries beyond what has been covered in Chapter Two. The objective is to examine the background and development and transition of the implementation of education decentralization reforms. We now turn to examining these country experiences.

Education Decentralization Reforms

While there are a myriad of decentralization experiences in the educational sphere, we can draw upon some of these experiences to motivate the theoretical analysis in the succeeding chapters. In this section, we examine a number of country specific cases and discuss the impact of the decentralization reforms on education quality. We conclude the section with a summary discussion on how country specific studies have contributed so far to the literature on education decentralization and education quality, and a discussion about how this dissertation will contribute to the existing gap in the literature.

Market-based Competition and School Choice

A different type of education decentralization reform currently being proposed involves improving education outputs through market-based competition and choice. The term "school choice" means giving parents the power and opportunity to choose the school their child will attend.

Traditionally, children in the U.S. are assigned to a public school according to where they live. People of means are considered to have school choice, because they can afford to move to an area according to the schools available (i.e., where the quality of public schools is high), or they can choose to enroll their child in a private school. Parents without such means, until recently, generally had no choice of school, and had to send their child to the school assigned to them by the district, regardless of the school's quality or appropriateness for their child. One hypothesis for school choice reforms is that competition between local governments promotes efficient use of resources and reduces the overall size of government. Moreover, residents will "vote with their feet" by moving to another locality according to local taxes and the quality of education services.[68] Another hypothesis states that under school choice technical efficiency improves through availability of better information at the local level.

School choice means better educational opportunity, because it uses the dynamics of consumer opportunity and provider competition to drive service quality. There are different types of school choice programs. According to the U.S. for Education Reform there are full school choice programs, private scholarship programs, and charter schools. Full school choice programs, or voucher programs, are government financed per-pupil

[68] See Brennan and Buchanan (1980) and Tiebut (1956).

subsidies given to parents allowing them to enroll the student in a public or private school of their choice. The rationale is that parents are given choice and schools are required to compete for students in order to survive and the quality of education is expected to improve.[69] In a similar manner, private scholarship programs provide private funds to families of low socio-economic status giving them to opportunity to choose between schools.

Charter schools is a new form of choice, where schools are independent public schools, designed and operated by educators, parents, community leaders, educational entrepreneurs and others. Charter school designs differ according to the country of implementation, but in general they are sponsored by designated local or state educational organizations who monitor their quality and integrity, but allow them to operate freed from the traditional bureaucratic system of public schools. Charter schools design and deliver programs tailored to educational excellence and community needs.[70] School Choice programs have been implemented in countries like Chile, Belgium, and the United States. Several examples are discussed in this section.

Voucher Program in Chile

In Chile, the Pinochet government introduced in 1980 a modified voucher scheme and municipalized public education to increase competition among schools for students, and thereby raise the accountability and efficiency of schools through higher levels of student achievement. Under the voucher system, families can choose to send their children to free subsidized schools, either municipal or private, or they can choose fee-

[69] For a discussion on school vouchers see Hanson (1997), McGinn and Welsh (1999), and Parry (1997a).
[70] See McGinn and Welsh (1999), p. 45.

paying private schools if they can afford the tuition fees. Because this reform is one where money follows the student, it entails real choice.[71] Recent studies have indicated no significant differences in student achievement among public and private voucher schools.

A study by Parry (1997b) examines the impact of education vouchers in the Chilean experience. This study evaluates two of the fundamental argument supporting the use of education vouchers: first, do private schools produce higher quality education than public schools; and secondly, does competition force schools to produce higher quality education. The authors use data collected in 1990 measuring student achievement through fourth-grade student test scores in mathematics and Spanish. The difference between private, public, and private-subsidized schools is measured through the use of dummy and interactions variables. One fault in this analysis, however, is that student background characteristics are roughly measured through dummy variables that control for parent's level of education and socio-economic level. This is the only variable used for explaining student background. This study finds that public schools achieve higher performance with disadvantaged children while private-subsidized schools produce higher scores with 'high quality' students (students whose parents have high education level). Private and public schools seem to have specialized in a way that public schools achieve better results with disadvantaged students and private schools achieve better results with higher quality students.

[71] Vegas (1999).

A study by Vegas (1999) also of Chile explores the voucher programs using a national assessment data set (SIMCE) that includes information on teacher demographics and labor market characteristics, as well as teacher perceptions about school management. The study finds that when teacher data is matched with school-level data on student achievement, some teacher and school characteristics affect student performance, but a great deal of unexplained variance among sectors remains important in predicting student outputs. Moreover, teacher education, decentralization of decision-making authority, school's schedule enforcement and teacher's autonomy in designing teaching plans and implementing projects all appear to affect student outputs. Teacher autonomy was found to have a positive effect on student outputs only when decision-making authority is decentralized.

Increased Local Autonomy in Zimbabwe

An example of increased local autonomy that failed is that of Zimbabwe. In the late 1980's the Ministry of Education issued rulings to delegate decision-making power to local communities for construction of primary schools, authority to hire and fire teachers, and disbursing to schools the per capita grants and teacher's salaries paid to them by the education ministry. The Ministry of Education retained the authority of designing the curriculum, conducting examinations, and training teachers. This new system had some difficulties. Teachers were not getting paid on time, and some district councils were found retaining some of per-pupil grants for non-educational activities instead of passing them to individual schools. Moreover, the central government discovered numerous wages paid to phantom teachers. In summary, the efforts for

education decentralization in Zimbabwe failed and overall quality of education stayed low.[72]

Decentralization Reform in Minas Gerais, Brazil

In Minas Gerais, Brazil, in the early 1990s, low student test scores and high repetition and dropout rates raised concerns about the education system. Only about 40% of students completed all eight grades of primary school. The low performance of education outputs was attributed to inadequate funding, poorly trained teachers, rigid pedagogies, and over regulated management.[73] The state government then enacted an educational reform to grant financial, administrative, and pedagogical autonomy to elected boards in each school composed of teachers, parents, and students over the age of sixteen. Each board was given autonomy to decide in a democratic fashion how to spend grant funds and locally raised education revenues. The boards were also allowed to decisions on curriculum, pedagogy, the school calendar, and other functions. However, teachers' union bargaining was maintained at the state level. Lobo et al. (1995) state that school autonomy and greater transparency in decision-making in Minas Gerais has led to increased operational efficiency. Although an empirical evaluation of the effects of greater school autonomy in Minas Gerais has not been performed, early results of the 1994 student achievement tests of third graders show that in comparison with 1992, scores rose by 7 percent in science, 20 percent in Portuguese, and 41 percent in mathematics.

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[72] Fiske (1996), pp. 19-20.
[73] Fiske (1996), pp. 14-15.

School Autonomy and Decentralization in The Netherlands[74]

The Dutch education system has been decentralized and demand-driven since 1917. Almost 70 percent of schools in the Netherlands are administered and governed by private school boards. Public and private schools are funded by the government on an equal footing, and most parents have a choice of several schools near their homes.

Parental choice has spurred some schools to develop a unique profile and to improve the education they offer. While schools are free to determine what is taught and how, the Ministry of Education does impose a number of statutory quality standards. The Education Inspectorate is charged by the Minister of Education with supervising the manner in which schools fulfill their responsibilities.

In recent years, there has been a trend towards greater autonomy and decentralization. Many central government powers have been transferred to the level of the individual school. Central government control is increasingly confined to broad policy-making and to creating the right conditions for the provision of quality education. Institutions are being given greater freedom in the way they allocate their resources and manage their own affairs, although they still answer to government for their performance and policies. Schools receive extra funds to combat educational disadvantage. Additional funding is provided for schools in districts and regions with high numbers of underprivileged families.

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[74] See Patrinos (2000).

School Voucher System in Sweden[75]

Sweden has carried out a radical reform of its primary and secondary school system in the 1990s. A voucher system has replaced the earlier centralized system, and a parental choice reform has been instituted. Under the new system, all independent schools approved by the National Agency for Education are entitled to public funding. Parents are free to choose any school for their children. This has lead to a significant rise in both the number of independent schools, and in the number of students attending independent schools.

New school enrollment rules allows money to follow students, and municipalities are required to provide capitation grants to each private school equal to 85 percent of the public school cost. This new funding system enables nearly 90 percent of the private schools to be free from charging fees. As a result, enrollments in private schools continue to grow, more than doubling in recent years to reach almost 3 percent of total enrollments.

The Nacka municipality, outside Stockholm, created this particularly effective voucher system. Each year, parents are given a catalog profiling all the local schools plus a voucher that is to be handed over to the school of their choice. (Sweden, incidentally, is one of the few countries where an actual physical voucher is used.) Parents who do not choose a school are contacted by some of the closest schools to encourage an active choice. Active choice also is promoted by requiring parents to present a new voucher before the first, fourth, and seventh grade even if the child is attending the same school. Private and public schools alike follow the national curriculum. The competition this has

[75] Ibid.

caused between schools for pupils has resulted in more efficient allocations of funds and clearer institutional focus. However, fears that increased competition from independent schools would hurt public schools are thus found not to be warranted.

Capitation Grants in Armenia[76]

The government of Armenia, under its Model Charter for autonomous schools, is embarking on a reform strategy that will place more responsibility at school level. The project will support establishment of the necessary framework for managing education reform, including development of detailed implementation plans and capacity building for reforms of school finance and governance. Schools will receive lump sum funding from the Treasury on a capitation basis, and will be free to allocate these funds between different inputs within specified limits such as minimum salary rates. They will manage their budgets themselves, with the exception of major capital expenses. Newly established school boards, managed by principals selected by the board will manage budgets. Pilot implementation has just begun in 10 percent of the country's schools. The project funds technical assistance to help in defining details of the new funding formula, legal and regulatory framework, accountability and reporting requirements, and will fund training of school principals, board members and accountants.

The Pilot School Improvement Program is designed to build management capacity at the school level to match the autonomy reforms by providing grants up to $10,000 to schools for self-identified projects. These will be for investment projects, and

[76] Prepared by Grace Lang in response to a query from the Educational Advisory Service. Reproduced here for the Decentralization & School-Based Management Resource Kit. Coordinated by Karen Edge, Education Reform and Management Group, HDNED, World Bank (2000).

not for normal recurrent costs or reconstruction/civil works. Typical components so far have included purchase of equipment and teaching materials, teacher training in new subjects/methods–geared either to teaching the core curriculum better, or to introducing extra-curricular classes. Projects must show a strategy for sustainability and have included providing paid services to the community (e.g., computer or language training) or selling product of extracurricular vocational activities (e.g., agricultural/food products). Schools must be autonomous and finance 10 percent of costs.

Spain's Democratization and Decentralization Reform

Over the past 20 years, Spain has decentralized many aspects of its formerly centralized education system to 17 Autonomous Communities (ACs). The ACs were established in 1978, to support the transition to democracy from the former dictatorship government. This regional democratization also accommodated the historic regions (Catalonia, Basque Country and Galicia) that were demanding autonomy. Throughout Spain's 20-year decentralization process there have been interruptions often due to changes in elected national governments. In January 2000, after a 20-year decentralization process, the last of the 17 regional governments received decision-making authority over education (Hanson 1997).

The decentralization process in Spain began after General Franco's death in 1975 and marked the end of his 40-year authoritative and centralized regime. Under Franco, education served the elite. Textbooks and curriculum were strictly centralized in support of religion, Franco and the regime. Hanson notes that, "prior to the democratic transition of 1977 (when the first free elections were held), the system of public education at the

elementary, secondary and university levels was frequently characterized in the research literature as administratively and organizationally centralized, economically under-funded, politically controlled, and academically conservative."

In 1978, the 50 provinces were reconfigured into 17 ACs. The ACs reestablished many historic regions around language, tradition, and culture. Each AC was required to establish democratically elected parliaments and adopt a degree of self-rule. The decentralization to the regions was designed to be implemented gradually, based on their administrative capacity. In 1980, 6 of the 17 regions had been decentralized. The Ministry of Education (MEC) established the “minimum academic requirements” on curriculum content to meet the goal of having one educational system composed of 17 integrated, semi-autonomous bodies rather than separate educational systems. The requirements formalized the MEC’s regulation of 55 to 65 percent of the curriculum, while still granting curricular freedom to reflect local and regional priorities.

The central government established a block grant funding system. The ACs received block transfers that included funding for education, health, and transport. In addition, Inter-Territorial Compensation Funds (FCI) were established to achieve greater financial equity between wealthy and impoverished regions. By 1996, education spending had increased to over 5 percent of GDP compared to 1.8 percent in 1975.

In 1985, Spain enacted the Right to Education Law (LODE), reinforcing the decentralization and democratization of education. After this law, the following administrative structure was enforced (Hanson 1997):

State School Council (Consejo Escolar del Estado). The CEE is an 80 member national level advisory body. It is required to meet at least once a year and provide feedback on the state of education in Spain. The council and its members are also encouraged to submit proposals for educational change. The CEE membership includes

representation from: teachers; parents; administrative and staff; trade unions; private schools; tertiary institutions; MEC administrators (10%); and, education scholars. The presence of Ministry appointed delegates (10%) has often served as a disincentive for Council members to critique Ministry proposals and has often challenged the effectiveness of the Council.

Conference of Education Counselors. The Conference brings the Minister of Education and the Chief Education Officers from each AC. It is required to meet at least once a year and is comprised of 5 subcommittees that explore a range of educational issues. Hanson notes that the Conference has faced challenges due to the politics of the participants.

Education Council (Consejos Escolares del Centro). The LODE established Consejos Escolares del Centro (CEC) in each of the 17 ACs. According to Hanson, there were few CECs in effect during the first years of the reform.

Local School Council (Consejos Escolares). LODE also required the creation of Consejos Escolares (CE) in every public and private school receiving government funding.

School Principal. The primary focus of the principal is implementing the policies of the CE. The principal's responsibilities also include managing the school budget and overseeing personnel issues. The principal also works with the Chief of Academic studies to guide the teaching and learning processes. The school principal is elected by an absolute majority vote of the School Council members and can be fired by a two-thirds majority.

After 20 years of decentralization reform Hanson and Ulrich (1994) state that "School Based Management (SBM) is playing an important symbolic role in democratic participation at the local level, but has not as yet demonstrated the anticipated improvement in administrative processes." While the three different levels of administration were designed to collaborate and work together, there is little or no evidence that this has occurred. The authors also note that "almost without exception, the interviews conducted for this study revealed that educators…recognized that the practice of school-based management was not proving to be an effective mechanism for improving the quality of management and/or education in the schools."[77]

[77] Hanson and Ulrich (1994), page 20.

While SBM may not yet have achieved all of its stated goals, it has been successful in establishing a more widespread acceptance of the government's commitment to democratic participation. The number of public schools increased from 1,100 in 1975 to approximately 3,000 in 1995, thus increasing access to education. Moreover, in 1975, only 70 percent of 14 year olds were in school compared to approximately 100 percent of 15 year olds enrolled in 1995.[78] Unfortunately, the long-term impact of these changes has yet to be observed and evaluated.

Education Decentralization Efforts in Mexico

Before the Mexican educational reform in 1993, the education system was highly centralized and highly inefficient. One out of seven primary-age students lacked access to school, and in poor states such as Chiapas less than 20 percent of students were in school. In addition, newly hired teachers waited over a year for their first paychecks, and any mistakes would have to be corrected by a costly and time-consuming trip to the capital.[79]

The education decentralization process was implemented in three stages. Between 1978 and 1982, the Ministry of Education deconcentrated management of the education system to each of the thirty-one states of Mexico. Each state was given responsibility from budgeting and managing schools to the writing of curriculum and textbook choice. Revenue generation, core curriculum design and labor policy remained at the central level. During this first stage of reform, preschool enrollments increased, as well as

[78] Hanson (1997), page 15.
[79] Fiske (1996), page 17.

primary and secondary enrollment rates, especially in rural areas (Mexico's education decentralization process 1993).

During the second phase of the reform, 1983 to 1988, the government intended to transfer additional control to the authority of the states. Nevertheless, it failed because of teacher unions' opposition of negotiating with thirty-one states. Moreover, central government staff members resisted due to their interests in the centralized system and their long-standing cooperative arrangements with teachers (Fiske 1996).

In 1988, a new government came to power and negotiated an agreement with the national teachers union which permitted the 1993 "Ley General de la Educación." This new law transferred most educational decision-making authority for primary and secondary schools to the state governments. However, the central government's role in financing education through negotiated transfers to the states resulted in *de facto* continued centralization. It was not until 1998 that decentralization was in place when education transfers became automatic. The central government continues to directly operate a system of rural schools called CONAFE (National Board for Educational Improvement), which ensures learning opportunities for remote rural areas, especially for indigenous children (Fiske 1996).

While decentralization efforts in Mexico have not been primarily focused on improving learning, some components of the reform may have a positive impact on learning such as changes in teacher evaluations and pay as well as additional resources for poor and indigenous rural children. While CONAFE schools give parents a more important role than is found in the traditional public schools, teachers and parents are not yet actively engaged in leads to learning improvements at the level of the school. An

empirical study would help to determine any learning output improvement from education decentralization reforms.

From Decentralization to Centralization to Decentralization in Colombia[80]

Colombia is an interesting case of a country that implemented centralization reforms to correct a failed decentralized system. After twenty years, Colombia once again implements decentralization reforms as a medium of improving public services.

Following World War II, Colombia implemented decentralization reforms to break up an "oligarchical democracy" where political elites of the Conservative and Liberal Parties and the Roman Catholic Church controlled the country. Under the original decentralization reform, local municipalities exercised considerable control over education but lacked the financial, administrative, and political capacity to generate revenues, manage schools, and deal with teacher strikes.

The centralized system established in 1970 was created to correct the decentralized system. The Ministry of Education in Bogotá controlled all important decisions regarding curricula, textbooks, and other matters of educational policy. In addition, teachers were employees of the central government whose salaries were negotiated at the central level. This new system was successful at improving educational efficiency and at ending teacher strikes. However, after two decades, the centralized system developed into bureaucratic arteries which were unable to cope with growing demands for local autonomy. Moreover, during the centralized system, late 1980s,

[80] Fiske (1996), pages 1-4.

Colombia was at the edge of political, economic, and social collapse. Terrorist guerrillas and the corrupting influence of drug cartels had invaded the country. The government's step to restore credibility was to give ordinary citizens a greater role in managing public institutions.

The first step into greater decentralization was in 1985, when popular elections of the mayors of Colombia's 1,024 municipalities and thirty-three state governors were instituted. In 1989, Congress approved to give municipalities a greater role in decisions of the education and health sectors. The government's new decentralization reform was an effort to "municipalize" basic education and to increase the autonomy of local schools. Financial resources were transferred to municipalities and departments, and schools were given responsibility for managing personnel, design parts of the curriculum, and control aspects of finance. Moreover, parents and teachers were to gain greater voice in running schools and a voucher system for poor students was instituted at the secondary level. The legislation was adopted in 1993 and 1994 after continuous resistance from teacher unions. Local schools did not obtain autonomy to select, hire, and sanction personnel. A system of teacher evaluation was established, but measures of student output, such as test scores, were excluded.

The effects of the new decentralization reform were mixed. The 1994 budget for education increased to 3.65 percent of GDP, which was above the target figure of 3.5 percent. In addition, parent and community groups were not well organized, nor were the mayors and governors who had been recently elected. In summary, the decentralization effort in Colombia was successfully at improving legitimacy of the government, but the

impact was diminished by failure of support from important players including governors, community members and teachers.

Indonesia and Philippine's Local Funding

James, King and Suryadi (1996) investigate the impact of private vs. public finance of education and private vs. public management of schools on school cost and efficiency. The authors use a multi-product production function subject to a budget based on central government funding and local sources (parental fees and contributions). A Cobb-Douglas variable cost function is then derived and empirically tested to estimate efficiency as the cost per student of achieving a given level of academic performance and a given level of enrollment. A key issue in the cost function estimation is the presence of endogeneity in the source of funding. Instruments for local share of funding are then used to solve the issue.

James, King and Suryadi find that in Indonesia, where schools generally operate at very low funding levels, more money is likely to bring better school quality as measured by examination scores. Private management is found to be more efficient than public management in achieving academic quality. Moreover, this study finds that local funding further enhances efficiency whether the school is public or private; however, the incremental effect declines as the local funding share increases.

In the study of the impact of local contributions on the efficiency of management and finance in Indonesia, the authors measure only the fiscal dimension of community funding and not the decision-making community involvement. Since community and parental contributions plays an important role in education funding (30 percent of total

education funding) in Indonesia, does the community and parental associations have a word in the decision-making process of education functions? If yes, how does it contribute to efficiency effect estimated? These are some of the questions that could be further explored about education decentralization in Indonesia.

Concluding Thoughts

Based on the country experiences with education decentralization presented in this appendix, we can observe that education decentralization reforms vary from country to country, starting from the motives for implementation to the mix of decision power devolution. Moreover, once again we see that the results of these reforms are mixed. There is no consensus in the literature as to the impact of education decentralization on education output. The influence of education decentralization on education output can only be determined empirically.

APPENDIX B

THEORETICAL APPENDIX

The problem of the social planner is to maximize the following production function:

$$O_{i,t} = f(X_{i,t}, S_{i,t}, E_{i,t}, \bar{D}) \tag{1a}$$

subject to

$$P_i(X_{i,t}, S_{i,t}, E_{i,t}) \leq \overline{B} \tag{2a}$$

where

$$X_{i,t} = g(\bar{D}, Z^1{}_{i,t}) \tag{3a}$$

$$S_{i,t} = h(\bar{D}, Z^2{}_{i,t}) \tag{4a}$$

$$E_{i,t} = j(w_{i,t}, \bar{D}, a_{i,t}, Z^3{}_{i,t}) \tag{5a}$$

We set up the Lagrange function as follows:

$$\mathrm{L} = f(X_{i,t}, S_{i,t}, E_{i,t}, \bar{D}) + \lambda[\overline{B} - P_j(X_{i,t}, S_{i,t}, E_{i,t})] \tag{6a}$$

setting the partial derivatives of L equal to zero, with respect to each of the variables we wish to optimize $X_{i,t}, S_{i,t}, E_{i,t}$ (for simplicity we disregard the subscripts):

$$\frac{\partial L}{\partial X} = O_X^{'} - \lambda P_X^{'} = 0 \tag{7a}$$

$$\frac{\partial L}{\partial S} = O_S^{'} - \lambda P_S^{'} = 0 \tag{8a}$$

$$\frac{\partial L}{\partial E} = O_E^{'} - \lambda P_E^{'} = 0 \tag{9a}$$

$$\frac{\partial L}{\partial \lambda} = \overline{B} - P_j(X_{i,t}, S_{i,t}, E_{i,t}) = 0 \tag{10a}$$

Solving for λ in equation (7-9), yields the following equations:

$$\lambda = \frac{O_X^{'}}{P_X^{'}} \tag{7'a}$$

$$\lambda = \frac{O_S^{'}}{P_S^{'}} \tag{8'a}$$

$$\lambda = \frac{O_E^{'}}{P_E^{'}} \tag{9'a}$$

Substituting for λ into equations (7-9), yields the following:

$$\frac{O_X^{'}}{O_S^{'}} = \frac{P_X^{'}}{P_S^{'}} \tag{10a}$$

$$\frac{O_X^{'}}{O_E^{'}} = \frac{P_X^{'}}{P_E^{'}} \tag{11a}$$

$$\frac{O_S^{'}}{O_E^{'}} = \frac{P_S^{'}}{P_E^{'}} \tag{12a}$$

APPENDIX C

DATA DESCRIPTION AND SOURCES

Table C1. Data Sources

Variable	Variable Description	Primary Data Source
A) Measures of Education Output		
Primary Dropout Rate	Proportion of pupils who start primary school but do not eventually attain the final grade of primary school.	Barro, J. Robert and Jong-Wha Lee, 2000, updated with World Bank's EdStats 2006.
Primary Repetition Rate	Proportion of pupils who are enrolled in a given grade and enroll in the same grade in the following school year.	Barro, J. Robert and Jong-Wha Lee, 2000, updated with World Bank's EdStats 2006.
Primary Net Enrollment Rate	Ratio of official school-aged children enrolled in primary school to the total population of children of official primary school age.	World Bank's World Development Indicators 2004 CD-ROM; updated with OECD's Education Stats 2006 and World Bank's EdStats 2006.
Primary Completion Rate	Ratio of the total number of students successfully completing or graduating from the last year of primary school in a given year to the total number of children of official graduation age in the population.	World Bank's World Development Indicators 2004 CD-ROM; updated with OECD's Education Stats 2006 and World Bank's EdStats 2006.
Test Scores	Examinations in mathematics, science and reading conducted in various years for primary and secondary students of the same age or grade group. Scales range from 0 to 1000, with a mean of 500 and standard deviation of 100. For comparability of data we transformed all data to percentage form.	Barro, J. Robert and Jong-Wha Lee, 2000 and updated with TIMSS 1995 and 2003 results.
B) Measures of Family Inputs		
GDP per capita (PPP)	GDP per capita based on purchasing power parity (PPP). PPP GDP is gross domestic product converted to international dollars using purchasing power parity rates. An international dollar has the same purchasing power over GDP as the U.S. dollar has in the United States. GDP is the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products. It is calculated without making deductions for depreciation of fabricated	World Bank's World Development Indicators 2004 CD-ROM

	assets or for depletion and degradation of natural resources. Data are in current international dollars.	
Real GDP per capita (PPP) (in Log)	Log of GDP per capita.	World Bank's World Development Indicators 2004 CD-ROM
Percentage of "Primary School Complete" in population 25 and over	A measure of education attainment in terms of the percentage of population over the age of 25 years that have completed primary education level.	Barro, J. Robert and Jong-Wha Lee, 2000.
Average years of Primary Schooling in population 25 and over	A measure of education attainment in terms of the average years of primary schooling for the total population over the age of 25 years.	Barro, J. Robert and Jong-Wha Lee, 2000.
Average years of Schooling in Population 25 and over	A measure of education attainment in terms of the average years of schooling for the total population over the age of 25 years.	Barro, J. Robert and Jong-Wha Lee, 2000.
Fertility Rate	Total fertility rate represents the number of children that would be born to a woman if she were to live to the end of her childbearing years and bear children in accordance with prevailing age-specific fertility rates.	World Bank's World Development Indicators 2004 CD-ROM
C) Measures of School Resources:		
Real Gov't Current Education expenditure Per pupil – Primary (PPP)	Real government education expenditure per pupil at the primary school level.	Barro, J. Robert and Jong-Wha Lee, 2000.
Pupil-teacher Ratio Primary School	Measure of average number of pupils per teacher at the primary level for any given year.	Barro, J. Robert and Jong-Wha Lee, 2000, update with UNESCO and OECDstats 2006.
School Days (no.)	The length of the school year in terms of days.	Barro, J. Robert and Jong-Wha Lee, 2000.
Real Primary Teacher Salary (PPP)	Average real salary of primary school teachers.	Barro, J. Robert and Jong-Wha Lee, 2000, update with UNESCO and OECDstats 2006.
D) Measures of Decentralization		
Expenditure Decentralization - All	Share of expenditures of all sub-national governments (net of transfers to other levels of government) in total expenditures of consolidated central budget measured in percents. Scale from 0 to 100.	Database on Fiscal Indicators, by the World Bank, based on IMF's Government Finance Statistics. Data from Government Finance

Education Decentralization decision-making autonomy	Level at which decisions are taken in various functions in education: organization of instruction, planning and structures; personnel management; and resources.	Statistics 2004 was added OECD (1995), and OECD's *Education at a Glance* 1998, 2003.
E) Other Explanatory Variables		
Population density	Population density is midyear population divided by land area in square kilometers.	World Bank's World Development Indicators 2004 CD-ROM
Rule of Law	And index on a scale of 0 to 6 that measures perceptions of crime, the effectiveness, independence, and impartiality of the judiciary. In general, it measures the extent to which economic agents respect the rules that govern their interactions. The higher the score, the better the performance of the respective country.	Kaufman and Kraay (2002)
Corruption Indices	An index on a scale of 0 to 6 that measures perceptions of corruption. Corruption in this context is defined as the exercise of public power for private gain. A higher score indicates lower expectations of corruption.	Transparency International
Political Rights	A country rating on a scale of 1 to 7 that indicates the degree of political rights in regard to existence of free and fair elections, competitive parties or other political groupings, an opposition that plays a significant role in political decision-making, and the rights of minority groups to self-government. A rating of 1 indicates highest level of political rights (closest to ideals) suggested in the survey.	Freedom in the World 2003; Freedom House
Civil Liberties	A country rating on a scale of 1 to 7 that indicates the degree of civil liberties in regard to aspects such as the degree of freedom of expression, assembly, association, education, religion, and an equitable system of rule of law. A rating of 1 indicates the highest level of civil liberties.	Freedom in the World 2003; Freedom House
Freedom	An average of the index of political rights and the index of civil liberties.	Kagundu (2006)

Table C2. Descriptive Statistics

Variables		Mean	Std. Dev.	Min	Max	Observations
Education Indicators						
Primary Dropout Rate	overall	7.614216	10.15053	0	41	N = 204
	between		9.000619	0	37.93333	n = 57
	within		3.502271	-7.969117	19.86422	T-bar = 3.57895
Primary Repetition Rate	overall	3.119487	3.106699	0	15	N = 195
	between		2.632106	0	11.08	n = 57
	within		1.38879	-2.120513	12.0052	T-bar = 3.42105
Net Enrollment Rate	overall	93.88623	5.834477	72	101	N = 193
	between		5.618859	76	100	n = 59
	within		2.932492	75.34123	103.5577	T-bar = 3.27119
Primary Completion Rate	overall	95.22234	8.075666	61	107.6	N = 141
	between		6.571977	76.20555	103.3	n = 53
	within		4.929043	71.88901	108.7668	T-bar = 2.66038
Science Test Scores Primary Level	overall	54.58696	4.600773	46.6	66.9	N = 46
	between		3.532338	47.3	59.7	n = 23
	within		3.402137	46.93695	62.29946	T-bar = 2
Family Inputs:						
Real GDP per capita (PPP)	overall	14386.08	9859.483	729.1319	57296.92	N = 236
	between		9055.029	844.6488	33177.55	n = 61
	within		3311.968	2495.88	38505.45	T-bar = 3.86885
Real GDP per capita (PPP) (in Log)	overall	9.235264	0.9418597	6.591855	10.956	N = 236
	between		0.9587599	6.729481	10.34176	n = 61
	within		0.1757107	8.692822	9.927343	T-bar = 3.86885
Percentage of "Primary School Complete" in population 25 and over	overall	18.98112	8.641359	3.7	42.7	N = 143
	between		8.494092	4.06	41.65	n = 40
	within		3.333876	10.93112	31.24112	T = 3.575
Average years of Primary Schooling in population 25 and over	overall	4.879951	1.2636	1.915	7.667	N = 143
	between		1.267869	2.480667	7.6615	n = 40
	within		0.2560874	4.133551	5.899284	T = 3.575
Average years of Schooling in Population 25 and over	overall	7.887161	2.401819	2.359	12.247	N = 143
	between		2.30873	3.243667	12.0086	n = 40
	within		0.6068424	5.928561	9.50456	T = 3.575
Fertility Rate	overall	3.671114	1.821308	0.9483333	7.3	N = 226
	between		1.713694	1.080378	6.82275	n = 59
	within		0.5294255	0.8369716	5.638472	T-bar = 3.83051
School Resources:						
Real Gov't Current Education expenditure Per pupil – Primary (PPP)	overall	2502.147	2130.809	62.2	9744.4	N = 151
	between		1910.119	62.2	6596.05	n = 54
	within		1033.885	-437.9136	5750.487	T = 2.7963
Real Govt Current Education expenditure Per pupil –Primary (% of GDP per capita	overall	17.5346	8.011231	3	50.6	N = 216
	between		7.51456	3	36.35	n = 58
	within		4.069974	-3.798735	36.4346	T-bar = 3.72414

Pupil-teacher Ratio	overall	19.05627	8.090012	6.1	60.6	N = 234
Primary School	between		7.082374	8.7	47.65714	n = 61
	within		2.662903	9.099125	31.99912	T-bar = 3.83607
School Days (no.)	overall	194.0311	14.11755	165	234	N = 161
	between		14.71394	165	234	n = 45
	within		0	194.0311	194.0311	T = 3.57778
Real Primary Teacher	overall	9.733677	0.812774	6.909753	11.11033	N = 108
Salary (PPP)- Log	between		0.8050884	7.726287	10.82472	n = 41
	within		0.2541529	8.917142	10.55021	T = 2.63415
Decentralization Indicators:						
Expenditure	overall	21.57483	16.35571	1.521749	77.98507	N = 410
Decentralization - All	between		15.761	1.533219	61.84563	n = 102
	within		3.94572	-13.95999	43.30912	T-bar = 4.01961
Education Expenditure	overall	50.89109	32.42615	0	100	N = 239
Decentralization -	between		32.04365	0	94.70226	n = 62
Sub-national	within		7.324805	22.18322	84.86884	T-bar = 3.85484
Education Expenditure	overall	21.57483	16.35571	1.521749	77.98507	N = 89
Decentralization -	between		15.761	1.533219	61.84563	n = 30
Local	within		3.94572	-13.95999	43.30912	T-bar = 2.96667
Decision-making	overall	71.30822	26.81503	0	100	N = 73
Sub-national level-	between		26.11101	0	100	n = 39
All functions	within		13.85031	13.97489	121.3082	T-bar = 1.87179
Decision-making	overall	16.10959	23.11659	0	91	N = 73
Intermediate level-	between		21.43068	0	91	n = 39
All functions	within		13.37182	-8.557078	64.10959	T-bar = 1.87179
Decision-making	overall	18.71918	21.59362	0	71	N = 73
Local level-	between		16.88965	0	70	n = 39
All functions	within		14.67747	-15.61416	66.05251	T-bar = 1.87179
Decision-making	overall	38.17808	19.66338	0	100	N = 73
School level-	between		16.73329	0	79	n = 39
All functions	within		11.87278	8.511416	74.51142	T-bar = 1.87179
Other Control Variables:						
Population Density	overall	190.6309	712.8033	1.410518	6502.879	N = 229
	between		799.7825	1.492294	6156.897	n = 61
	within		42.82184	-282.7153	536.6128	T-bar = 3.7541
Rule of Law	overall	4.704951	1.589269	0.44	6	N = 138
	between		1.412164	1.25	6	n = 39
	within		0.6113412	2.378951	6.938951	T = 3.53846
Corruption Indices	overall	4.502286	1.468823	0.02	6	N = 138
	between		1.398543	1.353333	6	n = 39
	within		0.3860097	3.008432	5.718432	T = 3.53846
Freedom	overall	2.04108	1.438384	1	6.7	N = 145
	between		1.494367	1	6.7	n = 40
	within		0.3940374	0.3410806	4.52108	T = 3.625

Table C.3 List of All Sample Countries

Latin America & Caribbean
Argentina
Bolivia
Chile
Ecuador
Mexico
Panama
Paraguay

East Asia & Pacific
China
Indonesia
Mongolia
Thailand

Europe and Central Asia
Albania
Azerbaijan
Belarus
Bulgaria
Croatia
Czech Republic
Estonia
Georgia
Hungary
Kazakhstan
Kyrgyz Republic
Latvia
Lithuania
Moldova
Poland
Romania
Russian Federation
Slovak Republic
Slovenia
Tajikistan
Turkey
Ukraine

South Asia
India

Sub-Saharan Africa
Mauritius
Zimbawe

OECD
Australia
Austria
Belgium
Canada
Denmark
Finland
France
Germany
Greece
Iceland
Ireland
Italy
Japan
Korea, Rep.
Luxembourg
Netherlands
New Zealand
Norway
Portugal
Spain
Sweden
Switzerland
United Kingdom
United States

Non-OECD
Greenland
Israel

Table C.4 List of Sub-Sample of Countries

OECD
Australia
Austria
Belgium
Denmark
Finland
France
Germany
Greece
Iceland
Ireland
Italy
Japan
Korea, Rep.
Luxembourg
Netherlands
New Zealand
Norway
Portugal
Spain
Sweden
Switzerland
United Kingdom
United States

Latin America & Caribbean
Argentina
Chile
Mexico
Paraguay
Uruguay

Middle East & North Africa
Jordan

South Asia
India

Europe and Central Asia
Czech Republic
Hungary
Slovak Republic
Turkey

East Asia & Pacific
China
Indonesia
Malaysia
Philippines
Thailand

Table C.5 Correlation Matrix

	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)
(a)	1														
(b)	0.51	1													
(c)	-0.89	-0.07	1												
(d)	-0.74	-0.44	0.69	1											
(e)	-0.41	-0.48	0.35	0.46	1										
(f)	0.67	-0.08	-0.82	-0.76	0.06	1									
(g)	0.18	-0.75	-0.59	0.00	0.18	0.54	1								
(h)	-0.34	0.51	0.64	0.42	-0.35	-0.90	-0.77	1							
(i)	0.00	0.66	0.35	0.29	-0.45	-0.73	-0.68	0.93	1						
(j)	-0.71	-0.36	0.66	0.96	0.19	-0.85	-0.04	0.57	0.44	1					
(k)	0.44	0.88	-0.09	-0.28	-0.76	-0.29	-0.62	0.67	0.83	-0.09	1				
(l)	0.67	0.16	-0.66	-0.06	-0.37	0.17	0.41	-0.06	0.28	0.02	0.37	1			
(m)	-0.49	-0.44	0.40	0.92	0.22	-0.66	0.21	0.37	0.34	0.94	-0.16	0.30	1		
(n)	0.49	0.24	-0.42	-0.72	0.27	0.80	0.00	-0.62	-0.54	-0.89	-0.17	-0.23	-0.84	1	
(o)	-0.89	-0.35	0.88	0.94	0.38	-0.87	-0.24	0.57	0.33	0.92	-0.22	-0.35	0.77	-0.70	1

Variables Definition

(a)	Dropout rate	(f)	Education decentralization	(k)	Average years of schooling of adults
(b)	Repetition rate	(g)	Fiscal Decentralization	(l)	Per pupil spending (% GDP per capita)
(c)	Net enrolment rate	(h)	Fertility rate	(m)	Log of GDP per capita
(d)	Completion rate	(i)	Pupil-Teacher ratio	(n)	Infant mortality
(e)	Science Test Scores	(j)	# school days	(o)	Population Density

Table C.6 International comparative tests of student learning

Date of Testing	Sponsor	Study	Age Groups tested	No. of countries
1964	IEA	First International Mathematics Study (FIMS)	13, 17/18	12
1970-71	IEA	First International Science Study (FISS)	10, 14, 17/18	19
1980-82	IEA	Second International Mathematics Study (SIMSS)	13, 17/18	21
1984	IEA	Second International Science Study (SISS)	10, 14, 17/18	23
1988	IEA	International Association for the Evaluation of Educational Progress first study (IAEP 1): Mathematics and Science	13	6
1991	IEA	International Association for the Evaluation of Educational Progress first study (IAEP 2): Mathematics and Science	9, 13	20
1995	IEA	The Third International Mathematics and Science Study (TIMSS-95)	9, 13, 17/18	46
1999	IEA	Trends in International Mathematics and Science Study (TIMSS-R 99)	13, 14	38
2000	OECD	Program for International Student Assessment (PISA) Reading, Mathematics and Science	15	32
2001	IEA	Progress in International Reading Literacy (PIRLS)	9, 10	35
2003	IEA	Trends in International Mathematics and Science Study (TIMSS-03)	8, 13	N/A
2003, 2006	PISA	Program for International Student Assessment (PISA) Reading, Mathematics and Science	15	32

Figure C.1 Partial Correlation between Completion Rates and Education Decentralization

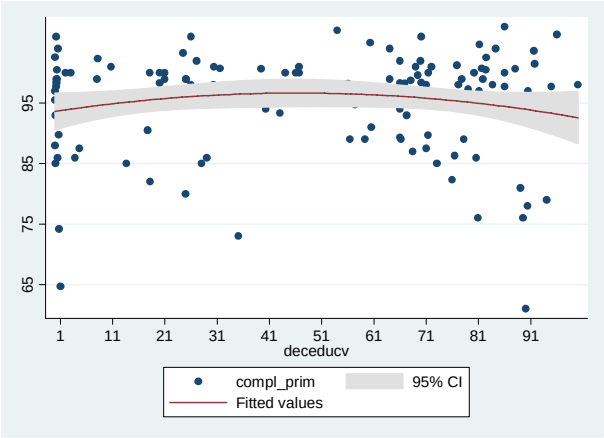


Figure C.2 Partial Correlation between Repetition Rates and Education Decentralization

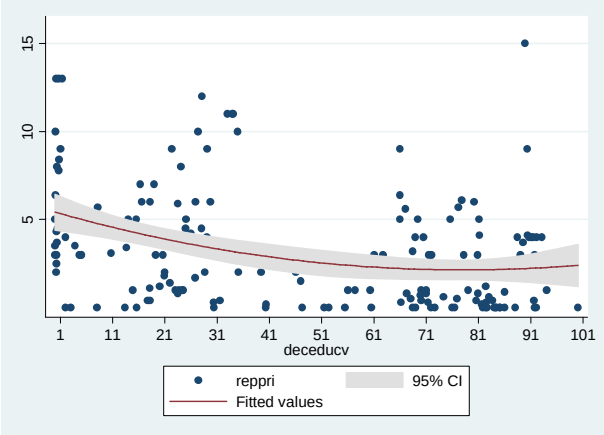


Figure C.3 Partial correlation between Dropout Rates and Education Decentralization

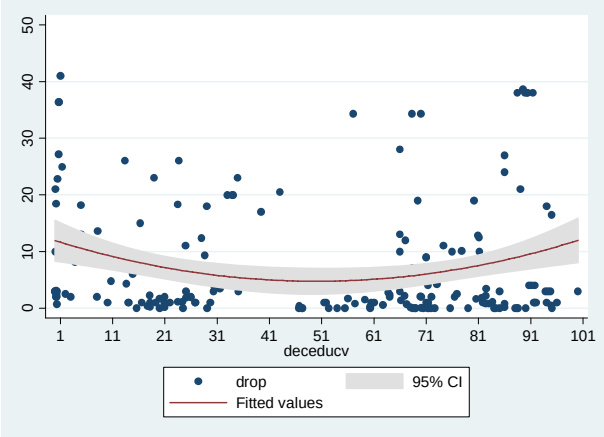


Figure C.4 Partial Correlation between Net Enrollment Rates and Education Decentralization

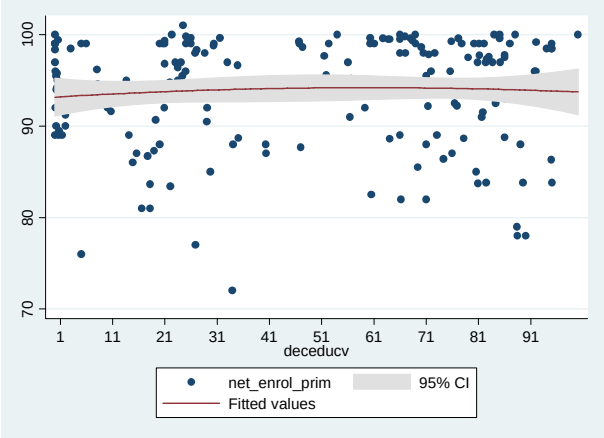
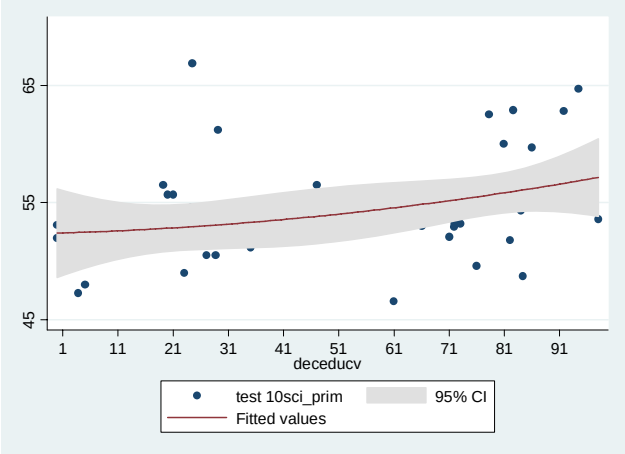


Figure C.5 Partial Correlation between Science Test Scores in Primary Level and Education Decentralization



APPENDIX D

TWO-STAGE LEAST-SQUARES ESTIMATION

An instrumental variable (IV, or instrument) can be used in regression analysis to produce a consistent estimator when the explanatory variables (covariates) are correlated with the error terms. This can be caused by endogeneity, by omitted covariates, or by measurement errors in the covariates. In this situation, ordinary linear regression produces biased and inconsistent estimates. However, if an instrument is available, consistent estimates may still be obtained. An instrument is a variable that does not itself belong in the regression, that is correlated with the suspect explanatory variable, and that is uncorrelated with the error term.

The instrument must be correlated with the model's predicting (endogenous explanatory) variable. The instrument cannot be correlated with the error term in the second stage model (that is, the instrument cannot suffer from the same problem as the original predicting variable). The instrument must act on the outcome only through the predicting variable, not directly.

An instrumental variable is one that is correlated with the independent variable but not with the error term. Suppose X is the T x K matrix of explanatory variables resulting from T observations on K variables. Let Z be a T x K matrix of instruments. Then,

$$\hat{\beta}_{IV} = (Z'X)^{-1}Z'Y = (Z'X)^{-1}Z'(X\beta + \varepsilon) = \beta + (Z'X)^{-1}Z'\varepsilon$$

One computational method often used for implementing the technique is two-stage least-squares (2SLS). Under the 2SLS approach, in a first stage, each endogenous covariate (predictor variable) is regressed on all valid instruments, including the full set of exogenous covariates in the main regression. Since the instruments are exogenous, these approximations of the endogenous covariates will not be correlated with the error term. So, intuitively they provide a way to analyze the relationship between the outcome variable and the endogenous covariates. In the second stage, the regression of interest is estimated as usual, except that in this each endogenous covariate is replaced with its approximation estimated in the first stage. The slope estimator thus obtained is consistent.

Instrumenting for Education Decentralization

In order to correct for potential endogeneity bias, we instrument for education decentralization using a dummy variable for colonial heritage, ethnic fractionalization, total population, and an indicator of governance. Colonial heritage, whether a country is a former British colony, is considered to be a good predictor of fiscal authority and organization (Diaz-Cayeros 2004; La Porta et al. 1998). The use of ethnic fractionalization follows from the link between the existence of multiple cultural, linguistic, and/or religious identities and the use of decentralized arrangements to accommodate the needs and wants of the population (Amoretti and Bermeo 2004; Linz 1999; Stepan 1999). At the same time, larger countries may adopt more decentralized systems to better cater preferences of their citizens and to bring government closer to the

people (Fisman and Gatti 2000). Furthermore, there is a link between good governance and decentralization, where good governance is a good predictor of decentralization.

Using the above instrumental variables for education decentralization, we run a reduced form model including all exogenous variables in our main regression. Table D.1 below, reports estimation results where the F test on instruments is the test statistic on the joint significance of instruments in the first-stage regression. The instruments perform well; the F-statistic of their joint significance in the first stage regression is 2.97 and is highly significant.

Table D.1 Instrumental Variables and Education Decentralization

	Pooled LS
Log Total Population	2.773*
	(1.669)
Dummy for Former British Colony	-16.072*
	(8.414)
Ethnic Fractionalization	29.987**
	(15.010)
Index of Freedom	-5.504*
	(3.179)
Pupil-Teacher Ratio	2.762***
	(0.598)
Population Density	-0.010
	(0.020)
Avg. years of Schooling (Adults >25)	1.342
	(3.343)
Ratio of per pupil Exp. to GDP p.c.	0.517
	(0.474)
# of school days	0.867***
	(0.240)
Log GDP per capita	29.154***
	(8.358)
Fertility Rate	-0.087
	(1.718)
F-Test of Instruments	2.97
	[0.0226]
Observations	126
R-squared	0.35

Note: Standard errors in parentheses. F-test of instruments, p-value in brackets.
* significant at 10%; ** significant at 5%; *** significant at 1%

APPENDIX E

ESTIMATION RESULTS

Table E.1 Pooled LS Estimates. Dependent Variable: Current Expenditures per Pupil at the Primary Level

	Pooled LS
Education Decentralization (Expenditure)	5.990* (3.383)
Net Enrollment Rate – Primary	19.806 (23.494)
Population Density	0.463*** (0.056)
Log GDP per capita	1,876.082*** (167.676)
Observations	117
R-squared	0.63

Note: Robust standard errors in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%.

Table E.2 Pooled LS Estimates. Dependent Variable: Repetition Rate

	Pooled LS	**Pooled LS**	**Pooled LS**
Educ. Decent (Expenditure)	0.028***	-0.419**	
	(0.009)	(0.190)	
Fiscal Decent. (All Expenditure)			0.057***
			(0.020)
Fertility Rate	-0.029	-0.169*	0.292*
	(0.139)	(0.100)	(0.158)
Pupil-Teacher Ratio	0.044		-0.054
	(0.046)		(0.048)
# of school days	0.013	0.007	0.055***
	(0.024)	(0.021)	(0.018)
Pop. Density	-0.001		0.005*
	(0.003)		(0.003)
Ratio of per pupil Exp. to GDP p.c.	-0.124**	0.437***	0.182***
	(0.054)	(0.094)	(0.048)
Adult Avg. years of schooling		0.889**	
		(0.420)	
Decent. x adult Schooling		-0.004	
		(0.006)	
Decent. x educ Spending		0.004***	
		(0.001)	
Log GDP p.c.		-0.860	
		(1.544)	
Decent x GDP p.c.		0.033	
		(0.020)	
Infant Mortality		0.034	0.083***
		(0.075)	(0.013)
Observations	108	108	250
R-squared	0.34	0.55	0.46

Note: Robust standard errors in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%.

Table E.3 Pooled LS Estimates. Dependent Variable: Completion Rate

	Pooled LS	**Pooled LS**
Educ. Decent (Expenditure)	0.595** (0.291)	
Fiscal Decent. (Expenditure)		0.194** (0.087)
Log GDP p.c.	6.210*** (1.655)	
Infant Mortality		-0.190** (0.084)
Pupil-Teacher Ratio		-0.598*** (0.223)
Ratio of per pupil Exp. to GDP p/c	-0.232 (0.141)	-0.386** (0.154)
Fertility Rate		-0.174 (0.516)
Decent x log GDP p.c.	-0.064* (0.033)	
Observations	81	146
R-squared	0.20	0.41

Note: Robust standard errors in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%.

Table E.4 Pooled LS Estimates. Dependent Variable: Science Test Scores

	Pooled LS	**Pooled LS**	**Pooled LS**	**Pooled LS**	**Pooled LS**
Educ. Decent (Expenditure)	0.051** (0.021)	0.056*** (0.020)	0.071** (0.027)	0.053** (0.020)	
Fiscal Decent (Expenditure)					0.132** (0.059)
Ratio of per pupil Exp. to GDP p/c	-0.321 (0.198)	-0.313** (0.128)	-0.314** (0.126)	-0.333** (0.126)	-0.150 (0.225)
Pupil-Teacher Ratio	-0.004 (0.205)				-0.363 (0.298)
Fertility Rate	0.042 (0.310)				0.595 (0.376)
Pop. Density	-0.005*** (0.001)	-0.005*** (0.001)			
Infant Mortality		-0.015 (0.108)			
Adult Avg. years of schooling			0.181 (0.628)		
Log GDP p.c.				1.443 (1.055)	2.926*** (1.303)
Observations	41	43	29	44	39
R-squared	0.24	0.25	0.28	0.22	0.36

Note: Robust standard errors in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%.

REFERENCES

Amoretti, Ugo M. and Nancy Gina Bermeo. 2004. *Federalism and Territorial Cleavages*. Baltimore, M.D.: Johns Hopkins University Press.

Arredondo, Armando and Emanuel Orozco. 2006. Effects of Health Decentralization, Financing and Governance in Mexico. *Journal of Public Health* 40, no. 1: 152-60.

Atkinson, A. 2005. *Atkinson review: Final report. Measurement of Government Output and Productivity for Government Accounts*: Palgrave, MacMillan, Basingstoke.

Bahl, Roy W. and Johannes F. Linn. 1992. *Urban Public Finance in Developing Countries*. Oxford; New York; Toronto and Melbourne: Oxford University Press for the World Bank.

Bahl, Roy W. and Shyam Nath. 1986. Public Expenditure Decentralization in Developing Countries. *Government and Policy* 4: 405-18.

Baltagi, Badi H. 1995. *Econometric Analysis of Panel Data*. Chichester ; New York: Wiley.

Behrman, Jere R. and Elizabeth M. King. 2001. Household Schooling Behaviors and Decentralization. *Economics of Education Review* 20, no. 4: 321-41.

Bird, Richard. 2000. Rationales and Forms of Decentralization. Paper Presented at the Rotman School of Management, University of Toronto.

Birdsall, N. 1993. Social Development in Economic Development. *Policy Research Working Paper Series* Working Paper No. 1123: The World Bank.

Brennan, Geoffrey and James M. Buchanan. 1980. *The Power to Tax: Analytical Foundations of a Fiscal Constitution*. Cambridge: Cambridge University Press.

Bryk, Anthony S. 1998. *Charting Chicago School Reform : Democratic Localism as a Lever for Change*. Boulder, Colo.: Westview Press.

Burki, Shahid Javed, Guillermo E. Perry, and William R. Dillinger. 1999. *Beyond the Center: Decentralizing the State*. Washington, D.C.: World Bank.

Davoodi, Hamid and Heng-fu Zou. 1998. Fiscal Decentralization and Economic Growth: A Cross-Country Study. *Journal of Urban Economics* 43, no. 2: 244-57.

Deny, Kevin J., Colm P. Harmon, and Sandra Redmon. 2000. Functional Literacy, Educational Attainment and Earnings - Evidence from the International Literacy Survey. *The Institute for Fiscal Studies,* Working Paper 00/09.

Diaz-Cayeros, Alberto. 2004. The Centralization of Fiscal Authority: An Empirical Investigation. Working Paper: Stanford University.

Dillinger, William R. and netLibrary Inc. Decentralization and its Implications for Urban Service Delivery. Published for the Urban Management Programme by The World Bank., Washington, D.C.

Elmore, Richard, B. Fuller, and G. Orfield. 1996. *Who Chooses, Who Looses? Culture, Institutions, and the Unequal Effects of School Choice*. New York: Teacher's College Press, Columbia University.

Filmer, Deon. 2002. Autonomy, Participation, and Learning in Argentine Schools: Findings and their Implications for Decentralization: The World Bank, Policy Research Working Paper Series: 2766.

Fiske, Edward B. Decentralization of Education: Politics and Consensus. World Bank,, Washington, D.C.

Fisman, Raymond J. and Roberta Gatti. 2000. Decentralization and Corruption: Evidence Across Countries. *World Bank Policy Research Working Paper* No. 2290.

Galiani, Sebastian and Ernesto Schargrodsky. 2002. Evaluating the Impact of School Decentralization on Educational Quality. *Economia: Journal of the Latin American and Caribbean Economic Association* 2, no. 2: 275-302.

Gaynor, Cathy. 1998. *Education Decentralization: Teacher Management*. Washington D.C.: The World Bank.

Godwin, R. Kenneth and Frank R. Kemerer. 2002. *School Choice Tradeoffs: Liberty, Equity, and Diversity*. Austin: University of Texas Press.

Guess, George M., William Loehr, and Jorge Martinez-Vazquez. 1997. Fiscal Decentralization: A Methodology for Case Studies: Briefing Note for CAER Consulting Assistance on Economic Reform II. Discussion Papers, No. 3.

Hanson, Mark. 1997. Education Decentralization: Issues and Challenges. *Partnership for the Educational Revitalization in the Americas* No. 9.

Hanson, Mark E. and Carolyn Ulrich. 1994. Democracy, Decentralization and School-Based management in Spain: University of California - Riverside.

Hanushek, Eric A. 1986. The Economics of Schooling: Production and Efficiency in Public Schools. *Journal of Economic Literature* 24: 1141-77.

_____. 1995. Interpreting Recent Research on Schooling in Developing Countries. *World Bank Research Observer* 10, no. 2: 227-46.

_____. 2003. The Failure of Input-Based Schooling Policies. *Economic Journal* 113, no. 485: 98.

Hanushek, Eric A. and Dennis D. Kimko. 2000. Schooling, Labor-Force Quality, and the Growth of Nations. *American Economic Review* 90, no. 5: 1184-1208.

Hanushek, Eric A. and Steven G. Rivkin. 2003. Does Public School Competition Affect Teacher Quality? In *The economics of school choice*:23-47. Chicago and London: University of Chicago Press.

Hausman, Jerry A. 1978. Specification Tests in Econometrics. *Econometrica* 46, no. 6: 1251-71.

Heyneman, S. and W. Loxley. 1983. The Effect of Primary School Quality on Academic Achievement Across Twenty-Nine High and Low-Income Countries. *American Journal of Sociology* 88: 1162-94.

Holmes, George M., Jeff DeSimone, and Nicholas G. Rupp. 2003. Does School Choice Increase School Quality?: National Bureau of Economic Research, Inc, NBER Working Papers: 9683.

Hoxby, Caroline M. 2000. Does Competition Among Public Schools Benefit Students and Taxpayers? *American Economic Review* 90, no. 5: 1209-38.

Hoxby, Caroline Minter. 1994. Do Private Schools Provide Competition for Public Schools?: National Bureau of Economic Research, Inc, NBER Working Papers: 4978.

Hsiao, C. 1986. *Analysis of Panel Data*. New York: Cambridge University Press.

Jacobson, S.L. 1998. The Effects of Pay Incentives on Teacher Absenteeism. *The Journal of Human Resources* 24, no. 2: 280-7.

James, Estelle, Elizabeth M. King, and Ace Suryadi. 1996. Finance, Management, and Costs of Public and Private Schools in Indonesia. *Economics of Education Review* 15, no. 4: 387-98.

Jimenez, Emmanuel and Vicente Paqueo. 1996. Do Local Contributions Affect the Efficiency of Public Primary Schools? *Economics of Education Review* 15, no. 4: 377-86.

Jimenez, Emmanuel and Yasuyuki Sawada. 1999. Do Community-Managed Schools Work? An Evaluation of El Salvador's Educo program. *World Bank Economic Review* 13, no. 3: 415-41.

Kagundu, Paul. 2006. The Quality of Governance, Composition of Public Expenditures, and Economic Growth: An Empirical Analysis, Georgia State University.

Kaufman, Daniel and Aart Kraay. 2002. Governance Indicators, Aid Allocation, and the Millennium Challenge account: Unpublished draft for discussion, World Bank, Washington, D.C.

King, Elizabeth M. and Berk Ozler. 2000. What's Decentralization Got to Do with Learning? Endogenous School Quality and Student Performance in Nicaragua: The World Bank, Development Research Group.

La Porta, Rafael, Florencio Lopez-de-Silanes, Andrei Shleifer, and Robert Vishny. 1998. The Quality of Government. *Journal of Law, Economics, and Organization* 15: 222-279.

Lange, David. 1988. *Tomorrow's schools: The Reform of Education Administration in New Zealand*. New Zealand: Wellington, Government Publisher.

Lee, Jong-Wha and Robert J. Barro. 2001. Schooling Quality in a Cross-Section of Countries. *Economica* 68, no. 272: 465-88.

Linz, Juan J. 1999. Democracy, Multinationalism and Federalism. In *Demokratie in Ost und West*, ed. W. Bush and A. Merkel:382-401. Frankfurt am Main: Suhrkamp.

Lobo, Thereza, André Guedes, Ana Lucia Amaral, and Robert Walker. 1995. Decentralized Management of Education in Minas Gerais, brazil. In *World Bank Seminar on Education Decentralization*. Washington D.C.: World Bank.

Lockheed, M.E. and Q. Zhao. 1993. The Empty Opportunity: Local Control and Secondary School Achievement in the Philippines. *International Journal of Education Development* 13, no. 1: 45-62.

Mahal, A., V. Srivasta, and D. Sanan. 2000. Decentralization and Public Sector Delivery of Health and Education Services: Evidence from Rural India. In *Governance, Decentralization and Reform in China, India and Russia*, ed. J. Dethier, 25:236-277. Boston, Dordrecht, London: Kluwer Academic Publishers.

Martinez-Vazquez, Jorge and Robert M. McNab. 2003. Fiscal Decentralization, Macrostability and growth. In *Working Paper No. 11/03*: Instituto de Estudios Fiscales.

McGinn, N. and T. Welsh. 1999. *Decentralization of Education: Why, When, What and How?* Edited by Fundamentals of Educational Planning Series: UNESCO.

Meuret, Denis., Jacques Prod'hom, and Eugene Stocker. 1995. *Decision-Making in 14 OECD Education Systems*. Indicators of Education Systems. Paris ; [Washington, D.C.]: Organisation for Economic Co-operation and Development.

Oates, Wallace E. 1972. *Fiscal Federalism*. New York,: Harcourt Brace Jovanovich.

Olson, Mancur. 1965. *The Logic of Collective Action; Public Goods and the Theory of Groups*. Harvard economic studies ; v. 124. Cambridge, Mass.,: Harvard University Press.

Organisation for Economic Co-operation and Development. 1998. *Education at a Glance: OECD Indicators 1998*. Paris and Washington D.C.: OECD.

_____. 2004. *Education at a glance: OECD Indicators 2004*. Paris and Washington, D.C.: OECD.

Otsuka, Keijiro, Hiroyuki Chuma, and Yujiro Hayami. 1992. Land and Labor Contracts in Agrarian Economies: Theories and Facts. *Journal of Economic Literature* 30, no. 4: 1965-2018.

Ozler, Berk. 2001. Decentralization and Student Achievement: The Case of Nicaragua's School Autonomy Reform. Ph.D.

Parry, Taryn Rounds. 1997a. Decentralization and Privatization: Education Policy in Chile. *Journal of Public Policy* 17, no. 1: 107-33.

_____. 1997b. Theory Meets Reality in the Education Voucher Debate: Some Evidence from Chile. *Education Economics* 5, no. 3: 307-31.

Patrinos, H.A. 2000. Market Forces in Education. *European Journal of Education* 35, no. 1: 61-80.

Prawda, Juan. 1993a. Education Decentralization in Latin America: Lessons Learned. *International Journal of Educational Development* 13, no. 3: 253-64.

_____. 1993b. Mexico's Education Decentralization Process. *World Bank Conference on Decentralization of Education Systems* January 12-13.

Pritchett, Lant and Deon Filmer. 1997. What Educational Production Functions Really Show?. A Positive Theory of Education Spending. *Development Research Group* Working Paper No. 1795: The World Bank.

Prud'homme, Remy. 1995. The Dangers of Decentralization. *World Bank Research Observer* 10, no. 2: 201-20.

Psacharopoulos, G. and M. Woodhall. 1985. *Education for Development: An Analysis of Investment Choices*. Oxford: Oxford University Press for the World Bank.

Ranis, G., F. Stewart, and A. Ramirez. 2000. Economic Growth and Human Development. *World Development* 28, no. 2: 197-219.

Ritzen, Jozef M. M., Jan van Dommelen, and Frans J. de Vijlder. 1997. School Finance and School Choice in the Netherlands. *Economics of Education Review* 16, no. 3: 329-35.

Robalino, David A., Oscar F. Picazo, and Albertus Voetberg. 2001. Does Fiscal Decentralization Improve Health Outputs? Evidence from a Cross-Country Analysis: The World Bank, Country Economics Department Paper Series No. 2565.

Robertson, Peter J. and Kerri L. Briggs. 1998. Improving Schools Through School-Based Management: An Examination of the Process of Change. *School Effectiveness and School Improvement* 9, no. 1: 28-57.

Rondinelli, D.A., J.R. Nellis, and G.S. Cheema. 1984. Decentralization in Developing Countries: A Review of Recent Experience: The World Bank, Staff Working Paper No. 581.

Sawada, Yasuyuki. 2000. Community Participation, Teacher Effort, and Education Outcomes: The Case of El Salvador's Educo Program: The Davidson Institute Working Paper Series No. 307, University of Michigan Business School.

Stepan, Alfred. 1999. Toward a New Comparative Analysis of Democracy and Federalism: 'demos constraining' and 'demos enabling' federations *Dados* 42, no. 2.

Stevans, Lonnie K. and David N. Sessions. 2000. Private/Public School Choice and Student Performance Revisited. *Education Economics* 8, no. 2: 169-84.

Tanzi, Vito. 1996. Fiscal Federalism and Decentralization: A Review of Some Efficiency and Macroeconomic Aspects. In *Annual World Bank Conference on Development Economics, 1995*:295-316. Washington, D.C.: World Bank.

Thomas, Kathleen M. 2001. Does the Centralization of Public Education Cause a Decline in Per Pupil Spending?: The University of Texas at Dallas, Research Scholar Working Paper.

Tiebout, Charles M. 1956. A Pure Theory of Local Expenditures. *The Journal of Political Economy* 64, no. 5: 416-424.

UNESCO. 2003. From Targets to Reform: National Strategies in Action. In *Education For All Global Monitoring Report 2003/4: Gender and Education For All: The Leap to Equality*, ed. Scientific and Cultural Organization United Nations Educational:416. New York: UNESCO Publishing.

_____. 2005. *Decentralization in Education: National Policies and Practices*. Education Policies and Strategies. Paris: United Nations Educational, Scientific,and Cultural Organization.

Vegas, Emiliana. 1999. School Choice, Student Performance, and Teacher and School Characteristics: The Chilean Case: The World Bank, Policy Research Working Paper Series: 2833.

Winkler, Donald R. and Alec Ian Gershberg. 2000. Education Decentralization in Latin America: The Effects on the Quality of Schooling. In *Annual World Bank Conference on Development in Latin America and the Caribbean, 1999: Decentralization and Accountability of the Public Sector: Proceedings of a conference held in Valdivia, Chile, June 20-22, 1999*:203-25. Washington, D.C.: World Bank.

_____. 2004. Education Decentralization in Africa: A Review of Recent Policy and Practice. In *Building state capacity in Africa: New Approaches, Emerging Lessons,* ed. Sahr John Kpundeh and Brian Levy 377. Washington D.C.: World Bank Publications.

Wong, K. 1998. Transforming Urban School Systems: Integrated Governance in Chicago and Birmingham (U.K.). In *Cross-Atlantic Conference - A Working Conference on School Reform in Chicago and Birmingham*.

Wooldridge, Jeffrey M. 2002. *Econometric Analysis of Cross Section and Panel Data*. Cambridge and London: MIT Press.

World Bank. 1995a. *Development in Practice: Priorities and Strategies for Education*. Washington D.C.: World Bank.

_____. 1995b. Staff appraisal Report: El Salvador Basic Education Modernization Project: IBRD Report: 14129-ES.

_____. 2000. Decentralization & School-Based Management Resource Kit: The World Bank. Education Reform & Management Thematic Group, HDNED.

_____. 2003. *World Development Report 2004: Making Services Work for Poor People*. Washington, D.C.: Oxford University Press.

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