Three essays on financing education: Exploring the role of the government And the private sector

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Abstract:

The role of improved schooling has become controversial because expansion of school investment has not guaranteed improved educational outcomes. This thesis pays attention to why government investments in education have not produced the desire effects of increased educational attainment and higher enrolment rate. We show that the results depend on the methodology. We also provide evidence that the robust association between cognitive skills and economic growth reflects a causal effect of the economic benefits of effective school policy: we find that, countries that improved their cognitive skill, through different facets of school choice, autonomy and accountability over time experienced relative increases in their growth paths. We show that quality of education significantly matter for technological progress and that it is a source of divergence in OECD economies. We also analyse in a dispassionate way, voters influence on public policy especially, that pertaining to public school resource allocation, in one country India we take India because the country's overall success story hides striking inter- and intra-state variation in literacy rates. There is suggestion that larger districts with more elected legislators and also districts with higher voter turnout benefit from greater allocation of public school resources, which in turn are expected to boost schooling outcomes. In other words, these results highlight the power of democracy in ensuring a better allocation of public school resources in our sample.

Contents

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Producing the present piece of work has been one of the most important challenges in my life. A PhD thesis is a unique experience, in which one can feel isolated and left out in many ways.

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List of Tables

Tables for chapter 2

Appendix

Tables for chapter 3

Appendix for table 3

Tables for chapter 4

Appendix for table 4

Chapter 1 introduction

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1. Introduction

There is a voluminous literature on the determinants of economic growth. It started with the basic growth model of Solow (1957) which began with an aggregate production function where the output of the macro economy is a direct function of the capital and labour in the economy and then added an element of technological change to get the movement of the economy over time. The sources of this technological change, although central to understanding growth, were not an integral part of the analysis. Then augmented neoclassical growth theories, developed by Mankiw, Romer, and Weil (1992), extend this analysis to incorporate education, stressing the role of education as a factor of production.

However, it has been difficult to compare the alternative models and to choose among them based on the economic growth data. Some of the variables that economists consider to be important for economic growth are difficult to use in empirical specifications because of lack of data. So, the many empirical models that have been used to explain the differences in cross-country long-run growth have also resulted in different, and sometimes conflicting, results.

For example, Barro (1991), and Barro and Sala-i-Martin (1992) focused their research on cross-section econometrics with growth rates of ten years regressed on country characteristics and their policies (GDP, government consumption, rule of law, terms of trade, democracy index and inflation rate). Acemoglu, Johnson and Robinson (2001) also focused their research on the effect of institutions on economic performance. Others, like Islam (1996) used panel data models to determine growth and convergence by estimating income as a function of factor accumulation and efficiency. They all found out that, after controlling for factor accumulation, institutions, and government policies, the level of education plays a large role in output differences.

The fact is that the most prosperous economies of the world today exhibit the highest rates of educational attainment (UNDP, 2007) and the poorest countries happen to have very low educational rates. This is certainly not a coincidence. Education provides people with the tools they need to perform adequately in the job

market and enhance their productivity. Not only is the provision of high-quality education linked to economic prosperity, but also the lack of education creates a perpetuating state of poverty (Perry et al., 2006; Hanushek and Woessmann, 2007). Lack of human capital implies low productivity and low economic growth. And the result is poverty. Poverty reduces the capacity to absorb new human capital. And the cycle continues.

The hypothesis is that human capital is an important growth determinant, and its accumulation and investment in it are among the key drivers of economic growth. For example Lucas (1988), Romer (1990a), and Aghion and Howitt (1998)) stress the role of education in increasing the innovative capacity of the economy through developing new ideas and new technologies. These are called endogenous growth models because technological change is determined by economic forces within the model. Under these models, a given level of education can lead to a continuing stream of new ideas, thus making it possible for education to affect growth even when no new education is added to the economy.

Human capital enriched by education can lead to a reduction in absolute poverty and also improve health and nutrition. Therefore, it is natural to believe that a productive development strategy would be to raise the schooling levels of the population which is the initiative and a central element of the Millennium Development Goals (i.e., education for all).

Human capital as a source of new knowledge shifts the production function upwards and generates worldwide economic growth. For example, after the Second World War, Europe was rejuvenated by the Marshall plan. The injection of huge money into the economy was a success because, although the infrastructures, i.e., physical capital had been destroyed, Europe still had available skills required for modern industry. On the other hand, foreign aid to third world countries has mostly resulted in failure because they lacked human capital, and therefore the injection of physical capital has been wasteful (Mincer (1981)).

Azariadis and Drazen (1991) provide a different perspective on why countries grow at different rates. In their paper, they note that countries with unequal human capital endowments grow at different rates. They also found that an economy which is low in human capital needs government investment to make acquiring skills cheaper to bridge the differences in per capita growth among economies. In their own words, government intervention helps to avoid “low-development traps”.

Additional role for human capital is attracting other factors such as physical capital, which also contribute to per capita income growth. Skilled workforce attracts a lot of firms, making it worthwhile for other workers to acquire skills as well. This rise in education makes it more profitable for firms to invest or enter a country, which in turn reduces unemployment. Therefore education benefits both the educated and the uneducated.

The underlying idea is that government spending on education is geared to boost school input, which in turn would boost educational attainment. However, even if schooling policy is made a focal point, many of the approaches undertaken do not seem very effective and do not lead to the anticipated outcomes. A key part of the explanation is that the United States uses its inputs much more productively than does, for example, Ghana. So, despite all the attributes of human capital as a panacea for growth, it is very difficult to measure it, because there are still unanswered questions on the level and type of human capital that is necessary to boost economic growth, and what the role of government policies toward human capital formation should be.

In most countries, the ultimate responsibility and supervision of the school system remains with the state. But within this state supervision, both the operation and the funding of schools may show differing shares of public and private involvement. For example, schools may be operated (managed) by a public entity, but draw heavily on private funding, i.e., parents have to pay tuition fees, or schools are operated by a private entity (e.g., a business, the church) but obtain most of their funding from a public entity, which could be through base funding or vouchers. On average, across countries, 83% of schools are publicly operated, and the remaining 17% are managed by a private entity. But the share of publicly operated schools varies substantially across countries.

These differences in resources in education, and in growth rate across developed economies have motivated a lot of debate on the role of education in fostering innovation and growth (Aghion at al. (2005), Romer (2000)). Other papers have studied funding of schools and its effect on growth, and also the effects of changing the mix of public education expenditure across primary, secondary and tertiary education. For example, the US devotes 3% of its GDP to tertiary education, whilst in Europe this is only 1.4% of GDP. These studies have come up with the following questions: Is this European deficit in tertiary education investment significant for growth? Do these cross-country differences in public and private involvement in the operation and

funding of schools matter for student achievement and economic growth? Or, are differences between the ownership structure and governance of schools the main reason behind the growth process? Our research is to shed light on these issues empirically using data collected from various sources.

This paper uses internationally comparable data to provide cross-country evidence on the association between student achievement, quality of education and economic growth across different countries. We establish a causal relationship between education and economic growth and, more importantly, between educational policy initiatives and educational outcomes.

2 Aims and objectives

Although this thesis certainly does not provide (or aims to provide) definitive answers, we hope to show that it is fruitful to pay more attention to the construction of human capital and the way in which human capital accumulation is affected by institutions. In addition, without arguing that this road is the only one, we hope to show that a stronger focus on the question of how to accumulate human capital efficiently may have an impact on both theoretical and empirical studies on human capital and growth and how it is financed. This paper aims to contribute to the debate over the role of human capital (as in education) on growth, and investigate the determinants of human capital accumulation, emphasizing on the efficiency of human capital accumulation in terms of the quality of education and its effectiveness in enhancing growth.

We also focus our attention on the allocation of public school resources in India: we argue that the greater political participation among voters in a district is likely to induce elected legislators to improve the tax-funded public service delivery in the locality, which among others would include distribution of public school inputs.

Finally we analyse the effect heterogeneity of society has on the allocation of public school inputs. Given that political institutions play a major role in providing education and are led by people of different political persuasions, it is important to understand whether gender/caste characteristics of elected legislators would influence the policies they choose and how it impacts on people's lives

3 Research questions

A first and foremost question is what human capital actually is. Most studies include proxies such as 'average years of education in a population' without clarifying how they relate to human capital. The second question that comes to mind is how institutional development and educational policy in different countries will affect the accumulation of human capital. The third question is how human capital relates to economic growth, while the fourth question relates to the strength of the relation between human capital and growth.

Given the main focus of this thesis, we try to answer some of the questions above. We also try to answer the following questions: Why does a dollar of educational spending yield different effects in Asia, Latin America, Africa and OECD countries? What do the weak links between government spending on education and educational attainment indicate? Do cross-country differences in educational policy matter for student achievement and economic growth? Are differences between the ownership structure and governance of schools important for long-run economic growth? Finally, does socioeconomic endowment matter, in securing greater shares of government funding?

4 Thesis structure

The dissertation is organized as follows: Chapter 2 analyses why more spending in schools has not led to substantially better results in educational attainment and enrolment; Chapter 3 describes the relationship between the quality of education and growth, with primary focus on school policy, and finally, chapter 4 analyse the determinants of the allocation of school inputs in India.

Chapter 2

In a period of growing government deficits, public policy has come under closer scrutiny around the world, and as such it is important to examine why more spending on schools has not led to substantially better performance. Accordingly, this chapter

analyses the impact of real increases in government spending on schooling outcomes, both enrolment and attainment, at various levels of schooling**.**

We build up a country-level data-set for the period 1980-2010 from various published sources. The baseline variables include government expenditure on education as a percentage of Gross Domestic Product, educational attainment, enrolment rate and growth rate of real Gross Domestic Product. Information on real GDP per capita and its growth is obtained from version 7.0 of the Penn World Tables (PWT70-Summers, and Heston). Unlike most existing studies, our sample covers both developed and developing/emerging economies for a recent period of time, considers a range of indices of enrolment and attainment that distinguishes between primary and secondary levels of schooling and also contributes to the literature by bridging the methodological gaps. In particular, we measure educational outcomes not only by net enrolment at primary and secondary levels, but also by educational attainment (i.e., the average number of years of education of working age population) at primary, secondary and overall (pooled) level. While we start with pooled OLS estimates for the sample countries, we compare these simple OLS estimates with the FE-OLS and dynamic GMM estimates, which not only minimise the biases arising from unobserved heterogeneity but also that from reverse causality (or simultaneity). It also offers all the advantages of OLS and it improves FE-OLS. It means that the static specification of the linear fixed effects is enhanced by including autoregressive coefficients (lagged dependent variables), which allow feedback from current or past shocks to current values of the dependent.

We find that results depend on the methodology and find that ceteris paribus government spending on education has positive impact on educational attainment, but no significant effect on primary or secondary school enrolment as such. There is little regional variation such that relative to the overall sample the effect of education spending on educational attainment is rather marginal in Africa. Accordingly, we argue that educational attainment is not just a matter of resources. Once you have reached an indispensable minimum to get the educational system going, in terms of buildings, materials, teachers and infrastructure in general, additional resources might just be absorbed by the system in a very inefficient way, which may involve some degree of unjustified overpayments or simply corruption. Something that really matters might be a complete structural reform in order to improve the quality of education in most countries.

Chapter 3

The objective of this paper is to revisit what is known about the role of education in promoting economic growth. Combining different data, we are able to construct a data-set containing quality education based on 25 OECD countries, from 1980-2010. The data on GDP per capita and its growth for our analyses come from the Penn World Tables. Data on quantitative educational attainment are taken from the latest version of the Barro and Lee (2010) database. Using the insight of Hanushek and Kimko (2000), whereby growth is generated by cognitive skills of a country through high quality education, we establish a causal relationship between education and economic growth and, more importantly, between educational policy initiatives and educational outcomes. We then build on the motivation of these analyses to advance the literature on education and growth by enhancing the quality of the data. Our main innovation is to introduce education policies into the equation in order to show that education policy is closely associated with the long-run growth potential of OECD countries. We intend to assess the importance of the different facets of institutional structures of choice, autonomy and accountability to student achievements and economic growth. The analysis presumes that a country's level of economic growth can sufficiently characterize the set of institutional features that are complementary to human capital. And for this purpose we investigate the relevance and statistical significance of cognitive skills, taking into considering the possible institutional structure of education.

The investigation begins by instrumenting cognitive skills by some of the characteristics of educational systems in 25 OECD countries; this approach provides information on how variations in student outcomes that are related to educational policies affect growth. Our results suggest that different facets of a country's educational policies, i.e., choice, autonomy and accountability, are strongly associated with the level of student achievement and economic growth across OECD countries.

In highlighting the importance of policies affecting student achievement and economic growth, we add to the compelling evidence that cognitive skills are associated with better economic outcomes at country level and also the individual level.

Chapter 4

Chapter 4 examines the determinants of the allocation of public school resources in Indian districts in the post reform period, 1992-2002. Given the pronounced inter- and intra-regional variation in literacy, our analysis particularly highlights the role of voter turnout, gender/caste of elected state assembly legislators and also the size of the districts on districts' access to various public school resources, which in turn determines school performance.

Using various official sources, we put together a unique two-period district-level panel data for 1992 and 2002.

This includes All India School Education Survey (AISES) data, 1992-93 (6^{th}) and 2002-03 (7^{th}), and Census data (1991 and 2001). District-level AISES data cover information on the number of *recognised* schools' characteristics of teachers (gender/caste), and physical facilities (nature of school building, access to drinking water, lavatory within the school premises) at primary, upper primary and secondary levels of schooling. The 1991 and 2001 district-level Census data provide information on population composition (classified by gender/caste) and literacy rates for different age categories of the population (male/female and total), and access to various infrastructural facilities, which is important for our analysis.

We merge 1991 Census data with 6^{th} AISES to generate district-level information for 1992. Similarly, we merge 2001 Census data with 7^{th} AISES data to generate the corresponding district-level information for 2002.

Ceteris paribus, results using 1992-2002 fixed effects district-level panel data models from major Indian states identify significant and positive effects of voter turnout as well as district size on districts' access to various public school resources, while politician's gender and caste has rather limited effect on allocation of public school resources in our sample. In particular, there is suggestion that larger districts with more elected legislators and also districts with higher voter turnout benefit from greater allocation of public school resources, which in turn are expected to boost schooling outcomes.

In other words, these results highlight the power of democracy in ensuring a better allocation of public school resources in our sample.

Chapter 5 presents the major conclusions that could be drawn out from the present thesis.

Chapter 2:

Does Public Spending On Education Boost Educational Attainment: Recent Evidence from a Cross-Country Analysis

Does Public Spending On Education Boost Educational Attainment: Recent Evidence from a Cross-Country Analysis

Abstract

In a period of growing government deficit, public policy has come under closer scrutiny around the world. Using recent cross-country panel data from 90 countries over 1980-2010, the present paper examines the efficacy of public spending on education on a number of educational outcomes at different levels of schooling. We show that the results depend on the methodology and find that ceteris paribus government spending on education has positive impact on educational attainment, but no significant effect on primary or secondary school enrolment as such. We also observe some regional variation such that relative to the overall sample the effect of education spending on educational attainment is insignificant in Africa. In view of these results we discuss possible alternative policies, some of which will be tested in the subsequent chapters.

JEL classification: H52; E62
Keywords: educational attainment; public spending

1. Introduction

"Education is one of the most powerful instruments for reducing poverty and inequality." (World Bank 2011). Education is equally central to enhancing country's competitiveness in the global economy. Therefore, ensuring access to quality education for all, in particular for the poor and rural population, is central to the economic and social development of a country. The latter has galvanized unprecedented efforts to meet the UN Millennium Development Goals (MDGs) by 2015 around the world.

An important assumption in the development community is that public expenditure in education is the prime policy instrument for achieving desired educational outcomes. Public provision far exceeds non-governmental provision in the supply of schooling, particularly at the primary level, and public expenditure greatly exceeds private expenditure. Improving performance and achieving yet unfulfilled outcomes therefore involves increasing the volume, efficiency and effectiveness of public expenditure on education.

The pertinent issue is that merely allocating more public resources for the provision of quality education may not necessarily lead to desirable outcomes, especially if budget formulation execution and monitoring are malfunctioning (see Rajkumar & Swaroop 2008; World Bank 2003). The available empirical evidence on whether more resources from the government will translate into better educational attainment remains weak. This issue has generated a huge and controversial literature dating back to the 1960s (Coleman et al., 1966)[1] and dominated by research from the USA. Hanushek (1996) in several well-known reviews of the US literature concluded that 'there is no strong or consistent relationship between school resources and student performance''. Harbison and Hanushek (1992) found that only six out of 12 studies reported a statistically significant association between government expenditure on education and educational attainment in a sample of developing countries. Along the same line, Rajkumar and Swaroop (2008), using a pooled dataset of 91 developed and developing countries, discovered that the relationship between education, public spending and education failure rate was small and statistically insignificant. Anand and Ravallion (1993) too stated that per capita public spending on education in a country did not have any statistically significant effect on the country's literacy rate.

Some recent studies have highlighted the possible role of governance on the efficacy of public spending on education. Björkman (2006), for example, found that a higher share of grant reaches schools in less corrupt regions of Uganda, and that students in those regions scored 0.4 standard deviations higher in the primary level exit examination. Similarly, Rajkumar and Swaroop (2008) found that a one percentage point increase in the share of public education spending to GDP lowers education failure rate by 0.7 percent in countries with good governance, but had no discernible effect in countries with weak governance.

A common source of waste and inefficiency in education is resource misallocation and misappropriation within education ministries and the devolved bureaucracies through which public expenditure on education is channelled. Pritchett (1996) noted that all of the negative or ambivalent findings on public spending could potentially be a reflection of differences in the efficacy of spending. According to him

[1] The Equality of Educational Opportunity Study (EEOS), also known as the "Coleman Study," was commissioned by the United States Department of Health, Education, and Welfare in 1966 to assess the availability of equal educational opportunities to children of different race, color, religion, and national origin. This study was conducted in response to provisions of the Civil Rights Act of 1964 and serves as an example of the use of a social survey as an instrument of national policy-making.

these differences could be attributed to corruption and patronage, among others. In other words, a unit's worth of public spending does not necessarily buy a unit's worth of service. The argument is as follows, most spending on public education goes to finance school education, at present public financing is about 75% - 95% in most countries. An overwhelming proportion of school finance would be spent on staff salaries (both teachers and other staff) while the rest would finance other non-teaching school inputs. So it appears that most of this school level spending would have only limited direct impact on learning outcomes.

There is also ample evidence that many schools in developing countries are not very effective in imparting learning, and operate far below any conceivable efficient frontier, often attributable to corruption at various levels,[2] Structural inefficiencies, arising from administrative problems, weak absorption capacities, and lack of direct school inputs from the government and/or that of indirect inputs like teacher's absence. This unsatisfactory state of affairs is all the more glaring given that each year the governments of developing countries spend about $260 billion on education[3] (e.g., see Marlaine Lockheed and Adriaan Verspoor 1991; Ralph Harbison and Hanushek 1992; Hanushek 1995; Glewwe 1999a)

Another factor is that many countries are well below the efficiency frontier in their use of public expenditure to produce educational outcomes. Low standards of quality and efficiency in poorly performing schooling systems are prevalent and persistent in poor countries, in poor regions within countries and among poor populations. Low standards cannot be corrected by higher levels of educational expenditure, without management and service delivery reform or within the context of current school organization.

Spending on education may be more effective in countries with better-trained teachers; these countries can be expected, on average, to have higher income levels than

[2] Corruption lowers private investment, thereby reducing economic growth even in countries in which bureaucratic regulation are very cumbersome. The negative association between corruption and investment as well as growth is significant both in a statistical and in economic sense. Mauro, 2001.

[3] A common source of waste and inefficiency in education is resource misallocation and misappropriation within education ministries and the devolved bureaucracies through which public expenditure on education is channelled. Reinikka and Svensson used panel data for 1991-1995 from a quantitative service delivery survey (QSDS) in Uganda to measure the 'leakage' of funds for education from their intended purposes. They found that only 13% of non-wage expenditures allocated to schools were actually received. The bulk of allocated spending was used by officials for administration, or for purposes unrelated to education, or was privately appropriated. (Non-wage recurrent expenditures are typically 25-35% of total recurrent outlays, though in Uganda they declined from 54% to 14% over the period as teachers' salaries were raised).

others, and governance is generally better in these countries. Of course school inputs would have indirect effects on learning outcomes; for example, presence and perseverance of teachers matter; quality of school building, access to drinking water/toilets or playing fields may make schooling experience more enjoyable than otherwise. Educational attainment may also depend on educational motivation and child's interest in the school and again public spending may have direct little impact there.

The available empirical evidence on whether more resources from the government will translate into better educational attainment remains ambiguous. First, it is difficult to compare existing studies because educational outcome variables are not consistent across countries. Studies are drawn from schools across many countries and contain information about a variety of measures of student outcomes. Data on enrolment rates are widely available, but they do not reflect quality differences across countries. Moreover, enrolment numbers, especially at the primary level, include repeaters as well as students that subsequently drop out of school. For example, Barro and Lee (2001) using primary school drop-out and repetition rates on a set of resource variables showed that resources are insignificant determinants of dropout and repetition rates. Using similar data, a study by Hanushek and Kimko (2000) showed that direct spending on schools is unrelated to student performance. While these bleak pictures concerning the ability of government expenditure to raise educational outcomes appear to represent the majority view in literature, there are some notable exceptions. McMahon (1999), report a robust and significantly positive impact of resources and grade five survival rates and another study by Wossmann (2000), using class size as the resource variable, reported a positive and significant impact. Baldacci et al. (2004) come up with even stronger finding that spending is the only determinant of combined primary and secondary enrolment which remains significant across a number of different econometric specifications.

A further problem is that most related research in this respect predominantly focuses on the link between resources and educational performance within a country, particularly in the United States. Unfortunately, no such encompassing evidence is available for other countries perhaps because of lack of data availability. So it is

unclear whether the existing results holds[4] when one considers some less developed regions, e.g., Africa as a whole or sub-Saharan Africa in particular. So it is important to re-examine whether a dollar educational spending yields the same effect in Asia, Latin America, Africa and OECD countries, other factors remaining unchanged.

We aim to bridge these gaps in the literature, so we build a comprehensive panel data set of public spending on education[5] and educational outcomes for 90 countries including many developing countries, drawn from Barro-Lee (2010), Penn World Tables and various UNESCO annual reports. The latter allows us to focus on direct measures of educational outcomes including enrolment and attainment. We also distinguish between primary and secondary enrolment and attainment rates in our analysis.

Our aim therefore is to use the recent available data to analyse whether increased government spending in education will result in increased educational attainment and will increase in resources available to education increase enrolment rate in schools? Lack of appropriate data has meant that there have been relatively few studies exploring the relationship between government expenditure on education and outcome across countries. We also look at whether governance has a part to play in the effectiveness of allocating of public resources, especially in developing countries.

Methodologically, we extend pooled OLS estimates and use fixed effect (FE) OLS and the Generalized Method of Moments (GMM) panel estimator. This is because pooled OLS estimates can be biased because of the presence of unobserved country-level heterogeneity in data. While FE-OLS estimates help redress the bias arising from omitted variables, it cannot resolve the bias arising from endongeniety or reverse causality with a dynamic framework. Hence our preferred estimates are the system GMM panel fixed effects estimates. By accounting for simultaneity, fixed effects, and lagged dependent variables as regressors, we try our best to identify the true effect of government spending on various educational outcomes.

Our paper's findings are robust to econometric specifications that allow government expenditure in education to influence educational outcomes at various

[4] See Hanushek (1996) 'there is no strong or consistent relationship between school resources and student performance'

[5] The impact of public spending will depend on the degree to which public spending is translated to create effective public services. The ineffectiveness of public spending might include poor targeting of institutional inefficiency such as leakage in public spending and weak institutional capacity or the displacement of private sector effort by public spending. In this light it is common for various international financial institutions to ensure reducing unproductive expenditures and thus improving the delivery of public services.

levels of schooling, after controlling for various observed and unobserved factors that may also influence educational outcomes. There is evidence that government spending on education significantly boosts educational attainment, but it fails to have any significant effect on enrolment at any level of schooling. We also identify some regional variation in our data that highlights the insignificant effect of educational spending either on enrolment or attainment in Africa. It is argued that these results highlight that resources are necessary, but not sufficient for educational outcomes. As possible alternatives, one needs to probe into the varying institutional set-up in the education sector in the sample countries, with a view to resolve the conflict of interest between/among various actors.

The paper is organized as follows, in section 2 we describe the data used. Section 3 explains the methodology while section 4 analyses the empirical results. Finally section 5 concludes with essential policy implications of our results.

2. Data Description

We use various existing sources to construct five-yearly data for 90 countries over a thirty year period 1980-2010. Data on enrolment (primary/secondary) and government spending on education come from the UNESCO Annual Statistics (1980-2010) while information on school attainment is obtained from Barro and Lee (2010), who revised the original Barro and Lee (2001) series to eliminate anomalies in connection with attainment rate. Information on real GDP per capita is obtained from version 7.0 of the Penn World Tables (PWT70-Summers, and Heston).

The measure of total government expenditure on education is expressed as a percentage of GDP in a given year. The latter shows the proportion of a country's wealth being devoted to the development of education, which allows us to link education spending with real GDP per capita. The net enrolment rate is the total enrolment at a given educational level, divided by the population of the age group that typically corresponds to that level of education (after excluding the drop- outs and repeaters). Our data enables us to distinguish between primary and secondary enrolment rate. We also observe educational attainment, which measures the highest level of education attained for the population aged 25 and above. This measure excludes students that drop out of school prematurely and is not affected by number of repeaters and as such can be used as a proxy for quality of education, in contrast,

enrolment rates correspond to some measure of quantity of education provided. We acknowledge that there are vast differences in quality between school systems across countries. However, qualitative measures of human capital are not widely available and when they exist, they do so for a small group of relatively developed countries.

We also obtain various country-level institutional indices including a measure of corruption from the International Country Risk Guide (ICRG 1984-2010). The ICRG index of corruption is a subjective measure prepared by experts on a regular basis for international business, which measures corruption within the political system. We chose the corruption index because in our opinion corruption affects not only the broad macroeconomic variables such as government investment and growth but also income distribution. Government officials may use their authority for private gain in designing and implementing public policies. (Tanzi and Davoodi 1997). In this way, corruption distorts the government's role in resource allocation. It has been further contended that corruption increases poverty by creating incentives for higher investment in capital-intensive projects and lower investment in labour-intensive projects (United Nations Development Programme, 1997). Such a bias in investment strategy deprives the poor of income-generating opportunities. The corruption index is measured on a scale of 0 to 6, with higher values indicating lower levels of corruption.

2.1. Descriptive statistics

A list of our regression variables is summarised in Table A1. The table also shows the corresponding means and standard deviations of these variables.

The complete data covers 90 heterogeneous countries over 30 years (1980-2010), thus giving rise to a sample of country-year observations of 630. There is however some missing observations for some variables as highlighted in Table 1. The mean value of educational attainment is 6.8 years. The average share of government expenditure on education (in GDP) is about 4.4% of GDP and ranges from 12.9% to 0.8% of GDP. The mean value of corruption index is 3.3 on a scale of 0-6. Note that higher value of the index indicates lower level of corruption. We need to bear this in mind while interpreting the estimated coefficients.

The countries included in our sample are rather heterogeneous in all respects. Therefore the specification measurement is likely to suffer from heterogeneity uncertainty, which means that it unclear which subsets of countries obey a common linear model. So it is important to identify the regional variation in this respect. To this

end, we classify these countries into four groups, namely, OECD, Asia, Africa and Latin America. The corresponding descriptive statistics by region are shown in Table A2. Clearly, both share of public spending and educational attainment are the highest in OECD countries. Expenditure and cost differences between countries make it difficult to establish norms of cost-effectiveness or standard prescriptions for reform, because expenditure and efficiency levels achievable in some parts of the world may simply not be attainable elsewhere.

Real schooling expenditure per student increased substantially in most of the sampled OECD and East Asian countries. The question of interest is whether this vast expansion of schooling resources per student led to an improvement in students' educational performance. Many Asian countries have been able to achieve significant educational results at modest cost. Drop-out rates are lower, educational attainment are higher and education expenditure as a share of GDP is lower in East Asia than in other regions. In many African countries similar levels of expenditure relative to GDP are inadequate to raise achievements to within striking distance of international goals.

Among the non-OECD sample countries, highest share of public spending is observed in Africa (4.7% of GDP), followed by Latin America (4.1% of GDP) and Asia 4.1% of GDP), note however that educational attainment is the highest among the Asian countries 7.8, closely followed by Latin America 7.3. In contrast Africa tends to have the lowest educational attainment among the non-OECD sample countries, thus questioning the efficacy of public spending on education for imparting learning. The latter induces us to control for the ICRG corruption index (0- most corrupt and 6 least corrupt).

In an attempt to understand the relationship between education spending and educational outcome, we consider various non-parametric kernel plots for selected measures of educational outcomes.

First Figures A1 to A4 show the non-parametric Epanechnikov kernel regression of government educational expenditure on educational attainment rate in the full sample. Similarly figures A5-A6 show the corresponding kernel regression of primary and secondary enrolment rates on government spending on education. Evidently the effect of government spending on enrolment is much flatter than that for educational attainment for much of the distribution of government spending on education. We next conduct some multivariate analysis to examine if this holds after controlling for other factors as well.

3. Methodology

This section describes the econometric methods that we use to assess the relationship between public spending on education and educational attainment. One way to model empirically the macroeconomic contribution of government spending to educational attainment is to use cross country education productions of the following form:

$$A_{it} = \beta_1 e_{it-1} + \beta_2 x_{it-1} + \alpha_i + \gamma_t + \epsilon_{it} \quad (1)$$

where A_{it} is the index of educational attainment in country *i* in year *t*.

This model allows us to examine the impact of government investment on educational attainment of 90 heterogeneous countries over 30 years (1980-2010). Educational attainment is expressed as a function of one period lagged values of share of government spending on education and other control variables *x* rates, which are measures of quantity and access to education in each country. Second, we use a composite index of educational attainment (educat) which is a measure of internal efficiency in the education system, we are also able to distinguish educational attainment between primary, secondary levels and tertiary education.

Our central explanatory variable of interest is the share of government spending on education (in GDP). The underlying idea is that a higher share of education spending by the government will to some extent boost educational outcomes. Other factors remaining unchanged, our analysis particularly focuses on the size and significance of estimated β_1 that captures the marginal effect of government spending on indices of educational attainment.

In addition, we include country specific intercepts (α_i) The country specific intercepts can be seen as picking up any bias arising from country-specific fixed effects. It also allows permanent differences in the level of income between countries that are not captured by x_{it} . We also include year specific fixed effects (γ_t) to minimise any bias arising from unobserved year specific effects.

Other control variables include real GDP per capita and an index of corruption. The index of corruption is added as an independent variable to determine the efficacy of public spending in boosting educational attainment.

3.1. Econometric issues

Several econometric problems may arise from estimating equation (1): because our empirical results are based on OLS regression methodology, which assumes that public spending is exogenously determined. However, it is possible that the two main variables in our analysis, public spending and educational attainment, are jointly determined (endogenous)[6]. Although we have used one period lagged value of the explanatory variables to determine educational attainment as in equation 1, one can still raise questions about endogeneity bias of our estimates. There is also the possibility of reverse causation. For example, it is likely that when a government is faced with poor and/or deteriorating educational attainment status of their citizens, governments increase spending on education. Other problems include omitted variable bias and measurement errors in the regressors.

To address the problems, we first use FE-OLS estimates that control for both country and year specific unobserved heterogeneity in our data and any omitted variables that are constant over time. However the use of fixed effects to address unobserved heterogeneity can bring substantial gains in robustness, but not without costs. For example fixed effect which is based on within country variation does not take into consideration dynamics of adjustments. Given this unattractive trade-off between robustness and efficiency, we use the dynamic model GMM advocated by Arellano and Bond (1991), and Arellano and Bover (1995) to eliminate the fixed effect problems.

The motivation for dynamic modelling GMM are (1) that it offers all the advantages of OLS and (2) it improves FE-OLS and also act as a robustness check of our educational outcome estimates. It means that the static specification of the linear fixed effects in equation 1 is enhanced by including autoregressive coefficients (lagged dependent variables), which allow feedback from current or past shocks to current values of the dependent variable A_{it}.

[6] A variable is endogenous if it is correlated with the disturbance i.e. in this equation $A_{it} = \beta_1 e_{it} + \beta_2 x_{it} + \alpha_i + \epsilon_{it}$ x_i is endogenous if $cov(x_i \epsilon_i) \neq 0$ x_i is exogenous if $cov(x_i \epsilon_i) = 0$, OLS estimate will be consistent only if $cov[x_i\ \epsilon_i] = 0$. (Wooldridge 2002; 2006).

3.2. Dynamic GMM

We use the Generalized-Method-of-Moments (GMM) estimators developed for dynamic panel data that were introduced by Holtz-Eakin, Newey, and Rosen (1990), Arellano and Bond (1991), and Arellano and Bover (1995) as follows:

$$A_{it} - A_{it-1} = A_{it-1} + \beta_1 e_{it-1} + \beta_2 x_{it-1} + \alpha_i + \gamma_t + \epsilon_{it} \quad (2)$$

where A is the index of educational attainment, X represents the set of explanatory variables, α is an unobserved country-specific effect, γ is year specific fixed effects, ϵ is the error term, and the subscripts i and t represent country and time period, respectively. We also use time dummies to account for period-specific effects. We rewrite equation (2) as:

$$\Delta A_{it} = (\alpha - 1)A_{i,t-1} + x'_{it-1}\beta + \alpha_i + \gamma_t + \epsilon_{it} \quad (3)$$

To eliminate the country-specific effect, we take first-differences of equation (3), which act as instruments to deal with the endogeneity of the explanatory variables;

$$A_{it} - A_{it-1} = \alpha(A_{it-1} - A_{it-2}) + \beta'(x_{i,t} - x_{i,t-1}) + (\epsilon_{i,t} - \epsilon_{i,t-1}) \quad (4)$$

However the new error term $\epsilon_{i,t} - \epsilon_{i,t-1}$ is correlated with the lagged dependent variable, $A_{it-1} - A_{it-2}$. So Under the assumptions that the error term is not serially correlated, and the explanatory variables are weakly exogenous (i.e., the explanatory variables are uncorrelated with future realizations of the error term), the GMM dynamic panel estimator uses the following moment conditions.

$$E\left[A_{i,t-s}.\left(\epsilon_{i,t} - \epsilon_{i,t-1}\right)\right] = 0 \text{ for } s \geq 2;\ t = 3,\ldots,T \quad (5)$$

$$E\left[x_{i,t-s}.\left(\epsilon_{i,t} - \epsilon_{i,t-1}\right)\right] = 0 \text{ for } s \geq 2;\ t = 3,\ldots,T \quad (6)$$

There are, however, some shortcomings with this difference estimator, when the explanatory variables are persistent over time i.e. government expenditure in education, lagged levels make weak instruments for the regression equation in differences. Instrument weakness influences the asymptotic and small-sample performance of the

difference estimator. Asymptotically, the variance of the coefficients rises. In small samples, weak instruments can bias the coefficients. See Alonso-Borrego and Arellano (1996) and Blundell and Bond (1997)

To reduce the shortcomings, we use a new estimator that combines in a system the regression in differences with the regression in levels (Arellano and Bover's 1995 and Blundell and Bond 1997). The instruments for the regression in differences are the same as above. The instruments for the regression in levels are the lagged differences of the corresponding variables. These are appropriate instruments under the following additional assumption: although there may be correlation between the levels of the right-hand side variables and the country-specific effect in equation (3) but there is no correlation between the differences of these variables and the country-specific effect, i.e.

$E[A_{i,t+p}.\mathfrak{y}_i] = E[A_{i,t+q}.\mathfrak{y}_i]$ (7)

and $E[X_{i,t+p}.\mathfrak{y}_i = E[X_{i,t+q}.\mathfrak{y}_i]$ for all p and q (8)

The additional moment conditions for the second part of the system (the regression in levels) are

$E\left[\left(A_{i,t-s} - A_{i,t-s-1}\right).\left(\mathfrak{y}_i + \epsilon_{i,t}\right)\right] = 0$ for s = 1 (9)

$E\left[\left(X_{i,t-s} - X_{i,t-s-1}\right).\left(\mathfrak{y}_i + \epsilon_{i,t}\right)\right] = 0$ for s = 1 (10)

Thus, we use the moment conditions presented in equations (5), (6), (9), and (10), use instruments lagged two periods (t-2), and employ a GMM procedure to generate consistent and efficient parameter estimates.

Consistency of the GMM estimator depends on the validity of the instruments. To address this issue we consider two specification tests suggested by Arellano and Bond (1991), Arellano and Bover (1995), and Blundell and Bond (1997). The first is a Sargan test of over-identifying restrictions, which tests the overall validity of the instruments by analysing the sample analog of the moment conditions used in the estimation process. The second test examines the hypothesis that the error term $\epsilon i,t$ is not serially correlated. In both the difference regression and the system difference-level regression we test whether the differenced error term is second-order serially correlated (by construction, the differenced error term is probably first-order serially correlated even if the original error term is not).

4. Results and discussion

This section presents and analyses the baseline estimates of educational attainment and also various robustness checks that we perform. Our central objective is to estimate the effects of public spending on education on educational outcomes after controlling for other determinants influencing education attainment/enrolment. In doing so, we also try our best to redress the potential biases arising from omitted variables and simultaneity.

4.1. OLS estimates of educational outcomes

We start with an analysis of the OLS estimates of equation (1). Tables 1 and 2 show the simple OLS estimates of various educational outcomes: total educational attainment as well as educational attainment for primary, secondary and tertiary levels. We also determine net enrolment rate of primary and secondary education (nerp, ners).

Table 1 shows the estimates of total educational attainment. Here we show estimates for four specifications as we include additional explanatory variables. In all specification, lagged government spending is significantly and positively linked with educational attainment. It is also evident that the estimate is hardly affected by the inclusion of lagged GDP per capita as a control variable which enters the model positively and statistically significantly. Specification (4) is the most complete specification which still suggests a positive and significant effect of lagged government spending on educational attainment when we include the lagged corruption index and a dummy of Africa. Evidently, the Africa dummy is negative and significant, suggesting a lower level of educational attainment for Africa. Also the lagged corruption coefficient is negative and significant, suggesting that less corrupt countries (i.e., those with lower levels of corruption) experience a lower educational attainment, other things remaining unchanged. This is a counter-intuitive result and we would argue that this may be attributed to the OLS estimation bias that cannot take account of the unobserved country-level factors influencing educational outcomes.

Table 2 shows the OLS estimates of educational outcomes by schooling levels. Four measures of educational attainment are used. In all columns (corresponding to different measures of educational attainment, lagged government expenditure has a positive and significant effect on educational attainment. Lagged government expenditure also affects net Primary education enrolment rate and secondary education

enrolment rates positively and significantly and the magnitude of the effect is especially high for secondary enrolment rate. Among other results, real GDP per capita has positive effect on attainment and enrolment rates, except secondary school attainment rate and primary school net enrolment rate. Further, the corruption index coefficient is still negative and significant in all columns except net primary enrolment rates.

Educational outcomes by regions

We also explore if the effects of government spending on educational outcomes may vary across the geographical regions in our sample. The underlying idea is that regions with better institutions, e.g., better budget formulation, execution and monitoring may experience better educational attainment as government expenditure increases (World Bank, 2003). Thus, we re-ran the educational attainment regressions for different geographical regions, namely, OECD, Asia, Africa and Latin America, in our sample, using simple OLS.

Table 3 shows the simple OLS estimate for these four regions. In the four columns of the OLS regressions, government spending is significantly and positively linked with educational attainment after controlling for lagged government expenditure in education in all regions, except for Africa. The coefficient of lagged government spending is negative and insignificant for Africa. Lagged real GDP is highly significant in all four column but as with the last regressions very low explanatory power. The corruption index is negatively significant for countries within OECD, which is again counter-intuitive. The corruption index on Africa is negative but insignificant.

The case of Africa is of special interest to us as it is the region with very high government spending share and yet one with the lowest educational attainment. Table 4 shows the OLS estimates of various educational outcomes for Africa. It is interesting to note that the effect of government spending on educational attainment is negative and insignificant for this subsample too irrespective of the choice of educational outcomes. Lagged GDP per capita is significant in all regressions except primary net enrolment and the lagged corruption is also insignificant other than secondary school attainment rate.

4.2. FE-OLS estimates of educational outcomes

One may however argue that the OLS estimates are likely to be biased because of possible omitted factors. Hence next we consider the FE-OLS estimates that control for

both country and year specific unobserved heterogeneity in our data. These estimates are summarised in Table 5 for the full sample that controls for both country and year specific unobserved fixed effects. Evidently, government expenditure on education is positive and significant for all attainment indices except tertiary school attainment rate. It is also not significant for primary enrolment rate, but turns out to be positive and significant for secondary enrolment rates. These FE-OLS estimates are not very different from the OLS estimates in table 4. Note that in this case the corruption coefficient turns out to be insignificant for most indices.

In Table 6 we consider the FE-OLS estimates of various educational outcomes for Africa only. These FE-OLS estimates reiterate the insignificant effect of government spending on the various education outcome variables for Africa as we have seen in the OLS regression results summarised in Table 4. There is no significant effect of government expenditure on any of the attainment rates and also the enrolment rate. It also reiterates the positive effect real GDP have on some indices, which is similar to table 4.

4.3. Dynamic GMM estimates results

Table 7 summarizes the GMM estimates of changes in educational attainment as a function of lagged values of share of government spending on education and other explanatory variables. This is an extension of the FE-OLS estimates as it allows us to take account of the dynamics where educational outcomes depends on past educational outcomes as well as lagged government expenditure, among others. Thus we expect current educational outcomes to respond to past outcomes. The process of adjustment may depend both on the passage of time (which indicates the importance of lagged values of these changes as regressors) and on the difference between equilibrium outcome and the previous year's actual level.

We use forward orthogonal deviations proposed by Arellano and Bond 1995 to preserve gaps in our data, this solves autocorrelation problems. We use generalized method of moments (GMM) with *linear* moment conditions, which amounts to the requirement that the instrumental variables are uncorrelated with the error term in the growth regression in equation (1). The economic meaning of these conditions is that the instrumental variables can only affect educational attainment through government expenditure and the other variables in the conditioning information set. A crucial assumption for the validity of GMM is that the instrument is exogenous. To test this

condition, we use Sargan's test of the over identifying restrictions, and we cannot reject the given moment conditions. Note that the Sargan and Hansen tests do not reject the econometric specification[7]. All the diagnostic tests indicate a well specified model.

After controlling for all other factors, the coefficient of government spending on attainment is positive and significant, thus highlighting the beneficial role of spending on educational attainment. Unlike the FE-OLS, estimates government spending on education has insignificant effect on primary net enrolment and secondary school net enrolment rates. A comparison of the spending effect on primary, secondary and tertiary attainment suggests that the marginal effect is the highest at the primary level. In particular 1 standard deviation (i.e., 1.7 as shown in table A1) increase in government spending would enhance primary educational attainment by 0.216*1.7=0.3672 years.

It is also noteworthy here that the corruption coefficient now turns out to be positive and significant. In other words, other things remaining unchanged, less corrupt countries tend to have better educational outcomes. We believe that this is the true effect of corruption in our sample as GMM redresses the shortcomings of OLS and FE-OLS. Table 8 also redresses the shortcomings of OLS and FE-OLS for the subsample (African countries), government expenditure on education is significant and positive for primary enrolment rate, but insignificant for other variables. Also the corruption coefficients for the indices have the right signs with column 1, 3, and 4 positive and significant.

5. Concluding remarks

In a period of severe constraint on government budget around the world, it is important to understand the efficacy of public spending on education for delivering education around the world with a view to design public policy. Using a rich cross-country data from a sample of 90 countries over the period 1980-2010, the present paper updates the existing literature with a view to inform the policy makers.

Unlike most existing studies, our sample covers both developed and developing/emerging economies for a recent period of time, considers a range of

[7] Sargan test of over identifying restrictions: chi2(2) = 2.77 Prob > chi2 = 0.250
Hansen test of over identifying. restrictions: chi2(1) = 2.03 Prob > chi2 = 0.154

indices of enrolment and attainment that distinguishes between primary and secondary levels of schooling and also contributes to the literature by bridging the methodological gaps. In particular, we measure educational outcomes not only by net enrolment at primary and secondary levels, but also by educational attainment (i.e., the average number of years of education of working age population) at primary, secondary and overall (pooled) level. While we start with pooled OLS estimates for the sample countries, we compare these simple OLS estimates with the FE-OLS and system GMM estimates which not only minimise the biases arising from unobserved heterogeneity, but also that from reverse causality (or simultaneity).

We compare the full sample estimates with those from different developing regions of the world. Our analysis highlights the importance of GMM estimates and suggests that government spending on education has positive and significant effect on educational attainment at all levels and the effect is largest at the primary level. We however fail to identify any significant beneficial effect of government education spending on primary and secondary enrolment levels, which primarily been guided by household decisions. Further despite very high level of government education spending in Africa, we do not find any statistically significant effect on educational attainment or enrolment in Africa who needs it most.

This evidence implies that just providing more resources is unlikely to improve student performance if future actions of schools follow their past behaviour. While schools in some regions seem to make good use of additional resources, others do not. In other words, a general increase in school resources does not necessarily promise significant positive improvements in student performance. A possible solution may lie in changing the incentive structure of the main actors in the schooling system rather than changing the level of available resources. The most important and most promising way forward for future research in this area therefore seems to be to look for evidence on the effect of the institutional set-up of the schooling system, since this will generate the incentives with a view to promote educational performance of students.

Accordingly, one needs to consider alternative policies, e.g., private intervention, public school autonomy and/or encouraging students to attend schools by providing incentives (e.g., mid-day meals, scholarships, text books, uniforms, laptops) to deliver ‘education for all’, which has met with some success in some parts of the world.

Tables

Table 1. OLS estimates of educational outcomes

VARIABLES	(1) Educational attainment	(2) Educational attainment	(3) Educational attainment	(4) Educational attainment
Lagged Government Expenditure on education	0.258***	0.257***	0.266***	0.322***
	(0.0524)	(0.0521)	(0.0525)	(0.0499)
Lagged Real GDP per Capita		0.000987**	0.000758*	0.000639*
		(0.000389)	(0.000397)	(0.000384)
Corruption index			-0.173***	-0.161***
			(0.0584)	(0.0563)
Africa				-4.678***
				(0.411)
Constant	6.017***	5.707***	6.343***	7.398***
	(0.370)	(0.390)	(0.420)	(0.391)
Year dummies	no	no	no	Yes
Observations	540	540	535	535
Number of countries	90	90	90	90

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 2. OLS estimates of educational outcomes by schooling level

VARIABLES	(1) Educational attainment	(2) Primary school attainment rate	(3) Secondary school attainment rate	(4) Tertiary school attainment rate	(5) Primary school net enrolment rate	(6) Secondary school enrolment rate
Lagged Government expenditure on education	0.322***	0.123***	0.178***	0.0178***	0.725**	1.433***
	(0.0499)	(0.0244)	(0.0277)	(0.00623)	(0.326)	(0.330)
Lagged Real GDP per capita	0.000639*	0.000303*	0.000192	0.000119**	0.00208	0.00459*
	(0.000384)	(0.000183)	(0.000216)	(4.78e-05)	(0.00252)	(0.00250)
Lagged Corruption Index	-0.161***	-0.0593**	-0.0879***	-0.0136*	-0.561	-0.884**
	(0.0563)	(0.0272)	(0.0314)	(0.00701)	(0.368)	(0.369)
Africa	-4.678***	-2.536***	-1.733***	-0.408***	-24.44***	-45.85***
	(0.411)	(0.301)	(0.198)	(0.0519)	(2.430)	(3.610)
Constant	7.398***	4.842***	2.163***	0.413***	91.88***	71.94***
	(0.391)	(0.225)	(0.208)	(0.0489)	(2.473)	(2.878)
Year dummies	Yes	yes	yes	yes	yes	Yes
Observations	535	535	535	535	532	534
Number of countries	90	90	90	90	90	90

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 3: OLS estimates of educational attainment by regions

VARIABLES	(1) Educational attainment Africa	(2) Educational attainment Asia	(3) Educational attainment Latin America	(4) Educational attainment 0ECD
Lagged Government expenditure on education	-0.0616	0.216**	0.216**	0.274***
	(0.110)	(0.105)	(0.105)	(0.0688)
Lagged Real GDP per capita	0.000760***	0.000231***	0.000231***	0.00657***
	(0.000135)	(6.93e-05)	(6.93e-05)	(0.00132)
Lagged Corruption	-0.180	0.220	0.220	-0.297***
	(0.116)	(0.210)	(0.210)	(0.0713)
Constant	3.331***	4.039***	4.039***	9.160***
	(0.637)	(0.886)	(0.886)	(0.560)
Observations	100	73	73	185
Number of countries	25	19	19	35

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 4. OLS estimates of educational outcomes for Africa

VARIABLES	(1) Educational attainment	(2) Primary school attainment rate	(3) Secondary school attainment rate	(4) Tertiary school attainment rate	(5) Primary school net enrolment rate	(6) Secondary school net enrolment rate
Lagged Government expenditure on education	-0.0616	-0.00111	-0.0379	-0.00210	-0.869	0.836
	(0.110)	(0.0747)	(0.0387)	(0.00501)	(1.331)	(1.317)
Lagged Real GDP per capita	0.000760***	0.000433***	0.000316***	2.16e-05***	0.00247	0.00630***
	(0.000135)	(9.81e-05)	(4.84e-05)	(5.35e-06)	(0.00158)	(0.00122)
lagged Corruption	-0.180	-0.0862	-0.0988**	-0.000802	0.465	-0.497
	(0.116)	(0.0770)	(0.0406)	(0.00590)	(1.540)	(1.206)
Constant	3.331***	2.264***	0.901***	0.0599**	71.74***	16.13**
	(0.637)	(0.452)	(0.226)	(0.0277)	(7.780)	(6.932)
Observations	100	100	100	100	75	41
Number of countries	25	25	25	25	23	17

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 5. Fixed effects OLS estimates of educational outcomes

VARIABLES	(1) Educational attainment	(2) Primary school attainment rate	(3) Secondary school attainment rate	(4) Tertiary school attainment rate	(5) Primary school net enrolment rate	(6) Secondary school net enrolment rate
Lagged Government expenditure on education	0.217***	0.106***	0.103***	0.00697	0.541	0.892***
	(0.0518)	(0.0251)	(0.0292)	(0.00652)	(0.362)	(0.335)
lagged Real GDP capita	0.000823**	0.000317*	0.000353	0.000153***	0.00127	0.00559**
	(0.000383)	(0.000185)	(0.000216)	(4.82e-05)	(0.00267)	(0.00248)
Lagged corruption Index	-0.317***	-0.0826***	-0.205***	-0.0302***	-1.017**	-1.424***
	(0.0573)	(0.0277)	(0.0323)	(0.00721)	(0.400)	(0.371)
Constant	7.032***	4.286***	2.353***	0.393***	87.77***	63.12***
	(0.337)	(0.163)	(0.190)	(0.0424)	(2.355)	(2.184)
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	535	535	535	535	532	534
R-squared	0.117	0.069	0.121	0.067	0.022	0.064
Number of countries	90	90	90	90	90	90

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 6. FE-OLS estimates of educational outcomes for Africa

VARIABLES	(1) Educational attainment	(2) Primary school attainment rate	(3) Secondary school attainment rate	(4) Tertiary school attainment rate	(5) Primary school net enrolment rate	(6) Secondary school net enrolment rate
lagged Government Expenditure on education	0.0224	0.0412	-0.0133	-0.00553	-0.0179	1.570
	(0.124)	(0.0810)	(0.0431)	(0.00661)	(1.514)	(1.571)
lagged Real GDP per capita	0.000922***	0.000507***	0.000382***	3.42e-05***	8.64e-06	0.00731**
	(0.000211)	(0.000138)	(7.32e-05)	(1.12e-05)	(0.00240)	(0.00258)
lagged Corruption index	-0.166	-0.0900	-0.0791*	0.00322	0.194	-0.740
	(0.121)	(0.0794)	(0.0422)	(0.00647)	(1.637)	(1.274)
Constant	2.605***	1.950***	0.611**	0.0442	74.39***	12.18
	(0.704)	(0.460)	(0.245)	(0.0376)	(8.760)	(10.36)
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	100	100	100	100	75	41
R-squared	0.279	0.227	0.348	0.115	0.000	0.359
Number of countries	25	25	25	25	23	17

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 7.GMM estimate of changes in educational attainment by schooling level

VARIABLES	(1) Total educational attainment	(2) Primary school attainment rate	(3) Secondary school attainment rate	(4) Tertiary school attainment rate	(5) Primary school net enrolment rate	(6) Secondary school net enrolment rate
government Expenditure on education	1.474** (0.587)	0.216** (0.0986)	0.0221** (0.120)	0.0574** (0.0366)	1.411 (1.969)	3.422 (4.034)
Real GDP Per capita	0.00459 (0.00322)	0.000892 (0.000685)	0.000354 (0.000372)	-0.000139 (0.000156)	-0.0121 (0.00878)	0.0162 (0.0161)
corruption	0.897** (0.368)	0.161** (0.0657)	0.0688** (0.0536)	0.00442** (0.0193)	-0.892 (0.943)	2.653 (2.237)
Lagged educational attainment rate	0.771*** (0.193)					
Lagged primary School attainment rate		0.872*** (0.0723)				
Lagged Secondary school Attainment rate			1.033*** (0.0585)			
Lagged tertiary School attainment rate				1.098*** (0.0967)		
Lagged net Primary enrolment rate					0.615** (0.234)	
Lagged Secondary school Enrolment rate						0.937*** (0.225)
Constant	-9.016** (3.980)	-1.030 (0.798)	-0.0629 (0.697)	0.328 (0.235)	35.41* (20.20)	-24.68 (21.65)
Year dummies	yes	yes	yes	yes	yes	yes
Observations	533	532	532	532	419	344
Number of countries	90	90	90	90	87	80

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Sargan test of overid. restrictions: chi2(2) = 3.43 Prob > chi2 = 0.180
Hansen test of overid. restrictions: chi2(2) = 5.25 Prob > chi2 = 0.572

Table 8.GMM estimate of changes in educational attainment by schooling level for subsample (Africa)

VARIABLES	(1) Total educational attainment	(2) Primary school attainment rate	(3) Secondary school attainment rate	(4) Tertiary school attainment rate	(5) Primary school net enrolment rate	(6) Secondary school net enrolment rate
lagged Educational Attainment rate	0.892***					3.330
	(0.0916)					(2.259)
government Expenditure on Education	0.201	0.138	0.0540	0.00296	5.263*	-11.13
	(0.169)	(0.129)	(0.0480)	(0.00878)	(3.172)	(28.84)
Real GDP Per capita	6.79e-05	1.11e-05	5.30e-05	7.57e-06	-0.00294	0.0138
	(0.000159)	(0.000109)	(5.57e-05)	(9.11e-06)	(0.00586)	(0.0299)
corruption	0.202*	0.136	0.0667*	0.00549	4.873*	5.937
	(0.120)	(0.0886)	(0.0396)	(0.00674)	(2.720)	(16.31)
lagged Primary school Attainment rate		0.907***				
		(0.0863)				
lagged tertiary school Attainment rate			0.865***			
			(0.113)			
lagged Primary school enrolment net Rate				0.790***		
				(0.140)		
lagged Secondary school Net enrolment rate					1.031*	
					(0.621)	
Constant	-0.755	-0.483	-0.256	-0.0166	-3.557	58.15
	(0.782)	(0.616)	(0.192)	(0.0435)	(29.51)	(119.7)
Observations	108	108	108	108	71	46
Number of countries	25	25	25	25	23	18

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Sargan test of overid. restrictions: chi2(2) = 0.60 Prob > chi2 = 0.742
Hansen test of overid. restrictions: chi2(2) = 0.74 Prob > chi2 = 0.692

Appendix

Table A1: Variable definitions and descriptive statistics

Variable label	Abbreviation	Mean (sd)	Number of observations
Government expenditure on education	Govoe	4.4(1.7)	622
Educational attainment	Eduat	6.8(3.1)	630
Net enrolment rate, primary	Nerp	86(17)	627
Net enrolment rate, secondary	Ners	63(27)	628
Real GDP per capita	rgdpch	315(181)	630
Index of corruption (least corrupt=6)	Corp	3.3(1.4)	625
Democratic accountability	dema	4.4(0.5)	628

Table A2 Summary statistics 1999-2004 – a regional perspective

	OECD	Asia	Africa	Latin America	All
	Mean(standard deviation)	Mean(standard deviation)	Mean(standard deviation)	Mean(standard deviation)	Mean(standard deviation)
Government expenditure on education	4.9(1.2)	4.1(1.9)	4.7(1.7)	4.1(1.9)	4.4(1.6)
Educational attainment	10.8(1.8)	7.8(2.5)	3.3(1.3)	7.3(1.0)	7.7(3.4)
Net enrolment rate, primary	95(4.7)	92(7.3)	71(19)	91.5(7.3)	86(16)
Net enrolment rate, secondary	86.1(8.6)	63(16.7)	30.2(18)	63.5(16.1)	63(27)
corruption index(least corrupt=6)	4.4(1.27)	2.7(0.8)	2.5(1.03)	2.7(0.8)	3.3(1.4)

Figure A1 Kernel plot between educational attainment (Eduat) rate and government expenditure on education

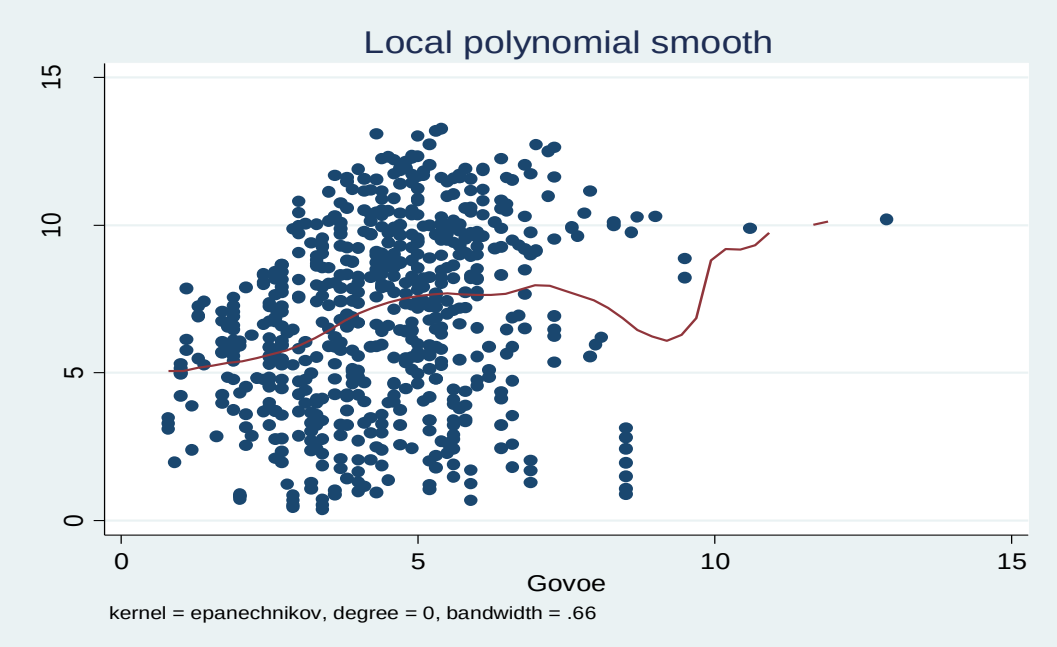


Figure A2 Kernel plot between primary school (Eduatps) attainment rate and government expenditure on education

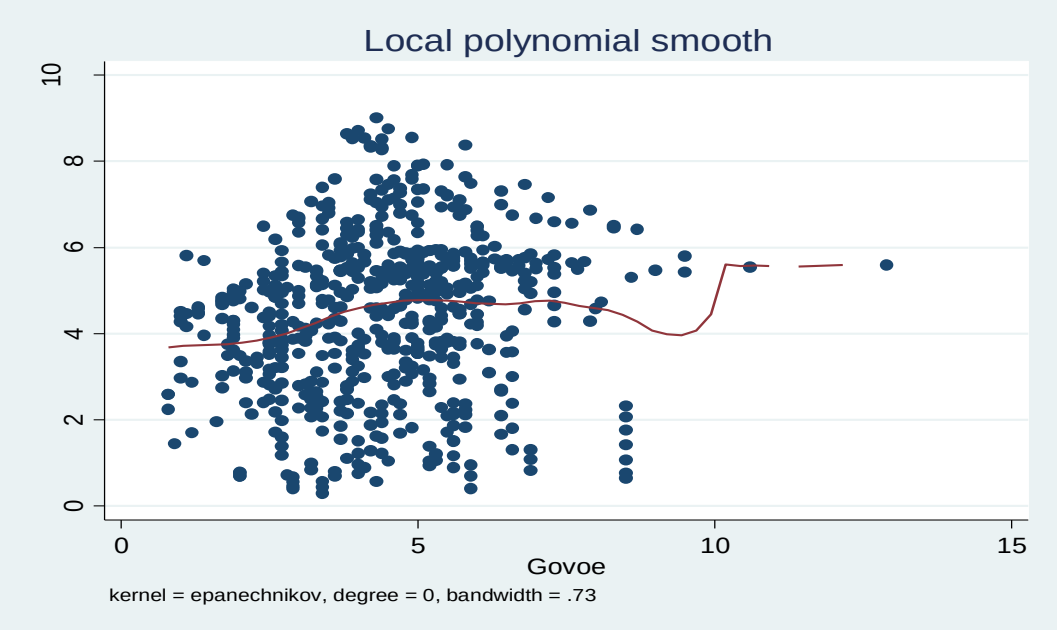


Figure A3 Kernel plot between secondary school attainment rate (Eduatsec) and government expenditure on education

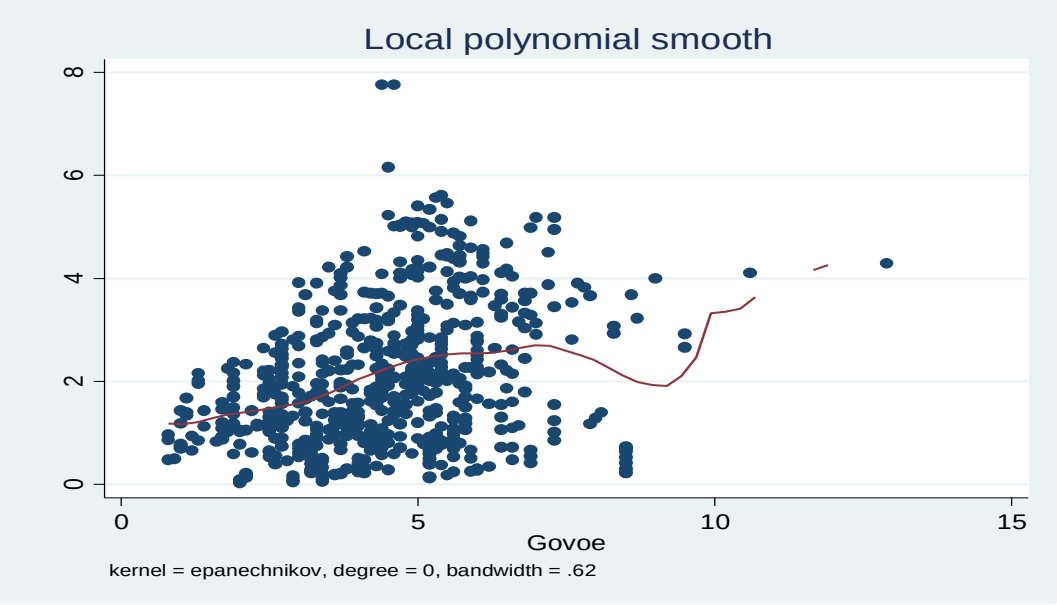


Figure A4 Kernel plot between tertiary school attainment rate (Eduatter) and government expenditure on education

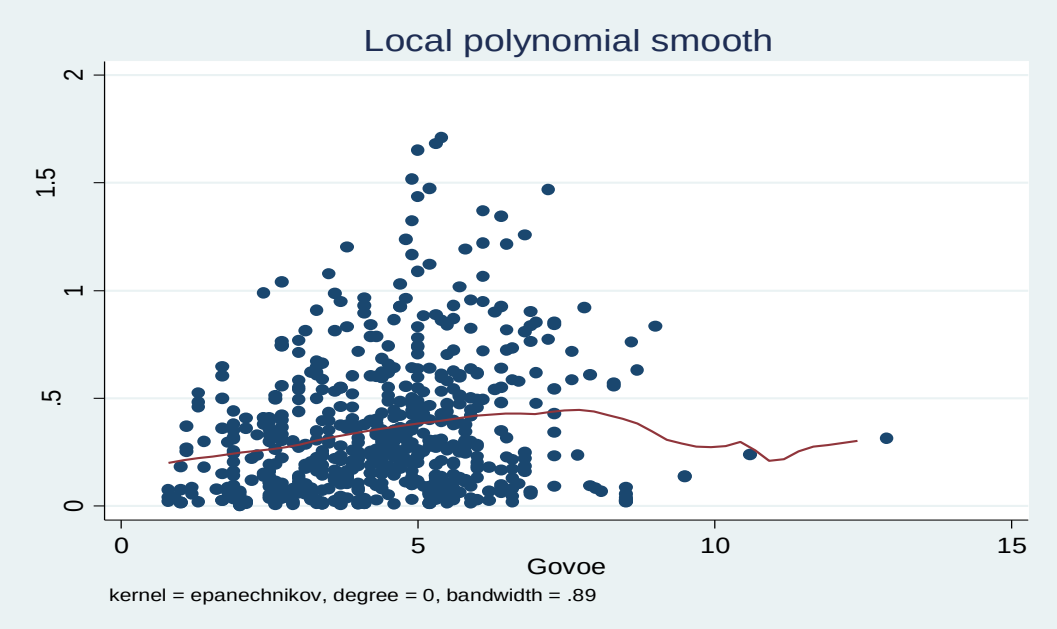


Table A5: Kernel plot between net primary school enrolment rate (NERP) and government expenditure on education(GOVOE)

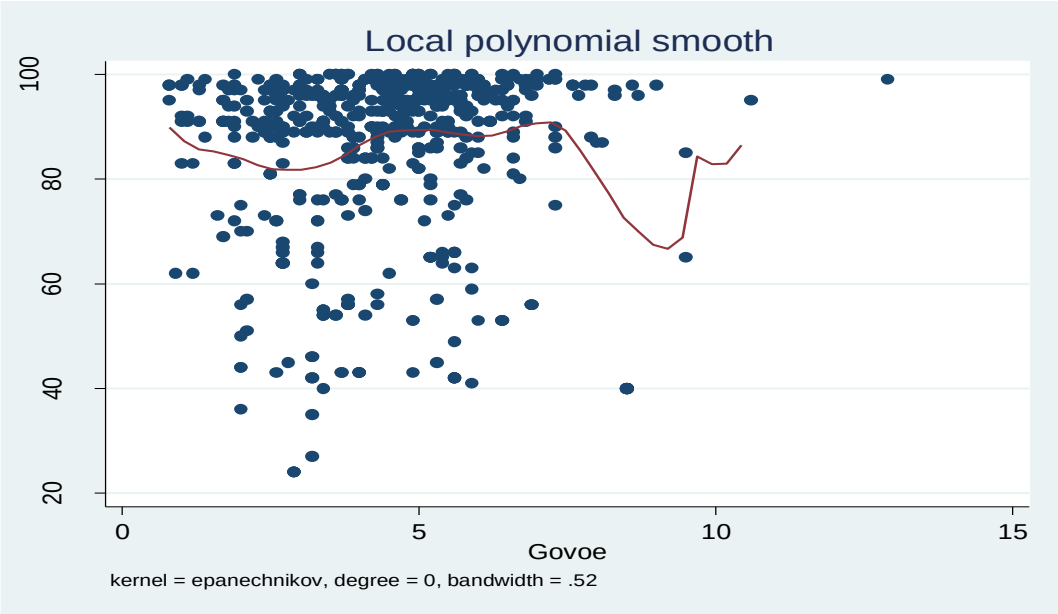
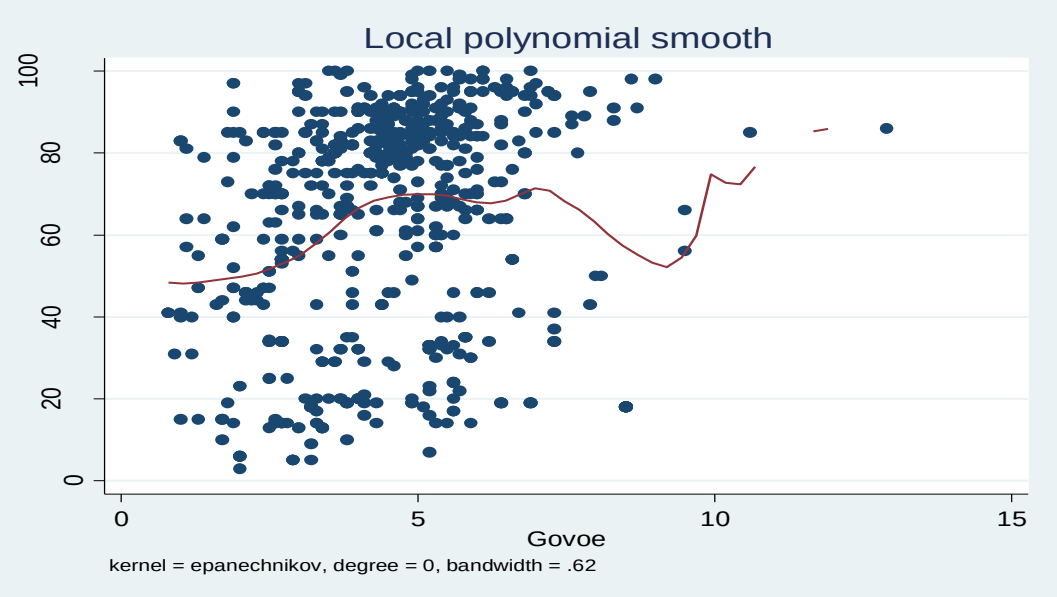


Table A6: Kernel plot between net secondary school enrolment rate (NERS) and government expenditure on education



Chapter 3:

The effects of cognitive skills and educational policy on economic growth in OECD countries

The effects of cognitive skills and educational policy on economic growth in OECD countries

Abstract:

Research in the economics of growth, both theoretical and empirical, has thus far produced surprisingly few resilient results about policies that might promote long-run growth in developed countries. Using panel growth regressions for 25 OECD countries and six five year periods (1980-2010), our analysis suggests that human capital measured in terms of cognitive skills in international achievement tests of Mathematics, Science and Reading have a large effect on long-run economic growth. We provide evidence that the robust association between cognitive skills and economic growth reflects a causal effect of the economic benefits of effective school policy: we find that, countries that improved their cognitive skill, through different facets of school choice, autonomy and accountability over time experienced relative increases in their growth paths. In highlighting the importance of policies affecting student achievement and economic growth, we add to the compelling evidence that better test scores are associated with better economic outcomes at country level and also the individual level.

JEL-Code: 120, O40.
Keywords: education, growth, cognitive, skills, choice, autonomy, accountability, OECD.

1. Introduction

The answer to the question regarding what educational policy will produce long-run growth in developed countries is mixed, and has occupied the minds of economists and policymakers for a long time. Governments around the globe have for decades worked to improve their education systems in order to provide the best education possible to their country, but the outcomes have generally fallen short of expectations. Nowhere is this more apparent than in the context of economic growth, where educational investments have not appeared to generate the economic outcomes promised by theoretical growth models (Hanushek and Woessmann (2012).

Thus, it is not surprising that several countries have embarked on national initiatives aimed at improving the foundations and competitiveness of their education system. This means shaking up bureaucratic inertia and approaching a more advanced form of education, i.e., reforming the institutional structure of their school systems (see

Aghion, 2007).[8] It also means shifting away from simply ensuring access to schooling to an interest in the quality of learning. Spending more on public education in the hope that the additional resources would translate into better student outcomes has been shown by Hanushek, 2002, as not to guarantee more learning, and also not to have any significant effect on student achievement.

The objective of this paper is to revisit this analysis and review what is known about the role of education in promoting economic growth. Further, we establish a causal relationship between education and economic growth and, more importantly, between educational policy initiatives and educational outcomes. We then build on the motivation of these analyses to advance the literature on education and growth by enhancing the quality of the data. Our main innovation is to introduce education policies into the equation in order to show that education policy is closely associated with the long-run growth potential of OECD countries. We intend to assess the importance of the different facets of institutional structures of choice, autonomy and accountability to student achievements and economic growth. The analysis presumes that a country's level of economic growth can sufficiently characterize the set of institutional features that are complementary to human capital. And for this purpose we investigate the relevance and statistical significance of cognitive skills, taking into considering the possible institutional structure of education.

The investigation begins by instrumenting cognitive skills by some of the characteristics of educational systems in 25 OECD countries; this approach provides information on how variations in student outcomes that are related to educational policies affect growth. Our results suggest that different facets of a country's educational policies, i.e., choice, autonomy and accountability, are strongly associated with the level of student achievement and economic growth across OECD countries.

We use the data that describes long-run growth for OECD countries on educational outcomes to estimate cross-country regressions. This follows a growing literature which, over the past ten years, demonstrates that consideration of cognitive

[8] For example there is the English reform, which has two main features: an increase of yearly tuition fees and the Graduate Contribution Scheme. There is also the German Excellence Initiative (approved by the Schroeder government) which devotes 1.900 million €, over a period of five years, to a competitive program aimed at generating world class institutions from the matrix of the German universities and France's approach, which put emphasizes in universities' autonomy. (see Aghion 2007).

skills dramatically alters the assessment of the role of education and knowledge in the process of economic development.

Analysing growth in 1960-1990 for a sample of 31 countries with available data (including 18 OECD countries), Hanushek and Kimko (2000) first showed a statistically and economically significant positive relationship between cognitive skills and economic growth. This relationship between cognitive skills and economic growth has been subsequently confirmed in a range of studies with different focuses. Most recently, Hanushek and Woessmann (2009) extend the empirical analysis to incorporate 50 countries that have participated in one or more international test between 1964 and 2003 and have aggregate economic data for the period, 1960-2000.

The same type of exercise was carried out by Woessmann (2009), where he investigates whether a causal interpretation of the robust association between cognitive skills and economic growth is appropriate and whether cross-country evidence supports the economic benefits of effective school policy. As a starting point for our analyses, we replicate the basic analysis of Woessmann (2009), replacing the extended version of the Cohen and Soto (2007) data on years of schooling by the newly available latest version of the Barro and Lee (2010) database on years of schooling and also other recent economic data, but we also specifically test whether schools produce more output from an exogenous increase in their resources if they are more autonomous, accountable and face more competition and how these institutional policies affect growth.

Economists have considered the process of economic growth for a long time, but over the past 20 years, have linked analysis much more closely to empirical observations and in the process rediscovered the impact human capital in the form of education has on economic growth. The empirical macroeconomic literature focusing on cross-country differences in economic growth employs measures of years of schooling[9], to test the human capital aspects of growth models. Initial analyses employed school enrolment ratios (Barro (1991), and Mankiw, Romer and Weil (1992)). Subsequent works by others have attempted to distinguish among alternative mechanisms through which education affect growth. For example, Benhabib and Spiegel (1994) showed, based on cross-country regressions over the 1965-1985 period, that human capital accumulation (where human capital is measured by school

[9] Years of education are the same as educational attainment in our analysis.

enrolment) was not significantly correlated with growth, whereas human capital stocks were. More recent work by Krueger and Lindahl (2001), using panel data of number of years in education for 110 countries between 1960 and 1990, finds a positive correlation between growth and human capital stocks and the rate of accumulation of human capital. While school attainment has been convenient in empirical work because of its availability across countries, its use as a proxy for human capital is very restrictive. Not only does it ignore differences in school quality, but also other important determinant of people's skills. It does not differentiate education by quality and quantity, the two were used as perfect substitutes in most models. A modified human capital, measured in terms of cognitive skills on international achievement test of Mathematics, Science and Reading by Hanushek and Kimko (2000) provides the necessary measurement to analysing education and growth empirically.

Hanushek and Kimko find a statistically and economically significant positive effect of cognitive skills on economic growth in 1960-1990 that dwarfs the association between years of schooling and growth. Their estimates stem from a statistical model that relates annual growth rates of real GDP per capita to the measure of cognitive skills, years of schooling, the initial level of income, and a variety of other control variables. They find that adding cognitive skills to a base specification including only initial income and years of schooling boosts the variance in GDP per capita among the 31 countries in their sample. At the same time, the effect of years of schooling is greatly reduced by including cognitive skills, leaving it mostly insignificant, while adding other factors leaves the effects of cognitive skills basically unchanged.

This focus on cognitive skills has a number of potential advantages: first, it captures variations in the knowledge and ability that schools strive to produce and relate the outputs of schooling to subsequent economic growth success. Second, by allowing for differences in performance among students with different quality of schooling but possibility the same quantity of schooling, it opens the investigation of the importance of different policies designed to affect the quality aspects of schools.

The question it raises is whether this strong relationship between cognitive skills and growth reflects a causal relationship that can support direct education policy, in the form of accountability, autonomy and choice, we try in this paper to shed light on this question.

Proponents of greater accountability, autonomy, and choice contend that these reforms will improve student outcomes by heightening incentives for various actors to

perform at high levels. Accountability systems combine clear standards, external monitoring of results, and corresponding rewards and sanctions based on performance indicators. By providing better information on student outcomes, proponents argue, such systems directly and indirectly reward students, teachers, and school leaders for their efforts. Decentralizing decision-making to the schools, advocates suggest, substitutes the creativity and knowledge of local decision-makers for the inertia and rigidity of centralized bureaucracies. Supporters of school choice contend that giving parents free choice among schools and enabling private providers of education to receive government funding unleashes competitive forces that will drive school improvement. We also place a particular focus on how these three factors interact with cognitive skills to determine student outcomes and economic growth.

While cognitive skills can be developed in a variety of ways, we focus on how it can be developed through education and how education policies affect it. Educational policy differs considerable by countries, with different countries pursuing very different policies. On average across countries, 83% of schools are publicly funded, and the remaining 17% are managed by a private entity. Even the share of publicly operated schools varies substantially across countries. And on other level there is a different mix of public education expenditure across primary, secondary and tertiary education. While US devotes 3% of its GDP to tertiary education, in Europe it is only 1.4% of GDP. These analyses enter into the debates about the relative importance of these education policies, we analyse how differences in the operation of schools affect student achievement and economic growth and also how differences between the ownership structure and policies of schools affect the growth process of countries.

The paper proceeds as follows: in section 2 we provide a brief review of the links between the institutional structure and incentives in the school system, section 3 present the data, section 4 present our estimation strategy, where we first show the relationship between educational attainment and economic growth in OECD countries. We then analyse the growth of OECD countries where the education process takes account of accountability, autonomy, and choice. This approach has great potential to shed light on the effects of institutional variation on student outcomes and impact on growth. Its chief advantage stems from the ability to exploit the substantial variation in education policies across OECD countries. Section 5 reports our results, and section 6 concludes.

2. Institutional structure and incentives in the school system

Research on how school policy can successfully advance educational achievement is an expanding field that still leaves many open questions. However, available evidence is that institutional reforms are linked to substantial long-term economic benefits.

All over the world, many countries tend to finance and manage the great majority of their schools publicly. However, the dominance of the public sector in education often limits incentives to improve student achievement while controlling costs. A lack of competition and choice in most state-run school systems often creates obstacles to leaving bad schools, thereby constraining the ability of parents to ensure high-quality education. Centralized bureaucracies often allow little flexibility at the school level, limiting school's ability to respond to parental demands. And information on what students and schools actually achieve is often unavailable, hindering parent's ability to make informed choices. The rationale for the recent wave of market-oriented reforms in the school system in many countries is to change this (Woessmann 2005)

The aim of market-oriented reforms is to enhance choice on the demand side, to provide suppliers with more autonomy, and to provide parents with more information about student outcomes. The main consequence of these changes in the institutional framework of the system is that they alter the incentives that actors face. The institutions of the school system are the set of rules and regulations that determine rewards and penalties for those involved in the schooling process. Economic theory suggests that people respond to these incentives, if the actors in the education process are rewarded for producing better student achievement, and if they are penalized for not producing high achievement, they will change their behaviour in a way that improves achievement. It is also argued that the ability to choose schools will open up possibilities for students who are locked in inferior neighbourhood schools and that the competitive market place will have great incentives to meet the needs of all students more fully than existing schools, and in the words of Godwin and Kemerer, 2002, market-oriented reforms may make the education system more equitable through open enrolment.

While the relative lack of accountability, autonomy, and choice in the compulsory education sector as currently constituted tends to dull incentives to improve quality and restrain costs (see Hanushek 1995), market-oriented models may create incentives that

ultimately lead to better student learning. Attempts to provide parents with additional choice and to allow non-governmental providers to enter the education market clearly represent market-oriented reforms. And enabling the schools to exercise at least some autonomy is obviously essential for them to compete.

In sum, institutional reforms that ensure informed choice between autonomous schools may be expected to improve student achievement because they create incentives for everyone involved to provide the best learning environment for students (see Bishop and Woessmann, 2004, for a general model of the institutional effects in education).

As already stated, proponents of greater accountability, autonomy, and choice contend that these reforms will improve student outcomes by heightening incentives for various actors to perform at high levels. Accountability systems combine clear standards, external monitoring of results, and corresponding rewards and sanctions based on performance indicators. By providing better information on student outcomes, proponents argue, such systems directly and indirectly reward students, teachers, and school leaders for their efforts. Decentralizing decision-making to the schools, advocates suggest, substitutes the creativity and knowledge of local decision-makers for the inertia and rigidity of centralized bureaucracies. Supporters of school choice contend that giving parents free choice among schools and enabling private providers of education to receive government funding unleashes competitive forces that will drive school improvement.

Evidence of market-oriented system of education does suggest some clear general policies that are important. Foremost among these is the incentives that the teachers face (see Muralidharan and Sundararaman, 2009). That is, if the teachers in the education process are rewarded for producing better student achievement, and if they are penalized for not producing high achievement, achievement is likely to improve. The incentives to produce high quality education, in turn, are created by the institutions of the education system, the rules and regulations that explicitly or implicitly set rewards and penalties for the people involved in the education process. Therefore, the key to improvement appears to lie in better incentives that will lead to managerial decisions keyed to student achievement and that will promote strong schools with high-quality teachers.

Here, three interrelated policies come to the forefront: promoting more competition, so that parental demand will create strong incentives to individual schools; choice and competition in schools were proposed a half century ago by Milton

Friedman (1962). The idea is that parents, interested in the schooling outcomes of their children, will seek out productive schools. This demand-side pressure will result in incentives for each school to produce an effective and efficient education system. These incentives will also put pressure on schools to ensure high quality staff in addition to a good curriculum. In a cross-country comparison, students in countries with a larger choice tend to perform better on average (see Woessmann (2009), and recent evidence corroborates the conclusion that this is due to a causal effect of autonomy and competition (West and Woessmann (2010).

3. Data

Our analysis relies on measures of cognitive skills, developed by Hanushek and Kimko (2000) and Hanushek and Woessmann (2007). Employing direct cognitive skill measures has the significant advantage of permitting quality differences to arise from factors outside of formal schools. Hanushek and Kimko combined data from international tests given over the past 45 years in order to develop a single comparable measure of skills for each country that can be used to index skills of people in the labour force. They use data from six voluntary international tests of mathematics and science over the period 1964-1991. These tests were organized by two organizations: the International Association for the Evaluation of Educational Achievement (IEA) and the International Assessment of Educational Progress (IAEP). Hanushek and Woessmann (2007) expanded the set of international cognitive skills to include several tests made available during the 1990s. The additional test score data were the Trends in International Mathematics and Science Study (TIMSS) of the IEA and the Programme for International Student Assessment (PISA) administered by OECD.

PISA programme assesses the mathematical, scientific, and reading literacy of the student population in each participating country. The PISA test not only provides achievement data for representative samples of students in the participating countries but also a rich array of background information on each student and on the student's school. The database provides an indicator for whether each student's school is privately operated (as well as the share of its funding that it receives from government sources) or if it is a public school, defined as being managed directly or indirectly by a public education authority, government agency, or governing board appointed by government or elected by public franchise.

Combining the data, we are able to construct a dataset containing cognitive skills and educational institutional measures of OECD countries. These educational measures of specific control variables, choice, autonomy and accountability, are taken from Aghion (2007) and West and Woessmann (2010).

All international growth rates are based on the Penn World Table data (Version 7.0). Data on quantitative educational attainment and the levels of educational attainment are taken from the latest version of the Barro and Lee (2010) database. The dataset extends coverage of mean years of schooling data to 146 countries over 5-year intervals from 1950-2010, disaggregated by gender and age (15+ and 25+).

Census and survey data obtained from UNESCO institute for statistics (1980-2010) and Eurostat (1980-2010) are used to construct estimates of net enrolment rate for both primary and secondary schools. The new data is an extension of notion of human capital that has been developing over the years and the key element here is to equate knowledge and skills across countries.

3.1. Descriptive statistics

Table 1 shows the descriptive statistics for the 25 OECD countries considered in our study. The complete data covers 25 OECD countries over 30 years (1980-2010), thus giving rise to a sample of country-year observations of 175. The table shows the corresponding means and standard deviations of the variables.

The table confirms that there is a wide variety in countries' growth rates. For instance, the growth rate varies from lows of 1 to 9.2. Table 1 also shows a country's average annual GDP per capita growth from 1980-2010, our main measure of development. What is also clear from the table is that both total years of education and cognitive skills vary widely, suggesting that any impact of these human capital measures on growth differences should be easily detected.

Form the figures in the appendix we can assess the impact institutional measures have on economic growth when they are interacted with cognitive skills. While cognitive skills on its own have a positive impact, combined cognitive skills and any of the institutional measures have a much higher positive impact on economic growth.

4. Methodology

In this section we outline our methodological approach to our analysis on education and economic growth. To determine empirically the relationships among educational attainment, cognitive skills, education policies and growth we use a panel data set on 25 OECD countries over six five-year time periods.

Recent interest in economic growth has led to an upsurge of empirical analyses of why some nations grow faster than others. The standard method for establishing the effect of education on economic growth is to estimate cross-country growth regressions where a country's average annual growth in gross domestic product (GDP) per capita over several decades is expressed as a function of measures of education and a set of other variables deemed to be important for economic growth. Our interest is on how appropriate education policies will impact on growth, we therefore measure human capital not only by the quantity of education but also by its quality (which is a reflection of cognitive skills in a country) and organizational characteristics of the education systems.

With this objective in mind we show the relationship between educational attainment, cognitive skills and economic growth for the OECD countries. This relationship takes the following form:

$$g_{i,t} = \beta_0 + +\beta_1 h_{i,t} + \beta_2 x_{i,t} + \propto_i + \gamma_t + \varepsilon_{i,t} \qquad (1),$$

where a country's growth rate (g) is a function of the skills of workers (h), termed human capital, and other factors (x) that include initial levels of income.

Human capital is nonetheless a latent variable that is not directly observed. Hence, it is necessary to specify how h is measured. The vast majority of existing theoretical and empirical work on growth begins by taking the quantity of schooling of workers as a direct measure of human capital.

In our opinion, a more satisfying alternative is to concentrate on the cognitive skills component of human capital which is the test-score measures of mathematics, science, and reading achievement (see Hanushek and Kimko, 2000). The use of cognitive skills means that we are able to capture variations in the knowledge and

ability that schools strive to produce, and thus relate the acknowledged outputs of schooling to subsequent economic success. It also allows for differences in performance among students with differing quality of schooling (but possibly the same quantity of schooling).

In addition, we include country specific intercepts (α) The country specific intercepts can be seen as picking up any bias arising from country-specific fixed effects. It also allows permanent differences in the level of income between countries that are not captured by x. We also include year specific fixed effects (γ) to minimise any bias arising from unobserved year specific effects, and the subscripts *i* and *t* represent country and time period, respectively.

Although we used fixed effects to capture country-specific intercepts, regressions using cognitive skills across countries may be hampered by endogeneity biases.[10]
Our empirical results are based on the OLS regression methodology, which assumes that cognitive skill is exogenously determined. The questions are, does higher cognitive skill cause educational policy or does educational policy cause cognitive skills and how can we separate the effects of these variables on growth?

We address this issue in our analyses by using institutional structure of the school systems as instruments for the cognitive-skill measure, thereby using only that part of the international variation in cognitive skills that can be traced back to international differences in school systems. We use institutional features, notably choice, autonomy and accountability, that have been shown in education and growth to be associated with student achievement (see Woessmann, 2007).

We then use two-stage least squares (2SLS) to estimate simultaneous equations for growth, cognitive skills and educational policy and by making identifying assumptions about the exogenous determinants of cognitive skills, educational policy and growth, we can determine the separate impacts of cognitive skills and educational policy on growth. Apart from identifying the causal effect by the use of instruments, our estimation strategy is to estimate how a country's educational system affects economic growth for a given supportive institutional structure like choice, autonomy and accountability. So, we augment specification (1) by including the interaction terms between cognitive skill and the three different facets of school policy mentioned above.

[10] A variable is endogenous if it is correlated with the disturbance i.e. in this equation $g_{i,t} = \beta_0 + +\beta_1 h_{i,t} + \beta_2 x_{i,t} + \propto_{i,t} + \gamma_{i,t} + \varepsilon_{i,t}$ is endogenous if $cov(x_i \varepsilon_i) \neq 0$ x_i is exogenous if$cov(x_i \varepsilon_i) = 0$, OLS estimate will be consistent only if $cov[x_i\ \varepsilon_i] = 0$. (Wooldridge,2006).

This means we are able to test whether cognitive skills are affected by education policy or vice versa. The underlying idea is that the effect of a given educational policy is allowed to vary with quality human capital based on cognitive skills of the population. Suppose, for example, an education policy based on the institutional structures indicated above create quality education which enhances human capital into greater productivity then, the education policy would generate higher student output, which will eventually promote higher economic growth all else equal. In other words, a sufficient condition for policy on education that produces higher educational attainment is that they enhance the return to any given investment in the country. We would like to test this sufficient condition by interacting cognitive skills with the different school policies. This will give us the indication of whether school policy based on choice, autonomy and accountability, promotes economic growth.

In this paper, our broad aim is, therefore, to capture the effects on growth of variations in cognitive skills, choice, autonomy and accountability, on their own, and also when cognitive skills interact in turn with the other three variables. The overall growth equation, taking all of these factors into account, can be expressed as follows:

$$growth_{i,t} = \beta_0 + \beta_1(initial\ GDP\ per\ capita) + \beta_2\,(cognitive\ skills) + \beta_3\,(choice) + \beta_4(autonomy) + \beta_5(accountability) + \beta_6(choice * cognitive\ skills) + \beta_7(autonomy * cognitive\ skills) + \beta_8(accountability * cognitive\ skills) + \propto_{i,t} + \gamma_{i,t} + \varepsilon_{i,t} \quad (2)$$

Based on this overall growth equation, one can calculate the marginal impacts of the following partial derivatives:

$$\frac{\Delta\,(growth)}{\Delta(choice)} = \beta_3 + \beta_6(mean\ of\ cognitive\ skills) \quad (2a)$$

$$\frac{\Delta(growth)}{\Delta(autonomy)} = \beta_4 + \beta_7(mean\ of\ cognitive\ skills) \quad (3a)$$

$$\frac{\Delta(growth)}{\Delta(accountability)} = \beta_5 + \beta_8(mean\ of\ cognitive\ skills) \quad (4a)$$

$$\frac{\Delta(growth)}{\Delta(cognitive\ skills)} = \beta_2 + \beta_6(\,mean\ of\ choice) + \beta_7(mean\ of\ autonomy) + \beta_8(mean\ of\ accountability) \quad (4b)$$

The above marginal partial derivatives give us the total (direct and indirect) effects of choice, autonomy, accountability and cognitive skills on growth. But although the final

objective is to find these partial derivatives for the most comprehensive of all cases, i.e., where all the nine β-coefficients (β_0 to β_8) are non-zero, we will also be interested in the cases where some of the β-coefficients are equal to zero. Our step-by-step procedure and analysis of results is presented in the section below.

4. Results

We start with an analysis of the fixed effects OLS (FE-OLS) on the impact of educational attainment on economic growth, because simple OLS specifications have only contemporaneous X variables (see Appendix Table 1).

Table 2 shows the robustness of results using FE-OLS estimates that control for both country and year specific unobserved heterogeneity in our data. The point estimate on educational attainment remains strong and statistically highly significant. The inclusion of initial GDP per capita in all specifications simply reflects the condition of convergence, it suggests that any differences in growth rates will eventually die out. These results are consistent with past estimation where initial income negatively affects growth, supporting the notion of conditional convergence in growth rates. (See Barro, 2001).

Growth is insignificantly related to enrolment at the primary level. However, it is positively related to net enrolment at the secondary level. This we believe is more relevant for assessing the productive potential of a country and the welfare implications for the future of these students. This level of schooling is also a prerequisite for tertiary education and also the labour force and would, therefore, affect growth through this channel. There is little indication that this association differs across the decomposed levels of educational attainment, although the positive association of the individual levels of attainment, i.e., tertiary educational attainment (column (4)) seems to increase with a country's growth level, measured by average growth rate on GDP 1980-2010 have a much more pronounced effect on growth than the other types of attainment.

5.1 Variations in Cognitive Skills Driven by School Structure: Instrumental Variable Models

Even if the cognitive skills-growth relationship is causal, it is further important to remember that cognitive skills are likely to depend not only on formal schooling but also on non-school factors such as families, peers, and ability. The results presented so

far would only be relevant for school policy if the variation in cognitive skills emanating from school policies is in fact related to economic growth.

One way of addressing this issue is to use measures of the institutional structure of the school systems as instruments for the cognitive-skill measure, thereby using only that part of the international variation in cognitive skills that can be traced back to international differences in school systems. We use educational institutional features such as the share of privately operated schools (choice), the localization of decision-making (autonomy), and the existence of external exit exam systems (accountability), that have been shown in the literature on quality of education in economic growth to be associated with student achievement (see Woessmann, 2007). Table 3 shows these results.

First in column (1) we can see that cognitive skills have a positive effect on economic growth, supporting Hanushek and Kimko's results on the positive impact cognitive skills have on economic growth. A leading policy question refers to the effects of different educational policies on economic growth. We start by incorporating the different educational policies in our growth regression.

School choice, as measured by the share of privately operated schools in a system, consistently shows a positive association with student achievement in OECD countries (see West and Woessmann, 2008). In our sample, the share of private enrolment in a country is significantly positively associated with cognitive skills in the first stage of our IV model (see Appendix Table 2). The second-stage estimate of the growth model, Table 3, confirms the results of the FE-OLS that schooling-induced differences in cognitive skills are significantly related to economic growth. The rule of thumb of a first stage F-statistic greater than 10 suggested by Stock, Wright, and Yogo (2002), however, indicates the possibility of a weak instrument problem. In our estimation, F-statistic is smaller than 10 suggesting our instruments are strong. The Sargan test does not reject the validity of the over identification restrictions suggesting that school choice is a valid instrument and the Durbin-Wu-Hausman test presents no evidence of endogeneity of the cognitive skill measure.

An institutional feature regularly shown to be positively associated with student achievement is the extent to which schools (or at least local decision-makers) are autonomous to make their own decisions about the organization of instruction (see Woessmann, 2003). Specification 3 of Table 3 shows that the share of decisions on the organization of instruction that are made at the local level is significantly positively

associated with our cognitive-skill measure, and the 2SLS estimator confirms the significantly positive effect of cognitive skills on economic growth. The results suggest that cognitive skills generated in an autonomous school system lead to higher long run growth of economies. Again, the Sargan test does not reject the validity of the over identification restrictions and the Durbin-Wu-Hausman test presents no evidence of endogeneity of the cognitive-skill measure.

A final institutional feature, external exit exam systems are a device to increase accountability in the school system that has been repeatedly shown to be related to better student achievement (see Bishop, 2006). The first specification reported in Appendix Table 2 uses the share of students in a country who are subject to external exit exams as an instrument for our measure of cognitive skills in the growth regression. The first-stage results confirm a statistically significant association between external exit exams and cognitive skills. The effect of cognitive skills on economic growth in the second stage of the instrumental variable (IV) estimation is statistically significant.

One potential worry about the exogeneity of our instruments is that institutional features of school system may be correlated with other variables, which are themselves correlated with economic growth. To test whether this affects our identification, we add a variable that tends to enter most robustly in growth regressions, i.e., investment as a ratio of GDP, to our IV model (see Appendix Table 3). Our model is not affected, as the investment index variable does not enter significantly in any of the specifications[11].

There are obvious limitations of cross-country regressions with small data samples, and these are an issue in IV specifications. Nonetheless, the results of using the three institutional features of the school systems as instruments strongly suggest a causal interpretation of the results previously presented. Caution is appropriate in interpreting IV results for our relatively small samples of countries and the aggregate nature of the institutional measures, but these make the statistical significance, reasonable precision, and quantitative robustness of the results based on various instruments even more striking.

In Table 4, we test the strength of the educational institutional measure variables of choice, autonomy and accountability, on economic growth. A simple FE-OLS regression with these variables at individual levels (columns (1)-(3), Table 4), show a

[11] However we did not estimate the pairwise correlation between the investment term and the institutional variables

positive association with economic growth after controlling for initial GDP per capita and year specific effects they are all consistently significant, both in magnitude and statistically. When all the variables were used in the same regression (column (4)), i.e., the case where $\beta_2 = \beta_6 = \beta_7 = \beta_8 = 0$, the coefficient of the choice variable is significant but turns negative, which could be due to the existence of multicollinearity.[12] In Table 5, we added cognitive skill to the three institutional variables: here all variables, remain positive and significant (the choice variable becomes highly significant), in column (4), where $\beta_6 = \beta_7 = \beta_8 = 0$; the results change very little. Among the three institutional variables, autonomy and accountability seem to be more important than choice (with or without the presence of cognitive skills in the set-up).

Understanding the sources of international variation in student achievement levels is an important project, all the more so because recent research shows that international differences in student achievement are a key driver of differences in long-run economic growth rates (Hanushek and Kimko, 2009). Economic theory suggests that strong education systems will increase the long-run rate of economic growth, because education is an investment in human capital that increases labour productivity. And because it is a leading input for innovation and technical progress, it in turn influences growth rates (Barro and Sala-i-Martin, 2004).

Having looked at the strength of qualitative (via cognitive skills) and institutional (via choice, autonomy and accountability) variables separately in the growth regression, we now focus our attention to the role of cognitive skills in particular. In other words, we study how cognitive skills affect the growth outcome by itself, as well as via its interactions with each of the institutional variables. This is what we capture in Table 6, where cognitive skills is used as a regressor first, on its own, and then, as a term interacting with choice, autonomy and accountability. It is interesting to note from columns (1), (2) and (3) of Table 6, where cognitive skills interacts with choice, autonomy and accountability in turn, that the interaction terms are always highly significant (at the 5% level), showing that cognitive skills thrive most in conjunction with the institutional variables, in particular when such schools have the autonomy and are accountable to others. It is also notable that in column (4), i.e., the case where $\beta_3 = \beta_4 = \beta_5 = 0$, where all the interaction terms are present in the same regression,

[12] Table A3 in the appendix show the OLS results.

all three remain significant (though at the 10% level). Also interesting is the fact that the effect of cognitive skills on growth, though positive, loses its significance in all but the first specification, thereby underlying the importance of its interaction with the three institutional variables.

We next study the importance of the three institutional variables in the growth process by focusing on their individual effects on growth as well as via their interaction with the cognitive skills variable. The results of this exercise are shown in Table 7. It is clear from the regressions that when we consider each institutional variable on its own and its interaction with cognitive skills only (at the exclusion of the other two institutional variables), as is clear from specifications (1), (2) and (3), the individual and interaction terms are both highly significant, suggesting once more that the choice, autonomy and accountability variables are very important in the growth process. In column (4), where $\beta_2 = 0$, we find that only the autonomy and accountability terms (on their own) remain significant.

We finally bring everything together in Table 8 by including cognitive skills and the three institutional variables (choice, autonomy and accountability) as separate regressors, and in addition capture the effects of the (choice*cognitive skills), (autonomy*cognitive skills) and (accountability*cognitive skills) interaction terms. As before, initial GDP per capita and the country FE are also included in all the regressions. The main finding here is that the coefficients of all the interaction terms are consistently positive and highly significant in all the regressions. The positive and significant coefficients suggest that better institutional structure of school systems will, in fact, enhance the positive growth effects of cognitive skills even after controlling for a variety of policy-related variables. Correspondingly, it could be interpreted as suggesting that the effectiveness of educational structure in encouraging growth is increasing in cognitive skills.

For example the interaction variable that links choice and cognitive skills is to test if privately operated schools affect the impact of cognitive skills on growth (see Table 8, column (1)). The estimate for cognitive skills and the interaction term are significant, implying that the complementarity between cognitive skills and choice suggests that economic returns comes from policies that effectively improve student achievement and thus add to the skills of the labour force. In such systems, privately operated schools face particularly strong incentives to perform well. Another question

that we attempt to address is how autonomy influences the impact cognitive skills have on economic growth.

Results in Table 8, column (2), shed light on this question. The results suggest that the effects of school autonomy on student achievement depend on whether schools are able to manage their budgets and curriculum. The coefficient of cognitive skills, autonomy and the interaction term is significant, which means autonomy-based systems may function better if cognitive skills systems create comparable information on economic growth.

Finally, the interactions between the effects of cognitive skills and accountability (Table 8, column (3)), may be expected at the system level. Accountability and cognitive skills seem to be complementary in any decision-making area that includes scope for local knowledge leads. However, when we include all seven variables (i.e., cognitive skills, choice, autonomy, accountability, and the three interaction terms) in the same regression, most of the terms become insignificant (Table 8, column (4), where all β-coefficients are non-zero). This is likely due to possible multicollinearity among the institutional variables when they are included in the same regression.

Overall, Table 8 supports our hypothesis that for OECD countries to benefit (in terms of higher growth) from human capital in the form of education, school policy should pay more attention to the quality of education by putting in place a system where the institutional structure provides incentives to the operators of the education system, because performance responds to incentives. This is evident from the fact that in all the regressions (unless all the variables are included together), cognitive skills have a positive effect on growth on their own as well as through their interaction with the institutional variables.

Finally, we look at the marginal (i.e., both direct and indirect) effects of skills and institutions on growth, because the implications of the results become clearer if one looks at the marginal impacts of cognitive skills and institutional structures, respectively, on annual economic growth. As far as regressions, (1), (2) and (3) in Table 8 are concerned, all the marginal partial effects are positive; thus the marginal contributions of choice, autonomy, accountability and cognitive skills to long-run growth (both direct and indirect) are unambiguously positive, which is along expected lines. However, when we consider regression (4) in Table 8, only the $\frac{\Delta(growth)}{\Delta(autonomy)}$ and the $\frac{\Delta(growth)}{\Delta(accountability)}$ marginal effects are positive (and equal 3.395 and 3.586, respectively),

while the others turn out to be zero, but this is because when all eight variables plus the constant term are included in the same regression, many of the coefficients turn out to be insignificant, as noted earlier.

5. Conclusion

Most research on the human capital component of growth is concentrated on the accumulation of more education. The common approach to estimating this kind of model is to relate changes in GDP per worker to changes in the quantity of education. Quality of education is measured by the knowledge that students gain as depicted in the acquiring of cognitive skills, and this is substantially more important for economic growth than the mere quantity of education.

This research provides evidence on whether or not students perform better in school systems that have various forms of choice, autonomy and accountability policies in place relative to systems that do not. We also focus on how these three factors interact with cognitive skills to determine economic growth.

This paper empirically assesses the impact that cognitive skills and institutional characteristics have on the economic growth and their interactive effects in 25 OECD countries. The results show that interaction effects of cognitive skills and institutional structures have a significant impact on economic growth. The results remain robust under alternative panel estimations. In particular, the marginal contributions of cognitive skills, choice, autonomy and accountability to long-run growth (both direct and indirect) are unambiguously positive in almost all the regressions. The results also reflect that economic growth accelerates the process of cognitive skills in the presence of good institutions, therefore economic growth is vital in increasing good institutions. One could provide a more detailed interpretation of alternative educational policies in the context of this model of quality versus quantity, although our main point in this discussion was to show that public support to education needs to be adequately designed and channelled in order to be unambiguously growth-enhancing.

TABLES

Table 1: Descriptive statistics

variable	observation	mean	Standard deviation	min	max
Average annual growth rate in GDP 1980-2010	175	3.7	2.9	1	9.2
Cognitive skills	174	4.9	0.2	4.6	4.9
Average year of total education	175	9.6	1.8	4.7	13.27
Average Year of Primary Schooling	175	5.5	1.03	3.5	7.9
Average year of secondary schooling	175	3.4	1.2	0.85	7.8
Average year of tertiary schooling	175	0.62	0.33	0.1	1.7
choice	175	0.2	0.2	0.01	0.8
autonomy	175	0.5	0.2	0.13	0.9
accountability	175	0.6	0.4	0	1

Table 2 FE-OLS estimates of educational attainment and economic growth

VARIABLES	(1) growth	(2) growth	(3) growth	(4) growth	(5) growth	(6) growth
Initial GDP per capita	-0.095*	-0.041	-0.079	-0.140**	-0.0049	-0.068
	(0.055)	(0.056)	(0.055)	(0.061)	(0.060)	(0.064)
Total educational Attainment	0.645**					
	(0.258)					
Primary Educational attainment		1.783*				
		(0.933)				
Secondary educational Attainment			0.821**			
			(0.386)			
Tertiary educational Attainment				4.676***		
				(1.46)		
Net primary Enrolment rate					0.034	
					(0.062)	
Net secondary Enrolment rate						0.128***
						(0.040)
Constant	-2.32	-6.10	1.01	1.072	0.431	-7.28**
	(2.45)	(5.14)	(1.30)	(0.88)	(5.95)	(3.46)
Observations	175	175	175	175	171	165
R-squared	0.103	0.036	0.089	0.151	0.002	0.107
Number of countries	25	25	25	25	25	25

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 3 Instrumental Variable Estimates

FE-OLS estimate of cognitive skills on economic growth		Instrumental Variable Estimate Second stage IV estimate of cognitive skills on economic growth			
	(1)		(2)	(3)	(4)
	Growth		Growth (choice)	Growth (autonomy)	Growth (accountability)
variables		variables			
Initial GDP per capita	-0.642 (0.580)	Initial GDP per capita	-0.201 (0.887)	-1.290 (0.161)	-2.147 (0.135)
Cognitive skills	0.852** (0.311)	Cognitive skills	2.068** (0.306)	1.062 *** (0.055)	2.862 *** (0.117)
constant	3.153 (14.58)	constant	13.65*** (0.018)	12.72 (0.632)	9.85 (0.258)
observations	174		174	174	174
Number of countries	25				
R-squared	0.068		0.450	0.558	0.260
F-test			1.2	6.18	5.13

Notes dependent variable of FE-OLS and of second stage is the average annual growth rate of GDP per capita 1980-2010 the variables in parenthesis is variable which are used as instruments.

Notes column (1): Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.
Notes column (2): Sargan statistic (over identification test of all instruments): 0.244 Chi-sq(1) P-val = 0.6213

Stock-Yogo weak ID test critical values: 10% maximal IV size 19.93

Tests of endogeneity of: cognitive skills

H0: Regressor is exogenous

Wu-Hausman F test: 1.21313 F(1,163) P-value = 0.27234

Durbin-Wu-Hausman chi-sq test: 1.23372 Chi-sq(1) P-value = 0.26668

Notes column (3): Sargan statistic (over identification test of all instruments): 0.640 Chi-sq(1) P-val = 0.4237

Stock-Yogo weak ID test critical values: 10% maximal IV size 19.93

Tests of endogeneity of: cognitive skills

H0: Regressor is exogenous

Wu-Hausman F test: 6.18956 F(1,163) P-value = 0.01386

Durbin-Wu-Hausman chi-sq test: 6.10946 Chi-sq(1) P-value = 0.0134

Notes column (4): Sargan statistic (over identification test of all instruments): 0.541 Chi-sq(1) P-val =0.4621

Stock-Yogo weak ID test critical values: 10% maximal IV size 19.93

Tests of endogeneity of: cognitive skills
H0: Regressor is exogenous
Wu-Hausman F test: 5.13277 F(1,163) P-value = 0.02479
Durbin-Wu-Hausman chi-sq test: 5.09819 Chi-sq(1) P-value = 0.02395

Table 4 FE-OLS estimates for the role of education policy based on choice, accountability and autonomy on economic growth

VARIABLES	(1) growth	(2) growth	(3) growth	(4) growth
Initial GDP per capita	-0.012	-0.017	-0.124**	-0.122*
	(0.057)	(0.057)	(0.058)	(0.059)
Choice	0.291*			-0.319**
	(0.164)			(0.151)
Autonomy		4.883***		3.008**
		(1.643)		(1.312)
Accountability			4.057**	3.917**
			(1.62)	(1.768)
Constant	3.064***	-22.72**	-21.35**	-36.07***
	(3.741)	(8.88)	(10.05)	(10.58)
Observations	168	168	168	168
R-squared	0.004	0.024	0.101	0.109
Number of countries	25	25	25	25

Robust standard errors in parentheses *** p<0.01, ** p<0.05,

Table 5: FE-OLS estimates for the role of education policy based on choice, accountability and autonomy on economic growth

VARIABLES	(1) growth	(2) growth	(3) growth	(4) growth
Initial GDP per capita	-0.0642	-0.0708	-0.1618***	-0.1601**
	(0.0589)	(0.0586)	(0.0575)	(0.0584)
Cognitive skills	0.0790**	0.0812**	0.0670*	0.0689**
	(0.0317)	(0.0308)	(0.0327)	(0.0330)
Choice	3.416*			-2.558
	(1.751)			(1.600)
Autonomy		5.089***		3.198**
		(1.357)		(1.314)
Accountability			3.785**	3.573*
			(1.653)	(1.817)
Constant	-0.8106	-27.62***	-22.99**	-38.45***
	(1.542)	(7.269)	(9.570)	(9.955)
Observations	167	167	167	167
R-squared	0.060	0.082	0.147	0.155
Number of countries	25	25	25	25

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 6: FE-OLS estimates for the role of education policy based on choice, accountability and autonomy on economic growth

VARIABLES	(1) growth	(2) growth	(3) growth	(4) growth
Initial GDP per capita	-0.708*** (0.000)	-0.551* (0.060)	-0.713** (0.057)	-0.702** (0.058)
Cognitive skills	0.606* (0.351)	0.0410 (0.678)	0.0196 (0.613)	0.171 (0.711)
Choice*Cognitive skills	0.932** (0.022)			0.688* (0.058)
Autonomy*Cognitive skills		1.642** (.005)		0.782* (.062)
Accountability*Cognitive skills			1.063** (0.023)	0.605* (0.093)
Constant	1.746 (13.63)	5.045 (13.45)	3.676 (15.07)	1.420 (15.13)
Observations	167	167	167	167
R-squared	0.065	0.065	0.068	0.075
Number of countries	25	25	25	25

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 7: FE-OLS estimates for the role of education policy based on choice, accountability and autonomy on economic growth

VARIABLES	(1) growth	(2) growth	(3) growth	(4) growth
Initial GDP per capita	-0.625	-0.616	-1.601**	-1.683**
	(0.618)	(0.581)	(0.592)	(0.670)
Choice	-6.828**			-8.791
	(3.245)			(5.448)
Choice*Cognitive skills	2.419***			1.379
	(0.634)			(1.180)
Autonomy		4.601***		3.433**
		(1.372)		(1.226)
Autonomy*Cognitive skills		1.569***		0.643
		(0.484)		(1.001)
Accountability			3.579**	3.566*
			(1.705)	(1.881)
Accountability*Cognitive skills			0.864**	0.141
			(0.374)	(0.738)
Constant	26.21***	-25.31***	-21.14**	-38.64***
	(3.605)	(71.68)	(99.28)	(99.48)
Observations	167	167	167	167
R-squared	0.050	0.087	0.148	0.168
Number of countries	25	25	25	25

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 8: FE-OLS estimates for the role of education policy based on choice, accountability and autonomy on economic growth

VARIABLES	(1) growth	(2) growth	(3) growth	(4) growth
Initial GDP per capita	-0.558	-0.562	-1.543**	-1.624**
	(0.661)	(0.617)	(0.639)	(0.732)
Cognitive kills	11.50	10.72	11.26	9.950
	(28.26)	(28.20)	(24.13)	(25.59)
Choice	-6.065*			-8.384
	(3.409)			(5.742)
Choice*Cognitive skills	2.254***			1.303
	(0.666)			(1.225)
Autonomy		4.655***		3.395**
		(1.367)		(1.244)
Autonomy*Cognitive skills		1.488***		0.650
		(0.496)		(1.046)
Accountability			3.613**	3.586*
			(1.708)	(1.889)
Accountability*Cognitive skills			0.800**	0.100
			(0.377)	(0.788)
Constant	-31.15	-30.73**	-26.78*	-43.43***
	(14.16)	(14.29)	(13.70)	(13.01)
Observations	167	167	167	167
R-squared	0.055	0.092	0.153	0.172
Number of countries	25	25	25	25

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Appendix

Table A1 OLS estimate of educational attainment and economic growth

VARIABLES	(1) growth	(2) growth	(3) growth	(4) growth	(5) growth	(6) growth
Initial GDP per Capita	-0.782 (0.691)	-0.381 (0.681)	-0.490 (0.719)	-1.033 (0.690)	-0.261 (0.713)	-0.801 (0.714)
Total Educational attainment	4.416*** (1.388)					
primary Educational attainment		8.562** (3.453)				
Secondary Educational attainment			2.823 (1.974)			
tertiary Educational attainment				31.02*** (7.972)		
Net Primary Enrolment rate					0.398 (0.538)	
Net secondary Enrolment rate						1.120*** (0.286)
Constant	-4.012 (13.70)	-9.688 (19.43)	28.20*** (7.520)	19.77*** (6.271)	-0.564 (51.84)	-57.89** (24.79)
Observations	175	175	175	175	171	165
Number of countries	25	25	25	25	25	25

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table A2 first stage IV regression

First-stage regressions			
variables	Cognitive skills	Cognitive skills	Cognitive skills
Initial GDP per capita	0.413 (0.142)	0.431 (0.287)	0.385 (0.169)
Choice	5.453 (0.094) **		
autonomy		2.045 (0.000) ***	
accountability			4.005 (0.021) **
constant	4.715 (0.000) ***	2.888 (0.000) ***	4.394 (0.000) ***

TABLE A3 FE-OLS with interaction terms with cognitive skills

VARIABLES	(1) growth	(2) growth	(3) growth
Initial GDP per capita	-2.081*** (0.561)	-2.247*** (0.558)	-2.340*** (0.580)
investment	0.452 (0.536)	0.493 (0.525)	0.472 (0.536)
Cognitive skills	10.87 (19.86)	6.794 (21.14)	6.410 (20.81)
Choice*cognitive skills	0.799*** (0.004)		
Autonomy*cognitive		1.141** (0.033)	
Accountability*cognitive skills			0.798** (0.044)
Constant	-102.5 (99.76)	-100.7 (106.1)	-94.11 (104.0)
Observations	167	167	167
R-squared	0.253	0.275	0.278
Number of countries	25	25	25

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table A4 OLS estimates for the role of education policy based on choice accountability and autonomy on economic growth

VARIABLES	(1) growth	(2) growth	(3) growth	(4) growth
Initial GDP per capita	-0.216	-0.211	-0.306	-0.228
	(0.695)	(0.690)	(0.690)	(0.693)
choice	-7.128			-12.37
	(16.91)			(17.73)
autonomy		26.04		19.38
		(18.69)		(21.97)
accountability			13.97	11.03
			(10.08)	(11.63)
Constant	38.60***	22.98**	28.56***	22.39*
	(5.702)	(11.08)	(7.640)	(11.95)
Observations	168	168	168	168
Number of countries	25	25	25	25

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table A5 OLS estimates for the role of education policy based on choice accountability and autonomy on economic growth

VARIABLES	(1) growth	(2) growth	(3) growth	(4) growth
Initial GDP per capita	-0.548	-0.505	-0.613	-0.557
	(0.686)	(0.696)	(0.686)	(0.696)
Cognitive skills	0.524**	0.410	0.468*	0.446*
	(0.252)	(0.259)	(0.251)	(0.259)
choice	-7.174			-12.43
	(17.06)			(16.73)
autonomy		16.20		7.226
		(18.25)		(21.15)
accountability			13.30	12.89
			(9.873)	(10.91)
Constant	13.38	8.576	6.421	6.373
	(13.15)	(14.32)	(13.58)	(14.87)
Observations	167	167	167	167
Number of countries	25	25	25	25

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table A6 OLS estimates for the role of education policy based on choice accountability and autonomy on economic growth

VARIABLES	(1) growth	(2) growth	(3) growth	(4) growth
Initial GDP per capital	-0.299	-0.375	-0.557	-0.507
	(0.685)	(0.672)	(0.679)	(0.683)
Cognitive skills	6.419	-0.0762	-0.916	-1.538
	(12.05)	(12.11)	(11.84)	(12.22)
Choice*cognitive skills	0.150			-0.144
	(0.334)			(0.338)
Autonomy*cognitive skills		0.611**		0.320
		(0.288)		(0.342)
Accountability*cognitive skills			0.443**	0.367*
			(0.174)	(0.216)
Constant	3.252	20.75	28.19	26.36
	(5.969)	(5.889)	(5.821)	(5.918)
Observations	167	167	167	167
Number of countries	25	25	25	25

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Tables of Descriptive Statistics

Variables	Data Source	Mean(standard deviation)
Dependent variable Average annual growth rate in GDP 1980-2010	Penn World Table Version 7.0, (Heston et al., 2010)	3.7(2.9)
Cognitive skills	Hanushek and Kimko (2000) combined data from international tests given over the past 45 years in order to develop a single comparable measure of skills for each country that can be used to index skills of people in the labour force.	4.98 (0.22)
Independent variable Average year of total education	Barro and Lee, Educational attainment for total population,1980-2010	9.64(1.82)
Independent variable Average Year of Primary Schooling	Barro and Lee, Educational attainment for total population,1980-2010	5.54(1.03)
Independent variable Average year of secondary schooling	Barro and Lee, Educational attainment for total population,1980-2010	3.47(1.23)
Independent variable Average year of tertiary schooling	Barro and Lee, Educational attainment for total population,1980-2010	0.62(0.33)
Independent variable Net enrolment rate for primary schools, 1980-2010	UNESCO Annual Statistics	96.29(4.5)
Independent variable Net enrolment rate for secondary schools, 1980-201	UNESCO Annual Statistics	86.70(8.4)
Independent variable Choice	The measure of school choice is taken from the school background questionnaires of the PISA tests. compiled by Aghion (2007) and West and Woessmann (2010)	0.21(0.23)
Independent variable Autonomy	The measure of autonomy is taken from the school background questionnaires of PISA tests, compiled by Aghion (2007) and West and Woessmann (2010)	0.54(0.22)
Independent variable Accountability	The measure of school accountability is taken from the school background questionnaires of PISA tests, compiled by Aghion (2007) and West and Woessmann	0.62 (0.42)

Figure 1: cognitive skills and growth across OECD countries

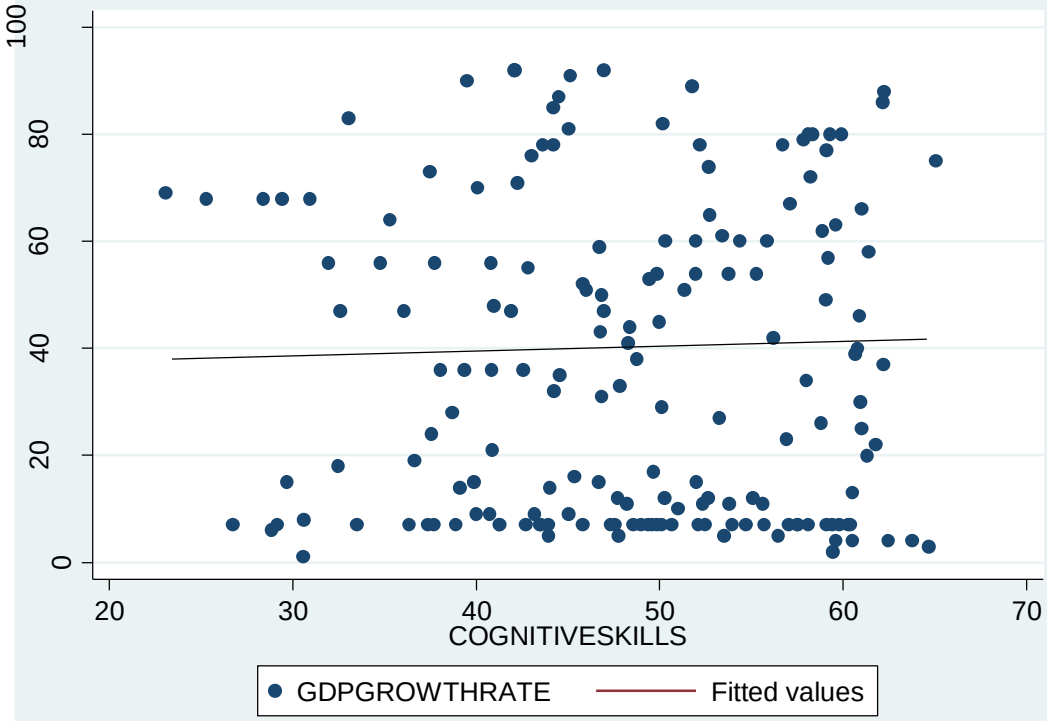


Figure 2: the interaction effect of cognitive skills and the different school policies on OECD growth rate

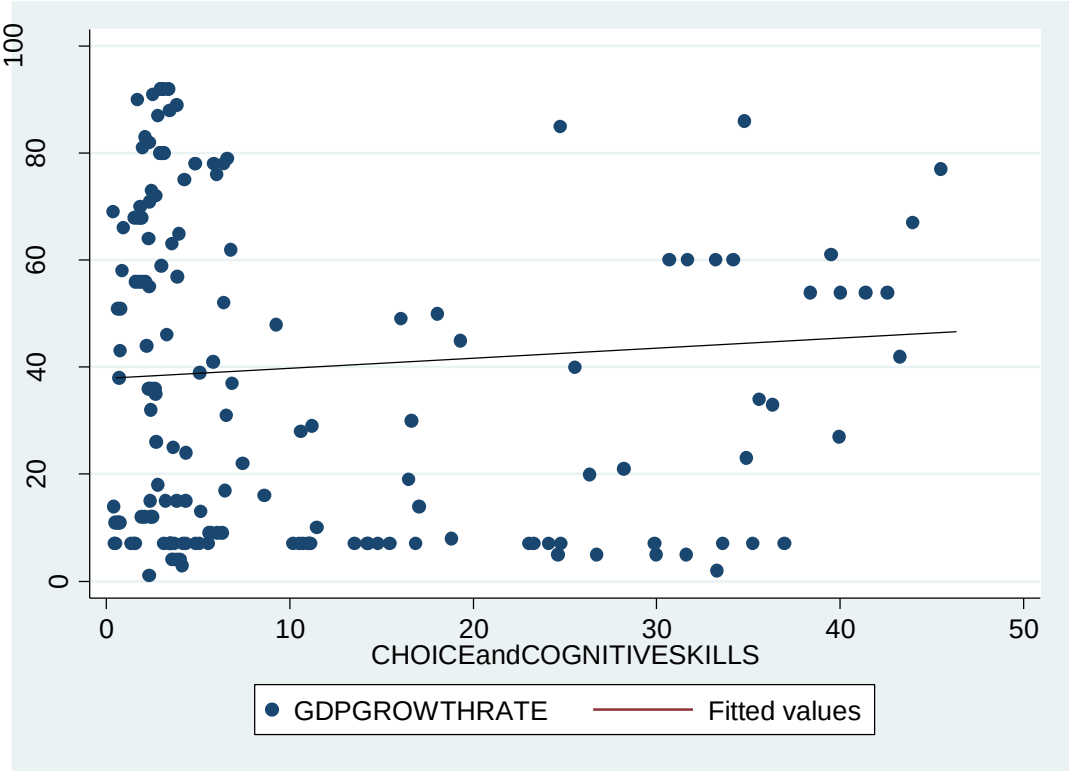


Figure 3: the interaction effect of cognitive skills and the different school policies on OECD growth rate

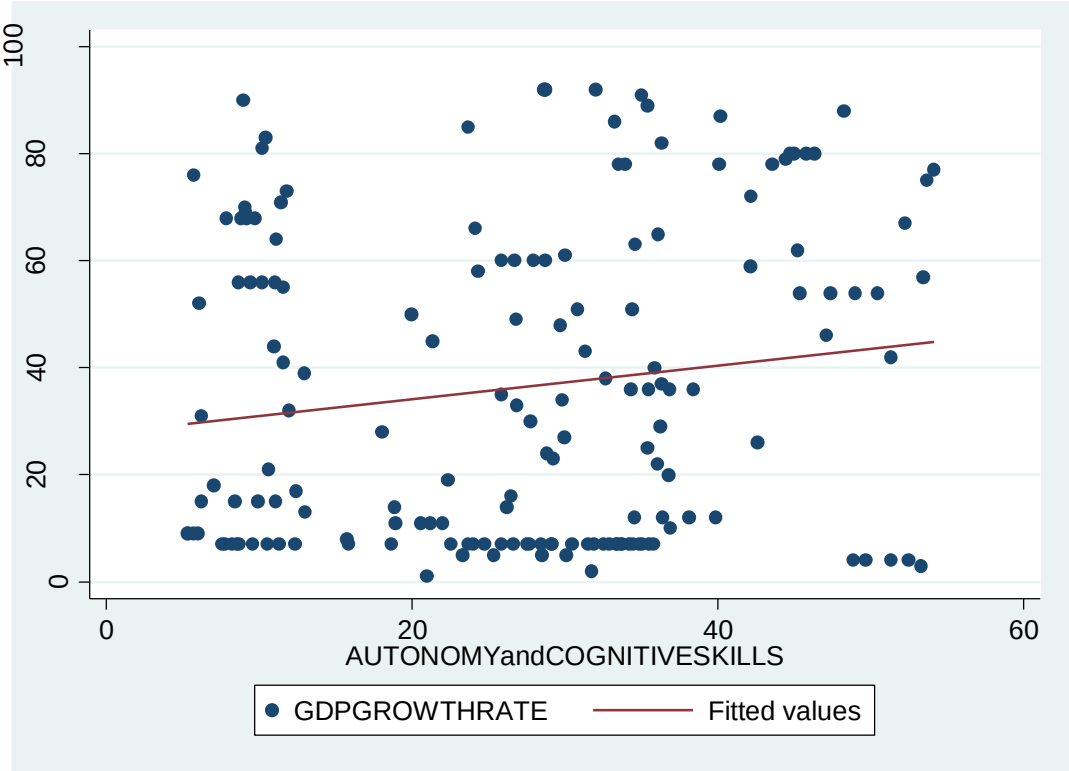
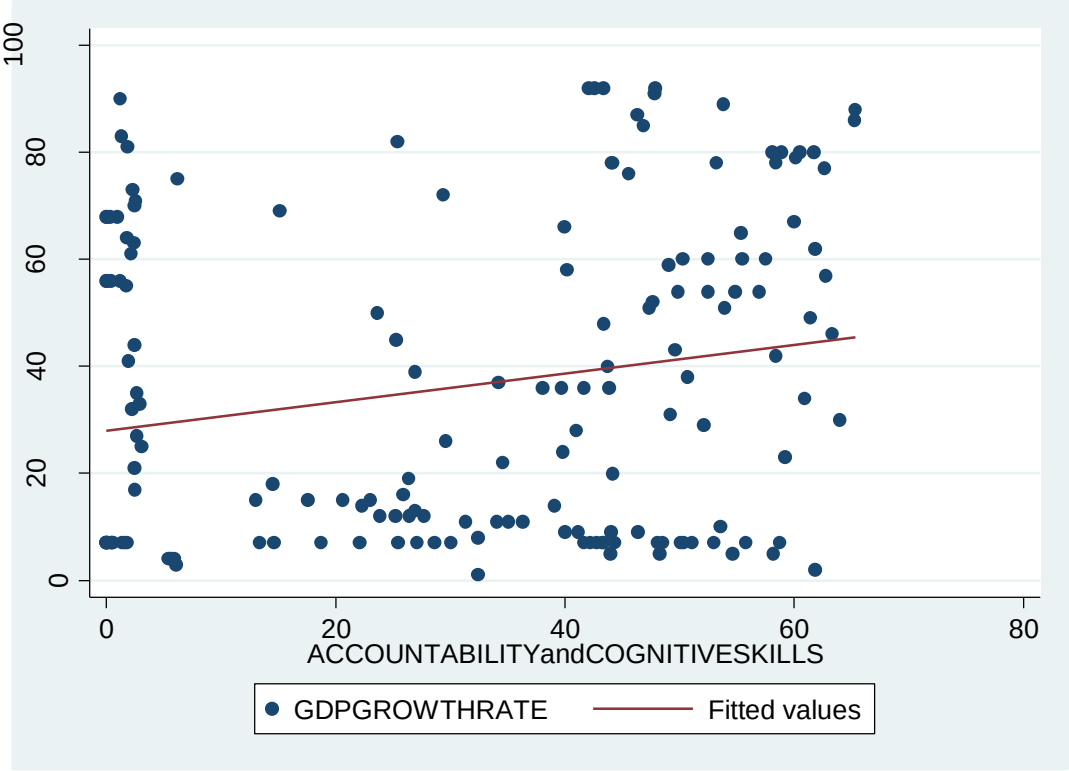


Figure 4: the interaction effect of cognitive skills and the different school policies on OECD growth rate



Chapter 4:
Political Economy Analysis of Allocation of Public School resources: Evidence from Indian Districts

A political economy analysis of allocation of public school resources: evidence from Indian districts

Abstract: *School budget is a significant proportion of GDP in most developing countries as many of them tend to follow an input-based approach to boost literacy. While public provision of schooling has commonly been perceived as uniform and egalitarian, recent studies highlight the bias in the incidence of public spending, especially in developing countries (World Bank 2003). In this context, the present paper examines the allocation of public school resources in Indian districts that remains little understood. One reckons that the strength of India's democracy would ensure a fairer allocation of educational spending/allocation school inputs; this is because it is difficult for a democratically elected government to be unresponsive to the needs of their electorate, especially when the latter are well informed and politically aware,* (Clots-Figueras, I 2012). *Results using a unique district-level panel data for 1992-2002 tend to highlight the inadequate allocation of public school funds. Ceteris paribus, we find that greater voter turnout is associated with significantly greater share of public schools and lower pupil teacher ratio at primary and upper-primary levels of schooling while larger district with more elected legislators significantly boost infrastructural facilities in government's schools in the district. However, politician's gender and caste have limited or no effect on the allocation of any public school resources in our sample.*

JEL classification: H4; D70; H19; I2; O10
Keywords: Education, public school resources, voter participation, gender, caste of legislators, district size, India

1. Introduction

Eight out of ten of the world's children live in developing countries where educational attainment is typically lower than that in the developed world. This in turn makes investment in education a policy priority for economic growth and poverty alleviation, as has been pushed forward in the adoption of Millennium Development Goals (MDGs) by the UN (e.g., see Becker 1995; Hanushek 1995; UNDP 1990; World Bank 2001). School budget is a significant proportion of GDP in most developing countries and many low-income countries tend to follow an input-based approach to boost literacy. Public provision of goods and services has commonly been perceived as uniform and egalitarian and has therefore been defended on normative grounds. In fact, universal public provision has been viewed as the main vehicle to achieving the equity goals in the economy (see Tawney [1952]).

In an important work, Le Grand (1982), however, documents that the actual incidence of public spending may be highly skewed in favour of more influential population groups, arguing that the middle class and the rich turn out to be the primary beneficiaries in many areas of public intervention in the UK including public investment in education, health, housing and transportation. This bias in the incidence of public spending is even more significant in developing countries; for example, Reinikka and Svensson (2004) found that in Uganda socioeconomic endowment matters, and schools use their bargaining power to secure greater shares of government funding.

A World Bank (2003) report that children from poor households have much less access to schooling at progressively higher levels than children from richer families, and their attrition rates increase with the grade (see World Bank 2003, Chapters 2 and 7).[13] In this context, the present study specifically examines the factors determining the allocation of public school inputs in Indian districts, which remains little understood.

India is an important case in point. The country's overall success story hides striking inter and intra-state variation in literacy rates. The government's flagship programme Sarva Shiksha Abhiyyan (SSA) launched in the new Millennium emphasizes huge spending of school infrastructure and teacher training. Annual Report of the Education Department of Government of India claims that the programme has been very successful to significantly increase the number of new schools, appointment of new teachers, construction of building and additional class room, facilities for access to drinking water and toilet in the school premises; however Rs 100.000 crore extra spending on these programmes fails to boost learning outcomes significantly in last five years. The Annual Status of Education Report (ASER 2011) reveals that the proportion of class 5 children able to read a class 2 text has fallen from 53.7% in 2010 to 48.2% in 2011. In the Programme for International Student Assessment (PISA) international competition for children's learning, India came 72nd out of 73 countries. These observations would naturally question the effectiveness of the distribution of public school inputs to all regions and to all sections of the community. This is because the effect of school inputs on school outcomes would not only depend on improving the

[13] Considering the distribution of public spending on education for 21 developing economies, WB (2003) found that the median incidence of spending on education on the poorest quintiles is about 14 percent (the minimal is 7percent); for some countries public education spending on the top quintile is three and more times that on the bottom quintile. Moreover, this bias closely mirrors the skewness of income distribution in the sample countries.

supply of school inputs, but also in ensuring that the additional resources are utilised effectively by all those who are lagging behind.

One reckons that the strength of India's democracy should ensure a fairer allocation of educational spending/allocation school inputs; this is because it is difficult for a democratically elected government to be unresponsive to the needs of their electorate, especially when the latter are well informed and politically aware (Clots-Figueras, I 2012).

Given that the Indian districts have education offices, politicians in the state governments could keep in close contact with these offices, and could influence the way expenditures are made there. They could also decide to transfer more funds to preferred district, e.g., if it pertains to their own constituencies. Following the recent political economy literature, our analysis highlights the role of voter's turnout (Betancourt and Gleason, 2000), gender/caste of elected legislators (Pande, 2003; Duflo and Chattopadhyay, 2004) and also the number of elected legislators in a district on the allocation of public school resources in Indian districts.

Recent study by Fujiwara (2011) showed that enhanced political participation of less educated voters in Brazil shifted government spending towards health care, a policy that is particularly beneficial to the poor, leading to improved health service utilization (pre-natal visits) by less educated mothers and lower prevalence of low weight births in this group. Now turning our attention to the allocation of *public school* resources (and not the overall public services per se), we argue that the greater political participation among voters in a district is likely to induce elected legislators to improve the tax-funded public service delivery in the locality, which among others would include the distribution of public school inputs. This is because greater voter turnout highlights constituents' awareness of the local issues including schooling outcome determining their children future productivity and earnings, which will be hard to avoid, especially if the elected members want to be re-elected. If voter turnout has no effect on these allocations, it can be interpreted as evidence that the voice mechanism fails and the state level decision makers do not respond to their electorate's preferences. This forms the basis of our first hypothesis.

Our second hypothesis focuses on the effect of gender and caste of the local legislators on the allocation of public school inputs. Given that political institutions play a major role in providing education and are led by people of different political persuasions, it is important to understand whether gender/caste characteristics of

elected legislators would influence the policies they choose. Downs (1957) argued that political decisions should only reflect the preferences of the electorate, if candidates could commit to implement specific policies when elected and only cared about winning the elections. If this were the case, female political representation would not matter for policy outcomes, because equilibrium policies would follow the preferences of the median voter. Thus, as long as women could vote in the elections, their preferences would be represented by the candidate elected, irrespective of the gender of the candidate. The same would apply to politicians belonging to a given caste. However, Besley and Coate (1997) and Osborne and Slivinski (1996) show how in the absence of complete policy commitment, the identity of the legislator matters for policy determination, as increasing political representation of a group would increase its influence in policy. Further following Lott and Kenny (1999), one can argue that women and low caste legislators generally have lower incomes than the general population and are over-represented in Indian poverty estimates; as such, it is likely that they would benefit more from the redistributive public spending (including education spending), and may thus lobby for such spending. Thus, our second hypothesis is that the female and low castes of legislators are likely to boost access to various public school resources in their constituencies as this would help their cohorts.

Finally, we argue that the responsiveness of the political system to a district's concerns may be influenced by the number of representatives a district has, which is determined by the number of constituencies within a district. Because constituencies are based on population, more urbanized districts tend to have more constituencies. Hence, the significance of this variable would indicate a bias in the allocation mechanisms. In this respect, it is also interesting to assess whether the female and low caste MLAs are more effective to improve public school resources, when they are in a districts with more constituencies. In the absence of a prior, we use our data to explore the nature of the relationship in this respect. Clearly this is not an exhaustive list of all possible political economy factors that may influence allocation of public school resources and we acknowledge that there may be factors like political competition that we have not controlled for. We particularly choose these variables as the voters (rather than politicians) can directly influence these factors and as such results from our analysis could yield important implications for future policies.

Our analysis has been facilitated by the access to unique district-level data for 1992 and 2002 that we compile from various official sources including Population

Census (1991 and 2001), All India School Education Survey (1992 and 2002) and also National Sample Survey (NSS). The district is the best unit of analysis because it allows us to estimate the effect of the gender of the politicians in the lowest possible administrative area where their electoral constituency is located. Moreover, given that the Indian districts are the lower level of administration and have educational offices; legislators in a particular district could also direct funds to these offices, having an effect not only on their constituencies but also on the overall district.

We consider a number of public school resources for our analysis. Access to school is often voted as a barrier to universal education. Schooling may be worse when pupils per teacher are high since teachers are the single most important factor for improving student attainment (Hanushek et al. 2005). Consistent exposure to effective teachers can overcome the obstacles to learning and may even close the learning gap. Accordingly, we not only consider the determinants of shares of government schools in a district, but also some indices of quality of schools as reflected in pupils per teacher (PTR) ratio at primary, upper secondary, secondary schools. Access to various physical infrastructures is also shown to be important determinants of school attendance and attainment**;** hence, we consider the shares of government schools with access to drinking water, pucca building, and toilet for girls.

Since we have access to two-years panel data for each of the districts drawn from 17 major states of India, we use district fixed effects estimates that allows us to exploit the variation in the outcome variables over the years for a given district to identify a causal effect of turnout and legislator characteristics on district's access to various public school resources. In doing so, we try our best to minimise the omitted variable bias and also control for unobserved district and year-level trends so as to identify the true effects of voter turnout and legislator characteristics on selected public school resources which have important bearing on student performance.

Results from our analysis contribute to a growing literature on the provision of publicly provided goods as well as allocation of public spending on different accounts at national/subnational levels in developing countries, especially India. Pande (2003) analyses how the reservation of seats for SC/STs in the State Assemblies increases the transfers that these groups receive. Besley et al (2004) study the effect of reservations for SC/STs in village councils on the public goods that lower castes receive. Bardhan et al (2010) examine the effect of reservations of Panchayat Pradhans on targeting to poor and SC/ST households. Bardhan et al, find that the village councils with a leader from

the scheduled castes (SC) or scheduled tribes (ST) tend to receive more credit from the Integrated Rural Development Programme (IRDP). Regarding the role of women leaders, Chattopadhay and Duflo (2004) show how the reservation of one-third of the seats for women in Panchayats (local rural self-government) in the states of West Bengal and Rajasthan has a positive effect on investment in infrastructure relevant to women's needs. Clots-Figueras (2012) showed that increasing female political participation has a significant positive effect on primary education in urban areas by 6 percentage points, which is 21% of the difference in primary education attainment between the richest and the poorest Indian states. Pal and Ghosh (2012), however, distinguish dominant (landed or capitalist) elite from minority elite like women and low caste legislators and find that the presence of low caste and female legislators in parliament do not necessarily have a significant impact on state education spending. Finally, an electoral system based on constituencies coupled with an administration system based on districts seems to generate urban bias in allocation of publicly provided goods to rural households in India see Betancourt and Gleason 2000.

Our point of departure is to examine if the selected arguments, namely, voter turnout, gender and caste of elected legislators and also number of constituencies per district can explain the allocation of public school resources in Indian districts. Ceteris paribus, there is evidence from our analysis that greater turnout significantly boost shares of government schools (in total schools) and also their access to some physical infrastructure e.g., pucca buildings and lowers pupils per teacher ratio (PTR) at various levels of schooling. In contrast, we find that the gender/caste of the elected legislators have rather limited effects in our sample: greater share of low caste legislators may boost certain public school resources only if voter turnout is higher while we do not find any significant role of female legislators. There is further suggestion that rural and poorer districts tend to have lower share of public schools in total schools which raises concerns about access to schools in these regions. There is no evidence that ethnically fractionalised districts have less public schools, rather there is evidence that these districts tend to have higher share of public schools with drinking water. In other words, the current process of allocation of public school resources seems to be inadequate as it may not help securing 'education for all'; rather the process seems to serve those better who live in larger districts with more elected legislators to represent their interests and where voters are more politically aware thus contributing to higher turnout.

These findings have important implications for future policy. Access to school is often voted as a barrier to universal education. Schooling may be worse when pupils per teacher are high and/or there are poor physical infrastructural facilities. In addition to secure funds for better school inputs (both teaching and non-teaching), there is clearly a need to ensure a better allocation of these resources so that funds reach those who need them most – poorer districts, rural regions and also ethnically diverse regions. Further efforts can be made to encourage voter turnout so that voters can vote securely and peacefully without being influenced.

The rest of the paper is as follows section 2 explains the data used. Section 3 explains the methodology, section 4 shows the results obtained and section 5 concludes.

2. Data

The empirical analysis focuses on examining what determines the allocation of public school resources in Indian districts, using data compiled from various official sources.

In this section we explain the process of data generation, its shortcomings and also describe the data at our disposal.

2.1 Data generation

To answer our central queries, we collected Data from various sources: This includes All India School Education Survey (AISES) data 1992-93 (6^{th}) and 2002-03 (7^{th}) and Census data (1991 and 2001) and National Sample Surveys (93-94 and 2004-05 rounds). District-level AISES data cover information on *recognised* government schools characteristics including those relating to gender/caste of teachers, access to physical facilities (nature of school building, access to drinking water, lavatory within the school premises) at primary, upper primary and secondary levels of schooling.[14] 1991 and 2001 district-level Census data provide information on population composition (classified by gender/caste) and literacy rates for different age categories of the population (male/female and total), and access to various infrastructural facilities which is important for our analysis. We also get information on mean per capital monthly expenditure and poverty measures from the relevant NSS rounds (1992-93 and 1999-00).

[14] Note that our analysis does not include the case of government aided schools.

Clearly, the data collection for the analysis in the paper was intensive and required us to carefully match different parts of the data painstakingly. First, we collected district level data from the 6th and 7th AISES surveys conducted in 1992 and 2002 for 16 major states of India. In this respect, we followed the 1991 Census district convention and specifically included the districts whose boundaries did not change over the decade 1992-2002 so that the sample districts are comparable in our sample. Note that in 2000 three of the sample states, namely, Bihar, UP and MP were split to create new states of Jharkhand, Uttaranchal and Chhatisgarh; the latter required some districts which were in these original states in 1991 to be allocated to the newly created states by 2002. However for our purpose, these districts were still allocated to the original states namely Bihar, MP and Rajasthan as this partition was only enacted at the turn of the Millennium. This generated district-level information from AISES, Census and NSS for each of two years 1992 and 2002.

We next consider assembly constituency level data available from the Election Commission of India (ECI). While the lowest unit of administration is the district, the basic unit of the electoral process is the constituency in India. The latter is defined in terms of population and at a much lower level of aggregation than the district. Since our analysis focuses on school resources, we make use of assembly election data for the relevant years for the sample states. The boundaries of assembly constituencies are drawn to make sure that there are approximately the same number of inhabitants in each constituency. The assemblies vary in size according to state population. A very detailed dataset was collected on the elections held by the State Legislatures in India during 1990-2002, Since different states have elections in different years, we carefully go through the PDF reports published by the ECI with a view to closely match the election years with the two AISES survey years 1992 and 2002.

The ECI provides information at the constituency level of the candidate who won, whether he contested in a SC/ST reserved constituency, his or her gender and political party. It also provides data on all female candidates who contested for election, their political parties and the votes they obtained. For female and male politicians who won against a candidate of the other gender, the information was gathered regarding the runner-up in each particular election and regarding the votes obtained by him/her. This data was painstakingly inputted. This generates the constituency-level election data for the sample districts for the years around 1992 and 2002 since different states have elections in different years.

Finally we need to match the district-level data from AISES and NSS with the election information available from the ECI. This is done as follows. First, we consult different constituency delimitation orders and the publications "State Elections in India" (which lists the constituencies that are included in each district in each election year) to find out whether some districts have been divided, have been newly created or have disappeared during any election year during the sample period 1990-2002. There are about 463 districts in 16 major states in India. Considering the districts that did not split or disappear, this leads to a choice of 361 districts for each of the sample years 1992 and 2002 (Kumar and Somanathan, 2009). Finally, we follow Bose and Singh (1988) to match the sample constituencies with the sample districts selected as above, which gives rise to about 3000 constituencies from these 361 districts for each of the sample years. Similar procedure has been followed by Clots-Figueras (2012). Once we identify the districts in which the constituencies are located, we generate the district level average voter turnout, voting difference between winners and losers, share of female and low caste (SC/ST) legislators in total assembly seats. Which are then matched with the district-level AISES Census and NSS information.

In particular, 1992 AISES data has been matched with 1991 Census data, 1993-94 NSS data and aggregated district-level election information (both Parliamentary and Assembly elections) for 1991 for most states. Similarly, 2002 AISES data has been matched with 2001 Census data, 1999 NSS data and 1999 district level election information for most states in our sample. Appendix Table A1 describes the source of each of the regression variables and also their respective means and standard deviations. This allows us to build up a two-period panel data for the period 1992-2002. Construction of two-period district-level data allow us to control for district-specific unobserved heterogeneity while analysing the factors determining various teaching and non-teaching inputs at the district level.

2.2 Data Description

There are three broad types of *recognised* schools in India, namely, government schools, private aided schools (PA) and private unaided schools (PUA) schools.[15]

[15] In order to receive recognition, however PA and PUA schools must fulfil several requirements that are prohibitively expensive for many schools, especially those serving the poor (e.g., hold a sizeable cash bond with the government, provide sizeable playgrounds, etc.).

Government and aided schools are invariably 'government-recognised', i.e. they have the government stamp of approval. They are similar to each other in many respects since aided schools are almost entirely financed by the government and have little control over staffing (hiring/firing) and fee levels, despite being nominally privately managed. PUA schools (whether recognised or not) are more autonomous than aided schools and are totally self-funded out of fee income. Thus PUA schools are the truly 'private' schools in India. Our analysis resource allocation in this paper focuses on fully funded government schools only, which are fully regulated by the relevant government department in the Indian states.

Table1 summarises the average characteristics of the sample districts over 1992-2002. While average literacy is around 50% for India as a whole, there are striking intra- and inter-state variations in literacy across India. The literacy rate in Kerala is almost 100%, while there are some states where literacy is well below the national average of 50%. Even within a state, literacy is even lower among women, especially women belonging to the backward castes (23.76% as compared to 39.29% for all Indian women; Clots-Figueras, 2012). On an average, voter turnout is 57% for the sample as a whole, but again there can be wide variation as highlighted in the Table. Likewise, there are large variations in the provision of general infrastructure across government schools in India. For example, on an average 56% of total schools in a district are fully government funded while as high as 84% of government schools had pucca buildings. In contrast, only about 2% of government schools had access to drinking water in the school premise and only about 37% of these government schools had a lavatory for girls in the school premise.

Next we compare the selected public school resources for the two sample years, namely, 1992 and 2002 (see Table 2). While there has been a slight rise in the share of government schools across sample districts, there has been a significant increase in pupil-teacher ratio (PTR), especially at the secondary level over the decade. There has also been a steady increase in most school inputs that we consider, namely access to drinking water, pucca building and lavatory within the school premise over the sample period 1992-2002. These changes have resulted in a significant increase in literacy for both 10-14 and 15-19 years old over the decade. But the question remains as to what extent the allocation of these resources have been influenced by various political economy factors that we consider.

3. Methodology

As indicated earlier, our primary objective is to examine the determinants of the allocation of public school resources in a district with special reference to our central hypotheses. Thus for the i-th district in year t, share of any public school resource Y_{it} will be given by:

$$Y_{it} = \alpha_0 + \alpha_1 Turnout_{it} + \alpha_2 Lowcaste\_MLA_{i_t} + \alpha_3 Female\_MLA_{it} + \varphi_i + \theta_t + \epsilon_{it} \qquad (1)$$

In particular, Y_i may refer a series of dependent variables of our interest indicating physical access to government schools, teaching and also various non-teaching inputs all of which enter the education production functions to boost performance. In particular, we consider (i) the share of government schools in total schools; (ii) pupils per teacher at primary, upper-primary and secondary levels; (iii) the average share of government schools with access to drinking water, pucca building and toilet in the school premise in the district.

Our central hypotheses relate to that the role of average voter turnout (turnout), share of female (female_MLA) and share of low caste (lowcaste_MLA) legislators (elected for the state assembly) at the district level. Voter turnout shows the awareness of local citizens to local issues including education. In general, it is expected that local legislators would be more responsive to their clientele by raising Y if local turnout rate is high. In other words, the significance of the estimated coefficient of the turnout variable could signify the democratic accountability of local legislators towards the electorate. Identity of the local legislator, caste and gender, would in contrast signify if low caste and female assembly legislators in the district would favour spending on particular public school input because it would help their cohort. In addition, we include various district-level time-invariant (φ_i) and year-specific (θ_t), ϵ_{it} refers to district and year specific random error term.

It may however be possible that female and lowcaste MLAs are more accountable to voters only if turnout is higher in the particular district. In order to account for this effect, we next, we augment specification (1) by including the interaction terms between turnout and Female_MLA and also that between turnout and Lowcaste_MLA:

$$Y_{it} = \beta_0 + \beta_1 Turnout_{it} + \beta_2 Lowcaste_{MLA_{i_t}} + \beta_3 Female_{MLA_{it}} + \beta_4 Turnout_{it} * Lowcaste_{MLA_{i_t}}$$
$$+ \beta_5 Turnout_{it} * Female\_MLA_{it} + \varphi_i + \theta_t + \epsilon_{it} \quad (2)$$

In other words, estimated coefficients of β_4 and β_5 would account for the differential effects of low caste and female legislators in high-turnout districts in our sample.

Further we argue that the district size as measured by number of constituencies (nconstituency) in a district could be an important argument to influence the allocation of public school resources in a district. This is because the higher the number of constituencies, the greater is number of representatives from the district, who can lobby for various public school resources. To this end, we augment specification (2) by the number of constituencies (nconstituency) in a district; we also include two interaction terms nconstituen*Lowcaste$_{MLA}$ and nconstituency* Female$_{MLA}$ in order to identify the differential effect of low caste and female MLAs in larger districts, if any.

$$Y_{it} = \gamma_0 + \gamma_1 Turnout_{it} + \gamma_2 Lowcaste\_MLA_{it} + \gamma_3 Female\_MLA_{it}$$
$$+ \gamma_4 Turnout_{it} * Lowcaste\_MLA_{i_t} + \gamma_5 Turnout_{it} * Female\_MLA_{i_t}$$
$$+ \gamma_5 Nconstituency_{it} + \gamma_6 Nconstituency_{it} * Lowcaste_{MLA_{it}}$$
$$+ \gamma_7 Nconstituency_{it} * Female\_MLA_{it} + \varphi_i + \theta_t + \epsilon_{it} \quad (3)$$

While equations (1) - (3) control for various district-level time-invariant (φ_i) and year-specific (θ_t) unobserved factors, there may still be some time-varying district-level unobserved factors which may influence the allocation of various public school resources. Hence, we augment specification (3) by including other control variables with a view to minimise the omitted variable bias, if any:

$$Y_{it} =$$
$$\delta_0 + \delta_1 Turnout_{it} + \delta_2 Lowcaste\_MLA_i + \delta_3 Female\_MLA_{it} + \delta_4 Turnout_{it} * Lowcaste\_MLA_{i_t} +$$
$$\delta_5 Turnout_{it} * Female\_MLA_{it} + \delta_6 Nconstituency_{it} + \delta_7 Nconstituency_{it} * Lowcaste\_MLA_{it} +$$
$$\delta_8 Nconstituency_{it} * Female\_MLA_{it} + \beta_X X + \varphi_i + \theta_t + \epsilon_{it} \quad (4)$$

The set of explanatory variables X in equation (4) accounts for other observed control variables. X includes an index of ethnic fractionalisation and poverty rate (hcr). The ethnic fractionalisation index is calculated as follows: $1-\Sigma_i p_i^2$, where p_i refers to the population share of i-th ethnic group in the districts, i=SC, ST and upper caste Hindu

and Muslim. Ethnic diversity may affect provision of public goods; the relationship could be attributed to taste differences of different sections of the population (Alesina, Baqir and Easterly, 1999), unequal distribution of the benefits from public goods (Khwaja, 2000) and/or inability to impose social sanctions in ethnically diverse communities (e.g., Miguel and Gugerty, 2005), thus leading to failures in collective actions. There is some recent literature that stresses the link between ethnic fractionalisation and the poor delivery of public services (e.g., see Alesina, Baqir and Easterly, 1999). Banerjee and Somanathan (2001) have extended the idea of ethnic diversity for the provision of public goods in the Indian districts and suggest that more heterogeneous communities tend to be politically weaker and therefore are less likely to get the goods they want and are more likely to get some of the inferior substitutes. In addition, we control for the head count poverty rate to examine if the poorer districts receive less allocation of public school resources. In view of the pronounced rural-urban heterogeneity in India, we also control for rural location of the district with a view to identify the differential allocation of public school resources to rural areas, if any.

4. Empirical results

This section presents and analyses our estimation results. We start with the ordinary least squares (OLS) estimates of Y in terms of lagged explanatory variables. These estimates for specification (1) are shown in Appendix Table A1, which fail to identify any significant relationship in our sample. Note, however, that OLS suffers from both omitted variable and simultaneity bias arising from inclusion of potentially endogenous explanatory variables. Hence, our analysis relies on the fixed effects OLS estimates of equations (1)-(4) summarised in Tables 3-6, to which we now turn to. In doing so, we control for district and year-specific unobserved factors with a view to minimise any omitted variable bias in our estimates. Following the growing political economy literature on public goods provision we also argue that the key explanatory variables are purely exogenous and would not bias our estimates in any way. We develop our analysis in steps as outlined in equations (1)-(4), which also allows us to check the robustness of our estimates. Finally, we also estimate an extended model where we not only include the additional variable, but also control for district*year fixed effects to control for district-level time-varying unobserved factors (see Table 7).

4.1. FE-OLS estimates

We develop our analysis in steps gradually extending our fixed effects panel data model controls to minimise omitted variable bias of estimates.

We start with specification (1) to test the validity of our first and second hypotheses. We include both district and year specific fixed effects and cluster all standard errors at district level; the latter helps us to minimise any correlation of errors over the years for a given district. These robust FE-OLS estimates are shown in Table 3, which allows us to exploit the variation of any Y over the two years for a given district to identify a causal effect of the chosen variables, namely, voter turnout and gender/caste of elected legislators. There is confirmation from these results that voter's turnout significantly boost shares of government schools and lower pupil-teacher ratio (PTR) at various levels. However, the effect of voter turnout is limited on access to school physical infrastructures, especially pucca buildings. Greater turnout is also associated with significantly higher proportion of pucca school buildings in the district, but fails to have any significant effect on school's access to drinking water and government schools with lavatory for girls.

In contrast, the effect of gender/caste of the legislators has a rather limited effect on public school resource allocation in our sample. Women or SC/ST legislators fail to have any significant favourable effect on any school inputs, teaching or non-teaching. In fact, there is suggestion that districts with more women or SC/ST legislators tend to have lower proportion of government schools with pucca building.

Next we augment specification (1) to include interaction terms between voter turnout and gender/caste of the legislators. These estimates are summarised in Table 4. These results reiterate the robust effect of voter turnout on share of government schools as well as pupil-teacher ratio. Now greater share of female and low-caste legislators are both associated with significantly greater share of government schools and lower pupil-teacher ratio at the primary level. While districts with more low caste teachers have lower share of schools with drinking water, they tend to have significantly higher share of government schools with drinking water if the voter turnout is higher (as the interaction term is significant and positive). In other words, this evidence suggests the disciplining role of voter turnout on legislator behaviour to influence public policy.

Table 5 shows the augmented estimates of equation 3 when number of constituencies in a district is included along with two interaction terms with gender and

caste of legislators. Reassuringly our estimates do not change much as we move from specification 2 to specification 3 as summarised in Table 5.

One can however suspect that there are other time-varying factors that may influence various school inputs that we consider which in turn may bias our estimates. Accordingly, Table 6 augments specification (3) by including district-level ethnic heterogeneity, poverty head count rate (hcr) and also controls for the rural location, if any. As before, districts with greater turnout tend to have significantly higher share of public schools and also lower pupil-teacher ratios in public schools at primary and upper-primary levels; the effect is not however significant at the secondary level. There is also an unexpected effect of higher turnout in that it is associated with significantly lower share of government schools with separate lavatory for girls. Districts with higher low caste MLAs do not have significantly better allocation of public school resources per se; however their effect turns out to be favourable and significant only for the districts with higher turnout; the effect is only significant and positive for the allocation of public schools with access to drinking water. Unfortunately, however, the weaker effect of female MLAs that we find in Table 4 vanishes in Table 5 and 6 as we control for number of constituencies in the district and its interactions terms. Clearly this result contradicts Clots-Figueras (2012) who find that presence of women legislators in the year of birth of the child improves child educational outcomes. However, our result is compatible to Pal and Ghosh (2012) who argued that the weaker effect of low caste and female MLAs in the allocation of education spending in Indian states can be attributed to their lower bargaining power in the state legislature.

Among other results, we find that rural districts and also poorer districts tend to have significantly lower share of fully funded public schools, thus highlighting a bias against rural and poorer districts. Estimates of specification (4) suggest that ethnic fractionalization index is associated with significantly higher share of government schools with drinking water, but the effect remains insignificant in other respect. It is generally argued in the literature that heterogeneous communities tend to be politically weaker and therefore are less likely to get the goods they want and more likely to get some of the inferior substitutes (see Banerjee and Somanathan (2007). Perhaps this is an interesting result in that access to drinking water may be more important in more diverse districts where untouchability among certain castes is still prevalent.

5. Conclusion

The paper examines the political economy determinants of the allocation of public school resources in Indian districts in the post reform period 1992-2002. In this respect, our analysis particularly focuses on the role of voter's turnout, identity (gender/caste) of elected state assembly legislators and also the number of constituencies in a district. As such, this is not an analysis of all possible political economy variables determining allocation of public school resources across Indian districts and we accept that there may be other variables, e.g., political competition, that we have not included in the analysis. But we believe our methodology will minimize any omitted variable bias of our estimates. We particularly choose these variables as the voters (rather than politicians) have a direct influence on these factors and as such results from our analysis could yield important policy implications.

Using various official sources, we put together a unique two-period district-level panel data for 1992 and 2002. Fixed effects panel data estimates highlight the aspect of the bias in the allocation of public school resources in Indian districts. We also control for various unobservable trends to minimise any further bias in our estimates. Results from our analysis provides some support to our first hypothesis that greater voter turnout is not only associated with greater share public schools, but also lower pupil-teacher ratio in the district. However, gender and caste of the elected state legislators have a rather limited effect. We fail to identify any significant effect of female MLAs on the selected public school resources. But the low caste legislators tend to have a significant effect on certain physical infrastructural inputs only when turnout and number of constituencies are higher. Further bias is identified in the allocation process, as the richer districts and also urban districts tend to have a greater share of public schools in our sample. Interestingly, greater ethnic fractionalisation is associated with greater share of government schools with drinking water facilities. While the existing literature generally tends to argue that ethnic fractionalisation leads to worse or inferior provision of public goods, we would argue that this result may have a social significance if untouchability is a problem in ethnically diverse communities, thus necessitating more demand for drinking water facilities within schools. Clearly, the current process seems to favour the larger districts and the districts with higher voter turnout, thus disregarding the needs of the poor and the marginalised. As such these

results raise concerns about the inequitable distribution of public school resources, which in turn may obstruct the attainment of universal literacy across all social classes and regions.

It is therefore not very surprising as to why huge investment under SSA is failing to produce the desired outcome. On the positive sides, these results highlight the positive role of voters in attracting the attention of politicians in democratic set up as it is harder for democratically elected government to be unresponsive to the needs and values of their clientele, especially when the electorate is well informed and politically aware. So it is important to make voters aware of their rights to education. Further, given the problem of ensuring adequate allocation of public school resources for all and also that the link between increased school resources and student performance remains ambiguous in the literature (e.g., Hanushek, 1997)[16], there remains a case for the introduction of school vouchers programme that would fund students (rather than schools), which may potentially be a more efficient as well as equitable than the current system for boosting education for all. This is because school vouchers financed and monitored/regulated by the state would empower parents with the purchasing power to find the best school for their children, thus inducing competition as well as incentives for improving both public and private schools.

[16] Leaving aside some studies on the impact of mid-day meals, there is a dearth of systematic studies on the effectiveness of ongoing public programmes in India aimed to boost school inputs. Available evidence suggests limited positive effect of mid-day meals on girls' school attendance in Madhya Pradesh (Afridi, 2010).

Table

Table 1: Variable definitions and descriptive statistics for sample districts, 1992-2002

Variable	Observation	Mean	Standard. Deviation	Min	Max
Literacy rate (litrt)	713	.4966823	.1631373	.1447053	.9582419
Share of government school in total school (pgsch)	767	.5635903	.3933929	.0010535	1.05665
Government schools with drinking water (pgdw)	763	.0213523	.2352175	.0213523	.997663
government schools with pucca building (pgpucca)	766	.8444108	.1648442	0	1
Government schools with lavatory for female (pglav)	816	.3794924	.2677733	.0106762	.99444
Voters turnout (Turnout)	684	57.1235	12.27586	12.27586	86.4

Table 2, Descriptive statistics: Variation of public school resources over the decade 1992-2002

	1992		2002	
Variable	Mean	Standard. deviation	Mean	Std. Dev.
Literacy rate 10-14	0.678943	0.160847	0.810496	0.130207
Literacy rate 15-14	0.632984	0.153508	0.760741	0.133689
Share of government school in total school (Pgsch)	0.550367	0.419528	0.578713	0.36632
Pupils per teacher ratio, government upper primary (ptrgup)	38.02762	51.87547	39.2431	82.44183
Pupils per teacher ratio, government secondary(ptrgs)	27.83853	8.631072	41.60052	153.5914
Government schools with drinking water (pgdw)	0.580874	0.243233	0.786603	0.172426
Government schools with pucca building (pgpucca)	0.857067	0.156957	0.832586	0.171241
Government schools with lavatory for female (pglav)	0.33095	0.259546	0.428403	0.267213

Table 3. FE-OLS estimates of various public school resources for specification (1)

VARIABLES	(1) Share of government school in total school	(2) Pupils per teacher , government primary	(3) Pupils per teacher, government upper primary	(4) Pupils per teacher , government secondary	(5) Government schools with drinking water	(6) Government schools with pucca building	(7) Government schools with lavatory for female
Turnout	0.00315**	-4.458*	-0.912***	-0.477*	-0.0025***	0.00131**	-0.00245**
	(0.00138)	(2.284)	(0.310)	(0.287)	(0.000836)	(0.000618)	(0.00100)
Lowcaste MLA	-0.0252	191.7	3.006	46.14	-0.143	0.0672	-0.0169
	(0.292)	(228.6)	(23.92)	(48.66)	(0.131)	(0.114)	(0.111)
Female MLA	0.0996	-6.931	-16.58	16.73	0.173	-0.154**	-0.0521
	(0.117)	(92.97)	(20.38)	(57.72)	(0.112)	(0.0643)	(0.120)
Constant	0.312***	268.5**	90.32***	45.08***	0.758***	0.777***	0.505***
	(0.112)	(133.6)	(16.97)	(9.970)	(0.0589)	(0.0463)	(0.0666)
District FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	610	598	613	645	597	611	645
R-squared	0.066	0.018	0.019	0.010	0.560	0.082	0.154
Number of districts	333	311	326	335	336	333	337

Robust standard errors in parentheses (all standard errors are clustered at district level) *** p<0.01, ** p<0.05, * p<0.1

Table 4. FE-OLS including interaction terms with turnout, specification 2

VARIABLES	(1) Share of government school in total school	(2) Pupils per teacher , government primary	(3) Pupils per teacher, government upper primary	(4) Pupils per teacher , government secondary	(5) Government schools with drinking water	(6) Government schools with pucca building	(7) Government schools with lavatory for female
Turnout	0.0108***	-6.675**	-1.595**	-0.916	-0.007***	0.00226*	-0.00242
	(0.00307)	(3.371)	(0.726)	(1.593)	(0.00199)	(0.00122)	(0.00149)
Female MLA	1.770**	-938.6*	-76.10	165.8	0.166	0.111	-0.871
	(0.806)	(561.6)	(130.6)	(219.8)	(0.504)	(0.396)	(0.575)
Lowcaste MLA	1.638**	-202.5	-151.3	-85.96	-1.236***	0.260	0.132
	(0.713)	(480.6)	(126.2)	(286.9)	(0.445)	(0.334)	(0.317)
Female MLA*turnout	-0.0276**	15.42	0.981	-2.485	-0.000268	-0.00438	0.0136
	(0.0122)	(9.825)	(2.403)	(3.005)	(0.00832)	(0.00643)	(0.00876)
Lowcaste MLA*turnout	-0.0282***	6.679	2.808	2.384	0.0198***	-0.00326	-0.00268
	(0.0101)	(10.92)	(2.602)	(5.905)	(0.00765)	(0.00489)	(0.00513)
Constant	-0.160	404.0**	130.0***	70.52	1.017***	0.719***	0.504***
	(0.212)	(171.4)	(38.20)	(84.09)	(0.122)	(0.0834)	(0.0966)
District FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	610	598	613	645	597	611	645
R-squared	0.123	0.019	0.023	0.011	0.571	0.084	0.158
Number of districts	333	311	326	335	336	333	337

Robust standard errors in parentheses (all standard errors are clustered at district level) *** p<0.01, ** p<0.05, * p<0.1

Table 5. FE-OLS estimates of various public school resources for specification 3

VARIABLES	(1) Share of government school in total school	(2) Pupils per teacher , government primary	(3) Pupils per teacher, government upper primary	(4) Pupils per teacher , government secondary	(5) Government schools with drinking water	(6) Government schools with pucca building	(7) Government schools with lavatory for female
Turnout	0.011***	-6.287*	-1.900***	-0.755	-0.006***	0.00254**	-0.0031**
	(0.00313)	(3.312)	(0.715)	(1.511)	(0.00207)	(0.00123)	(0.00155)
Lowcaste MLA	1.348*	-539.6	-124.4	-103.3	-1.232***	-0.0369	0.214
	(0.754)	(740.7)	(140.7)	(293.8)	(0.419)	(0.337)	(0.332)
Female MLA	1.488*	-1,332	-34.57	202.9	0.253	0.372	-0.751
	(0.761)	(873.5)	(240.1)	(256.3)	(0.547)	(0.391)	(0.682)
Number of constituency	0.00767	-25.58	7.228	-3.354	0.0206**	0.00893	0.0578***
	(0.0142)	(34.79)	(4.787)	(4.658)	(0.00922)	(0.0268)	(0.0161)
lowcaste MLA*turnout	-0.029***	5.586	3.880	1.795	0.0164**	-0.00400	-0.000111
	(0.0102)	(10.71)	(2.442)	(5.609)	(0.00797)	(0.00486)	(0.00530)
Female MLA*turnout	-0.0269**	16.57	0.907	-2.555	-0.000955	-0.00533	0.0131
	(0.0121)	(10.78)	(2.845)	(3.115)	(0.00842)	(0.00633)	(0.00907)
Number of constituency *lowcaste MLA	0.0565	62.80	-22.66	11.40	0.0444*	0.0498*	-0.0568
	(0.0572)	(82.44)	(16.71)	(8.398)	(0.0239)	(0.0297)	(0.0367)
Number of constituency *female MLA	0.0376*	50.95	-6.473	-5.046	-0.00565	-0.0308	-0.0151
	(0.0198)	(52.37)	(15.91)	(6.008)	(0.0227)	(0.0199)	(0.0304)
Constant	-0.316	584.9	105.9**	82.36	0.700***	0.582**	0.0338
	(0.257)	(417.1)	(52.22)	(108.6)	(0.156)	(0.287)	(0.176)
District FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	610	598	613	645	597	611	645
R-squared	0.132	0.020	0.037	0.011	0.576	0.102	0.173
Number of districts	333	311	326	335	336	333	337

Robust standard errors in parentheses (all standard errors are clustered at district level) *** p<0.01, ** p<0.05, * p<0.1

Table 6. FE-OLS estimates of various public school resources for the complete specification 4

VARIABLES	(1) Share of government school in total school	(2) Pupils per teacher , government primary	(3) Pupils per teacher, government upper primary	(4) Pupils per teacher , government secondary	(5) Government schools with drinking water	(6) Government schools with pucca building	(7) Government schools with lavatory for female
Turnout	0.013***	-17.27*	-3.942**	-1.760	-0.00546	0.00296	-0.0074**
	(0.00455)	(8.800)	(1.588)	(3.232)	(0.00355)	(0.00262)	(0.00325)
Lowcaste MLA	0.950	-0.959	27.77	-93.15	-1.614***	-0.215	0.266
	(0.834)	(1,030)	(321.5)	(468.8)	(0.603)	(0.400)	(0.541)
Female MLA	1.097	-1,123	-1.532	382.3	0.235	0.228	-0.808
	(0.876)	(935.2)	(294.0)	(406.8)	(0.735)	(0.503)	(0.797)
Number of constituency	0.0245	54.97	13.33*	-1.579	0.0450***	0.0476	0.0721***
	(0.0302)	(53.87)	(7.083)	(3.275)	(0.0161)	(0.0857)	(0.0153)
Lowcaste MLA*turnout	-0.0277**	13.99	5.237	2.987	0.0229***	-0.00272	0.00500
	(0.0117)	(15.60)	(3.579)	(8.525)	(0.00865)	(0.00606)	(0.00713)
Female MLA*turnout	-0.0231	11.27	0.412	-5.577	-0.000790	-0.00426	0.0104
	(0.0154)	(11.60)	(3.457)	(5.090)	(0.0111)	(0.00881)	(0.0108)
Number of constituency *lowcaste MLA	0.0734	65.65	-47.59	3.197	0.0335	0.0652**	-0.0911*
	(0.0555)	(88.53)	(35.25)	(12.44)	(0.0451)	(0.0314)	(0.0506)
Number of constituency *female MLA	0.0577*	76.41	-4.901	-0.649	-0.0104	-0.0235	0.0147
	(0.0342)	(60.08)	(20.91)	(8.571)	(0.0295)	(0.0261)	(0.0331)
Ethnic heterogeneity	-0.120	46.81	-101.0*	-56.40	0.770**	0.0638	-0.219
	(0.582)	(407.8)	(56.26)	(94.87)	(0.364)	(0.231)	(0.320)
Rural	-5.12e-08*	0.000110	2.31e-06	1.56e-05	-1.48e-08	-8.05e-09	2.77e-08
	(3.05e-08)	(7.26e-05)	(5.92e-06)	(1.40e-05)	(1.75e-08)	(2.04e-08)	(2.05e-08)
HCR	-0.309**	189.9	23.95	-128.5	-0.0573	-0.0164	0.163
	(0.146)	(125.6)	(17.78)	(124.6)	(0.135)	(0.0811)	(0.108)
Constant	-0.406	153.2	195.0**	152.1	0.207	0.139	0.142
	(0.412)	(595.6)	(93.83)	(199.7)	(0.305)	(0.890)	(0.270)
District FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	529	521	530	561	514	530	562
R-squared	0.178	0.038	0.069	0.021	0.574	0.083	0.182
Number of districts	304	286	298	307	306	304	309

Robust standard errors in parentheses (all standard errors are clustered at district level) *** p<0.01, ** p<0.05, * p<0.1

Appendix

Table A1. Variable definitions and sources

Variable	Abbreviation	Data source	Mean (standard deviation)
Dependent variable Pupils per teacher ratio**,** government upper primary	PTR upper primary	All India School Education Survey (AISES) data 1992-93 (6^{th}) and 2002-03 (7^{th}) and Census data (1991 and 2001).	38.8 (68.7)
Dependent variable Pupils per teacher ratio**,** government secondary	PTR secondary	All India School Education Survey (AISES) data 1992-93 (6^{th}) and 2002-03 (7^{th}) and Census data (1991 and 2001).	34.7 (108.6)
Dependent variable Government schools with drinking water	PGDW	All India School Education Survey (AISES) data 1992-93 (6^{th}) and 2002-03 (7^{th}) and Census data (1991 and 2001).	0.681 (0.235)
Dependent variable government schools with pucca building	PGPUCCA	All India School Education Survey (AISES) data 1992-93 (6^{th}) and 2002-03 (7^{th}) and Census data (1991 and 2001).	0.844 (0.165)
Dependent variable Government schools with lavatory for female	PGLAV	All India School Education Survey (AISES) data 1992-93 (6^{th}) and 2002-03 (7^{th}) and Census data (1991 and 2001).	0.379 (0.268)
Independent variable: proportion of seat won by low caste women in the district	lowcasteMLA	Collected from different volumes of the Statistical Reports on the General Elections to the Legislative Assemblies from ECI.	0.221 (0.200)
Independent variable: Proportion of seat won by women in the district elections	FemaleMLA	Collected from different volumes of the Statistical Reports on the General Elections to the Legislative Assemblies from ECI.	0.047 (0.085)
Independent variable: Ratio of total voters in the district to total registered voters.	Turnout	Collected from different volumes of the Statistical Reports on the General Elections to the Legislative Assemblies from ECI.	61.95 (10.54)
Independent variable: Total number of constituency in a district	Nconstituency	Collected from different volumes of the Statistical Reports on the General Elections to the Legislative Assemblies from ECI.	10.16 (6.14)
Ethnic heterogeneity index	Ethhety	Created from Census	0 .358 (0.121)
Poverty head count ratio	HCR	NSS data	0.227 (0.122)

Table A2. OLS estimates of public school resources with lagged explanatory variables, specification 1

VARIABLES	(1) Share of government school in total school	(2) Pupils per teacher ratio, government primary	(3) Pupils per teacher ratio, government upper primary	(4) Pupils per teacher ratio, government secondary	(5) Government schools with drinking water	(6) government schools with pucca building	(7) Government schools with lavatory for female
Turnout	-0.00203	8.230	0.0401	-1.655	0.00177	-0.00177	-0.00134
	(0.00149)	(8.008)	(0.604)	(2.952)	(0.00121)	(0.00111)	(0.00150)
Lowcaste MLA	-0.137*	-90.92	-15.48	-9.797	-0.0165	-0.0288	0.0112
	(0.0707)	(130.2)	(14.84)	(33.88)	(0.0544)	(0.0390)	(0.0428)
Female MLA	0.0193	-662.4	-38.37	-21.03	0.147	0.0296	0.110
	(0.0910)	(575.6)	(46.56)	(22.75)	(0.0933)	(0.0614)	(0.111)
EthnicHeterogeneity	0.0846	81.79	-21.41	-127.4	0.00814	-0.0800	-0.0759
	(0.0983)	(363.1)	(24.20)	(108.2)	(0.0991)	(0.0617)	(0.0996)
Rural	5.21e-09	-2.16e-05	6.40e-06	-3.02e-06	1.40e-09	-2.10e-09	-1.54e-08
	(7.89e-09)	(4.94e-05)	(3.94e-06)	(3.79e-06)	(8.88e-09)	(5.48e-09)	(1.30e-08)
Hcr	0.168*	29.74	-31.66	80.86	-0.128*	0.00191	-0.257**
	(0.0869)	(159.4)	(27.17)	(88.62)	(0.0767)	(0.0496)	(0.101)
Constant	0.182	-523.2	25.26	171.8	0.582***	0.895***	0.549***
	(0.122)	(608.6)	(51.13)	(224.9)	(0.0924)	(0.0839)	(0.119)
State FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	284	265	267	288	256	284	290
R-squared	0.902	0.254	0.680	0.089	0.546	0.748	0.744

Robust standard errors in parentheses (all standard errors are clustered at district level) *** p<0.01, ** p<0.05, * p<0.1.
All explanatory variables are lagged, i.e., they refer to the initial year 1992

Table A3. Estimates of an extended model including voting margin of the winner

VARIABLES	(1) Share of government school in total school	(2) Pupils per teacher , government primary	(3) Pupils per teacher, government upper primary	(4) Pupils per teacher , government secondary	(5) Government schools with drinking water	(6) Government schools with pucca building	(7) Government schools with lavatory for female
Turnout	0.0128***	-18.69**	-4.005**	-1.512	-0.00645*	0.00301	-0.00742**
	(0.00456)	(9.456)	(1.627)	(3.391)	(0.00361)	(0.00264)	(0.00330)
Femalemla	1.081	-1333	-8.194	409.5	0.111	0.228	-0.804
	(0.875)	(992.8)	(298.5)	(407.9)	(0.743)	(0.501)	(0.803)
Lowcastemla	0.949	-977.5	27.50	-84.86	-1.641***	-0.218	0.267
	(0.834)	(1029)	(322.3)	(474.9)	(0.609)	(0.402)	(0.540)
Female*turnout	-0.0230	13.25	0.462	-5.782	0.000205	-0.00426	0.0104
	(0.0153)	(12.15)	(3.492)	(5.083)	(0.0112)	(0.00876)	(0.0108)
Lowcast*turnout	-0.0276**	15.02	5.266	2.714	0.0240***	-0.00268	0.00495
	(0.0117)	(15.65)	(3.595)	(8.693)	(0.00883)	(0.00607)	(0.00712)
Nconstituency	0.0251	61.43	13.67*	-2.980	0.0499***	0.0473	0.0719***
	(0.0307)	(59.20)	(6.981)	(3.325)	(0.0164)	(0.0864)	(0.0154)
Nconstituency*female	0.0589*	92.51	-4.242	-3.577	-0.00254	-0.0234	0.0142
	(0.0359)	(63.20)	(21.47)	(9.204)	(0.0310)	(0.0270)	(0.0343)
Nconstituency*lowcaste	0.0731	61.49	-47.75	4.134	0.0311	0.0654**	-0.0909*
	(0.0555)	(88.62)	(35.20)	(12.39)	(0.0449)	(0.0314)	(0.0507)
Mean winning margin	-0.0244	-323.9	-9.726	56.56	-0.229	-0.00129	0.00927
	(0.0746)	(271.8)	(14.41)	(67.29)	(0.176)	(0.0492)	(0.0636)
ethhety	-0.120	37.91	-99.78*	-58.49	0.779**	0.0581	-0.218
	(0.583)	(409.8)	(56.59)	(93.37)	(0.358)	(0.230)	(0.320)
rural	-5.12e-08*	0.000110	2.40e-06	1.55e-05	-1.18e-08	-8.17e-09	2.77e-08
	(3.06e-08)	(7.27e-05)	(5.92e-06)	(1.40e-05)	(1.76e-08)	(2.04e-08)	(2.05e-08)
hcr	-0.308**	212.2*	24.93	-131.5	-0.0612	-0.0172	0.162
	(0.147)	(128.1)	(18.43)	(127.7)	(0.136)	(0.0819)	(0.109)
Constant	-0.401	214.2	195.7**	145.0	0.242	0.143	0.142
	(0.414)	(651.1)	(94.60)	(204.7)	(0.305)	(0.890)	(0.272)
District FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
District*Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	527	519	528	559	512	528	560
R-squared	0.178	0.041	0.070	0.022	0.575	0.085	0.182
Number of districts	303	285	297	306	305	303	308

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table A4: Distribution of 1991 and 2001 sample districts across selected states

States	1991 districts	2001 districts	Sample districts unchanged
AP	23	23	22
Assam	23	23	22
Bihar+Jharkhand	42	37+18	28+12
Gujarat	19	25	12
Haryana	16	19	6
Himachal	12	12	12
J&K	14	14	14
Karanataka	20	27	18
Kerala	14	14	13
MP+ Chhatisgarh	45	45+16	37+6
Maharashtra	30	35	30
Orissa	13	30	13
Punjab	12	17	3
Rajasthan	27	32	26
Tamli Nadu	21	30	20
UP+Uttaranchal	63	70+13	45+5
WB	17	18	17
Total	**411**	**518**	**361**

Source: Tables 1 and 7 from Kumar and Somanathan (2009)

Chapter 5: conclusion of thesis

Chapter 5 conclusion

This thesis has examined human capital in the form of education and explored how the role of the government and education policy has affected educational attainment and economic growth.

In chapter 2 we presented cross-country evidence on the effectiveness of public spending on educational outcomes. it has also improves our understanding of the links between public spending and governance .The results highlight the importance of GMM estimates and suggests that government spending on education has positive and significant effect on educational attainment at all levels and the effect is largest at the primary level. We however fail to identify any significant beneficial effect of government education spending on primary and secondary enrolment levels, which primarily been guided by household decisions. Further despite very high level of government education spending in Africa, we do not find any statistically significant effect on educational attainment or enrolment in Africa who needs it most.

This evidence implies that just providing more resources is unlikely to improve student performance if future actions of schools follow their past behaviour. While schools in some regions seem to make good use of additional resources, others do not. In other words, a general increase in school resources does not necessarily promise significant positive improvements in student performance. A possible solution may lie in changing the incentive structure of the main actors in the schooling system rather than changing the level of available resources. Our findings also indicate that in countries which are rated as corrupt, public spending on education at the margin is ineffective.

We also find in chapter 3 that changes in the educational institutional structure are fundamental to improving school outcomes and human capital accumulation. The results show that interaction effects of cognitive skills and institutional structures have a significant impact on economic growth. In particular, the marginal contributions of cognitive skills, choice, autonomy and accountability to long-run growth (both direct and indirect) are unambiguously positive. The results also reflect that economic growth accelerates the process of cognitive skills in the presence of good institutions, therefore

economic growth is vital in increasing good institutions. One could provide a more detailed interpretation of alternative educational policies in the context of this model of quality versus quantity, although our main point in this discussion was to show that public support to education needs to be adequately designed and channelled in order to be unambiguously growth-enhancing.

Finally in chapter 4 there is confirmation from our results that voter's turnout significantly boost shares of government schools and also their access to several school infrastructures, especially pucca buildings. Greater turnout is also associated with significantly lower pupil-teacher ratio (PTR) at various levels. In other words, these results highlight the power of democracy in ensuring better allocation of public school resources.

The intuition behind our research is that what matters most for economic performance and efficiency in education is the provision of a set of institutional factors that will produce the motivation needed to succeed, both to teachers and to students. This institutional structure encompasses competition, accountability, choice and efficient public spending with redistributive objectives and this clearly transcends the traditional division between public and private schools. In some countries public schools have become relatively efficient by decentralization, by being allowed to be independent and autonomous in their decisions, competing openly with their counterparts in the system. The effects of these institutional factors on economic growth will determine whether public spending on education is efficient for attacking the problem of poor economic growth.

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