

FAMILY AND SCHOOL FACTORS ON EDUCATIONAL OUTCOMES IN CONTEMPORARY BRAZIL

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Declaration

The work described in this thesis is entirely the work of the author and does not include any collaborative work.

This thesis has not been previously submitted for a degree, diploma or any other qualification at the University of Oxford or elsewhere.

Luana Goveia Marx

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To Louis and Thomas, born along with these lines

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Abstract

This thesis investigates how family and school factors affect selected educational outcomes in Brazil. In particular, the effectiveness of two nationwide compensatory policies - the National Fund for Basic Education and Bolsa Família - in improving and equalizing educational outcomes is assessed. Three main research questions are answered. First, what are the trends in Inequality of Educational Opportunities (IOE) during the twentieth and beginning of the twentieth-first centuries in Brazil? Second, is there stability or change in average scholastic performance as measured by test scores in language and mathematics over time? Do changing school resources predict average scholastic performance over time? Third, does the Bolsa Família programme improve test scores performance in language and mathematics of poor beneficiary pupils? The Brazilian National Household Sample Survey, Prova Brasil (or Brazil Exam), School Census, Single Registry, and the Attendance System are used to answer these questions. The key findings from the observational studies are as follows. First, there is an equalisation in early educational transitions (completing some and graduating primary education), followed by a strengthening in the association between parental education and the completion of secondary and some tertiary education respectively. We also observe a stable but very unequal trend for completing university degree over time. Second, there are positive gains in average school performance between 2009 and 2015 (compared to the same schools in 2007): from 4 to 24 of a standard deviation for mathematics, and from 19 to 37 of a standard deviation for language. Moreover, increasing selected school resources have significant effects on average school achievement in language and mathematics over time, but the effects are very small, between 0.3 and 2.3 of a standard deviation. Third, there is a positive effect of the Bolsa Família programme on test scores in language and mathematics, but the effect is very small: between 1 and 3 of a standard deviation. This thesis addresses the influence of family and school on inequalities in selected educational outcomes accounting for socioeconomic differences observed by region and school type in a large and unequal developing country. The findings have important implications for future research and policy on this topic.

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1. **Introduction**

Does educational expansion reduce educational inequality? Do schools reproduce social stratification or promote social mobility? Does policy intervention at the family-level improve school outcomes of disadvantaged children? These questions have guided theory and practice aiming at improving educational opportunities for all. This thesis addresses these questions by investigating the ways family and school factors matter for selected educational outcomes in Brazil, namely: educational attainment, average school test scores performance, and pupil's individual test scores performance. We address the first question by exploring the trends in Inequality of Educational Opportunities (IOE) during the twentieth and beginning of the twentieth-first centuries in Brazil, a period of sharp educational expansion. Secondly, we assess whether increasing selected school resources lead to gains in average scholastic performance as measured by test scores in language and mathematics between 2007 and 2015 in urban Brazil. Thirdly, we investigate whether the cash benefit of the *Bolsa Família* programme improve test scores performance in language and mathematics of beneficiary pupils compared to similar disadvantaged pupils who are non-beneficiaries of the programme. Given the socioeconomic differences among the five geographical regions of the country - namely south, southeast, midwest, north and northeast - this study also explores regional differences in answering these three research questions. Overall, by exploring these three main questions this thesis extends the literature by disentangling the ways in which family and school factors matter for educational success and inequality in a developing country. In particular, this thesis also extends the literature on IOE, school effectiveness research, and programme evaluation using an exceptional combination of household survey, educational assessment, and administrative data. From a theoretical point of view, this thesis speaks to the work of several authors from different theoretical perspectives who address the three main questions posed by this study, as summed-up in the following three paragraphs.

In chapter 2 on trends in IOE during educational expansion, we mainly speak to work such as Boudon's (1974) primary and secondary effects of stratification, Lucas' (2001) 'Effectively Maintained Inequality' hypothesis, and Goldthorpe (2013) on education as a 'positional advantage'. This theoretical perspective challenges the idea that policies that raise the level of attainment of children from less advantaged backgrounds generate greater social mobility *per se*. According to this view, educational policy appears very limited in its capacity to decrease IOE over time due mainly to two reasons: i) the ability of better-off parents to use their socioeconomic resources to improve their children's educational careers and thus help

maintain their class position advantage; ii) better-off children who do not do well educationally still have their parents' socioeconomic resources to protect them against loss of class position.

In chapter 3 we assess stability and change in school average test scores performance over time, as well as on whether school resources predict average school performance. For that purpose, we speak to Willms and Raudenbush (1989), Raudenbush (1989), and Gray et al (1995) on that school effects may be far more stable over time than they have appeared when estimated by means of conventional cross-sectional, single level linear models. We also speak to authors such as Coleman (1966), Plowden (1967), Jencks *et al.* (1972), Reynolds et al (2000), Teddlie and Reynolds (2000), Creemers (2007), Teddlie and Stringfield (2007) on the idea that educational outcomes of children are mainly influenced by family background and that school- resources do not matter much. The main criticism of this work centered on its simplified input-output model, which treated schools as 'black boxes', focusing on static school's characteristics. For the critics, school's composition, resources and teaching practices, for instance, are likely to influence children's educational outcomes and should therefore be addressed. Hence, Mortimore et al's (1988) notion that 'school matters' has inspired numerous studies on the relevance of school inputs, such as school resources (Hanushek, 1997), and teachers' characteristics and practices (Rivkin et al, 2005; Hill et al., 2005; Ladd, 2009), for instance. According to this view, schools are greatly differentiated in terms of their socioeconomic compositions, contexts, and resources (physical and human), thus affecting children's educational outcomes. The theoretical debate has now shifted from 'whether schools matter or not' to 'how, in which contexts and for which groups schools matter most'.

In chapter 4 on whether the *Bolsa Família* programme improve test scores performance of poor beneficiary pupils, the debate is on the use of Conditional Cash Transfers (CCT) as an instrument to reduce poverty. Critics of CCTs argue that poverty is best reduced by economic growth, particularly in poorer countries, where administrative and fiscal capacities are likely to be low and governments should focus their scarce resources on providing basic infrastructure that would be beneficial for the entire population instead of focusing their limited capacities on a vulnerable group. Moreover, critics argue that CCTs might have perverse effects on beneficiaries, such as discourage labour in low-productivity and low-paid settings, consequently undermining the economy (Freeland, 2007). On the other side, defenders of CCTs argue that in most developing countries public expenditure on infrastructure and public services often fails to reach the most vulnerable groups of the population (De Ferranti et al, 2004: 209). Also, authors such as Roemer (1999) and Bourguignon et al (2007) argue that because most of socioeconomic inequalities are inherited from parents, over which individuals

have no control, the state should have a moral obligation to address such inequalities and, under this scenario, CCTs are reliable instruments to address such disadvantages.

From a policy perspective, this thesis addresses three main educational policies aiming at promoting not only school access but also performance in an inclusive way in Brazil. The main policy aiming to improve access was the educational expansion carried out in the second half of the twentieth century. During this time primary education became mandatory, and more places became available in secondary and tertiary education. This study investigates whether IOE was reduced in the context of this educational expansion in chapter 2. Subsequently, chapters 3 and 4 carry out a comprehensive examination of the effectiveness of two nationwide compensatory policies implemented at school and household levels respectively: the FUNDEB and *Bolsa Família*. The National Fund for Basic Education (FUNDEB - *Fundo de Manutenção e Desenvolvimento da Educação Básica*) is a student-based funding formula implemented at school level that distributes funds fairly within regions, states and municipalities in order to equalize public expenditure per student and per teacher in the whole country. This thesis investigates whether the FUNDEB has been successful in improving school's average scholastic performance and in decreasing the large disparities in performance observed by region.

The *Bolsa Família* programme or Family Allowance, is a Brazilian CCT implemented at household level, that provides a monthly direct cash transfer to poor families conditioned on health checks and school attendance for their children. The cash paid to the family aims at alleviating the short-term income deprivation. The conditionalities aim at breaking down the long-term intergenerational transmission of poverty by improving on children's nutritional and educational levels. This thesis assesses whether the conditionality of attending school has improved test scores performance of beneficiary pupils compared to observably similar but non-beneficiary pupils.

The Brazilian educational system has expanded quickly over the last decades. By 2002, 97 percent of the children in the relevant age group were enrolled in primary school (Borman and Reimers, 2007). Despite this expansion, educational attainment is still low compared to countries with similar levels of development (Fernandes, 2004) as the country presents only 6 years of schooling on average (see table 1.1). The great educational expansion in Brazil has shifted the channels through which socioeconomic differences are reproduced across generations: no longer in terms of only the access to lower levels of schooling, but rather as social differences in the quality of education, as most of the expansion was possible in fragile institutions of insufficient quality to enable the newly incorporated groups of worse-off children to succeed academically. Hence, the gap in upper educational levels appears to be

widening: attainment rates both in secondary and tertiary education are among the lowest when compared to OECD countries and other middle-income countries. Likewise, Brazilian students perform below the OECD average in the Programme for International Student Assessment (PISA) exam (OECD, 2013: 34). In PISA, Brazil is one of the lowest performing countries despite some progress in the mid-2000s. Between 2000 and 2009, the average score across the three subjects tested (reading, math, and science) rose 33 points for the country: from 368 to 401. This represented the third largest [1] improvement of PISA scores for the period. Nevertheless, Brazil's learning outcomes are below the average for middle-income countries; and even below those of some lower income countries, such a Thailand and Jordan; and other Latin American countries such as Chile, Uruguay, Mexico, Trinidad and Tobago, and Colombia (Bruns et al, 2012: 18; PISA, 2009).

Barros and Lam (1996) highlighted the main drawbacks of the Brazilian educational system that were marking the 1990s and are still observed nowadays: i) average educational attainment remarkably low in the upper educational levels; ii) unequally distributed education (a country with a high degree of income inequality and a close link between income inequality and education); iii) educational attainment between children and their parents and grandparents highly correlated, indicating high inequality of opportunities and limits on the extent of social mobility; and iv) large regional disparities in children's educational attainment. The education inequality is related to many other regional socioeconomic differences found in the country, such as income and wealth. According to these authors, those disparities are large, temporally stable and difficult to explain. They are likely to reflect a very unequal regional allocation of the investments in education.

Table 1.1 below shows basic educational indicators in 2003 in Brazil and in its five geographical regions. The educational expansion put into practice in the 1990's managed to weaken regional disparities in the attendance of the primary level of schooling (all regions with above 95 per cent attendance of school age children). Likewise, weak regional disparities can also be observed in the attendance of the secondary level (all regions with approximately 80

[1] First largest was Luxembourg with an increase of 38 points; and second comes Chile with an increase of 37 points (Bruns et al, 2012: 18; PISA, 2009).

per cent). Yet, school enrollment in secondary education has failed to reach universal coverage, with important disadvantages among non-white and low socioeconomic background youths (Marteleto et al., 2012a; Marteleto et al., 2012b; Fernandes 2004). Considering that only an average of 80 percent of the relevant age-group students in Brazil have access to secondary school, access to this level has become an important bottleneck in the successful educational trajectories of the Brazilian youth. Attendance to the tertiary level presents more regional disparities than noticed in lower educational levels: whilst in southeast the attendance to tertiary education is 39.2 percent, northeast presents only 31.2 percent.

Despite the progress achieved by the expansion in the access to education, the completion of secondary and access and completion of tertiary education seems to remain very unequal in the country. Even though the attendance ratio in tertiary education for the age group 18-24 years is above 30 percent for all regions in Brazil in 2002, the proportion drops sharply to a national average of 9.3 percent for those who have completed at least one year of tertiary education. Among them, more regional disparities are observed: whilst 11.8 percent of those residing in the richest southeast have completed at least one year of tertiary education, only 4.8 and 5.2 of those from the poorest north and northeast regions respectively have done so. Regional disparities are also seen in the educational attainment for those who are 25 years or older. Those residing in the north or northeast regions have 1 and 1.5 less completed years of schooling than the national average.

Table 1.1 Illiteracy rate [a] and gross attendance ratio [b] of primary, secondary and tertiary education per region, 2002

Regions	**Levels of Education**					
	Illiteracy (%)	Primary Education (%)	Secondary Education (%)	Tertiary Education (%)	At least 1 year of Tertiary Education [e] (%)	Average years of Schooling [d]
South	7.1	97.0	78.9	37.5	10	6.2
Southeast	7.5	97.4	83.6	39.2	11.8	6.6
Midwest	10.2	97.1	80.2	33.6	9.8	6.1
North[c]	10.6	95.3	80.2	31.8	4.8	5.1
Northeast	24.3	95.2	79.2	31.2	5.2	4.5
Brazil	12.4	96.5	81.1	34.0	9.3	5.9

Source: Author's compilation using PNAD 2003 and IPEA DATA
a) Illiteracy rate: population aged 15 or older
b) Gross Attendance Ratio: the total enrollment in a specific level of education, regardless of age, expressed as a percentage of the population in the official age group corresponding to this level of education
c) Urban area only. Excluding people from rural Rondônia, Acre, Amazonas, Roraima, Pará and Amapá.
d) Average years of completed education for those who are 25 years or older
e) For those who are 25 years old or older

Table 1.2 below compares the share of national and per capita incomes by region between 1940 and 1996, a period that encompasses the educational expansion. A persistent regional inequality is observed during the twentieth century. While in 1939 the northeast region was responsible for 17 percent of the national income, the southeast region had 63 percent of it. This trend has been persistent: by the end of the century the northeast region had 13.5 percent of the share of national income compared to 58 percent of the southeast. Likewise, the northeast region reached the end of the twentieth century with a per capita income approximately a third of the southeast region. The south region has similar patterns of socioeconomic development observed in the southeast region. The south presented a per capita income twice as higher than the northeast. The north region is proportionately closer to the northeast in terms of national and per capita incomes.

Table 1.2 Shares of territory, population, and income per region, 1939-1996, Brazil

Region	Share of National Territory (%)	Share of National Population (%)		Share of National Income (%)		Per Capita Income (USD of 95/year)	
		1940	1996	1939	1996	1939	1996
North	45.3	3.5	7.2	2.7	5.0	446	2,592
Northeast	18.3	35.0	28.5	16.9	13.5	286	1,836
Southeast	10.9	44.5	42.7	63.0	58.1	839	5,443
South	6.8	13.9	15.0	15.3	15.8	659	4,318
Midwest*	18.9	3.1	5.5	2.1	4.8	413	3,914

* Income shares does not add up to 100 per cent due to the exclusion of the Federal District from this region
Data calculated and organized by Azzoni (1997) based on sources from Getúlio Vargas Foundation (FGV – Fundação Getúlio Vargas), the Brazilian Institute of Geography and Statistics (IBGE – Instituto Brasileiro de Geografia e Estatística), and the Institute of Applied Economic Research (IPEA – Instituto de Pesquisa Econômica Aplicada).

According to Plank et al (1996: 11), the geographical distribution of resources and institutional capacities has been a contentious issue over time. Among them, the location of administrative and financial[2] responsibility for schools, especially at the primary level; and the status of regional differences in the effort to reduce educational inequalities. On one side, states and municipalities of the richer southeast region have tended to favour decentralization policies which would give them greater control over local resources. On the other side, the poorer northeast has been more likely to defend centralized policies in order to ensure a continued flow of federal transfers for their under developed educational system (Castor and Zabot, 1989). The end of the expansion period was marked by educational reforms and compensatory policies that targeted this historical unequal distribution of resources. Among the reforms, the

[2] The funding of schools is defined by the Ministry of Education: the federal government must spend annually at least 18 per cent of its net revenues taxes in the maintenance and development of education; while states and municipalities, at least 25 per cent of their income from tax revenues, including those resulting from federal transfers. In addition to public funds, a 2.5 per cent payroll tax contributes to education finance (*Constituição do Brasil de 1988*, 2010). The federal government is responsible for the federal educational system, and consequently, for financing federal public institutions, including primary federal schools. The federal government also plays a supplementary role: it guarantees a minimum standard of quality through technical and financial assistance to states and municipalities (Constituição do Brasil de 1988, 2010). By and large, the federal government performs a normative (set guidelines and bases), redistributive and supplementary function in relation to other areas of education aiming at diminishing regional and social inequalities (Inep, 2011: 8).

main one was the third National Education Guidelines and Framework Law of 1996 (LDBEN – *Lei de Diretrizes e Bases da Educação Nacional*). The law organized education in two levels: basic (comprising early childhood, primary and secondary education) and higher. The law also set the basis for a comprehensive and national approach to tackle educational inequalities (LDBN, 2010). Subsequently, compensatory policies followed the LDBEN of 1996 as part of the reform's strategy to close the gaps in learning opportunities and outcomes between better-off and worse-off children.

As briefly mentioned above, there are mainly two types of compensatory policies. The first aims to close the structural gaps between school environments attended by richer and poorer children through more equitable funding. One of the most relevant policies of this type is the National Fund for Basic Education (FUNDEB - *Fundo de Manutenção e Desenvolvimento da Educação Básica)*. The fund was financed by taxes and aimed at guaranteeing a minimum educational spending per pupil as a means of reducing regional and inter-state inequalities (Castro, 2011; Guimarães de Castro, 1999: 22). For that purpose, the fund increased teachers' salaries, mandated the redistribution of funds across states and municipalities in order to help disadvantaged schools to meet the per student spending floor, and pledged federal government funds to fill any remaining gaps. With FUNDEB the federal government started playing a distributive role from better-off to worse-off regions based on equalizing public expenditure per student and per teacher in the whole country (Schwartzman, 2004: 22). As a consequence, poorer states in the north and northeast regions could expand their school offers and catch up with southern states in the universalisation of primary education (OECD, 2011: 181; Reimers, 2006: 478).

The second type of compensatory policies aims to equalize the distribution of educational opportunities by intervening at household level in order to counterbalance the greater resources some children have in their home. These policies assume that school outcomes reflect both school and family resources. The main policy of this type in Brazil is the *Bolsa Família* programme (BFP), which transfers cash to low-income families provided their children have at least 85 percent of school attendance, and contributes to making access to primary school universal. *Bolsa Família* also has a regional relevance given that the poor are highly concentrated in the northeast, which receives more than 50 percent of the total income

transfer under the *Bolsa Família* programme[3]. The BFP has had an important impact in poorer regions, mobilising resources and creating incentives for poor municipalities to increase their capacities to deliver educational services to their citizens (OECD, 2013: 131).

In this context, this thesis examines the ways in which family and school factors matter for selected educational outcomes in Brazil accounting for socioeconomic inequalities observed by geographical region[4]. Particularly, we assess the effectiveness of the two main compensatory policies of the country - FUNDEB and *Bolsa Família* - in improving and equalizing educational outcomes. For that purpose this thesis is organised into six chapters. This introductory Chapter 1 is followed by Chapter 2, which empirically explores cohort interpretations of change in educational attainment in a general ordered logit model during a period of educational expansion. Chapter 3 assesses the average scholastic performance as measured by test scores of students in a panel of public primary urban schools that have their resources changing over time due to the FUNDEB reform in a longitudinal model with school fixed effects. Chapter 4 investigates the effect of *Bolsa Família* programme on test scores performance of beneficiary pupils compared to similar pupils whose families do not receive the benefit using a Propensity Score Matching model. Chapter 5 presents conclusive remarks.

[3] As a comparison, the richer southeast and south region receives approximately 25 and 18 percent of the total income transfer of the programme respectively (OECD, 2013: 131).
[4] The five geographical regions: south, southeast, midwest, north and northeast.

2. Patterns of Educational Stratification During Educational Expansion in Brazil

2.1. Introduction

Research in the industrialized world has shown that the influence of parental background on educational attainment has remained stable or declined over time. In contrast, less is known about the developing world. This chapter empirically explores how parental background and regional socioeconomic differences may affect the probability of completing selected educational levels for individuals in the age group of 25-65 who were born between 1931 and 1989 in Brazil. The country provides an interesting case study because the end of the educational expansion of the second half of the twentieth century was concomitant with the economic crisis of the 1980s, known as the 'lost decade', which led to a sharp decline in family income. Subsequently, when the educational expansion of the primary education was completed, Brazil experienced a period of rapid economic growth in the 2000s led by the 'boom' in commodities prices, which resulted in growing family income. Brazil also figures among the most unequal nations: the richer southeast and south present considerable socioeconomic advantages compared to the poorer northeast, north and midwest respectively[5].

The association between parental background or resources when one individual is growing-up and this individual's life outcomes is known to be correlated with social stratification. According to Boudon (1974) there are two effects of stratification linked to this association. First, parental resources are closely linked with their offspring's educational attainment because the family influences the cognitive and non-cognitive abilities of children and consequently their school achievement. Secondly, parents and children from various social backgrounds make different educational decisions, even when these children have similar school outcomes. Erikson and Jonsson (1996) describe five mechanisms by which parent's resources influence school outcomes and consequently stratification: 1) cognitive abilities are partly transmitted genetically; 2) cognitive abilities are also the result of the environment; 3)

[5] Whereas the southeast and south regions together account for 73 percent of the Brazilian Gross Domestic Product (GDP); the northeast, north and midwest account together for only 27 percent of the national GDP (IBGE, 2012).

parental interaction with their children pass on the social skills that are favoured in school; 4) differing nutrition and health habits among different social groups are associated with children's school performance; 5) family size is related to students' school performance as the more siblings a child has the less well she or he will perform in school. From a sociological perspective there are three main ways of measuring parent's resources when an individual is growing-up: social class, occupational status and education. Although these three measures represent different ways of calculating socioeconomic background and can be linked to different mechanisms by which parental resources affect their offspring life's outcomes, they are statistically highly correlated and it is hard to disentangle them (Bukodi and Goldthorpe, 2013; Pfeffer, 2008).

We assess trends in Inequality of Educational Opportunity (IEO) in Brazil defining parental background as parents' educational attainment. More specifically, the extent to which education promotes mobility considering the statistical association between family background - parental socioeconomic conditions when growing up – and individual's educational attainment. Educational mobility is therefore defined here as the association between parents' and children's educational attainment. This helps understanding the causal part of the intergenerational association in educational status. Education is known to have a dual role in intergenerational transmission of advantages. It is both the main channel for socioeconomic reproduction and the main avenue for socioeconomic mobility (Blau and Duncan 1967: Ch. 5; Hout and DiPrete 2006).

This approach to understanding social mobility has a long tradition in sociology and has been widely used in different contexts (Breen and Jonsson, 2005) despite its limitations, such as lack of information on individual performance and motivation, among others (Jencks e Tach, 2006). Brazil has numerous studies following the IOE approach to assess social mobility over time (Silva and Hasenbalg, 2003). Recent evidence shows that IEO has been decreasing over the last decades in Brazil, particularly in the completion of secondary education, and the enrollment and completion of university. Despite the chances of completing secondary education have also increased for all, the advantages of better-off families have remained stable over time (Ribeiro, 2017: 62). We are particularly interested in assessing to what extent the IOE can be explained by regional differences in the distribution of parental education during a period of educational expansion.

Early research in Europe, the United States and East Asia found a consistent decline in the influence of parental background on the highest educational level attained, which was driven by educational expansion, but persistence in the effects of social background on the odds of making the educational transitions. Overall, the decline in IOE over time has been

driven by educational upgrading, rather than by changes in the association between parental socioeconomic conditions and the educational outcomes of their offspring. Therefore, the influence of family background on educational attainment has remained stable or has declined over time in the industrialized world, an early conclusion known as 'persistent inequality' (Shavit and Blossfeld, 1993).

Recent research suggests more variation across countries and over time than these early conclusions on 'persistent inequality'. According to Torche (2010: 86), these diverging paths bring questions about different factors driving changes in IOE in different contexts. To date, researchers have focused on two main explanations. The first one is educational reforms. The literature suggests that reforms decreasing the costs of schooling for families delay early decision points, limit track differentiation, and reduce class size appear to favour of the equalisation of educational opportunity, ultimately favouring lower-class students (Breen and Jonsson, 2005; Jonsson, Mills and Müller, 1996). Secondly, there might be changing competition in the access to specific educational levels: changing scarcity and competition emerges from educational expansion. In this way, when a particular educational level expands, and provided that the upper class has reached universal access (or 'saturation') to this level, admission will be then extended to children from lower classes that were previously excluded from this level of schooling. Under these circumstances inequality will thus decline. This explanation relies on the Maximally Maintained Inequality (MMI) of Raftery and Hout (1993). According to this theory, educational expansion only leads to an increase in educational opportunities for children from lower educational backgrounds when children from higher educational background are already completing the transitions of the levels that are being expanded (Lucas, 2001).

Changing scarcity at a particular educational level, however, may also lead to widening disparities in higher levels. If the expansion of the secondary level is not followed by a proportional expansion of the tertiary level, a bottleneck will be created because a rising number of secondary education graduates will not be able to gain access to scarce university places. In this case, better-off individuals will be more likely to take up tertiary level places and thus maintain their class advantages. This situation is more likely to take place in less developed countries. The emergence of a bottleneck, for instance, appears to have contributed to growing inequality in the access to post-secondary education in Russia during the Soviet period. The secondary education grew rapidly when tertiary education did not grow at a proportional rate. This resulting bottleneck hurt disadvantaged classes more than the advantaged ones (Gerber and Hout, 1995). Lately, in the post-Soviet period, the educational stratification in secondary and postsecondary educational levels continued to grow even in the

absence of a bottleneck. In this period, the economy deteriorated and families faced a sharp drop in their incomes, exhibiting a pattern of educational inequality that probably reflected the differential impact of economic changes on different groups in the post-Soviet Russian society (Gerber, 2000).

During economic downturns such as the macroeconomic context of post-Soviet Russia, it is widely acknowledged that employment and real wages decline and become more volatile, consequently constraining families' abilities to afford educational investments (Fallon and Lucas, 2002). Economic downturns may also affect the cost and the returns to education. Given that access to education is not homogeneously distributed across different socioeconomic groups, economic fluctuation may substantially change educational stratification. The Russian case suggests potential determinants on IOE: i) the bottleneck created by a non-proportional expansion of higher educational levels (after the expansion of lower levels); and ii) the effect of the macroeconomic fluctuations on families' conditions (Gerber, 2000). Less is known about educational expansion during economic fluctuations and consequent changes in educational stratification in the late industrialized world, such as Latin America. This region has been experiencing a period marked by economic decline and volatility over the last decades of the twentieth century followed by recovery and growth boosted by the rise in the commodities prices of the early 2000s.

Torche (2010) assessed trends in educational stratification of those who had grown up during the 1980s crisis in four Latin American countries: Brazil, Chile, Colombia and Mexico. She found equalisation in early educational transitions (completing primary and entering secondary school), with a decline in inequality in the access to these initial levels. Equalisation here seems to be driven by expansion in the context of universal access by the upper class ('elite saturation'), as in the industrialized world. The decline in inequality, however, cannot be seen in the two higher transitions – secondary school graduation and college entry. The probability of completing high school conditional on having entered this level remained stagnant across cohorts. Consequently, an unprecedented strengthening of the association between parental background and the probability of graduating secondary school and entering college were found among those who had grown up during the 1980s crisis. Latin American countries were therefore marked by an increase in socioeconomic inequality at the secondary and postsecondary levels for the cohorts that experienced the economic downturn. In the particular case of Brazil, Torche (2010: 103) found an absolute decline in educational attainment for the youngest cohorts, constituted of those born between the late 1950s and mid 1970s. These cohorts experienced their educational path during the 1980s, reflecting a slowdown in their educational attainment. In a context of overall stagnation, the lower classes

experienced a sharp decline in their ability to retain children in school at higher levels of education. Torche's (2010) found the macroeconomic context as a critical determinant of changes in educational stratification over time.

Early research on IOE in Brazil has assessed the overall effects of family background and individual characteristics on the chances of progressing in the educational system. Most studies have shown that inequality factors related to family socioeconomic conditions, skin colour and location of birth (urban/rural) restrain the chances of progressing in the educational system and were not substantively changing over time (Fernandes and Neves, 2010; Osório e Soares, 2005; Fernandes, 2001; Hasenbalg and Silva, 2000; Hasenbalg and Silva, 1999; Silva e Souza, 1986). Ribeiro's (2011) cohort analysis has found persistent inequality of opportunities in Brazil regarding: i) area of residence (urban x rural); ii) place of birth (the richer south x the poorer north); iii) mother's and father's social class; iv) working mothers; v) mother's and father's educational attainment; vi) growing up in single parent families or with many siblings; vii) persistent inequality over time; viii) parental wealth (Ribeiro, 2011: 41, 42, 51, 56, 78, 87). Ribeiro's (2011) study, despite accounting for regional divisions, relies on data[6] with a small sample size - only 8,359 individuals – and does not include rural areas of the North region. This very small sample size coupled with the exclusion of large areas of the North region might bias his IOE analysis.

In a more recent analysis, Ribeiro (2017) presented trends of IOE in Brazil for birth cohorts of the newest available nationally represented household survey data[7] with parental retrospective information. He found that the influence of parental socioeconomic background on chances of completing the first two transitions (half and full primary education respectively) have decreased over time. He also found that the chances of completing secondary education have increased over time, although without a decrease in inequality between different socioeconomic backgrounds. There was a decrease in the socioeconomic inequalities to enter

[6] Ribeiro's (2011) used the cross sectional Social Inequality Household Survey (PDSD – *Pesquisa Dimensões Sociais da Desigualdade*) of 2008.
[7] Ribeiro (2017) used the cross sectional Brazilian National Household Sample Survey (PNAD) of 2014 with a sample size of 34.023 individuals (head of households or partners).

and complete university, although this trend was driven by a decrease on the chances for those from higher classes instead of by an increase on the chances of individuals from lower classes.

Our study expands Ribeiro (2011; 2017) and Torche (2010) by assessing both older and newer cohorts over a longer period of time, with nationally represented data with larger sample size with two points in time. More specifically, Torche (2010) uses data from 1996/97[8] with individuals born between 1940-75 assessing IOE trends of those who had grown-up during the 1980s economic crisis in selected Latin American countries, including Brazil. The corresponding sample size for Brazil is only 5,451 individuals and accounts for only 70 percent of the national population. Ribeiro (2017) uses data[9] from 2014 with individuals born between 1950-89 in Brazil with a sample size of 34,023 individuals. Our study uses household survey data collected in 1996 and 2014 representative of the entire country with a sample size of 281,280 individuals born between 1931 and 1989. We also account for regional differences in IOE. Perhaps more importantly, unlike Ribeiro (2011; 2017) and Torche (2010), we start our educational levels with 'no education' or less than one year of schooling to account for the high proportion of illiterate individuals between the 1930s and 1950s in Brazil, approximately 50 percent of the population aged 15 years or older (Ferraro, 2002: 34). Comparatively, Ribeiro (2017) lowest educational level considered is 'some primary education' and Torche (2010) 'graduate primary', which does not include an important part of the population. In this chapter, for instance, illiterate individuals account for 12 percent of our sample. Dropping these individuals out of our analysis or including them under the second transition 'some primary education' would very likely bias our outcomes.

We cover the entire period of the educational expansion in Brazil in the twentieth and beginning of twentieth-first centuries. This chapter explore empirically cohort interpretations of change in educational attainment in a general ordered logit model during a period of economic growth followed by downturn and sharp recovery in Brazil across its five different geographical regions. Including this introduction, this chapter is organised into six sections. In

[8] Torche (2010: 89, 90) uses Brazil Survey of Living Conditions (*Pesquisa sobre Padrões de Vida*).
[9] Ribeiro (2017) uses The Brazilian National Household Sample Survey (PNAD, *Pesquisa Nacional por Amostra de Domicílios)*.

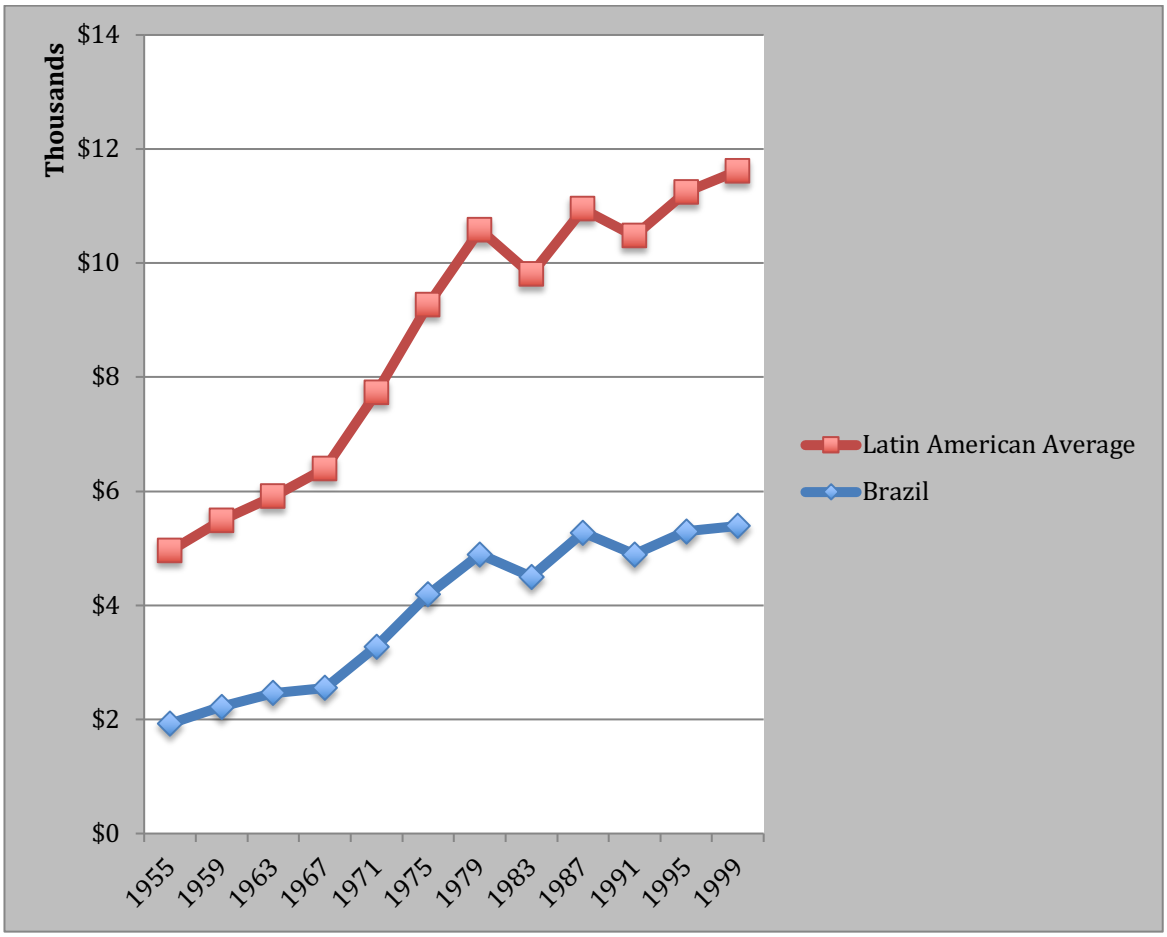
the next item, the Brazilian macroeconomic context during the educational expansion is discussed. The third section presents the educational reforms, the structure of the educational system and particular characteristics of the cohorts analysed in this study. The fourth section presents the data, variables and the statistical model. The main results are presented in the fifth section; and in the last section the main results are summarised with concluding remarks.

2.2. The Brazilian context during the educational expansion

Brazil has been through deep changes in its macroeconomic context over the second half of the twentieth and beginning of the twentieth-first centuries that might have affected IOE. Figure 2.1 below shows trends in GDP per capita between 1955 and 1999 in Brazil and the Latin American Average (Argentina, Chile, Colombia, Mexico, Peru, Uruguay and Venezuela). The figure shows trends in the GDP per capita observed during the 'economic miracle'[10] of the 1970s followed by the 'lost decade' of the 1980s and beginning of the 1990s. The observed income losses had a detrimental effect on the living standards of the population. There is evidence that during the 1980s and 1990s the poorer groups (such as the unemployed or those in the informal sector), as well as part of the lower-middle class (such as skilled and semi-skilled workers and government employees) had to bear a disproportionate share of the decline in GDP in Latin America. Albanez et al (1989: 18, 19), attributed this to three main changes which occurred on the labour market as a result of the economic crisis: i) overall employment creation slowed down considerably during this period; ii) a deterioration in the quality of the new jobs (basically, low-productivity jobs created in the informal urban sector); iii) drastic reduction in the remunerations of the employed labour force.

[10] Brazilian Gross Domestic Product (GDP) grew on average 7.5 percent per year between the 1960s and the 1970s, the period of the so-called 'Brazilian miracle', but growth slowed down to about 2.5% per year on average from 1980-2005. Nevertheless, Brazil has been growing faster than OECD member countries, particularly around 2010. This recent growth was supported by major macroeconomic reforms introduced in the early 1990s, as well as by significant productivity gains and a rapid integration into the world economy (OECD, 2013: 29).

Figure 2.1 GDP per capita (USD) for Brazil and the Latin American Average*: 1955-1999



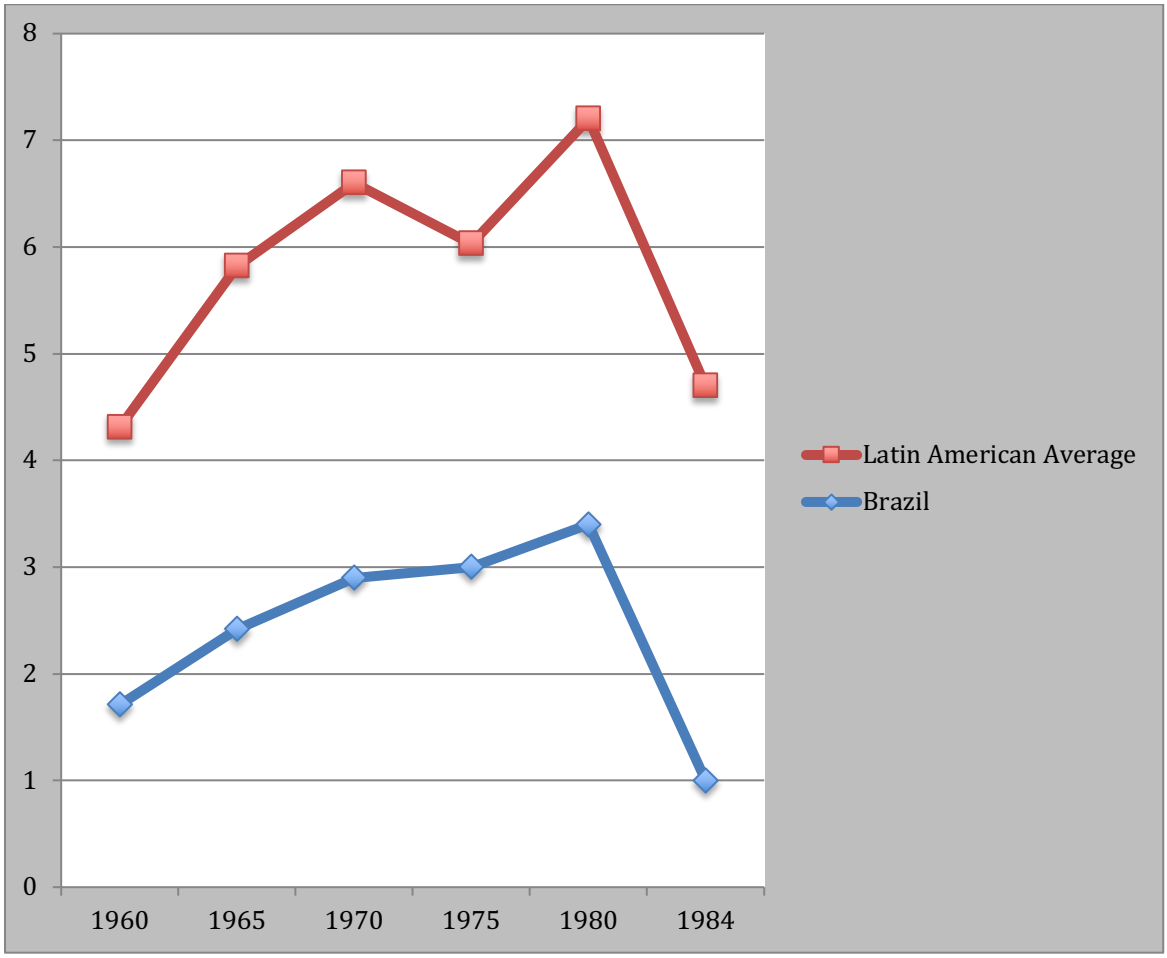
Source: Author's elaboration with data from Maddison (2001: 522). (1990 International Geary-Khamis dollars)
* Latin American Average = Argentina, Chile, Colombia, Mexico, Peru, Uruguay and Venezuela

The 'lost decade' led to austerity measures[11] implemented as part of the structural adjustment reforms in the 1980s and 1990s, which resulted in a sharp decline in public spending on schooling in Latin America as figure 2.2 shows. Austerity also resulted in reduced

[11] By and large, economic adjustment and stabilization referred basically to two policies: i) stabilization policies: aimed at reducing the rate of inflation to a sustainable level and closing fiscal and trade deficits with a clear short-term focus and often funded by the IMF; ii) structural adjustment policies: aimed at changing the overall structure of the economy through reforms of policies and institutions – microeconomic (such as taxes), macroeconomic (such as fiscal imbalance), and institutional (public sector inefficiencies) (World Bank, 1988: 10, 11).

government funding for public education programmes, lower personal incomes and family budgets available for education, and an increased focus on encouraging private initiatives, which only better-off families could afford (Reimers and Tiburcio, 1993: 14).

Figure 2.2 Public expenditure on education as percentage (%) of GDP, 1960-1984



Source: Author's elaboration with data from Tilak (1989: 131). (1990 International Geary-Khamis dollars. Proportion of the population below $4/day Geary-Khamis dollars)
* Latin American Average = Argentina, Chile, Colombia, Mexico, Peru, Uruguay and Venezuela

The adjustment policies had a negative impact on education, such as that the previous progress in educational finance made in the seventies was undone in the eighties' (Reimers, 1991: 322). Given that past educational expansions carried out in the 1960s and 1970s had incorporated a large number of children from less advantaged classes, who were more dependent on educational system inputs, the reduction in the public spending on education may have been most problematic for those most in need (Torche, 2010: 88).

At the beginning of the twentieth-first century Brazil experienced a return to economic growth. Enrollment in primary education reached 96 per cent, with only 9.5 per cent of them in the private sector. However, this figure did not mean that most of students, once enrolled,

would complete primary schooling (Guiraldelli Junior, 2006: 198, 1999). Among those who completed primary schooling, only a small portion would enter secondary education. According to Reimers (2006: 452), two main factors constrained the expansion of secondary education in Brazil: i) expansion in access to primary level was achieved with a number of measures that reduced structural quality – as a result, many of the children who gained access to primary school repeated grades multiple times, thus, the number of those who eventually graduated from this level was only a fraction of the number of those who gained initial access to primary schools; ii) expansion in the access to secondary school was constrained by policy given that the emphasis during most of the century was on the universalization of primary education and literacy. A process of social segmentation in educational institutions has undermined the gains of the quantitative expansion (Reimers, 2006: 14). We therefore observe in Brazil a situation in which the availability of places does not seem to be the main barrier regarding IOE, but completing a given educational transition once enrolled.

2.3. Educational reforms and Inequality of Educational Opportunity in Brazil

The current Brazilian educational system is the result of the reforms that took place in 1971, 1988 and 1996. The most important change occurred in 1971, extending the duration of compulsory primary schooling from four to eight years. Despite mandatory since the early 1970s, the universalisation of the eight years of primary education was only fully achieved in the late 1990s (LDBEN, 1971; LDBEN, 1961). Table 2.1 below shows how the structure of the Brazilian education system has been organized according to the three main reforms: 1961, 1971 and 1996.

Table 2.1 Structure of the Brazilian Education System According to the Main Reforms: LDBEN of 1961, 1971 and 1996

LDBEN of 1961			**LDBEN of 1971**			**LDBEN of 1996**		
Level	*Duration* (years)	*Age* (years old)	*Level*	*Duration* (years)	*Age* (years old)	*Level*	*Duration* (in years)	*Age* (years old)
Primary Education (**Compulsory**)	4	7 - 10	'1st Level' (**Compulsory**)	8	7 - 14	Primary Education (**Compulsory**)	8	7 - 14
Gymnasium	4	11-14						
'Collegial' or High School	3*	15 - 17	'2nd Level'	3*	15 - 17	Secondary Education	3*	15 - 17
Higher Education	Minimum 4	Over 17	Higher Education	Minimum 4	Over 17	Higher Education	Minimum 4	Over 17

Source: Author's organization based on LDBEN (1961); LDBEN (1971); LDBEN (2010).
* If associated with vocational/professional training, secondary education can last 4 or 5 years.

Despite the above-mentioned educational reforms, little substantial changes have been observed in the structure of the educational system. Considering the International Standard Classification Education (ISCED), the Brazilian education system is divided into two levels after the LDBEN of 1996: basic education and higher education, as table 2.2 below shows. The Basic education is constituted of three stages[12]: ISCED 0 – early childhood education (pre-primary), which includes provision for children from 0 to 3 years old (day-care centre/nursery); and from 4 to 5 (pre-school); ISCED 1 – primary education, from 6 to 14 years of age, which is compulsory and free of charge in public schools; ISCED 2 – lower secondary education, which is compulsory and free of charge in public schools; ISCED 3 – the final stage of basic education, with a minimum of three year's attendance, from 15 to 17 years old; ISCED 4 – higher education (Inep, 2011: 6). This new structure allowed vocational education to be integrated with secondary schools or in partnership with specialized technical colleges (LDBEN, 2010). This basic structure does not have separated tracks and those who complete

[12] The stages presented here follow the International Standard Classification Education (ISCED) of the United Nations Educational, Scientific and Cultural Organization (Unesco). See Unesco (2011).

either secondary or vocational/technological education can apply to a university education degree.

Table 2.2 Structure of the basic education system and educational authorities (2008)

General Programme	Specific Programme	International Denomination	Grades/Years	Theoretical Age	Authority	ISCEDs
Basic Education	Early Childhood Education	Initial Education	4 years	0 - 3	Municipalities	ISCED 0
		Pre-School	2 years	4 - 5		ISCED 1
	Primary Education (*compulsory*)	Elementary Education	1st grade	6 - 10	Municipalities, States	ISCED 2
			2nd grade			
			3rd grade			
			4th grade			
			5th grade			
		Lower Secondary School	6th grade	11 - 14		
			7th grade			
			8th grade			
	Secondary Education	Upper secondary education	1st form	15 - 17	States	ISCED 3
			2nd form			
			3rd form			
	Vocational and Technological Education	Upper secondary education	Forms 1 - 3	15 - 17	States	ISCED 3

Source: Ministry of Education (2008); Inep (2011: 6).

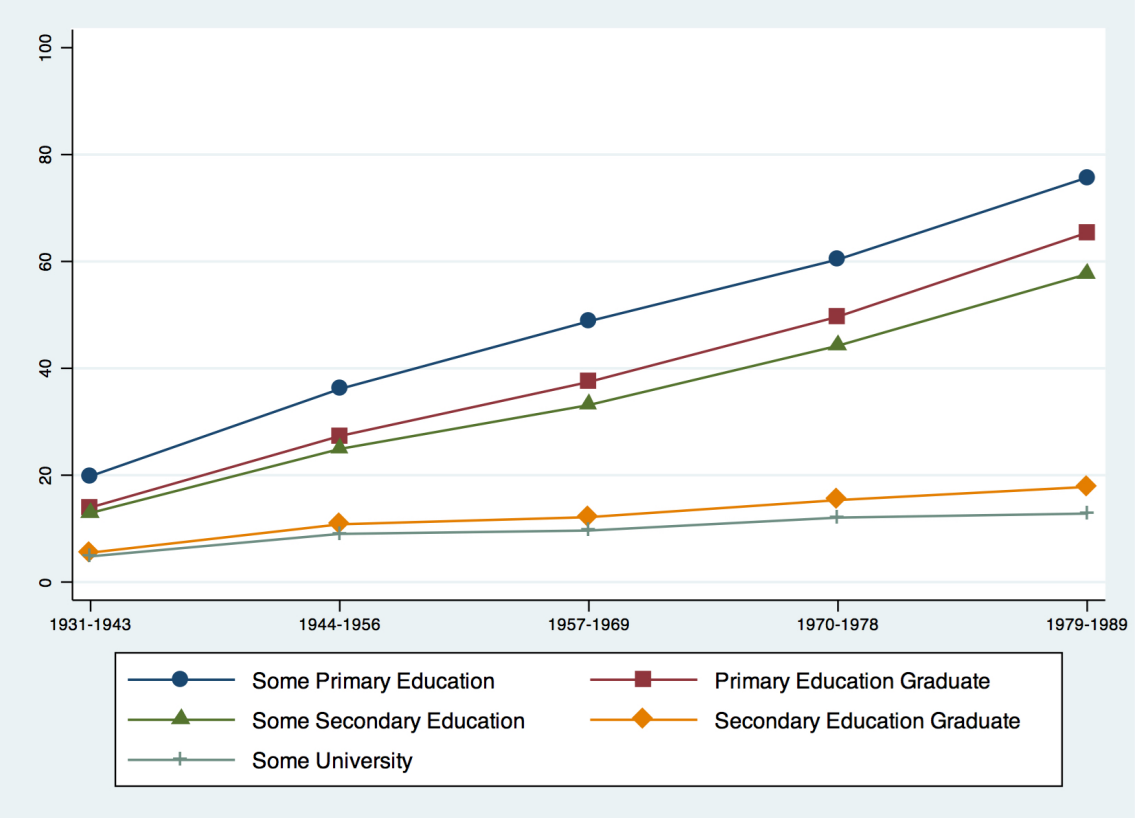
Given that the basic structure of the divisions of the Brazilian educational system remained constant over the years and the reforms, it is possible to create a simple system of educational attainment: i) no education (0 or less than 1 year) ii) some primary education (1 - 7 years of schooling); iii) primary graduate (8 years of schooling); iv) some secondary (9 - 10 years of schooling), v) secondary graduate (11-12 years of schooling); vi) some university (13 – 14 years of schooling); vii) university graduate (15 years of schooling or more). These educational levels are sequential and conditional, which means that each level is conditioned to the successful completion of the previous one.

In this chapter we will assess individuals who were born between 1931 and 1989. Considering that in Brazil children enter school at six or seven years old, and finish it when they are around 18 or 25 years old (depending on the individual's own educational attainment), we will assess the educational path of individuals who might have attended school between

1937 and 2014. During this time, there was a great expansion of the mandatory eight years of primary schooling and a fair expansion of the non-mandatory secondary level. The tertiary level expanded at a much lower rate than the lower schooling levels during the same period. The macro context of the country during the schooling period of our cohorts was marked by educational expansion and great economic growth (the 'Brazilian' miracle of the 1970's) followed by the economic downturn (the 'lost decade') of the 1980's, the structural adjustments of the 1990's, and finally the return to growth of the early 2000s.

Given the universalization of primary schooling attendance, there is very little social mobility associated with completing this level. With an overall low attendance in secondary and tertiary education, the main educational dividers for younger groups are likely to be first the completion of secondary education once entering it; and secondly the completion of the tertiary degree once enrolled in university. The lower socioeconomic classes are less likely to have completed secondary and tertiary education compared to upper classes. Consequently, the completion of these upper levels is key to understand intergenerational reproduction of inequality of opportunities in the country. In order to examine the educational expansion and their potential impact on IOE in Brazil, we present the probability of making each educational transition conditional on having made the previous ones across five cohorts (Figure 2.3).

Figure 2.3 Proportion of completed school transitions by birth cohort, Brazil



Source: author's organization based on PNADs 1996 and 2014

Figure 2.3 shows a steady increase in the probability of attending some primary education (T1), graduating from primary education (T2), and entering secondary education (T3) across cohorts. These trends reveal a substantial and consistent expansion of the mandatory primary schooling in the country over time. The proportions are different for graduating secondary school (T4) and entering university (T5). There is a monotonic increase across cohorts in the probability of graduating secondary school (T4) and entering university (T5), although at a stagnant rate for T5 (attending some university) for the cohort born in 1970/78 who went to university during the 'lost decade' and following austerity measures of the 1990s. The completion of school transitions calculated separately by the great south and north regions present similar trend as those reported for the whole country in figure 2.3. However, the north region has had proportionally fewer individuals completing the transitions compared to the south region. For C5 (1979/89) for instance, whereas 71 percent of individuals completed primary school in the south, only 60 completed the same level in the north. The gap is smaller for upper transitions: whereas 21 percent completed secondary education in the south, 18 percent completed it in the north. The proportion of completing transitions by cohort separated by region is in Appendix D, figures D.1 and D.2.

These trends show that overall educational expansion in Brazil was mostly driven by gains at lower levels of the system, which were carried over to higher transitions, while the conditional graduation of secondary education and start of tertiary education remained stagnant with small gains for those who went to school after the 'lost decade'. The patterns of expansion across educational levels led to different predictions about IOE in the country. The completion of first and second cycles of primary education substantially expanded across cohorts. Providing that completion rates among the upper classes reach universality, such expansion should result in reduced inequality. The situation is different for upper educational levels — completion of secondary and entering tertiary education - given that stagnant or conditional completion rates across cohorts might impose constraints on equalisation. It looks like the most determinant transition for IOE is the graduation of secondary education. It seems that the Brazilian case does not align with the 'bottleneck' given that the graduation of secondary school does not rely on the availability of places as those who do not graduate already had their places guaranteed.

2.4. Data and Methods

Given the lack of long-term panel data on social mobility in Brazil, we will use repeated cross-sectional household sample surveys between the 1990s and 2010s to assess patterns of Inequality of Educational Opportunities (IOE) during the twentieth and beginning of the

twentieth-first centuries in Brazil. We use the Brazilian National Household Sample Survey (PNAD, *Pesquisa Nacional de Amostra Domiciliar*) for the years of 1996 and 2014. We therefore pool the data from two years of PNAD and fit a single generalised ordered logit regression or partial proportional odds model of highest educational level attained (Fu, 1998; Williams, 2006) to this pooled dataset. The model is further explained in item 2.4.2 below.

The PNAD has been collected yearly since 1967[13] by the Brazilian Institute of Geography and Statistics (IBGE – *Instituto Brasileiro de Geografia e Estatística*). The main goal of PNAD is to investigate a variety of socioeconomic and demographic characteristics of the country's population (PNAD, 2012: 17; 37). The PNAD is a probability, stratified, and multistage survey of Brazilian households. The sampling design follows a three-step probabilistic procedure. First, counties are selected - the primary units. Secondly, Census tracts[14] within counties are chosen - the secondary units. Finally, the tertiary units, which are households[15] within sectors, are selected (IBGE, 2011: 42). The PNAD questionnaire has a core component collected yearly with information on household conditions, education and labor market participation plus a supplement addressing different topics each year. Information on social mobility is only present on a few of these supplements. We will therefore only use the PNADs of 1996 and 2014 as they have supplements with retrospective questions on parental education and father's occupation when the respondents were teenagers (around 15 years). These PNADs years allow for cross-temporal comparisons on the basis of common variables and the same sampling design over time. We restrict our sample to head of households and their partners aged between 25 and 65 years old who were born between 1931 and 1989 to ensure they were active in the labour market at the time of the survey. After this age restriction, and excluding missing cases, analytical sample sizes are: 124,601 in 1996 and 156,679 in 2014. Our final pooled sample equals to 281,280 heads or their partners.

[13] Except for the years of 1970, 1980, 1991, 2000, 2010.
[14] Census tract is the smallest territorial unit of data collection of the Population Census, defined by the IBGE by pre-identified limits in continuous areas, respecting the political-administrative division of Brazil. The national territory of Brazil was divided in 316.574 census tracts for the 2010 Population Census (IBGE, 2011: ps. 19, 23).
[15] The PNAD considers as households those constructions where one or more persons live together, that are private as well as those habitation units within collective households (PNAD, 2012: 20, 42).

2.4.1. Variables

We use five birth cohorts that cover most of the 20th and the beginning of the 21st centuries, a period of rapid expansion of primary education, and strong economic growth followed by a downturn and recovery. The cohorts are divided as following: C1: 1931-1943; C2: 1944-1956; C3: 1957-1969; C4: 1970-1978; and C5: 1979-1989. We have included interaction terms between the cohorts and each of our independent variables. There is a potential recall bias (Grimes and Schulz, 2002; Sackett, 1979) associated with older cohorts in recalling the parental education when they were 15 years old. However, it is not clear what impact recall bias would have on trends in IOE from cohort analysis. According to Sackett (1979), recall bias can happen in the data collection stage, when there is intentional or unintentional differential recall of information about an episode, outcome, or exposure by individuals in one group compared to a distinct group. This happens because recall of information asked in retrospective questions, such the ones about parental education in this chapter, relies entirely on memory, which can often be imperfect and consequently unreliable, particularly in older individuals, making it difficult to remember with accuracy past episodes (Koriat, 1993). Evidence suggests that 20 percent of details of a certain life event cannot be retrieved after one year of its occurrence and 50 percent cannot be retrieved after 5 years (Bradburn et al, 1987). Hence, the accuracy of recall significantly depends on the time span between a certain episode and its recall. The longer the time span, the higher the probability of inaccurate recalls (Margetts et al, 2003). Given that, recall bias might arise in this chapter, for instance, in the accuracy of the answer to the retrospective question about parental education to individuals aged around 60 years old when they were 15 years old, particularly considering that in the same sample there are individuals aged 25 years old who answer to the same retrospective question. In order to assess the potential effect of recall bias on retrospective information on parental education we calculate the mean years of the parental education reported by our oldest cohort, born between 1931-1943, and compare it with the mean years of education of the adult Brazilian population (above 25 years old) during the years this cohort would be 15 years old (1946-1958). The reported retrospective mean years of schooling of the parents of our oldest cohort is similar to the mean years of schooling of the corresponding Brazilian adult population of the same period of time. We would have an indication of recall bias had we observed more or less mean years of parental education reported by our oldest cohort compared to the mean years of education of the adult Brazilian population of the same time. There is no indication that recall bias is an issue in this chapter. Outcomes of this analysis are in tables A.2 and A.3 of Appendix A.

Educational attainment is our outcome variable and is formulated as an ordinal variable with six categories: i) no education (0 or less than 1 year) ii) some primary education (1 - 7 years of schooling); iii) primary graduate (8 years of schooling); iv) some secondary (9 - 10 years of schooling), v) secondary graduate (11-12 years of schooling); vi) some university (13 – 14 years of schooling); vii) university graduate (15 years of schooling or more). The entry and completion of each of these four levels is conditional on the completion of the previous one. As mentioned above, there is no difference between vocational and academic tracks in the Brazilian educational system. The variables used to measure family background include mother's and father's education, which was formulated as an ordinal variable with 4 categories: from no education to advanced degree. Family background can be measured in terms of different components, such as parental status, class, occupation and education, all of which may be interdependently contributing to understand the influence of social origins in certain life outcomes (Bukodi and Goldthorpe, 2013). This chapter particularly employs parental education as the indicator of an individual's social background mainly because there is a high level of missingness (35 percent) associated with father's occupation plus limitations for the specificities of the Brazilian job market. For example, there is not a category for the large Brazilian informal sector, which account for 42 percent of the country's workforce. Informal employment encompasses those persons whose main jobs lack basic social or legal protections or employment benefits (ILO, 2012). Having said that, we have tested father's occupational status as a measure of family background. Sensitivity analysis has been performed with a measure of father's occupational status, which is a proxy for household's permanent income and it was coded using the International Socio-Economic Index (ISEI)[16] (Ganzeboom et al, 1992). We have therefore run a model using father's ISEI as a measure family background and

[16] Ribeiro (2017) found that there is a hierarchy within the ISEI one-digit classification in terms of income, education and occupational status in Brazil. Although this hierarchy is not perfect, the author found it has remained stable throughout the 1970s, 1980s, 1990s and 2010s, which marks the period of our study and makes ISEI a suitable measure of socioeconomic background. The ISEI variable is calculated according to father's job title using the standard ISCO-88 classification (ILO, 1990). For Brazil, job title was originally coded using nationally specific occupational classification and recoded into the ISCO-88 schema in consultation with national experts. The father's job title and the correspondent ISEI was calculated based on a retrospective question answered by the head of household or partner about their father's occupation when they were 15 years old. The answer was given based on a long list of national occupational classification.

the outcomes of the sensitivity analysis are in table D.1 of Appendix D. No significant differences were found between our current model using parental education as a measure of family background and the model using father's ISEI as family background.

Besides parental background, we also control for individual characteristics such as sex, skin colour, and urban/rural location of household. These three individual variables are formulated as dummies. We also use region of birth to run our analysis separately for each region. The geographical regions are: south, southeast, midwest, north and northeast, which are coded as a dummy: 1 for the richer 'south' (south and southeast) and 0 for the poorer 'north' (north, northeast and midwest). Please check table 2.3 for the descriptive statistics of our variables.

As observed in table 2.3 below, there is a pattern of missing values connected to father's information in our sample. Father's educational attainment, with 20 percent of missing cases. By only analysing a subset of cases, our estimates will be less precise than had there been no missing data. Arguably and more importantly, our estimates may be biased if the complete cases differ systematically to the incomplete cases. Whether missing data causes bias depends on how missing data is associated with other variables. A weak correlation is found between missing cases of father's and mother's educational attainment. For instance, there is no evidence suggesting that the missing cases for father's education are more concentrated within less educated mothers. In other words, the distribution of observed and missing cases of father's education is very similar throughout mother's levels of educational attainment. Likewise, no urban/rural location bias is found. Likewise, no gender bias is observed. All in all, we assume there is random missingness associated with father's education. As said above, models were run with and without father's education and no significant differences were found. Outcomes of the sensitivity analysis are in Appendix D.

There is a potential bias associated with selective mortality among the older cohort (Williams and Collins, 1995). However, it is not clear what impact selective mortality might have on trends in educational inequality from cohort analysis. Deaton and Paxson (2001) showed that potential bias might arise, for instance, if lower educated individuals would be more likely to die at a younger age. The latter example in itself would not affect our findings. However, if mortality were selective according to educational level, such that lower educated people would have a shorter life expectancy, the extent of occupational status inequality in older cohorts would be understated and would lead our findings to underestimate the decline in inequality over cohorts (Breen et al., 2009). In order to investigate the potential effect of selective mortality on educational attainment we calculate the mean years of education in the early 1980s and 1990s for our older cohort, those born between 1931 and 1940 using the

Brazilian population census (Appendix A). We do not observe an increase in the mean years of schooling over this 10-year period. We would have an indication of selective mortality had we observed an increase in the cohort's educational attainment over this period as it would suggest less educated people were dying earlier and pushing up the mean years of schooling. There is no indication that selective mortality is an issue in our analysis.

Despite the above-mentioned limitations, our data cover a period of over 60 years, during which Brazil has experienced important and rapid socioeconomic changes: universalization of primary education, expansion of secondary and tertiary education, urbanization and growth of the middle class, economic crisis, austerity measures followed by recovery and growth.

2.4.2. Generalised ordered logit model

In order to assess the effects of parental background on educational attainment we use a generalised ordered logit regression or partial proportional odds model of highest educational level attained (Fu, 1998; Williams, 2006). Under this model, the probability of individual $\boldsymbol{i}$ attaining a level of education larger than $\boldsymbol{j}$ is written as:

$$\boldsymbol{P(y_j > j) = g(X\beta_j) = \frac{exp(\alpha_j + X_i\beta_j)}{1 + [exp(\alpha_j + X_i\beta_j)]}}, j = 1, 2, \dots, M-1$$

Where M is the number of categories of the ordered outcome variable – completed years of schooling. When M = 2, the general ordered logit model is equivalent to the logistic regression model. When M > 2, the general ordered logit model becomes equivalent to a series of binary logistic regressions where categories of the dependent variable are combined. For instance, if $M = 4$, then for $j = 1$ category 1 is contrasted with categories 2, 3, and 4; for $j = 2$ the contrast is between categories 1 and 2 versus 3 and 4; and for $j = 3$, it is categories 1, 2, and 3 versus category 4. g is the logit link (or the link function), X is a vector of values for the explanatory variables for the i observation, α is a vector of category specific thresholds; and β is a vector of coefficients. Note that the βs coefficients are subscripted by j as in the partial proportional odds model the βs are not necessarily the same for all values of j. This is a key feature of this model and implies that the association between X and the probability of attaining a particular level of schooling are allowed to vary across different educational levels. The other type of ordered logit regression – with proportional odds – constrains the βs to be the same across different educational levels. A common problem with the proportional odds is that its assumptions of parallel lines are often violated as it is common for one or more β to differ across values of j (Williams, 2006). Although the proportional odds model provides a

parsimonious analysis for our data, it violates the parallel lines assumption and would therefore produce incomplete or spurious results (Please check our estimates in Appendix B). We therefore estimate the partial proportional odds model that provides an accurate yet parsimonious depiction of the association between family background characteristics and the probability of completing subsequent educational levels (Williams 2006). Please check our estimates for Brazil in table 2.4 below. Changes in educational attainment over time are captured by a set of cohort-specific dummies and a full set of interactions between cohort dummies and each one of the family background and individual measures.

The ordered logistic regression model has origin in the 'educational transition' approach commonly utilised to analyse trends in inequality of educational opportunity. Among the most prominent early studies using sequential binary logistic regression models to assess the probability of individuals to make educational transitions are Mare (1980, 1981) and Shavit and Blossfeld (1993). The outcome of interest in the educational transition formulation is the probability of making subsequent transitions conditional on having made the previous one, so that the risk set decreases across transitions. The ordered regression model, in contrast, estimates two quantities of interest: the unconditional probability of reaching a particular educational level and the conditional probability of the transition from one level to the next. We focus our attention on the latter because it captures inequality dynamics across subsequent stages of the educational career and ensures comparability with studies that use the educational transition approach. Importantly, the conditional transition probabilities obtained from the ordered regression models do not need to be identical to estimates obtained by the educational transition approach (Breen et al., 2009). While the ordered regression models use all observations to estimate the transition probabilities, the educational transition model includes only those who reached educational level j–1 in the model for transition j. Therefore, if the educational transition model is subject to selection bias from unmeasured factors affecting whether or not students continue to the next level of education (see e.g., Cameron and Heckman, 1998), then transition probabilities obtained from the ordered regression model will provide unbiased estimates of the transition probabilities.

2.5. Outcomes

In order to analyse trends in IOE in Brazil over the twentieth and beginning of the twentieth-first century we assess the association between parent's education and their offspring's educational attainment across cohorts using generalized ordered logit models. The descriptive statistics of our variables are in table 2.3 below. Our regression model is displayed in the following table 2.4 and its predicted probabilities are in table D.2 of appendix D. Overall,

our regression analysis suggests decreasing inequality over cohorts in graduating primary education and growing inequality in graduating secondary education and university. Our evidence suggests that the educational expansion policy of the second half of the twentieth century has been successful in dramatically increasing access to primary education and reducing inequalities by sex (with a female advantage), skin colour, urban/rural location, great region and parental education. Nevertheless, the growing inclusive access to the primary educational level has not been followed by a growing and more inclusive access to the higher educational levels. We observe a growing advantage in the graduation of secondary and particularly tertiary education by sex (with a female advantage), skin colour, urban/rural location, great region and parental education. In addition, the strongest predictor for educational attainment is parental education, which is also the predictor that mostly contributes to inequality in the access to higher transitions.

Table 2.3 Descriptive statistics of the variables

Variables	Observations	Mean	Std. Dev.	Min.	Max.
Educational Attainment	280,549	3.351	1.876	1	7
C1: 1931-1943	281,280	.084	.277	0	1
C2: 1944-1956	281,280	.229	.420	0	1
C3: 1957-1969	281,280	.367	.482	0	1
C4: 1970-1978	281,280	.164	.370	0	1
C5: 1979-1989	281,280	.156	.363	0	1
Male (vs Female)	281,280	.460	.498	0	1
Urban (vs Rural)	281,280	.848	.359	0	1
South (vs North)	281,280	.503	.500	0	1
White (vs non-White)	281,258	.489	.500	0	1
Mother's education [a]	128,237	1.650	.669	1	4
Father's education [a]	117,438	1.732	.704	1	4

Source: author's calculation based on PNADs 1996 and 2014.
(a) Variable includes the following categories: 1 = less than 1 year of schooling; 2 = incomplete 1st cycle of primary education (1 -3 years of schooling); 3 = complete 1st cycle of primary education (4 years of schooling); 4 = incomplete primary education (5-7 years of schooling); 5 = complete primary education (8 years of schooling); 6 = entering secondary education (9-10 years of schooling); 7 = complete secondary education (11-12 years of schooling); 8 = entering university; 9 = complete university; 10 = advanced degree.

More specifically, gender differences in completing educational transitions are very small for older cohorts. However, there is a growing female advantage in higher transitions, particularly for the younger cohorts C4 and C5, those born after 1970. The predicted probability of completing some primary education for C4, for instance, is 36 percent for men compared to 34 percent for women. For C5 the predicted probability of completing some primary is 18 percent for men compared to 14 percent for women. Likewise, the predicted probability of graduating primary education is slightly higher for men: 10 percent compared to

7 percent for women. On the other hand, the predicted probability for women is higher for graduating secondary education: 43 percent compared to 39 percent for men. For graduating university, whilst there is a small male advantage of 3 percent of predicted probability for C1 and C2, those born between 1931-1956, the younger cohorts C4 and C3, born after 1970, experience a female advantage in completing this level of schooling: 20 percent for women compared to 17 percent for men.

White Brazilians have a small advantage over non-whites in graduating secondary education over cohorts, an advantage that gets stronger for completing university. The predicted probability of a white individual in completing secondary school in the oldest cohort C1, for instance, is 10 percent compared to 5 percent for non-whites. For those born in the younger cohort C4, whites have a predicted probability of 27 percent compared to 24 percent for non-whites. The inequality related to skin colour to graduate university, though, gets stronger over time: whilst the predicted probability for whites finishing university is 14 percent compared to 4 percent for non-whites for the older cohort C2, for the youngest cohort C5 the predicted probability for whites compared to non-whites for graduating university is 27 percent compared to 11 percent respectively. Differently, for completing the basic primary schooling there is just a small white advantage (1-2 percent) that remains stable over cohorts, decreasing for the youngest C5, signalling that the expansion and universalization of primary education might have contributed to decrease inequalities related to skin colour in this basic level of study.

Those born in urban areas also have advantage over those born in rural locations in completing high educational transitions. The predicted probability of graduating secondary education is 9 percent for urban individuals compared to 1 percent for rural individuals for those born between 1931 and 1943 (C1). For the youngest cohort C5 (1979-89) the predicted probability of graduating secondary is 43 percent for an urban individual compared to 29 percent for a rural one, reflecting an increase in the access but also in urban/rural differences in finishing secondary school over time. The urban advantage in completing university degree is stronger and grows across cohorts: whilst the predicted probability of graduating university is 7 percent for urban individuals born between 1931-1943 (C1) compared to zero percent for rural ones; for those born between 1979-1989 (C5) the predicted probability is 21 percent for urban compared to 3 percent for rural individuals. As observed, the access to university degree grew over time, but this growth has not reached rural areas.

The influence of mothers' education on their offspring's probability of completing selected school transitions decreases over cohorts for lower levels, but increases over time for higher transitions. Furthermore, less educated mothers (with less than 4 years of formal

education) have a stronger influence on the completion of some primary school whereas more educated mothers (with 11 years of formal education) have stronger influence in the completion of university degree. More specifically, for the oldest cohort C1 (1931/43) whilst individuals whose mothers have less than one year of formal education have a predicted probability of 47 percent for completing some primary school, individuals whose mothers have 11 years of education have a predicted probability of only 4 percent for completing the same level. This pattern decreases across cohorts: for the youngest cohort C5 (1979/89), individuals whose mothers have less than one year of schooling have a predict probability of 38 percent for completing some primary compared to 1 percent for individuals whose mothers have 11 years of education. The figure is the opposite for the highest transition: for the oldest cohort C1 (1931/43) individuals whose mothers have less than one year of education have a predicted probability of 1 percent for graduating university compared to 76 percent for individuals whose mothers have 11 years of schooling. This very unequal pattern does not decrease across cohorts: for the youngest cohort C5 (1979/89) those whose mothers have less than one year of education have a predicted probability of 3 percent for graduating university compared to 66 percent for those whose mothers reached 11 years of schooling.

The influence of fathers' education on their offspring's probability of completing selected school transitions is similar to the mother's: there is a decrease over cohorts for lower educational levels, but an increase over time for higher levels. In addition, less educated fathers (with less than 4 years of formal education) have a stronger influence on the completion of some primary school whereas more educated fathers (with 11 years of formal education) have stronger influence in the completion of university degree. In particular, for the oldest cohort C1 (1931/43) individuals whose fathers have less than one year of formal education have a predicted probability of 44 percent in graduating primary school compared to only 8 percent for individuals whose fathers have 11 years of education. This pattern decreases across cohorts: for those born between 1979 and 1989, individuals whose fathers have less than one year of schooling have a predict probability of 37 percent for completing some primary compared to 1 percent for individuals whose fathers have 11 years of education. For the highest transition, though, there is an inversion in the father's influence on educational attainment: for the oldest cohort C1 (1931/43) individuals whose fathers have less than one year of school have a predicted probability of 1 percent for graduating university compared to 53 percent for individuals whose fathers have 11 years of schooling. This very unequal pattern increases over time: for the youngest cohort C5 (1979/89) those individuals whose fathers have less than one year of education have a predicted probability of 3 percent for graduating university compared to 70 percent for those whose fathers reached 11 years of schooling.

We have agglomerated the regions into two main zones due to the small-N for less populated regions such as north, for which our model does not run; and midwest and south, which presented puzzling outcomes given their small-N. Therefore, we have joined south and southeast into the great 'south'; and north, northeast and midwest into the great 'north' given the socioeconomic and geographical similarities among them. There is advantage of being born in the great south for completing early transitions such as some primary and graduating primary, but this advantage decreases across cohorts, signaling that the expansion and universalization of primary education in the country has contributed to decrease inequality of access to basic educational levels among regions. A southern individual who was born between 1931 and 1943 (C1), for instance, has a predicted probability of 54 percent for completing some primary education compared to 39 percent for a northern one. As a time comparison, a southern individual born between 1979 and 1989 (C5) has a predicted probability for completing primary education of 9 percent compared to 8 percent for a northern one. A stronger southern advantage is observed for graduating university, but contrarily it increases over time. As such, an individual from the south and the oldest cohort C1 has a predicted probability of 6 percent for completing university compared to 5 percent for individuals from a northern individual born in the same cohort. These numbers point to a very incipient higher education system, not developed and spread enough to be regionally unequal. Over time, however, the completion of the highest degree became more regionally unequal: southern individuals of the youngest cohort C5 have a predicted probability for graduating university of 22 percent compared to 15 percent for their northern counterparts. We have also calculated the predicted probability of attaining these selected educational transitions by parental educational separated by the great south and north regions but the outcomes have not significantly differed and therefore are not presented here.

Table 2.4 Parameter Estimates Generalised Ordered Logistic Regression with Partial Proportional Odds of Social Background on Conditional Educational Transitions: cohorts born between 1931 and 1989, Brazil

	Odds Ratios					
Covariates	*Y > No formal education*	*Y* > Some Primary	Y > Primary Graduate	Y > Some Secondary	Y > Secondary Graduate	Y > Some University
C1: 1931-1943 (omitted)						
C2: 1944-1956	2.039***	4.394***	4.545***	3.900***	3.993***	3.477***
	(0.210)	(0.662)	(0.812)	(0.716)	(1.249)	(1.164)
C3: 1957-1969	5.839***	10.70***	10.34***	7.811***	5.334***	5.370***
	(0.605)	(1.534)	(1.759)	(1.365)	(1.618)	(1.740)
C4: 1970-1978	13.01***	31.30***	39.58***	30.19***	19.97***	16.13***
	(2.302)	(5.313)	(7.669)	(6.013)	(6.742)	(5.852)
C5: 1979-1989	104.5***	112.3***	145.4***	93.67***	21.24***	12.42***
	(34.00)	(22.12)	(30.36)	(19.74)	(7.449)	(4.986)
Male (vs female)	1.335***	1.427***	1.444***	1.415***	1.796***	1.849***
	(0.0513)	(0.0613)	(0.0693)	(0.0697)	(0.124)	(0.136)
Urban (vs rural)	2.440***	7.055***	6.991***	6.124***	8.223***	7.680***
	(0.111)	(0.731)	(0.907)	(0.816)	(2.103)	(2.106)
South (vs north)	1.590***	0.724***	0.664***	0.666***	0.714***	0.665***
	(0.0646)	(0.0348)	(0.0352)	(0.0363)	(0.0545)	(0.0533)
White (vs non-white)	1.673***	1.515***	1.704***	1.798***	2.284***	2.467***
	(0.0681)	(0.0778)	(0.101)	(0.111)	(0.219)	(0.255)
Mother's education [a]	3.302***	3.237***	3.559***	3.612***	3.522***	3.409***
	(0.173)	(0.152)	(0.184)	(0.192)	(0.249)	(0.252)
Father's education [a]	3.244***	3.115***	2.987***	2.906***	2.301***	2.297***
	(0.148)	(0.135)	(0.135)	(0.133)	(0.126)	(0.130)
Male x C1 (omitted)						
Male x C2	0.802***	0.732***	0.691***	0.698***	0.637***	0.635***
	(0.0404)	(0.0368)	(0.0383)	(0.0397)	(0.0501)	(0.0534)
Male x C3	0.624***	0.683***	0.660***	0.655***	0.496***	0.496***
	(0.0325)	(0.0329)	(0.0350)	(0.0357)	(0.0381)	(0.0409)
Male x C4	0.572***	0.578***	0.557***	0.557***	0.392***	0.368***
	(0.0556)	(0.0373)	(0.0376)	(0.0384)	(0.0375)	(0.0386)
Male x C5	0.451***	0.440***	0.395***	0.430***	0.359***	0.345***
	(0.0846)	(0.0384)	(0.0326)	(0.0345)	(0.0361)	(0.0378)
Urban x C1 (omitted)						
Urban x C2	1.142**	0.773**	0.793	0.878	0.622*	0.670
	(0.0667)	(0.0895)	(0.114)	(0.130)	(0.172)	(0.201)
Urban x C3	0.977	0.561***	0.582***	0.661***	0.466***	0.465***
	(0.0577)	(0.0613)	(0.0794)	(0.0932)	(0.126)	(0.135)
Urban x C4	0.969	0.540***	0.548***	0.590***	0.356***	0.335***
	(0.102)	(0.0680)	(0.0839)	(0.0940)	(0.107)	(0.109)
Urban x C5	0.665*	0.445***	0.424***	0.446***	0.330***	0.501*
	(0.140)	(0.0617)	(0.0670)	(0.0721)	(0.101)	(0.181)
South x C1 (omitted)						
South x C2	1.186***	0.948	0.935	0.914	1.080	1.086
	(0.0636)	(0.0532)	(0.0572)	(0.0575)	(0.0939)	(0.0997)
South x C3	1.371***	1.205***	1.109*	1.150**	1.350***	1.445***
	(0.0778)	(0.0646)	(0.0648)	(0.0692)	(0.114)	(0.130)
South x C4	1.297**	1.366***	1.310***	1.371***	1.404***	1.465***
	(0.148)	(0.0963)	(0.0963)	(0.103)	(0.146)	(0.165)
South x C5	0.862	1.539***	1.434***	1.461***	1.408***	1.508***
	(0.188)	(0.148)	(0.128)	(0.127)	(0.152)	(0.176)
White x C1 (omitted)						
White x C2	1.020	1.101	1.025	1.005	0.987	0.927

	(0.0548)	(0.0652)	(0.0689)	(0.0705)	(0.106)	(0.107)
White x C3	0.902*	1.017	0.954	0.911	0.826*	0.756**
	(0.0507)	(0.0576)	(0.0613)	(0.0613)	(0.0861)	(0.0855)
White x C4	0.882	0.821***	0.737***	0.691***	0.636***	0.630***
	(0.0965)	(0.0597)	(0.0576)	(0.0558)	(0.0768)	(0.0838)
White x C5	0.855	0.838*	0.771***	0.802**	0.796*	0.741**
	(0.190)	(0.0828)	(0.0726)	(0.0740)	(0.0976)	(0.0994)
Mother's education x C1 (omitted)						
Mother's education x C2	0.988	0.902*	0.884**	0.866**	0.845**	0.860*
	(0.0673)	(0.0491)	(0.0526)	(0.0530)	(0.0674)	(0.0718)
Mother's education x C3	0.939	0.838***	0.785***	0.783***	0.734***	0.710***
	(0.0637)	(0.0435)	(0.0444)	(0.0456)	(0.0562)	(0.0570)
Mother's education x C4	0.702***	0.727***	0.671***	0.684***	0.671***	0.723***
	(0.0811)	(0.0489)	(0.0466)	(0.0482)	(0.0592)	(0.0674)
Mother's education x C5	0.724	0.727***	0.666***	0.649***	0.657***	0.646***
	(0.149)	(0.0637)	(0.0548)	(0.0519)	(0.0599)	(0.0625)
Father's education x C1 (omitted)						
Father's education x C2	0.969	0.903**	0.939	0.964	1.095	1.084
	(0.0583)	(0.0461)	(0.0496)	(0.0515)	(0.0688)	(0.0706)
Father's education x C3	0.859**	0.819***	0.879**	0.876***	1.154**	1.099
	(0.0526)	(0.0400)	(0.0444)	(0.0448)	(0.0700)	(0.0694)
Father's education x C4	0.864	0.696***	0.684***	0.680***	0.931	0.892
	(0.100)	(0.0447)	(0.0433)	(0.0430)	(0.0686)	(0.0694)
Father's education x C5	0.525***	0.721***	0.708***	0.732***	1.039	0.990
	(0.110)	(0.0624)	(0.0555)	(0.0551)	(0.0821)	(0.0823)
Constant	0.0231***	0.000767***	0.000398***	0.000403***	0.000109***	0.000102***
	(0.00185)	(0.000102)	(6.32e-05)	(6.54e-05)	(3.12e-05)	(3.09e-05)
Observations	110,079	110,079	110,079	110,079	110,079	110,079

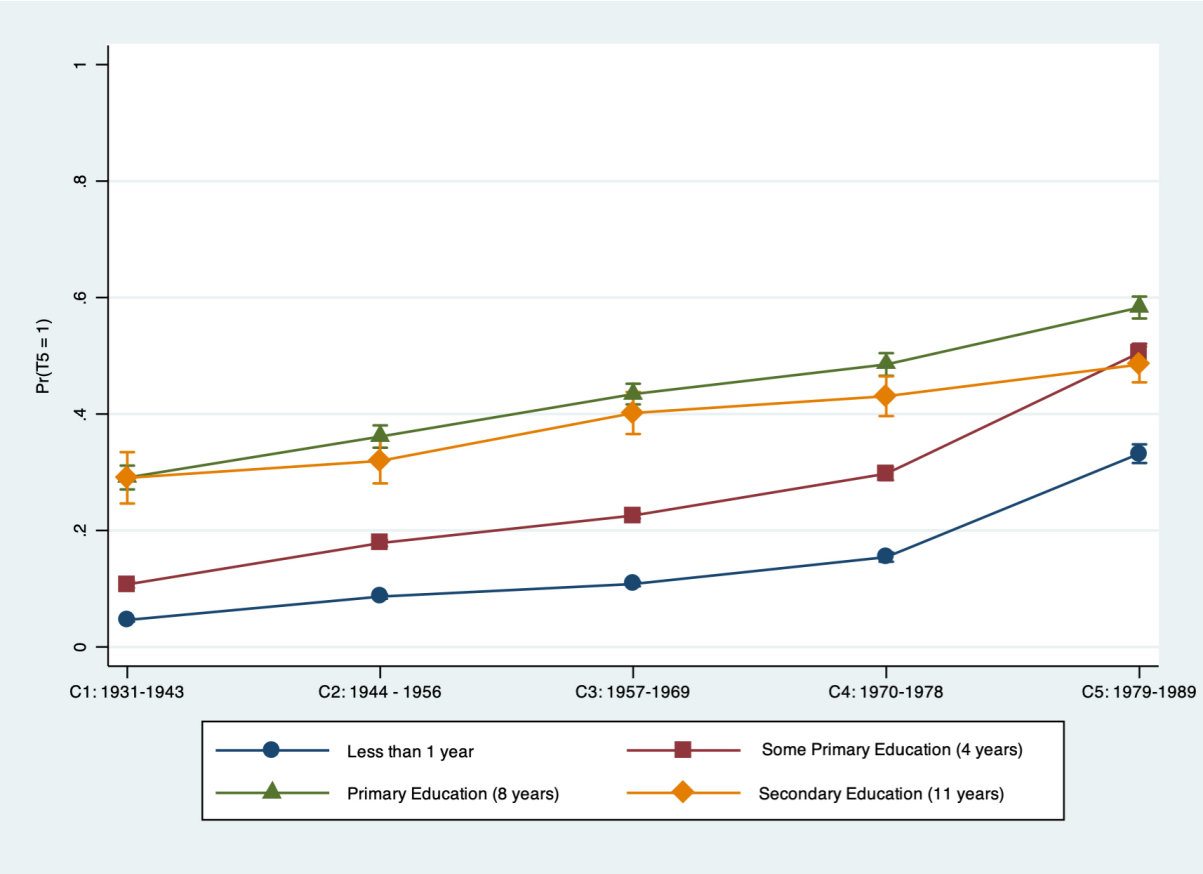
Source: author's calculation based on PNADs 1996 and 2014. Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

(a) Variable includes the following categories: 1 = less than 1 year of schooling; 2 = incomplete 1st cycle of primary education (1 -3 years of schooling); 3 = complete 1st cycle of primary education (4 years of schooling); 4 = incomplete primary education (5-7 years of schooling); 5 = complete primary education (8 years of schooling); 6 = entering secondary education (9-10 years of schooling); 7 = complete secondary education (11-12 years of schooling); 8 = entering university; 9 = complete university; 10 = advanced degree.

A useful way to summarize the results of the educational transitions that mostly contributes to IOE is by using a graphical display of trends. As our model reveals, the trends over cohorts are very similar for both parents' education and we therefore present only the graphical outcomes of the influence of mothers' education across cohorts. Figures 2.4 to 2.6 below report changes over time in the influence of mothers' educational attainment on their offspring probability of graduating secondary education, entering and graduating university in Brazil respectively. The influence of mothers' education on the graduation of secondary school strengthen across cohorts, particularly for those born after 1970 and are part of the C4, the cohort that experienced their educational path during the lost decade of the 1980s, as displayed in figure 2.4. Secondary education is not mandatory in Brazil and, despite increases in the access during the educational expansion of the end of the twentieth century, it is still a divisive educational transition in terms of educational stratification. In particular, as figure 2.5 reveals, the influence of mother's education on the university entry, despite growing across cohorts, is weaker and does not appear to strengthen for C4 compared to the trends for secondary

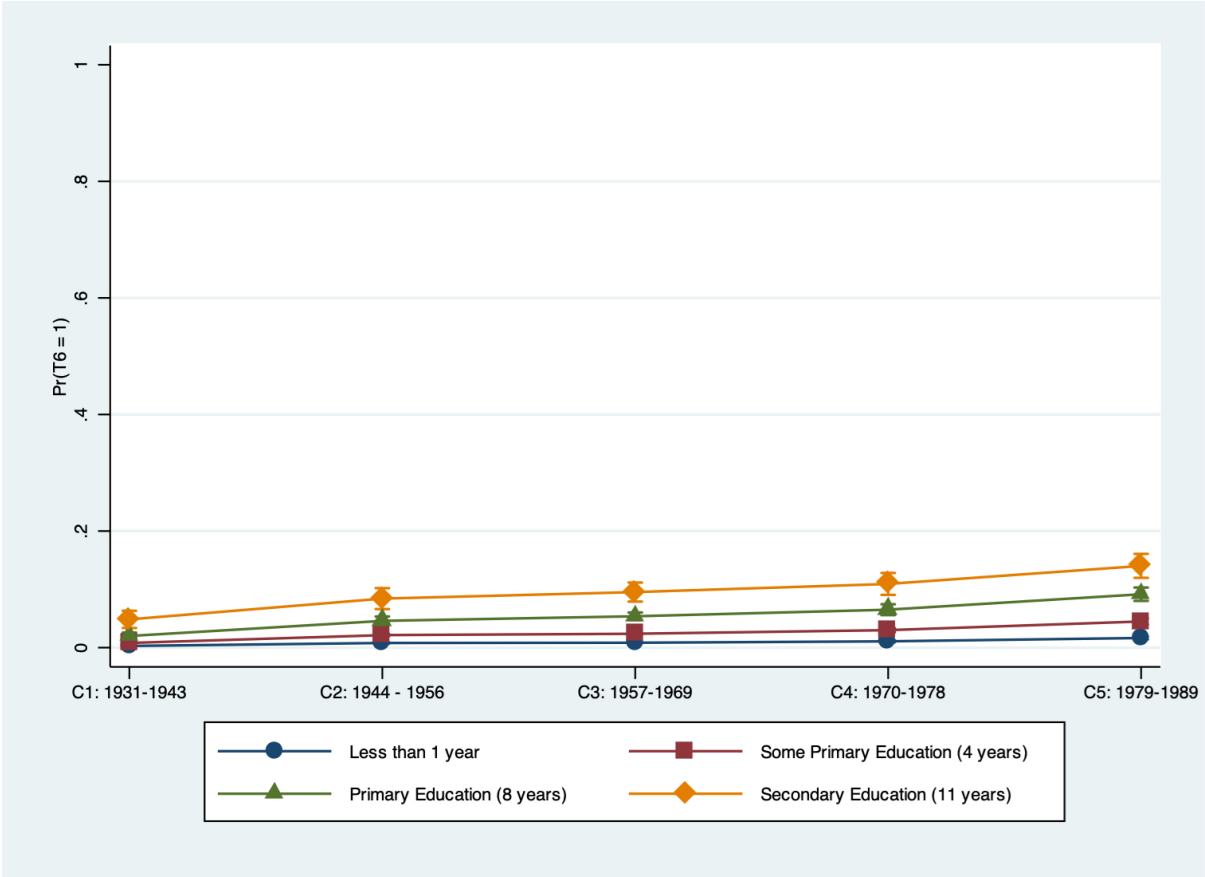
graduation. For university graduation, as figure 2.6 reveals, we observe the widest gaps between socioeconomic groups, with small changes across cohorts, signaling stability in IOE over time for this transition. More educated parents (with 11 years of formal education) have stronger influence in the completion of university degree whereas individuals with less educated parents (with 4 years or less of schooling) have very little chance of completing university. Despite being the transition showing the highest IOE, very little has changed across cohorts.

Figure 2.4 Conditional probability of graduating secondary education (T5) by mother's educational attainment over cohorts, Brazil



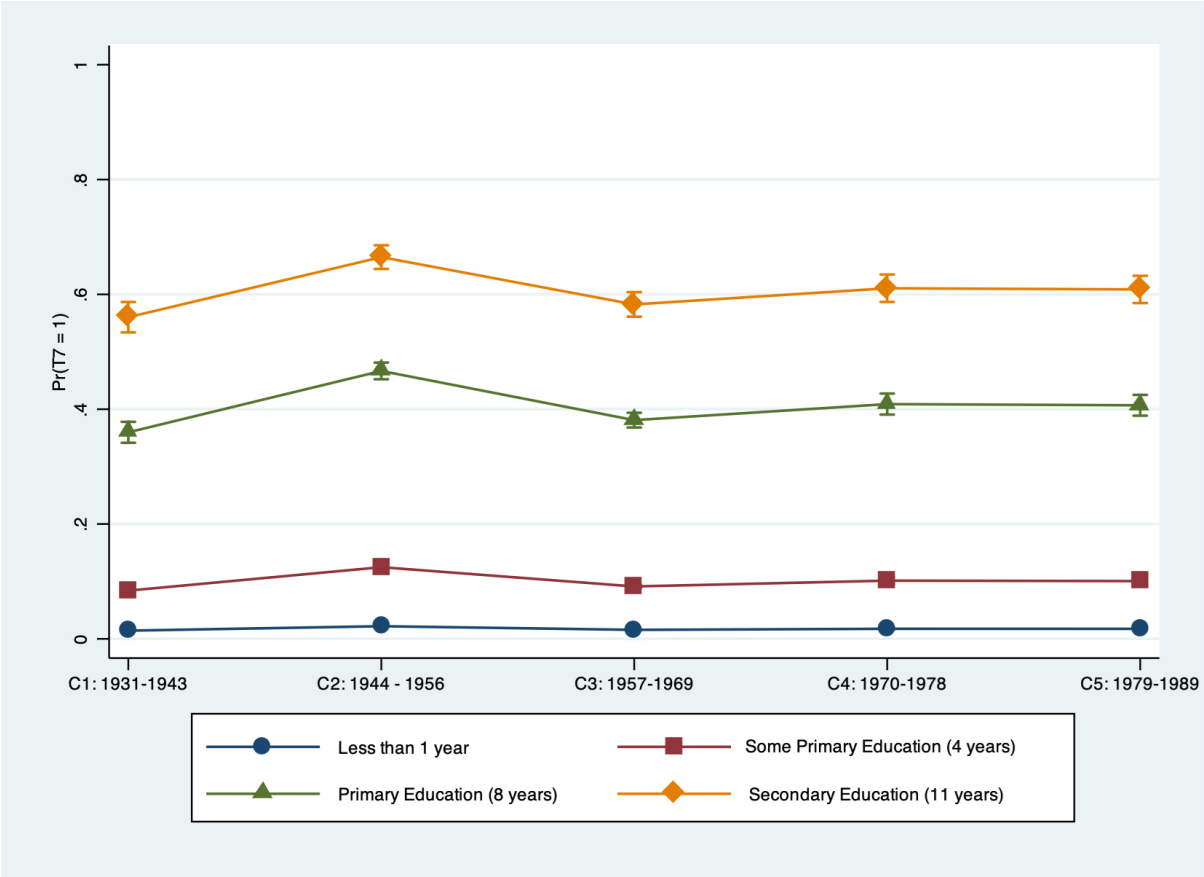
Source: author's calculation based on PNADs 1996 and 2014.

Figure 2.5 Conditional probability of entering university (T6) by mother's educational attainment over cohorts, Brazil



Source: author's calculation based on PNADs 1996 and 2014.

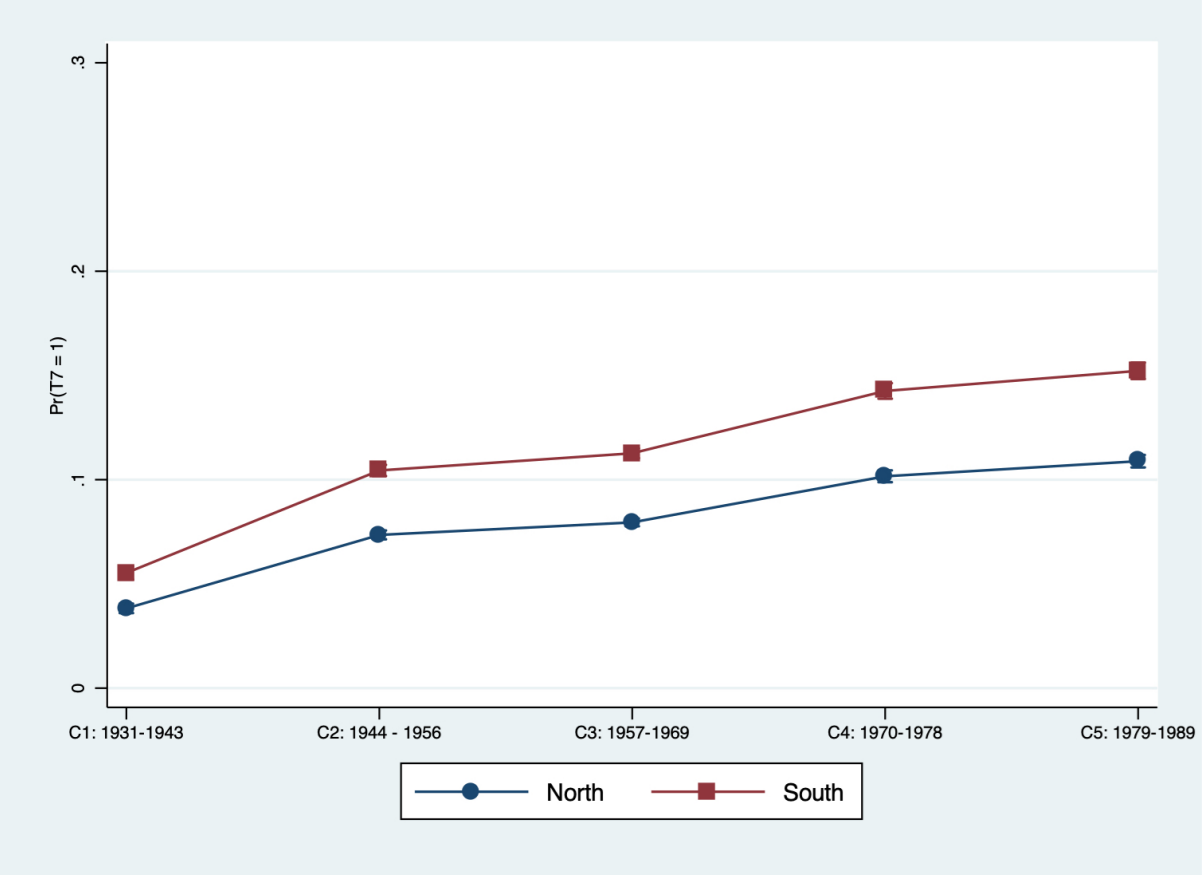
Figure 2.6 Conditional probability of graduating university (T7) by mother's educational attainment over cohorts, Brazil



Source: author's calculation based on PNADs 1996 and 2014.

Figure 2.7 below reports changes across cohorts in the chances of graduating university by the great regions north and south. A stronger southern advantage is observed for graduating university. This advantage slightly increases across cohorts, widening the north-south gap in educational attainment.

Figure 2.7 Conditional probability of graduating university (T7) by great region over cohorts, Brazil



Source: author's calculation based on PNADs 1996 and 2014.

We have performed sensitivity analysis with Generalised Ordered Logistic Regression with Partial Proportional Odds under an alternative assumption. We have run a model with father's ISEI as our main explanatory variable to compare with our current model using mother's and father's educational attainment as our main explanatory variable. The regression models with both sets of explanatory variables present very similar outcomes. Therefore, we keep our current model using mother's and father's educational attainment given the high level of missing cases connected to father's ISEI. The model with father's ISEI is in Appendix D.

2.6. Conclusions

In order to investigate trends of IOE during the twentieth and beginning of the twentieth-first centuries in Brazil, we use an ordinal regression methodology with partial proportional odds and cohort comparison based on retrospective information. Such methodology allows us to evaluate the long-term consequences of changes in educational stratification. This chapter also accomplishes two objectives. First, it expands research on IOE

to Latin America. Secondly, it addresses changes in educational stratification in a context of educational expansion and sharp macroeconomic changes. Brazil, as well as other Latin American countries, provides a unique case study because of the deep economic crisis of the 1980s, known as 'the lost decade', which was followed by a strong recovery in the early 2000s fueled by the rise in commodities prices.

Overall, our findings for Brazil are twofold. On one side, they suggest equalisation in early educational transitions – completing some and graduating primary education. As in the industrialized world, equalisation in these two lower levels in Brazil appears to be driven by expansion of universal access by the upper classes – or elite saturation. In other words, our findings agree with the 'persistent inequality' reported for the industrialized countries (Shavit e Blossfeld, 1993), for late industrialized countries (Torche, 2005; Torche, 2010; Gerber e Hout, 1995; Gerber, 2000), and also for Brazil (Fernandes, 2001; Silva e Souza, 1986; Ribeiro, 2011, 2017). The declining and stagnating influence of parental education in graduating primary education might be associated with the fast educational expansion of primary schooling during the second half of the twentieth century, when the primary level also became mandatory. On the other side, we observe a strengthening in the association between parental education and the graduation of secondary and entry to university followed by a stable but very unequal trend for graduating university. Using a larger time span and more representative sample size[17] than Torche (2010) and Ribeiro (2011, 2017) for Brazil, we confirm Torche's (2010) and Ribeiro's (2017) particular finding that graduating secondary education and entering university are the transitions that most contribute to IOE in the country. Although our descriptive data as well as Ribeiro's (2011, 2017) findings point to an increase in the chances of completing secondary education over time, this growing attendance is coupled with an increasing influence of parental background. Our findings also agree with Torche (2010) that the increase in IOE for secondary level is stronger for the cohort C4 (1970/78), particularly for

[17] Torche (2010) and Ribeiro (2011, 2017) do not include in their sample or mention the large proportion of the population without formal education. Moreover, Torche (2010) does not address those who attended only some years of primary schooling but did not complete it. Such absences might have overestimated the representativeness of their sample for a country with a large proportion of low educated people and consequently biased their outcomes.

the offspring of low educated parents. C4 experienced the economic downturn of the 1980s during their school time and therefore the instable macroeconomic situation of that period might help explain this particular strengthening of parental background for completing secondary school. Apart from confirming the previous findings above-mentioned, our results also bring new conclusions. Our outcomes challenge Ribeiro (2011), who finds that completing primary education is the transition that contributes most for IOE in Brazil. Rather, as said above, we find that completing secondary education is the most determinant transition for IOE in the country. Our findings also contradict Ribeiro (2017), who finds a decrease in socioeconomic inequalities to enter and complete university over time. According to this author, this trend is driven by a decrease in the chances for those from higher classes instead of by an increase in the chances for those from lower classes. Instead, we find a small increase in parental influence for entering university across cohorts for all socioeconomic groups. Moreover, we find a stable and very unequal trend across cohorts for completing university, with those with better-educated parents with much higher chances of completing a university degree compared to those with lower educated parents. Our findings suggest that the tertiary education did not follow the expansion of lower educational levels and that the university degree is still restricted to better-off individuals.

Despite growing parental influence on completing secondary education across cohorts, the attendance to this level has increased over time – according to official registries previously mentioned in this thesis, as well as our descriptive statistics and regression model. It looks like the main problem for holding a secondary degree in Brazil has not been the lack of places, but instead completing it once enrolled given that the completion of the transition 'some secondary education' has had only a small increase in parental influence over time as well as small differences between the different groups (by sex, skin colour, urban/rural location, region of birth). In other words, our outcomes suggest that the IOE associated with the completion of secondary education is the result of shrinking demand rather than from the limited ability of secondary institutions to expand their supply. Such inability to keep the attendance and consequently complete secondary school once enrolled to it is more pronounced for individuals with less educated parents, resulting in widening socioeconomic gaps. This result confirms Torche's (2010) analysis for Brazil and also Latin America. Consequently, our study disagrees with Gerber and Hout's (1995) bottleneck explanation for increasing IOE in upper educational transitions. In other words, whilst the increase in IOE in the access to postsecondary school was explained by a supply-driven factor (or 'bottleneck') in the Soviet Russia, the Brazilian case suggests instead a demand-driven explanation. Furthermore, a bottleneck explanation cannot account for growing inequality in the probability of graduating secondary education in

Brazil because no expansion of the system is required for those already enrolled in secondary school to graduate.

Our findings also point to growing regional differences between those born in the great south and north in attaining the university degree over cohorts. This outcome confirms (Ribeiro, 2011) and is expected given that historically the south has had more provisions of higher education institutions than the north given its stronger economy. This study expands Ribeiro (2011) in assessing whether the influence of parental education on educational attainment of their offspring varies by great region. However, we find no significant difference. Therefore, despite providing an overview of educational stratification in Brazil over time, this conventional analysis of IOE is not ideal for a more realistic account of the country's wide regional gaps. The household survey with retrospective parental information is rare[18] and has a small number of cases that might increase the likelihood of bias in geographically large regions with small sample sizes[19].

[18] Although the PNAD series started in 1967, only the years of 1982, 1988, 1996, and 2014 contain retrospective parental information on education and occupation.

[19] That is the case of the north region. Our regression model counted only 5 thousand individuals from this region, which has 16 million inhabitants and geographically 45 percent of the Brazilian territory (IBGE, 2010). Our Generalised Ordered Logistic Regression did not run for the north region due to its small N.

3. The Effects of School's Resources on Average Test Scores Performance in Urban Brazil: A Longitudinal Analysis with School Fixed Effects

3.1. Introduction

School input policies have been pursued over a long period of time around the world, but there is no clear evidence and no overall consensus that the added resources have improved student's performance (Hanushek 1986, 1997, 2003, 2006). Longitudinal research on school effects has shown that school effects may be more stable over time than they have appeared when estimated by cross-sectional models (Willms and Raudenbush, 1989; Raudenbush, 1989; Gray et al, 1995). Such evidence on potentially limited school effects brings into question the effectiveness of a recent educational reform in Brazil in which the objective is an equitable resource distribution across regions, states and municipalities through an increasing per student spending floor and teacher's salary floor. The National Fund for Basic Education (FUNDEB) reform started in 2007 and aimed at improving learning outcomes through increasing and redistributing resources. In this chapter we examine how successive cohorts of students perform in a panel of public primary schools, which have their resources increasing over time due to the FUNDEB reform. We assess if the FUNDEB has been successful in improving school's average scholastic performance and in narrowing the large disparities in performance observed by region. We use *Prova Brasil* (Brazil Exam) data for the years of 2005, 2007, 2009, 2011, 2013 and 2015. *Prova Brasil* is a census-like bi-annual assessment data of pupils' performance as measured by test scores in mathematics and language. We estimate a longitudinal model with school fixed effects. The design is longitudinal for the repeated observations of each school, but cross-sectional with respect to each cohort of students.

A pupil's educational outcome is shaped mainly by two separate environments: home, where family can provide material, emotional and intellectual support to foster cognitive growth; and school, where infrastructure, organisation and teachers can help develop skills. The idea that educational outcomes of children are mainly influenced by family background and that school resource variables do not matter much has been central to the quantitative research on the determinants of scholastic outcomes since the publication of the 'Coleman Report' in 1966 (Coleman et al, 1966; Plowden, 1967; Jencks *et al.*, 1972; Reynolds et al, 2000; Creemers, 2007; Teddlie and Stringfield, 2007). The report utilised regression analyses without considering the hierarchical structure of the data (school, class, pupils) and concluded that 'schools bring little influence to bear on a child's achievement that is independent of her background and general social context' (Coleman et al, 1966: 325). Many of the Coleman school factors were related to school resources (e.g. per pupil expenditure, school facilities,

number of books in the library), which were not very strongly related to student achievement. Nevertheless, despite little attention, 5 to 9 percent of the total variance in individual student achievement in the report was uniquely accounted for by school factors. Among school resource measures, Coleman found that teacher characteristics were positively associated with student outcomes, and more strongly so for minority students compared to white students (Coleman et al., 1966). Nonetheless, the implication drawn by many was that schools simply do not matter. From a policy perspective, the report had an underlying idea that putting more money into schools to try to improve quality was unlikely to matter either[20].

However, according to Mortimore et al (1988), it is true that better-off families – with comfortable housing, healthy diet and positive attitudes towards their offspring's education – contrast a great deal with worse-off families – with inadequate housing, poor diet and low or no positive attitudes towards their offspring's education. Similar to families, schools can also vary a great deal among themselves. Schools are differentiated in terms of their socioeconomic compositions, contexts, and resources (physical and human). Mortimore et al (1988) argued that the debate should therefore focus on how these two separate environments – school and family – differently affect pupils' outcomes (Mortimore et al, 1988). Likewise, Hanushek's (1986) meta-analysis presented mixed outcomes: some studies presented a positive relationship between school spending and student outcomes, while others presented no or a negative relationship. Such conclusion was reinforced by later research of the same author (e.g. Hanushek, 1997, 2006). Above all, Hanushek's conclusion was a 'statement of uncertainty' on whether a significant and systematic relationship exists between educational spending and student's outcomes. Likewise, recent re-analysis of Coleman's report data found that even after statistically taking into account students' family background, a large proportion of the variation among true school means was related to differences explained by school characteristics (Borman and Dowling, 2010; Konstantopolous and Borman, 2011).

[20] For an early discussion about the Coleman et al (1966) findings and their contradictory interpretations regarding their potential policy implications, please see Bowles and Levin (1968) 'The Determinants of Scholastic Achievement – an Appraisal of Some Recent Evidence'; and Kain and Watts (1970) 'Problems in Making Policy Inference from the Coleman Report'.

In short, while family background certainly matters most, schools matter as well. The 'statement of uncertainty' has been replaced with an empirically grounded confidence that school resources do matter. Nevertheless, decades after the Coleman report and the following research it influenced a great deal, there is still no clear consensus about the importance of school resources on pupil's achievement. The debate has now shifted from 'whether school matter or not' to 'how, in which contexts and for which groups school matter most'. This evidence has inspired numerous studies on the relevance of school inputs, such as aggregate per pupil cost (Gundlach and Wößmann, 2001; Gundlach et al, 2001; Holmlund et al, 2010; Nicoletti and Rabe, 2012), school resources and infrastructure (Hanushek, 1997; Gaviria et al, 2004; Franco et al, 2007; Murillo and Román, 2011; Paget et al, 2016), teachers' characteristics and practices (Rivkin et al, 2005; Hill et al., 2005; Seidel and Shavelson, 2007; Ladd, 2009), and class size (Slavin, 1989; Rivkin et al, 2005; Hattie, 2005; Wößmann and West, 2006; Jepsen and Rivkin, 2009).

Amid controversies on the role played by school resources on students' achievement, Education Effectiveness Research (EER) or School Effectiveness Research (SER)[21] has expanded to different countries and regions with diverse socioeconomic realities, bringing other perspectives to the debate (Heynemann, 1976; Heynemann and Loxley, 1983; Fuller, 1987; Scheerens, 2001b; Willms, and Somer, 2001; Van der Werf et al, 2001; Hallinger, and Kantamara, 2001; Ferrão, 2014). Although research conducted in the United States (US), Europe, Australia and other East Asian countries[22] has typically found school infrastructure and resources to be of very limited significance to effective schooling (Hanushek, 1986, 1989, 1997, 2006; Purkey and Smith, 1983; Sammons et al, 1995; Gundlach and Wößmann, 2001; Gundlach et al, 2001; Häkkinen et al, 2003; Hanushek and Luque, 2003), evidence from other parts of the developing world has suggested the opposite. Schools' resources seem to be of greater importance for scholastic achievement for low- and middle-income countries than for high-income ones (Heynemann, 1976; Heynemann and Loxley, 1983; Fuller, 1987; Riddell, 1989; Fuller and Clarke, 1994; Velez et al 1994; Bedi and Marshall, 1999; Scheerens, 2001b;

[21] Please check Goldstein and Woodhouse (2000) for more details about the debate on these terminologies.
[22] Hong Kong (China), Japan, South Korea, Singapore, Thailand and Philippines. In: Gundlach and Wößmann (2001).

Glewwe, 2002; Lee et al, 2005; Hanushek, 2006; Murillo, 2007; Murillo and Román, 2011). Moreover, early evidence has suggested that the lower the income of a country, the weaker the influence of pupils' family socioeconomic status (SES) on achievement and the stronger the relationship of school factors with academic achievement (Heynemann and Loxley, 1983).

Likewise, in Harbison and Hanushek's (1992) school effectiveness research in developing nations, 65 percent of the studies concluded that school infrastructure (libraries, bathrooms, access to running water etc.), access to academic resources (textbooks and writing materials etc.), and teacher's education (teacher subject knowledge and pedagogical training) had a significant effect on school's performance. For the particular case of the disadvantaged rural Northeast of Brazil, Harbison and Hanushek's (1992) found that some schools in this area lacked permanent physical structure, textbooks and had teachers with a fourth-grade education only. According to them, under these circumstances, modest resources can in fact have discernible effects. Willms and Somers (2001) analysed school resources in terms of the availability of didactic materials for teaching/learning (board, calculators, maps, etc.) and found that, for the 13 countries[23], the growth by one unit in the number of those materials was associated with an increase of almost 2 points on the language test. The study also found that schools with larger libraries reached higher scores as compared to schools that had small libraries (LLECE, 2000: 17). The paradigms developed in conjunction with the Coleman Report and other surveys in industrialized societies appeared to have very different results when applied internationally. Hanushek's more recent work recognized that the importance of school resources and infrastructure may vary with the level of resources already available. The author stressed that the data from the developing world, compared with the outcomes for the US, suggested with more confidence that the identified resources positively influence student performance (Hanushek, 2005). Other studies have, in various combinations, supported and advanced these conclusions (Teddlie and Reynolds, 2000; Soares et al, 2001; Ferrão and Fernandes, 2003; Gaviria et al 2004; Lee et al, 2005; Franco et al, 2007; Biondi and Felício, 2007; Murillo and Román, 2011).

[23] Argentina, Bolivia, Brazil, Colombia, Costa Rica, Cuba, Chile, Honduras, Mexico, Paraguay, Peru, Dominican Republic and Venezuela.

More recently, Murillo and Román (2011), looking at the effects of resources in a comparative study with schools from 16 Latin American countries[24], found that schools' infrastructure and teaching resources did have a positive effect on pupils' academic performance. Their results showed that the availability of basic infrastructure and services (water, electricity, sewage), didactic facilities (sport installations, labs, libraries), as well as the number of books in the library and computers in school had a significant effect on the achievement of primary education students in Latin America. However, their relative weight varies significantly from country to country. Murillo and Román's (2011) findings were consistent with most of the studies on Latin America (Vélez et al., 1994; Murillo, 2007), and on developing countries in general (Hanushek, 1995). Despite this evidence, studies that have examined the relationship between school resources and performance in developing countries are still scarce and raise issues about causal interpretation of the estimated relationships due to the poor quality of data and methods, such as reduced longitudinal designs (Hanushek, 2006: 897).

In line with research from the developing world, evidence from Brazil has found that the availability of adequate school infrastructure and resources consistently and positively influence students' performance (Harbison and Hanushek, 1992; Velez et al 1994; Gaviria et al, 2004; Murillo and Román, 2011). The national literature has focused on the effects of school's and teacher's determinants on student's achievement, with most of the findings based on cross-sectional designs (Fletcher, 1998; Fuller et al, 1999; Alves and Soares, 2008; Ferrão and Fernandes, 2001; Ferrão et al, 2003; Ferrão and Fernandes, 2003; Lee et al, 2004; Gaviria et al, 2004; Soares, 2005; Franco et al, 2007; Soares and Candian, 2007; Ferrão, 2014). Nevertheless, cross-sectional designs lack the time component to estimate the effects of the recently implemented educational reform on financial equalization - the FUNDEB. This reform aimed at addressing inadequate infrastructure and resource gaps between school and regions based on the continuous increase of per pupil expenditure and teacher's salary floor (Herran and Rodrigues, 2000).

[24] Argentina, Brazil, Colombia, Costa Rica, Cuba, Chile, Ecuador, El Salvador, Guatemala, Mexico, Nicaragua, Panama, Paraguay, Peru, Dominican Republic and Uruguay.

More specifically, in 1998 a major educational reform aimed at financial equalization and equitable resource distribution was implemented – the National Fund for Elementary Education (FUNDEF – *Fundo de Manutenção e Desenvolvimento do Ensino Fundamental e de Valorização do Magistério*). FUNDEF established a per student spending floor, mandated the redistribution of funds across states, municipalities and regions, pledged central government funds to fill any remaining gaps and increased teacher's salaries. After the expiry of FUNDEF in 2006, the substitute National Fund for Basic Education (FUNDEB - *Fundo de Manutenção e Desenvolvimento da Educação Básica)* was enacted. FUNDEB, which started in 2007, increased spending and expanded the funding equalization policies of FUNDEF. Despite evidence on the importance of school factors on achievement in Brazil, there is no known assessment of whether the continuous increase in per pupil and teacher's salary's set by FUNDEB in 2007 has led to any real gains in school's infrastructure and ultimately in average school's test scores performance over the years. One of the reasons for such gap is the lack of research with longitudinal design in the country. We aim at filling this gap by assessing trends in school resources and average school test scores performance over nine years in urban Brazil.

Evidence on the effects of school resources over long periods of time that accounts for the entire Brazilian territory are rare. Biondi and Felício (2007) used a 5-year panel of schools with SAEB data with a representative sample of the Brazilian territory to assess the effects of school resources on children's proficiency. The outcome variable was mean school test scores in maths. The authors found that teacher's experience, teacher's low turnover, and access to internet had positive effect on the average school's test scores. The authors, however, did not account for regional achievement gaps known to exist in Brazil.

The recent paper of Soares et al (2016) investigated the effect of Brazilian primary schools on the probability of their students achieving three categories of mathematics proficiency (Insufficient, Basic and Proficient). The years of 2007, 2009 and 2011 of the census-like *Prova Brasil* assessment data was used to fit a hierarchical multinomial model in order to examine the influence of various school-level factors including infrastructure (e.g. quality of school buildings, computing and library resources) and homework policy, on students' mathematics proficiency. The design was longitudinal for schools but cross-sectional for pupils. The key findings suggested that school infrastructure and homework policy were associated with students being assessed at the Basic proficiency level in mathematics; and homework policy was associated with students being assessed as Proficient in mathematics. Despite this more detailed account of the effects of particular school's characteristics on pupil's proficiency level, the paper did not investigate how these school characteristics might have affected pupil's proficiency differently by region.

Paget et al (2016) continued the focus on national test scores assessment and school effectiveness analyses over time in Brazil. The authors assessed the extent to which school resources may predict students' test scores. Their empirical illustration on resource allocation to student performance was restricted to one particular region of Brazil: the northeast, represented by the disadvantaged state of Paraíba. The authors fitted a 5-year multilevel longitudinal model with the years of 2007, 2009, and 2011 of *Prova Brasil* data. They found that infrastructure and academic resources significantly predicted performance in Portuguese and mathematics in the northeast state of Paraíba. This outcome confirms the international literature as it shows that pupils living in a poor context are likely to have their performance significantly affected by school resources. Paget et al (2016) study, however, did not account for regional performance gaps. Given the wide socioeconomic and performance gaps between the Brazilian regions, we hypothesize that the importance and size of the effects of school resources are likely to vary by region.

We extend the studies of Biondi and Felício (2007), Soares et al (2016) and Paget et al (2016) by: i) assessing the effects of school resources on school average test scores performance using a panel of schools with recent census-like data of the entire Brazilian urban territory; ii) assessing the differences in importance and size of school resources on school's average performance by region; iii) exploring particular types of school resources that are sensitive to the redistributive educational reform implemented in 2007; iv) drawing policy implications on the effectiveness of the 2007 educational reform on per pupil's spending and teacher's salary floor. Drawing on a 9-year longitudinal model with school fixed effects, this chapter seeks to investigate the effects of changing school resources on school's average performance as measured by test scores over time in Brazil. We consider changes in school resources caused by the 2007 FUNDEB reform that established increasing per student spending floor and teacher's salary floor with a redistributive approach by regions and municipalities. We assess how these changes in public educational spending might have altered the average patterns of average scholastic performance of successive cohorts of pupils in unique schools over nine years. We shall discuss four research questions herein:

1) Is there stability or change in average scholastic performance as measured by test scores in language and mathematics between 2007 and 2015 on the *Prova Brasil* tests for 9th graders in urban Brazil?

2) To what extent do school resources predict average school achievement in mathematics and Portuguese language between 2007 and 2015 on the *Prova Brasil* tests for 9th graders in urban Brazil?

3) Are these school resources effects different for different geographical regions (south, southeast, midwest, north and northeast)?

4) Is there any evidence that the reforms of establishing a minimum per student spending floor and teacher's salary floor in the country via redistributive resources managed to reduce regional differences in average school performance over time?

Including this introduction, this chapter is organised into five sections. In the next section, the Brazilian context for educational equalization is presented, highlighting the main educational reforms and the descriptive statistics of average school resources and outcomes over time. The third section presents the data, variables and methods used in this analysis. The findings are presented in the fourth section; and in the last section the main results are summarised with concluding remarks.

3.2. The Brazilian context during educational equalization

Contemporary and democratic Brazil has decreased illiteracy to around 9 per cent of its population[25]; extended access to primary education to more than 95 per cent of the school age children; established assessment systems using an internationally benchmarked index that measures the progress of each school against a baseline (the SAEB/*Prova Brasil* system); created student-based funding formulas that distribute funds fairly within regions, states and municipalities (the FUNDEF/FUNDEB); and used conditional cash transfers such as the *Bolsa Família* programme to lift poor families out of poverty through increasing the basic school attendance of their children (OECD, 2011b). Despite the encouraging lessons from the large Brazilian federal system[26], important challenges remain in the primary education for the twentieth-first century: i) overall low quality of education offered mainly in public schools; ii) low level of student performance[27]; iii) inequalities in learning outcomes by region and state

[25] According to the Brazilian National Household Survey (PNAD, 2010), the overall illiteracy rate in the country in 2009 was 8.9 per cent.
[26] For more information on the achievements of the Brazilian educational system please check OECD (2011b).
[27] The average academic proficiency of pupils studying in Brazilian public primary schools is below levels that are considered satisfactory according to the Brazilian Ministry of Education Standards (INEP, 2006: 137).

of residency (Guimarães de Castro, 1999: 5; UNESCO, 2002: 27; Soares, 2002: 388; INEP 2002; INEP, 2006: 137; INEP, 2007; Klein, 2006; Rodrigues et al, 2011; Bruns et al, 2012: 35). The core equity issue in the Brazilian educational policy has therefore recently shifted from equalizing access to equalizing learning outcomes (Bruns et al, 2012: 37).

The SAEB/*Prova Brasil* assessment system has also revealed an overall low level of pupils' performance in the country. The results for the years 2007, 2009, 2011, 2013 and 2015 for 9th graders in maths and language reveal that only approximately 10 percent has attained an 'adequate' level of math skills. Most students fell under the 'basic' level of the SAEB/*Prova Brasil* proficiency scale - approximately 52 percent, a share that has remained mostly stable over the years. On the other hand, the 'below basic' level, responsible for more than 30 percent of students, has oscillated more during this period (between 34 and 39 percent). The 'advanced' level represented the lowest share of students (between 0.9 and 1.4 percent). Overall, the changes over time have not been marked and a slightly upward trend can be observed for the adequate and advanced levels (table 3.1 below).

Table 3.1 Test Scores Level in Maths based on the Prova Brasil Proficiency Scale, 9th Graders

SAEB Proficiency Scale		**Distribution of Students (%)**			
		2007	**2009**	**2011**	**2013**
Below Basic	0-225	38.2	39.4	34.2	36.0
Basic	225-300	52.5	50.3	53.6	52.3
Adequate	300-350	8.3	9.3	10.9	10.4
Advanced	350-425	0.9	1.1	1.4	1.3

Author's calculations with *Prova Brasil* data from 2007, 2009, 2011 and 2013.

Brazil has three types of free public[28] schools: federal, state and municipal. States and municipalities have autonomy to organize their own systems of education provided they follow a mandatory nationally defined core curriculum set by the Ministry of Education. Federal

[28] The private schools account for 15.5 percent of the Brazilian students (INEP, 2012a: 14). Private schools are not part of our analysis and they are not part of the *Prova Brasil* data.

schools account for approximately 0.5 percent of the primary and secondary school students and are very selective. Students are selected through competitive tests and usually those from higher SES get the places (INEP, 2012a: 14; Menezes-Filho, 2007). State and municipal schools together account for 84 percent of the total enrolment in primary and secondary education[29] (INEP, 2014: 12; INEP, 2012a: 14). The majority of children from lower SES status attend public state or municipal schools, where the access is free of charge and without a selection process. Children's admission to these schools is based on residency criterion. Therefore, the socioeconomic conditions of families determine the neighbourhood and consequently the school their children attend (Fletcher, 1998).

Apart from overall low performance levels, inequality in SES background is also high in the Brazilian education system. According to Willms and Somer (2001: 418, 419, 420), the *between-school* variation in average SES was 47 percent for Brazil in a cross-sectional and comparative study of 1998 for Latin American countries[30]. Comparatively, the average *between-school* SES variation in Latin America was 45.5 percent: it ranged from 28.8 percent for Cuba to 50 percent for the Dominican Republic. The level of SES segregation for Cuba is low and comparable to that found amongst high-income countries (Ho and Willms, 1996; Willms and Paterson, 1995). Brazil's *between-school* SES variation is one of the largest compared to other Latin American countries. This outcome suggests that the Brazilian education system is highly segregated with large differences in group composition across low- and high- SES schools.

Inequalities in average achievement between schools are also high in Brazil. Willms and Somer (2001: 418, 419, 420) found that in Brazil *between-school* differences explain 30 percent of the variance in math scores. As a comparison, *between-school* variation in test scores tend to be below 15 percent in high-income countries. Other Latin American countries presented, on average, similar between-school variation in achievement. Compared to Brazil,

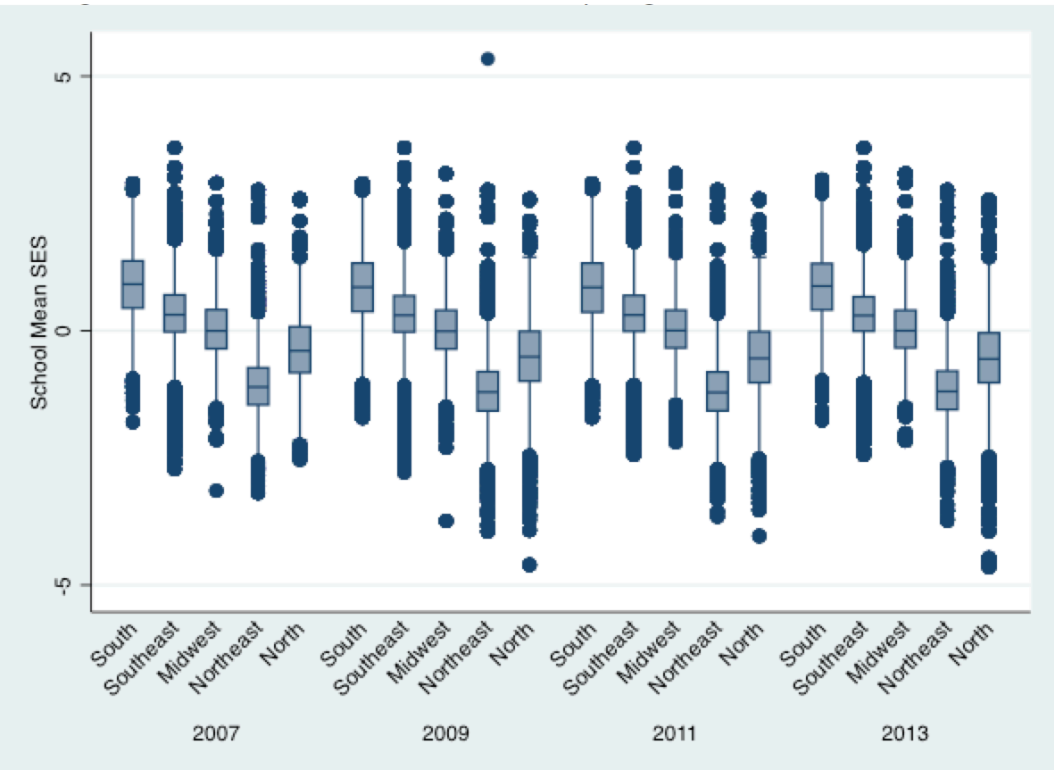
[29] Among this 84 percent, state schools represent 46 percent of the enrolments and municipal schools represent 38 percent of the enrollments (INEP, 2014: 12; INEP, 2012a: 14).
[30] 13 Latin American countries took part in this cross-sectional and comparative study: Argentina, Bolivia, Brazil, Colombia, Costa Rica, Cuba, Chile, Honduras, Mexico, Paraguay, Peru, the Dominican Republic, and Venezuela.

Chile had the smallest *between-school* variance in maths (19.5), and Argentina had the largest variance in maths (41.2 percent). Overall, the *between-school* test scores variance was lower than the *between-school* SES variance for nearly every country in Latin America, including Brazil. This suggests that inequalities in achievement are not quite as high as one might expect, given the extent of segregation along social class lines. Therefore, to some extent, schooling might have a leveling effect in Latin America and Brazil, but it might be of a small size.

Inequality of school SES composition is also observed by geographical regions in Brazil. Figure 3.1 reveals the distribution of average school SES by regions over time. A division is observed between the richer south and southeast and the poorer north and northeast, with the midwest figuring in the middle, but closer to the more socioeconomically prosperous southern regions. This regionally unequal pattern of school SES composition appears to be constant over time. The observed inequality in school SES composition reflects the regional divisions related to the living standards of the country. The analysis of the Gross Domestic Product (GDP) (at purchasing power parity) per capita for Brazil in 2012[31], for instance, reveals the striking regional unequal distribution of socioeconomic development. Whilst Brazil presented a GDP per capita on average of USD 11,800.00, the southeast, midwest and south regions presented all a GDP per capita above the average: USD 15,534.00, USD 15,249.00, USD 13,360.00 respectively. On the other side, the poorer northeast and north presented GDPs per capita well below the average: USD 5,687.00 and USD 7,610.00 respectively. The GDP per capita of the northeast is approximately 1/3 of the wealtier southeast region.

[31] The International Monetary Fund (IMF), World Economic Outlook Database, available at: https://www.imf.org/external/pubs/ft/weo/2015/01/weodata/index.aspx. Accessed in May 2016.

Figure 3.1 Box plots – school mean SES by region over time, 9th graders

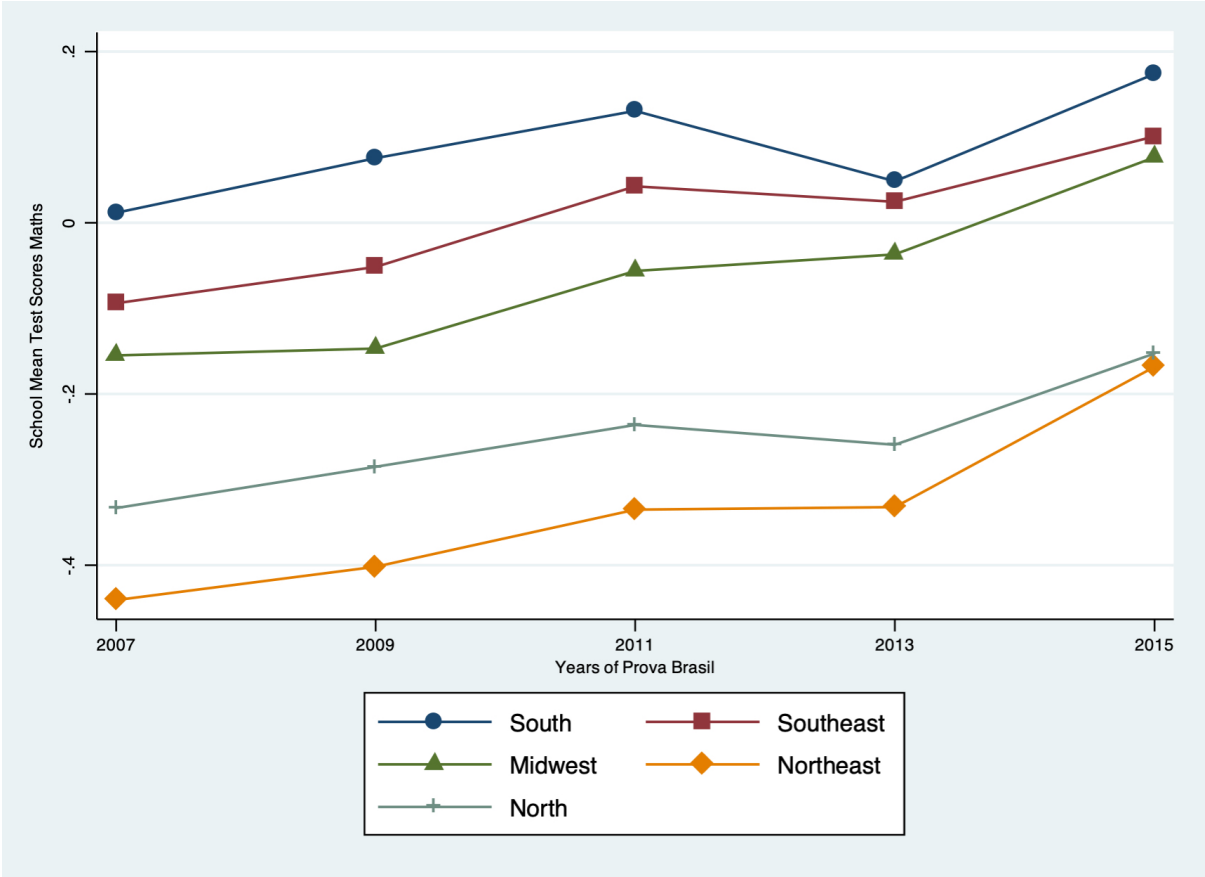


Author's calculations with *Prova Brasil* data from 2007, 2009, 2011 and 2013.

Regional socioeconomic inequalities are also reflected in school average test scores (figure 3.2). Southern schools are the top performers, followed by the southeastern and the midwestern schools respectively. Northeastern and northern schools are at the bottom of the performance distribution. Figure 3.2 also reveals that this unequal pattern for average maths[32] performance appears to be persistent over time, despite the upward trend. Regional differences are striking: southern schools outperformed their northeastern counterparts by more than ½ of a standard deviation.

[32] We also tested for language and it presented similar pattern.

Figure 3.2 School mean test scores level in mathematics over time for 9th graders by region, Brazil



Author's calculations with *Prova Brasil* data from 2007, 2009, 2011 and 2013.

Therefore, although the upward trend in average school performance over time, the global pattern of inequality in school average achievement looks persistent and stable over time, despite a slightly smaller gap in the last two waves between poorer and richer regions. In order to address the striking and persistent educational inequalities by region, the federal government implemented two main reforms in 2007 that will be assessed in this chapter. More specifically, we will assess if those reforms have had effects on the availability and quality of selected school resources and ultimately on school average performance. In the first reform, the previous FUNDEF was replaced by the National Fund for Basic Education (FUNDEB - *Fundo de Manutenção e Desenvolvimento da Educação Básica)*. The replacement of FUNDEF by FUNDEB meant an increase in the redistributive educational budget. Up to 2006, states and municipalities had to contribute with 15 percent of the total of their tax revenues. The FUNDEB increased the share of contributions to 16.7 percent in 2007, 18.3 percent in 2008 and 2009, and 20 percent from 2010 on for states and municipalities. The FUNDEB also set the share of contribution from the federal government to the fund to be 10 percent of the national tax revenues. The fund's budget would be used to meet the minimum costs to be spent per student

throughout the entire country (Castro, 2011). The budget available for redistribution from richer to poorer areas increased from BRL 2 billions (or USD 570 million) in 2007 to BRL 5.1 billions (or USD 1,5 billion)[33] in 2009. During this period, Brazil was experiencing a strong economic growth led by a boom in the commodities prices in the global market what meant that the fund managed to collect enough to keep the level of investment initially set in 2007.

The second educational reform of 2007 was the establishment of the Teacher's Minimum Salary, which established a national teacher's salary floor of BRL 950 (or USD 400.00) per month for 40 hours per week of work. This reform also established that teachers should spend a maximum of 2/3 of their working time teaching and the other 1/3 of the time preparing classes and attending training courses. As said above, the teacher's salary floor increases over time[34]. In 2013, for instance, the floor was set at BRL 1,567.00, which was equivalent to USD 655.00, according to the Brazilian Real-US Dollar parity for September of that year. Comparatively, the national minimum wage for 2013 was BRL 678.00, or USD 284.00. Therefore, the teacher's floor in 2013 was 2.4 times higher than the minimum wage. In order to become a teacher in Brazil, it is mandatory to hold an undergraduate degree whilst the minimum wage of the country applies for unskilled or low-skilled occupations. Nevertheless, when compared to other occupations for undergraduate degree holders, teachers face disadvantages. According to a recent report, the average earnings of the teachers was equivalent to 51 percent of the average earnings of other occupations that require an undergraduate degree. From another perspective, a teacher earns, on average, a third of an engineer with an undergraduate degree (CDES, 2014).

Despite the Teacher's Minimum Salary reform, teacher's occupation is still considered low paid compared to other occupations that require an undergraduate degree. If teachers are underpaid, it may be harder to recruit able and motivated individuals into the profession, or to retain them. In a recent study with 30 countries (OECD members plus emerging countries) about teacher's salary, their work condition at schools and the educational performance of their

[33] According to the BRL USD conversion rate of May 2007.
[34] In 2010 it was BRL 1,024.00; in 2011 BRL 1,187.00; in 2012 BRL 1,451.00; in 2013 BRL 1,567.00 (CDES, 2014).

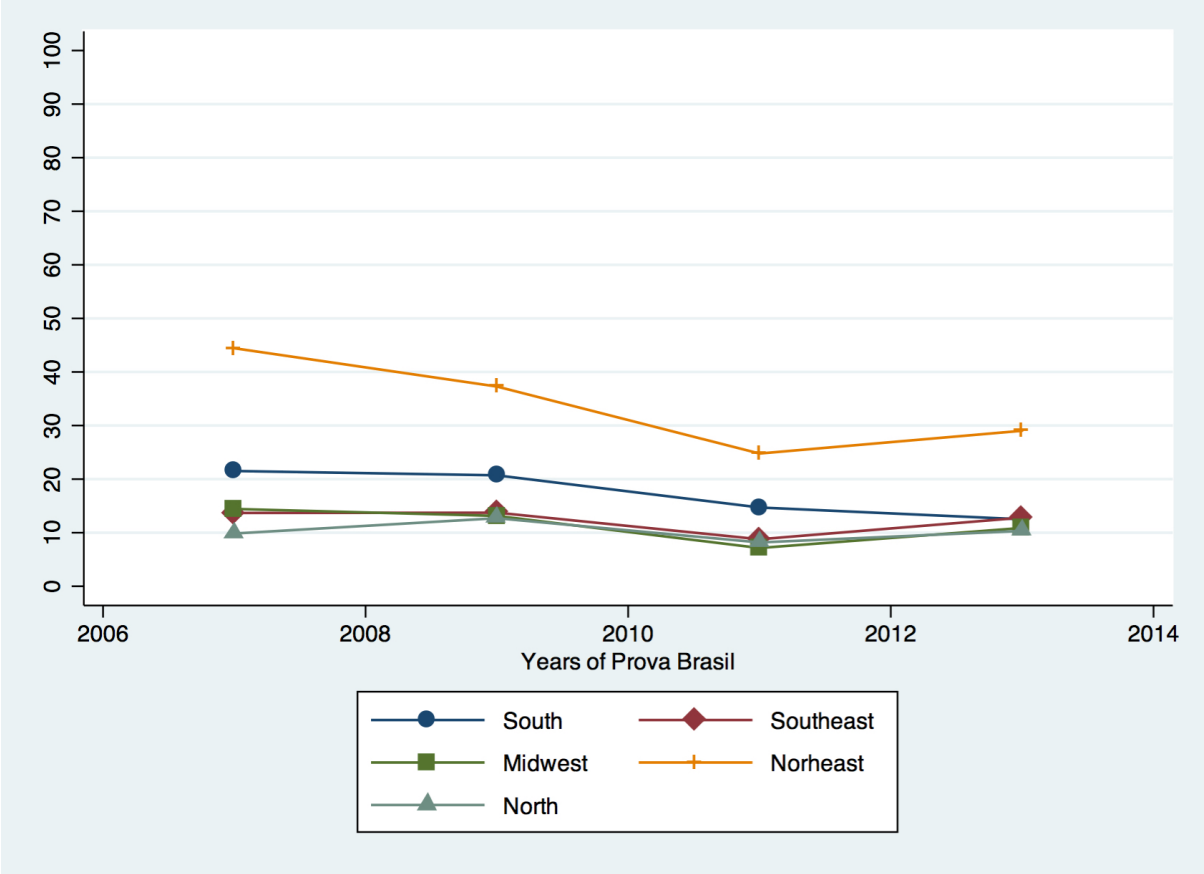
students, Brazil came out at the bottom of the list. According to the study, Brazilian teachers earn USD 14,8 thousand per year considering the average of the 15 years prior to the year of the study (2014). This amount is lower than the annual teacher's salary in other countries like Turkey and Chile; and above the teacher's salary of only two countries: Hungary and Indonesia. Comparatively, the highest teachers' salaries are in Switzerland (USD 68,8 thousand) and the Netherlands (USD 57,8 thousand) respectively (Dolton et al, 2014).

The success of both the Teacher's Minimum Salary and per pupil spending floor depends on resources from FUNDEB. Whilst richer Brazilian regions are more likely to spend above the established student and teacher floors, poorer regions and locations are less likely to have the means for meeting the minimum costs. These disadvantaged regions are therefore more likely to benefit from FUNDEB resources. Schools in disadvantaged regions and locations are more likely to provide basic education within a poorer infrastructure, facilities, administrative and learning resources framework. Therefore, assessing whether the quality and availability of such spending-related school resources have increased or decreased over time, particularly in poorer regions, is central for assessing the success of the FUNDEB reform.

3.2.1. Changes in the availability and quality of school resources over time

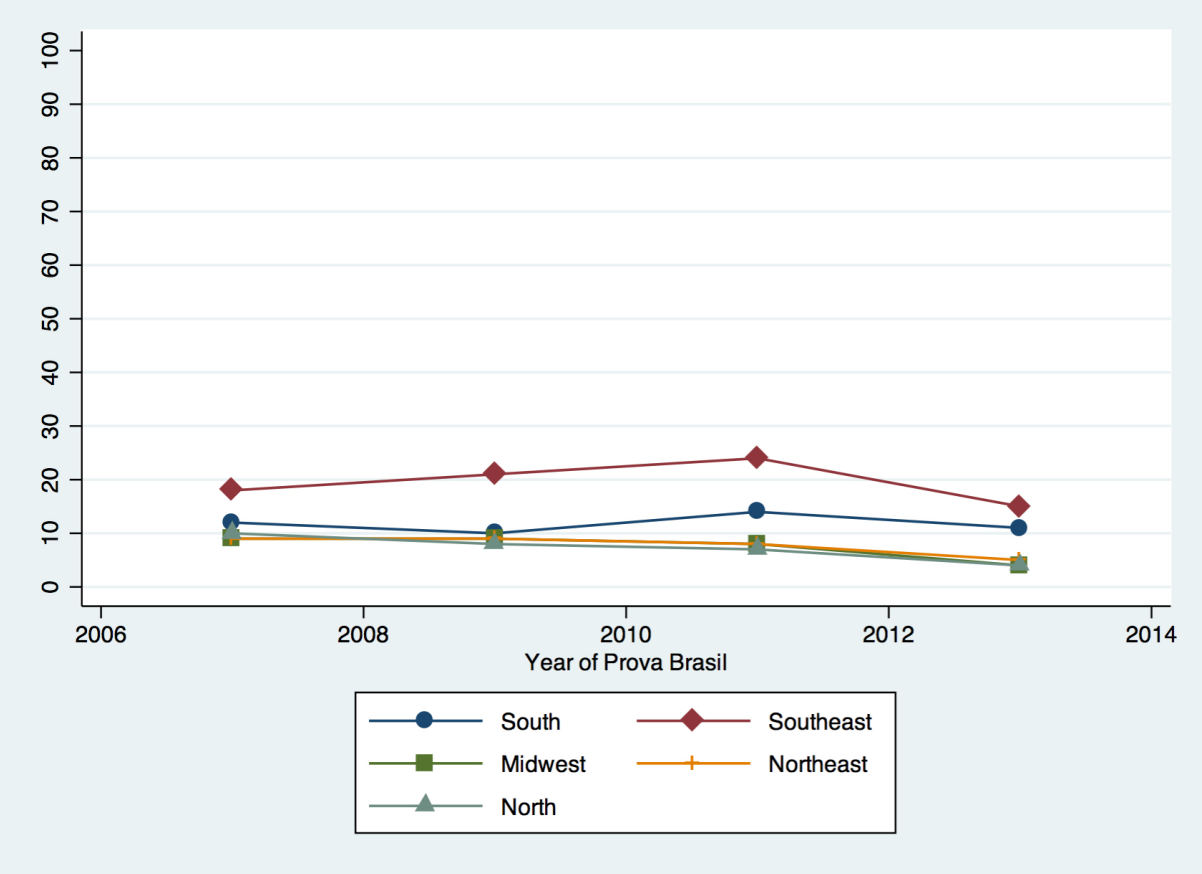
In order to assess the effectiveness of the FUNDEB reform on the availability and quality of school resources and ultimately on school average test scores performance, we will consider three main blocks of school resources that are likely to be sensitive to fluctuations in funding availability and distribution: administrative, learning and infrastructure. As administrative resources we consider teacher's salary, and availability of administrative staff and teachers. As learning resources, we consider availability of textbooks for pupils. Finally, as infrastructure we consider the quality of the physical infrastructure and facilities of the schools. These variables are explained in detail in item 3.3.1 further in this chapter. In this section we present descriptive information on the dynamics of each of these variables by region, where the main gaps in average school performance are found in Brazil. This descriptive information will also help us to interpret our findings and to shed light on the 'black box' that is generally associated with the concept of 'school resources' in SER. Figures 3.3 to 3.9 below shows the school's proportion of these resources' variables over time by region in Brazil.

Figure 3.3 School proportion of teacher earning below the floor by region, Brazil



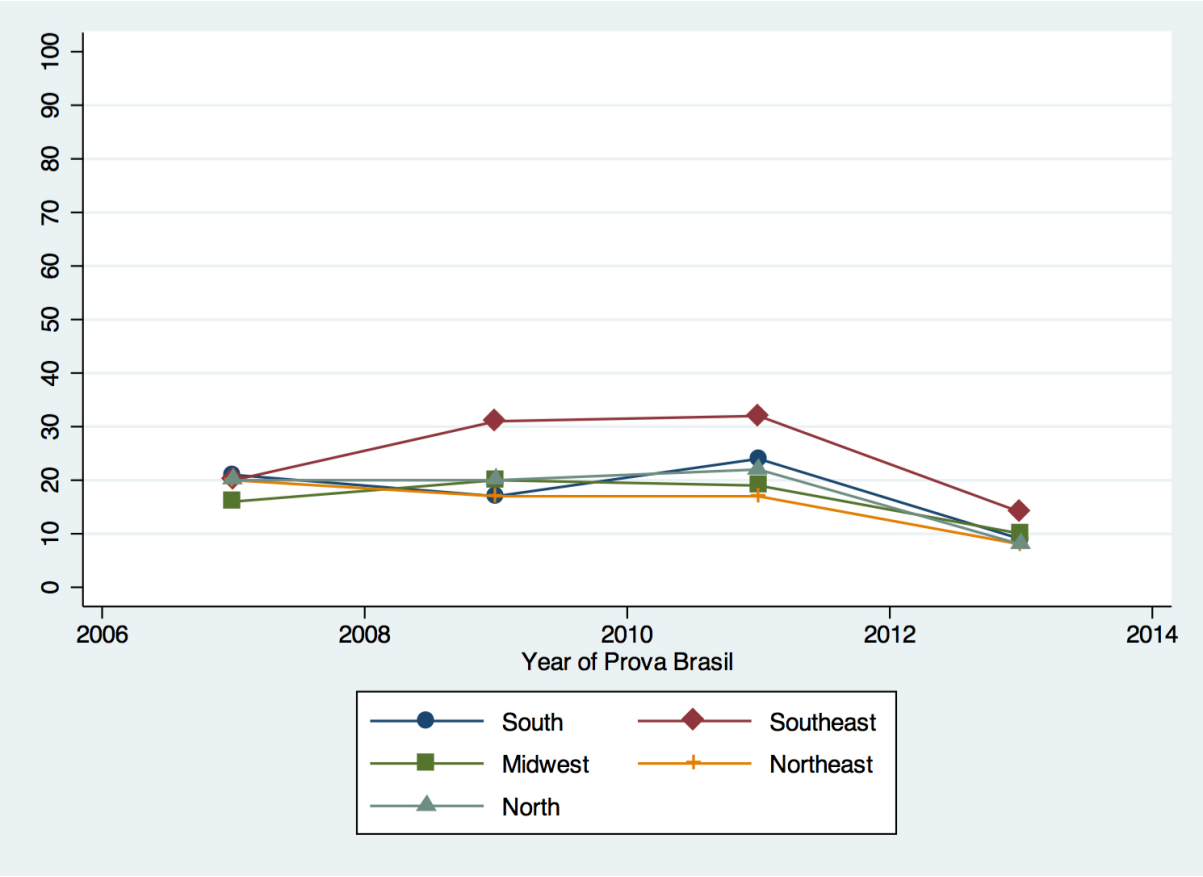
Author's calculations with *Prova Brasil* data from 2007, 2009, 2011 and 2013.

Figure 3.4 Proportion of schools reporting problems with high absence of teachers by region, Brazil



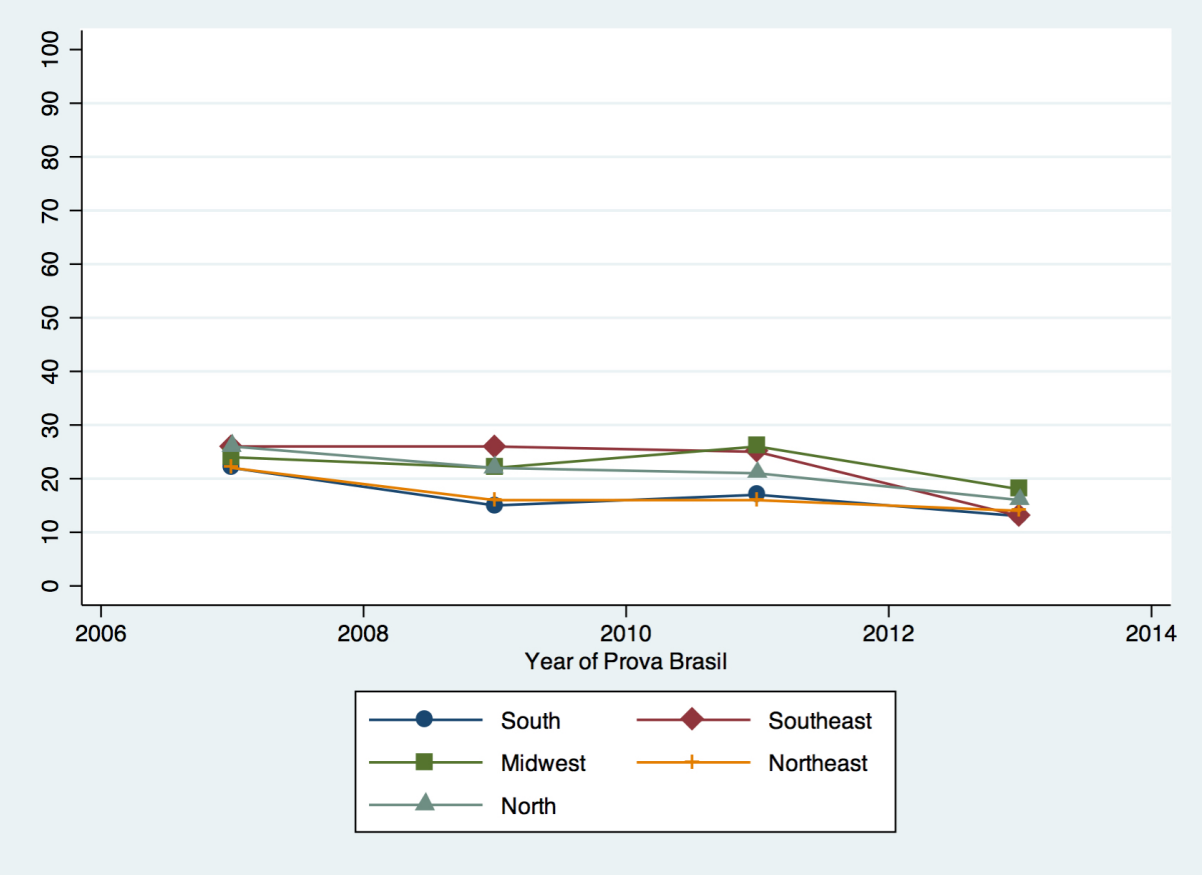
Author's calculations with *Prova Brasil* data from 2007, 2009, 2011 and 2013.

Figure 3.5 Proportion of schools reporting problems with lack of teachers by region, Brazil



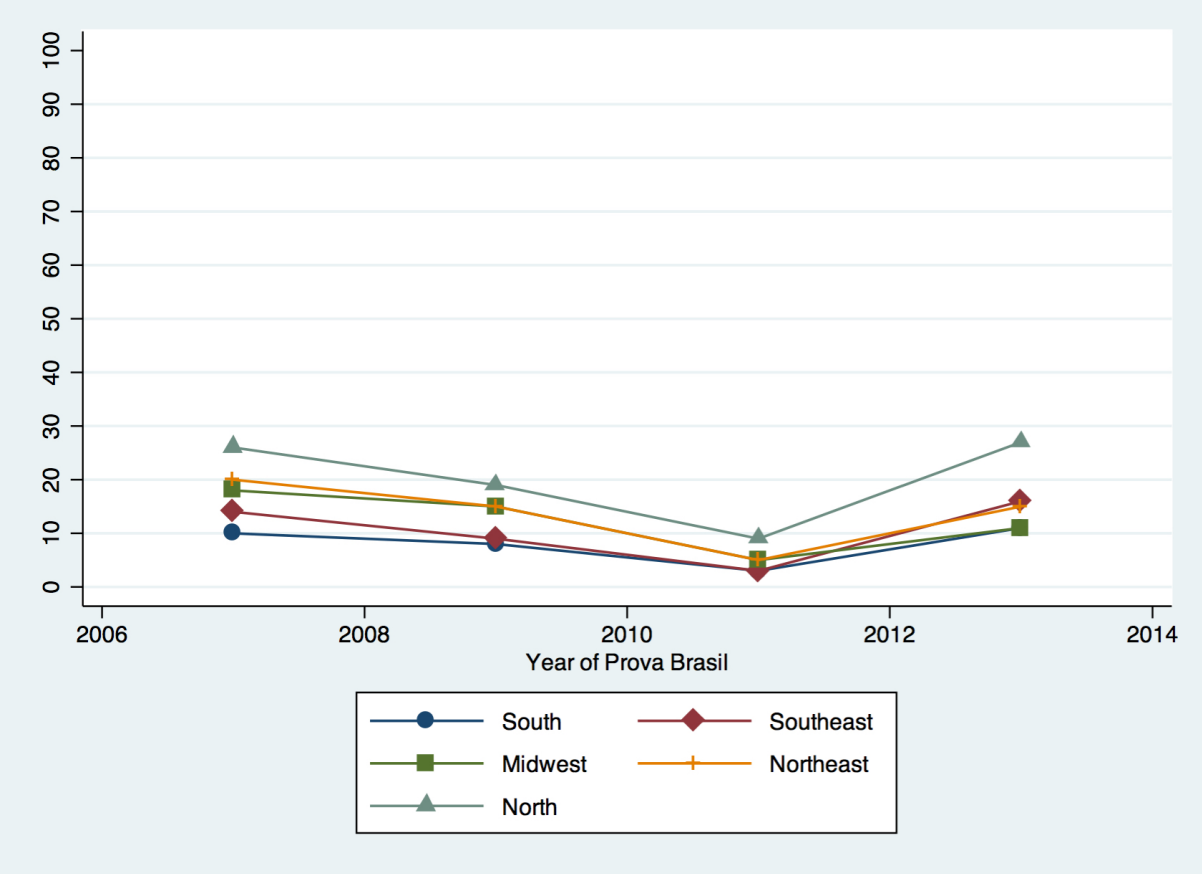
Author's calculations with *Prova Brasil* data from 2007, 2009, 2011 and 2013.

Figure 3.6 Proportion of schools reporting problems with lack of administrative staff by region, Brazil



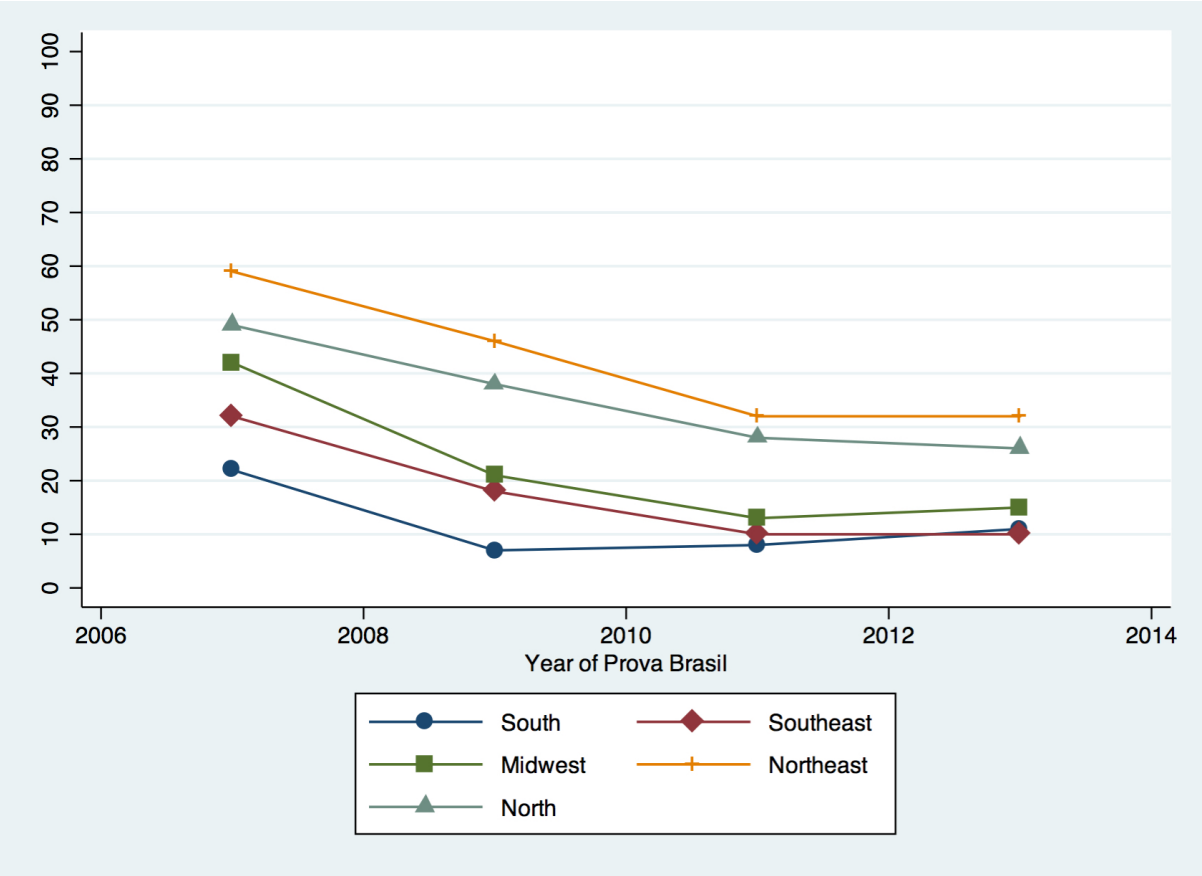
Author's calculations with *Prova Brasil* data from 2007, 2009, 2011 and 2013.

Figure 3.7 Proportion of schools reporting problems with lack of textbooks by region, Brazil



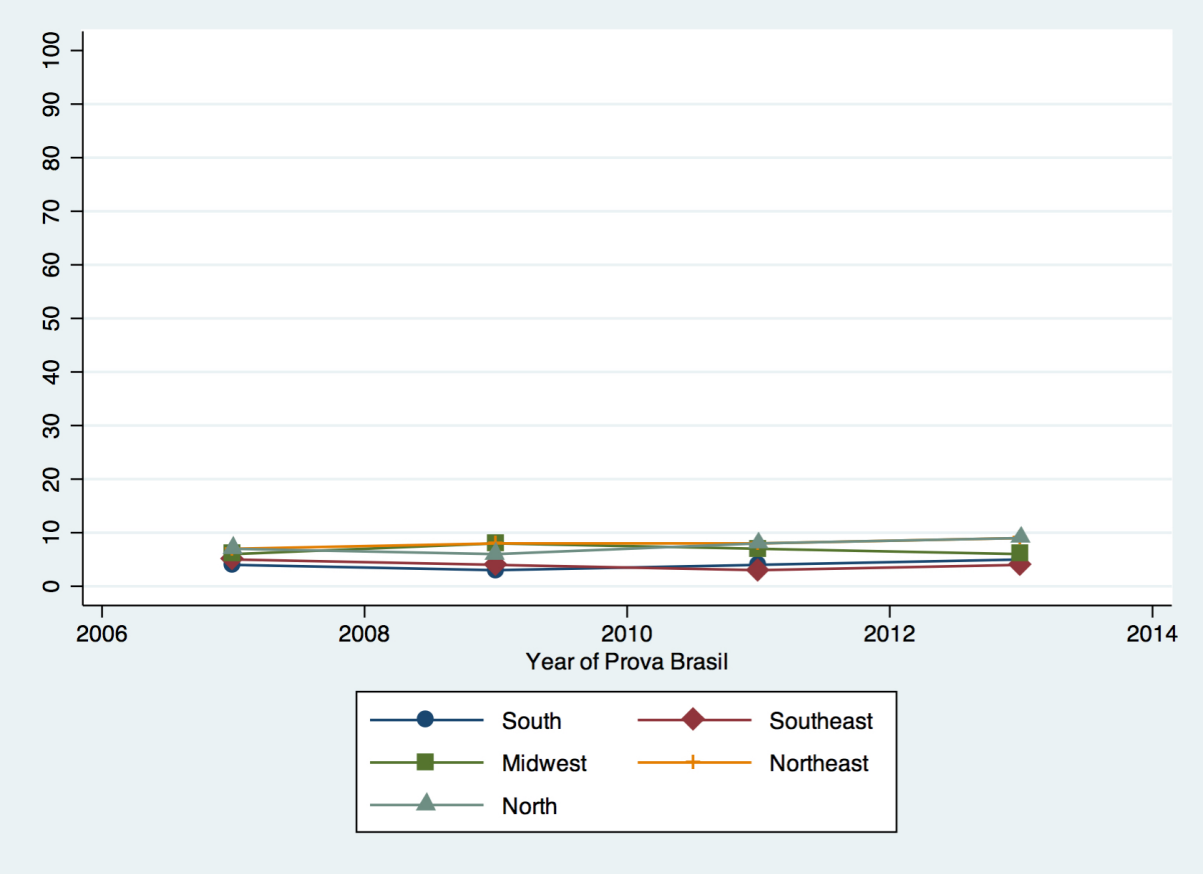
Author's calculations with *Prova Brasil* data from 2007, 2009, 2011 and 2013.

Figure 3.8 Proportion of schools with low quality facilities by region, Brazil



Author's calculations with *Prova Brasil* data from 2007, 2009, 2011 and 2013.

Figure 3.9 Proportion of schools with low quality infrastructure by region, Brazil



Author's calculations with *Prova Brasil* data from 2007, 2009, 2011 and 2013.

The changes over time of these particular resources presented common patterns. The proportion of teachers earning below the floor (figure 3.3), low availability of textbooks (figure 3.7), and low quality of facilities (figure 3.8) present a downward trend between 2007 and 2011 followed by stability or slightly upward trend from 2011 to 2013. It therefore suggests that the FUNDEB resources have probably improved material and human conditions of free public schools in Brazil in the short term.

The global downward trends observed for these particular resources also meant a reduction in regional gaps for some cases. There is a reduction in regional gaps of schools reporting proportion of teachers earning below the floor over time (figure 3.3). For this particular resource, the gap between northeastern schools and those from other regions drop but remain high at 15 percent. The gaps between the other regions are smaller and decrease from 10 to 5 percent. The gaps also drop for schools reporting low availability of textbooks (figure 3.7) among all regions: from 10 to 5 percent. There is an exception for northern schools: besides reporting the highest proportion of low availability of textbooks compared to other regions, the gap between north and all the others remain between 10 and 15 percent over the years. Regarding low quality of facilities (figure 3.8), it looks like northeastern schools benefit

more over time as the gap between these schools and the wealthier southeastern schools decreases by half: from 40 to 20 percent. The gaps between all the other regions also decrease: between 10 to 5 percent.

We have also observed puzzling outcomes: the reporting of low-quality infrastructure (figure 3.9) was low (between 5 and 10 percent) for all regions without observable changes over time. Puzzling outcomes are also observed for administrative school resources, named: absence and lack of teachers (figures 3.4 and 3.5), and shortage of administrative staff (figure 3.6). In these cases, schools from the disadvantaged north and northeast regions reported proportionally less problems than schools from the wealthier south and southeast regions. Also, there is no clear overall trend. One potential explanation for these puzzling outcomes is that these variables are based on subjective assessment by principal, teachers and external evaluators, which could make it difficult for regional comparisons. Whilst a certain level of resources and conditions can be considered as 'good or high' in poor regions, the same level might be judged as 'bad or low' in richer regions. We also note that the resources with less puzzling outcomes are those answered by teachers and external evaluators whereas those answered by principals looked less reasonable.

3.3. Data and methods

We use the *Prova Brasil* (or Brazil Exam) of the years 2007, 2009, 2011, 2013 and 2015 to assess the effect of school resources on test scores performance in a longitudinal design with school fixed effects.

Prova Brasil (or Brazil Exam) is a census-like, cross-sectional, and longitudinal assessment data of all public schools of basic education in the country. More specifically, the design is cross-sectional with respect to different cohorts of students for each *Prova Brasil* wave; but the design is also longitudinal due to repeated observations for each school. Notice that each school contains a new sample of students at each *Prova Brasil* wave. Pupils do not have a unique identification code that allows them to be traced across different waves of the test (INEP, 2013). The assessment data are based on a standardised test of language (reading in Portuguese) and mathematics (problem solving) of 5th and 9th graders. The surveys and tests in Portuguese language and mathematics have remained basically the same over the years. It has been administered biennially to every public school offering primary education across Brazil provided that there is a minimum of 20 students enrolled per grade tested at each school. The only students who do not sit the exam are those: (a) not attending school on the day of the test; (b) enrolled in schools that have refused to be part of the *Prova Brasil* test; (c) their parents

do not want them to sit the test; (d) are enrolled in schools with less than 20 students in either 5th or 9th grades; or (e) are enrolled in private schools (INEP, 2013).

Prova Brasil's central aim is to monitor the quality of the public system of primary schooling in the country in terms of overall achievement (Schiefelbein and Schiefelbein, 2003; Wagner, 2010; Wagner et al, 2012). For that purpose, it uses the proficiency as measured by test scores of pupils in core knowledge in maths and language based on 'reference matrices' set by the Ministry of Education and that all schools in the country are supposed to follow. Additionally, students, teachers, school principals, and external evaluators fill out contextual questionnaires consisting of closed questions. Test sitters provide information about their personal characteristics (such as age, sex, skin colour, motivation to study maths and language, study habits) and family background (such as household assets[35], parental schooling, parental attitudes towards the student's education). Test sitters' teachers are asked about their income, educational and professional qualifications, pedagogical practices, years of experience, among others. Principals report their income, educational and professional qualifications, years of experience, as well as the school's organization, financial resources, infrastructure, among others. Finally, external evaluators provide information on schools' overall infrastructure and organization (INEP, 2012b; 2013).

*Prova Brasil'*s scores are obtained via a quantitative standardized measure of abilities in the subjects of maths and language. Tests are on the Item Response Theory (IRT) in the form of multiple choices, with one correct and three incorrect responses.[36] The test scores scale ranges from 0 to 500: it is continuous, cumulative and comparable across 5th and 9th grades, and also across time. Its comparability relies on invariance of scale over the years and between grades, with common items contained in the tests. Hence, it is expected that 5th graders score significantly below 9th graders. Moreover, *Prova Brasil*'s design follows the Balanced Incomplete Block (BIB) model. That is, the full 'reference matrix' or core curriculum contains 169 questions for each subject. Each student answers 13 questions. Consequently, the full core

[35] Household assets include the presence and number of items such as car, TV, washing machine, etc.
[36] The IRT assumes that the probability of a correct response to items is modeled as a mathematical function of the student's proficiency (non-observed variable) and parameters (item's properties). The higher the proficiency of a student, the higher is the probability of her to score (INEP, 2013).

curriculum for one subject and one grade is only covered by a minimum of 13 students (INEP, 2013).

The census-like sampling of *Prova Brasil*, the voluntary and self-administrated nature of participation, the low-stakes nature of the assessment for students (the assessment does not affect students' school marks), and the anonymous cross-sectional nature of the data support analyses designed to monitor at a general level rather than track progress for the purpose of merit-based school marks. This voluntary low-stakes nature of student's participation might have an impact on how the pupils perform on the test and consequently on the outcomes and their interpretation[37]. The overall debate about large-scale educational assessment systems considers mainly two points. On the one hand, researchers argue that such assessment systems can contribute to policy discussion and evaluation, particularly if the tests are low-stakes, voluntary, and the analyses produced focus on transparency and monitoring rather than on accountability and merit-based incentives (Ravela, 2005; Wagner, 2010; Wagner et al, 2012). In this capacity, the *Prova Brasil* assessment data is ideally suited to provide feedback for policy makers and researchers as one of many conduits of information necessary for the consideration and continued development of educational policy. On the other hand, some authors argue that the low-stakes, voluntary nature of *Prova Brasil* assessment may lead to non-completion and low-motivation issues that might affect the quality of the data and the conclusions drawn from it (Wise and DeMars; 2005; Wise et al, 2006). Others argue that large sample sizes are not necessarily representative. Harbison and Hanushek (1992), for instance, in their research about educational achievement of the northeast region of Brazil in the 1990s, noted that the lowest educational outcomes tended to be in very small schools, and that these schools were primarily located in rural areas. This might be an issue for the external validity of our findings as the *Prova Brasil* sampling strategy does not allow the test to be administered to very small schools due to the requirement of a minimum of 20 students enrolled in either 5th or 9th grades. Therefore, *Prova Brasil* sample is likely to be biased towards under representing rural areas, where poor educational conditions are likely to exist. Consequently, although *Prova Brasil*'s sample very large coverage, we cannot generalize our findings to rural and/or

[37] Please see Wise and DeMars (2005) for the debate on voluntary low-stakes test and student's performance.

very small schools, which limits the validity of our study to medium and large urban schools in Brazil.

Despite the above-mentioned weaknesses of the *Prova Brasil* assessment system, evidence suggests that it is a well-designed subject proficiency measure and is comparable to international assessments, such as PISA (Crespo Soares et al, 2000; Soares, 2004; Lopes-Rossi 2012). Moreover, since we aim at assessing the longitudinal nature of school resources on pupil's performance over time by region, the large and geographically representative structure of *Prova Brasil* data is well suited and an advantaged for the purposes of our research.

3.3.1. Variables

The *Prova Brasil* waves of 2007, 2009, 2011, 2013, and 2015 are constituted by all public primary schools of the country that met the basic criterion of minimum of 20 students enrolled in the 5th or 9th grades. We focus on 9th graders only, which mean a total of 7,000,069 students, distributed in 30,647 schools from urban areas, the 27 states of the country, and the five geographical regions over a period of nine years. Out of the total of 30,647 urban schools present in our sample, 30,580 are present in all the five waves of *Prova Brasil* considered in our study, which means an attrition rate of only 0.2 percent.

We focus on urban schools only because the year of 2007, our base category for time change, does not include rural schools. The year 2007 is our base category because it is the starting year of the policy we are assessing. We do not have the *Prova Brasil* data for the year 2005, which would provide us with data before 2007, and therefore a more direct measure of the potential impact of the FUNDEB 2007 on school resources and test scores performance over time. Despite this, we keep 2007 as our base category for assessing changes over time because we assume that the consequences to schools of the increase in financial resources caused by the FUNDEB reform did not have immediate effect on the quantity and quality of school resources as well as the test scores performance of the students, our variables of interest. The restriction of our sample to urban schools means that our findings will only be able to be generalized to 66 percent of Brazilian schools given that 34 percent of the schools of the country are located in rural areas (INEP, 2013). We use 9th graders instead of 5th graders because we strongly rely on socioeconomic background questions answered by the students. Older students are more likely to know their parents' educational level and household assets and therefore give more reliable answers for less spurious outcomes. Please see table 3.2 below for the number of students and schools in each year of the *Prova Brasil*.

Table 3.2 Prova Brasil waves, 9th graders

Year	***Pupils***		***Schools***
	Number	*Percentage (%)*	*Number*
2007	*1,398,146*	*20.0*	*20,616*
2009	*875,880*	*12.5*	*12,032*
2011	*1,244,677*	*17.8*	*18,416*
2013	*1,804,491*	*25.8*	*19,114*
2015	*1,676,875*	*24.0*	*19,207*
Total	*7,000,069*	*100.00*	*30,647*

Author's calculations with *Prova Brasil* data from 2007, 2009, 2011, 2013, and 2015.

Table 3.3 below illustrates how we use the *Prova Brasil* tests and surveys to construct the measures used in this chapter. We use information from all four socio-economic surveys (students, teachers, principal, and school), plus test scores results. School's socioeconomic characteristics were taken from the student socio-economic survey. School's infrastructure, facilities, administrative and learning resources measurements were obtained from the school, principal and teacher's surveys. As there was more than one student per school, information from the student's survey and test scores were also aggregated at the school level. Likewise, as there was often more than one teacher who completed the survey per school, the measures from the teacher survey were also aggregated as the average within each school and then merged into the master data-set with measures from the other surveys. This study respects the association between students and their specific teachers aggregated at school level. Studies from Murnane (1975) and Summers and Wolfe (1977) showed the importance of putting together datasets in which inputs of teachers were associated exclusively with the outcomes of their students. Such approach is important for two mains reasons: i) it emphasizes input from the classroom (teacher) level, as well the school level; ii) it associates student level output variables with student-level input variables, rather than school-level input variables (Reynolds et al, 2000).

All the four socio-economic surveys (students, teachers, principal, and school), and the test scores results have in common a unique school identification number that is permanently assigned to schools and allow all the data set to be merged together. All surveys also have in common contextual information such as the type of administration of the school (federal, state or municipal) and location regarding urban/rural, federal state and geographical region.

Table 3.3 Origins of the variables from Prova Brasil for the years of 2007, 2009, 2011, 2013, and 2015

Use	***Measures***	***Survey of Origin***
Outcome	Test scores in mathematics and language	Student – test outcomes
Controls	School Type: state/municipal	All
	Location: region	All
	Socioeconomic Background	Student – socioeconomic questionnaire
Predictors	Year of *Prova Brasil*	All
	Infrastructure: physical	School
	Infrastructure: facilities	School and Principal
	Learning resources	Teacher
	Administrative	Principal and Teacher

Author's compilation with *Prova Brasil* data from 2007, 2009, 2011, 2013 and 2015.

Our outcome variable is mean school's proficiency as measured by test scores in Portuguese language and mathematics for 9th graders. Whereas *Prova Brasil* provides a panel of schools, it does not track students over time, so that it does not allow the calculation of individual-level changes in performance, or 'gain scores' over time, in the terminology of Kane and Staiger (2002). We have also tested a two-level Hierarchical Linear Model[38] (HLM) (pupils nested in schools) using pupil's individual test scores as our outcome variable and found similar results to our present model with mean school test scores as the outcome variable. The scaled average school test scores has a mean of zero and a standard deviation of 1 for the entire sample.

[38] For this test we followed Willms and Raudenbush's (1989) multilevel model that is cross-sectional with respect to each cohort of students, but longitudinal for the repeated observations of each unique schools in Scotland. In this model, pupil's test scores is the outcome variable.

As controls, we use two types of school's contextual characteristics. First, we control for type of administration and location of the schools. Evidence for Brazil and elsewhere has shown that there are significant educational achievement gaps regarding type of school, and geographical region (see, e.g. Klein, 2006; Thomas, 2001; Soares and Alves, 2013). Therefore, our first type of controls will be the following: i) set of dummies of the of school's administrative type as state or municipal; ii) set of dummies for region, with southeast as the reference category. These administrative and location controls are located in all *Prova Brasil* surveys.

As for the second type of controls, we use the socioeconomic characteristics of the schools. The importance of accounting for student background characteristics in any SER study has been widely recognised for some time (see, e.g. Goldstein et al., 1993; Gray et al, 1990; Sammons et al., 1995). In the Brazilian context, the effects of socioeconomic background, skin colour and sex of students on educational achievement has been extensively researched and applied in investigations into school effectiveness (see, e.g. Harbison and Hanushek, 1992; Arias et al, 2002; Fernandes, 2005). This wide evidence has suggested that socioeconomic characteristics must be considered and accounted for in any investigation into the effects of schooling in Brazil. For the present chapter, we will control for the following school socioeconomic characteristics: i) the school SES calculated as an average of a Principal Component Analysis (PCA) of pupil's household assets plus their mother's and father's educational attainment; ii) the school's proportion of white students; iii) the school's proportion of male students. The controls on socioeconomic school's characteristics are taken from the student's socioeconomic survey and aggregated at school-level.

Our main predictor is 'year of *Prova Brasil*'. According to Gray at al (1995), the improvement of schools takes place over extended periods of time. Therefore, we use the years of 2007, 2009, 2011, 2013 and 2015, which are coded as a set of dummies with the year of 2007 as the reference category.

As also mentioned above, in Harbison and Hanushek's (1992) school effectiveness research in developing nations, most of the studies concluded that school infrastructure, access to learning resources, and teacher education had a significant effect on school performance. More recent analyses have supported and advanced these conclusions (Teddlie and Reynolds, 2000; Soares et al, 2001; Ferrão and Fernandes, 2003; Gaviria et al 2004; Lee et al, 2005; Franco et al, 2007; Biondi and Felício, 2007; Murillo and Román, 2011). We will use school resources predictors that might have been affected by the 2007 FUNDEB financial and redistributive reform. Such predictors, together with the time predictor, will provide a figure of the dynamics of the school effects over time in Brazil.

Four blocks of predictors are constructed to represent school resources that are assessed in the national literature on SER (Harbison and Hanushek, 1992; Gaviria et al, 2004; Franco et al, 2007; Biondi and Felício, 2007; Murillo and Román, 2011; Paget et al, 2016; Soares et al, 2016). The first block is designed to represent the quality of the schools' physical infrastructure using items from the school's survey. The infrastructure components of the school were rated by an external evaluator on a four-step ordinal scale of zero (i.e. 'does not exist') to three (i.e. 'good'). The measure of infrastructure is created by adding infrastructure-related variables together (roof, walls, floors, doors, entrance, windows, bathrooms, hallways, schoolyard, kitchen, classrooms, plumbing/water, and electricity) and re-escalating their total sum into a three-step ordinal variable (good; regular, bad) that provides a summary of the current state of the school's infrastructure.

The second block of predictors is constructed to represent the quality of the schools' facilities using items from the school's and principal's surveys. The facilities' components of the school were rated by an external evaluator and the principal on a four-step ordinal scale of zero (i.e. 'does not exist') to three (i.e. 'good'). The measure of facilities is created by adding facilities-related variables (access to computer and internet for students and teachers, computers for the administration of the school, DVDs, DVD player, TV, stereo, library, sports quad, projectors, slides projector, photocopier, printer, lad, auditory, music and arts room) together and recoding their total sum into a three-step ordinal variable ('good', 'regular', 'bad').

The third block – schools' learning resources – is represented by the access to textbooks using items from the teacher's survey. The availability of textbooks is rated by the teachers on a six-step ordinal scale of zero (i.e. 'no textbooks for students') to five (i.e. 'textbooks for all students'). The availability of textbooks was summed-up and recoded into a three-step ordinal variable ('less than half', 'half', 'more than half') to provide the proportion of textbooks students have access to in the school.

The fourth block represents school's administrative resources and is constructed using teacher's and principal's survey. This block is made of five variables. The school's proportion of teachers with university degree and with teachers earning below the salary floor are taken from the teacher's survey and the respective proportions are calculated at school level. The remaining three variables of this block are taken from the principal's survey and therefore are originally at school-level. The principal answered whether the functioning of the school had been affected by problems regarding lack of administrative staff, high absence of teachers and lack of teachers. The original answers are a four-step ordinal scale of zero (i.e. 'no') to four (i.e. 'yes, a lot') that are recoded into a three-step ordinal variable.

3.3.2. Longitudinal model with school fixed effects

In order to analyse the temporal dynamics of the influence of spending-related school resources on average school performance in Brazil, we estimate a longitudinal model with school fixed effects using a panel of schools covering the entire Brazilian territory for 9 years. We use a multiple regression framework to identify the contribution of school resources in predicting average school performance as measured by test scores in maths for 9th graders by region. For the whole country and each of its geographical regions, we enter the variables on school's socioeconomic context and resources into our model in orderly blocks as illustrated by the following descriptions and equations:

Specification 1: school's contextual characteristics

This specification establishes the predictive relationship between the mean school test scores in maths for 9th graders and schools' socioeconomic context, region and administrative type in order to establish them as the controls for the ensuing models. This specification can be expressed with the equation:

$$\boldsymbol{Y_{it} = \beta_0 + \beta_1 TI_{it} + \beta_2 TS_i + \beta_3 RE_i + \beta_4 CO_{it} + \varepsilon_{it}}$$

Where:

i = schools;

t = year of *Prova Brasil*: 2007, 2009, 2011, 2013, 2015;

Y*it* = mean test score for the school *i* in the year *t*;

B_0 = intercept;

ε_{it} = residual term.

TI = year of *Prova Brasil*: 2007, 2009, 2011, 2013, 2015;

TS = type of school as state or municipal (fixed-effect);

RE = regions south, southeast, midwest, north and northeast (fixed-effect);

CO = vector of school contextual controls: proportion of male pupils; proportion of white pupils; and average SES;

Specification 2: school's spending-related resources

This specification examines the predictive relationship between the mean school test scores in maths for 9th graders and spending-related school resources after controlling for school's contextual characteristics.

$$Y_{it} = \beta_0 + \beta_1 TI_{it} + \beta_2 TS_i + \beta_3 RE_i + \beta_4 CO_{it} + \beta_5 SR_{it} + \varepsilon_{it}$$

Where:

SR = vector of spending-related school resources: proportion of teachers with university degree; proportion of teachers earning below the salary floor; quality of infrastructure; quality of facilities; availability of textbooks; lack of administrative staff; high absence of teachers; lack of teachers.

By using fixed-effects model in longitudinal data we can eliminate unobserved variables that are specific to each school and are fixed (or time-invariant) over time. This, however, only eliminates the correlation between the independent variables and the fixed effects. If independent variables are correlated with the error term which contains time-varying unobserved characteristics, then the estimated coefficients would be biased. As it is inevitable to have unobserved variables in a fixed-effects model, our model will likely have some degree of omitted variable bias. Also, the model does not control for unmeasured stable characteristics whose effects change across time (Treiman 2009), such as the effect of time-invariant gender on learning that might be different at different ages. In the particular case of our model with average school test scores performance as the dependent variable, there are time varying factors that could be affecting school performance over time that however cannot be measured, consequently limiting the interpretation of the outcomes. Among these potential time varying factors, there is the economic growth that Brazil experienced during the period considered in this analysis. Economic growth changes over time and, when there is positive growth, job opportunities and family's affordability to buy goods tend to increase, for instance, which could positively affect the attitudes of parents regarding their offspring's outcomes at school, leading to an overall upward trend in test scores performance. Also, improvements in teachers' training courses could also happen across the years leading to better teaching practices inside the classrooms, which could also be associated with upward trends in performance. Competition between schools might arise with the participation in a countrywide assessment system such as *Prova Brasil*, consequently motivating the school staff to improve their pedagogical practices in order to do better in the exam and see the performance of their school evolving over time. These are some of the time varying factors that could also affect average test scores performance across the years and cannot be measured by our model, but should be taken into account in the interpretation of our findings.

3.4. Outcomes

Table 3.4 below has the descriptive statistics of all variables used in our analysis.

Table 3.4 Descriptive statistics of the Prova Brasil variables for the years of 2007, 2009, 2011, 2013 and 2015, 9th graders, Brazil

		Mean	Std. Dev.	Min	Max	Observations
Region South	Overall	.174	.379	0	1	N = 89,385
Region Midwest	Overall	.088	.283	0	1	N = 89,385
Region Northeast	Overall	.254	.435	0	1	N = 89,385
Region North	Overall	.069	.254	0	1	N = 89,385
Region Southeast (Ref.)	Overall	.414	.492	0	1	N = 89,385
Year of 2007	Overall	.231	.421	0	1	N = 89,385
	Between		.253	0	1	n = 30,647
	Within		.380	-.269	1.031	T-bar = 2.917
Year of 2009	Overall	.135	.341	0	1	N = 89,385
	Between		.179	0	1	n = 30,647
	Within		.305	-.365	.935	T-bar = 2.917
Year of 2011	Overall	.206	.404	0	1	N = 89,385
	Between		.198	0	1	n = 30,647
	Within		.373	-.294	1.006	T-bar = 2.917
Year of 2013	Overall	.214	.410	0	1	N = 89,385
	Between		.212	0	1	n = 30,647
	Within		.376	-.286	1.014	T-bar = 2.917
Year of 2015	Overall	.215	.411	0	1	N = 89,385
	Between		.231	0	1	n = 30,647
	Within		.373	-.285	1.015	T-bar = 2.917
School Mean Test Scores Maths	Overall	-.090	.356	-1.867	2.256	N = 89,334
	Between		.329	-1.867	2.082	n = 30,603
	Within		.164	-1.648	1.506	T-bar = 2.919
School Mean Test Scores Language	Overall	-.204	.354	-2.014	1.621	N = 89,334
	Between		.316	-2.014	1.553	n = 30,603
	Within		.193	-1.651	1.308	T-bar = 2.919
School's Proportion of Male Pupils	Overall	41.413	10.024	0	1	N = 89,385
	Between		7.707	0	1	n = 30,647
	Within		7.673	2.813	86.913	T-bar = 2.917
School's Proportion of White Pupils	Overall	32.466	17.533	0	100	N = 89,385
	Between		16.142	0	100	n = 30,647
	Within		8.1742	-13.934	85.216	T-bar = 2.97
School Mean Socio-economic Status (SES)	Overall	-.130	1.062	-4.204	8.377	N = 89,218
	Between		1.040	-3.857	8.377	n = 30,621
	Within		.346	-2.417	2.885	T-bar = 2.914
School Proportion of Teachers with University Degree	Overall	92.065	25.643	0	100	N = 89,385
	Between		16.865	0	100	n = 30,647
	Within		20.840	12.065	170.86	T-bar = 2.917
School Proportion of Teachers Earning BELOW the Floor	Overall	20.221	38.299	0	100	N = 89,385
	Between		30.130	0	100	n = 30,647
	Within		27.541	-59.779	100.22	T-bar = 2.917
School Quality of Infrastructure	Overall	2.579	.600	1	3	N = 89,385
	Between		.458	1	3	n = 30,647
	Within		.433	.979	4.179	T-bar = 2.917
School Quality of Facilities	Overall	1.923	.650	1	3	N = 89,385
	Between		.512	1	3	n = 30,647
	Within		.445	.323	3.523	T-bar = 2.917
School Availability of Textbooks	Overall	3.357	1.377	1	5	N = 89,306
	Between		.991	1	5	n = 30,639
	Within		1.049	.157	6.557	T-bar = 2.915
School Lack of Administrative Staff	Overall	2.715	.667	1	3	N = 89,385
	Between		.498	1	3	n = 30,647

	Within		.509	1.115	4.315	T-bar = 2.917
School High Absence of Teachers	Overall	1.634	.702	1	3	N = 89,385
	Between		.541	1	3	n = 30,647
	Within		.472	.034	3.234	T-bar = 2.917
School Lack of Teachers	Overall	1.766	.738	1	3	N = 89,385
	Between		.554	1	3	n = 30,647
	Within		.527	.166	3.366	T-bar = 2.917

Author's calculations with *Prova Brasil* data from 2007, 2009, 2011, 2013 and 2015.

In order to answer our first question on to what extent school resources predict school average achievement in mathematics and language between 2007 and 2015 on the *Prova Brasil's* tests for 9th graders, we have run a longitudinal model for the entire Brazilian territory as table 3.5 below shows. We have also run sub-group analysis to consider sub-group variation by region and the outcomes are displayed in item 3.4.1 below.

Average test scores performance has significantly improved for each additional year of *Prova Brasil*, particularly for mathematics in the year of 2015. For maths, in 2009, 2011, 2013 and 2015 schools score respectively 4, 11, 13 and 24 of a standard deviation higher than the same schools in 2007. In language the average gains in score are approximately twice higher: in 2009, 2011, 2013 and 2015 schools score respectively 19, 21, 23, and 37 of a standard deviation higher than the same schools in 2007. Our study therefore suggests an overall upward trend in average school performance over time of 20 percent for maths and 18 percent for language scores.

The specifications 1 and 3 of the table 3.5 below show the parameter estimates for the effect of the average student intake. Other things being equal, the proportion of male students does not seem to have an influence on average school performance for maths and language (less than 0.01 of a standard deviation), despite statistically significant. For maths, schools with a higher proportion of boys score positively whereas for language schools with a higher proportion of boys score negatively. The proportion of white students has a very small positive and significant effect on average school test scores performance. Schools with higher mean SES perform, on average, 4 of a standard deviation higher in maths than their counterparts with poorer student intake, and 3.4 higher in language.

The specifications 2 and 4 of the table 3.5 below add school variables to the model. Overall, the inclusion of these variables does not change the coefficients of average school's contextual characteristics. School resources variables seem to have a significant effect on average school performance, but the effect is very small for both subjects. An increase in one of the frequency of teacher's absence decreases, on average, school's performance by 1.2 of a standard deviation. Likewise, an increase in one unit in the availability of textbooks increases the average school performance by 0.06 of a standard deviation in maths and 1 in language.

An increase in one unit in quality of infrastructure increases by 0.06 of a standard deviation in maths and 0.08 in language. The other school resources variables, despite significant, present coefficients below 0.05 of a standard deviation. There is a significant proportion of teachers whose salaries are below the floor, but this proportion has a very small negative effect on school's average performance.

Table 3.5 School fixed-effects regression model

	MATHEMATICS		LANGUAGE	
Outcome Measure:	**(1)**	**(2)**	**(3)**	**(4)**
School Mean Test Scores on MATHEMATICS AND LANGUAGE	**School Context Controls**	**School Explanatory Variables**	**School Context Controls**	**School Explanatory Variables**
Fixed Parameters				
Year of 2009 (Ref.: 2007*)	0.037***	0.039***	0.192***	0.193***
	(0.00237)	(0.00249)	(0.00248)	(0.00262)
Year of 2011 (Ref.: 2007*)	0.117***	0.115***	0.215***	0.211***
	(0.00211)	(0.00226)	(0.00221)	(0.00237)
Year of 2013 (Ref.: 2007*)	0.130***	0.130***	0.233***	0.233***
	(0.00259)	(0.00267)	(0.00271)	(0.00280)
Year of 2015 (Ref.: 2007*)	0.237***	0.236***	0.374***	0.373***
	(0.00267)	(0.00273)	(0.00280)	(0.00287)
School's Proportion of Male Pupils	0.001***	0.001***	-0.002***	-0.002***
	(9.66e-05)	(9.64e-05)	(0.000101)	(0.000101)
School's Proportion of White Pupils	0.003***	0.003***	0.003***	0.003***
	(9.91e-05)	(9.90e-05)	(0.000104)	(0.000104)
School Mean Socio-economic status (SES)	0.041***	0.040***	0.034***	0.034***
	(0.00187)	(0.00187)	(0.00196)	(0.00196)
School Proportion of Teachers with University Degree		5.00e-05		5.40e-05*
		(3.13e-05)		(3.28e-05)
Schools Proportion of Teachers Earning BELOW the Floor		-8.75e-05***		-0.0001***
		(2.25e-05)		(2.36e-05)
School Quality of Infrastructure		0.006***		0.008***
		(0.00146)		(0.00153)
School Quality of Facilities		0.002		0.001
		(0.00151)		(0.00158)
School Availability of Textbooks		0.006***		0.009***
		(0.00122)		(0.00128)
School Lack of Administrative Staff		-0.0003		0.002**
		(0.00119)		(0.00125)
School High Absence of Teachers		-0.012***		-0.011***
		(0.00138)		(0.00144)
School Lack of Teachers		-0.004***		-0.003**
		(0.00126)		(0.00132)
Constant/Intercept	-0.321***	-0.333***	-0.402***	-0.433***
	(0.00583)	(0.00887)	(0.00612)	(0.00930)
Random Part				
/sigma_u (between subject)	.279	.277	.268	.266
/sigma_e (within subject)	.183	.183	.192	.192
rho	.699	.697	.660	.657
Number of Unique Schools	30,580	30,580	30,580	30,580
Number of Observations	89,177	89,177	89,177	89,177

Author's calculations with *Prova Brasil* data from 2007, 2009, 2011, 2013 and 2015.
Standard errors in parentheses *** p<0.01, ** p<0.05, * p< 0.10.

3.4.1. Outcomes by region

In order to assess the question of whether spending-related school resources affect school average performance differently by region we have run our model separately for each

region. Other things being equal, each year of *Prova Brasil* represents a gain in average school's performance for all regions.

In the more affluent regions of southeast, south and midwest the changes in average test score performance over time are as follows. **Southeast** (table 3.6): for maths, in 2009, 2011, 2013 and 2015 schools score respectively 5, 13, 14 and 21 of a standard deviation higher than the same schools in 2007. For language the gains in performance are higher: in 2009, 2011, 2013 and 2015 schools score respectively 20, 23, 23, and 34 of a standard deviation higher than the same schools in 2007. **South** (table 3.7): for maths, in 2009, 2011, 2013 and 2015 schools score respectively 8, 13, 11 and 24 of a standard deviation higher than the same schools in 2007. For language the gains in performance are higher: in 2009, 2011, 2013 and 2015 schools score respectively 23, 22, 24, and 42 of a standard deviation higher than the same schools in 2007. **Midwest** (table 3.8): in maths, in 2009, 2011, 2013 and 2015 schools score respectively 1, 9, 13 and 25 of a standard deviation higher than the same schools in 2007. In language the gains in performance are higher: in 2009, 2011, 2013 and 2015 schools score respectively 21, 23, 28, and 43 of a standard deviation higher than the same schools in 2007.

In the poorer regions of northeast and north, schools perform as follows over time. **Northeast** (table 3.10): for maths schools perform in 2009, 2011, 2013 and 2015 respectively 2.5, 8, 11, and 26 of a standard deviation higher than the same schools in 2007. For language the gains are also higher for northeastern schools: in 2009, 2011, 2013 and 2015 schools score respectively 17, 17, 21, and 38 of a standard deviation higher than the same schools in 2007. **North** (table 3.9): for maths schools perform in 2011, 2013 and 2015 respectively 8, 10, and 20 of a standard deviation higher than the same schools in 2007. For language the gains are also higher for northeastern schools: in 2009, 2011, 2013 and 2015 schools score respectively 18, 17, 22, and 33 of a standard deviation higher than the same schools in 2007.

Our models do not suggest that the more disadvantaged northeast and north regions are doing better, or that the regional performance gaps are decreasing over time, as it was intended by the recent FUNDEB reform. On the contrary, the average gains in school performance over time is lower for the poorer regions of northeast and north compared to the more affluent regions of southeast, south and midwest. Furthermore, regional analyses on the effect of specific resources on average school performance show that the differences are small and we cannot observe a clear and systematic pattern. High absence of teachers is the strongest predictor and is significant for all regions. It predicts 1.3 and 1.1 percent of school performance respectively in the southeast and south for both subjects. In the midwest is predicts 1.8 percent for maths and 1.5 percent for language. In the north it predicts 2.2 percent for maths and 1.9 percent for language whereas in the northeast it predicts only 0.8 percent for both subjects.

Quality of school infrastructure, for instance, is insignificant in predicting average school for the wealthier south for maths and language. It is also insignificant in predicting school performance for maths in the poorer northeast and north. Quality of school infrastructure predicts school average performance in the midwest by 2 of a standard deviation for maths and language whereas it predicts 1 of a standard deviation in the north for language, and less than 0.05 in the northeast for language, and southeast for both subjects. Quality of school's facilities is insignificant in the south, and presents a very low significance level in the southeast and midwest. In the northeast it predicts 0.7 of a standard deviation for both subjects whereas in the north it predicts 1.3 of a standard deviation only for language. Availability of textbooks is insignificant in the midwest whereas it predicts 1.4 and 1.8 of a standard deviation in the north for maths and language respectively. In the southeast it predicts 0.6 and 0.9 of a standard deviation for maths and language respectively. In the south it predicts 0.8 of a standard deviation for both subjects whereas in the northeast the predictability is even lower for maths (0.6) and low for language (0.8). Lack of administrative staff is insignificant for the poorer northeast and north whereas it has a very low significance level for both subjects in the midwest and southeast regions. In the south it predicts 1 of a standard deviation for both subjects. Lack of teachers is insignificant in the north for maths and significant for language (1.9 of a standard deviation) while it predicts 0.8 of a standard deviation of school average performance in the northeast for both subjects. Similarly, it predicts 0.8 of a standard deviation of school performance for maths and 0.7 for language in the wealthier southeast. In the midwest lack of teachers predicts 1 of a standard deviation of school performance for both subjects whereas in the south it is insignificant in predicting maths and it predicts language by 0.6 of a standard deviation.

The influence of school's mean SES present significant effect in predicting average school's performance in all regions. While the average effect of school SES on school test scores performance is 4 of a standard deviation for maths and 3.5 for language in Brazil, its influence in the regions of southeast (3.3 for maths and 2.6 for language), south (3 for maths and 2 for language) and north (2.2 for maths and 2.1 for language) is slightly reduced. The effect of school SES on average school performance is higher for the poorer northeast region (around 5 of a standard deviation for both subjects) and midwest region (5 of a standard deviation for maths and 3.4 for language).

Table 3.6 School fixed-effects regression model for Southeast

Outcome Measure: School Mean Test Scores on MATHEMATICS AND LANGUAGE	MATHEMATICS (1) School Context Controls	MATHEMATICS (2) School Explanatory Variables	LANGUAGE (1) School Context Controls	LANGUAGE (2) School Explanatory Variables
Fixed Parameters				
Prova Brasil 2009 (Ref.: 2007*)	0.046***	0.051***	0.192***	0.196***
	(0.00341)	(0.00367)	(0.00357)	(0.00384)
Prova Brasil 2011 (Ref.: 2007*)	0.131***	0.132***	0.233***	0.233***
	(0.00315)	(0.00336)	(0.00329)	(0.00351)
Prova Brasil 2013 (Ref.: 2007*)	0.139***	0.139***	0.226***	0.227***
	(0.00387)	(0.00399)	(0.00405)	(0.00417)
Prova Brasil 2015 (Ref.: 2007*)	0.214***	0.213***	0.344***	0.343***
	(0.00413)	(0.00420)	(0.00431)	(0.00439)
School's Proportion of Male Pupils	-0.0002*	-0.0002	-0.003***	-0.003***
	(0.000153)	(0.000153)	(0.000160)	(0.000160)
School's Proportion of White Pupils	0.003***	0.003***	0.003***	0.003***
	(0.000160)	(0.000159)	(0.000167)	(0.000167)
School Mean Socio-economic status (SES)	0.033***	0.033***	0.026***	0.026***
	(0.00296)	(0.00295)	(0.00309)	(0.00309)
School Proportion of Teachers with University Degree		8.28e-05*		6.88e-05
		(4.78e-05)		(4.99e-05)
Schools Proportion of Teachers Earning BELOW the Floor		-0.0001***		-0.0001***
		(3.53e-05)		(3.69e-05)
School Quality of Infrastructure		0.004*		0.005**
		(0.00226)		(0.00236)
School Quality of Facilities		0.004*		0.002
		(0.00222)		(0.00232)
School Availability of Textbooks		0.006***		0.009***
		(0.00182)		(0.00190)
School Lack of Administrative Staff		-0.005***		-0.002
		(0.00169)		(0.00177)
School High Absence of Teachers		-0.013***		-0.013***
		(0.00198)		(0.00207)
School Lack of Teachers		-0.008***		-0.007***
		(0.00183)		(0.00191)
Constant/Intercept	-0.201***	-0.195***	-0.300***	-0.307***
	(0.00952)	(0.0141)	(0.00995)	(0.0147)
Random Part				
/sigma u (between subject)	.275	.272	.253	.250
/sigma e (within subject)	.176	.176	.184	.184
rho	.708	.704	.653	.649
Number of Unique Schools	11,457	11,457	11,457	11,457
Number of Observations	36,969	36,969	36,969	36,969

Author's calculations with *Prova Brasil* data from 2007, 2009, 2011, 2013 and 2015.
Standard errors in parentheses *** p<0.01, ** p<0.05, * p< 0.10.

Table 3.7 School fixed-effects regression model for South

Outcome Measure: School Mean Test Scores on MATHEMATICS AND LANGUAGE	MATHEMATICS (1) School Context Controls	MATHEMATICS (2) School Explanatory Variables	LANGUAGE (1) School Context Controls	LANGUAGE (2) School Explanatory Variables
Fixed Parameters				
Prova Brasil 2009 (Ref.: 2007*)	0.081***	0.085***	0.226***	0.230***
	(0.00749)	(0.00777)	(0.00785)	(0.00815)
Prova Brasil 2011 (Ref.: 2007*)	0.132***	0.131***	0.222***	0.220***
	(0.00494)	(0.00519)	(0.00518)	(0.00544)
Prova Brasil 2013 (Ref.: 2007*)	0.107***	0.109***	0.242***	0.244***
	(0.00682)	(0.00693)	(0.00715)	(0.00727)
Prova Brasil 2015 (Ref.: 2007*)	0.236***	0.237***	0.416***	0.417***
	(0.00708)	(0.00715)	(0.00742)	(0.00751)
School's Proportion of Male Pupils	0.001***	0.001***	-0.002***	-0.002***
	(0.000225)	(0.000225)	(0.000236)	(0.000236)
School's Proportion of White Pupils	0.003***	0.003***	0.004***	0.004***
	(0.000211)	(0.000211)	(0.000222)	(0.000221)
School Mean Socio-economic status (SES)	0.030***	0.030***	0.020***	0.020***
	(0.00432)	(0.00432)	(0.00453)	(0.00453)
School Proportion of Teachers with University Degree		0.0001**		0.0002**
		(9.32e-05)		(9.77e-05)
Schools Proportion of Teachers Earning BELOW the Floor		-0.0001**		-9.99e-05*
		(5.66e-05)		(5.94e-05)
School Quality of Infrastructure		-0.002		0.002
		(0.00378)		(0.00396)
School Quality of Facilities		-0.002		-3.65e-05
		(0.00367)		(0.00385)
School Availability of Textbooks		0.008**		0.008**
		(0.00348)		(0.00365)
School Lack of Administrative Staff		0.011***		0.0102***
		(0.00303)		(0.00318)
School High Absence of Teachers		-0.010***		-0.011***
		(0.00345)		(0.00362)
School Lack of Teachers		0.002		0.00608*
		(0.00308)		(0.00323)
Constant/Intercept	-0.264***	-0.299***	-0.409***	-0.466***
	(0.0164)	(0.0250)	(0.0172)	(0.0262)
Random Part				
/sigma u (between subject)	.248	.248	.230	.229
/sigma e (within subject)	.189	.189	.198	.198
Rho	.632	.632	.574	.573
Number of Unique Schools	5,447	5,447	5,447	5,447
Number of Observations	15,582	15,582	15,582	15,582

Author's calculations with *Prova Brasil* data from 2007, 2009, 2011, 2013 and 2015.
Standard errors in parentheses *** p<0.01, ** p<0.05, * p< 0.10.

Table 3.8 School fixed-effects regression model for Midwest

Outcome Measure: School Mean Test Scores on MATHEMATICS AND LANGUAGE	MATHEMATICS (1) School Context Controls	MATHEMATICS (2) School Explanatory Variables	LANGUAGE (1) School Context Controls	LANGUAGE (2) School Explanatory Variables
Fixed Parameters				
Prova Brasil 2009 (Ref.: 2007*)	0.005	0.010	0.205***	0.210***
	(0.00743)	(0.00795)	(0.00772)	(0.00827)
Prova Brasil 2011 (Ref.: 2007*)	0.087***	0.092***	0.220***	0.224***
	(0.00767)	(0.00821)	(0.00798)	(0.00854)
Prova Brasil 2013 (Ref.: 2007*)	0.131***	0.135***	0.282***	0.284***
	(0.00876)	(0.00903)	(0.00911)	(0.00939)
Prova Brasil 2015 (Ref.: 2007*)	0.245***	0.249***	0.424***	0.426***
	(0.00920)	(0.00931)	(0.00956)	(0.00969)
School's Proportion of Male Pupils	0.002***	0.002***	-0.002***	-0.002***
	(0.000311)	(0.000310)	(0.000323)	(0.000323)
School's Proportion of White Pupils	0.001***	0.001***	0.001***	0.001***
	(0.000339)	(0.000338)	(0.000353)	(0.000352)
School Mean Socio-economic status (SES)	0.050***	0.050***	0.035***	0.034***
	(0.00593)	(0.00591)	(0.00617)	(0.00615)
School Proportion of Teachers with University Degree		-3.40e-06	-0.355***	4.46e-05
		(9.84e-05)	(0.0191)	(0.000102)
Schools Proportion of Teachers Earning BELOW the Floor		-5.33e-05		-0.0001
		(8.29e-05)		(8.62e-05)
School Quality of Infrastructure		0.020***		0.021***
		(0.00463)		(0.00482)
School Quality of Facilities		-0.010*		-0.009*
		(0.00507)		(0.00528)
School Availability of Textbooks		-0.001		0.0005
		(0.00385)		(0.00401)
School Lack of Administrative Staff		0.007*		0.007*
		(0.00387)		(0.00403)
School High Absence of Teachers		-0.018***		-0.015***
		(0.00486)		(0.00506)
School Lack of Teachers		-0.010**		-0.010**
		(0.00425)		(0.00442)
Constant/Intercept	-0.263***	-0.262***		-0.371***
	(0.0184)	(0.0282)		(0.0294)
Random Part				
/sigma u (between subject)	.234	.232	.238	.236
/sigma e (within subject)	.181	.180	.188	.188
rho	.625	.624	.614	.612
Number of Unique Schools	2,555	2,555	2,555	2,555
Number of Observations	7,841	7,841	7,841	7,841

Author's calculations with *Prova Brasil* data from 2007, 2009, 2011, 2013 and 2015.
Standard errors in parentheses *** p<0.01, ** p<0.05, * p< 0.10.

Table 3.9 School fixed-effects regression model for North

Outcome Measure: School Mean Test Scores on MATHEMATICS AND LANGUAGE	MATHEMATICS (1) School Context Controls	MATHEMATICS (2) School Explanatory Variables	LANGUAGE (1) School Context Controls	LANGUAGE (2) School Explanatory Variables
Fixed Parameters				
Prova Brasil 2009 (Ref.: 2007*)	0.017*	0.014	0.189***	0.184***
	(0.00912)	(0.00967)	(0.00910)	(0.00963)
Prova Brasil 2011 (Ref.: 2007*)	0.088***	0.078***	0.183***	0.166***
	(0.00784)	(0.00855)	(0.00782)	(0.00852)
Prova Brasil 2013 (Ref.: 2007*)	0.100***	0.100***	0.223***	0.219***
	(0.00964)	(0.0101)	(0.00962)	(0.0100)
Prova Brasil 2015 (Ref.: 2007*)	0.201***	0.202***	0.335***	0.331***
	(0.00888)	(0.00914)	(0.00886)	(0.00911)
School's Proportion of Male Pupils	0.002***	0.002***	-0.001***	-0.001***
	(0.000377)	(0.000376)	(0.000376)	(0.000374)
School's Proportion of White Pupils	0.001**	0.001**	0.002***	0.002***
	(0.000475)	(0.000474)	(0.000474)	(0.000472)
School Mean Socio-economic status (SES)	0.023***	0.022***	0.023***	0.021***
	(0.00657)	(0.00656)	(0.00656)	(0.00654)
School Proportion of Teachers with University Degree		-4.53e-05		4.94e-05
		(0.000107)		(0.000107)
Schools Proportion of Teachers Earning BELOW the Floor		-6.22e-05		0.0001
		(0.000109)		(0.000108)
School Quality of Infrastructure		0.008		0.010**
		(0.00517)		(0.00515)
School Quality of Facilities		0.003		0.013**
		(0.00575)		(0.00573)
School Availability of Textbooks		0.014***		0.018***
		(0.00413)		(0.00411)
School Lack of Administrative Staff		0.006		0.001
		(0.00455)		(0.00453)
School High Absence of Teachers		-0.021***		-0.019***
		(0.00525)		(0.00523)
School Lack of Teachers		0.006		0.009**
		(0.00477)		(0.00475)
Constant/Intercept	-0.425***	-0.468***	-0.469***	-0.556***
	(0.0201)	(0.0306)	(0.0200)	(0.0305)
Random Part				
/sigma u (between subject)	.229	.226	.231	.228
/sigma e (within subject)	.178	.177	.178	.177
rho	.623	.619	.629	.626
Number of Unique Schools	2,354	2,354	2,354	2,354
Number of Observations	6,167	6,167	6,167	6,167

Author's calculations with *Prova Brasil* data from 2007, 2009, 2011, 2013 and 2015.
Standard errors in parentheses *** p<0.01, ** p<0.05, * p< 0.10.

Table 3.10 School fixed-effects regression model for Northeast

Outcome Measure: School Mean Test Scores on MATHEMATICS AND LANGUAGE	MATHEMATICS (1) School Context Controls	MATHEMATICS (2) School Explanatory Variables	LANGUAGE (1) School Context Controls	LANGUAGE (2) School Explanatory Variables
Fixed Parameters				
Prova Brasil 2009 (Ref.: 2007*)	0.027***	0.026***	0.178***	0.176***
	(0.00473)	(0.00489)	(0.00509)	(0.00526)
Prova Brasil 2011 (Ref.: 2007*)	0.088***	0.083***	0.179***	0.171***
	(0.00442)	(0.00493)	(0.00475)	(0.00530)
Prova Brasil 2013 (Ref.: 2007*)	0.113***	0.109***	0.218***	0.213***
	(0.00520)	(0.00552)	(0.00559)	(0.00594)
Prova Brasil 2015 (Ref.: 2007*)	0.263***	0.259***	0.385***	0.379***
	(0.00526)	(0.00557)	(0.00565)	(0.00599)
School's Proportion of Male Pupils	0.002***	0.002***	-0.002***	-0.002***
	(0.000188)	(0.000188)	(0.000202)	(0.000202)
School's Proportion of White Pupils	0.0005**	0.0005**	0.0009***	0.001***
	(0.000224)	(0.000224)	(0.000241)	(0.000241)
School Mean Socio-economic status (SES)	0.055***	0.055***	0.050***	0.050***
	(0.00387)	(0.00386)	(0.00415)	(0.00415)
School Proportion of Teachers with University Degree		-3.40e-05		-2.98e-05
		(5.87e-05)		(6.31e-05)
Schools Proportion of Teachers Earning BELOW the Floor		2.80e-05		-3.14e-05
		(4.02e-05)		(4.32e-05)
School Quality of Infrastructure		0.004		0.006**
		(0.00284)		(0.00305)
School Quality of Facilities		0.008**		0.007**
		(0.00318)		(0.00342)
School Availability of Textbooks		0.006**		0.008***
		(0.00246)		(0.00264)
School Lack of Administrative Staff		-0.001		0.002
		(0.00266)		(0.00286)
School High Absence of Teachers		-0.008***		-0.006*
		(0.00292)		(0.00314)
School Lack of Teachers		-0.008***		-0.008***
		(0.00273)		(0.00294)
Constant/Intercept	-0.446***	-0.452***	-0.505***	-0.531***
	(0.0117)	(0.0175)	(0.0126)	(0.0188)
Random Part				
/sigma_u (between subject)	.251	.250	.261	.259
/sigma_e (within subject)	.188	.188	.202	.202
rho	.641	.638	.625	.622
Number of Unique Schools	8,767	8,767	8,767	8,767
Number of Observations	22,618	22,618	22,618	22,618

Author's calculations with *Prova Brasil* data from 2007, 2009, 2011, 2013 and 2015.
Standard errors in parentheses *** p<0.01, ** p<0.05, * p< 0.10.

3.5. Conclusions

In order to enhance our understanding of the association between school resources and 9th graders' test scores achievement in urban Brazil, we use five waves (2007, 2009, 2011, 2013 and 2015) of nationally representative assessment data. Beyond the methods and findings of this chapter, we hope it raises awareness on the potential and limitations of the *Prova Brasil* database for an international audience as it is one of the very few English language investigations that outlined the *Prova Brasil* assessment system[39]. The advantages of using the *Prova Brasil* test to measure educational achievement are the reliability and validity of the instrument developed for over 20 years; the wide geographical coverage of the test in a large country; the comparability over time and between grades (5th and 9th grades); the comparability to other international measures (such as PISA); and the carefully developed and detailed scales used to interpret the scores into a practical understanding of students' ability and knowledge.

One of the disadvantages of using these measures is that non-cognitive or other cognitive measures such as procrastination, time management, self-confidence or self-perception, are not fully considered. Moreover, the use of aggregate measures discards most of the variance in achievement between students in the same school. This study also does not consider school's organizational factors (Lee et all, 1993), which might influence the internal allocation of resources. The *Prova Brasil*'s panel of schools also brings one important limitation of causality for the analysis of the effectiveness of the FUNDEB reform. The panel of schools started in 2007, the same year of the implementation of FUNDEB. We therefore do not have information on the situation of the same schools before the implementation of FUNDEB and cannot directly measure the impact of this policy. Nevertheless, we assume that the consequences to schools and students of the increase in financial resources caused by the FUNDEB reform that started in 2007 did not have immediate effect on the quantity and quality of schools' resources as well as the test scores performance of the students, our variables of interest. Therefore, we keep 2007 as our base category for comparison with the subsequent years of *Prova Brasil*. Our analysis also brings other two main limitations regarding its external

[39] For other more empirical evidence on *Prova Brasil* in English language, please check: Leme et al (2012), Soares and Alves (2013), Simoes and Sabates (2014), Paget et al (2016), and Soares et al (2016).

validity. First, *Prova Brasil* does not include schools with less than 20 students enrolled. Secondly, we exclude rural schools from our analysis, as the year 2007, our base category, does not include rural schools in its sample. The restriction of our sample to urban schools means that our findings are only able to be generalized to 66 percent of Brazilian schools given that 34 percent of the schools of the country are located in rural areas. Consequently, although *Prova Brasil*'s sample very large coverage, we cannot generalize our findings to rural and/or very small schools, which restricts the validity of our study to medium and large urban schools in the country. The results of this chapter should therefore be interpreted with caution due to the mixed cross-sectional and longitudinal nature of the data, the voluntary and low-stakes nature of the testing, and the absence of very small and rural schools.

Answering the research question on stability or change in average scholastic performance as measured by test scores over time, our study finds upward trends in average school performance over time for language and mathematics. This upward trend contradicts the main literature on that school effects may be far more stable over time than they have appeared when estimated by means of conventional cross-sectional, single level linear models as proposed by Willms and Raudenbush (1989), Raudenbush (1989), and Gray et al (1995). The gains are higher in 2015, particularly for language. For maths, the gains in performance are 4 of a standard deviation in 2009 compared to the same schools in 2007. The gains rise by 11 and 13 percent respectively in 2011 and 2013, peaking in 24 in 2015 compared to the same schools in 2007. The gains in performance are higher for language: 19, 21, and 23 of a standard deviation respectively in 2009, 2011, 2013, peaking in 37 in 2015 compared to the same schools in 2007. The richer regions of southeast, south, and midwest present gains in performance similar to the Brazilian average. The poorer regions of northeast and north have performance gains lower than the average for both subjects (around 2.5 of a standard deviation) in 2009, but they catch up with the national average gains by 2015. For maths, northeast has performance gains slightly above the average (26 of a standard deviation) by 2015; and for language northeast has also gains slightly above the average (38 of a standard deviation) in 2015. Despite the overall upward trend in performance for the poorer regions, the gaps between them have remained stable over time. Further, as we cannot directly measure the effect of the FUNDEB reform as stated above, it is unclear whether it is the additional funding provided by this reform and/or other time-varying factors omitted from the model that could also be driving the average school performance significantly up over these years. This overall upward trend could also be associated with the economic growth that the country experienced during this period, positively affecting the attitudes of parents regarding their offspring's education; improvements in teachers' training courses leading to better teaching practices consequently

increasing students' scholastic performance; or even the participation in a countrywide assessment system such as *Prova Brasil*, which could motivate the school staff to improve their pedagogical practices in order to do better in the exam and see the average school performance evolving over time.

Answering the research question on the effect of selected resources on school performance over time, our study finds that these resources have significant effects on average school achievement in maths and language for 9th graders, but the effects are very small: between 0.3 to 2.3 of a standard deviation. This outcome surprisingly confirms the international literature for the developed world that found school resources to have a very small or insignificant effect on pupil's test scores performance (Hanushek, 1986, 1989; Purkey & Smith, 1983; Sammons et al., 1995). Our study therefore contradicts the previous outcomes found for the developing world (Heyneman and Loxley, 1983; Fuller, 1987; Harbison and Hanushek, 1992; Fuller and Clarke, 1994), and also for Brazil (Velez et al., 1994; Murillo, 2007; Willms and Somer, 2010; Murillo and Román, 2011), in which school resources have a higher effect on scholastic performance in middle- and low-income countries.

Regarding the specific literature on the effects of resources on average school performance using repeated cross-sectional or longitudinal data in Brazil, our outcomes agree with Biondi and Felicio's (2007) study using a panel with the years of 1999, 2001 and 2003 on the very small effects of selected school resources on performance. Our study also partially agrees with Paget et al (2016) on the significant effects of some school resources on student's test scores for the years of 2007, 2009 and 2011. The authors found that infrastructure and academic resources significantly predicted test scores performance in the disadvantaged northeastern state of Paraíba in a repeated cross-sectional design whereas our model with a longitudinal design does not find that infrastructure positively predicts school average performance in the northeast and that academic resources such as availability of textbooks only has a very small positive effect of 0.08 of a standard deviation in that region. We have extended the studies of Biondi and Felício (2007), Soares et al (2016) and Paget et al (2016) by assessing the effects of selected resources on school average test score performance using a panel of schools with recent census-like data of the entire Brazilian urban territory for a longer period of time; and also by assessing the differences in importance and size of resources on school's average performance by region.

Additionally, we answer our second research question on whether there are different effects of resources on test scores performance by socioeconomically different geographical regions. We find no regional differences on the importance and size of our selected school resources on average school performance. We therefore contradict our hypothesis based on the

main international literature that the importance and size of the effects of school resources are likely to vary among socioeconomically different regions. According to this hypothesis, school resources would have larger effects on school average performance in poorer regions and smaller effects in richer regions. Our findings, however, show very small significant effects of school resources on average performance for all regions, without any differentiation by socioeconomic level. We also find that the effects of the average school SES are larger than the effects of school resources on test scores performance, even in poor regions. We therefore cannot confirm Heyneman and Loxley's (1983) evidence that the lower the income of a place, the weaker the influence of family SES on achievement and the stronger the relationship between school factors and academic achievement. Instead, our results are in accordance with Hanushek (2006) and also suggest that Brazil has not yet achieved a minimum level of quality of academic, administrative and physical resources across all regions for public primary education. According to Hanushek (2006), this minimum level of school resources would be a threshold from which increases in resources would not make a significant difference on school performance anymore.

Our descriptive outcomes suggest an overall increase in the availability and quality of school resources, particularly for poorer regions. However, it looks like the increasing improvements in infrastructure, administrative and academic resources have not yet been reflected on the average performance of the schools. Whilst these outcomes could be interpreted as positive effects of the FUNDEB reform in delivering more resources to needy schools, they also suggest that FUNDEB might not have been successful in its ultimate goal: increasing quality of learning in an inclusive way. Despite a higher flow of resources going to locations and institutions in higher need in the north and northeast, we cannot observe a correspondent higher average performance in those locations, as previously hypothesized. We therefore answer our third research question with lack of evidence that a continuous increase in school resources, particularly for more disadvantaged areas, could lead to a decrease in historical regional gaps in average school test scores performance.

This chapter is based on three major strands of SER: the assessment of stability and sources of changes of school effects over time; the attempt to relate school inputs to school outcomes using statistical models; and school improvement studies, which document the implementation of school change efforts and their potential failure or success. By using current data, our study adds to the SER evidence the small positive effect of school resources on educational performance as measured by test scores in a developing context with a longitudinal perspective. Perhaps more importantly, our study contributes to assess an educational policy that aimed at increasing quality of schooling by increasing and redistributing school resources

in a large and unequal country. This chapter therefore addresses substantive and methodological issues of quantitative educational research in Brazil. It also contributes to the international literature on SER in a developing context with the use of reliable and geographically representative large-N data for a very large and unequal country. Finally, this study contributes to the growing body of international evidence on the effects of resources on school outcomes, and directs further research into the effects of increasing school resources over time in the developing world.

4. How is Bolsa Família Programme Affecting School Performance of Economically Disadvantaged Pupils in Brazil?

4.1. Introduction

Bolsa Família (BF), or Family Allowance, is a Brazilian Conditional Cash Transfer (CCT) programme that provides a steady stream of cash to poor families conditioned on health checks and school attendance for their children; and to extremely poor families regardless of the presence of children. The cash paid to the family aims at alleviating the short-term income deprivation. The conditionalities aim at breaking down the long-term intergenerational transmission of poverty by improving children's nutritional and educational levels (MDS, 2012). CCTs have been widely implemented in low and middle-income countries and have led poor households to make more use of health and education services (Fiszbein et al., 2009). In most countries CCTs have helped increase school enrolment and attendance among beneficiaries (e.g. Schultz, 2004; Maluccio and Flores, 2005; Maluccio et al, 2006; Filmer and Schady, 2008; Schady and Araujo, 2008; Filmer, and Schady, 2009a). In Brazil BF has been successful in reducing short-term income poverty and child labour, increasing school attendance and decreasing grade repetition and dropout rates of beneficiary children; and also increasing the monthly household expenditures in items related to children's education (IPEA, 2012; Soares, Ribas, Osório, 2010; MDS, 2007a; MDS, 2012; Oliveira and Soares, 2013). Despite advances in school enrolment and attendance, there is scarce and inconclusive evidence on whether the increase in schooling caused by CCTs has led to more learning both abroad (Behrman et al, 2000; Behrman et al, 2005; Ponce and Bedi, 2008; Filmer and Schady, 2009b; Barham et al, 2013; Baird et al, 2014) and in Brazil (Santarrosa, 2011; Cireno et al, 2013). This chapter addresses how the Brazilian CCT *Bolsa Família* might be influencing beneficiary's children test scores performance in mathematics and language.

Evidence suggests that educational achievement of children is positively correlated with their parents' socioeconomic conditions such as education, income and wealth both abroad (Björklund and Salvanes, 2011) as well as in Brazil (Ferrão and Fernandes, 2003; Soares e Collares, 2006). As such, economically vulnerable children are more likely to present lower test scores performance than children from stronger socioeconomic background abroad (West, 2007) and also in Brazil (Ferrão et al, 2002b; Ferrão and Fernandes, 2003). The reasons for the low performance of poor children are therefore multi-faceted, going beyond the scope of the schools (Ferrão et al, 2003). Outside the school system the processes that aggravate educational inequalities stem from the living conditions of poor children, which is likely to debilitate their health and make them more vulnerable to physical and psychological hazards.

A pupil whose parents have no steady source of income might be at an educational disadvantage relative to a pupil who has a stable situation regarding basic needs such as food and housing. Even if they are aware of the potential long-term benefits associated with school attendance, the short-term demands may make regular school attendance a luxury compared to the gains in the family income a child could bring if active in the labour market. One way to close the gap in educational opportunities between richer and poorer children is to implement compensatory policies that give economically vulnerable children proportionately more resources to overcome the multifaceted forms of social disadvantage they face at home (Reimers, 1999: 543, 544, 545). Currently, one of the most widely implemented compensatory policies in low and middle-income countries are the CCT programmes.

Despite being widely used across developing countries, the use of CCTs as a poverty reduction instrument is controversial. Critics of CCTs rely on two main points. First, they argue that poverty is best reduced by economic growth, particularly in poorer countries, where administrative and fiscal capacities are likely to be low and governments should focus their scarce resources on providing basic infrastructure that would be beneficial for the entire population instead of focusing their capacities on monitoring a particular vulnerable group. The second main argument against CCTs states that these programmes might have some perverse incentive effects on recipients, such as discourage labour in low-productivity and low-paid settings, consequently undermining the economy (Freeland, 2007; Fiszbein et al, 2009: 46, 47). Defenders of CCTs argue that in most developing countries public expenditure on infrastructure and public services often fails to reach the most vulnerable groups of the population. A study on Nicaragua, for instance, found that only 10 percent of households in the bottom quintile of the income distribution had access to electricity at the end of the 1990s compared to more than 90 percent of the households in the top quintile (De Ferranti et al, 2004: 209). Corruption is another factor that may lower the quality of public infrastructure and services and prevent them to reach the needy (Mauro, 1996). Moreover, considering the fact that markets rarely work perfectly in practice, insurance and credit markets are often beyond the reach of many poor families. Credit-constrained families are less likely to make profitable investments in their children's education or in business projects (Diagne et al, 2000; Ghosh et al, 2001; Petrick, 2005; Fletschner, 2009). Direct transfer of cash might therefore enable these families to make investments that would otherwise not have taken place. Income shocks might pause investments in schooling and/or health investments, potentially with long-term consequences (Fields et al, 2007; Ferreira and Schady, 2008). Lastly, considering that many of the socioeconomic inequalities are inherited from parents, over which individuals have no control, brings to the state a moral obligation to address such inequalities (Roemer, 1998;

Bourguignon et al, 2007). In such cases, direct cash transfers might be suitable instruments to soften inherited disadvantages.

Among those who support direct cash transfers to economically vulnerable groups of the population, the debate lies on whether making the cash transfers conditional on certain behaviours or not (Schubert and Slater, 2006; Farrington and Slater, 2006; Slater, 2011; Baird et al, 2011; Baird et al, 2014; Benedetti et al, 2016). The main arguments against conditionalities are mainly based on ethical considerations, potentially weak institutional capacities for implementing, managing and following-up conditionalities in low-income countries, and potential high cost of complying with the conditions (Schubert and Slater, 2006; Slater, 2011). From an ethical point of view, defenders of unconditional cash transfers (UCTs) for the poor argue that it is unethical to condition the receipt of cash that will be used for the subsistence on vulnerable children's behaviour (Freeland, 2007; Krubiner and Merritt, 2017). From a cost-benefit point of view, defenders of UCTs argue that some of the neediest households might find the conditions too costly to comply and thus be deterred from taking up the benefits. In such cases, schools might be too far away from their households; or the families might be aware of a bad reputation of the local school; or perhaps they might consider wasteful for children to spend time at school rather than learning vocational skills with their parents; or the burden of adhering to conditionalities might fall disproportionately on women, since it is mainly mothers and other female carers who take children to clinics and ensure they go to school (Freeland, 2007; Molyneux, 2007; Bradshaw and Víquez, 2008; Krubiner and Merritt, 2017). Under these circumstances, conditions might exclude some of the people who anti-poverty programmes generally aim to reach. Therefore, by pushing poor households to do something that they would otherwise not be doing, CCTs could be imposing costly distractions on people who are trying to cope with a situation of income vulnerability and instability. This uncertainty over the effectiveness of conditionalities is reinforced by evidence from several African and South Asian countries, where cash transfers are made unconditionally: Zambia (Schubert, 2005), Namibia (Kaufmann, 2010; Osterkamp, 2013), Malawi (Devereux et al, 2006; Miller et al, 2011; Miller and Tsoka, 2012), South Africa (Agüero et al, 2006), and India - Madhya Pradesh (Beck et al, 2015) all showed significant increases in beneficiaries' education, health and nutrition outcomes without attaching conditions.

Nevertheless, evidence for Latin America in countries such as Mexico and Ecuador; as well as for other parts of the world, such as Cambodia and even Malawi also showed that the impact of CCTs on service use might not be solely explained by the cash component of the programme (Schady and Araujo, 2008; Filmer and Schady, 2009a; De Brauw and Hoddinott, 2011; Baird et al, 2011). These findings suggest that the conditions might be a central part of

the success of CCTs in Latin America and other parts of the world, at least in terms of increasing the use of basic services. The design of cash transfer programmes is markedly different according to structural differences between countries and regions. In Africa, where pre-existing welfare regimes are often weak or nonexistent, the origins of cash transfer programmes come from alternatives to tackle hunger and HIV using tools other than in-kind benefits. The preference for unconditional schemes is linked to serious capacity constraints in service delivery in health and education. In several African countries it is acknowledged that there is no point in increasing the demand for basic services if the supply side is very weak or nonexistent. Contrarily, in Latin America, cash transfer schemes are thought as a response to structural changes in the economy that threatens vulnerable people's basic consumption level and use of basic services in contexts with stronger basic structure. In such cases, conditional transfers are more likely to make a difference to school attendance, attainment and perhaps performance, as well as health and nutritional status than unconditional schemes (Handa and Davis, 2006: 516; Slater, 2011: 256).

Defenders of conditioning cash transfers to certain behaviour consider mainly three types of conceptual arguments in which establishing conditions is likely to be attractive. First, individuals do not always behave in a fully informed and rational way and might hold persistently erroneous beliefs. Persistent misinformation could lead to an inefficiently low level of investment in education (Das et al, 2005). People might also have self-control problems and procrastination in a way that their day-to-day behaviour is inconsistent with their own attitudes toward their future (see O'Donoghue and Rabin, 1999), which might prevent disadvantaged families in making the effort to invest in their children's education. Second, when private investment in children's education among the poor may be below a minimum level considered appropriate for a particular society (Currie and Gahvari, 2007). Under this idea, private investment in children's education can be considered too low either because decision makers have misguided beliefs about the investment in children's education and the subsequent returns to these investments; because parents may be poorly informed about the returns to investment in education; or because parents may not consider education to be a worthy investment for the future and might value their own welfare and current wellbeing more than of their children. The third conceptual argument pro conditionalities is when conditions are necessary for political economy reasons. In other words, when redistribution is politically feasible due to its condition on co-responsibilities. Attaching direct cash transfers to improving children's educational opportunities and health condition is likely to provide stronger political acceptability for CCTs. This latter conceptual argument for CCTs applies if the wider population shows little support for redistribution unless it is seen as a transfer for the poor who

is willing to follow a good behaviour. Under this scenario, even in situations in which unconditional transfers look more appropriate, conditions might be justified because of its potentially stronger political support and benefits (Fiszbein et al, 2009: 8, 9, 10, 11, 42, 50, 64, 66). Analysis of the way the Brazilian media reports the *Bolsa Família* programme suggests that the conditions make the transfers more accepted by the wider society. Lindert and Vincensini (2008) found that most media criticism of the programme was about the possibility that it would create dependency and about concerns that the conditions were not being monitored and enforced properly.

As said above, there is extensive evidence that CCTs have increased the use of education services as measured by increases in enrolment and attendance, and decreases in grade repetition abroad (Schultz, 2004; Maluccio and Flores, 2005; Maluccio et al, 2006; Filmer and Schady, 2008; Filmer and Schady, 2009a; Schady and Araujo, 2008; Li et al, 2017) and also in Brazil (Soares, Ribas, Osório, 2007; MDS, 2007a; Schaffland, 2011; IPEA, 2012; MDS, 2012; Oliveira and Soares, 2013; Baird et al, 2014). The increase in the use of education services by vulnerable children that has successfully been achieved via CCTs are, however, considered only as an 'intermediate' outcome. Put differently, increases in school enrolment and attendance of beneficiary children is seem as only an intermediate step to help vulnerable children ultimately complete more years of schooling, learn more and earn higher wages as adults (Fiszbein et al, 2009: 141). Overall, research on the impact of CCTs does not present strong evidence about final outcomes on education. A number of studies have shown that the higher levels of school enrolment and attendance have not necessarily resulted in better performance on test scores abroad (Behrman et al, 2000; Behrman et al, 2005; Ponce and Bedi, 2008; Filmer and Schady, 2009b; Barham et al, 2013; Baird et al, 2014) and also in Brazil (Santarrosa, 2011; Cireno et al, 2013).

Traditionally, in countries with CCT programmes, school enrolment and educational attainment have been used as proxies for measuring the CCTs' success. Nevertheless, there is minimal evidence that students from CCTs' beneficiary families actually demonstrate knowledge gains, which would be reflected in improvements in test scores measurements (Gove, 2005). The international evidence on final educational outcomes is scarce and inconclusive. In Mexico, Behrman et al (2000) assessed the short-term effect of the CCT *Oportunidades* on test scores in mathematics and language. They found no significant differences between treatment and control groups after almost a year and a half of exposure to the programme. Behrman et al (2005) assessed the long-term impact of two additional years of exposure to *Oportunidades* on test scores in mathematics and language. They found that young adults whose families benefited from the programme for two additional years when they were

children did not perform better on these tests compared to those whose families received transfers for a shorter period of time. In Ecuador, Ponce and Bedi (2008) assessed the short-term impact of the CCT *Bono de Desarrollo Humano* on test scores in mathematics and language and found no significant effect. Their estimates showed that despite the sharp increase in enrollment, no positive effects on test scores were associated with the programme. In Cambodia, Filmer and Schady (2009b) assessed the effect of the CCT Cambodia Education Sector Project (CESSP) in language and mathematics test scores and also found no significant effect that could be attributed to the programme. The international evidence has also reported more optimistic outcomes. Barham et al (2013) assessed the effect of the CCT *Red de Protección Social* in Nicarágua on language and mathematics test scores of boys measured 10 years after the start of the programme. They found that a statistically significant increase of approximately one-quarter of a standard deviation in test scores for the now young men. This evidence on Nicaragua showed that schooling and achievement gains coincided, implying potentially important long-term returns to CCT programmes.

Likewise, evidence on the effect of the Brazilian CCT *Bolsa Família* on final educational outcomes is also very scarce, mixed and inconclusive. Put differently, the question on whether more schooling of economically disadvantaged children has led to more learning of those children has yet to be conclusively answered. Santarrosa (2011) assessed the impact of BF programme on children's test scores proficiency in the city of São Paulo. The author used the assessment data *Prova São Paulo* (São Paulo Exam) of the years 2007, 2008 and 2009. *Prova São Paulo* is a panel data and the same students can be traced over three years. It is based on standard test of language (Portuguese) and mathematics and is similar to *Prova Brasil*. The author used fixed effects and difference-in-difference estimators combined with reweighting based on propensity score estimators to fit the *Prova São Paulo* data. The results showed no significant impact of the *Bolsa Família* programme on beneficiary children test scores proficiency in either mathematics or language. The findings of this study are restricted to the city of São Paulo, which is the financial capital of the country and is located in the wealthiest region and state. The findings, therefore, cannot be extended to medium, small, or poorer cities, as well as to rural locations or poorer regions. In other words, the external validity of this study has important limitations. Cireno et al (2013) assessed the effect of BF programme on 5th and 9th graders test scores in mathematics and language using *Prova Brasil* assessment data for 5th and 9th graders in the entire country. The authors used Ordinary Least Squares (OLS) model to fit the data, controlling for schools' characteristics (school socio-economic level, quality of school facilities, urban or rural location, administrative dependency on municipal, state or federal government, and school shift), and pupil and family characteristics

(sex, race, whether or not the pupil works, and parents' schooling level). Their results suggested that BF recipients performed, on average, worse in *Prova Brasil* than non-recipients. The findings of this study have to be interpreted with caution given the absence of a reliable counterfactual group of students with observably similar characteristics. In other words, Cireno et al (2013) are comparing BF beneficiary pupils with all other children. Such strategy is more likely to bring negative outcomes given that beneficiary pupils are expected to be in a more vulnerable situation and therefore perform lower than children with stronger socioeconomic background. The authors also did not consider the regional division of the country. Simões and Sabates (2014) assessed the effect of *Bolsa Família* on the average school test scores performance of 4th graders in Brazil. Noteworthy, the authors did not estimate the direct effect of BF on beneficiaries' performance (average treatment on the treated - ATT), but on the mean school outcomes based on the whole group of students – beneficiaries and non-beneficiaries (average treatment effect - ATE). Based on a linear-interactive model, the authors demonstrated that BF factors (time and cash) interacted in predicting changes in average school performance. Their results suggested a positive effect of length of participation in BF (*time-effect*) and amount of cash received (*cash-effect*) with respect to school outcomes, but with substitute effects. The substitute effect implies that the BF cash effect on test scores performance is maximised when families start the programme. This result suggests that potential positive effects on test scores due to increases in the per capita cash transfer to families are constrained by a timeframe within which that policy is more likely to generate educational benefits. The results also suggested that the effect of BF was higher for language than for mathematics; and also, a regional variance in mathematics as it was only significant for the northeast and south regions.

This chapter seeks to investigate the effect of BF programme on test scores performance in mathematics and language of beneficiary pupils compared to similar pupils whose families do not receive the benefit in Brazil and also by geographical regions. We extend the studies of Santarrosa (2011) and Simoes and Sabates (2014) by i) assessing the effect of BF on individual students test scores; and ii) considering the entire Brazilian territory and separately by region. Including this introduction, this chapter is organised into six sections. In the next section, contextual information on the Brazilian CCT *Bolsa Família* is presented, with the main characteristics of the programme with emphasis on the features directly related to schooling. The third section presents the data and variables. The fourth section presents the statistical methods. The findings are presented in the fifth section; and in the last section the main results are summarised with concluding remarks.

4.2. The Bolsa Família Programme

In the last few decades, Brazil has dramatically expanded its primary education system, going from an enrollment rate of 72 per cent in 1981 to 97 percent in 2007 of the 7-14 year old population (IPEA 2011). In the early 2000s, a period when the universalisation in the access to primary education had been achieved, the debate regarding the inequality of educational opportunities in Brazil and also in Latin America turned its focus to the fact that some of the children who enroll attain fewer grades than the number of years they spend in school and drop out of school before completing primary education. The Brazilian model of educational expansion was based on building more schools and hiring and training more teachers, without specific interventions responsive to the family conditions of disadvantaged children. Improving educational opportunities of the poorest groups requires tackling the reasons for their lower enrollment, attendance and performance and higher dropouts (Reimers, 1999: 541, 542).

As said above, CCTs are currently the most popular type of compensatory policies in the developing world that directly tackle vulnerable families. CCTs are programmes that transfer cash to poor families, on the condition of pre-specified investments in education and health of their children and teenagers. Health and nutrition conditions generally require periodic check-ups, growth monitoring and vaccinations for children. Education conditions usually require school enrolment and regular attendance. CCTs have two main objectives: i) to provide poor households with a minimum and stable consumption floor; ii) to encourage improvements in children's education and health to break a vicious cycle whereby poverty is transmitted across generations through the conditionalities (Fiszbein et al, 2009: 1, 31).

CCTs were first implemented in Brazil and Mexico in the 1990s, especially at local and regional levels. In the 2000's, given the relative success of the iconic *Bolsa Família* programme in Brazil and *Oportunidades* (former *Progresa*) in Mexico, as reported by increases in school enrolment, education attainment and immediate poverty alleviation as proxy measures, other countries have been adopting similar policies. Since the late 1990's CCTs have rapidly spread to more than 40 countries, mostly across Latin America, Asia and Africa, among a host of adopting countries that vary greatly in their own demographics and socioeconomic structures (Handa and Davis, 2006). CCTs also vary in scope: some programmes are nationwide while others are regional, and yet others are small-scale pilot initiatives. Some programmes require that households receiving transfers comply only with schooling conditions while others, especially programmes in Latin America and the Caribean, require that households comply with both schooling and health conditions. CCTs-like programmes also exist in developed countries. Mayor Bloomberg's Opportunity NYC is a pilot programme implemented in New

York City that offered cash payouts to families conditional on compliance with children's education, family preventive health measures and parents' employment. CCTs also vary a great deal in scope: some of the programmes are nationwide, such as *Bolsa Família* in Brazil, *Oportunidades* in Mexico and *Familias en Acción* in Colombia; some of them are targeted to a region or a narrow population, such as *Chile Solidario* and Social Risk Mitigation Project in Turkey; and some of the programmes are even small-scale pilot efforts such as *Red de Protección Social* in Nicaragua and Cash Transfer for Orphans and Vulnerable Children in Kenya (Miller et al., 2009; Fiszbein et al., 2009: 1, 3, 5).

Mexico's *Oportunidades* has an experimental design and successive waves of data collected to analyse its impact. Brazil is also exemplary in the use of its CCT *Bolsa Família*, which is similar to Mexico's *Oportunidades* in coverage and importance. However, in other important aspects, *Bolsa Família* provides something of an interesting contrast to the Mexican case: it takes a softer track on conditionalities; and puts more emphasis on redistribution than on human capital formation. Moreover, unlike *Oportunidades*, the CCT *Bolsa Família* did not explicitly incorporate impact evaluations in its design – it is therefore not an experiment. As a result, much less is known about the effects *Bolsa Família* has had on consumption, poverty, health, nutrition and education (Fiszbein et al., 2009: 1, 6; MDS, 2012; 2013).

The *Bolsa Família* programme is the main anti-poverty programme in Brazil and the largest CCT programme in the world in number of beneficiary households: with a budget of USD 8,320 billion[40] in 2011, BF benefits approximately 14 million households (out of 70 million households in the whole country) and it is present in all municipalities[41] of the country, which corresponds to a relative coverage of about 20 per cent of the population. While from 2003 to 2011 the percentage of beneficiary families has grown from 12 per cent to 18 per cent of all Brazilian families, the percentage of eligible but non-beneficiary families has decreased from 7 per cent to 3 per cent (MDS, 2012; IPEA, 2012: 10; IBGE, 2010; Fiszbein et al., 2009:

[40] Brazilian Currency BRL 17,4 billion. Reference 18 January 2013 with an exchange rate of BRL 1 of American Dollars USD 0.49. Currency converter used OANDA: http://www.oanda.com/currency/converter/ .
[41] According to the 2010 Population Census Brazil has 5,565 municipalities throughout the whole country (IBGE, 2010).

5). The programme was created in October 2003[42] by the federal government. The key tool for monitoring and evaluation of the BF is the Single Registry (*Cadastro Único*), that is a representative map of the low-income families in Brazil.

4.2.1. Overview of the *Bolsa Família* Programme

Table 4.1 Overview of the Bolsa Família Programme

Year Started	2003 (but predecessor programmes began in the 1990's, the main one *Bolsa Escola* – School Allowance, started regionally in 1996)
Run by	The National Citizens Income Secretariat (SENARC - *Secretaria Nacional de Renda de Cidadania*) of the Ministry of Social Development (MDS - *Ministério do Desenvolvimento Social e Combate à Fome*)
Payment done by	The *Caixa Econômica Federal*, a federal bank. It is responsible for receiving information collected by each municipality on its population in poverty, processing this information, calculating per capita incomes and, thus, defining how much each particular family will receive, printing the ATM cards and sending them to each family and, making the payments every month. The *Caixa* processes information following the rules set down by SENARC
Targeting Method	Geographic targeting and means testing (self-declared)
Coverage - families	13,7 million families (*See table 4.2*)
Coverage – school children	17 million school children, which represents 30% of the entire student population in the Brazilian public schools
Incidence	73.7% to poorest quintile; 94% to poorest 40% (2006 data)
Cost - Overall	USD 8.320 billion
Cost - National Accounts	0.4 % of the GDP
Paid to	Mother or main woman of the household
Payment Method	Through a debit card distributed to the beneficiaries
Payment Frequency	Monthly
Duration	As long as eligible, with recertification every 2 years
Benefits	See table 4.3
Education Conditionalities	See table 4.4

Author's organization - mixed sources: Soares, Souza, Osório and Silveira (2010); Soares, (2012); Fiszbein et al., (2009: 242).

[42] The programme, in its current form, started in 2004 with the provision of transfers to poor households with children of up to 15 years and/or a pregnant woman; and to extremely poor households regardless of their composition. BF was a merging between existing four major programmes: *Bolsa Escola* (School Allowance), a minimum income grant conditioned to primary school attendance; *Fome Zero* (Zero Hunger) and *Bolsa Alimentação* (Food Allowance) programmes, two income grants related to food security; and *Vale Gás* (Gas Allowance), a subsidy to help poor households buy cooking gas (Fiszbein et al., 2009: 35, 36; Soares, 2012).

4.2.1.1. Coverage of the Bolsa Família Programme

The coverage of the BFP may vary as the programme is not an entitlement. The number of beneficiaries must be adjusted to the available budget. Once the set budget cap is met, new families are included only if other families leave the programme, unless a supplementary credit is voted by the Congress. The budget cap is set based on national and municipal quotas (Soares, 2012: 6), which ensure the distribution of the programme throughout the whole country. Please see table 4.2 below for more detailed coverage over time.

Table 4.2 Coverage of the Bolsa Família Programme

Criterion / Year	2003	2005	2007	2009
Size (in people)				
Brazilian population (millions) (Household survey)	171.6	180.1	182.4	185.1
Individuals in beneficiary families (millions) (Household survey)	27.4	31.0	33.1	41.2
Beneficiaries as percentage of population	16.0%	17.2%	18.1%	22.2%
Size (in households)				
Households in Brazil (millions) (Household survey)	48.7	52.0	54.5	56.9
Beneficiary households (millions) (Household survey)	5.75	6.62	7.16	9.2
Beneficiary / Total (Household survey)	11.8%	12.7%	13.2%	16.2%
Beneficiary households (millions) (Single Registry)	7.50	10.59	11.07	12.38
Beneficiary / Total (Single Registry)	15.4%	20.4%	20.3%	21.8%
Size (percentage of national income)				
Average household monthly income (USD) (Household survey)	236	256	287	309
Participation in household income (Household survey)	0.3%	0.5%	0.6%	0.7%
Programme expenditure (USD billion of 2009) (Budget)		3,952	4,948	6,098
GDP (USD billion of 2009) (Budget)	1,218	1,329	1,465	1,537
BF programme expenditure as percentage of GDP		0.30%	0.34%	0.40%

Source: Soares, Souza, Osório and Silveira (2010).
*Brazilian Real BRL converted to United States Dollar (USD): Reference 18 January 2013 with an exchange rate of BRL 1 of American Dollars USD 0.49. Currency converter used OANDA: http://www.oanda.com/currency/converter/

4.2.1.2. Eligibility and benefits of Bolsa Família Programme

Families living on less than USD 68 (poverty line) per capita per month are entitled to the BFP. The amount of cash benefits received by each family depends on the number of children they have. Please note that the levels of income disclosed in table 4.3 below always refer to per capita family income as measured in the Single Registry. The BF law defines a family as a group of related individuals living in the same house (Soares, 2012: 7, 8). As such,

a family of four individuals, for instance, composed of mother, father and two school-aged children, that have their **per capita** income below USD 68 (or a global household income below USD 272) would receive a fixed cash benefit of USD 34 for the family, plus USD 16 per school child. This would mean a total of USD 66 per month of cash benefit receive for the family of four. Given that this family monthly household income is USD 272, the cash benefit from *Bolsa Familia* would mean an increase in the monthly household income of 24 percent[43].

From 2003 to 2008, each family received the cash benefit calculated according to the number of children up to 15 years old, up to three children per family. From 2008 on the benefit has been expanded to include up to two teenagers 16-17 years old. In 2011, the limit on the number of children was raised from three to five. The benefit is usually paid to the mother or, in the absence of the mother, to the father or other adult of the family. Benefits are conceded for a two-year period and may be renewed for as long as the family remains eligible. Table 4.3 contains a detailed account of the fixed benefit per family and the variable benefit calculated per child (Soares, 2012: 7, 8).

[43] A study conducted at the Amazonas State University, Brazil, by Cavalcante, Hounsell, de Souza and Peralta, has confirmed that the cash benefit received by the *Bolsa Família* Programme represents an average of 24 percent of the total monthly household income of beneficiary families. The study was conducted in deprived neighbourhoods of the city Tefé located in the Amazonas state. The study was retrieved from https://www.mamiraua.org.br/documentos/d90659f6c9f4ec6a964306bf2b40dab4.pdf . Viewed: Oct 2019.

Table 4.3 Cash benefits of the *Bolsa Família* Programme

Date	January 2004	July 2007	June 2008	July 2009	March 2011
Law	Law 10.836	Decree 6157	Law 11.692 and Decree 6491	Decree 6917	Decree 7447
Extreme Poverty Line (monthly per capita income – before tax)	USD 24	USD 29	USD 29	USD 34	USD 34
Poverty Line (monthly per capita income – before tax)	USD 49	USD 59	USD 59	USD 68	USD 68
Fixed Benefit	USD 24	USD 28	USD 30	USD 33	USD 34
Variable Benefit	USD 7 per child aged 0–14 years old	USD 9 per child aged 0–14 years old	USD 10 per child aged 0–15 years old USD 15 per teenager aged 16–17 years old	USD 11 per child aged 0–15 years old USD 16 per teenager aged 16–17 years old	USD 16 per child aged 0–15 years old USD 18 per teenager aged 16–17 years old

Source: SENARC/MDS; Casa Civil/Presidência. Organized by Soares 2012.
Brazilian Real BRL converted to United States Dollar (USD): Reference 18 January 2013 with an exchange rate of BRL 1 of American Dollars USD 0.49. Currency converter used OANDA: http://www.oanda.com/currency/converter/

In addition to periodic visits to local social service offices, other administrative records are used to regularly screen beneficiaries' eligibility. Social service and formal labour market registries are matched with the Single Registry data every year to check out changes in beneficiaries' family per capita income. If someone from a beneficiary family receives an undeclared social security benefit or a formal labour market paycheck, both the family and their local municipal administration are informed of the situation, and it is expected a social worker will visit the family (or the family visit the social service office) to check whether they are still eligible for the BF cash benefits. One month after the second notice is given, the benefit is blocked until the situation is cleared. Once the Single Registry is updated, the benefit can be unblocked if the family is still eligible and cancelled if otherwise (Soares, 2012: 7).

4.2.1.3. Monitoring of the conditionalities of the Bolsa Família Programme

Conditionality monitoring is a complex effort carried out by different institutions. The educational conditionality is monitored by municipal and state educational secretariats and consolidated by the Ministry of Education; health conditionalities are monitored by municipal and state health secretariats and consolidated by the Ministry of Health. The Ministry of Social

Development centralises data received from both Education and Health Ministries and organises the Single Registry for a comprehensive monitoring and follow-up of compliance of the conditionalities (Soares, 2012: 9).

The education conditionalities of the BF programme are as follows: i) children aged 6-15 years old must maintain a minimum of 85 per cent of school attendance[44], and teenagers aged 16 – 17 years old a minimum of 75 per cent of school attendance[45]. Table 4.4 below shows that the central government has been successful in monitoring the school attendance of approximately 14 million beneficiary children. This amount represents approximately 40 per cent of the existing 33.7 million children in the country. If a child is missing school above the 15 percent permitted, their family will not automatically lose the BF benefits. Instead, the local social workers and the beneficiary families will first be informed about the situation up to four times before any cut in the cash benefits is made (Soares, 2012: 10, 11).

Table 4.4 Monitoring of education over time

Time	In Million Children	In %
2006 2nd semester	9.6	62.8
2007 1st semester	12.0	78.9
2007 2nd semester	13.2	84.7
2008 1st semester	13.0	84.9
2008 2nd semester	12.7	84.8
2009 1st semester	13.0	85.7
2009 2nd semester	14.0	89.5
2010 1st semester	13.6	85.7

Source: Sistema de Acompanhamento da Freqüência Escolar do PBF. DEGES/SEANRC/MDS.

In case the attendance continues below 85 per cent after the first warning, and the child's family gives no acceptable justification, two months later a second letter is sent and the benefit is temporarily blocked. The benefit will be paid as soon as the attendance situation is cleared. If the child's attendance remains low for another two months, the benefit is suspended —meaning that it will not be paid even when the situation is rectified. After one year of

[44] The mandatory primary school attendance in the country for children in the same age group is 75 per cent.
[45] Teenagers aged 16 – 17 years old are supposed to be attending the secondary education, which attendance is not mandatory in Brazil.

noncompliance the benefit is permanently cancelled and passed on to another family (Soares, 2012: 11). Table 4.5 below shows that only less than 5 percent of the beneficiary families who had had the first warming for non-compliance had their benefits cancelled for non-compliance of conditionalities.

Table 4.5 Beneficiary families sanctioned for noncompliance, 2006–2008

Action	Number of Families	Percentage
1st Warning	2,092,394	100.0%
Blocked benefit	765,011	36.6%
1st Suspension	339,205	16.2%
2nd Suspension	149,439	7.1%
Cancellation of benefit	93,231	4.5%

Source: DEGES/SEANRC/MDS.

4.2.1.4. Selection process for Bolsa Família via the Single Registry

The selection process to receive the *Bolsa Família* cash benefit has two steps. First, families register themselves at their municipal social service offices in order to have their eligibility checked out. Secondly, the verified list with the eligible families is sent to the MDS that performs a national random selection of eligible families. Therefore, the registration process relies partly on self-registration at local level and partly on a random selection of the registered and eligible families through a lottery at national level (MDS, 2007a; Soares, 2012).

4.2.1.5. Structural and targetting biases

Considering that the BFP's design is based on a defined threshold – the poverty line - we would expect that all families with children that lie below the poverty line would receive the cash benefits while all poor families with per capita income above the poverty line would be left out of the programme. Nevertheless, some evidence on the structure and implementation of the BFP points to key factors that might lead to mistargetting and misallocation of the benefits. These factors are:

i) No clear start of the programme: as wrote in the footnote 42 of this chapter BF was created in 2004 as a result of a merging between four existing major anti-poverty programmes. All recipients of the previous programs automatically became beneficiary of the BF. This merging into BF was implemented without any eligibility checks, bringing issues on the eligibility of the beneficiaries.

ii) Self-selection into the programme: families with per capita income potentially below the poverty line have to register in their local municipalities in order to apply for the BFP cash benefits.

iii) Assignment based on self-reported income: the self-reported assignment variable 'per capita income' is usually not fully verified by the authorities leading to inclusion errors and misclassification of the eligible groups (Zimmermann and Espínola, 2015; Kerstenetzky, 2009; Handa and Davis, 2006).

iv) Informal source of reported income: a large share of income in poor households in Brazil comes from informal work[46] and income from informal work is often not reported (Zimmermann and Espínola, 2015; Kerstenetzky, 2009; Handa and Davis, 2006).

v) Registration based on current income situation: local municipalities only collect the current income of potentially eligible families and therefore it does not capture income's fluctuations that can be significant particularly for those on informal employment or self-employment (Kerstenetzky, 2009).

vi) Decentralized targeting at municipality level: municipalities are responsible for the registration of potentially eligible families – Brazil has more than 5,000 municipalities

vii) Incipient and partially decentralized monitoring system: the monitoring of the education conditionality has started only in 2006 and is carried out by the Ministry of Education. This monitoring system depends on reliable information on attendance collected by schools.

Given the above reported structural characteristics, several factors might bias our analysis. First, the eligibility criteria are self-reported and not fully checked by local authorities. Secondly, exclusion from the program does not necessarily occur when there are changes in per capita income. Thirdly, the merging process from 2004 made each additional recipient automatically eligible for the BFP without further checks. These factors point to

[46] The non-agricultural informal employment in Brazil accounts for 42 percent of the country's workforce. Informal employment encompasses those persons whose main jobs lack basic social or legal protections or employment benefits and affects individuals mostly under poor conditions (ILO, 2012).

potential crossings around the eligibility threshold, indicating that BF cash benefits might be misallocated in the country. This mistargetting issue centrally affects the selection of our method and consequently might be taken into consideration in the analysis of our outcomes.

4.3. Data and variables

We use the *Prova Brasil* (or Brazil Exam) of the year 2011 to assess the effect of *Bolsa Família* Programme on test scores performance of school children in Brazil in a cross-sectional design. It provides nationwide test scores for 5th and 9th graders plus socioeconomic characteristics and school information. The *Prova Brasil* is the main dataset of this chapter and it is fully described in item 3.3 of chapter 3.

4.3.1. Complementary administrative data

Prova Brasil, however, does not identify *Bolsa Família* beneficiary children, the main predictor of our analysis. In order to identify BF children in the *Prova Brasil* system we use administrative data from the BF programme. We merge data from the Attendance System, which controls school attendance of BF beneficiary children with unique family and child IDs, with the School Census, which is annually collected from schools and use the same unique ID for each child. The merge between Attendance System and School Census allows us to individually identify 86 percent of BF children that was once monitored by the Attendance System in the School Census of 2011. Finally, we merge the School Census version with identified BF children with *Prova Brasil* 2011. The result is a data set that allows us to compare test score performance of beneficiary and non-beneficiary pupils of BFP. For this chapter we have just kept BF pupils who sat the *Prova Brasil* in 2011 and, therefore, were enrolled in the 5th or 9th grade in 2011.

4.3.1.1. Bolsa Família Programme data

The Single Registry (*Cadastro Único*) is an administrative database that contains information of economically vulnerable people in Brazil. The Single Registry is a tool used by the central government to know who the vulnerable people are, where and how they live. It contains information from BF beneficiary families as well as from vulnerable but non-beneficiary families. The entry criterion for the Single Registry is based on income: families

whose monthly per capita income are lower than half the minimum wage[47] or whose total income is less than three minimum wages can be included in the Single Registry (Soares, 2012: 5). In 2011, there were 21 million families enrolled in the Single Registry dataset (MDS, 2013). The collection of information for the Single Registry is made locally. Municipal social service offices receive a standardized questionnaire from the central government. After filling the questionnaires with information from potentially vulnerable families, they are sent back to the central government to be included into the Single Registry (Soares, 2012: 5).

Single Registry contains information on: i) individual and household identification numbers; ii) family composition (number of members; elderly; pregnant and lactating women; and disabled people); iii) household overall characteristics (number of rooms; construction type; household property status; sanitation conditions; access to lighting, water, water treatment and garbage collection); iv) educational qualification of family members; v) professional qualification and labour market position and activity; vi) income; vii) household expenditures; viii) social programmes benefits (including BF).

The Attendance System dataset contains school attendance of BF beneficiary children only plus family and pupil ID. It allows the reliable collection of beneficiary pupils' attendance from all schools throughout the country.

4.3.1.2. School Census data

School Census (*Censo Escolar*) is a nationwide survey on education carried out annually since 1995. All public and private Brazilian schools take part in the census, which covers primary and secondary education. Information is collected on schools' characteristics, such as infrastructure, system of education, teachers' overall work organization, enrolments, attendance, dropouts, and pupil's achievement, measured by fail/pass according to each schools' own rules (INEP, 2012).

[47] The minimum wage in Brazil in 2011 was USD 266,67 (BRL 545,00). Source: Portal Brasil: www.portalbrasil.net/salariominimo_2011.htm .; Lei n° 12.382, de 25/02/2011.
Reference 18 January 2013 with an exchange rate of BRL 1 of American Dollars USD 0.49. Currency converter used OANDA: http://www.oanda.com/currency/converter/ .

The School Census is the tool used by the Ministry of Social Development (MDS) of Brazil to check BF beneficiary children's school attendance in order to assess the compliance with the conditionalities of the programme. Each student enrolled in basic education has an individual ID number and a family number, or Social Identification Number (NIS - *Número de Identificação Social*) that is administered and followed-up by the School Census. The student's individual and family identification numbers of the School Census data are the same used in the Single Registry and Attendance System. These unique identification numbers allow the matching between School Census, Attendance System, and Single Registry data sets at student level. Consequently, BF beneficiary students can be found in the School Census data in order to have their school attendance monitored for the compliance check of *Bolsa Família* programme.

Prova Brasil 2011 exceptionally provides a unique student ID code that allows the matching with School Census at pupil level. This matching allows us to connect *Prova Brasil* with Single Registry in order to identify BF beneficiary children in the *Prova Brasil* data. The connection between *Prova Brasil* and *Single Registry* (via School Census) is therefore essential for the ultimate goal of this chapter: to assess how the BFP might be influencing beneficiary children scholastic performance as measured by test scores.

4.3.2. Variables

4.3.2.1. Variables of Prova Brasil

We focus on 5th and 9th graders and use the year 2011 of *Prova Brasil*. That means a total of *3,968,*084 students, distributed in *39,259* schools. Our outcome variable is pupils' proficiency as measured by test scores in maths and language for 5th and 9th graders. As predictors we use pupil's, family's and school's characteristics.

In order to assess the effect of *Bolsa Família* programme on beneficiary students test scores performance we use a Propensity Score Matching design (see more details of this design in item 4.4 below). For that we match two groups of students as similar as possible based on a set of observable characteristics linked to the eligibility of the programme. We then split these students into two groups that the main difference is being beneficiary or not of the BFP. We name the group of beneficiary pupils as 'treatment' and the group of non-beneficiary but similar pupils as 'control' group.

We use three types of observable characteristics for the matching technique: individual, family and school. The choice of these observable variables are linked to the main socioeconomic characteristics of the BF beneficiaries found in the Single Registry database

and are therefore linked to the eligibility of the programme (Camargo et al, 2013). As individual characteristics, we use sex as a dummy female (vs. male); self-reported skin colour as a dummy white (vs. non-white); place of residence as a dummy urban (vs. rural); state of residence[48] as a set of dummies, with São Paulo state as the reference category. According to the Single Registry most of the BF beneficiaries are women (55.5 percent) and black or mulatto (73.7 percent); live in urban areas (75.3 percent); the state of Maranhão, located in the northeast region, has the highest proportion of beneficiaries (57 percent) while Santa Catarina, located in the south region, has the lowest proportion of beneficiaries (7.3 percent) (Camargo et al, 2013).

As family characteristics we use a Principal Component Analysis (PCA) of pupil's household assets. A set of dummies on mother and father educational attainment: illiterate/semi-illiterate, incomplete primary education, complete secondary education or above, with complete primary education as the reference category. We also use an ordinal variable on number of members living in the household ranging from 1 to 7. As the BFP targets socioeconomically disadvantaged families, the inclusion of family SES in the matching technique is key. Moreover, the educational level of the beneficiaries is very low, with 52 percent of them without complete primary education - making it fundamental to match treatment and control groups by parental educational attainment. Moreover, most of the beneficiary households have 3.6 members (Camargo et al, 2013).

At school level, we also use as predictors school administration type, infrastructure, facilities and access to learning resources. These school-level variables are also used in chapter 3 and are fully described in the item 3.3.1 of that chapter. Given that our outcome variable is pupil's test scores performance, we match students enrolled in schools with similar type of administration, quality of infrastructure, facilities and learning resources as the school also influences student's learning outcomes. Besides, students are enrolled in schools located in their neighbourhood or as close as possible from their homes. Deprived neighbourhoods tend

[48] Brazil has 26 states distributed within 5 geographical regions: North: Amazonas, Roraima, Amapá, Pará, Belém, Tocantins, Rondônia, Acre; Northeast: Maranhão, Piauí, Ceará, Rio Grande do Norte, Pernambuco, Paraíba, Sergipe, Alagoas, Bahia; Midwest: Mato Grosso, Mato Grosso do Sul, Goiás; Southeast: São Paulo, Rio de Janeiro, Espírito Santo, Minas Gerais; South: Paraná, Rio Grande do Sul, Santa Catarina.

to have schools with poorer infrastructure and quality of teaching, and consequently lower student's performance. Therefore, controlling for observed schools' characteristics also work as a proxy for the SES level of the neighbourhood.

4.3.2.2. Variables of Bolsa Família data

We use two variables from the Single Registry: individual and family IDs. From the Attendance System we use three variables: individual and family IDs plus the variable whether the student was a beneficiary of BFP in 2011 or not. This variable was calculated according to the monitoring of school attendance as a compliance check of the BFP. Our aim with the use of Single Registry and Attendance System was to identify BF children in the School Census 2011. The main predictor of this chapter comes from these data sets and is whether the student was a beneficiary of BFP in 2011 or not.

4.3.2.3. Variables of School Census

For the purposes of this chapter we use individual student ID variable to match School Census with *Prova Brasil* at student level; plus the variable whether the student was a beneficiary of BFP in 2011 or not.

4.4. Method

We fit *Prova Brasil* data with a Propensity Score Matching (PSM) model.

4.4.1. The evaluation problem

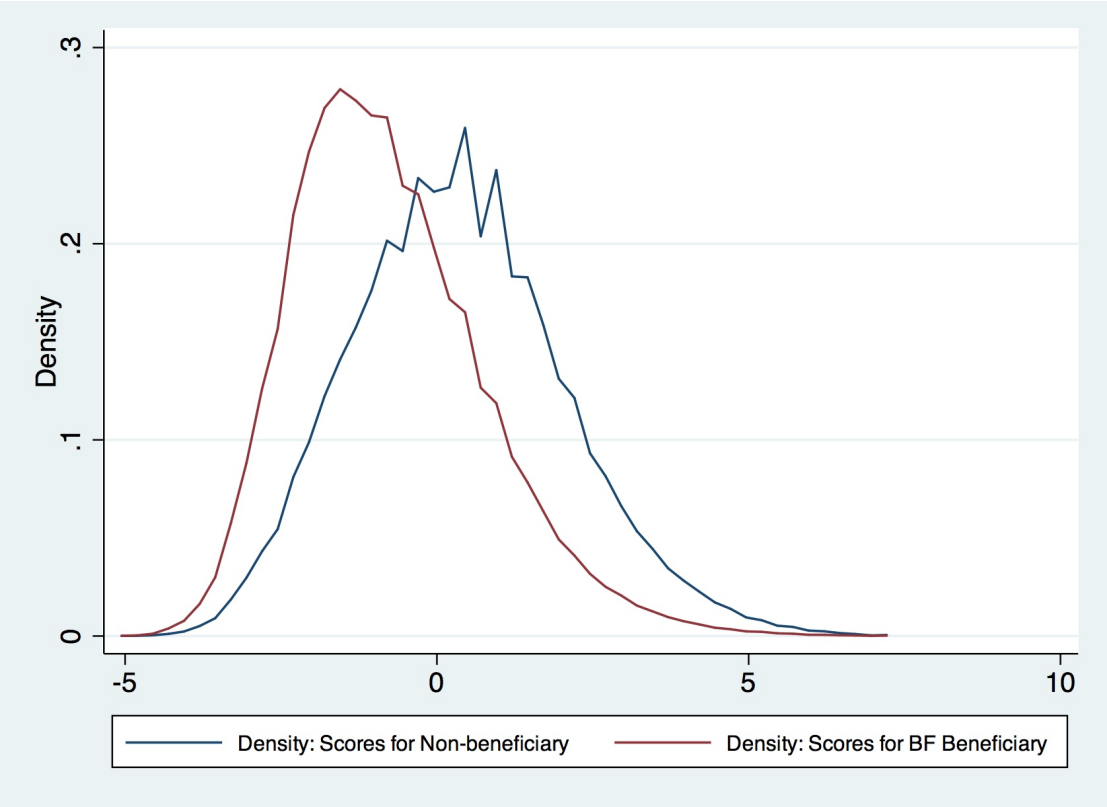
By using standard regression techniques for assessing the effects of a non-experimental policy such as BFP we face a central challenge: we compare in the same model vulnerable children receiving cash benefits with children with very different characteristics, including those with significantly higher SES. Clearly there is a comparability problem known as 'the evaluation problem' in this way of assessing BF's effects on children's school outcomes. Ideally, when performing an evaluation of a given treatment into a specific group of the population, we would look at how a non-treated individual would perform if the same individual would have received the treatment (Heckman et al, 1999). However, there is no possibility of observing the treatment effect for the same person, i.e., once with treatment and once without it. This evaluation problem is addressed by searching for comparable non-treated individuals (the counterfactual or control group), whose only observable difference is the participation in the programme. Hence, socioeconomic characteristics need to be comparable between the treated and non-treated individuals.

Given a programme design in which the inclusion criterion is a defined per capita income threshold, such as the BFP, one possible methodological approach would be the Regression Discontinuity Design (RDD). The major feature of RDD is that the data illustrates a discontinuous function of a particular assignment variable (or set of variables), creating a clear threshold differentiating eligible and non-eligible individuals. The performance of this discontinuous function is commonly determined by a programme regulation. RDD therefore uses this pattern of discontinuous dependence created generally by administrative regularization, and applies the eligibility criteria as an instrumental variable to estimate the Average Treatment Effect (ATE). The discontinuity pattern differs based on the participation function and presents two different types of design: the 'sharp' and the 'fuzzy'. A deterministic participation function of Z presents a sharp design whilst a non-deterministic function of Z presents a fuzzy design. Both designs present discontinuous cut-off points at the assignment variable. RDD has the ability of taking observed and unobserved heterogeneity into account for a given range around the assignment threshold. This is based on the assumption that treated and non-treated individuals are similar (observed or unobserved heterogeneity) around the cut-off point (Marcantonio and Cook, 1994).

As discussed earlier, we should expect a sharp discontinuity around the eligibility threshold of the BFP[49] given its defined per capita poverty line. Nevertheless, the programme has key weaknesses regarding its structure and targeting, as discussed in the item 4.2.1.5. of this chapter. Therefore, contamination between treatment and control groups prevents us from using RDD in our analysis. Figure 4.1 below shows an overlap area between beneficiaries and non-beneficiaries of the BFP with common observable socioeconomic characteristics.

[49] Table 4.3 presents the eligibility threshold – the poverty line – for the years 2004, 2007, 2008, 2009 and 2011.

Figure 4.1 Kernel density plots Principal Component Analysis (PCA) of household assets by Bolsa Família beneficiary and non-beneficiary, Brazil



Author's calculations with *Prova Brasil* 2011.

Despite being a disadvantage for the RDD, this overlap between beneficiaries and non-beneficiaries constitutes an advantage for another policy evaluation design, the Propensity Score Matching (PSM). Overall, PSM design relies on common observable characteristics to build comparable treatment and control groups. According to Winship and Morgan (1999), one of the strengths of PSM is that it ensures that we have both control and treatment cases over the range of *Z* that is relevant to the analysis. In the RDD, the opposite holds: there are no values of Z that contain both treatment and control cases.

4.4.2. Propensity score matching

PSM is a framework that aims to replicate an experimental data set by analysing two observably comparable groups. It assumes that all relevant differences between the two groups are captured by their observables X. It matches two similar individuals, one treated and one non-treated, with both having the same probability of receiving treatment, conditional on the vector of characteristics X (Rosenbaum and Rubin, 1983). PSM finds that the non-treated individual fulfills the same characteristics as the treated one, comparing the outcome between the two groups. PSM has the ability to address the effect of a programme in a broader way,

even though observations might be dropped in the cause of common support (or overlap). It is also capable of increasing the likelihood of comparisons across the treated and counterfactual groups, and could lower the bias of a programme's impact in the case of a large common support (or overlap) (Khandker et. al, 2010). However, one key disadvantage of PSM is that if unobservable characteristics determine programme participation in any way, the Conditional Independence Assumption (CIA) will not hold, leading to selection bias. The CIA needs to hold for an analysis of the Average Treatment Effect on the Treated (ATT)[50], our focus in this chapter. The term 'treatment effect' refers to the causal effect of a binary (0–1) variable on an outcome variable of scientific or policy interest. Our explanatory binary variable is 'being a beneficiary of the BFP' and the policy interest is to evaluate whether BFP has had a positive effect on beneficiary children's scholastic performance as measured by test scores. RDD is able to overcome unobservable heterogeneity given a particular range for an assignment variable, while PSM provides us with complete sample validity of the BFP's effect, but is not able to eliminate unobservable selection factors.

In the particular case of the *Bolsa Família* programme there is a known unobserved self-selection bias caused by the rule that potentially eligible families have to apply to the programme in order to be considered for the benefit. These families have to register in their local municipalities in order to be considered for the cash benefits of the programme. This rule brings key unobserved characteristics that cannot be tested in our PSM model and that might bias our outcomes. Specifically, eligible families who register for the programme might have more access to information, know more about their rights, and also live in less isolated areas. The more informed the family is about the programme and its conditionalities, the more likely this family will give incentives to their children to attend school and comply with the education conditionality. This higher attendance and positive attitudes towards education might positively affect these students test scores performance, our variable of interest, consequently biasing our results. Moreover, self-selection might exclude from the programme those families living in very isolated areas and in even more vulnerable situation than many of the better-

[50] In the case of the Average Treatment Estimator (ATE), the conditional independence assumption would also need to hold for the treated sample.

informed families that receive the benefit. The poorest are usually harder to be found and checked because they often change economic activities and even place of residence (Kerstenetzky, 2009). These families excluded by their isolated and/or less-informed condition might have lower positive attitude and motivation towards the education of their children. These students usually have a more difficult access to school due to longer commuting time. These more tired and less motivated pupils are more likely to have lower scholastic performance compared to children from families with similar socioeconomic conditions but more motivated and informed. The self-selection issue found in the application process to the BFP can therefore bias our treatment group to have higher test scores performance than their similar peers in the control group.

PSM is based on the:

(1) Conditional Independence Assumption (CIA) or balancing property assumption:

$$Y_i^0 \perp d_i | P(X_i)$$

It assumes all the relevant differences between treated and non-treated are captured in their observable attributes. Where Y_i^0 is the potential outcome of individual *i* in the control group, d_i stands for the treatment of individual *i*, and $P(X_i)$ is the probability of getting treatment conditional on the vector of observable characteristics *X*. The assumption says that the vector of observed variables *X* fully determines the possible outcome within the non-treated group, Y^0, hence being able to overcome treatment selection bias. In other words, it means that based on *Xs*, we have all relevant variables which may be able to determine the participation rule regarding treatment, as well as the non-treated outcome. Thus, after controlling for Xs, we can say that the outcome of individuals without treatment (Y_i^0) is independent of their participation status.

The balancing process used for the propensity scores makes the treated and non-treated individuals comparable to each other, assuring that the CIA holds. The balancing process is based on the:

(2) Common Support (or overlap) condition assumption:

$$0 < P\,[d = 1 \mid X] < 1$$

This assumption says that for each characteristic of X, there are individuals from the treated and non-treated groups, indicating an overlapping trend between both groups. The common support area allows selecting counterfactual observations from the non-treated pool a control group in which the distribution of observed variables is as similar as possible to the

distribution in the treated group. Once the propensity score is calculated, matching is performed based on fitting weights assigned to the neighbourhood of *P(X)*.

Conditional on the assumptions above, the matching estimator is then:

$$\hat{\alpha}^M = \Sigma_{i\epsilon T} \left\{ Y_i - \Sigma_{j\epsilon C} \widetilde{W_{l_J}} Y_i \right\} W_i$$

Where *T* and *C* stand for the treatment and control groups respectively, *i* for the treated individuals in the treatment group *T*, *j* for non-treated individuals in the control group C, $\widetilde{W_{l_J}}$ for the weights on *j* for group *i,* while W_i stands for the reweighting that is needed to build the distribution for the beneficiary group.

According to Cameron and Trivedi (2005: 872) the matching technique is a good methodology in the following cases:

i) when there is a good set of variables *X*s to build a good control group;

ii) when there is a large amount of observations that we can control for;

iii) when the Average Treatment on the Treated (ATT) is the parameter of interest as if selection bias from unobserved characteristics is likely to be negligible, then PSM may provide a good comparison with randomized estimates (Khandker et. al, 2010).

The data we have available to assess the BFP provide a good basis for these three cases.

Blundell and Costa Dias (2008) argue that building a control group based on a set of variables *X*s is a delicate issue, as by choosing a large set of *X* variables, the overlapping support condition will not be fulfilled, and a small set would lead to a problem of unbalance where the CIA does not hold. Additionally, unsuitable characteristics for *X* would create problems in both assumptions. Therefore, the authors suggest that the *X* vector should explain both the treatment upon its assignment and its outcome. This is the condition that leads to a balanced CIA assumption, but it is not necessarily the condition that allows the overlapping support condition to hold. Contrarily, Diaz and Handa (2006) provide a valuable contribution to the discussion about the use of PSM for the evaluation of CCTs. They test the reliability of PSM as an alternative framework for evaluating programmes that were not implemented as randomized control trial. They compare outcomes from a non-experimental dataset (the Mexican national household survey on income and expenditure, ENIGH) to outcomes from experimental datasets, finding no statistically significant bias between the estimates, which indicates that the PSM is a good alternative tool to carry out treatment evaluation when working with non-experimental data. Additionally, they also argue that PSM is a good method if the researcher possesses a dataset containing a rich set of variables able to estimate the propensity score, as well as in-depth information on the beneficiary selection process. All in all, these

findings strongly point towards the use of the PSM for the evaluation of the *Bolsa Família* Programme.

4.4.2.1. Matching estimators

We base our analyses on three main types of matching estimators: 1) Traditional matching estimator: one-to-one (nearest neighbour); 2) Simple smoothed matching estimators: k-nearest neighbor and radius; 3) Weighted smoothed matching estimators: kernel.

The one-to-one estimator matches only one treated observation to each single non-treated observation. When performed 'with replacement' many treated observations may be matched to the same non-treated unit. On the other hand, when performed 'without replacement' once a non-treated unit has been matched, it cannot be used again. K-nearest neighbor matching uses a certain range for non-treated individuals, which are the K- closest match of the treated observations. For each treated observation *i*, select a control observation *j* that has the closest *X*. The radius matching, proposed by Dehejia and Wahba (2002), is a modification of caliper matching. Caliper matching chooses the counterfactual group in one particular range of the propensity score only, providing an alternative to overcoming bad matches (Blundell and Costa Dias 2008). The radius consists of using the set of individuals in the control group within the caliper. In other words, each treated observation *i* is matched with control observations *j* that fall within a specified radius. If none untreated observation is found within the radius around the treated one, it is left unmatched. Kernel matching is a non-parametric matching estimator. It calculates weights according to the distance in the propensity scores between treated and non-treated individuals, where the weight assigned to the treated individual tends to be closer to one as the kernel function draws nearer to the matched individual, while it falls as the propensity score of the matched observation becomes more distant to one. Kernel matching is a weighted regression of the counterfactual group outcome on an intercept, with weights given by the kernel weight (Heckman et al 1997, 1998; Smith and Todd, 2005). In other words, each treated observation *i* is matched with several control observations, with weights inversely proportional to the distance between treated and control observations.

4.5. Outcomes

This chapter uses a combination of administrative and survey data from four different sources: i) The Single Registry (*Cadastro Único*) 2012 from the Ministry of Social Development and Fight Against Hunger (MDS) of Brazil; ii) Attendance System (*Sistema Presença*) 2012 from the Ministry of Education (MEC); iii) School Census 2011 from MEC;

iv) Brazil Exam (*Prova Brasil*) 2011 from MEC. In table 4.6 below we present the descriptive statistics of all variables used in the analyses carried out in this chapter.

Table 4.6 Descriptive Statistics

Variable	Observations	Mean	Std.Dev.	Min	Max
Test Scores Maths	3,939,676	-.458	.913	-2.860	2.653
Test Scores Language	3,939,676	-.704	.958	-3.136	2.375
BFP Beneficiary in 2011	3,968,084	.337	.473	0	1
Female	3,820,672	.508	.500	0	1
White	3,498,837	.370	.483	0	1
Urban (vs. Rural)	3,968,084	.910	.286	0	1
Region: South	3,968,084	.127	.333	0	1
Region: Southeast	3,968,084	.434	.495	0	1
Region: Midwest	3,968,084	.074	.262	0	1
Region: Northeast	3,968,084	.269	.443	0	1
Region: North	3,968,084	.097	.295	0	1
State: Rio Grande do Sul	3,968,084	.039	.193	0	1
State: Santa Catarina	3,968,084	.036	.186	0	1
State: Paraná	3,968,084	.052	.222	0	1
State: São Paulo	3,968,084	.244	.429	0	1
State: Rio de Janeiro	3,968,084	.063	.243	0	1
State: Espírito Santo	3,968,084	.018	.131	0	1
State: Minas Gerais	3,968,084	.109	.312	0	1
State: Mato Grosso do Sul	3,968,084	.014	.118	0	1
State: Goiás	3,968,084	.030	.171	0	1
State: Distrito Federal	3,968,084	.013	.113	0	1
State: Mato Grosso	3,968,084	.017	.128	0	1
State: Bahia	3,968,084	.065	.247	0	1
State: Sergipe	3,968,084	.010	.100	0	1
State: Alagoas	3,968,084	.019	.136	0	1
State: Pernambuco	3,968,084	.042	.200	0	1
State: Paraíba	3,968,084	.017	.127	0	1
State: Rio Grande do Norte	3,968,084	.014	.119	0	1
State: Ceará	3,968,084	.049	.216	0	1
State: Piauí	3,968,084	.014	.119	0	1
State: Maranhão	3,968,084	.038	.192	0	1
State: Pará	3,968,084	.041	.197	0	1
State: Amapá	3,968,084	.005	.069	0	1
State: Tocantins	3,968,084	.009	.097	0	1
State: Roraima	3,968,084	.003	.056	0	1
State: Amazonas	3,968,084	.025	.157	0	1
State: Acre	3,968,084	.004	.067	0	1
State: Rondônia	3,968,084	.009	.094	0	1
Household Assets (PCA)	3,059,612	.001	1.734	-4.979	7.135
Mother: Illiterate/Semi-illiterate	2,728,506	.206	.404	0	1
Mother: Incomplete Primary Education	2,728,506	.244	.430	0	1
Mother: Complete Primary Education	2,728,506	.196	.397	0	1
Mother: Complete Secondary Education or above	2,728,506	.354	.478	0	1
Father: Illiterate/Semi-illiterate	2,235,310	.250	.433	0	1
Father: Incomplete Primary Education	2,235,310	.217	.412	0	1
Father: Complete Primary Education	2,235,310	.201	.401	0	1
Father: Complete Secondary Education or above	2,235,310	.332	.471	0	1
Number of Household Members	3,863,873	4.139	1.221	1	7
School Type: Federal	3,968,084	.001	.035	0	1
School Type: State	3,968,084	.430	.495	0	1
School Type: Municipal	3,968,084	.569	.495	0	1
School Quality of Infrastructure	3,505,502	2.630	.586	1	3
School Quality of Facilities	3,286,984	2.022	.668	1	3
School Availability of Textbooks	3,951,886	2.896	.385	1	3
School High Absence of Teachers	3,922,612	1.538	.724	1	3

Author's calculations with *Prova Brasil* 2011 and *Projeto Presença.*

There are two options for our PSM analysis. One is the use of as many variables as possible with the argument that over parameterizing does not affect consistency or cause bias in the estimates. The other is to introduce only relevant variables for the determination of treatment. Bryson et al (2002) argue against the introduction of excessive parameters as it could compromise the common support condition by downsizing the common support area; as well as increase variance. On the other side, Rubin and Thomas (1996) state that the introduction of extra variables is justified. The authors recommend that when there are doubts regarding the relevance of one covariate, or its relation with the outcome variable, all possible relevant covariates should be introduced in the estimation. Caliendo and Kopeinig (2008) argue that if this approach is to be used, the selection of variables should rely on economic theory over empirical findings and the institutional setting. We understand PSM as a tool for the multidimensionality problem found in observational studies and not a tool to exclusively estimate selection into treatment. We therefore follow the recommendation of Rubin and Thomas (1996) and introduce variables into our PSM model due to precautionary reasons and a better fit, despite having a questionable level of significance and respective importance.

In order to calculate our PSM model[51] we use the following explanatory variables for program participation:

- Individual Characteristics of the pupil: female (vs. male); white (vs. non-white); urban (vs. rural); set of dummies of state of residency with São Paulo as the reference category.
- Background characteristics: Household Assets (PCA); mother and father educational attainment as a set of dummies: illiterate/semi-illiterate, incomplete primary education, complete secondary education or above, with complete primary education as the reference category; number of members in the household.
- School characteristics: type of administration as a set of dummies: federal, state and municipal, with state as the reference category; indexes of school quality of infrastructure, facilities, and availability of teachers and textbooks.

[51] Leuven and Sianesi (2003).

The main explanatory variable is:

- *Bolsa Família* Programme Beneficiary in 2011

The response variables are:

- Test Scores in Mathematics for 5th and 9th graders
- Test Scores in Portuguese language for 5th and 9th graders

Our sample for 5th graders includes approximately 800,000 pupils in the treatment and 1,300,000 pupils in the control group. For 9th graders we have approximately 500,000 pupils in the treatment and 1,300,00 pupils in the control group. The descriptive statistics of the variables used in the PSM analysis separated by treated and non-treated groups can be found in the tables E.1, E.2, E.3, and E.4 of Appendix E.

The first step of the PSM is to calculate the probability of receiving treatment – the *Bolsa Família* cash benefit. We run a probit model[52] for the binary treatment case. Since the CIA is a prerequisite for PSM, the outcome variable has to be independent of treatment conditional on the propensity score (Caliendo and Kopeinig, 2008). We save the propensity scores (predicted probabilities) from our probit model in order to use them to find matches for the treated observations. The output of our probit models[53] for 5th and 9th graders show that students who are white, from urban areas, attend federal schools, have their mother and/or father with a complete secondary education and are from the southeast or south regions are less likely to receive the cash benefits of the BFP. The output of this model also shows us that the balancing property, or in other words, the similar characteristics between treated and control observations, is satisfied.

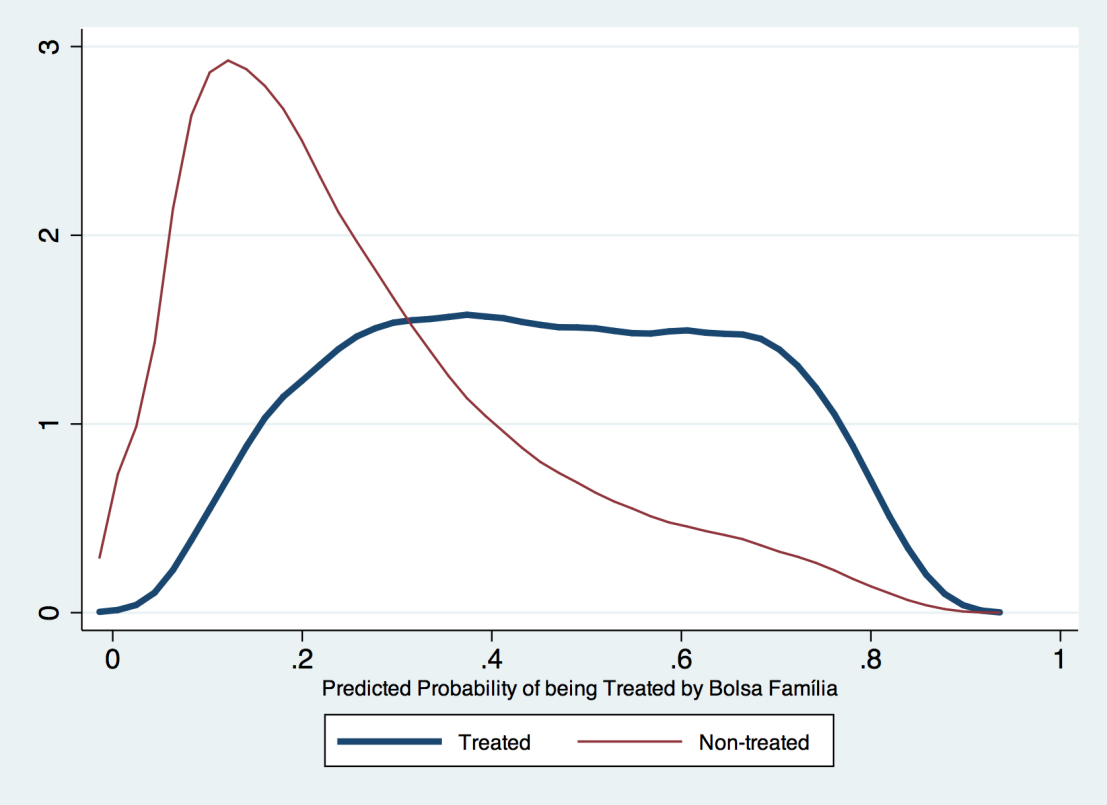
4.5.1. The Common Support Condition

As said above, the overlapping pattern of our test scores data is a particular and necessary characteristic of the PSM method, and is determined based on the propensity score. Figures 4.1 and 4.2 below show the area of common support for 5th and 9th graders respectively,

[52] The use of a logit or a probit model achieves analogous results (Caliendo and Kopeinig 2008).
[53] Please check Appendix C for the outcomes of our probit models.

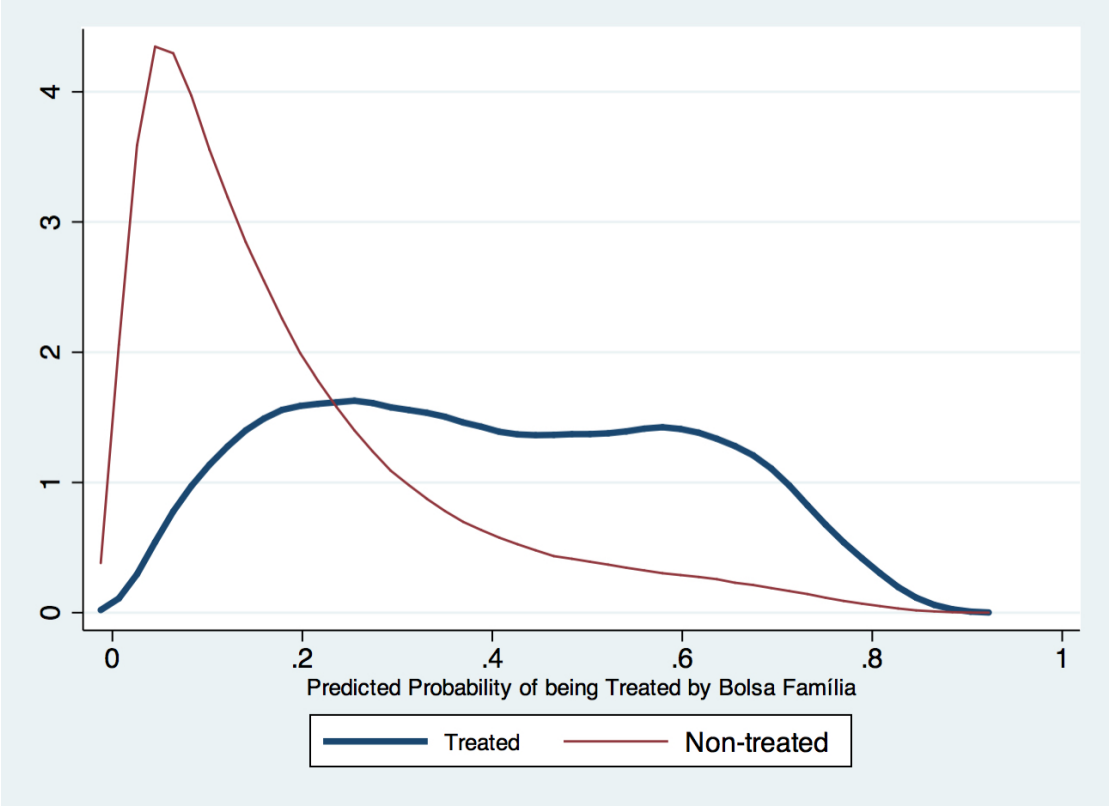
conditional on the 48 variables introduced for the calculation of the selection into treatment, i.e., propensity score. This ensures that there are no observations among the treated group that the propensity score is higher than the maximum, or less than the minimum, of the counterfactual group. Since the matching is always performed in the support area, for 5th graders we work with 448,522 observations, with 300,927 untreated and 147,595 treated pupils. For 9th graders, the common support area includes the total of 662,190 pupils, with 502,805 untreated and 159,385 treated. The common support condition holds for all other sub samples. In these cases, overparameterizing does not constraint the common support area (Bryson et all, 2002).

Figure 4.2 Common Support area for 5th graders, Brazil



Author's calculations with *Prova Brasil* 2011.

Figure 4.3 Common Support area for 9th graders, Brazil

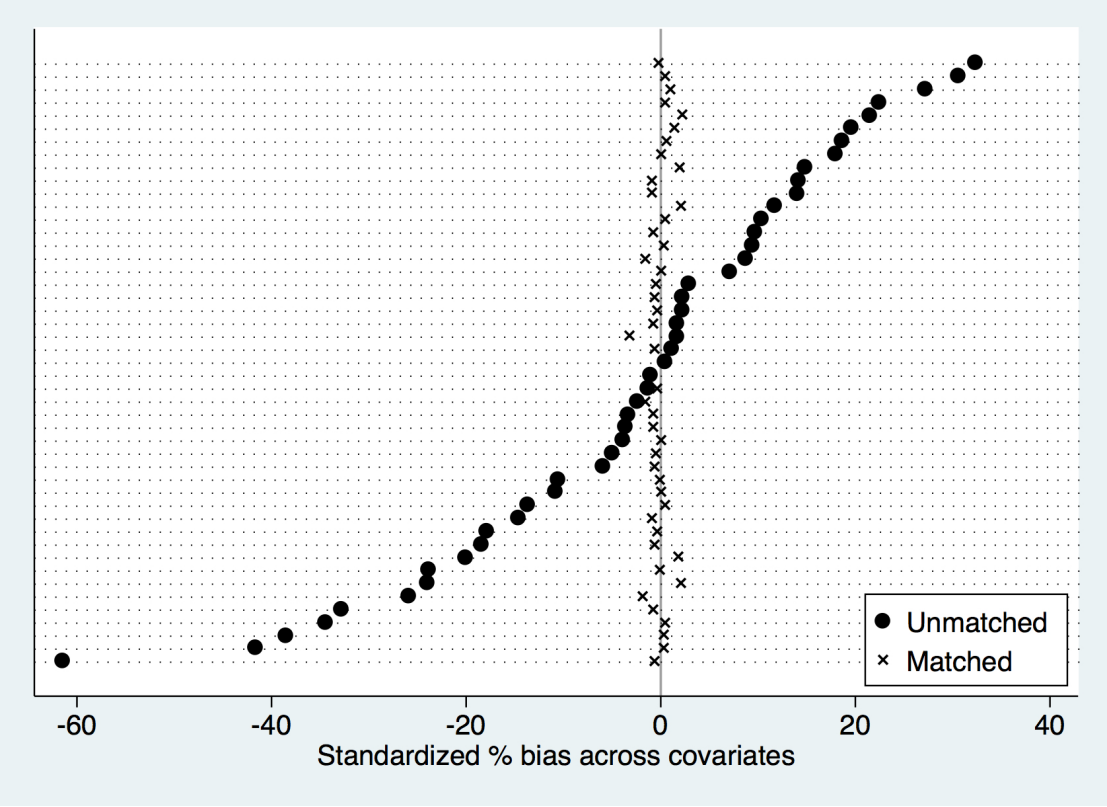


Author's calculations with *Prova Brasil* 2011.

4.5.2. The Balancing Condition

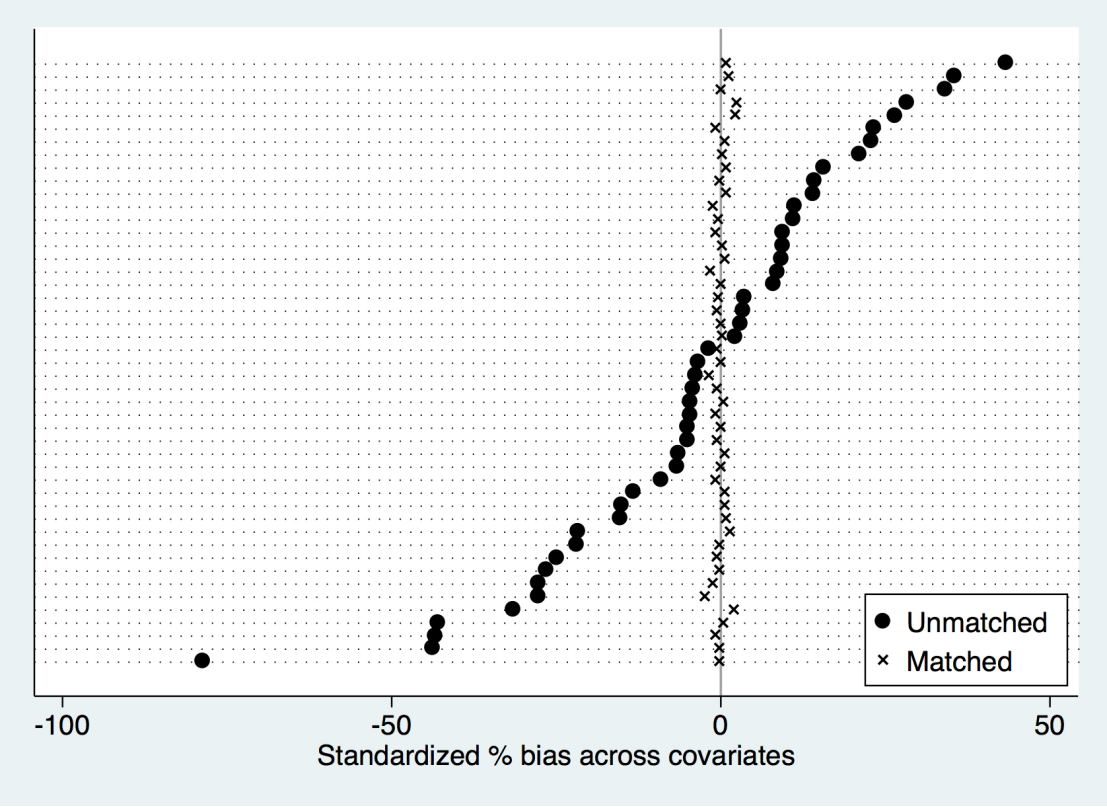
The balancing condition is the prerequisite to using propensity score as the matching technique by showing that treated and non-treated are similar and comparable. The output of the balancing shows the t-test for the equality of the means in both the treated and non-treated groups for the matched and the unmatched samples. The test is carried out in the common support area and is based on the regression of a particular variable on the treatment indicator. The output also shows the standardized bias, as well as the reduction of this bias as a percentage due to matching. The output of the balancing tests for our 5th and 9th grade samples can be found in Appendix F, tables F.1 and F.2. It is important to analyse the balancing condition for each variable after the matching process to verify if the variables' means of non-treated samples are comparable to the means of treated ones. We can see that after matching, most of the treated and non-treated groups become more comparable as figures 4.3 and 4.4 below show.

Figure 4.4 Common Support area for 5th graders, Brazil



Author's calculations with *Prova Brasil* 2011.

Figure 4.5 Common Support Area for 9th graders, Brazil



Author's calculations with *Prova Brasil* 2011.

The percentage of bias reduction is high for most of them, indicating that the balancing condition holds[54] despite a few variables that are not balanced (some even present an increase in the estimation bias). For a robustness check we run the estimations without these variables that can over- or underestimate our results, such as the ones presenting high percentage of bias increase (some state dummies and some parental educational level, for instance). We find no substantial differences in our estimates. The effect of the treatment varies in less than 0.5 percent in response to these robustness checks. We therefore decide to keep all variables in our PSM estimates as they are considered important for the fit of our model.

4.5.3. Findings from the matching estimators

Outcomes of our PSM analysis for 5th and 9th graders sitting maths and language tests are displayed between tables 4.7 and 4.10 below. We look at the BF programme's effect on two different variables, test scores in maths and language for samples of 5th and 9th graders separately. For robustness, we implement three matching methods and their specifications: one-to-one, nearest neighbor, and kernel. The specifications are as follow: for one-to-one matching, the counterfactual group is constructed with replacement; for nearest neighbor matching, we use five nearest neighbors; for radius matching we use a caliper of 0.01; and for kernel matching the bandwidth is 0.06. Overall, we can see that the BFP has a small positive impact of between 2 and 3 of a standard deviation on students' test score performance for both 5th and 9th graders in maths and as well as in language.

After matching treated and control 5th graders for maths and language (tables 4.7 and 4.8 below), our matching estimators suggest that beneficiary students perform on average 2 of a standard deviation more than similar pupils whose families are not beneficiary of the programme, suggesting a rather positive effect of BF on performance, despite small.

[54] We do find however, that for some variables, treated and non-treated are still statistically significantly different after matching. Even though this can be caused by a possible unobservable bias, we consider this to be a result of the high amount of observations in the dataset, making any difference statistically significant.

Table 4.7 Bolsa Família effects on test scores in mathematics, 5th graders, 2011 Brazil

Matching Method	Treated	Controls	Difference	S.E.	T-stat
Unmatched	-.843	-.450	-.393	.003	-147.56
One-to-One (with replacement)	-.843	-.860	.017	.004	4.34
Nearest Neighbour	-.843	-.860	.018	.003	5.39
Radius (within calliper)	-.843	-.861	.019	.003	6.03
Kernel	-.843	-.830	-.013	.003	-4.20

Author's calculations with *Prova Brasil* 2011 and *Projeto Presença.*

Table 4.8 Bolsa Família effects on test scores in language, 5th graders, 2011 Brazil

Matching Method	Treated	Controls	Difference	S.E.	T-Stat
Unmatched	-1.203	-.836	-.367	.003	-140.21
One-to-One (with replacement)	-1.203	-1.220	.016	.004	4.11
Nearest Neighbour	-1.203	-1.221	.017	.003	5.41
Radius (within calliper)	-1.203	-1.220	.017	.003	5.67
Kernel	-1.203	-1.191	-.012	.003	-4.09

Author's calculations with *Prova Brasil* 2011 and *Projeto Presença.*

After matching treated and control 9th graders for maths and language (tables 4.9 and 4.10 below), beneficiary students perform, on average, 3 of a standard deviation above similar pupils whose families are not beneficiary of the programme for maths and language respectively.

Table 4.9 Bolsa Família effects on test scores in mathematics, 9th graders, 2011 Brazil

Matching Method	Treated	Controls	Difference	S.E.	T-Stat
Unmatched	-.209	.102	-.311	.002	-130.00
One-to-One (with replacement)	-.209	-.240	.031	.004	8.36
Nearest Neighbour	-.209	-.237	.028	.003	9.36
Radius (within calliper)	-.209	-.236	.027	.003	9.62
Kernel	-.209	-.207	-.002	.003	-0.78

Author's calculations with *Prova Brasil* 2011 and *Projeto Presença.*

Table 4.10 Bolsa Família effects on test scores in language, 9th graders, 2011 Brazil

Matching Method	Treated	Controls	Difference	S.E.	T-Stat
Unmatched	-.320	-.016	-.304	.002	-126.43
One-to-One (with replacement)	-.320	-.340	.019	.004	5.26
Nearest Neighbour	-.320	-.342	.022	003	7.33
Radius (within calliper)	-.320	-.343	.022	.003	8.01
Kernel	-.320	-.314	-.006	.003	-2.07

Author's calculations with *Prova Brasil* 2011 and *Projeto Presença.*

4.5.4. Heterogeneous treatment effects by region

While finding an overall effect of the *Bolsa Família* programme on test scores performance, we are also interested in the differences in its effects between the five geographical regions. Tables with the matching estimators by region can be found in Appendix G. Overall, the differences in performance are very small but positive for beneficiary pupils and slightly larger for richer regions: 2 and 1 of a standard deviation in the richer and poorer regions respectively. More specifically, for 5th graders, beneficiaries from the southeast, south and midwest perform, on average, only 2 of a standard deviation higher than their matched peers in the control group. Beneficiary pupils from the northeast and north perform, on average, only 1 of a standard deviation higher than their matched counterparts in the control group. For 9th graders regional differences are basically null: BFP beneficiary students from all regions perform, on average, approximately 2 of a standard deviation higher than observably similar non-beneficiary pupils.

4.6. Conclusions

Throughout developing countries, particularly in Latin America, CCT programmes have been playing an important role in social policy for over a decade. These programs aim to reduce poverty and to promote accumulation of human capital. As mentioned above, evidence has shown the significant and positive impact of these programmes on school enrolment and regular attendance. While these are clearly the first steps to enhance educational outcomes, they do not guarantee improvements in knowledge gains nor can work as a proxy measure for school success. As the ultimate goal of CCTs is to build human capital and break down the intergenerational cycle of poverty, then the measurement of learning and gains in cognitive skills should constitute a central part in the evaluation of success of such programmes. While there is extensive research on the effects of CCTs on enrolment and attendance, their effects on learning as measured by test scores performance has not yet been as extensively examined. This chapter contributes to the scarce literature on the impact of CCTs on learning outcomes in the developing world by using information from Brazil and by focusing on the effect of the programme on test scores using an exceptional dataset.

By addressing the evaluation problem present in observational studies such as BF we have used Propensity Score Matching to fit our data and answer the question on whether the BFP helps to increase scholastic performance of beneficiary pupils. Yet the structure and implementation of the BFP present some key issues leading to mistargetting and misallocation of the cash benefits. While PSM provides us with complete sample validity of the BFP's effect, it is not able to eliminate unobservable selection factors, consequently bringing key untestable characteristics that might bias our outcomes. Among these untestable characteristics we have that those families who do apply to the programme are more likely to have more access to information and to their rights, and also live in less isolated areas. The more informed a family is about the programme and its conditionalities, the more likely this family will give incentives to their children to regularly attend school. This higher attendance and attitudes towards education might positively affect these students' test scores performance, our variable of interest, consequently biasing our results so that the beneficiary pupils might score higher than observably similar non-beneficiary pupils. Moreover, given that registration to the programme is based on self-reported income usually not fully verified by the authorities, the benefits might also go to families that are not eligible, causing eligibility bias. This can lead to better-off families receiving the cash benefits in place of more vulnerable families because the BFP has a budget cap and stops adding more families to the programme once the cap is reached. This eligibility bias could also increase the test scores performance of the treatment group compared

to the control given the potential presence of more better-off pupils in the group with beneficiary pupils.

Our PSM estimates show a positive effect of BFP on test scores in maths and language for both 5th and 9th graders. However, the effect is very small: between 1 and 3 of a standard deviation higher. Further, there is also a very small regional difference in performance between beneficiary and non-beneficiary pupils: beneficiary pupils from the richer regions of southeast, south and midwest perform, on average, 2 of a standard deviation higher than their matched non-beneficiary peers while beneficiary pupils from the poorer north and northeast perform an average of 1 of a standard deviation higher than their matched peers. Overall, the slightly higher performance of beneficiary children might be due to the programme itself as it increases school attendance, or it can be driven by the biases of the PSM and the BFP designs above-mentioned. Likewise, the slightly higher achievement of BF pupils in richer regions might be the result of better school infrastructure found in these places instead of a leveling up effect of the BFP on pupils' performance. It could also be that socioeconomically vulnerable pupils score similarly low, regardless of region or BF cash benefit.

We have extended the studies of Santarrosa (2011), Cireno et al (2013), and Simoes and Sabates (2014) respectively by i) considering the entire Brazilian territory, including small cities and rural locations, and separately by region; ii) building a counterfactual group of non-beneficiary pupils with observably similar characteristics; and iii) assessing the effect of BF on individual students test scores. Our results do not align with Santarrosa (2011), who found no significant effect of the BF programme on beneficiary children test scores proficiency in the city of São Paulo. Our study contradicts Cireno et al (2013), which found that BF beneficiary pupils performed, on average, worse in *Prova Brasil* than non-beneficiaries. The authors did not use a counterfactual group, comparing BF beneficiary pupils with all other children regardless of their socioeconomic condition. Our results also contradict Simoes and Sabates (2014), which found that the effect of BF was higher for language than for mathematics; and also found a regional variance in mathematics as it was significant only for the northeast and south regions. As a comparison, we found no difference in the programme's effect between subjects and also its effect was significant for all regions and for both subjects. Noteworthily, Simoes and Sabates (2014) did not estimate the direct effect of BF on beneficiaries' performance but on the mean school test scores based on the proportion of BF students in each school.

There are also some possible explanations for the very modest effect of BF on test scores, despite positive documented effects on educational attainment and attendance. One of them is the lack of baseline data in our analysis of pupil's test score performance. Another

possibility is that important constraints at the household level might not be properly addressed by CCTs as currently designed. These constraints could include poor parenting practices, lack of information on the potential that education might offer in later life stages, and poor emotional environment for instance (Reimers et al, 2006: 46). A CCT by itself or even in combination with high-quality schools is unlikely to remedy such disadvantages. This is particularly important because recent theoretical and empirical research suggests that the returns to investments later in the life cycle will be limited if children do not have adequate levels of cognitive, social, and emotional development in early childhood (Cunha et al. 2006; Knudsen et al. 2006). Under these circumstances, interventions that seek to improve parenting practices and the quality of the home environment are likely to be particularly important. Furthermore, the quality of instruction available to beneficiary children at schools might not be adequate. The role that quality of schools attended by beneficiary children plays for the success of BF to enhance children's human capital has not yet been fully assessed by the existing evaluations, nor have the evaluations been designed to examine the independent and combined effects of improving quality of schooling along with the cash transfers (Fizbein and Schady, 2009; Reimers et al, 2006: 46). In any case, even if the additional enrollment that results from CCTs does not translate substantially into more learning, as this study suggests, CCTs could result in other advantages in adulthood. Because of the prolonged time at school, students could be developing important non-cognitive skills, like discipline, responsibility, and motivation, and those skills may have large payoffs in the labor market, such as higher salaries (Carneiro et al, 2003).

The main conclusion of this chapter highlights the need for possible design changes in CCT programmes in general and in *Bolsa Família* in particular, such as linking cash benefits to performance rather than use of educational services alone such as enrollment. This could potentially provide more encouragement for learning. There is also a need for a more in depth look at the quality of the schools the children are attending to determine whether the BFP itself might be supplemented by interventions aimed at school quality. An important challenge for the future is better understanding what complementary actions would ensure that CCTs have greater impact on other educational outcomes, such as achievement and cognitive development, rather than simply enrolment and school attendance. The main contribution of this chapter is to present a more detailed account of the causal relationship between the education conditionality of a CCT programme and test scores achievement of its beneficiary children. This chapter also identifies very small heterogeneous outcomes by region related to pupil's test scores performance.

5. **Conclusion**

This thesis investigates the ways in which family and school factors matter for selected educational outcomes in Brazil, namely, educational attainment, average school test scores performance, and pupil's individual test scores performance. More specifically, it carries out a comprehensive examination of the effectiveness of two nationwide compensatory policies - the FUNDEB and *Bolsa Família* - in improving and equalizing educational outcomes using an exceptional combination of household survey, educational assessment, and administrative data. Given the sharp socioeconomic differences among the five geographical regions of the country - namely south, southeast, midwest, north and northeast - this study also explores regional differences in these selected educational outcomes.

Three main research questions are answered. First, by using the Brazilian National Household Sample Survey (PNAD) we assess the trends in Inequality of Educational Opportunities (IOE) in the twentieth and beginning of the twentieth-first centuries in Brazil, a period marked by educational expansion. We find an equalisation in early educational transitions (completing some and graduating primary education) and a strengthening in the association between parent's educational attainment and the graduation of secondary and tertiary education of their offspring. Our findings thus agree with the 'persistent inequality' reported for the industrialized countries (Shavit e Blossfeld, 1993), and also for late industrialized countries (Torche, 2005; Torche, 2010; Gerber e Hout, 1995; Gerber, 2000). On the one hand, the declining and stagnating influence of parental educational attainment in graduating primary education might be associated with the fast educational expansion of primary schooling during the second half of the twentieth century, when the primary level also became mandatory. On the other, we observe a strengthening in the association between parental education and the graduation of secondary and entry to university followed by a stable but very unequal trend for graduating university, with those with better educated parents having much higher chances of completing a university degree than those with lower educated parents. The tertiary education did not follow the expansion of lower educational levels and the university degree is still restricted to better-off individuals. The outcomes of this chapter do not reveal any significant differences in IOE between better-off and worse-off regions. Overall, this chapter expands the literature on educational stratification in Latin America in a context of educational expansion and sharp macroeconomic changes. It also expands evidence for Brazil by using a larger time span and a geographically more representative sample size than previous research on the country such as Torche's (2010) and Ribeiro's (2011, 2017).

Second, by using the *Prova Brasil* assessment data we ask whether increasing selected school resources led to gains in average scholastic performance as measured by test scores in language and mathematics between 2007 and 2015. Our findings suggest positive gains in average school performance over time for both subjects, thus contradicting the main literature that points to rather stable average school performance over the years such as Willms and Raudenbush (1989), Raudenbush (1989), and Gray et al (1995). For maths, the average gains in performance rise from 4 to 24 of a standard deviation between 2009 and 2015 (compared to the same schools in 2007). For language, the gains in performance are higher, they rise from 19 to 37 of a standard deviation between 2009 and 2015 (compared to the same schools in 2007). The richer regions of southeast, south, and midwest present gains in performance similar to the Brazilian average whilst the poorer regions of northeast and north have performance gains lower than the average, but they catch up with the national average gains by 2015. This later catch up might indicate that the FUNDEB resources have successfully reached poorer regions and helped them to level up their average educational outcomes with better-off parts of the country. We also measure the effects of a number of specific resources such as quality of infrastructure and facilities on average test scores. These resources have significant effects on average school performance, but the effects are very small: between 0.3 to 2.3 of a standard deviation. This outcome confirms the international literature for the developed world that found school resources to have a very small or insignificant effect on pupil's test scores performance (Hanushek, 1986, 1989; Purkey & Smith, 1983; Sammons et al., 1995). Our study therefore contradicts the previous outcomes found for the developing world (Heyneman and Loxley, 1983; Fuller, 1987; Harbison and Hanushek, 1992; Fuller and Clarke, 1994). No regional differences on the size of these effects are found, thus contradicting the main literature in the field such as Heyneman and Loxley's (1983) evidence that the lower the income of a place the stronger the relationship between school factors and school performance. By using current longitudinal data, this chapter adds to the school effectiveness research the positive but very small effect of school resources on scholastic performance as measured by test scores in a developing country. It also shows school average test scores performance significantly increasing over time. This chapter also contributes to an assessment of an educational policy that aimed at improving quality of schooling by increasing and redistributing school resources in a large and unequal country. Finally, this chapter contributes to the growing body of international evidence on the effects of resources on school outcomes.

Third, by using *Prova Brasil*, School Census, Single Registry, and the Attendance System in a Propensity Score Matching design we investigate whether the cash benefit of the *Bolsa Família* programme improve test scores performance in language and mathematics of

beneficiary pupils compared to similar disadvantaged pupils who are non-beneficiaries of the programme. We find a significant positive effect of the *Bolsa Família* programme on both subjects, but the effect is very small: between 1 and 3 of a standard deviation. Additionally, we find that beneficiary pupils from the richer regions of southeast, south and midwest perform, on average, 1 of a standard deviation higher than beneficiary pupils from the poorer north and northeast. This slightly higher achievement of BF pupils in richer regions might be the result of better school infrastructure found in these places instead of a leveling up effect of the BFP on pupil's performance. This chapter extends the scarce literature on the impact of CCTs on learning outcomes in the developing world. It also specifically fills the gap on the effect of the Brazilian CCT *Bolsa Família* on pupils' test scores performance by considering the entire Brazilian territory and separately by region, building a counterfactual group of non-beneficiary pupils with observably similar characteristics, and assessing the effect of BF on pupils' individual test scores performance. This chapter also contradicts the main recent literature on the effects of BF on test scores performance that had previously found a negative or null effect of BFP on beneficiary pupils' learning outcomes such as Cireno et al (2013) and Santarrosa (2011).

The findings of this thesis have extended the literature on IOE, school effectiveness research, and programme evaluation. This study also brings important policy implications for the theory and practice on the influence of family and school resources on educational outcomes in developing countries.

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Appendices

APPENDIX A

Table A1. Mean Years of Schooling Earliest Birth Cohort, Born 1931-1943 in the Early 1980s and 1990s

Males	
1980	4
1991	4
Females	
1980	4
1991	4

Source: Author's calculation based on Brazil Population Census of 1980 and 1991.

Table A2. Average Years of Schooling of Fathers and Mothers of Earliest Birth Cohort, Born 1931-1943

Fathers	3.3
Mothers	2.7
Mean	3

Source: author's calculation based on PNADs 1996 and 2014.

Table A3. Average Years of Schooling of Adult Men and Women in 1950-1960, Brazil

Men	3
Women	2.5
Mean	2.7

Source: MEC (1996) and Population Census of 1950 and 1960.

Table B.1. Parameter Estimates Ordered Logistic Regression with Proportional Odds of Social Background on Conditional Educational Transitions: cohorts born between 1931 and 1989, Brazil

Outcome Measure: Completed Years of Schooling	
Covariates	**Odds Ratios**
C1: 1931-1943 (omitted)	
C2: 1944-1956	2.467***
	(0.170)
C3: 1957-1969	8.860***
	(0.586)
C4: 1970-1978	23.69***
	(2.210)
C5: 1979-1989	128.5***
	(14.00)
Male (vs female)	1.407***
	(0.0426)
Urban (vs rural)	3.027***
	(0.124)
South (vs north)	1.105***
	(0.0370)
White (vs non-white)	1.679***
	(0.0577)
Mother's education [a]	3.462***
	(0.121)
Father's education [a]	3.192***
	(0.0968)
Male x C1 (omitted)	
Male x C2	0.748***
	(0.0276)
Male x C3	0.656***
	(0.0231)
Male x C4	0.555***
	(0.0275)
Male x C5	0.494***
	(0.0275)
Urban x C1 (omitted)	
Urban x C2	1.262***
	(0.0638)
Urban x C3	1.040
	(0.0500)
Urban x C4	1.129*
	(0.0801)
Urban x C5	0.763***
	(0.0638)
South x C1 (omitted)	
South x C2	0.854***
	(0.0348)
South x C3	0.923**
	(0.0357)
South x C4	0.950
	(0.0510)
South x C5	0.926
	(0.0553)
White x C1 (omitted)	
White x C2	1.071*
	(0.0447)
White x C3	0.924**
	(0.0366)
White x C4	0.772***
	(0.0421)
White x C5	0.819***
	(0.0497)
Mother's education x C1 (omitted)	
Mother's education x C2	0.951
	(0.0394)
Mother's education x C3	0.758***
	(0.0295)
Mother's education x C4	0.671***

	(0.0335)
Mother's education x C5	0.543***
	(0.0288)
Father's education x C1 (omitted)	
Father's education x C2	0.953
	(0.0347)
Father's education x C3	0.780***
	(0.0269)
Father's education x C4	0.642***
	(0.0294)
Father's education x C5	0.579***
	(0.0290)
Cut 1 Constant	45.38***
	(2.569)
Cut 2 Constant	887.5***
	(53.19)
Cut 3 Constant	1,595***
	(96.19)
Cut 4 Constant	2,040***
	(123.3)
Cut 5 Constant	9,548***
	(589.4)
Cut 6 Constant	13,447***
	(834.9)
Observations	110,079

Source: author's calculation based on PNADs 1996 and 2014. Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1
(a) Variable includes the following categories: 1 = less than 1 year of schooling; 2 = incomplete 1st cycle of primary education (1 -3 years of schooling); 3 = complete 1st cycle of primary education (4 years of schooling); 4 = incomplete primary education (5-7 years of schooling); 5 = complete primary education (8 years of schooling); 6 = entering secondary education (9-10 years of schooling); 7 = complete secondary education (11-12 years of schooling); 8 = entering university; 9 = complete university; 10 = advanced degree.

Table B.2. Brant Test of Parallel Regression Assumption

Covariates	chi2	p>chi2	df
All	2064.08	0.000	136
C2: 1944-1956	1.71	0.789	4
C3: 1957-1969	4.08	0.395	4
C4: 1970/1978	8.92	0.063	4
C5: 1979/1989	26.77	0.000	4
Male	15.69	0.003	4
White	11.75	0.019	4
Urban	3.81	0.432	4
Father's index occupational status [b]	4.18	0.382	4
Father's education [a]	15.64	0.004	4
Mother's education [a]	3.02	0.555	4
Male x C2	2.63	0.621	4
Male x C3	10.32	0.035	4
Male x C4	9.84	0.043	4
Male x C5	7.66	0.105	4
White x C2	3.21	0.524	4
White x C3	3.54	0.471	4
White x C4	7.55	0.109	4
White x C5	3.20	0.525	4
Urban x C2	2.52	0.642	4
Urban x C3	2.60	0.627	4
Urban x C4	4.69	0.320	4
Urban x C5	5.69	0.223	4
Father's SES x C2	2.99	0.560	4
Father's SES x C3	3.48	0.481	4
Father's SES x C4	1.86	0.762	4
Father's SES x C5	8.49	0.075	4
Father's education x C2	5.41	0.248	4
Father's education x C3	14.71	0.005	4
Father's education x C4	16.94	0.002	4
Father's education x C5	15.54	0.004	4
Mother's education x C2	1.77	0.778	4
Mother's education x C3	3.44	0.487	4
Mother's education x C4	2.66	0.616	4
Mother's education x C5	0.23	0.994	4

Result of the Brant test: 'A significant test statistic provides evidence that the parallel regression assumption has been violated'.

*Table C.1. Probit regression model for 5th Graders in **MATHEMATICS**, 2011, Brazil*

Bolsa Família Beneficiary (vs non-Beneficiary)	dF/dx
Test Scores Maths	-0.0491***
	(0.000936)
Female	-0.00505***
	(0.00145)
White	-0.0366***
	(0.00153)
Urban (vs. Rural)	-0.0161***
	(0.00283)
State: Rio Grande do Sul (vs. São Paulo)	0.0544***
	(0.00483)
State: Santa Catarina (vs. São Paulo)	-0.0699***
	(0.00365)
State: Paraná (vs. São Paulo)	0.0303***
	(0.00352)
State: Rio de Janeiro (vs. São Paulo)	0.201***
	(0.00344)
State: Espírito Santo (vs. São Paulo)	-0.292***
	(0.00166)
State: Minas Gerais (vs. São Paulo)	0.127***
	(0.00292)
State: Mato Grosso do Sul (vs. São Paulo)	0.0903***
	(0.00682)
State: Goiás (vs. São Paulo)	0.123***
	(0.00552)
State: Distrito Federal (vs. São Paulo)	0.0873***
	(0.00721)
State: Mato Grosso (vs. São Paulo)	0.0558***
	(0.00585)
State: Bahia (vs. São Paulo)	0.275***
	(0.00411)
State: Sergipe (vs. São Paulo)	0.293***
	(0.00935)
State: Alagoas (vs. São Paulo)	0.287***
	(0.00610)
State: Pernambuco (vs. São Paulo)	0.320***
	(0.00445)
State: Paraíba (vs. São Paulo)	0.317***
	(0.00635)
State: Rio Grande do Norte (vs. São Paulo)	0.265***
	(0.00663)
State: Ceará (vs. São Paulo)	0.318***
	(0.00421)
State: Piauí (vs. São Paulo)	0.254***
	(0.00744)
State: Maranhão (vs. São Paulo)	0.250***
	(0.00578)
State: Pará (vs. São Paulo)	0.202***
	(0.00472)
State: Amapá (vs. São Paulo)	0.149***
	(0.0120)
State: Tocantins (vs. São Paulo)	0.171***
	(0.00966)
State: Roraima (vs. São Paulo)	0.212***
	(0.0150)
State: Amazonas (vs. São Paulo)	0.235***
	(0.00489)
State: Acre (vs. São Paulo)	0.196***
	(0.0124)
State: Rondônia (vs. São Paulo)	0.0888***
	(0.00940)
Household Assets (PCA)	-0.0441***
	(0.000492)
Mother: Illiterate/Semi-illiterate (vs. Complete Primary Education)	0.0233***
	(0.00248)
Mother: Incomplete Primary Education (vs. Complete Primary Education)	0.0179***
	(0.00225)
Mother: Complete Secondary Education or above (vs. Complete Primary Education)	-0.0577***
	(0.00210)
Father: Illiterate/Semi-illiterate (vs. Complete Primary Education)	0.0234***
	(0.00237)
Father: Incomplete Primary Education (vs. Complete Primary Education)	0.0174***
	(0.00231)

Father: Complete Secondary Education or above (vs. Complete Primary Education)	-0.0302***
	(0.00213)
Number of Household Members	0.0519***
	(0.000680)
School Type: Federal (vs. State)	-0.214***
	(0.0170)
School Type: Municipal (vs. State)	0.0126***
	(0.00177)
School Quality of Infrastructure	-0.00131
	(0.00137)
School Quality of Facilities	-0.0126***
	(0.00124)
School Availability of Textbooks	-0.00222
	(0.00184)
School High Absence of Teachers	-0.00754***
	(0.00116)
Observations	448,522

Author's calculations with *Prova Brasil* 2011 and *Projeto Presença*.
Standard errors in parentheses *** p<0.01, ** p<0.05, * p< 0.10.

*Table C.2. Probit regression model for 5th Graders in **LANGUAGE**, 2011, Brazil*

Bolsa Família Beneficiary (vs non-Beneficiary)	dF/dx
Test Scores Language	-0.0535***
	(0.000956)
Female	0.0104***
	(0.00147)
White	-0.0366***
	(0.00153)
Urban (vs. Rural)	-0.0154***
	(0.00282)
State: Rio Grande do Sul (vs. São Paulo)	0.0573***
	(0.00485)
State: Santa Catarina (vs. São Paulo)	-0.0681***
	(0.00366)
State: Paraná (vs. São Paulo)	0.0277***
	(0.00351)
State: Rio de Janeiro (vs. São Paulo)	0.202***
	(0.00344)
State: Espírito Santo (vs. São Paulo)	-0.292***
	(0.00167)
State: Minas Gerais (vs. São Paulo)	0.127***
	(0.00292)
State: Mato Grosso do Sul (vs. São Paulo)	0.0920***
	(0.00682)
State: Goiás (vs. São Paulo)	0.128***
	(0.00553)
State: Distrito Federal (vs. São Paulo)	0.0900***
	(0.00722)
State: Mato Grosso (vs. São Paulo)	0.0600***
	(0.00586)
State: Bahia (vs. São Paulo)	0.279***
	(0.00410)
State: Sergipe (vs. São Paulo)	0.295***
	(0.00933)
State: Alagoas (vs. São Paulo)	0.290***
	(0.00609)
State: Pernambuco (vs. São Paulo)	0.323***
	(0.00444)
State: Paraíba (vs. São Paulo)	0.320***
	(0.00633)
State: Rio Grande do Norte (vs. São Paulo)	0.270***
	(0.00661)
State: Ceará (vs. São Paulo)	0.323***
	(0.00420)
State: Piauí (vs. São Paulo)	0.257***
	(0.00743)
State: Maranhão (vs. São Paulo)	0.256***
	(0.00576)
State: Pará (vs. São Paulo)	0.208***
	(0.00472)
State: Amapá (vs. São Paulo)	0.157***
	(0.0120)
State: Tocantins (vs. São Paulo)	0.173***
	(0.00967)
State: Roraima (vs. São Paulo)	0.219***
	(0.0150)
State: Amazonas (vs. São Paulo)	0.239***
	(0.00488)
State: Acre (vs. São Paulo)	0.202***
	(0.0124)
State: Rondônia (vs. São Paulo)	0.0913***
	(0.00941)
Household Assets (PCA)	-0.0446***
	(0.000492)
Mother: Illiterate/Semi-illiterate (vs. Complete Primary Education)	0.0226***
	(0.00248)
Mother: Incomplete Primary Education (vs. Complete Primary Education)	0.0179***
	(0.00225)
Mother: Complete Secondary Education or above (vs. Complete Primary Education)	-0.0568***
	(0.00210)
Father: Illiterate/Semi-illiterate (vs. Complete Primary Education)	0.0224***
	(0.00237)
Father: Incomplete Primary Education (vs. Complete Primary Education)	0.0170***
	(0.00230)
Father: Complete Secondary Education or above (vs. Complete Primary Education)	-0.0288***
	(0.00213)
Number of Household Members	0.0511***
	(0.000681)
School Type: Federal (vs. State)	-0.214***

	(0.0170)
School Type: Municipal (vs. State)	0.0130***
	(0.00177)
School Quality of Infrastructure	-0.00172
	(0.00137)
School Quality of Facilities	-0.0125***
	(0.00124)
School Availability of Textbooks	-0.00250
	(0.00184)
School High Absence of Teachers	-0.00675***
	(0.00116)
Observations	448,522

Author's calculations with *Prova Brasil* 2011 and *Projeto Presença*.
Standard errors in parentheses *** p<0.01, ** p<0.05, * p< 0.10.

*Table C.3. Probit regression model for 9th Graders in **MATHEMATICS**, 2011, Brazil*

Bolsa Família Beneficiary (vs non-Beneficiary)	dF/dx
Test Scores Maths	-0.0201***
	(0.000647)
Female	0.00131
	(0.00102)
White	-0.0307***
	(0.00108)
Urban (vs. Rural)	-0.0153***
	(0.00207)
State: Rio Grande do Sul (vs. São Paulo)	0.0330***
	(0.00335)
State: Santa Catarina (vs. São Paulo)	-0.0563***
	(0.00271)
State: Paraná (vs. São Paulo)	0.0237***
	(0.00245)
State: Rio de Janeiro (vs. São Paulo)	0.133***
	(0.00309)
State: Espírito Santo (vs. São Paulo)	-0.192***
	(0.000925)
State: Minas Gerais (vs. São Paulo)	0.0874***
	(0.00236)
State: Mato Grosso do Sul (vs. São Paulo)	0.0644***
	(0.00542)
State: Goiás (vs. São Paulo)	0.0666***
	(0.00405)
State: Distrito Federal (vs. São Paulo)	0.0886***
	(0.00645)
State: Mato Grosso (vs. São Paulo)	0.0322***
	(0.00412)
State: Bahia (vs. São Paulo)	0.245***
	(0.00349)
State: Sergipe (vs. São Paulo)	0.282***
	(0.00833)
State: Alagoas (vs. São Paulo)	0.249***
	(0.00527)
State: Pernambuco (vs. São Paulo)	0.285***
	(0.00357)
State: Paraíba (vs. São Paulo)	0.286***
	(0.00532)
State: Rio Grande do Norte (vs. São Paulo)	0.247***
	(0.00603)
State: Ceará (vs. São Paulo)	0.271***
	(0.00358)
State: Piauí (vs. São Paulo)	0.226***
	(0.00627)
State: Maranhão (vs. São Paulo)	0.240***
	(0.00444)
State: Pará (vs. São Paulo)	0.160***
	(0.00465)
State: Amapá (vs. São Paulo)	0.187***
	(0.0112)
State: Tocantins (vs. São Paulo)	0.138***
	(0.00670)
State: Roraima (vs. São Paulo)	0.234***
	(0.0130)
State: Amazonas (vs. São Paulo)	0.220***
	(0.00451)
State: Acre (vs. São Paulo)	0.190***
	(0.0103)
State: Rondônia (vs. São Paulo)	0.0644***
	(0.00679)
Household Assets (PCA)	-0.0481***
	(0.000363)
Mother: Illiterate/Semi-illiterate (vs. Complete Primary Education)	0.0203***
	(0.00174)
Mother: Incomplete Primary Education (vs. Complete Primary Education)	0.0212***
	(0.00155)
Mother: Complete Secondary Education or above (vs. Complete Primary Education)	-0.0541***
	(0.00144)
Father: Illiterate/Semi-illiterate (vs. Complete Primary Education)	0.0259***
	(0.00167)
Father: Incomplete Primary Education (vs. Complete Primary Education)	0.0169***
	(0.00156)
Father: Complete Secondary Education or above (vs. Complete Primary Education)	-0.0340***
	(0.00148)
Number of Household Members	0.0443***
	(0.000482)
School Type: Federal (vs. State)	-0.154***

	(0.00710)
School Type: Municipal (vs. State)	0.00241**
	(0.00120)
School Quality of Infrastructure	0.000256
	(0.000943)
School Quality of Facilities	-0.00677***
	(0.000887)
School Availability of Textbooks	-0.000416
	(0.00148)
School High Absence of Teachers	-0.00549***
	(0.000735)
Observations	662,190

Author's calculations with *Prova Brasil* 2011 and *Projeto Presença*.
Standard errors in parentheses *** p<0.01, ** p<0.05, * p< 0.10.

*Table C.4. Probit regression model for 9th Graders in **LANGUAGE**, 2011, Brazil*

Bolsa Família Beneficiary (vs non-Beneficiary)	dF/dx
Test Scores Language	-0.0221***
	(0.000651)
Female	0.00987***
	(0.00104)
White	-0.0306***
	(0.00108)
Urban (vs. Rural)	-0.0146***
	(0.00206)
State: Rio Grande do Sul (vs. São Paulo)	0.0301***
	(0.00332)
State: Santa Catarina (vs. São Paulo)	-0.0581***
	(0.00269)
State: Paraná (vs. São Paulo)	0.0217***
	(0.00244)
State: Rio de Janeiro (vs. São Paulo)	0.131***
	(0.00308)
State: Espírito Santo (vs. São Paulo)	-0.192***
	(0.000912)
State: Minas Gerais (vs. São Paulo)	0.0851***
	(0.00234)
State: Mato Grosso do Sul (vs. São Paulo)	0.0629***
	(0.00540)
State: Goiás (vs. São Paulo)	0.0664***
	(0.00405)
State: Distrito Federal (vs. São Paulo)	0.0864***
	(0.00643)
State: Mato Grosso (vs. São Paulo)	0.0316***
	(0.00411)
State: Bahia (vs. São Paulo)	0.244***
	(0.00349)
State: Sergipe (vs. São Paulo)	0.278***
	(0.00833)
State: Alagoas (vs. São Paulo)	0.246***
	(0.00526)
State: Pernambuco (vs. São Paulo)	0.283***
	(0.00357)
State: Paraíba (vs. São Paulo)	0.284***
	(0.00532)
State: Rio Grande do Norte (vs. São Paulo)	0.245***
	(0.00603)
State: Ceará (vs. São Paulo)	0.271***
	(0.00358)
State: Piauí (vs. São Paulo)	0.223***
	(0.00626)
State: Maranhão (vs. São Paulo)	0.241***
	(0.00444)
State: Pará (vs. São Paulo)	0.160***
	(0.00465)
State: Amapá (vs. São Paulo)	0.188***
	(0.0112)
State: Tocantins (vs. São Paulo)	0.137***
	(0.00670)
State: Roraima (vs. São Paulo)	0.232***
	(0.0130)
State: Amazonas (vs. São Paulo)	0.221***
	(0.00451)
State: Acre (vs. São Paulo)	0.190***
	(0.0103)
State: Rondônia (vs. São Paulo)	0.0627***
	(0.00676)
Household Assets (PCA)	-0.0481***
	(0.000363)
Mother: Illiterate/Semi-illiterate (vs. Complete Primary Education)	0.0199***
	(0.00174)
Mother: Incomplete Primary Education (vs. Complete Primary Education)	0.0211***
	(0.00155)
Mother: Complete Secondary Education or above (vs. Complete Primary Education)	-0.0540***
	(0.00144)
Father: Illiterate/Semi-illiterate (vs. Complete Primary Education)	0.0251***
	(0.00166)
Father: Incomplete Primary Education (vs. Complete Primary Education)	0.0165***
	(0.00156)
Father: Complete Secondary Education or above (vs. Complete Primary Education)	-0.0335***
	(0.00148)
Number of Household Members	0.0440***
	(0.000483)
School Type: Federal (vs. State)	-0.155***

	(0.00684)
School Type: Municipal (vs. State)	0.00232*
	(0.00120)
School Quality of Infrastructure	0.000267
	(0.000943)
School Quality of Facilities	-0.00674***
	(0.000887)
School Availability of Textbooks	-0.000498
	(0.00148)
School High Absence of Teachers	-0.00528***
	(0.000735)
Observations	662,190

Author's calculations with *Prova Brasil* 2011 and *Projeto Presença*.
Standard errors in parentheses *** p<0.01, ** p<0.05, * p< 0.10.

APPENDIX D

Table D.1. Parameter Estimates Generalised Ordered Logistic Regression with Partial Proportional Odds of Social Background on Conditional Educational Transitions: cohorts born between 1931 and 1989, Brazil

	Odds Ratios					
Covariates	*Y > No formal education*	*Y* > Some Primary	Y > Primary Graduate	Y > Some Secondary	Y > Secondary Graduate	Y > Some University
C1: 1931-1943 (omitted)						
C2: 1944-1956	2.113***	4.546***	4.824***	4.677***	5.114***	4.101***
	(0.185)	(0.667)	(0.861)	(0.862)	(1.641)	(1.396)
C3: 1957-1969	5.846***	12.21***	12.51***	11.09***	8.965***	8.166***
	(0.510)	(1.716)	(2.143)	(1.965)	(2.800)	(2.684)
C4: 1970-1978	12.04***	27.37***	29.02***	24.40***	19.56***	15.81***
	(1.525)	(4.187)	(5.321)	(4.635)	(6.544)	(5.620)
C5: 1979-1989	55.71***	93.53***	103.2***	72.82***	25.65***	13.67***
	(10.58)	(14.57)	(18.78)	(13.65)	(8.623)	(5.107)
Male (vs female)	1.094*	1.087	1.033	1.001	1.160*	1.224**
	(0.0518)	(0.0609)	(0.0645)	(0.0641)	(0.101)	(0.114)
Urban (vs rural)	2.852***	9.002***	9.222***	8.714***	12.04***	10.94***
	(0.139)	(1.069)	(1.368)	(1.336)	(3.395)	(3.253)
South (vs north)	2.182***	0.946	0.882*	0.860**	0.783***	0.736***
	(0.107)	(0.0558)	(0.0579)	(0.0577)	(0.0714)	(0.0705)
White (vs non-white)	2.123***	2.169***	2.446***	2.549***	3.391***	3.466***
	(0.104)	(0.136)	(0.178)	(0.192)	(0.393)	(0.429)
Father's ISEI [a]	1.670***	1.723***	1.741***	1.749***	1.766***	1.765***
	(0.0433)	(0.0323)	(0.0342)	(0.0348)	(0.0418)	(0.0434)
Male x C1 (omitted)						
Male x C2	0.910	0.796***	0.777***	0.776***	0.716***	0.690***
	(0.0530)	(0.0494)	(0.0533)	(0.0546)	(0.0682)	(0.0700)
Male x C3	0.705***	0.738***	0.714***	0.695***	0.551***	0.532***
	(0.0419)	(0.0444)	(0.0474)	(0.0473)	(0.0514)	(0.0529)
Male x C4	0.626***	0.586***	0.606***	0.620***	0.516***	0.473***
	(0.0602)	(0.0418)	(0.0462)	(0.0483)	(0.0548)	(0.0543)
Male x C5	0.587***	0.596***	0.598***	0.650***	0.586***	0.548***
	(0.0904)	(0.0487)	(0.0493)	(0.0533)	(0.0633)	(0.0642)
Urban x C1 (omitted)						
Urban x C2	1.207***	0.706***	0.696**	0.700**	0.517**	0.615
	(0.0729)	(0.0914)	(0.112)	(0.117)	(0.156)	(0.198)
Urban x C3	1.011	0.471***	0.485***	0.507***	0.361***	0.360***
	(0.0619)	(0.0583)	(0.0747)	(0.0811)	(0.106)	(0.112)
Urban x C4	0.914	0.447***	0.455***	0.466***	0.274***	0.280***
	(0.0919)	(0.0606)	(0.0754)	(0.0805)	(0.0868)	(0.0947)
Urban x C5	0.568***	0.316***	0.294***	0.303***	0.236***	0.343***
	(0.0973)	(0.0443)	(0.0487)	(0.0519)	(0.0752)	(0.123)
South x C1 (omitted)						
South x C2	1.007	0.792***	0.764***	0.777***	0.996	0.985
	(0.0620)	(0.0521)	(0.0554)	(0.0577)	(0.0996)	(0.104)
South x C3	1.141**	0.964	0.884*	0.927	1.177*	1.235**
	(0.0731)	(0.0612)	(0.0618)	(0.0664)	(0.115)	(0.128)
South x C4	1.227*	1.141*	1.007	1.080	1.275**	1.313**
	(0.141)	(0.0864)	(0.0814)	(0.0889)	(0.143)	(0.158)
South x C5	0.840	1.393***	1.288***	1.328***	1.350***	1.386***
	(0.156)	(0.123)	(0.113)	(0.115)	(0.152)	(0.168)
White x C1 (omitted)						
White x C2	1.051	1.023	0.977	0.959	0.959	0.968
	(0.0642)	(0.0708)	(0.0776)	(0.0790)	(0.120)	(0.130)
White x C3	0.921	0.931	0.882	0.860*	0.798*	0.767**

	(0.0579)	(0.0623)	(0.0676)	(0.0684)	(0.0975)	(0.101)
White x C4	0.889	0.756***	0.699***	0.665***	0.616***	0.660***
	(0.0969)	(0.0594)	(0.0605)	(0.0593)	(0.0824)	(0.0960)
White x C5	0.809	0.730***	0.670***	0.711***	0.697***	0.690**
	(0.150)	(0.0669)	(0.0628)	(0.0668)	(0.0931)	(0.1000)
Father's ISEI x C1 (omitted)						
Father's ISEI x C2	0.987	0.967	0.964*	0.951**	0.943**	0.941**
	(0.0310)	(0.0204)	(0.0211)	(0.0210)	(0.0247)	(0.0256)
Father's ISEI x C3	0.947*	0.899***	0.887***	0.864***	0.908***	0.897***
	(0.0298)	(0.0184)	(0.0188)	(0.0185)	(0.0232)	(0.0238)
Father's ISEI x C4	0.893**	0.860***	0.844***	0.832***	0.880***	0.876***
	(0.0416)	(0.0213)	(0.0209)	(0.0207)	(0.0258)	(0.0269)
Father's ISEI x C5	0.884*	0.881***	0.857***	0.835***	0.902***	0.903***
	(0.0593)	(0.0267)	(0.0242)	(0.0227)	(0.0272)	(0.0286)
Constant	0.164***	0.00558***	0.00331***	0.00314***	0.000667***	0.000621***
	(0.0120)	(0.000750)	(0.000544)	(0.000534)	(0.000200)	(0.000195)
Observations	98,379	98,379	98,379	98,379	98,379	98,379

Source: author's calculation based on PNADs 1996 and 2014. Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

(a) Father's Socio-Economic Index of Occupational Status (ISEI)

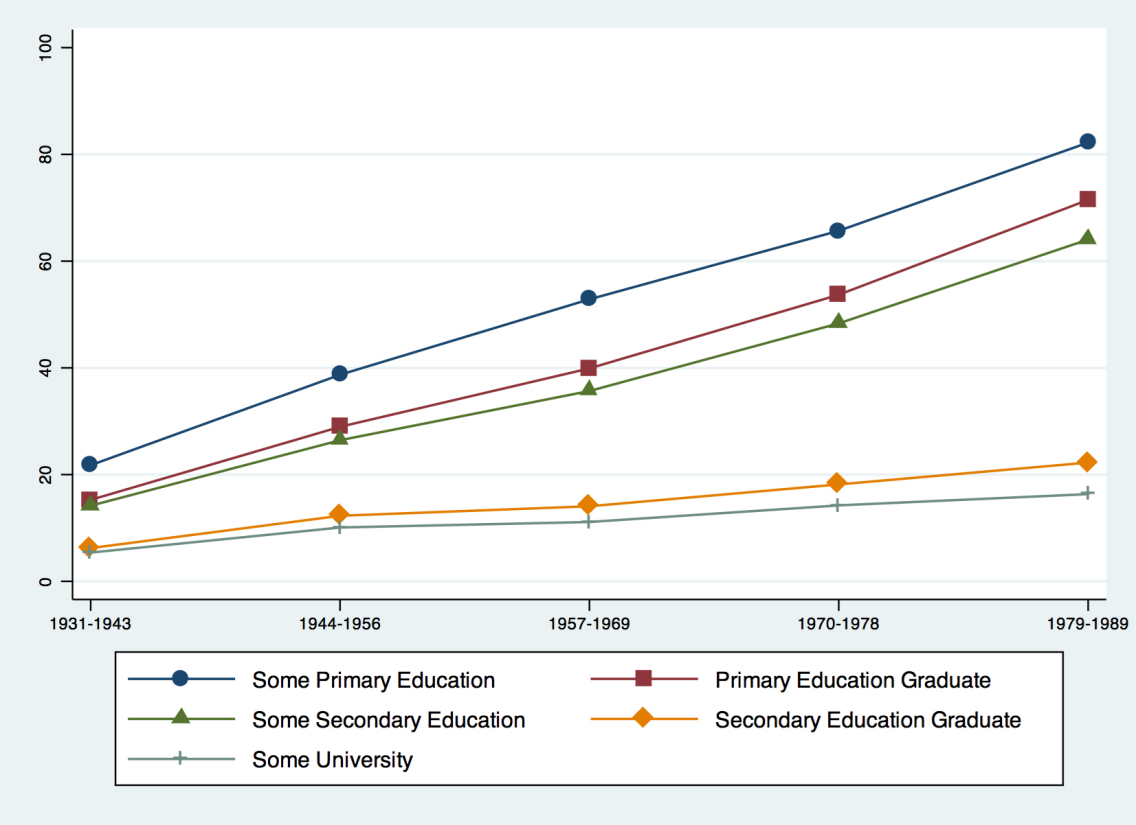
Table D.2 Predicted Probabilities of the Generalised Ordered Logistic Regression Model with Partial Proportional Odds of Table 2.4 of Chapter 2

	No formal education	***Some Primary***	***Primary Graduate***	***Some Secondary***	***Secondary Graduate***	***Some University***	***University Graduate***
Man x C1	*.28*	*.48*	*.06*	*.01*	*.08*	*.01*	*.07*
Woman x C1	*.32*	*.48*	*.05*	*.01*	*.08*	*.01*	*.04*
Man x C2	*.17*	*.46*	*.09*	*.02*	*.13*	*.02*	*.11*
Woman x C2	*.17*	*.46*	*.08*	*.02*	*.14*	*.02*	*.09*
Man x C3	*.10*	*.43*	*.11*	*.05*	*.19*	*.02*	*.09*
Woman x C3	*.09*	*.43*	*.11*	*.05*	*.19*	*.03*	*.09*
Man x C4	*.07*	*.36*	*.11*	*.06*	*.25*	*.03*	*.10*
Woman x C4	*.06*	*.34*	*.11*	*.06*	*.26*	*.04*	*.13*
Man x C5	*.03*	*.18*	*.10*	*.07*	*.39*	*.06*	*.17*
Woman x C5	*.02*	*.14*	*.07*	*.07*	*.43*	*.07*	*.20*
Urban x C1	*.25*	*.49*	*.07*	*.01*	*.09*	*.01*	*.07*
Rural x C1	*.53*	*.44*	*.01*	*-.00*	*.01*	*.00*	*.00*
Urban x C2	*.13*	*.45*	*.09*	*.03*	*.16*	*.02*	*.12*
Rural x C2	*.39*	*.52*	*.03*	*.01*	*.03*	*.00*	*.01*
Urban x C3	*.07*	*.40*	*.12*	*.05*	*.22*	*.03*	*.10*
Rural x C3	*.23*	*.60*	*.07*	*.02*	*.06*	*.00*	*.02*
Urban x C4	*.05*	*.31*	*.11*	*.06*	*.29*	*.04*	*.14*
Rural x C4	*.18*	*.58*	*.08*	*.03*	*.10*	*.01*	*.03*
Urban x C5	*.02*	*.12*	*.08*	*.07*	*.43*	*.07*	*.21*
Rural x C5	*.05*	*.41*	*.12*	*.07*	*.29*	*.03*	*.03*
South x C1	*.22*	*.54*	*.06*	*.01*	*.09*	*.01*	*.06*
North x C1	*.42*	*.39*	*.05*	*.01*	*.07*	*.00*	*.05*
South x C2	*.10*	*.51*	*.09*	*.03*	*.14*	*.02*	*.11*
North x C2	*.26*	*.40*	*.07*	*.02*	*.14*	*.01*	*.09*
South x C3	*.05*	*.44*	*.13*	*.05*	*.20*	*.03*	*.10*
North x C3	*.15*	*.42*	*.09*	*.05*	*.19*	*.02*	*.07*
South x C4	*.03*	*.34*	*.12*	*.06*	*.27*	*.04*	*.14*
North x C4	*.11*	*.37*	*.09*	*.06*	*.24*	*.03*	*.10*
South x C5	*.01*	*.12*	*.09*	*.06*	*.43*	*.07*	*.22*
North x C5	*.03*	*.20*	*.08*	*.08*	*.40*	*.05*	*.15*
White x C1	*.21*	*.52*	*.07*	*.01*	*.10*	*.01*	*.08*
Non-white x C1	*.45*	*.42*	*.04*	*.01*	*.05*	*.00*	*.02*
White x C2	*.10*	*.45*	*.09*	*.03*	*.16*	*.03*	*.14*
Non-white x C2	*.27*	*.47*	*.07*	*.02*	*.11*	*.01*	*.04*
White x C3	*.05*	*.39*	*.12*	*.05*	*.22*	*.04*	*.12*
Non-white x C3	*.15*	*.49*	*.10*	*.04*	*.15*	*.01*	*.04*
White x C4	*.04*	*.31*	*.11*	*.06*	*.27*	*.04*	*.16*
Non-white x C4	*.10*	*.40*	*.10*	*.05*	*.24*	*.03*	*.07*
White x C5	*.01*	*.11*	*.07*	*.05*	*.40*	*.08*	*.27*
Non-white x C5	*.03*	*.20*	*.10*	*.08*	*.42*	*.05*	*.11*
Mother's edu 1 x C1	*.46*	*.47*	*.03*	*.00*	*.02*	*.00*	*.01*
Mother's edu 2 x C1	*.09*	*.53*	*.10*	*.02*	*.15*	*.01*	*.09*
Mother's edu 3 x C1	*.01*	*.15*	*.06*	*.02*	*.26*	*.04*	*.46*
Mother's edu 4 x C1	*.00*	*.04*	*.02*	*.00*	*.14*	*.03*	*.76*
Mother's edu 1 x C2	*.30*	*.54*	*.06*	*.01*	*.06*	*.01*	*.02*
Mother's edu 2 x C2	*.05*	*.42*	*.11*	*.04*	*.21*	*.03*	*.13*
Mother's edu 3 x C2	*.00*	*.10*	*.04*	*.02*	*.23*	*.06*	*.53*
Mother's edu 4 x C2	*.00*	*.03*	*.01*	*.01*	*.11*	*.04*	*.80*
Mother's edu 1 x C3	*.20*	*.57*	*.09*	*.03*	*.08*	*.01*	*.02*
Mother's edu 2 x C3	*.03*	*.38*	*.14*	*.06*	*.26*	*.03*	*.09*
Mother's edu 3 x C3	*.00*	*.10*	*.06*	*.04*	*.32*	*.10*	*.37*
Mother's edu 4 x C3	*.00*	*.03*	*.02*	*.01*	*.18*	*.09*	*.66*
Mother's edu 1 x C4	*.15*	*.52*	*.10*	*.05*	*.14*	*.01*	*.02*
Mother's edu 2 x C4	*.03*	*.31*	*.13*	*.07*	*.32*	*.04*	*.10*
Mother's edu 3 x C4	*.01*	*.10*	*.06*	*.04*	*.35*	*.09*	*.35*

Mother's edu 4 x C4	*.00*	*.03*	*.02*	*.01*	*.21*	*.07*	*.65*
Mother's edu 1 x C5	*.06*	*.38*	*.13*	*.09*	*.28*	*.01*	*.03*
Mother's edu 2 x C5	*.02*	*.14*	*.10*	*.08*	*.49*	*.06*	*.12*
Mother's edu 3 x C5	*.00*	*.04*	*.03*	*.03*	*.40*	*.12*	*.36*
Mother's edu 4 x C5	*.00*	*.01*	*.01*	*.01*	*.20*	*.11*	*.66*
Father's edu 1 x C1	*.50*	*.44*	*.02*	*.00*	*.02*	*.00*	*.01*
Father's edu 2 x C1	*.12*	*.56*	*.09*	*.02*	*.12*	*.01*	*.07*
Father's edu 3 x C1	*.02*	*.24*	*.10*	*.02*	*.29*	*.03*	*.29*
Father's edu 4 x C1	*.00*	*.08*	*.05*	*.02*	*.27*	*.04*	*.53*
Father's edu 1 x C2	*.33*	*.53*	*.05*	*.01*	*.05*	*.00*	*.02*
Father's edu 2 x C2	*.06*	*.45*	*.11*	*.03*	*.19*	*.03*	*.11*
Father's edu 3 x C2	*.01*	*.15*	*.07*	*.03*	*.28*	*.06*	*.40*
Father's edu 4 x C2	*.00*	*.05*	*.03*	*.01*	*.18*	*.05*	*.68*
Father's edu 1 x C3	*.21*	*.57*	*.08*	*.03*	*.08*	*.00*	*.02*
Father's edu 2 x C3	*.04*	*.39*	*.14*	*.06*	*.25*	*.03*	*.08*
Father's edu 3 x C3	*.01*	*.13*	*.07*	*.05*	*.33*	*.09*	*.31*
Father's edu 4 x C3	*.00*	*.04*	*.02*	*.02*	*.19*	*.10*	*.62*
Father's edu 1 x C4	*.16*	*.52*	*.09*	*.04*	*.15*	*.01*	*.03*
Father's edu 2 x C4	*.03*	*.32*	*.13*	*.07*	*.31*	*.04*	*.10*
Father's edu 3 x C4	*.00*	*.11*	*.08*	*.05*	*.36*	*.08*	*.31*
Father's edu 4 x C4	*.00*	*.03*	*.03*	*.02*	*.21*	*.09*	*.60*
Father's edu 1 x C5	*.06*	*.37*	*.12*	*.09*	*.30*	*.01*	*.03*
Father's edu 2 x C5	*.02*	*.13*	*.10*	*.08*	*.49*	*.06*	*.13*
Father's edu 3 x C5	*.00*	*.03*	*.04*	*.03*	*.40*	*.12*	*.37*
Father's edu 4 x C5	*.00*	*.01*	*.01*	*.01*	*.17*	*.11*	*.70*

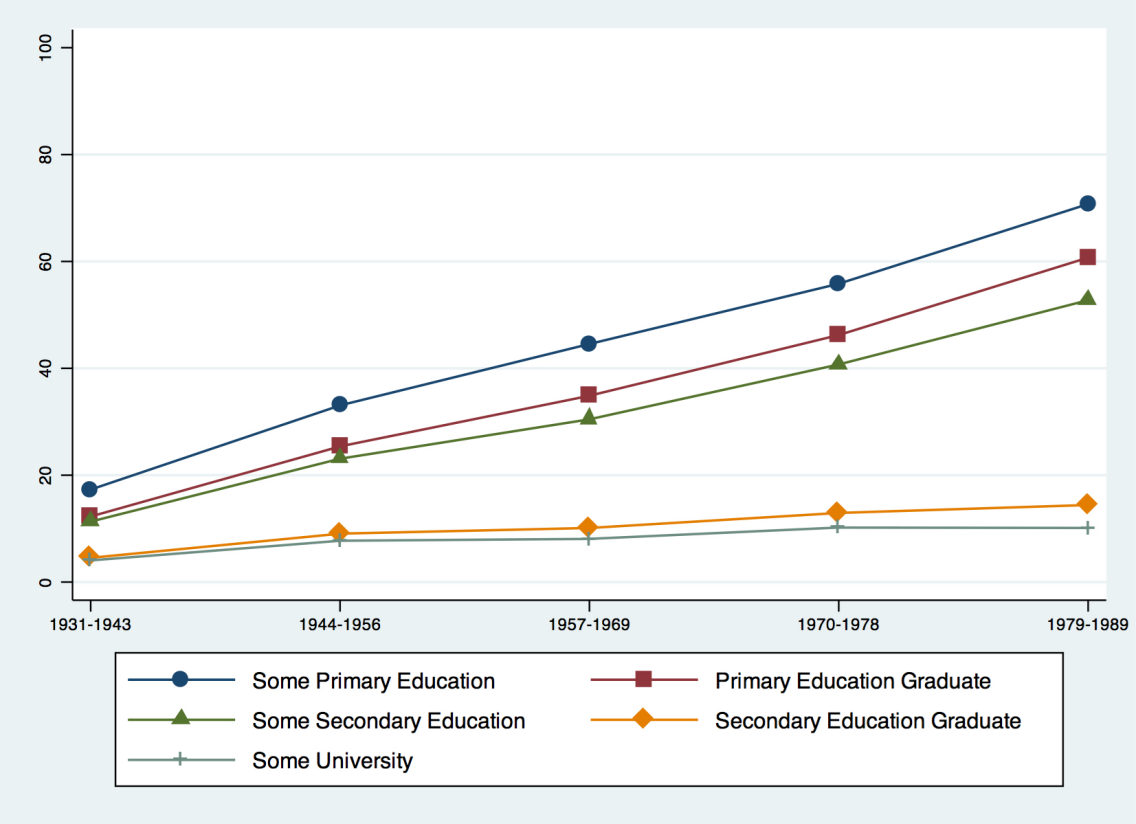
Source: author's calculation based on PNADs 1996 and 2014.

Figure D.1. Proportion of Completed School Transitions by Birth Cohort, South



Source: author's calculation based on PNADs 1996 and 2014.

Figure D.2. Proportion of Completed School Transitions by Birth Cohort, North



Source: author's calculation based on PNADs 1996 and 2014.

APPENDIX E

Table E.1. Descriptive Statistics for the Treatment Group, 5th Graders, Brazil

Variable	Observations	Mean	Std.Dev.	Min	Max
Test Scores Maths	822,112	-.996	.777	-2.860	1.578
Test Scores Language	822,112	-1.336	.758	-3.136	1.624
Female	778,336	.490	.500	0	1
White	690,867	.288	.453	0	1
Urban (vs. Rural)	828,895	.853	.354	0	1
State: Rio Grande do Sul	828,895	.024	.152	0	1
State: Santa Catarina	828,895	.014	.117	0	1
State: Paraná	828,895	829	.172	0	1
State: São Paulo	828,895	.128	.128	0	1
State: Rio de Janeiro	828,895	.071	.256	0	1
State: Espírito Santo	828,895	.001	.020	0	1
State: Minas Gerais	828,895	.105	.306	0	1
State: Mato Grosso do Sul	828,895	.012	.108	0	1
State: Goiás	828,895	.027	.161	0	1
State: Distrito Federal	828,895	.010	.101	0	1
State: Mato Grosso	828,895	.013	.113	0	1
State: Bahia	828,895	.103	.305	0	1
State: Sergipe	828,895	.018	.132	0	1
State: Alagoas	828,895	.829	.181	0	1
State: Pernambuco	828,895	.063	.157	0	1
State: Paraíba	828,895	.025	.157	0	1
State: Rio Grande do Norte	828,895	.024	.152	0	1
State: Ceará	828,895	.077	.266	0	1
State: Piauí	828,895	.022	.148	0	1
State: Maranhão	828,895	.062	.242	0	1
State: Pará	828,895	.068	.251	0	1
State: Amapá	828,895	.006	.078	0	1
State: Tocantins	828,895	.011	.102	0	1
State: Roraima	828,895	.004	.062	0	1
State: Amazonas	828,895	.035	.184	0	1
State: Acre	828,895	.006	.075	0	1
State: Rondônia	828,895	.008	.091	0	1
Household Assets (PCA)	555,298	-.714	1.556	-4.979	7.135
Mother: Illiterate/Semi-illiterate	491,992	.285	.451	0	1
Mother: Incomplete Primary Education	491,992	.275	.446	0	1
Mother: Complete Primary Education	491,992	.198	.398	0	1
Mother: Complete Secondary Education or above	491,992	.242	.428	0	1
Father: Illiterate/Semi-illiterate	403,504	.337	.473	0	1
Father: Incomplete Primary Education	403,504	.218	.413	0	1
Father: Complete Primary Education	403,504	.196	.397	0	1
Father: Complete Secondary Education or above	403,504	.248	.432	0	1
Number of Household Members	796,437	4.043	1.154	1	6
School Type: Federal	828,895	.001	.010	0	1
School Type: State	828,895	.216	.412		
School Type: Municipal	828,895	.783	.412	0	1
School Quality of Infrastructure	719,792	2.570	.626	1	3
School Quality of Facilities	671,532	1.824	.677	1	3
School Availability of Textbooks	824,665	2.851	.459	1	3
School High Absence of Teachers	819,389	1.340	.605	1	3

Author's calculations with *Prova Brasil* 2011 and *Projeto Presença.*

Table E.2. Descriptive Statistics for the Control Group, 5th Graders, Brazil

Variable	Observations	Mean	Std.Dev.	Min	Max
Test Scores Maths	1,306,543	-.640	.862	-2.860	1.578
Test Scores Language	1,306,543	-1.006	.847	-3.136	1.624
Female	1,262,300	.487	.500	0	1
White	1,136,467	.401	.490	0	1
Urban (vs. Rural)	1,314,820	.932	.251	0	1
State: Rio Grande do Sul	1,314,820	.043	.203	0	1
State: Santa Catarina	1,314,820	.048	.215	0	1
State: Paraná	1,314,820	.059	.235	0	1
State: São Paulo	1,314,820	.294	.456	0	1
State: Rio de Janeiro	1,314,820	.066	.249	0	1
State: Espírito Santo	1,314,820	.029	.167	0	1
State: Minas Gerais	1,314,820	.121	.326	0	1
State: Mato Grosso do Sul	1,314,820	.016	.124	0	1
State: Goiás	1,314,820	.030	.172	0	1
State: Distrito Federal	1,314,820	.017	.131	0	1
State: Mato Grosso	1,314,820	.017	.130	0	1
State: Bahia	1,314,820	.045	.045	0	1
State: Sergipe	1,314,820	.006	.080	0	1
State: Alagoas	1,314,820	.012	.108	0	1
State: Pernambuco	1,314,820	.024	.152	0	1
State: Paraíba	1,314,820	.010	.099	0	1
State: Rio Grande do Norte	1,314,820	.011	.104	0	1
State: Ceará	1,314,820	.029	.168	0	1
State: Piauí	1,314,820	.010	.101	0	1
State: Maranhão	1,314,820	.026	.158	0	1
State: Pará	1,314,820	.036	.188	0	1
State: Amapá	1,314,820	.005	.070	0	1
State: Tocantins	1,314,820	.008	.088	0	1
State: Roraima	1,314,820	.003	.051	0	1
State: Amazonas	1,314,820	.021	.142	0	1
State: Acre	1,314,820	.004	.063	0	1
State: Rondônia	1,314,820	.009	.097	0	1
Household Assets (PCA)	987,356	.285	1.690	-4.979	7.135
Mother: Illiterate/Semi-illiterate	787,982	.172	.377	0	1
Mother: Incomplete Primary Education	787,982	.214	.410	0	1
Mother: Complete Primary Education	787,982	.194	.395	0	1
Mother: Complete Secondary Education or above	787,982	.421	.494	0	1
Father: Illiterate/Semi-illiterate	653,215	.203	.402	0	1
Father: Incomplete Primary Education	653,215	.189	.392	0	1
Father: Complete Primary Education	653,215	.201	.400	0	1
Father: Complete Secondary Education or above	653,215	.407	.491	0	1
Number of Household Members	1,273,250	3.669	1.156	1	6
School Type: Federal	1,314,820	.001	.031	0	1
School Type: State	1,314,820	.296	.457	0	1
School Type: Municipal	1,314,820	.702	.457	0	1
School Quality of Infrastructure	1,175,364	2.676	.562	1	3
School Quality of Facilities	1,099,068	2.044	.663	1	3
School Availability of Textbooks	1,310,264	2.896	.384	1	3
School High Absence of Teachers	1,301,451	1.433	.668	1	3

Author's calculations with *Prova Brasil* 2011 and *Projeto Presença.*

Table E.3. Descriptive Statistics for the Treatment Group, 9th Graders, Brazil

Variable	Observations	Mean	Std.Dev.	Min	Max
Test Scores Maths	504,823	-.281	.794	-2.577	2.653
Test Scores Language	504,823	-.394	.795	-2.660	2.375
Female	494,249	.564	.496	0	1
White	455,459	.275	.446	0	1
Urban (vs. Rural)	509,511	.860	.347	0	1
State: Rio Grande do Sul	509,511	.022	.148	0	1
State: Santa Catarina	509,511	.011	.103	0	1
State: Paraná	509,511	.033	.179	0	1
State: São Paulo	509,511	.134	.341	0	1
State: Rio de Janeiro	509,511	.050	.218	0	1
State: Espírito Santo	509,511	.001	.015	0	1
State: Minas Gerais	509,511	.094	.291	0	1
State: Mato Grosso do Sul	509,511	.010	.100	0	1
State: Goiás	509,511	.026	.160	0	1
State: Distrito Federal	509,511	.007	.086	0	1
State: Mato Grosso	509,511	.014	.118	0	1
State: Bahia	509,511	.107	.309	0	1
State: Sergipe	509,511	.016	.127	0	1
State: Alagoas	509,511	.032	.176	0	1
State: Pernambuco	509,511	.083	.277	0	1
State: Paraíba	509,511	.031	.175	0	1
State: Rio Grande do Norte	509,511	.021	.143	0	1
State: Ceará	509,511	.097	.296	0	1
State: Piauí	509,511	.024	.152	0	1
State: Maranhão	509,511	.068	.253	0	1
State: Pará	509,511	.046	.210	0	1
State: Amapá	509,511	.005	.070	0	1
State: Tocantins	509,511	.013	.113	0	1
State: Roraima	509,511	.004	.067	0	1
State: Amazonas	509,511	.034	.181	0	1
State: Acre	509,511	.006	.077	0	1
State: Rondônia	509,511	.007	.086	0	1
Household Assets (PCA)	404,026	-.854	1.493	-4.979	7.135
Mother: Illiterate/Semi-illiterate	397,768	.299	.458	0	1
Mother: Incomplete Primary Education	397,768	.299	.458	0	1
Mother: Complete Primary Education	397,768	.188	.390	0	1
Mother: Complete Secondary Education or above	397,768	.213	.410	0	1
Father: Illiterate/Semi-illiterate	317,014	.386	.487	0	1
Father: Incomplete Primary Education	317,014	.257	.437	0	1
Father: Complete Primary Education	317,014	.178	.382	0	1
Father: Complete Secondary Education or above	317,014	.179	.384	0	1
Number of Household Members	499,774	4.813	1.182	1	7
School Type: Federal	509,511	.001	.012	0	1
School Type: State	509,511	.526	.499	0	1
School Type: Municipal	509,511	.474	.499	0	1
School Quality of Infrastructure	441,249	2.566	.615	1	3
School Quality of Facilities	415,083	1.968	.668	1	3
School Availability of Textbooks	506,751	2.901	.375	1	3
School High Absence of Teachers	502,407	1.568	.725	1	3

Author's calculations with *Prova Brasil* 2011 and *Projeto Presença*.

Table E.4. Descriptive Statistics for the Control Group, 9th Graders, Brazil

Variable	Observations	Mean	Std.Dev.	Min	Max
Test Scores Maths	1,306,198	-.006	.846	-2.577	2.653
Test Scores Language	1,306,198	-.123	.854	-2.659	2.375
Female	1,285,787	.518	.500	0	1
White	1,216,044	.423	.494	0	1
Urban (vs. Rural)	1,314,858	.942	.234	0	1
State: Rio Grande do Sul	1,314,858	.051	.220	0	1
State: Santa Catarina	1,314,858	.047	.211	0	1
State: Paraná	1,314,858	.066	.248	0	1
State: São Paulo	1,314,858	.309	.462	0	1
State: Rio de Janeiro	1,314,858	.059	.236	0	1
State: Espírito Santo	1,314,858	.024	.153	0	1
State: Minas Gerais	1,314,858	.107	.309	0	1
State: Mato Grosso do Sul	1,314,858	.016	.124	0	1
State: Goiás	1,314,858	.034	.181	0	1
State: Distrito Federal	1,314,858	.012	.110	0	1
State: Mato Grosso	1,314,858	.020	.139	0	1
State: Bahia	1,314,858	.046	.209	0	1
State: Sergipe	1,314,858	.006	.079	0	1
State: Alagoas	1,314,858	.011	.105	0	1
State: Pernambuco	1,314,858	.031	.173	0	1
State: Paraíba	1,314,858	.011	.106	0	1
State: Rio Grande do Norte	1,314,858	.009	.096	0	1
State: Ceará	1,314,858	.033	.178	0	1
State: Piauí	1,314,858	.010	.098	0	1
State: Maranhão	1,314,858	.024	.154	0	1
State: Pará	1,314,858	.025	.158	0	1
State: Amapá	1,314,858	.003	.059	0	1
State: Tocantins	1,314,858	.009	.095	0	1
State: Roraima	1,314,858	.002	.050	0	1
State: Amazonas	1,314,858	.020	.140	0	1
State: Acre	1,314,858	.004	.062	0	1
State: Rondônia	1,314,858	.009	.095	0	1
Household Assets (PCA)	1,112,932	.413	1.72	-4.979	7.135
Mother: Illiterate/Semi-illiterate	1,050,764	.158	.365	0	1
Mother: Incomplete Primary Education	1,050,764	.231	.421	0	1
Mother: Complete Primary Education	1,050,764	.201	.401	0	1
Mother: Complete Secondary Education or above	1,050,764	.410	.492	0	1
Father: Illiterate/Semi-illiterate	861,577	.194	.395	0	1
Father: Incomplete Primary Education	861,577	.223	.416	0	1
Father: Complete Primary Education	861,577	.213	.410	0	1
Father: Complete Secondary Education or above	861,577	.370	.483	0	1
Number of Household Members	1,294,412	4.400	1.144	1	7
School Type: Federal	1,314,858	.002	.051	0	1
School Type: State	1,314,858	.661	.473	0	1
School Type: Municipal	1,314,858	.336	.472	0	1
School Quality of Infrastructure	1,169,097	2.644	.566	1	3
School Quality of Facilities	1,101,301	2.141	.636	1	3
School Availability of Textbooks	1,310,206	2.924	.331	1	3
School High Absence of Teachers	1,299,365	1.756	.785	1	3

Author's calculations with *Prova Brasil* 2011 and *Projeto Presença.*

APPENDIX F

Table F.1. Balancing Test for 5th Graders Sample

		MEAN				T-TEST	
Variable	**Sample**	**Treated**	**Control**	**% Bias**	**% Bias Reduction**	**t**	**p>|t|**
Female	Unmatched	.490	.487	0.5		3.60	0.000
	Matched	.485	.484	0.3	40.9	0.83	0.405
White	Unmatched	.288	.401	-23.9		-155.29	0.000
	Matched	.302	.315	-2.8	88.1	-7.88	0.000
Urban (vs. Rural)	Unmatched	.853	.932	-25.8		-191.33	0.000
	Matched	.877	.916	-12.7	50.7	-34.98	0.000
State: Rio Grande do Sul	Unmatched	.024	.043	-10.8		-74.45	0.000
	Matched	.021	.027	-3.4	68.6	-10.79	0.000
State: Santa Catarina	Unmatched	.014	.048	-20.1		-135.09	0.000
	Matched	.020	.019	0.2	98.9	0.74	0.457
State: Paraná	Unmatched	.030	.059	-13.7		-94.30	0.000
	Matched	.041	.052	-5.6	59.3	-14.79	0.000
State: São Paulo	Unmatched	.128	.294	-41.7		-287.41	0.000
	Matched	.185	.238	-13.4	67.9	-35.66	0.000
State: Rio de Janeiro	Unmatched	.071	.066	1.6		11.74	0.000
	Matched	.076	.098	-8.5	-416.5	-20.66	0.000
State: Espírito Santo	Unmatched	.001	.029	-23.9		-154.08	0.000
	Matched	.001	.000	-0.0	99.9	-0.26	0.793
State: Minas Gerais	Unmatched	.105	.121	-5.0		-35.49	0.000
	Matched	.096	.122	-8.3	-65.9	-22.90	0.000
State: Mato Grosso do Sul	Unmatched	.012	.016	-3.3		-23.36	0.000
	Matched	.012	.016	-3.7	-9.7	-9.80	0.000
State: Goiás	Unmatched	.026	.030	-2.3		-16.54	0.000
	Matched	.022	.030	-4.7	-100.5	-13.26	0.000
State: Distrito Federal	Unmatched	.010	.017	-6.0		-41.39	0.000
	Matched	.001	.014	-3.5	41.0	-10.10	0.000
State: Mato Grosso	Unmatched	.012	.017	-3.6		-25.01	0.000
	Matched	.016	.022	-5.1	-42.0	-12.25	0.000
State: Bahia	Unmatched	.103	.045	22.5		167.72	0.000
	Matched	.080	.057	9.1	59.5	25.58	0.000
State: Sergipe	Unmatched	.018	.006	10.3		77.72	0.000
	Matched	.012	.008	4.0	60.8	11.85	0.000
State: Alagoas	Unmatched	.034	.012	14.9		112.35	0.000
	Matched	.034	.020	9.6	35.4	24.08	0.000
State: Pernambuco	Unmatched	.064	.024	19.6		147.21	0.000
	Matched	.066	.038	13.8	29.6	34.26	0.000
State: Paraíba	Unmatched	.025	.010	11.8		88.52	0.000
	Matched	.028	.017	8.2	30.3	19.73	0.000
State: Rio Grande do Norte	Unmatched	.024	.011	9.7		72.52	0.000
	Matched	.024	.018	4.3	56.2	10.53	0.000
State: Ceará	Unmatched	.077	.029	21.5		161.31	0.000
	Matched	.075	.045	13.5	37.2	34.42	0.000
State: Piauí	Unmatched	.022	.010	9.5		70.45	0.000
	Matched	.019	.014	4.1	56.7	10.99	0.000
State: Maranhão	Unmatched	.062	.026	18.0		134.49	0.000
	Matched	.037	.024	6.1	66.3	19.53	0.000
State: Pará	Unmatched	.068	.036	14.1		103.72	0.000
	Matched	.051	.044	3.1	77.9	8.78	0.000
State: Amapá	Unmatched	.006	.005	1.7		12.46	0.000
	Matched	.000	.006	-1.0	43.4	-2.62	0.009
State: Tocantins	Unmatched	.011	.007	2.9		21.22	0.000
	Matched	.008	.009	-1.0	66.3	-2.73	0.006
State: Roraima	Unmatched	.004	.003	2.3		16.44	0.000
	Matched	.004	.004	-0.1	93.7	-0.36	0.717
State: Amazonas	Unmatched	.035	.021	8.8		64.26	0.000
	Matched	.043	.039	1.8	78.9	4.15	0.000
State: Acre	Unmatched	.006	.004	2.2		16.30	0.000
	Matched	.005	.005	0.3	86.5	0.78	0.434
State: Rondônia	Unmatched	.008	.009	-1.3		-8.97	0.000
	Matched	.007	.009	-2.2	-77.2	-6.40	0.000
Household Assets (PCA)	Unmatched	-.714	.285	-61.5		-362.37	0.000
	Matched	-.496	-.199	-18.3	70.2	-51.70	0.000
Mother: Illiterate/Semi-illiterate	Unmatched	.285	.172	27.2		152.66	0.000
	Matched	.252	.211	9.7	64.3	26.02	0.000

Mother: Incomplete Primary Education	Unmatched	.275	.214	14.2		78.82	0.000
	Matched	.271	.265	1.4	90.4	3.56	0.000
Mother: Complete Primary Education	Unmatched	.198	.194	1.1		6.10	0.000
	Matched	.206	.217	-2.7	-143.0	-7.11	0.000
Mother: Complete Secondary Education or above	Unmatched	.242	.421	-38.5		-208.74	0.000
	Matched	.271	.307	-7.7	80.1	-21.28	0.000
Father: Illiterate/Semi-illiterate	Unmatched	.337	.203	30.6		156.06	0.000
	Matched	.294	.247	10.7	64.9	28.88	0.000
Father: Incomplete Primary Education	Unmatched	.218	.189	7.1		35.55	0.000
	Matched	.229	.231	-0.5	92.3	-1.42	0.155
Father: Complete Primary Education	Unmatched	.196	.200	-1.0		-5.05	0.000
	Matched	.206	.217	-2.7	-168.5	-7.20	0.000
Father: Complete Secondary Education or above	Unmatched	.248	.407	-34.4		-169.06	0.000
	Matched	.271	.305	-7.4	78.5	-20.50	0.000
Number of Household Members	Unmatched	4.043	3.669	32.4		226.59	0.000
	Matched	4.025	3.917	9.4	71.1	27.03	0.000
School Type: Federal	Unmatched	9.8e-05	.001	-3.8		-25.03	0.000
	Matched	.000	.000	0.1	98.5	0.33	0.739
School Type: State	Unmatched	.216	.296	-18.4		-129.82	0.000
	Matched	.229	.261	-7.4	60.0	-20.23	0.000
School Type: Municipal	Unmatched	.783	.702	18.6		131.17	0.000
	Matched	.771	.739	7.4	60.5	20.22	0.000
School Quality of Infrastructure	Unmatched	2.570	2.676	-17.9		-121.30	0.000
	Matched	2.601	2.646	-7.6	57.6	-20.62	0.000
School Quality of Facilities	Unmatched	1.824	2.044	-32.8		-212.40	0.000
	Matched	1.873	1.960	-13.0	60.4	-35.28	0.000
School Availability of Textbooks	Unmatched	2.851	2.896	-10.6		-76.80	0.000
	Matched	2.869	2.882	-3.0	71.3	-8.26	0.000
School High Absence of Teachers	Unmatched	1.340	1.433	-14.6		-102.73	0.000
	Matched	1.345	1.377	-5.0	66.1	-13.93	0.000

Author's calculations with *Prova Brasil* 2011 and *Projeto Presença*.

Table F.2. Balancing Test for 9th Graders Sample

		MEAN				T-TEST	
Variable	**Sample**	**Treated**	**Control**	**% Bias**	**% Bias Reduction**	**t**	**p>|t|**
Female	Unmatched	.564	.518	9.3		55.30	0.000
	Matched	.570	.562	1.5	84.3	4.14	0.000
White	Unmatched	.275	.423	-31.5		-177.08	0.000
	Matched	.294	.294	0.1	99.8	0.17	0.861
Urban (vs. Rural)	Unmatched	.860	.942	-27.7		-183.45	0.000
	Matched	.877	.904	-9.0	67.6	-24.00	0.000
State: Rio Grande do Sul	Unmatched	.022	.051	-15.2		-85.39	0.000
	Matched	.021	.021	-0.3	97.9	-1.16	0.247
State: Santa Catarina	Unmatched	.011	.047	-21.6		-116.32	0.000
	Matched	.013	.012	1.1	94.9	4.61	0.000
State: Paraná	Unmatched	.033	.066	-15.2		-86.04	0.000
	Matched	.045	.049	-2.0	86.7	-5.80	0.000
State: São Paulo	Unmatched	.134	.309	-42.9		-244.42	0.000
	Matched	.179	.199	-5.0	88.4	-14.50	0.000
State: Rio de Janeiro	Unmatched	.050	.059	-3.9		-23.19	0.000
	Matched	.053	.067	-6.4	-65.2	-17.37	0.000
State: Espírito Santo	Unmatched	.000	.024	-21.8		-110.46	0.000
	Matched	.000	.000	-0.1	99.5	-1.71	0.087
State: Minas Gerais	Unmatched	.094	.107	-4.6		-27.31	0.000
	Matched	.086	.102	-5.2	-14.8	-15.22	0.000
State: Mato Grosso do Sul	Unmatched	.010	.016	-5.1		-29.32	0.000
	Matched	.010	.012	-2.0	59.6	-6.23	0.000
State: Goiás	Unmatched	.026	.034	-4.6		-27.07	0.000
	Matched	.020	.027	-3.5	23.9	-11.20	0.000
State: Distrito Federal	Unmatched	.007	.012	-5.0		-28.59	0.000
	Matched	.008	.009	-1.5	69.7	-4.59	0.000
State: Mato Grosso	Unmatched	.014	.020	-4.3		-25.03	0.000
	Matched	.016	.019	-2.7	37.7	-7.44	0.000
State: Bahia	Unmatched	.107	.046	23.2		153.94	0.000
	Matched	.085	.076	3.2	86.3	8.69	0.000
State: Sergipe	Unmatched	.016	.006	9.5		64.09	0.000
	Matched	.013	.011	2.0	78.7	5.60	0.000
State: Alagoas	Unmatched	.032	.011	14.2		96.90	0.000
	Matched	.035	.028	5.2	63.4	12.18	0.000
State: Pernambuco	Unmatched	.083	.031	22.8		154.03	0.000
	Matched	.087	.071	6.7	70.6	16.17	0.000
State: Paraíba	Unmatched	.031	.011	14.0		95.07	0.000
	Matched	.034	.028	4.7	66.6	10.96	0.000
State: Rio Grande do Norte	Unmatched	.021	.009	9.5		63.13	0.000
	Matched	.022	.021	0.8	91.6	1.90	0.058
State: Ceará	Unmatched	.097	.033	26.5		180.14	0.000
	Matched	.096	.074	8.9	66.3	22.05	0.000
State: Piauí	Unmatched	.024	.010	11.0		73.54	0.000
	Matched	.021	.019	1.5	85.9	3.95	0.000
State: Maranhão	Unmatched	.068	.024	21.1		142.86	0.000
	Matched	.053	.042	5.2	75.5	14.37	0.000
State: Pará	Unmatched	.046	.025	11.2		72.17	0.000
	Matched	.033	.035	-1.3	88.7	-3.66	0.000
State: Amapá	Unmatched	.005	.003	2.3		14.40	0.000
	Matched	.004	.005	-0.6	73.9	-1.60	0.110
State: Tocantins	Unmatched	.013	.010	3.6		22.66	0.000
	Matched	.011	.013	-1.6	56.3	-4.19	0.000
State: Roraima	Unmatched	.004	.002	3.3		21.63	0.000
	Matched	.004	.004	-0.5	86.4	-1.19	0.233
State: Amazonas	Unmatched	.034	.020	8.7		55.72	0.000
	Matched	.036	.038	-1.2	85.6	-3.02	0.003
State: Acre	Unmatched	.006	.004	3.0		18.86	0.000
	Matched	.006	.006	-0.3	88.2	-0.91	0.363
State: Rondônia	Unmatched	.007	.009	-1.9		-11.20	0.000
	Matched	.007	.009	-2.2	-17.6	-6.34	0.000
Household Assets (PCA)	Unmatched	-.854	.413	-78.7		-415.41	0.000
	Matched	-.737	-.572	-10.2	87.0	-31.59	0.000
Mother: Illiterate/Semi-illiterate	Unmatched	.299	.158	34.1		193.05	0.000
	Matched	.290	.259	7.7	77.5	20.14	0.000
Mother: Incomplete Primary Education	Unmatched	.299	.231	15.6		85.52	0.000
	Matched	.308	.303	1.3	91.5	3.56	0.000

Mother: Complete Primary Education	Unmatched	.188	.201	-3.4		-18.11	0.000
	Matched	.190	.199	-2.3	32.7	-6.44	0.000
Mother: Complete Secondary Education or above	Unmatched	.213	.410	-43.4		-224.22	0.000
	Matched	.211	.240	-6.3	85.4	-19.35	0.000
Father: Illiterate/Semi-illiterate	Unmatched	.386	.194	43.3		218.97	0.000
	Matched	.362	.321	9.2	78.7	24.32	0.000
Father: Incomplete Primary Education	Unmatched	.257	.223	8.1		39.31	0.000
	Matched	.267	.272	-1.2	84.9	-3.31	0.001
Father: Complete Primary Education	Unmatched	.178	.214	-9.1		-42.96	0.000
	Matched	.185	.200	-3.7	59.6	-10.41	0.000
Father: Complete Secondary Education or above	Unmatched	.179	.370	-43.7		-200.01	0.000
	Matched	.186	.207	-4.8	88.9	-14.97	0.000
Number of Household Members	Unmatched	4.813	4.400	35.5		214.45	0.000
	Matched	4.851	4.770	7.1	80.1	21.22	0.000
School Type: Federal	Unmatched	.000	.002	-6.6		-33.87	0.000
	Matched	.000	.000	0.0	99.5	0.31	0.758
School Type: State	Unmatched	.526	.661	-27.7		-170.08	0.000
	Matched	.555	.605	-10.2	63.2	-28.47	0.000
School Type: Municipal	Unmatched	.474	.336	28.3		173.39	0.000
	Matched	.444	.395	10.2	63.8	28.46	0.000
School Quality of Infrastructure	Unmatched	2.566	2.645	-13.3		-76.51	0.000
	Matched	2.581	2.597	-2.7	79.6	-7.52	0.000
School Quality of Facilities	Unmatched	1.968	2.141	-26.6		-147.60	0.000
	Matched	1.994	2.035	-6.4	76.0	-17.86	0.000
School Availability of Textbooks	Unmatched	2.901	2.924	-6.5		-40.17	0.000
	Matched	2.908	2.910	-0.6	91.3	-1.56	0.119
School High Absence of Teachers	Unmatched	1.568	1.756	-24.8		-146.94	0.000
	Matched	1.593	1.624	-4.1	83.5	-11.79	0.000

Author's calculations with *Prova Brasil* 2011 and *Projeto Presença.*

*Table G.1. Bolsa Família Effects on Test Scores in **Mathematics** by Region, 5th Graders, 2011*

Matching Method	Treated	Controls	Difference	S.E.	T-stat
SOUTH					
Unmatched	-.711	-.312	-.400	.008	-48.49
One-to-One (with replacement)	-.711	-.735	.023	.012	1.94
Nearest Neighbour	-.711	-.711	.021	.009	2.21
Radius (within calliper)	-.711	-.733	.021	.009	2.36
Kernel	-.711	-.675	-.036	.009	-4.20
SOUTHEAST					
Unmatched	-.602	-.34	-.262	.004	-62.54
One-to-One (with replacement)	-.602	-.615	.013	.006	2.14
Nearest Neighbour	-.602	-.622	.021	.005	4.26
Radius (within calliper)	-.602	-.624	.023	.004	5.01
Kernel	-.602	-.586	-.016	.004	-3.64
MIDWEST					
Unmatched	-.744	-.479	-.266	.010	-26.81
One-to-One (with replacement)	-.744	-.747	.002	.01	0.19
Nearest Neighbour	-.744	-.760	.016	.011	1.44
Radius (within calliper)	-.744	-.761	.017	.010	1.60
Kernel	-.744	-.721	-.024	.010	-2.31
NORTHEAST					
Unmatched	-1.055	-.943	-.112	.005	-22.14
One-to-One (with replacement)	-1.055	-1.057	.002	.007	0.23
Nearest Neighbour	-1.055	-1.063	.008	.006	1.42
Radius (within calliper)	-1.055	-1.062	.007	.005	1.31
Kernel	-1.055	-1.032	-.023	.005	-4.33
NORTH					
Unmatched	-1.027	-.823	-.204	.008	-26.59
One-to-One (with replacement)	-1.027	-1.043	.015	.010	1.44

Nearest Neighbour	-1.027	-1.038	.010	.009	1.16
Radius (within calliper)	-1.027	-1.037	.010	.008	1.18
Kernel	-1.027	-1.013	-.014	.008	-1.75

Author's calculations with *Prova Brasil* 2011 and *Projeto Presença.*

*Table G.2. Bolsa Família Effects on Test Scores in **Language** by Region, 5th Graders, 2011*

Matching Method	Treated	Controls	Difference	S.E.	T-stat
SOUTH					
Unmatched	-1.126	-.734	-.393	.008	-48.45
One-to-One (with replacement)	-1.126	-1.141	.015	.011	1.32
Nearest Neighbour	-1.126	-1.145	.018	.009	2.01
Radius (within calliper)	-1.126	-1.142	.016	.009	1.86
Kernel	-1.126	-1.088	-.039	.008	-4.64
SOUTHEAST					
Unmatched	-1.020	-.747	-.272	.004	-65.42
One-to-One (with replacement)	-1.020	-1.039	.019	.006	3.19
Nearest Neighbour	-1.020	-1.040	.020	.005	4.25
Radius (within calliper)	-1.020	-1.042	.022	.004	4.95
Kernel	-1.020	-1.003	-.017	.004	-3.89
MIDWEST					
Unmatched	-1.077	-.838	-.239	.010	-24.04
One-to-One (with replacement)	-1.077	-1.085	.008	.014	0.57
Nearest Neighbour	-1.077	-1.097	.019	.011	1.75
Radius (within calliper)	-1.077	-1.092	.014	.010	1.39
Kernel	-1.077	-1.056	-.021	.010	-2.09
NORTHEAST					
Unmatched	-1.371	-1.249	-.122	.005	-23.82
One-to-One (with replacement)	-1.371	-1.384	.013	.007	1.81
Nearest Neighbour	-1.371	-1.380	.008	.006	1.47
Radius (within calliper)	-1.371	-1.379	.007	.005	1.34
Kernel	-1.371	-1.348	-.024	.005	-4.42
NORTH					
Unmatched	-1.336	-1.105	-.231	.008	-29.97
One-to-One (with replacement)	-1.336	-1.340	.004	.011	0.36
Nearest Neighbour	-1.336	-1.341	.005	.009	0.54
Radius	-1.336	-1.344	.008	.008	0.94

(within calliper)					
Kernel	-1.336	-1.317	-.019	.008	-2.27

Author's calculations with *Prova Brasil* 2011 and *Projeto Presença.*

*Table G.3. Bolsa Família Effects on Test Scores in **Mathematics** by Region, 9th Graders, 2011*

Matching Method	Treated	Controls	Difference	S.E.	T-stat
SOUTH					
Unmatched	-.057	.246	-.303	.007	-41.20
One-to-One (with replacement)	-.057	-.069	.012	.011	1.15
Nearest Neighbour	-.057	-.073	.016	.008	1.88
Radius (within calliper)	-.057	-.074	.017	.008	2.14
Kernel	-.057	-.013	-.044	.007	-5.84
SOUTHEAST					
Unmatched	-.070	.157	-.228	.004	-55.94
One-to-One (with replacement)	-.070	-.089	.018	.006	3.08
Nearest Neighbour	-.070	-.093	.023	.005	4.87
Radius (within calliper)	-.070	-.096	.025	.004	5.80
Kernel	-.070	-.050	-.021	.004	-4.91
MIDWEST					
Unmatched	-.128	.077	-.205	.010	-21.30
One-to-One (with replacement)	-.128	-.149	.020	.014	1.50
Nearest Neighbour	-.128	-.144	.016	.011	1.52
Radius (within calliper)	-.128	-.143	.015	.010	1.50
Kernel	-.128	-.101	-.027	.010	-2.76
NORTHEAST					
Unmatched	-.323	-.219	-.104	.004	-24.07
One-to-One (with replacement)	-.323	-.335	.012	.006	1.98
Nearest Neighbour	-.323	-.341	.018	.005	3.63
Radius (within calliper)	-.323	-.343	.019	.005	4.10
Kernel	-.323	-.328	.004	.005	0.97
NORTH					
Unmatched	-.306	-.108	-.197	.008	-25.44
One-to-One (with replacement)	-.306	-.335	.029	.011	2.59
Nearest Neighbour	-.306	-.329	.023	.009	2.58
Radius	-.306	-.329	.023	.008	2.71

(within calliper)					
Kernel	-.306	-.306	.000	.008	0.07

Author's calculations with *Prova Brasil* 2011 and *Projeto Presença.*

*Table G.4. Bolsa Família Effects on Test Scores in **Language** by Region, 9th Graders, 2011*

Matching Method	Treated	Controls	Difference	S.E.	T-stat
SOUTH					
Unmatched	-.228	.055	-.282	.007	-37.37
One-to-One (with replacement)	-.228	-.247	.019	.011	1.74
Nearest Neighbour	-.228	-.247	.019	.009	2.18
Radius (within calliper)	-.228	-.244	.016	.008	2.00
Kernel	-.228	-.186	-.041	.008	-5.35
SOUTHEAST					
Unmatched	-.184	.054	-.238	.004	-57.92
One-to-One (with replacement)	-.184	-.208	.024	.006	4.01
Nearest Neighbour	-.184	-.208	.024	.005	5.03
Radius (within calliper)	-.184	-.208	.024	.004	5.49
Kernel	-.184	-.161	-.023	.004	-5.51
MIDWEST					
Unmatched	-.229	-.035	-.194	.010	-19.86
One-to-One (with replacement)	-.229	-.238	.009	.014	0.69
Nearest Neighbour	-.229	-.245	.016	.011	1.51
Radius (within calliper)	-.229	-.243	.014	.010	1.38
Kernel	-.229	-.203	-.026	.010	-2.63
NORTHEAST					
Unmatched	-.432	-.318	-.114	.004	-26.59
One-to-One (with replacement)	-.432	-.449	.016	.006	2.74
Nearest Neighbour	-.432	-.448	.015	.005	3.14
Radius (within calliper)	-.432	-.448	.015	.005	3.31
Kernel	-.432	-.431	-.001	.005	-0.23
NORTH					
Unmatched	-.373	-.169	-.204	.008	-26.27
One-to-One (with replacement)	-.373	-.393	.021	.011	1.88
Nearest Neighbour	-.373	-.393	.020	.009	2.24
Radius	-.373	-.391	.018	.008	2.09

(within calliper)					
Kernel	-.373	-.367	-.006	.008	-0.76

Author's calculations with *Prova Brasil* 2011 and *Projeto Presença.*