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Beyond the Income Effect

Impacts of Conditional Cash Transfer Programs on Private Investments in Human Capital

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Abstract

In the past decade, conditional cash transfer (CCT) programs have become an important component of social policy in developing countries. While the impacts of these programs have been well researched with respect to their effectiveness to achieve intended outcomes, less is known about their impact on private expenditure decisions. This aspect has great policy relevance since changes in private household expenditures can either support or counteract the aim of the programs. This essay investigates the impact of a CCT program on private household expenditure decisions in nutrition, health and education which are seen as principal contributors to child human capital. First, household expenditure behavior under a CCT program is discussed based on Heckman's model on the technology of skill formation as a conceptual framework. The paper shows how intra-household preferences and perceptions on the substitutability or complementarity of investments can impact household resource allocation decisions. Subsequently, the theoretical implications are tested in the context of the Brazilian CCT program Bolsa Família, using the Brazilian household expenditure survey. Evidence is found that households increase their private expenditure in food and education disproportionally to the amount of cash transfer, that is, more than would be expected when considering the Engel curves of the expenditures under question.

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Beyond the Income Effect: Impacts of Conditional Cash Transfer Programs on Private Investments in Human Capital*

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1 Introduction

Conditional Cash Transfer programs (CCTs) have become an important component of social policy in many developing countries. According to Schady et al. [2009], over 30 countries around the world introduced variants of CCT schemes; this includes most of the countries in Latin America, some countries in Africa and also in Asia. In many countries, CCT programs make up almost 0.5% of GDP. In Brazil, almost 13.4 million households with an average size of 4.7 members[1] benefit from the CCT program "Bolsa Família (BFP)", which we will examine in this essay. In Mexico, 5 million beneficiary households (almost 18% of population) partake in a program called Oportunidades (formerly PROGRESA). The scale of funding and number of people involved in these social schemes underline the importance of developing a deeper understanding of how effective they are, through what channels they work and how the programs could be improved.

A typical CCT program targets the poor and provides cash conditional on the recipient household's participation in certain education and health services (e.g. school attendance, health check-ups and the updating of immunization cards) [Schady et al., 2009]. CCTs usually focus on two goals with differing time horizon. In the short term, they alleviate poverty through a cash transfer and in the longer term, they aim to avoid the intergenerational transmission of poverty through the imposition of conditionalities which require households to increase their demand for health and education services.

For the first objective, literature shows evidence that a transfer of funds can be effective in addressing poverty in the short term (Sergei et al. [2007], de Barros et al. [2007], Bastagli [2010]). However, the long run goal of these programs is more complex, since it depends on investments in human capital through health and education to break the cycle of intergenerational poverty transmission. In addition to direct benefits, human capital investments may also create externalities for non-beneficiaries, including for those who are supporting the program financially as a tax payer. The externalities of human capital accumulation may operate through its role in economic development (see Mincer [1958], Kremer [1993], Lucas [1988] and Grossman [1999]).

In this essay, we analyze how the participation in Bolsa Família affects private household expenditure decisions in child human capital; we refer to those expenditures as "investments"[2] in child human capital.[3] We proceed as follows: First, we build a conceptual framework for our

[1] This is the average size of Bolsa Família's treated households in POF(2009).

[2] Are we talking about investment or expenditures? Following Heckman and Cunha's (2007) approach, households expenditures on child health and education will be defined as investment in child human capital. The main reason for this is the fact that their productivity in later adult life will depend on this previous "investment" in their childhood.

[3] We see nutrition, health and education as the main determinants of child human capital. There is evidence

empirical analysis based on Heckman and Cunha's (2007) technology of human capital formation. In this framework, we distinguish between subcomponents of investments in nutrition, health and education and illustrate that the perception on the complementarity versus substitutability character of these investments is crucial for household expenditure decisions. Subsequently, guided by this theoretical framework, we estimate the impact of the Bolsa Família program on investments in child human capital.[4]

In order to identify the causal effect of the program, we apply a Regression Discontinuity Design (RDD) exploiting an eligibility threshold in income and the number of children as exogenous variation in treatment.[5] Our empirical models with income as one of our forcing variables and the expenditure shares of education and health (including food) as outcome variables resemble the concept of the Engel curve. This concept was originally introduced to analyze changes in the expenditure share of food with the expansion of income [Engel, 1857, 1895] but can also be extended to other goods. We make use of this similarity by confronting the estimated treatment effect with the respective Engel curve which is informative of the expenditure behavior of households with increasing income (e.g. through a cash transfer) in the absence of conditionalities. Hence, this comparison allows us to analyze whether BFP impacts household expenditure decisions beyond a pure income effect. Even though related approaches, confronting the results of other quasi-experimental designs with Engel curves, have been used to analyze food expenditures in Colombia and Mexico, to the best of our knowledge, this procedure combining inferences based on an RDD and Engel curves has not been used before to analyze household expenditure decisions in the context of BFP or other CCTs.[6]

This essay makes three contributions to the prevailing literature on CCT programs in general and BFP in particular. First, even though some aspects of BFP have been researched in depth, its impacts on private household expenditure decisions remains unclear. In this essay, we attempt to close this gap and provide evidence based on survey data at the household level. A

of a strong relationship between nutrition with health and education outcomes. See Alderman et al. [2001], Alderman et al. [2006], Glewwe and Miguel [2007] and Maluccio et al. [2009]. and according to Heckman [2006] early investments are crucial.

[4]We followed the expenditure aggregation used in POF for food/nutrition; health (e.g. medical expenses, services and medication) and education (e.g. fees for regular courses and complementary activities, school materials). This procedure resulted in aggregating more than 567 items for food/nutrition; 44 items for health and 53 items for education. Further details about this aggregation are available in IBGE-POF [2012]. We also consider how constrained households are in their demand of health services and medication due to their budget constraint.

[5]The fact that individuals are not able to "precisely" control the assignment variables in this program furnishes us with a source of exogenous variation in treatment status. [Lee and Lemieux, 2010]

[6]Related approaches approaches include Attanasio et al. [2011], Angelucci and Attanasio [2013] and Beatty et al. [2011]. Attanasio et al. [2011] interacted a parametric Engel curve estimation with a combination of matching and difference-in-difference for evaluating the effect of CCTs on expenditure on food in Colombia. Angelucci and Attanasio [2013] also used a similar methodology to analyze the impact of Oportunidades on demand for food in urban area in Mexico. Beatty et al. [2011] used a regression discontinuity Engel curve specification to test the fungibility of money hypothesis for the UK Winter Fuel Payment.

second contribution of our essay is the application of a multidimensional fuzzy RDD approach by combining the two forcing variables of income and number of children to evaluate the impact of Bolsa Família, for which experimental evidence is not available. Third, we analyze whether the impact of BFP goes beyond the pure cash transfer by confronting our results with standard Engel curves.

The remainder of the essay is organized as follows. Section 2 describes how our work relates to the previous literature. Section 3 develops a theoretical background on the mechanics of CCTs. Section 4 provides further details on the data and some descriptive statistics. Section 5 lays out the identification strategy and estimation. Subsequently, we interpret the results and present robustness checks. We make some concluding remarks in the final section.

Country	**Program**[a]	**Start**[b]	**Act.**[c]	**Cost**[d]	**Pay.**[e]	**Coverage**[f]		**Educ.**[g]	**Health**[h]
SS. Africa									
Burkina Faso	OV-Children	2008	X	1,400	P	3,250	hh	Yes	Yes
Kenya	CT-OV-Child	2004	X	2,200	P	12,500	hh	Yes	Yes
Nigeria	C-Poor	2008	X	NA	M	3,000	hh	Yes	Yes
E Asia/Pac.									
Cambodia	Cam-Educ	2005	X	5,000	P	3,850	hh	Yes	No
Cambodia	JF-PR-Sch	2002	-	3,000	P	4,185	w	Yes	No
Indonesia	JPS	1998	-	350,000	S	1,600,000	st	Yes	No
Indonesia	PKH	2007	X	110,000	M	387,928	hh	Yes	Yes
Philippines	PPPP	2008	X	471,000	M	380,000	hh	Yes	Yes
Eur/C. Asia									
Turkey	SRMP	2001	X	360,000	M	855,906	hh	Yes	Yes
LA/Car.									
Argentina	Familias	2002	X	853,300	M	504,784	hh	Yes	Yes
Bolivia	JP	2006	X	30,000	P	1,200,000	ch	Yes	No
Brazil	BA	2001	-	8,300	M	1,500,000	ch	No	Yes
Brazil	Bolsa Escola	2001	-	626,000	M			Yes	No
Brazil	Bolsa Família	2003	X	5,000,000	M	11,100,000	hh	Yes	Yes
Brazil	PETI	1996	-	297,222	M	3,300,000	hh	Yes	No
Chile	Solidario	2002	X	0.08%*	M	256,000	hh	Yes	Yes
Chile	SUF	1981	X	70,000	M	1,200,000	ind	Yes	Yes
Colombia	FA	2001	X	0.2%*	M	1,700,000	hh	Yes	Yes
Colombia	SCS	2005	X	NA	S	10,000	ind	Yes	No
Dom. Rep.	Solidaridad	2005	X	124,944	P	461.446	hh	Yes	Yes
Dom. Rep.	TA-Escolar	2001	-	57,000	M	100.000	hh	Yes	No
Ecuador	BDH	2003	X	194,000	W	1,060,416	w	Yes	Yes
El Salvador	Red Solidaria	2005	X	51,400	M	100.000	hh	Yes	Yes
Guatemala	MFP	2008	X	0.2%*	M	250	hh	Yes	Yes
Honduras	PAF	1998	X	20,000	M	240	hh	Yes	Yes
Jamaica	PAHE	2001	X	245,000	P	300,000	ind	Yes	Yes
Mexico	Oportunidades	1997	X	3,181,200	M	5,000,000	hh	Yes	Yes
Nicaragua	At-Crisis	2005	-	1,800	P			Yes	Yes
Nicaragua	RPS	2000	-	3,700	P	20,000	hh	Yes	Yes
Panama	Red de Oport.	2006	X	160,100	M	70,000	hh	Yes	Yes
Paraguay	Tekopor	2005	X	96,000	M	19,800	hh	Yes	Yes
Peru	Juntos	2005	X	100,000	M	453,823	hh	Yes	Yes
ME/N. Afr.									
Yemen	BEDP	2007	X		P			Yes	No
S. Asia									
Bangladesh	FSSAP	1994	X	40,000	P	723,864	w	Yes	No
Bangladesh	PE SP	2002	X	103,630	P	5,300,000	ind	Yes	No
Bangladesh	ROSC	2004	X	63,000	P	500,000	ch	Yes	No
India	Apni	1994	X	NA	W	NA		Yes	Yes
Pakistan	CSP	2006	-	1,373	P	13,265	hh	Yes	No
Pakistan	PEISEV	2003	-	706,500	P	8,000	st	Yes	No
Pakistan	PE SRP	2004	-	5,148	P	279,928	hh	Yes	No
Total				**13,036,695**		**31,911,234**			

Note:(a)Name of the Program; (b) Year of release; (c) Active: X (yes); (d) Transfer payment in US dollar; (e) P (parents), M (mother), W (women), S (students); (f) Coverage: hh (household), w (women), s (students), ch (children), ind (individuals); (g) Conditionality on education; (h) Conditionality on health; (*) share on GDP.

Table 1: CCT programs around the world

Source: Own elaboration based on Schady et al. [2009]

2 Motivation and related literature

In the last decade, CCT schemes have become a more and more frequent choice of social policy around the world. While only a handful of CCT programs existed at the end of the 1990s, the 2000s have seen a dramatic increase in the number and coverage of CCT schemes (see Table 1). Until 2009, more than 30 countries had introduced CCT schemes; approximately 32 million households worldwide[7] participated in CCTs with annual transfers amounting to a total of US$ 13 billion.[8]

Although the designs of the specific programs vary by country, most CCTs share a common characteristic: poor households receive cash if they comply with conditionalities which are linked to children's school attendance and (pregnant) women's and children's use of health services. In some programs, the number of children per household is also taken into account in determining the eligibility and amount of transfer (e.g. BFP in Brazil).

One of the best-documented programs, particularly in terms of its impacts, is Oportunidades (formerly PROGRESA) in Mexico.[9] The most pronounced differences between Oportunidades and BFP are that the former was accompanied by an intensive effort of impact evaluation[10] as part of its design and that it explicitly focuses on human capital formation. BFP started on a much larger scale (about 6.5 million beneficiary households in the first year), albeit without evaluations as an integral part of its design.[11] Human capital formation is also one of the justifications for the conditionalities in Bolsa Família, but it is not made explicit as its main purpose as in Oportunidades of Mexico (Schady et al. [2009], Soares [2012]).[12]

Due to the fact that random assignment of treatment was not part of Bolsa Família's design, the literature evaluating the impact of BFP can only rely on non- and quasi-experimental techniques to address the problem of potential selection bias. The approaches include Propensity Score Matching (PSM), instrumental variables (IV) and Regression Discontinuity Design (RDD)[13]. Soares [2012] provides a comprehensive review covering some of the main findings on

[7] If we consider that on average a household is composed of 4 people, which is an overly conservative guess for developing countries (in the case of BFP on average a household is composed by almost 5 people (4.7 according to POF 2008-2009)), more than 120 million people worldwide benefit from CCT programs.

[8] The information on CCT schemes, their coverage and total budget is based on Schady et al. [2009].

[9] PROGRESA started in 1997 covering about 300,000 households.

[10] The history of official evaluations of PROGRESA/Oportunidades as well as its schedule of upcoming evaluations are available on the official website of the program (www.oportunidades.gob.mx), starting with a first evaluation report from 1999.

[11] The design of the program took advantage of the knowledge accumulated in previous programs carried out abroad, including PROGRESA and ex-ante simulations (e.g. Bourguignon et al. [2003]).

[12] Soares [2012] argues that one of the reasons is that the program does not necessarily support beneficiaries for the time needed for a generation to complete school.

[13] Pedrozo Jr.'s (2010) thesis is composed by three papers on the relation of BFP eligibility rules and their impact on beneficiaries labor market decision. It is one of the few studies using RD design to evaluate BFP with PNAD data. A drawback of this dataset is that until 2010, it was not possible to identify BFP beneficiaries

the impact of BFP. In the following, we summarize the state of discussion in the literature on CCTs in general and BFP in particular.

The literature on CCTs covers many different questions, from the quality of targeting, to their impact on school attendance, school performance, health, nutrition, poverty, inequality, gender empowerment, fertility, consumption and savings.

Among the first issues which the literature addressed were the effectiveness of targeting and the short-term effect on poverty. Skoufias et al. [2001] shows that Oportunidades has succeeded in targeting, in particular, the poorest households. For the Brazilian Bolsa Família, Lindert et al. [2007] and Soares [2012] find that the program was successful in reaching most of the poor households. However, for BFP, the targeting was less successful in excluding non-eligible households from receiving the benefits. Soares [2012] find that approximately 49% of BFP's beneficiary households had a per capita income higher than the eligibility threshold in 2006. He suggests three possible reasons for this: fraud, income measurement error and income volatility. In the analysis of this essay, we also find a large number of BFP beneficiaries with an income per capita exceeding the eligibility threshold[14]. We will discuss this topic in further detail in section 5, when we lay out our identification strategy. In line with the result that CCTs have succeeded in reaching the poor, the literature finds evidence that CCTs were indeed effective in reducing poverty and also inequality, especially in Latin America (see de Barros et al. [2007], Rocha [2008], Sergei et al. [2007], Bastagli [2010]).

CCTs are shown to have an overall positive impact on school attendance, but this does not necessarily translate into better school performance [Bastagli, 2010]. Schultz [2004] and Brauw and Hoddinott [2011] show that PROGRESA has succeeded in increasing school enrollment[15], with Neto [2010] and Glewwe and Kassouf [2012] finding similar results for BFP. Filmer and Schady [2011] found a positive impact on school attendance in Cambodia with low sensitivity to the amount of cash transferred. For Mexico, Behrman et al. [2011] also found a positive impact on scholastic performance both for boys and girls, after 5.5 years of program participation. They also found evidence that the program reduces labor participation in young boys (aged 9 to 10) and increase the probability of working for older cohorts of girls (aged 13 to 15 pre-program and 19 to 21 post-program intervention). On the other hand, Santarrosa [2011] found no evidence of a positive impact of BFP on children's cognitive skills as measured by their performance on

directly in the data (de Souza [2010])

[14]After entry into the program, the eligibility of households is reviewed every two years. During this period, households income may vary without an immediate withdrawal from the program (Brazilian Decree Law Decret, n. 5.209, from March 12, 2008).

[15]Brauw and Hoddinott [2011] found evidence of causality due to the conditionality on school attendance.

math and language exams.[16]

Another important goal of CCTs is improving child health. In a randomized trial approach involving 320 treated and 185 control villages in Mexico, Gertler [2004] found a positive impact of PROGRESA on child health with respect to morbidity, height, and anemia. Behrman et al. [2011] show evidence of a positive impact on health, particularly on women, with larger impacts for those who receive the program for a longer time. For BFP in Brazil, Reis [2010] also found a positive impact on child health. Camelo et al. [2009] used the National Survey of Demography and Health from 2006 to analyze the impact of BFP on nutrition. They found a positive impact of the program on child food security and nutrition, but they did not find a reduction in morbidity.

Even though most of the literature evaluating CCTs converges in finding a positive impact of these programs on increasing the demand on child health and education services, the studies are usually not able to disentangle the role played by conditionalities, female bargaining power and the cash transfer. Among the exceptions, Teixeira et al. [2010] found evidence of a positive impact of conditionalities on children's school attendance and number of visits at health centers in the Tekopor's program (Paraguay). Baird et al. [2011] present the results of experiments with different conditionalities, focusing on schooling for young women in Sub-Saharan Africa. They found that the conditionality was only effective when the cash transfer was received directly by the young women.

Another research area is the impact of CCTs on fertility. On the one hand, CCTs usually aim to increase child human capital and target transfers to women. Therefore, if the programs succeed in breaking intergenerational poverty transmission by increasing child human capital, one might expect a negative impact on next generation's fertility.[17] On the other hand, the total amount of transfer usually increases with the number of children. This could be seen as an incentive for having additional children. If the latter is the case, meeting the programs objective of breaking intergenerational poverty transmission could be made more difficult. If the real costs of an additional child exceed the transfer, which seems likely given the relatively small additional transfer per child, less resources per capita are available for private investments in child human capital. Eventually, the former issue is an empirical question; studies by Rocha [2009] and Signorini and Queiroz [2012] have not found a significant impact of BFP on fertility.

Finally, due to the fact that CCT programs increase income, we would expect a positive im-

[16]There are few analyses on BFP and school achievement of beneficiary children. Despite the recent availability of data on standardized tests to measure school achievement in Brazil, most of them do not identify BFPs' beneficiary children.

[17]This demographic transition may operate through the relative wage of women. In their model on fertility and growth, Galor and Weil [1996] present a mechanism in which higher relative wages for women increase the cost for having children and lead to a decline in fertility.

pact on the overall consumption level of recipient households. Angelucci et al. [2012] evaluate the impact of Oportunidades on consumption, savings, ownership of different assets, and transfers of households in Mexican urban areas. They found a significant impact on non-durables, especially food, which is consistent with other findings in the literature (similar results were found by Attanasio et al. [2011] for Familias en Acción in Colombia and Schady and Rosero [2008] for Bono de Desarollo Humano in Ecuador), but they found no impact on savings. Interestingly, Angelucci and De Giorgi [2009] found spillover effects on expenditures of non-eligible households that were living in the same villages as Oportunidades' beneficiaries.[18]

Until today, there are relatively few studies on Bolsa Família's impact on household expenditures. Resende and Oliveira [2008] used the Brazilian household expenditure survey (POF, 2002-2003) to analyze the impact of Bolsa Escola (which was later incoporated by BFP). They found higher levels of consumption among beneficiaries, especially concentrated on education, hygiene products, clothing and food. Duarte et al. [2009] used survey data of 838 households living in a rural area in the Northeast of Brazil and found a positive impact of BFP on food consumption. Santos and Oliveira [2012] used POF 2008-2009 to analyze the impact of BFP on health expenditures of households from the state of Minas Gerais finding no evidence of such impacts. The above studies either relate to Bolsa Família's predecessor Bolsa Escola [Resende and Oliveira, 2008] or analyze the impact of Bolsa Família in particular regions [Duarte et al., 2009, Santos and Oliveira, 2012]. Given the great regional heterogeneity of Brazil (see section 4), there is a need for further research which covers all Brazilian regions.

In conclusion, there is a large and growing literature on the impacts of CCTs.[19] Overall, CCTs have been found to be effective in ensuring compliance with the conditionalities. As a result, school attendance and the use of health services has increased among the beneficiary population. The literature has also found evidence that CCTs, through the cash transfer, have increased the consumption level of the beneficaries, reduced poverty and inequality. Nonetheless, open questions remain with respect to the mechanisms through which CCTs affect household choices. In particular, more research is needed to investigate how the interaction between the conditionalities and the cash transfer affect household choices.

Our essay aims to fill this gap in the literature by providing further evidence on the impact of CCTs on beneficiary households' expenditure decisions. Changes in expenditure choices can be crucial in counteracting or fostering the CCT's objectives since the public provision of services

[18] Apart form being interesting this finding challenges some program evaluation methods that assume no impact on untreated.

[19] For a good summary about this discussion see Schady et al. [2009].

such as health or education may be offset by a crowding out of private expenditures or, in the best case, be complemented by private investments. In any case, developing a better understanding of the nature of this relation has crucial policy implications for the design of CCT programs. In the following section, we will illustrate this point more formally in building on Heckman and Cunha's (2007) model on the technology of skill formation.

Our subsequent empirical analysis relies on a rich dataset covering the entire Brazilian territory and provides detailed information about the consumption choices of beneficiaries of the largest CCT of which we have knowledge. Our approach differs from most of the empirical literature on BFP which use PSM to identify its impact, in that we adopt a multidimensional fuzzy RDD approach to identification by using two forcing variables (income per capita and number of children), which we believe is better fit to dealing with unobservable characteristics of households. We confront our results with standard Engel curves which are informative of the change in expenditure choices with the expansion of income. This comparison allows us to analyze whether the effect of BFP on expenditure choices goes beyond a pure income effect.

3 Household expenditure decisions under CCT

Conditionality in social policy, per se, is not new – conditionalities have long been an integral part of social programs in the past (e.g. in food programs).[20,21] The conditionalities currently applied in CCTs differ from previous conditionalities in their focus on breaking intergenerational poverty transmission through human capital accumulation and in that the conditionalities are imposed with respect to the demand for non-tradable services (e.g. health care and education). There are three critical variables that we consider in this essay as basic inputs for human capital production: nutrition[22], health and education.

To illustrate the potential mechanisms through which the program may affect beneficiaries' expenditure decisions, we formalize the household's maximization problem in an intertemporal

[20] An example is Fome Zero in Brazil, a previous program, commenced in 2003, in which beneficiaries received cash conditional on spending the transfer on food. Another example is the Supplemental Nutrition Assistance Program in the USA, well known as "food stamp program".

[21] We will refer to the conditionalities which we are addressing here 'Second Generation of Conditionalities' (SGC) of CCT programs. Distinctive to FGCs, SGCs are based on an intergenerational behavior constraint. The cash is directly transferred to a woman in the household conditional on the participation in health and educational services that increase their children's human capital. The 'First Generation' (FGC) imposed conditions regarding the consumption of tradable goods. It is likely inefficient to constrain households' consumption behavior using the FGC approach. For example, if one transfers food instead of cash or if one imposes a conditionality on the amount of money used for buying food (or any other tradable good targeting child nutrition, for example) this might create conditions for an informal market in which beneficiaries will trade their rights for specific items in exchange for other desired goods or services. In section 8.3, we demonstrate how transfers under different forms may affect household consumption choices and welfare in a one period optimization problem.

[22] There is evidence of positive impacts of improving nutrition during childhood on education. See Alderman et al. [2001], Alderman et al. [2006], Glewwe and Miguel [2007] and Maluccio et al. [2009]

choice model. The model helps us clarify three potential channels through which a CCT program may influence the household's choices, namely: household preferences (which includes the unitary household assumption, discount rates, altruism and parents' perception on investments in child human capital); the budget constraint (which is directly affected by the cash transfer) and the conditionalities of the program.

We assume that households consist of an adult parent and her child. Parents have common preferences and are altruistic regarding investments in their childrens' human capital. Adult individuals make intertemporal decisions taking into account two periods. In the first period, the adult works and is the parent of a child. During this period, she decides the amount of investment to be allocated to her child's human capital. She also decides the allocation of her child's time between human capital accumulation (e.g. schooling, participating in health services) and child labor. In the second period, she is retired and her consumption depends on her savings in period one.

Therefore, there is a trade-off between consumption in period one, savings for future consumption in period two and investments in child human capital. We adapt Heckman and Cunha's (2007) production function of skill formation for our purposes and follow similar assumptions. As an extension, we allow for differences in the types of investment in the skill formation technology. To confine our analysis to the issue of contemporary complementarity, we assume only one period of investment in child human capital.[23]

In the Heckman and Cunha [2007] model I_t denotes parental investments in child skills in period t. Governmental inputs (e.g. schooling) are kept implicit. Also, Heckman and Cunha [2007] keep implicit the possibility of contemporaneous complementarity between investments in health and education and their subcomponents.

In the following theoretical framework, we highlight the complementary relation among the components of I_t in a contemporaneous perspective. We know that for each year t parents can choose a bundle (B) of affordable goods/services related to investments in health and education of their children. Therefore, their decision is not only about how much to invest, but also concerns the types of goods and services. If it is true that there is dynamic complementarity of skill formation as indicated by Heckman and Cunha, it also seems likely that the level and type of investment matters. For example, parents may choose between the options of sending their

[23]Heckman and Cunha [2007] divide childhood in two periods and stress the impact of investments during early childhood. In our model, we focus on the complementarity of contemporaneous investments. Hence, we confine our analysis to one period of investment in child human capital; this choice reflects the data availability and corresponds to the analysis of contemporaneous expenditure decisions which we carry out in the empirical part of the paper.

children to public school and pay a private language course or math tutoring, or sending them to a private school, or saving money for college education. Some of these options can be seen as substitutes or complements.

We assume that the degree of complementarity (or substitutability) may vary between nutrition, health and education expenditures. Therefore, we keep the functional form of I_t implicit:

$$I_t = (1 - \psi)\ i(Z_{gt}, Z_{1t}, Z_{2t}, ..., Z_{it}) \tag{1}$$

whereby Z_{1t} to Z_{it} refer to private investments in child human capital with respect to nutrition (n), health (h) and education (e) at time t. (1-ψ) refers to the share of the child's time allocated to human capital accumulation (as opposed to child labor), such that $0 \geq \psi \geq 1$. Z_{gt} refers to government services (at time t) which are provided free of charge but the usage of these services still entails a cost ϕ to the household.[24] ϕ reflects the transport cost to the facility where the service is provided and the opportunity cost of the time spent in using the service. The production function of human capital is:

$$hc_{t+1} = f(H, hc_t, I_t) \tag{2}$$

whereby hc_t is the stock of human capital at stage t. Each individual is born with initial conditions hc_1 and H are time fixed parental characteristics (e.g. IQ, education, etc). Human capital in adult life is a function of parental characteristics (H), initial characteristics of the child (hc_1) and investments in period t (I_t).[25] Therefore:

$$hc_{t+1} = f(H, hc_1, (1 - \psi)\ i(Z_{gt}, Z_{1t}, Z_{2t}, ..., Z_{it})) \tag{3}$$

We further assume imperfect credit markets. Parents have no access to the credit market to finance their childrens' human capital accumulation, $s_t \geq 0$ (parents savings cannot be negative). Hence, I_t is constrained by total labor income wH which depends on adult human capital H

[24] Whether inputs to a production function are substitutes, complements or independent is usually defined through the cross-price elasticity of demand. At first glance, there seems to be no consumer price attached to the free provision of governmental services (such as public schools) which poses difficulties to reconcile the notion of complementarity and substitutability with Conditional Cash Transfer programs. Although the household does not have to pay an explicit price for using free government services, the household encounters an opportunity cost ϕ (i.e. the household member demanding the service can not use her/his time in another way). The cash transfer of the CCT can then be understood as a subsidy which changes the price / opportunity cost of accessing the service. Assuming a relatively low monetary time value for the household members subject to the conditionalities, it seems likely that the cost of demanding the free government services then becomes negative which triggers a change in behavior. In this paper, we are concerned with the question how this change in relative prices and the quantity demanded of free government services affects the choice of other inputs to human capital production.

[25] Differently to Heckman and Cunha [2007], we assume only one period t for investments in child human capital.

and the wage rate w and the child's time allocated to human capital production $(1-\psi)$.[26] The poverty line threshold is defined as the minimal level of consumption necessary to meet basic needs (c_{min}). We assume that if $Hw \leq c_{min}$, and $s_t \geq 0$, then $I_t < I_t^{opt}$, where I_t^{opt} is the optimal level of investment in child human capital in the absence of a credit constraint.[27]

In an overlapping generations perspective $I_t < I_t^{opt}$ generates $H'(I_t) < H^{opt}(I_t^{opt})$, where $H^{opt}(I_t^{opt})$ is the optimal stock of adult human capital, and therefore this lack of investment in human capital increases the chance of poverty transmission over generations. To break this vicious cycle, CCT programs transfer income to those below the poverty line threshold (c_{min}) under the following conditionality: the beneficiary households should achieve a minimal level of investment in child human capital ($I_t \geq I_c$).[28] To benefit from the cash transfer, the CCT program requires the households to abstain from child labor $\psi = 0$ and to make use of governmental services $Z_{gt} \geq Z_{ct}$, whereby Z_{ct} is the minimum required usage of the respective health and education services.

For simplicity, let us assume that Z_{gt} is a component of basic child health care (e.g. immunization and prenatal check-ups for pregnant women) or basic education investment (e.g. school attendance).[29] Also, let us consider that these basic services are provided free of charge.[30,31] However, additional services or services of a higher quality have to be paid by the household. The parents' maximization problem for those who receive the conditional cash transfer is the

[26] We assume that the main source of income, excluding transfers, for households under CCT is income from work.

[27] Even if a household is below the poverty line, I_t might be > 0 due to the fact that there is access to public schools free of charge, but we assume that $I_t < I_t^{opt}$ if $Hw + \$m\psi \leq c_{min}$.

[28] Where I_c is the investment in child human capital resulting from the conditionality. This also could be reached through a cash transfer (\$CT) if $I_t + \$CT \times \frac{\delta I_t}{\delta \$CT} \geq I_c$.

[29] There is no double conditionality regarding the same children at the same time. The health service conditionality binds from the mother's pregnancy until the child has reached six years of age while the education conditionality binds for children of 6 to 15 years of age.

[30] This is the case for the Bolsa Família program, since access to basic health and education services are provided free of charge.

[31] When comparing CCT treatment and non-treatment scenarios, it is important to keep in mind that basic services – the usage of which were required to receive payments – were already free of charge prior to the program. Therefore, compliance with the conditionality implies an opportunity cost for using the service, but no explicit cost.

following:

$$
\begin{aligned}
(c_t^*, c_{t+1}^*, I_t^*) = \underset{\{c_t^*, c_{t+1}^*, I_t^*\}}{max} & \{u(c_t) + \beta u(c_{t+1}) + \beta\alpha E[V(hc_{t+1})]\} \\
s.t.\ \ & c_t + I_t + \frac{c_{t+1}}{1+r} = wH + \zeta + \$CT + \$m\psi \\
& hc_{t+1} = f(H, hc_t, (1-\psi)\ i(Z_{gt}, Z_{1t}, Z_{2t}, ..., Z_{it})) \\
& \text{and } Z_{gt} \geq Z_{ct} \\
& \text{and } \psi = 0 \\
& \zeta = (\omega_+ - \phi) Z_{gt}
\end{aligned}
\tag{4}
$$

Whereby c_t is consumption in period t, c_{t+1} is consumption in the future, r is the interest rate, s_t stands for savings in period t ($c_{t+1} = (1+r)s_t$), \$CT is the cash transfer, $\$m(1-\psi)$ is the foregone income from child labor, whereby (m) is the child wage rate and (ψ) is the time allocated to child labor; β is the utility discount rate factor, α denotes parental altruism towards the children and ω_+ is the price (value) of Z_{gt} perceived by the parents.[32] Let us define the cost ϕ of accessing the governmental services Z_{gt} as a constant which reflects the cost of transport to access the services and the opportunity cost of the time spent to use the services.[33] We assume that the conditionality constraint binds exactly. Hence, $Z_{gt} = Z_{ct}$ and $\psi = 0$. Once in the program, parents accept to use Z_{gt} under the cost of ϕ. To solve for Z_{it}^* as a function of Z_{gt} from the optimization problem (4), we need to specify a functional form for the production function of human capital. Let us assume[34] that $E[V(hc_{t+1})] = u((\theta Z_{gt}^{\rho} + (1-\theta)\ Z_{it}^{\rho})^{(1/\rho)})$, whereby $0 \geq \theta \geq 1$. The household's maximization problem can be written as:

$$
\begin{aligned}
(c_t^*, c_{t+1}^*, Z_{gt}^*, Z_{2t}^*) = \underset{\{c_t^*, c_{t+1}^*, Z_{gt}^*, Z_{2t}^*\}}{max} & \{u(c_t) + \beta\ u(c_{t+1}) + \beta\alpha\ u(\theta Z_{gt}^{\rho} + (1-\theta)\ Z_{it}^{\rho})^{(1/\rho)})\} \\
s.t\ \ & c_t + \frac{c_{t+1}}{(1+r)} + \omega_+ Z_{gt} + \omega_{it} Z_{it} = wH + \$CT + (\omega_+ - \phi) Z_{gt}
\end{aligned}
\tag{5}
$$

Given that Z_{gt} is provided free of charge, its price for the households becomes the cost ϕ of

[32] Z_{gt} is provided free of charge, hence, there is no explicit price for the household. We can assume that the price of Z_{gt} perceived by the parents is equivalent to the cost of Z_{gt} to the government. If $\omega_+ > \phi$, the service Z_{gt} will enter in the budget constraint with a positive value. If $\omega_+ < \phi$, parents will only use Z_{gt} if confronted with a monetary incentive such as in a CCT program or if another enforcement mechanism (e.g. a law that makes school attendance compulsory) is put in place.

[33] In addition to the loss of income from child labor, the opportunity cost of time may include non-remunerated work in the household or in agriculture and parents' effort to support children in using the government services (e.g. tutoring, bringing children to school).

[34] While also other factors (H, hc_t) contribute to children's human capital formation, Z_{it} are the only determinants which parents can control directly – their own human capital H as well as children's initial conditions hc_t are predetermined to period t and can be treated as scalars.

accessing the service.

$$
\begin{aligned}
(c_t^*, c_{t+1}^*, Z_{gt}^*, Z_{2t}^*) = \underset{\{c_t^*, c_{t+1}^*, Z_{gt}^*, Z_{2t}^*\}}{max} & \{u(c_t) + \beta\ u(c_{t+1}) + \beta\alpha\ u(\theta Z_{gt}^{\rho} + (1-\theta)\ Z_{it}^{\rho})^{(1/\rho)})\} \\
s.t\ \ c_t + \frac{c_{t+1}}{(1+r)} + \omega_{it} Z_{it} + \phi Z_{gt}^{+} &= wH + \$CT
\end{aligned}
\tag{6}
$$

The household's problem can be solved by the Lagrangian method.

$$
\begin{aligned}
L(c_t^*, c_{t+1}^*, I_t^*, \lambda) = u(c_t) + \beta\ u(c_{t+1}) + \beta\alpha\ u(\theta Z_{gt}^{\rho} + (1-\theta)\ Z_{it}^{\rho})^{(1/\rho)}) - \\
- \lambda \left(c_t + \frac{c_{t+1}}{(1+r)} + \phi Z_{gt}^{+} + \omega_{it} Z_{it} - (wH + \$CT) \right)
\end{aligned}
\tag{7}
$$

The FOCs are:

$$
\begin{aligned}
&\partial L/\partial c_t = u'(c_t) - \lambda = 0; \\
&\partial L/\partial c_{t+1} = \beta\ u'(c_{t+1}) - \lambda \frac{1}{(1+r)} = 0; \\
&\partial L/\partial Z_{gt} = \beta\alpha\ u'(\theta Z_{gt}^{\rho} + (1-\theta)\ Z_{it}^{\rho})^{(1/\rho)}) \frac{(\theta Z_{gt}^{\rho} + (1-\theta)\ Z_{it}^{\rho})^{(1/\rho)})\theta\ Z_{gt}^{\rho}}{Z_{gt}(\theta Z_{gt}^{\rho} + (1-\theta)\ Z_{it}^{\rho}))} - \lambda\phi = 0; \\
&\partial L/\partial Z_{it} = \beta\alpha\ u'(\theta Z_{gt}^{\rho} + (1-\theta)\ Z_{it}^{\rho})^{(1/\rho)}) \frac{(\theta Z_{gt}^{\rho} + (1-\theta)\ Z_{it}^{\rho})^{(1/\rho)})(1-\theta)\ Z_{it}^{\rho}}{Z_{it}(\theta Z_{gt}^{\rho} + (1-\theta)\ Z_{it}^{\rho}))} - \lambda\omega_{it} = 0; \\
&\partial L/\partial \lambda = wH + \$CT - c_t - \frac{c_{t+1}}{(1+r)} - \phi Z_{gt} - \omega_{it} Z_{it} = 0.
\end{aligned}
\tag{8}
$$

In the CES human capital production function, the elasticity of substitution σ determines the degree of complementarity and substitutability between Z_{gt} and Z_{it}, where $\sigma = \frac{1}{1-\rho}$. According to the L'Hôpital rule, as $\rho \to -\infty$, $\sigma \to 0$. The CES human capital production function approaches the Leontief function, $u(\min(Z_{gt}, Z_{it}))$ and $Z_{it}^* = Z_{gt}^*$. As $\rho \to 1$, $\sigma \to \infty$, Z_{gt} and Z_{it} are CES perfect substitutes, $u((\theta)Z_{gt} + (1-\theta)Z_{it})$. In this case, the conditionalities of a CCT on Z_{gt} could lead households to decrease their demand for Z_{it}. If $-\infty < \rho < 1$, Z_{gt} and Z_{it} are complements and we can derive the optimal ratio of Z_{it} to Z_{gt}. In this case the first-order conditions are necessary and sufficient for an interior solution given concavity of the technology in terms of Z_{it} to Z_{gt}.[35] From the FOCs in (8), we solve $\partial L/\partial Z_{it}$ and $\partial L/\partial Z_{gt}$ for λ, then we take the ratio of $\frac{Z_{it}}{Z_{gt}}$ and solve for Z_{it}:

$$
Z_{it} = \left(\frac{(1-\theta)\phi}{\theta\omega_{it}} \right)^{\sigma} Z_{gt} \tag{9}
$$

By using the FOCs in (8) to solve $\partial L/\partial Z_{it}$ and $\partial L/\partial c_t$ for λ, we obtain equation (10). A similar

[35] This approach is similar to Heckman and Cunha [2007] for dynamic complementarity between I_t *and* I_{t+1}.

approach is taken with respect to $\partial L/\partial Z_{it}$ and $\partial L/\partial c_{t+1}$ and results in equation (11).

$$u'(c_t) = \beta\alpha\ u'\left(Z_{it}^{\rho}\left(\theta\left(\frac{\theta\omega_{it}}{(1-\theta)\phi}\right)^{\sigma}\right)+1-\theta\right)^{\frac{1}{\rho}}\frac{\left(Z_{it}^{\rho}\left(\theta\left(\frac{\theta\omega_{it}}{(1-\theta)\phi}\right)^{\sigma}\right)+1-\theta\right)^{\frac{1-\rho}{\rho}}}{\omega_{it}Z_{it}^{1-\rho}} \tag{10}$$

$$u'(c_{t+1}) = (1+r)\ \alpha\ u'\left(Z_{it}^{\rho}\left(\theta\left(\frac{\theta\omega_{it}}{(1-\theta)\phi}\right)^{\sigma}\right)+1-\theta\right)^{\frac{1}{\rho}}\frac{\left(Z_{it}^{\rho}\left(\theta\left(\frac{\theta\omega_{it}}{(1-\theta)\phi}\right)^{\sigma}\right)+1-\theta\right)^{\frac{1-\rho}{\rho}}}{\omega_{it}Z_{it}^{1-\rho}} \tag{11}$$

If we specify a functional form to $u(.)$, solve equations (10) and (11) for c_t and c_{t+1}, by substitution, we obtain a solution for Z_{it} which is informative of its determinants (eq. 12).[36] We observe that $\alpha,\ \beta,\ \rho,\ \theta,\ \omega_{it}$ *and* ϕ affect the demand for Z_{it} through contemporaneous consumption (c_t), while $\alpha,\ \rho,\ \theta,\ \omega_{it}$ *and* ϕ play a similar role through determining future consumption (c_{t+1}).[37]

$$Z_{it} = \frac{wH + \$CT - c_t^*(\alpha,\beta,\rho,\theta,\omega_{it},\phi) - \frac{c_{t+1}^*(\alpha,\rho,\theta,\omega_{it},\phi)}{(1+r)}}{\phi^{1-\sigma}\left(\frac{\theta\omega_{it}}{(1-\theta)}\right)^{\sigma}+\omega_{it}} \tag{12}$$

To summarize, equation (9) shows that the degree of complementarity or substitutability between Z_{it} and Z_{gt} is driven by the elasticity of substitution σ which determines how changes in relative prices ϕ and ω_{it} impact the demand for Z_{it}. CCT programs affect the relative price or cost of using governmental services. The CCT can be interpreted as a subsidy to the cost of accessing the governmental service Z_{it} whereby the cost of using governmental services (transport cost, opportunity cost of time) may be more than offset by the cash transfer. In analog, the availability of a cash transfer conditional on the usage of government services increases the opportunity cost of not using the respective services.

If $\sigma \to 1$, then $\phi^{1-\sigma} \to 1$, the production function approaches a Cobb-Douglas and changes in ϕ do not affect Z_{it} directly.[38] If $0 < \sigma < 1$, there will be complementarity between Z_{it} and Z_{gt} with respect to changes in ϕ relative to ω_{it}. If $\sigma > 1$, the cross-price elasticity of Z_{it} with respect to ϕ will be positive, which means that Z_{it} and Z_{gt} will be substitutes with respect to

[36] In section (8.4) of the appendix, to provide an example, we specify one possible functional form for the utility function and solve for the optimal choice of the investments Z_{it}.

[37] The effect of changes in relative prices on Z_{it}, including the interest rate (r), will depend on the functional form of the utility function $u(.)$. For example if a Cobb-Douglas utility function is specified, then Z_{it} does not depend directly on r, neither on ϕ. For further details, see section (8.4) of the appendix.

[38] The income effect compensates the substitute effect. This means that, in equation 9 if $\sigma \to 1$ changes in ϕ are compensated by changes in opposite direction of Z_{it}.

changes in their relative prices. Based on equations (10), (11) and (12), the determinants of Z_{it}^* can be written as follows:

$$Z_{it}^* = j(\alpha, \beta, r, \theta, \omega_{it}, \phi, \rho, wH, \$CT) \tag{13}$$

The optimal choice of Z_{it}^* depends on the household's preferences (α, β), Z_{it}^*'s price (ω_{it}), the opportunity cost (ϕ) of using the service Z_{gt}, income through labor and transfers $(wH + \$CT)$, properties of the investment function (θ, ρ) and the interest rate (r).[39]

Equations 12 and 13 help us to formulate the following hypotheses with respect to the three channels through which CCT participation might impact household expenditure decisions: income (\$CT), household preferences $(\alpha, \beta, \rho, \theta)$ and the imposition of the conditionality.

The first obvious candidate variable to explain changes in expenditure choices is income. Given parents' preferences[40], the additional amount of cash \$CT provided by the program may increase the expenditures in goods/services related to child human capital accumulation. Assuming an unitary household decision and exogenous preferences, we may expect that the effect of a CCT is similar to an expansion of the household income by the same amount. This reasoning leads to our null hypothesis.[41]

- **Proposition 1 (pure income effect)**: If the impact of CCT participation on the household's expenditure on good or service i unfolds only through the cash transfer, then eq. 14 should be satisfied.

$$\frac{\partial Z_{it}}{\partial CCT} = \frac{\partial Z_{it}}{\partial \$CT} \text{ for any } i=1,...,n \tag{14}$$

whereby CCT signifies participation in the conditional cash transfer program ("treatment") and \$CT is the amount of cash transfer by the CCT program.

A second potential channel concerns gender-specific differences in preferences together with a change in bargaining power. CCTs target women in receiving the cash transfer; this could lead to changes in intra-household bargaining power (see Thomas [1990] and Udry [1996]) in favor of

[39] As described in the text, the choice of Z_{it}^* also depends on the functional form of the utility function. We do not specify a functional form for the utility function in this section to avoid the imposition of properties that are inconsistent with the estimation of a demand system (see discussion in section (5), for which some goods may have a negative parameters with respect to income. In section 8.4 of the appendix, we assumed a logarithmic Cobb-Douglas utility function for which the expenditure shares on c_t, c_{t+1} and $I(Z_{gt} + Z_{it})$ are constant. In this case, the demand for Z_{it} will not directly depend on the interest rate (r).

[40] Jensen [2010] shows that perception of parents concerning the returns to education matters for their decision about investments in schooling.

[41] In this hypothesis, we also assume that the conditionality do not affect household expenditure choices other than through imposing $Z_{gt} \geq Z_{ct}$ and there is no change in parents' perception of the return on human capital. It is assumed that Z_{gt} is independent from other inputs $Z_{1t}, Z_{2t}, ..., Z_{it}$ to human capital production.

women. Attanasio et al. [2011] have suggested that this gender channel may explain changes in household expenditure decision making under CCTs.

For this gender mechanism to be effective, two necessary conditions must be satisfied: i) Preferences towards household expenditures, including investments in child human capital, are systematically different between men and women;[42] ii) The cash transferred to women is sufficient to change intra-household bargaining power in her favor. If these conditions are satisfied, different preferences between men and women together with increased female bargaining power may result in changed household choices. If the first condition (i) is not satisfied, we would not expect changes in household expenditure behavior even if the power relation within the household was changed. Therefore, our second hypothesis to be tested is the following:

- **Proposition 2 (Intra-household bargaining power change)**: If distributing cash to women increases their intra-household bargaining power, this would lead to changes in household expenditure choices towards goods and services related to child health and education if, and only if, women's preferences are different from men's preferences with respect to these goods. We test the following necessary, but not sufficient condition.

$$\frac{\partial Z_{it}}{\partial M_{hh}^{f}} = \frac{\partial Z_{it}}{\partial M_{hh}^{m}} \text{ for any } i=1,...,n \tag{15}$$

Where $M_{hh} = wH$ is household income, hh^f is an index for female-headed households and hh^m is an index for male-headed households.

Last, but not least, a third channel is related to the household's perception of how human capital is produced (whether inputs are independent, complements or substitutes to the conditionalities). We assume that households comply with the CCT conditionalities as long as the opportunity cost of sending their children to school and demanding the health services (including transport cost) is lower than the expected utility of the transfer and the services, which we assume henceforth. The household's budget constraint changes due to the transfer $\$CT > 0$. A priori, we would expect that the household increases its expenditure on investments in child health and education due to the increase in its budget, assuming that those investments are not regarded an inferior good.

If a CCT program obliges parents to choose a level of $Z_{gt} \geq Z_{ct}$, assuming this level is higher than chosen otherwise, this may translate into increased levels of investment in other inputs Z_{it} to human capital production. Equation (9) shows that if $0 \leq \sigma < \infty$; $0 < \theta < 1$; $\omega_{it} > 0$ and

[42] In this case, the unitary household assumption would not hold.

$\phi > 0$ such an effect may arise and its strength will depend on the value of σ and the functional form of the utility function.[43] Then, this increase in complementary inputs to child human capital production could operate through the following mechanism: If an input Z_{it} is perceived as complementary to Z_{gt} in human capital production, the choice of $Z_{gt} \geq Z_{ct}$ would increase the marginal utility from investments in the input Z_{it} of the human capital production function and parents may choose to increase their investment in child human capital at the expense of contemporaneous and future consumption.

To fix ideas, we illustrate this situation with an example on Z_{it}. Let's assume that there are two inputs (e.g. public school attendance (Z_{gt}) and school materials such as notebooks and textbooks (Z_{it})). It seems reasonable to expect some complementary relationship among them. It means that, if children start to attend school, from the demand side we could expect that parents may increase their expenditures on school materials, i.e. the fact that children attend school increases the payoff to the investment in school materials. Therefore, our third hypothesis to be tested is the following:

- **Proposition 3 (Complementary investments in child human capital)**: If the imposition of the conditionality leads to an increase in the usage of governmental services Z_{gt}, and parents perceive Z_{gt} and private inputs Z_{it} as complements ($0 < \sigma < 1$), we expect to observe an increase in the demand for Z_{it} – beyond a pure income effect.

$$\frac{\partial Z_{it}}{\partial CCT} > \frac{\partial Z_{it}}{\partial \$CT} \text{ for any } i=1,...,n \tag{16}$$

This channel is not completely independent from the previous one (intra-household bargaining power), because household's perception of the complementarity of inputs to human capital production could be impacted by increased women's bargaining power. However, if we reject the hypothesis of a pure income effect and do not reject the unitary household assumption, the above-described mechanism of complementary investments may be a candidate explanation for the households' choices under CCTs.

[43] We show in appendix (section 8.4) that under a strong assumption that the functional form of utility and human capital production functions have the properties of a Cobb Douglas, which is a particular case of a CES, then the demand for Z_{it} may not depend directly on Z_{gt}.

4 Data and descriptive statistics: Bolsa Família and POF

4.1 Bolsa Família Program

The Bolsa Família Program[44] (BFP) officially started in October 2003 and is regulated by a federal law since 9^{th} of January of 2004.[45] This law determines its eligibility rules, amount of transfer and other operational details.[46] The program resulted from an attempt to unify previous programs that were already in place on the federal level since 2001.[47] Among these programs, 'Bolsa Escola', a cash transfer conditional on school attendance, was closest in design to BFP. Lindert et al. [2007] and Soares [2012] provide a chronological review of social protection mechanisms in Brazil and detailed information about how BFP works.

The program consists of a cash transfer provided by the federal government to households with an income per capita below the poverty line. Eligibility is based on a combination of criteria including monthly income per household member, which may not exceed R$ 120[48], and the number of children in specific age brackets which are part of the household.[49] Households with an income per capita below the cut-off point receive an additional R$ 20 for each child up to 15 years of age and an additional R$ 30 for each child of 16 to 17 years of age. The amount of transfer is capped at three children[50] up to the age of 15 and two teenagers, families with more children do not receive more transfers. Households with a per capita income of less than R$ 60 qualify for the base transfer even if they do not have children.[51] To receive the transfer, beneficiary households are required to comply with the following conditionalities with respect to health and education.

- Health: a) immunization cards of children under seven years of age are up to date; b) Health service check ups for children under seven years of age; c) health service check ups for women aged 14 to 44 years and, if pregnant or lactating (breastfeeding) should carry out pre- and postnatal check-ups.

[44] 'Medida Provisória', n.132, October 20, 2003.
[45] Law n. 10,836, January 09, 2004.
[46] See section 8.1 for further details.
[47] 'Bolsa Escola' (11 April 2001); National Program for Food Access PNAA (13 of June 13 2003); Bolsa Alimentacao' / Food Stamp (6 September 2001); 'Programa Auxílio-Gás'/Gas stamp (24 January 2002) and the Federal Government Unified Registration (24 July 2001),
[48] The average exchange rate between 2007 and 2008 of US Dollar against Real was about US$ 1.00 = R$ 1.90.
[49] These values correspond to the period in which POF 2008-2009 survey was conducted. The current values are R$ 140 and R$ 70 for the poverty line and extreme poverty line respectively. Updated information on current values is available on the website of the Brazilian Ministry of Social Development (www.mds.gov.br).
[50] This cap on benefits was changed to 5 children by Law n. 12.512 of 2011.
[51] We are following the eligibility rule according to Brazilian Decree-Law n. 5,749 from 11 April 2006, law n. 11,692 from 10 June 2008 and the Decree-Law n. 6,491 from 26 June 2008. These rules were in vigor in the period of the survey and a summary of them are available on 8.1. The current values of eligibility and cash transfer are available on www.planalto.gov.br.

- Education: a) Children and teenagers between 6 and 15 must be enrolled in school and attend classes at least 85% of the time; b) Students between 16 and 17 must attend school with a frequency of at least 75%.

In cases where the households have children and adolescents at risk of or removed from child labor by the Program to Eradicate Child Labor (PETI), they must attend a special service provided by PETI and obtain the minimum frequency of 85% on a monthly basis. In the event of non-compliance, additional services are provided to these families to support them to meet the requirements; however, in the case of continued non-compliance, they may have the benefit of the Bolsa Família suspended or canceled.

Table 2 shows the number of BFP beneficiaries according to regions in Brazil. The number of beneficiaries increased from 6.57 million households in 2004 to 13.35 million households in 2011. The average number of members in households that received the program between 2008 and 2009 was 4.65 (median 4.00), and the average number of children and teenagers in these households was 2.25 (median 2.00).[52] This means that in 2009, approximately 57.5 million individuals, including almost 27.8 million children benefited from the transfers.

Region	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
North	528	698	1,024	1,082	1,076	1,286	1,348	1,477
Northeast	3,320	4,246	5,443	5,574	5,445	6,208	6,455	6,826
Southeast	1,731	2,325	2,876	2,848	2,637	3,105	3,186	3,296
South	701	987	1,027	956	854	1,096	1,064	1,036
Center-West	292	445	597	584	546	677	725	718
Total	6,572	8,700	10,966	11,043	10,558	12,371	12,778	13,352

Table 2: Number of BFP beneficiaries by region (in thousand of households)
Source: Ministry of Social Development (2012). The number of beneficiaries and the amount of transfer by state are available in section 8.1 of the appendix.

Table 3 shows that the amount of transfer to the households grew from R$ 834 million in 2004 (in values of 2011) to R$ 1.6 billion in 2011. This increase of 92% in real terms is mainly explained by the rise in the number of beneficiaries (103% in this period).

Graph 1 shows the share of total BFP transfers to GDP[53] (left side) and the share of treated households by region (right side). Besides illustrating the relevance of BFP, graph 1 also provides information on the regional heterogeneity in Brazil, which is complemented by graph 2 that shows differences among regions in terms of population distribution, GDP and GDP per capita.

[52] According to the POF 2008-2009.
[53] The period up to 2009 is constrained by the information available for regional GDP.

Region	2004	2005	2006	2007	2008	2009	2010	2011
North	71.6	75.0	96.9	111.6	120.5	154.2	155.1	198.4
Northeast	444.8	446.7	495.7	549.1	574.0	696.5	690.0	823.7
Southeast	204.8	215.6	228.2	244.7	243.7	304.5	305.5	379.2
South	79.8	87.7	80.2	81.0	78.0	103.5	100.1	118.1
Center-West	33.3	39.1	45.6	49.2	49.8	65.9	68.9	82.7
Total	834.3	864.1	946.6	1,035.6	1,065.9	1,324.5	1,319.6	1,602.1

Table 3: Amount of transfer from BFP by region (in million of R$ of 2011)

Source: Ministry of Social Development (2012). Values in R$ of 2011 based on IPCA (Portuguese acronym for Extended National Consumer Price Index elaborated IBGE). This is the official inflation index used by the Central Bank for inflation targeting. The average nominal exchange rate in 2011 was R$ 1.00 = US$ 0.59.

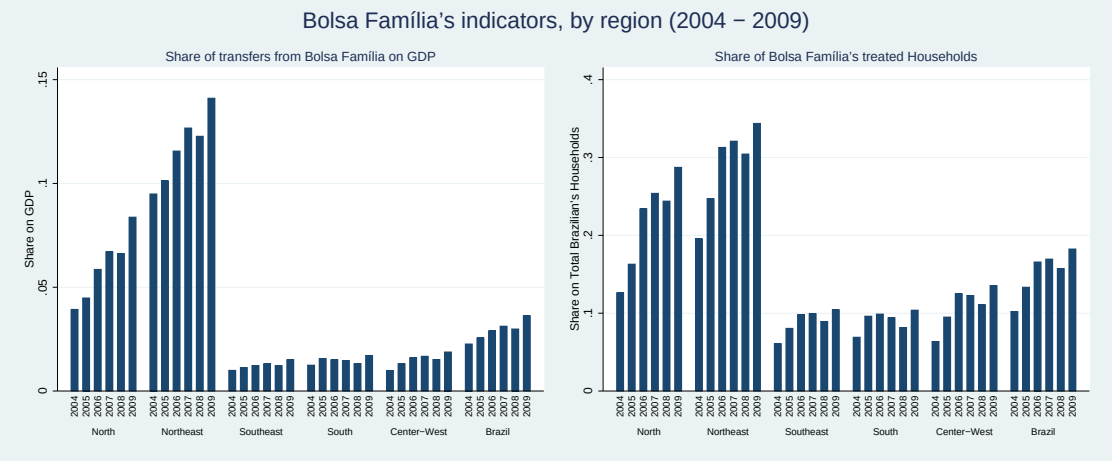

Figure 1: Bolsa Família beneficiaries and transfers, by region (2004 - 2009)

Source: Ministry of Social Development (2012) for total number of BFP's beneficiaries and total amount of transfer; IBGE (2012) for total population and GDP.

It is noticeable that the Southeast, South and Center-West regions are relatively more homogeneous in terms of GDP per capita, amount of BFP's transfers received and share of treated households. The North and Northeast regions' GDP per capita are dramatically lower, these regions receive a larger amount of transfers proportional to their GDP and have a larger share of treated households. The Northeast is the second most populous region with approximately 53.5 million people, which represents almost 28% of the Brazilian population.[54] Section 8.6 in the appendix provides further descriptives on regional heterogeneity in Brazil.

[54]This further illustrates the importance of BFP; BFP plays a significant role in the public discourse and elections (See Bohn [2011] and Zucco [2011].

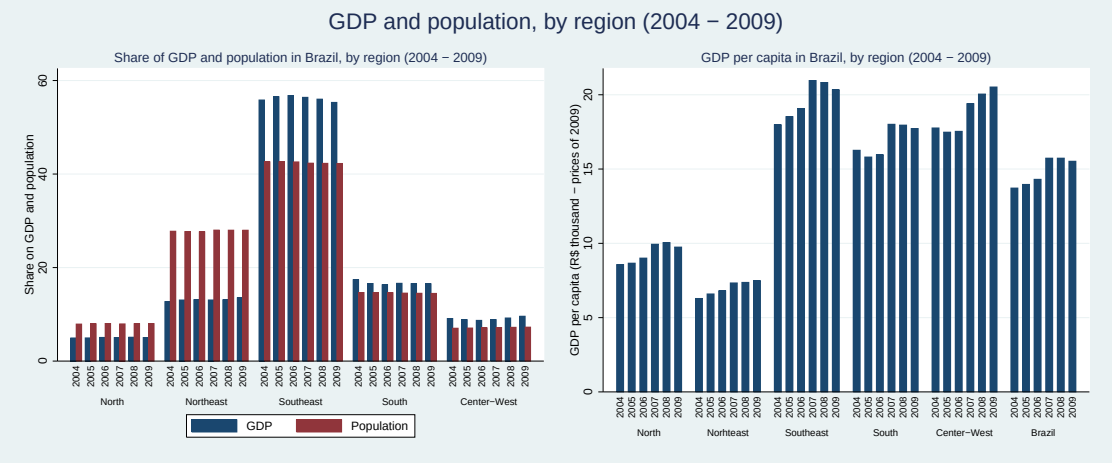

Figure 2: Distribution of GDP and population in Brazil, by region (2004-2009)
Source: IBGE (2012).

4.2 The data set

To investigate households' investment behaviors in child human capital, we rely on the Brazilian Household Expenditure Survey (Pesquisa de Orçamento Familiar - POF) conducted between 2008 and 2009 by the Brazilian Institute of Geography and Statistics (IBGE, acronym in Portuguese). POF 2008-2009 is the fifth survey conducted by IBGE on household expenditures. Previous surveys included ENDEF 1974-1975, POF 1987-1988, POF 1995-1996 and POF 2002-2003. Primarily, these surveys were designed to update the consumption patterns used as a reference for the consumer price index produced by IBGE, but after 2000, POF has also been used as an important survey to evaluate the living conditions of Brazilian households. POF 2008-2009's sample allows us to make inferences about the entire Brazilian territory.

The POF 2008-2009 survey was conducted according to seven different questionnaires. Of these, we used POF1 (Characteristics of the house and its respective dwellers); POF2 (household common assets); POF3 (Collective expenditure by household); POF4 (Individual expenditure) and POF5 (Individual work and income). The data was collected between 19 May 2008 and 18 of May 2009. The sample covers 190,159 individuals, 93,175 men and 96,984 women. Each surveyed individual has an identifier composed of 11 digits that allows us to identify their residence, household and geographical location, composed of 550 strata. Each of the households that were surveyed was visited by an interviewer on nine consecutive days. In addition to the detailed data about income and expenditure this survey also allows us to identify the households which participated in social programs, including the 'Bolsa Família' Program (BFP).

In line with BFP's design, we use the household level as reference unit. Therefore, our first

step was to aggregate the information from individual to household level and merge POF1, POF2, POF3, POF4 and POF5. This procedure resulted in 56,091 observations at the household level of which only 5 households had per capita income equal to zero[55]. From this, we identified 9,263 treated households. After analyzing household incomes per capita we observed some outliers, households classified as beneficiaries with incomes per capita much larger than the overall average income (R$ 828.29). We excluded 114 observations[56] of treated households (1.2% of total treated households) with incomes per capita above R$ 1,000. The resulting data set contains information on 55,976 households (9,149 BFP's beneficiaries and 46,827 non-beneficiaries).

To check whether our sample is representative, we compared it with the total share of BFP's treated and the amount of transfer by region available in Figure 1. The data are consistent with our sample on POF 2008-2009, for which 16.3% of total households (Brazil) are treated and the regional distribution follows a similar pattern: 22.0% (North), 27.9% (Northeast); 7.8% (Southeast); 5.6% (South), 7.6% (Center-West).[57]

4.3 Descriptive statistics

Before going into the analysis, it is informative to consider some descriptive statistics. Figure 3 provides a general overview of the expenditure composition of treated and untreated households. It is noticeable that most of the beneficiaries' expenditures are concentrated on essential goods such as food, housing, hygiene and transport. Moreover, if we compare the difference in expenditure share between treated and untreated households, there are three groups of goods for which the difference is large: food, transport and education. The expenditure share on food is almost twice as large for BFP beneficiaries, while their expenditure share on transport and education is approximately half of the share spent by non-beneficiaries.

[55]The observations with an income per capita equal to zero were excluded from the sample.

[56]In a previous version of the essay we used the full number of observations without dropping outliers: and the results - available upon request - remained unchanged.

[57]Without dropping 114 observations we have the following distribution of treated households: 16.51% (Brazil), 22.5% (North), 28.09% (Northeast); 7.90% (Southeast); 5.76% (South), 7.78% (Center-West)

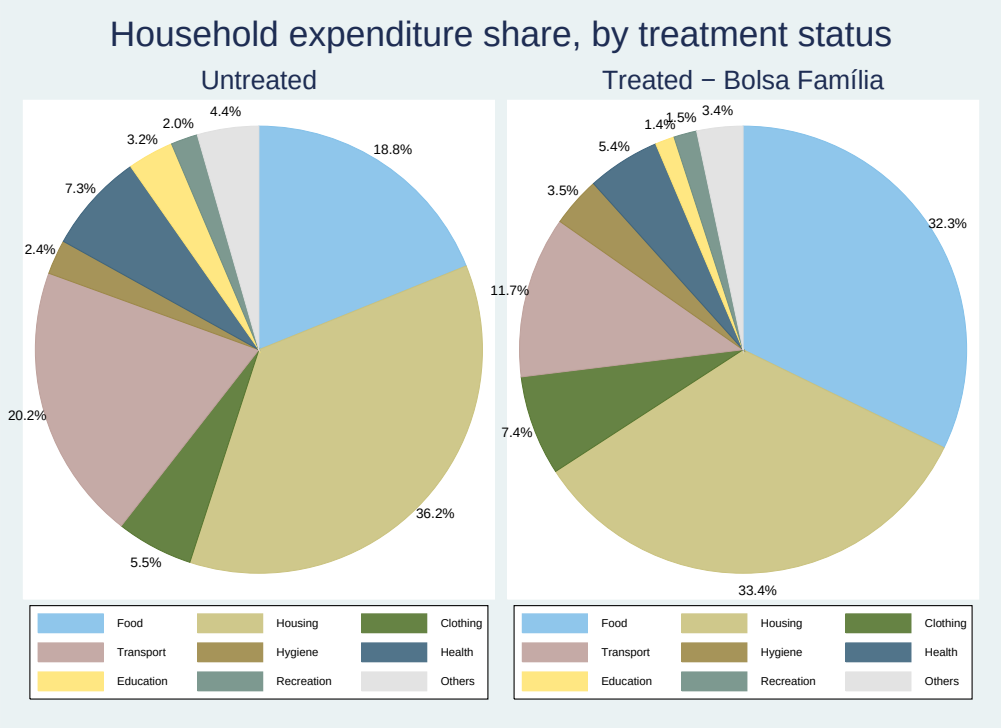

Figure 3: Household expenditure shares, by treatment status

Tables 4 and 5 show the number of observations (n), the mean, the standard deviation (sd), the minimum, the maximum (max) and the median (med) for some critical variables used in the model, including expenditures, amount of transfer and size of families according to treatment status (Bolsa Família= 1 for treated and Bolsa Família= 0 for untreated)[58].

The distribution of all variables is skewed. This is especially pronounced for the expenditure and income variables. Most interviewed persons report very low or no expenditures while few report high expenditures. Also, according to Table 4, which considers the absolute values of expenditure, the mean and the median for untreated households are larger than BFP's beneficiaries for all groups of goods.

The median amount of transfer from BFP is R$ 83.6 (mean R$ 84), which represents almost 20% of median labor income for these families. In per capita terms, they received about R$ 20.00 a month. As for the number of members, treated households are significantly larger than untreated (4.65 members on average against 3.09).

When we consider ethnicity, we notice that the number of self-declared white members are much larger among untreated households, while the number of self-declared blacks and 'pardos' are almost double among BFP's beneficiaries.

[58]The information about eligibility criteria and conditionalities of Bolsa Família Program is available in section 8.1 of the appendix

	Untreated (Bolsa Familia=0)						Treated (Bolsa Familia=1)					
Expenditure	**N**	**mean**	**sd**	**min**	**max**	**p50**	**N**	**mean**	**sd**	**min**	**max**	**p50**
01 Food	46,690	431.1	457.5	0.0	17,008	301.6	9,135	318.3	305.5	0.0	13,787	246.7
02 Housing	46,827	828.8	1,012.5	0.0	33,025	563.8	9,149	327.6	259.1	0.0	3,363	263.5
03 Clothing	46,491	127.0	196.9	0.0	4,429	66.0	9,104	73.4	92.8	0.0	1,662	44.5
04 Transport	46,498	464.5	1,003.5	0.0	31,126	141.0	9,104	115.1	254.8	0.0	5,309	34.7
05 Hygiene	46,691	54.3	84.1	0.0	1,411	23.9	9,135	34.6	49.0	0.0	532	16.8
06 Health	46,491	169.2	419.4	0.0	25,996	62.8	9,104	53.1	84.2	0.0	2,086	23.2
07 Education	46,491	72.8	241.4	0.0	6,665	0.4	9,104	13.8	35.2	0.0	1,199	4.0
08 Recreation	46,604	47.0	106.8	0.0	3,188	11.7	9,120	15.1	30.9	0.0	854	2.8
09 Smoking	46,491	12.2	37.4	0.0	867	0.0	9,104	8.0	22.5	0.0	475	0.0
10 Personal Services	46,491	26.2	48.6	0.0	2,003	10.3	9,104	8.6	14.9	0.0	249	4.1
10 Miscellaneous	46,646	62.7	233.8	0.0	11,654	4.7	9,127	16.6	62.9	0.0	2,427	0.2
12 Others	46,821	321.2	932.9	0.0	34,133	84.2	9,149	37.9	83.2	0.0	1,774	5.1
13 Increasing Assets	46,646	170.2	1,348.9	0.0	74,200	0.0	9,127	30.4	145.6	0.0	3,156	0.0
14 Decreasing Liabilities	46,570	60.5	322.4	0.0	17,500	0.0	9,114	14.8	59.1	0.0	1,913	0.0
Income												
01 Labor	46,750	1,855.8	3,140.8	0.0	112,515.0	1,001.7	9,149	558.4	557.0	0.0	6,965.2	434.1
02 Transfers	46,750	556.2	1,589.1	0.0	47,030.9	0.0	9,149	209.1	266.7	1.3	4,662.0	110.9
03 Rental	46,750	53.0	759.8	0.0	71,229.2	0.0	9,149	3.6	54.4	0.0	1,800.0	0.0
04 Other	46,750	46.1	333.8	0.0	24,400.0	0.0	9,149	9.7	87.3	0.0	2,566.7	0.0
Per capita Income	46,827	1,170.3	1,998.1	0.0	87,430.8	655.9	9,149	236.1	158.9	10.2	998.9	196.6
Income without BFP	46,827	1,170.3	1,998.1	0.0	87,430.8	655.9	9,149	216.1	159.0	0.0	989.7	177.9
Transfers												
01 Bolsa Família (BFP)	46,827	0.0	0.0	0.0	0.0	0.0	9,149	84.0	38.4	0.9	517.1	83.6
Bolsa Família (per capita)	46,827	0.0	0.0	0.0	0.0	0.0	9,149	19.9	11.2	0.3	153.5	20.0
02 Loas	46,827	8.1	61.2	0.0	2,000.0	0.0	9,149	9.6	63.7	0.0	867.4	0.0
03 Child Labor Err.	46,827	0.0	1.4	0.0	144.2	0.0	9,149	0.1	2.4	0.0	187.2	0.0
04 Bolsa Escola	46,827	0.2	3.9	0.0	415.0	0.0	9,149	0.3	6.2	0.0	465.0	0.0
05 Min. Income Prog.	46,827	0.1	4.4	0.0	980.1	0.0	9,149	0.6	8.5	0.0	254.8	0.0
Number of household members												
Total	46,827	3.09	1.51	1	18	3	9,149	4.66	1.85	1	20	4
Male	46,827	1.50	1.02	0	10	1	9,149	2.29	1.32	0	12	2
Female	46,827	1.59	0.99	0	11	1	9,149	2.37	1.24	0	9	2
Children and Teenager	46,827	0.81	1.04	0	11	0	9,149	2.27	1.49	0	12	2
Age 0-5 (male)	46,827	0.13	0.37	0	4	0	9,149	0.29	0.55	0	4	0
Age 0-5 (female)	46,827	0.12	0.36	0	4	0	9,149	0.27	0.54	0	5	0
Age 06-15 (male)	46,827	0.24	0.53	0	6	0	9,149	0.76	0.89	0	6	1
Age 06-15 (female)	46,827	0.23	0.51	0	5	0	9,149	0.72	0.86	0	7	1
Age 16-17 (male)	46,827	0.05	0.23	0	3	0	9,149	0.12	0.35	0	3	0
Age 16-17 (female)	46,827	0.05	0.22	0	2	0	9,149	0.11	0.32	0	2	0
Seniors (male)	46,827	1.09	0.73	0	8	1	9,149	1.12	0.77	0	7	1
Seniors (female)	46,827	1.19	0.68	0	7	1	9,149	1.28	0.62	0	7	1
Pregnancy												
Age 10-15	46,827	0.00	0.03	0	1	0	9,149	0.00	0.05	0	1	0
Age 16-17	46,827	0.00	0.03	0	1	0	9,149	0.00	0.05	0	1	0
Age 10-17	46,827	0.00	0.04	0	1	0	9,149	0.00	0.07	0	1	0
Age 18-25	46,827	0.01	0.10	0	2	0	9,149	0.02	0.13	0	3	0
Adult $>$ 26	46,827	0.01	0.12	0	2	0	9,149	0.02	0.15	0	3	0
Ethnicity												
White	46,827	1.62	1.55	0	10	1	9,149	1.21	1.60	0	13	1
Black	46,827	0.23	0.74	0	18	0	9,149	0.43	1.15	0	13	0
Asian	46,827	0.02	0.20	0	5	0	9,149	0.02	0.22	0	6	0
Pardo	46,827	1.20	1.54	0	15	1	9,149	2.96	2.21	0	16	3
Indigenous	46,827	0.01	0.19	0	15	0	9,149	0.02	0.32	0	12	0
Reference Person												
Woman	46,827	0.31	0.46	0	1	0	9,149	0.30	0.46	0	1	0
White	46,827	0.53	0.50	0	1	1	9,149	0.26	0.44	0	1	0
Black	46,827	0.09	0.28	0	1	0	9,149	0.11	0.31	0	1	0
Asian	46,827	0.01	0.08	0	1	0	9,149	0.00	0.06	0	1	0
Pardo	46,827	0.37	0.48	0	1	0	9,149	0.62	0.49	0	1	1
Indigenous	46,827	0.00	0.06	0	1	0	9,149	0.01	0.08	0	1	0
Illiterate	46,827	0.35	0.48	0	1	0	9,149	0.68	0.46	0	1	1

Table 4: Descriptive statistics (expenditure, income and demography)

Table 5 shows descriptive statistics for some critical variables in our essay. First, with respect to school enrolment[59] for children between six and 15 years old (this is one of the groups targeted

[59]The question on POF 1 is the following: What course do you attend? Although this question refers to school attendance, it does not provide any information on frequency. For this reason we interpret the answer as a better proxy for school enrolment than school attendance.

	Untreated (Bolsa Familia=0)						Treated (Bolsa Familia=1)					
	N	mean	sd	min	max	p50	N	mean	sd	min	max	p50
School Enrolment (share)												
Children / Teenager	23,710	0.77	0.38	0	1	1	8,357	0.82	0.29	0	1	1
Age 06-17	18,184	0.94	0.21	0	1	1	7,447	0.95	0.17	0	1	1
Age 00-03	7,310	0.20	0.39	0	1	0	2,606	0.16	0.35	0	1	0
Age 04-05	4,092	0.74	0.44	0	1	1	1,936	0.75	0.43	0	1	1
Age 06-15	15,734	0.97	0.15	0	1	1	6,993	0.98	0.12	0	1	1
Age 06-09	7,781	0.98	0.14	0	1	1	4,028	0.98	0.14	0	1	1
Age 10-15	10,733	0.97	0.16	0	1	1	5,233	0.98	0.14	0	1	1
Age 16-17	4,541	0.82	0.38	0	1	1	1,952	0.80	0.39	0	1	1
Age 18-25	15,981	0.31	0.44	0	1	0	3,541	0.28	0.42	0	1	0
Child labor (share)												
Age 06-17	15,734	0.05	0.19	0	1	0	6,993	0.08	0.24	0	1	0
Age 16-17	23,710	0.06	0.22	0	1	0	8,357	0.10	0.24	0	1	0
Health Service Constraint												
Service (household-number)	46,827	0.27	0.61	0	9	0	9,149	0.68	0.96	0	11	0
Pharmaceutical (household-number)	46,827	0.25	0.58	0	9	0	9,149	0.70	0.93	0	7	0
Service (children-number)	23,710	0.02	0.17	0	4	0	8,357	0.08	0.35	0	5	0
Pharmaceutical (children-number)	23,710	0.02	0.15	0	5	0	8,357	0.07	0.32	0	4	0
Service (household-share)	46,827	0.10	0.23	0	1	0	9,149	0.16	0.22	0	1	0
Pharmaceutical (household-share)	46,827	0.09	0.22	0	1	0	9,149	0.16	0.22	0	1	0
Service (children-share)	23,710	0.01	0.10	0	1	0	8,357	0.03	0.15	0	1	0
Pharmaceutical (children-share)	23,710	0.01	0.08	0	1	0	8,357	0.03	0.14	0	1	0
Health Insurance (share)												
Total	46,827	0.32	0.43	0	1	0	9,149	0.05	0.19	0	1	0
Female	42,758	0.33	0.45	0	1	0	9,087	0.05	0.20	0	1	0
Male	41,643	0.30	0.44	0	1	0	8,755	0.05	0.20	0	1	0
Age 06-15	15,734	0.29	0.45	0	1	0	6,993	0.05	0.22	0	1	0

Table 5: Descriptive statistics (health and education)

by BFPs' conditionality) the mean of the share of children enrolled at school by household is at 77% and 88% for untreated and treated respectively. However, among teenagers (16 and 17 years old) the mean is larger among the untreated households (82% against 80%). Also, the mean of the share of children between 0 and 3 in school is larger among the untreated (20% against 16%).

Table 5 shows that the proportion of individuals in the households that reported a medication or medical services constraint[60] is much larger among the treated (0.68 against 0.27 among the untreated). In the case of access to pharmaceuticals[61] the difference is almost threefold (0.70 among the treated against 0.25 among the untreated). Households which report health service constraints have a higher number of children on average. These differences could be explained by the fact that BFP households have more members. The share of members within the household that reported constraints is also larger among beneficiaries. The difference in the number of households covered by health insurance[62] is large. Only 5% of BFP's beneficiaries are covered by health insurance compared to 33% of the untreated households.

[60]The question on POF 4 is the following: have you needed any health service in the last 90 days but did not use it because of a budgetary constraint?

[61]The question on POF 4 is the following: have you needed any pharmaceutical product in the last 30 days but did not buy it because of a budgetary constraint?

[62]Brazil has a system of universal access to public health care (Sistem Único de saúde) which provides health services to its population free of charge. Since this system covers not only basic services, but also complex and sometimes expensive health treatments, it usually lacks the capacity to provide the services demanded.

When we inspect the relation between the number of children in the eligible age brackets with the mean transfer received by the households (Table 6), we notice that the amounts of transfer received by the households are mostly in line with the allocation rule. Apart from the group without children, the mean transfers are within the bounds of the foreseen transfer.

Child up to 15	Teenager 16 to 17	Mean transfer	Eligible Transfer	Obs.
0	0	69.56	62	3841
1	0	74.2	20-82	2904
2	0	86.53	40-203	2567
3	0	103.16	60-122	1293
0	1	74.3	30-92	481
1	1	84.54	50-112	575
2	1	100.59	70-132	361
3	1	117.42	90-152	183
0	2	77.41	60-122	32
1	2	101.72	80-142	38
2	2	113.4	100-162	24
3	2	124.83	120-182	14
all	all	90.51	20-182	13369

Table 6: Observed BFP transfers by number of children (irrespective of income)

5 Identification strategy and estimation

Based on our conceptual framework, there are three potential mechanisms through which CCT participation can affect household expenditure decisions. We will briefly review them in turn. If we abstract from the conditionalities and assume exogenous preferences of the unitary household, we would expect to see household expenditures adapt to the expansion of the overall household budget. This income effect constitutes the first mechanism.

In the theoretical discussion, we identified two reasons why the impact of the CCT may go beyond the pure income effect. Different preferences of household members together with a change in bargaining power due to the program can affect household choices. If we assume that women have different preferences than men and the cash transfer shifts bargaining power towards women, we would expect changes in household expenditure decisions due to the described gender channel. This second channel has been previously suggested in the literature (e.g. Attanasio et al. [2011]).

Third, by definition, a Conditional Cash Transfer program is more than an unconditional cash transfer; policy makers posit a (positive) effect of the conditionality on overall welfare. Otherwise, conditionalities which are costly to implement and monitor would be ineffective from a public

policy point of view.[63] The importance of building human capital to break intergenerational poverty transmission has been a popular candidate for justifying conditionalities. We abstract from the underlying justification and analyze household behavior in the presence of conditionalities. Based on our theoretical framework, we suggest that the imposition of conditionalities also affects the maximization problem of the unitary household whereby the optimal household choice depends on the household's perception of the human capital production function, i.e. whether the imposed conditions are complements, substitutes or independent of private investments in human capital.

To support our theoretical argument with empirical evidence, we will first attempt to exclude the rival hypotheses. To begin, we estimate the relationship between expenditure shares and income to which we refer from now as Engel curves (ECs).[64] The ECs are informative of the expected household expenditures under the null hypothesis: the impact of CCT participation is identical to an expansion of the household budget by the amount of transfer. In a second step, we run a fuzzy Regression Discontinuity Design specification to estimate the program impact. The comparison to the Engel curves provides us with evidence whether the impact of Bolsa Família goes beyond the predicted impact of a pure cash transfer, which we find is the case. Thirdly, we investigate the possibility that our results are driven by a gender channel and do not find evidence in support of this hypothesis. Finally, we reconsider our theoretical argument and suggest avenues for further research.

5.1 Null hypothesis: Pure income effect

How would household expenditures change due to a cash transfer in the absence of conditionalities?[65] In this case, the effect would reduce to the pure income effect – which can be analyzed with the standard microeconomic toolkit. Starting from an expenditure function with PIGLOG[66] preferences which indicates the minimum cost necessary to achieve a certain level of utility for given prices, Deaton and Muellbauer [1980] have derived an empirical approach to estimating a theory-consistent demand system, the Almost Ideal Demand System (AIDS). The approach provides an arbitrary first-order approximation to any demand system and "satisfies the axioms of choice exactly; it aggregates perfectly over consumers without invoking parallel linear Engel

[63] In this argument, we abstract from political economy rationales for the imposition of conditionalities. If the majority of society believes that it is fair to transfer the money under conditionalities (disregarding evidence of effectiveness), this may provide sufficient incentive for a government to implement such conditionalities to justify the resource allocation into the program or to capture votes at the next election, regardless of actual impact.

[64] Lewbel [2006] review some basic concepts and literature on Engel curves.

[65] Under the assumption that the preferences of the unitary household are exogenous and the cash transfer does not change intra-household bargaining.

[66] Price independent generalized logarithmic preferences.

curves; it has a functional form which is consistent with known household-budget data; it is simple to estimate, largely avoiding the need for non-linear estimation [...]" [Deaton and Muellbauer, 1980, p. 312]. Due to its desirable features, the AIDS system has been widely used in the analysis of expenditure behavior. The classical AIDS takes the form defined in equation 17 where s_i is the share of commodity (i) in total expenditure on goods and services, (m) is total expenditure, p_i is the price of commodity (i) and P is a price index.

To be informative of household behavior under the null hypothesis, we replace total expenditure (m) in the original specification by income per capita (m). This adaptation reflects our interest in how expenditure shares change with increases in income. On the one hand, the adapted specification is not very different from the original specification based on total expenditure; households at the low levels of income have very little ability to save and spend most of their income. On the other hand, the derivation of AIDS/QUAIDS is based on a cost function, as an optimization of minimum expenditure on a given basket using an indirect utility. To dispel doubts, we keep the estimation based on income as our baseline result and provide the results for logarithmic expenditure per capita instrumented by logarithmic income per capita as a robustness check (see section 8.7 of the appendix).[67]

$$s_i = \alpha_i + \sum_{j=1}^{k} \gamma_{ij}\ log(p_j) + \beta_i log\ (\frac{m}{P}) \tag{17}$$

To make this model consistent with utility maximization, three theoretical restrictions have to hold: the adding-up restrictions, homogeneity and symmetry.

$$\begin{gathered} \sum_{i=1}^{n} \alpha_i = 1 \ \ ; \ \ \sum_{i=1}^{n} \gamma_{ij} = 0 \ \ ; \ \ \sum_{i=1}^{n} \beta_i = 0 \\ \sum_{j} \gamma_{ij} = 0 \\ \gamma_{ji} = \gamma_{ij} \end{gathered} \tag{18}$$

If prices are known, equation 17 can be estimated by OLS, equation by equation. This procedure is equivalent to the estimation by maximum likelihood for the system [Deaton and Muellbauer,

[67] An important difference between using total expenditure or income per capita is linked to the assumptions related to savings. Usually the result of an AIDS/QUAIDS system are interpreted as a second stage of a two-stage budgeting, in which the first stage determines the allocation of total consumption across time periods. Therefore, it is assumed that inter-temporal separability between taste shifters for savings or total expenditure and the expenditure of a certain good holds. In order to deal with this issue we instrumented consumption with income, following Banks et al. [1997]. The shapes of the Engel curves using consumption per capita instrumented by income per capita do not show substantial changes to the baseline model, particularly for the linear version. The exception is the quadratic version for health care expenditures. The overall consistency of the results with our baseline estimation suggests that our approach of estimating the Engel curves using income is a reasonable approximation for estimations using total consumption, which are theoretically supported in their functional form in the AIDS and QUAIDS approaches.

1980]. In this case, the adding-up restriction is automatically satisfied.

Banks et al. [1997] have extended this system to a quadratic form (QUAIDS) which then writes as follows:

$$s_i = \alpha_i + \sum_{j=1}^{k} \gamma_{ij}\ log(p_j) + \beta_i log\ (\frac{m}{a(P)}) + \frac{\lambda}{b(P)} \left(log\ \left(\frac{m}{a(P)} \right) \right)^2 \tag{19}$$

To estimate the above equations, we would need detailed information on prices in Brazil which we do not have for all relevant goods. This constitutes an important limitation to our analysis. If prices were uniform in Brazil, this would not be a concern. However, this seems a too strong assumption given the great heterogeneity in living conditions, which vary greatly according to the region of residence (see descriptive statistics). It is important to take this regional heterogeneity into account in our estimations, due to the fact that it might be correlated with important differences on relative prices, particularly for non-tradeables, including health and education services. In addition, this source of heterogeneity could be correlated with unobservables in the quality of the services provided (e.g. public schools and public hospitals), the opportunity cost to access them, household preferences and returns on investment in child human capital.

If the true specification of the empirical model is linear as in equation 17, prices only affect the intercept α. In this case, one possibility to control for regional variation in prices is the inclusion of dummies based on a spatial definition (see also Attanasio et al. [2011]). Indeed, Banks et al. [1997] shows that the linear formulation appears to be a reasonable approximation for the food expenditure share curves if compared with a nonparametric estimation. The same applies for fuel and other goods, apart from alcohol and clothing.

We make use of the sampling strata of the POF survey and include 549 regional dummies, which are defined on the basis of the sampling units, in our specification to control for the regional variation in prices.[68] We work with the maintained hypothesis that prices differ between those strata but are uniform within spatial strata. Given the spatial proximity within any of the 549 strata, we believe that this is a reasonable approximation. We modify the above equation to allow for an error term ϵ and add the regional dummies whereby r_j refers to the dummy variables for the regional strata from 1 to 549.

$$s_i = \alpha_i + \sum_{j=1}^{549} \theta_j\ r_j + \beta_i log\ m + \epsilon \tag{20}$$

[68] There are 550 regional survey strata in our data set. They include the division of areas in urban, rural, states, metropolitan region, among others.

This specification is supported by Leser's (1963) work who compares different forms of Engel curves and shows that assuming constant prices, an estimation based on log of income as used by Working [1943] provides a good fit, particularly for cross sectional data.

To estimate a quadratic demand system, a QUAIDS, adds considerable complexity. The quadratic term in income in equation 19 then depends on prices: previously prices only entered as shifters of the intercept α. To allow for heterogenous coefficients, Attanasio et al. [2011] suggest to introduce interactions of the regional dummies with the linear and quadratic terms in total expenditure (in our case by income) in addition to the regional dummies. If we were to introduce interaction terms based on the sampling strata, 998 additional parameters would have to be estimated.

Instead, we maintain the hypothesis that regional differences in prices only affect the intercept and allow for a nonlinear relation between the expenditure share s_i and income m. We choose this approach (which is not identical to QUAIDS) because the specification has great similarity to the later applied RDD specification and eases the comparison of results.[69]

$$s_i = \alpha_i + \sum_{j=1}^{549} \theta_j \; r_j + \beta_i log \; m + \delta_i log \; m^2 + \epsilon \tag{21}$$

We estimate equations 20 and 21 on the subsample of untreated households to avoid contamination by BFP treatment. We estimate these equations separately for each commodity (i) by OLS under the assumption that differences in relative prices are captured by regional dummies. In this case, the adding-up restrictions are satisfied, without the imposition of cross-equation restrictions (homogeneity and symmetry) related to the price elasticities.

When estimating equations 20 and 21 we assume that log income (m) and its square are not correlated with the residuals ϵ. However, this is a strong assumption. There are three main reasons why income (or expenditure) may not be exogenous: a) non separability; b) transitory shocks and c) measurement errors.

If there is non-separability between labor supply and the utility function, income might be correlated with taste shifters which are captured by the residuals. This issue also applies when total expenditure is used as an explanatory variable. In this case, it might be related to intertemporal preferences (e.g. net savers might be more likely to spend more or less on specific goods). Another issue related to income is the presence of transitory shocks. For example, if a

[69] We also estimated equation 21 strictly following Attanasio et al.'s (2011) approach by including 26 regional dummies and their interactions with a linear and quadratic term in income. The results are robust with respect to the interpretation of the nature of goods as luxuries or necessities around the eligibility threshold.

person loses her job, the changes in her consumption may be proportionally little if compared to changes in her income. Finally, the presence of measurement error may be an issue for both income and expenditure explanatory variables (see Banks et al. [1997] and Attanasio et al. [2011]).

To deal with these potential endogeneity issues we follow Thomas [1997] and Thomas [1990][70] who used non-labor household income per capita as an instrument for total income per capita as a robustness check. We use an even narrower definition of non-earned income which is transferred non-labor income. This variable is composed of by private and public pension, social transfers (except BFP), allowances and other transfers. In this case, we used a subsample of households which did not participate in BFP but received another type of monetary transfer over this period. We assume that transferred income is not correlated with taste shifters that may impact expenditure share, but is positive correlated to total income. In addition, it is a source of income that is less vulnerable to transitory shocks than wages, for example. Our decision of using a subsample of households who receive transfers may generate a selection issue due to the fact that pensions are more likely to be transferred for elderly persons. For this reason, we run a similar test using only allowances.[71]

Figure 4 shows the graphical representation of the baseline results.[72] To illustrate the income effect due to the money transfer, we consider a typical household. The mean income per capita (before transfer) for households which are just below the eligibility threshold of the program (R$ 100 $<$ income p.c. $<$ R$ 120) and which participate in Bolsa Famila is at 109.8 R$ per capita.[73] The mean transfer for this income bracket constitutes R$ 19.72 per capita or 18 percent of the household income; it is hence a considerable increase in purchasing power for the households. The mean transfer moves the household from R$ 109.8 to R$ 129.5. When considering the below graphs, we can see how the household expenditure share would change for the typical household in the absence of other effects. The income before and after the transfer for the typical household corresponds to a move from log income 4.70 to 4.87 in the graph; the two levels of income are indicated by the two grey vertical lines.

From the graphs, we can see that the linear and quadratic models in income do not differ considerably around the threshold. For this reason, we confine our analysis to the linear model.[74]

[70] Thomas [1997] uses a previous version of the Brazilian POF dataset, called ENDEF, covering the period of 1975-76.

[71] The results are available upon request.

[72] The ECs, estimated based on log expenditure instrumented by log income, are available in section 8.7 of the appendix.

[73] We chose this income bracket because it is informative of income effects around the eligibility threshold. The results can be compared to the Local Average Treatment Effect which will be estimated using a Regression Discontinuity subsequently.

[74] This result seems in line with previous research. Attanasio et al. [2011] also found the linear specification to provide the best fit for the expenditure share on food which they analyzed in the context of a Colombian CCT

The Engel curves are informative of the nature of the respective goods, i.e. whether they are luxuries or necessities. While food, school materials, health care and medicine are a necessity, education is a luxury. In addition to the expenditure shares, we also report the graphs for the self-reported constraints on medical services and medication. We observe that the self-reported constraints fall with increasing income.

program.

Linear and quadratic Engel curves (based on log of income per capita) - baseline model

Linear Engel curves (standard errors in parenthesis)

	Expenditure Share										Perceived Constraint			
	Nutrition		Education		School Materials		Pharmaceuticals		Health Care		Pharmaceuticals		Health Services	
Constant	0.43	(0.019)	-0.0074	(0.0056)	0.012	(0.0014)	0.05	(0.007)	0.05	(0.009)	0.63	(0.09)	0.11	(0.023)
Income	-0.035	(0.001)	0.0049	(0.00037)	-0.0013	(0.00009)	-0.0037	(0.00045)	-0.00035	(0.0006)	-0.1	(0.0059)	-0.012	(0.0015)
Socio-economic controls	Yes		Yes		Yes		Yes		Yes		Yes		Yes	
Regional dummies	Yes		Yes		Yes		Yes		Yes		Yes		Yes	

Quadratic Engel curves (standard errors in parenthesis)

	Expenditure Share										Perceived Constraint			
	Nutrition		Education		School Materials		Pharmaceuticals		Health Care		Pharmaceuticals		Health Services	
Constant	0.38	(0.028)	0.015	(0.0083)	0.0092	(0.0020)	0.02	(0.01)	0.024	(0.014)	0.6	(0.13)	0.15	(0.03)
Income	-0.016	(0.0072)	-0.0028	(0.0021)	-0.00047	(0.00052)	0.0064	(0.0026)	0.0086	(0.0034)	-0.088	(0.033)	-0.027	(0.009)
Income^2	-0.0016	(0.00060)	0.00064	(0.00017)	-6.70E-05	(0.00004)	-0.00085	(0.00022)	-0.00075	(0.00029)	-0.0011	(0.0028)	0.0013	(0.0007)
Socio-economic controls	Yes		Yes		Yes		Yes		Yes		Yes		Yes	
Regional dummies	Yes		Yes		Yes		Yes		Yes		Yes		Yes	

Engel curves estimation of Linear/Quadratic model. Obs: 28,317. Standard errors clustered by region in parentheses. 549 regional dummies included, socio-economic controls: nr. of hh members, nr. of women, female hh head, black hh head, Asian hh head,Pardo hh head, indigenous hh head, hh head illiterate, Universal religion, Catholic religion, Batista religion, Evangelical religion, Assembly of god religion, Lutheran religion nb. of whites in hh, nb. of blacks in hh, nb. of Asians in hh, nb. of Pardo in hh, nb. of indigenous in hh, health insurance, child or teen pregnant (10-17), young adult pregnant (18-25), credit card, bank account.

Linear Engel curves - IV procedure (standard errors in parenthesis)

	Expenditure Share										Perceived Constraint			
	Nutrition		Education		School Materials		Pharmaceuticals		Health Care		Pharmaceuticals		Health Services	
Constant	0.44	(0.038)	-0.0096	(0.011)	0.018	(0.0029)	-0.13	(0.0160)	-0.17	(0.0200)	-0.18	(0.1800)	0.25	(0.0520)
Income	-0.044	(0.006)	0.005	(0.002)	-0.0023	(0.0004)	0.025	(0.0023)	0.037	(0.0030)	0.032	(0.0270)	-0.032	(0.0075)
Socio-economic controls	Yes		Yes		Yes		Yes		Yes		Yes		Yes	
Regional dummies	Yes		Yes		Yes		Yes		Yes		Yes		Yes	

Quadratic Engel curves - IV procedure (standard errors in parenthesis)

	Expenditure Share										Perceived Constraint			
	Nutrition		Education		School Materials		Pharmaceuticals		Health Care		Pharmaceuticals		Health Services	
Constant	0.57	(0.210)	0.0017	(0.048)	0.045	(0.014)	-0.59	(0.078)	-0.53	(0.093)	-3.5	(0.970)	0.84	(0.380)
Income	-0.087	(0.065)	0.0012	(0.016)	-0.011	(0.004)	0.18	(0.024)	0.16	(0.029)	1.2	(0.300)	-0.23	(0.120)
Income^2	0.0036	(0.005)	0.00031	(0.0013)	0.00075	(0.0003)	-0.013	(0.002)	-0.0099	(0.0023)	-0.093	(0.024)	0.017	(0.009)
Socio-economic controls	Yes		Yes		Yes		Yes		Yes		Yes		Yes	
Regional dummies	Yes		Yes		Yes		Yes		Yes		Yes		Yes	

Engel curves estimation of Linear/Quadratic model using IV procedure. The log of income per capita and its square were instrumented by log of (non-labor) transferred income per capita and its square, respectively, in the first stages. Obs.: 10,918. 549 regional dummies included, socio-economic controls: nr. of hh members, nr. of women, female hh head, black hh head, Asian hh head, Pardo hh head, indigenous hh head, hh head illiterate, Universal religion, Catholic religion, Batista religion, Evangelical religion, Assembly of god religion, Lutheran religion nb. of whites in hh, nb. of blacks in hh, nb. of asians in hh, nb. of pardo in hh, nb. of indigenous in hh, health insurance, child or teen pregnant (10-17), young adult pregnant (18-25), credit card, bank account. The results for the first stage are available in section 8.7 of the appendix, Table 23.

Table 7: Engel curves coefficients estimated on a subsample of untreated households (baseline model)

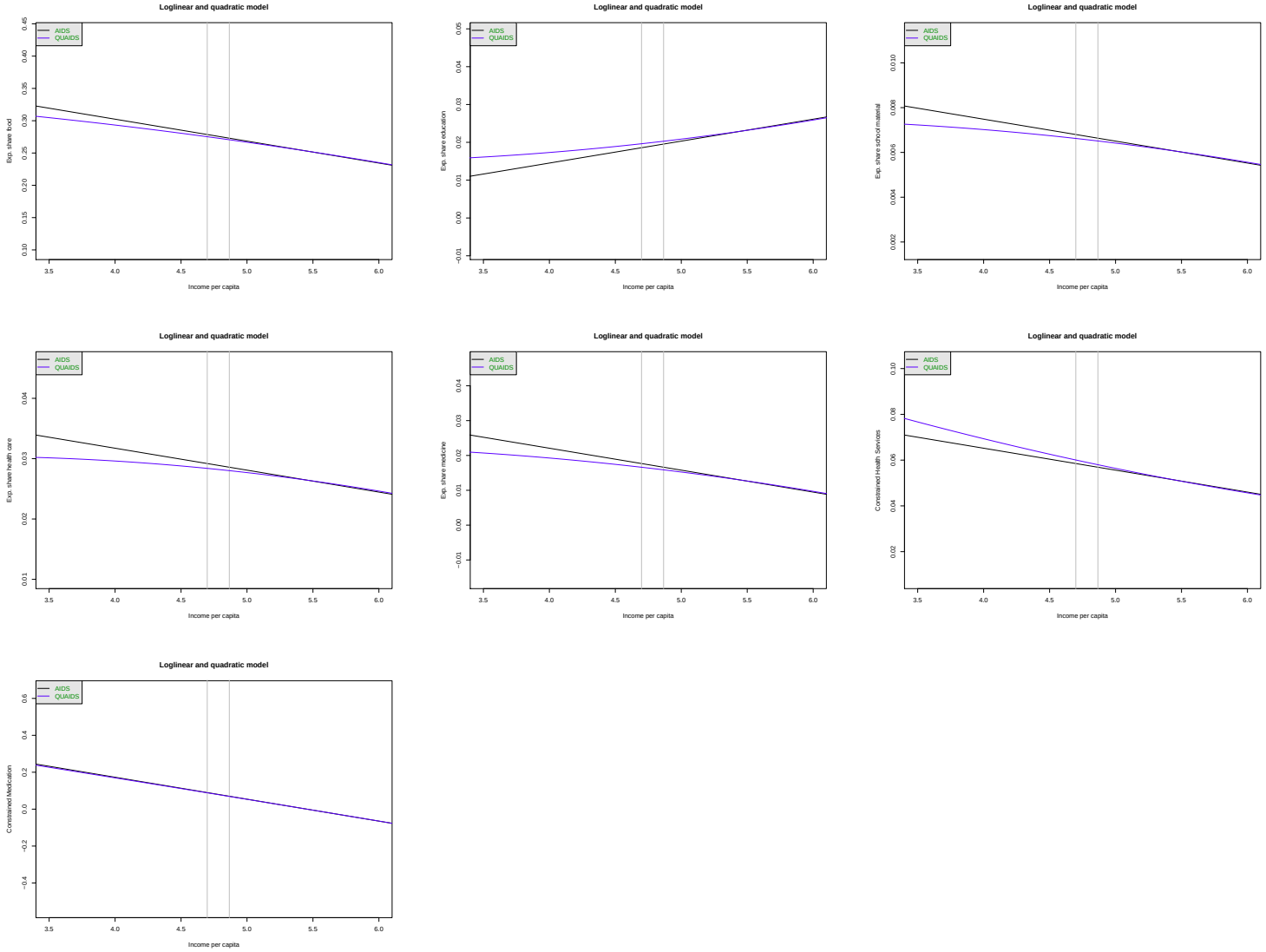

Figure 4: Engel curves estimated on subsample of untreated households (OLS).

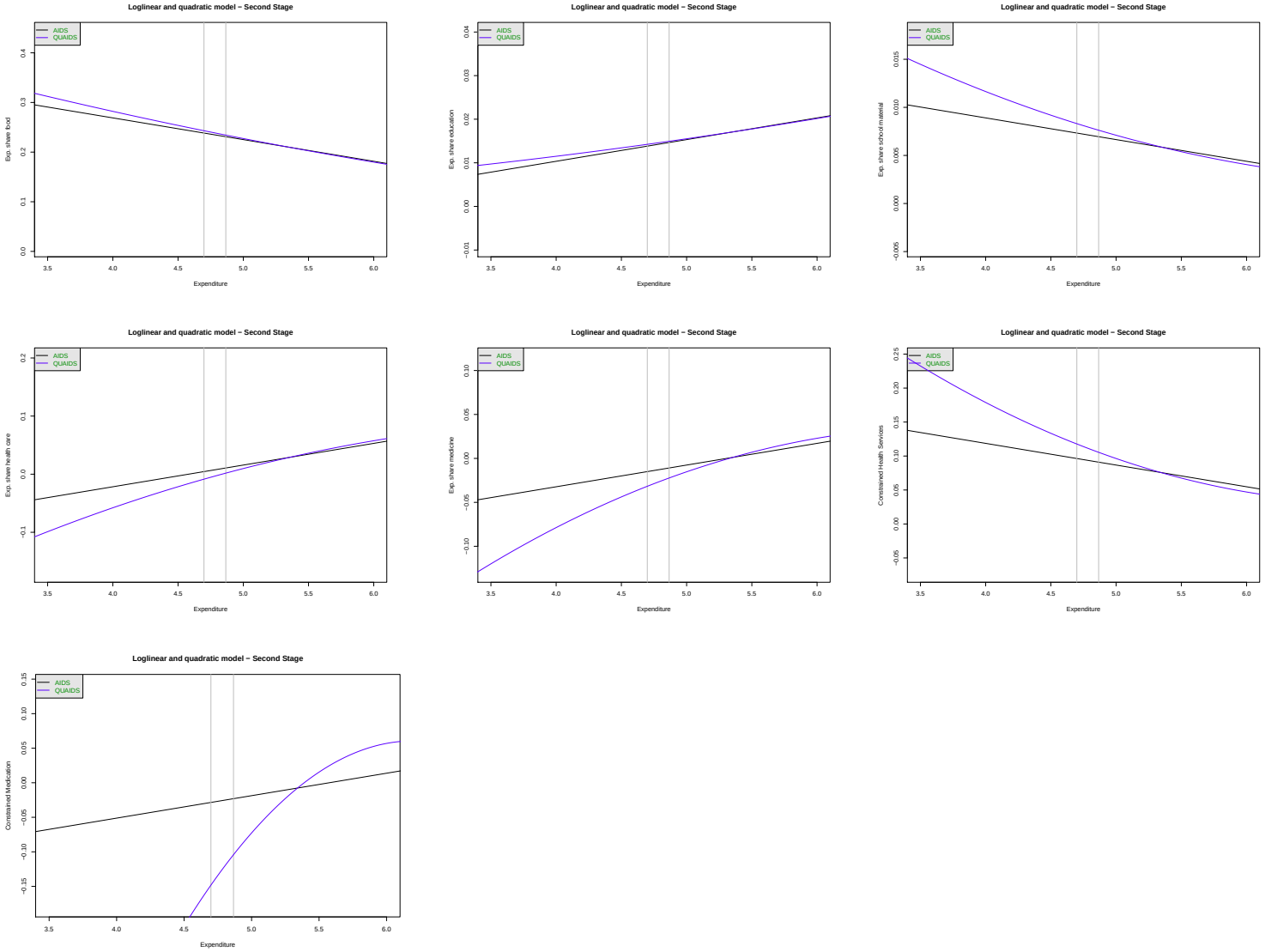

Figure 5: ECs estimated on subsample of untreated households using non-labor transferred income as instrument for income

Table 7 shows the result of our estimations of the equations 20 and 21 on the subsample of untreated households with OLS and with IV (using non-labor transferred income as an instrument). In the linear specification, the signs and coefficient estimates are similar for food, education, school materials and the perceived health service constraint. The signs of the coefficent estimates change for pharmaceuticals, health care and the perceived pharmaceuticals constraint.

Figure 5 shows the graphical representation of the Engel curves for the IV procedure using transferred non-labor income per capita as an instrument for total income per capita. We observe that, around the threshold, the EC shape is consistent for the expenditure shares of food, education, school materials and the perceived health service constraint. For expenditures on health care, expenditures on pharmaceuticals and the perceived constraint on pharmaceuticals, the relation is inverted. This may be due to a selection issue; pensions are received by elderly people who have a higher likelihood of experiencing health problems. If we run an OLS with income per capita for the subsample of households that received transfers, the Engel curves have similar shapes as the full subsample of BFP untreated, as shown in Table 4, except with respect to the expenditure share on health care. We also used only allowances (instead of all types of non-labor transferred income) as an instrument for income and the shapes of the estimated Engel curves for health expenditures, pharmaceuticals and the perceived constraint on pharmaceuticals are in line with the baseline model in Table 4.[75]

In addition, we also estimated Engel curves based on total expenditure instead of income as a robustness check (see section 8.7). We adopted two different procedures to deal with the potential endogeneity of total expenditure. First, we used the residual of a regression of the logarithm of total expenditure per capita on the logarithm of income per capita and other covariates used in the second stage as a control function (CF). Second, we used income as an instrument for total expenditure. These procedures (CF and IV) are similar for the linear case, but not for a non-linear specification and have been previously used in the literature by Banks et al. [1997], Attanasio et al. [2011].[76]

Table 24, Table 25 and the graphical representation of the ECs in Tables 13 and 14 report the results of this robustness exercise. We find that the predicted shapes of the Engel curves, using total expenditure per capita instrumented by income per capita and the control function approach, are consistent with the Engel curves from our baseline model, using income per capita,

[75] Results are available upon request

[76] Banks et al. [1997] used log of income after tax as an instrument for log of expenditure and Attanasio et al. [2011] used expected income in the first stage of a CF. They argue that this variable would be less sensitive for short term shocks that could affect income, but not consumption.

with the exception of the quadratic specification for health care expenditures. Table 24, Table 25 and the graphical representation of ECs in Tables 13 and 14 report the results of this robustness exercise. We find that the predicted shapes of the Engel curves, using total expenditure per capita instrumented by income per capita and the control function approach, are consistent with the Engel curves from our baseline model, using income per capita, with the exception of the quadratic specification for health care expenditures.

Overall, the Engel Curves for the expenditure shares of food, education, school materials and the perceived constraint on health services seem to be consistent across different estimation approaches, taking into account the potential endogeneity issues previously discussed.

In the next section, we will compare the results of the EC baseline model with the results from the RDD approach. The baseline model is used as an additional counterfactual and is informative of household behavior under an income expansion without conditionalities. In the interpretation of the comparison, we will focus on the signs of the estimated parameters (more than their magnitude). The results of the IV procedure (using non-labor income as an instrument) and the estimations with total expenditure as an explanatory variable (section 8.7 of appendix) are kept as robustness check for the baseline model.

5.2 Is there an impact beyond cash transfer?

Now that we have an idea of the counterfactual effect of a pure cash transfer in the Brazilian context, we can analyze whether the effect of Bolsa Família goes beyond the pure cash transfer. We apply a specification which is largely similar to the previously estimated Engel curves – a variant of a Regression Discontinuity Design with income as one of our forcing variables. On the one hand, income determines the eligibility to the Bolsa Família program and, on the other hand, income is increased as a result of the program and an important determinant of expenditure shares (see Engel curves). By applying an RDD based on income (net of the transfer), we investigate whether there is a continuous relationship between the outcome variables and income; or whether due to the program, we find a jump in the outcome variables at the eligibility threshold while controlling for initial income. If there is a discrete jump in expenditure share for treated households in this relation which goes beyond what would be expected by the above Engel curves, we can reject the hypothesis that BFP only unfolds its impact through the income effect.

To identify the treatment effect, we exploit exogenous variation in treatment created through the eligibility criteria (see section 8.1) of BFP. The eligibility to receive the cash transfer under

BFP is based on a combination of criteria including the income per capita of the household, which may not exceed R$ 120, and the number of children.[77,78] The amount of transfer varies according to the income of the family, whether they are below the poverty line (R$ 120 per capita month) or the extreme poverty line (R$ 60 per capita month), and the number of children.[79]

Figure 6 shows the relation between income per capita and participation in BFP. Participation falls with increasing income as expected and we can spot a considerable drop in participation around the second threshold of R$ 120 (corresponds to 4.8 in log income).[80] But the cut-off is not sharp. We notice that a considerable number of households who are above the threshold of R$ 120 receive the program. This indicates that the rule is either not strictly implemented, some households under-reported vis-à-vis public authorities (but not to the household survey interviewer), we incur measurement error in the income measure or there is income volatility (see discussion in section 2). The latter is likely to explain part of the deviation from the eligibility rule due to the fact that household's income is only re-assessed two years after successful entry into the program.[81]

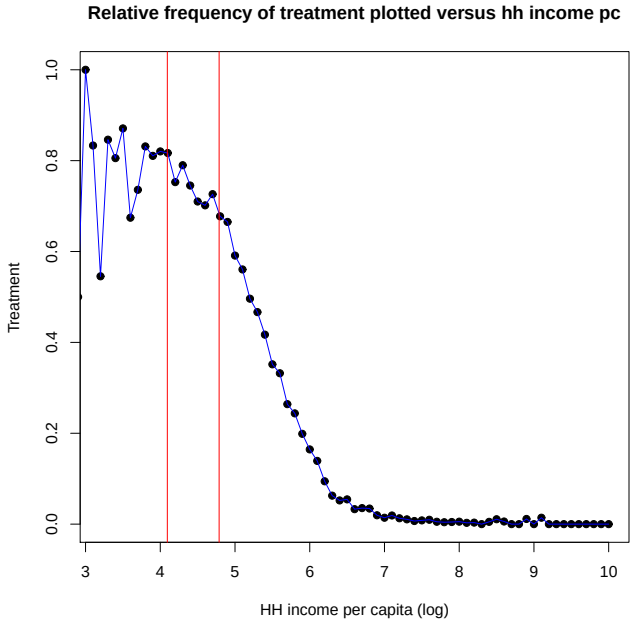

Figure 6: Participation in BFP plotted against income per capita

[77]The average exchange rate between 2007 and 2008 of US Dollar against Real was about US$ 1.00 = R$ 1.90.

[78]In the empirical analysis, we focus on the joint effect of the cash transfer and the conditionality on school attendance on investments in child human capital. Compliance with this conditionality is non-trival as households encounter an opportunity cost of time (see section 3). We use the number of children of school age (between 6 and 17 years old) as a forcing variable.

[79]These values correspond to the period in which POF 2008-2009 survey was conducted. The current values are R$ 140 and R$ 70 for the poverty line and extreme poverty line respectively. Updated information on current values is available on the website of the Brazilian Ministry of Social Development (www.mds.gov.br).

[80]The first threshold corresponds to the eligibility criterion for the basic transfer.

[81]During this period, households income may increase above the threshold without having the benefit suspended.

Table 8 shows the income decomposition for households participating in BFP. A considerable share of income comes from self-employment. Furthermore, many working conditions categorized as income from employment may be informal without official contract or provide so little income that they are tax exempted and hence do not appear in the official social insurance registers. For these reasons, it is relatively easy for households (at this low income level) to under report their official income. This situation poses a challenge for our identification strategy which relies on the assumption that individuals do not have complete control over the forcing variable. We argue that, at best, households only have partial control over the forcing variable. Many households are unable to cheat due to their formal modes of employment and the monitoring of eligibility by the public authorities. Furthermore, it is unlikely that they manage to cheat on the second part of the rule: the number of children. Nevertheless, to rule out lingering doubts about the identification strategy, we carry out extensive robustness tests, including tests on whether predetermined characteristics are locally randomized around the thresholds which would indicate systematic cheating.

Variable	Mean	Share
Total hh income	811.1	1
Income from labor	579.6	0.71
Income from employment	373.7	0.46
Income as employer	16.01	0.02
Self employed	189.9	0.23
Income from transfers	216.8	0.27
Income transfer from INSS	78.61	0.1
Public Pensions	10.84	0.01
Private Pensions	1.56	0
Federal Social Programs	96.69	0.12
Allowances	18.06	0.02
Other	11.07	0.01
Rental income	3.54	0

Table 8: Income decomposition for BFP participants

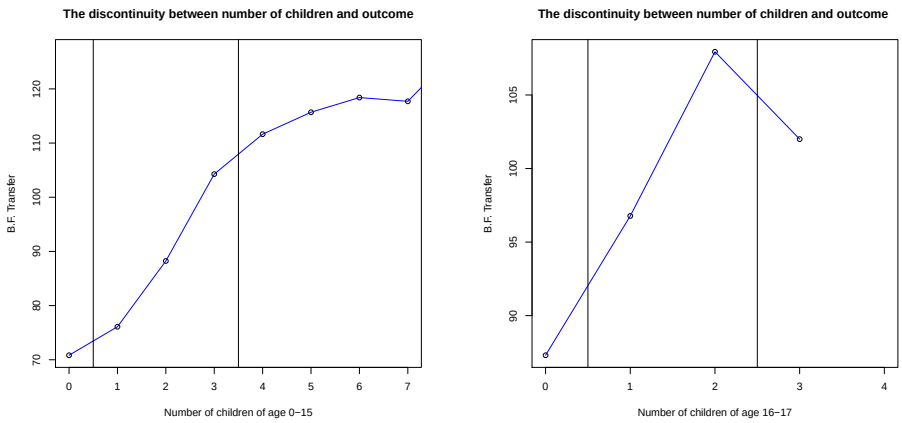

Figure 7: Amount of transfer plotted against the number of children

Given that we have an eligibility rule, consisting of two components, it is natural to apply a variant of Regression Discontinuity Design which takes both into account. We adapt the approach of Arcand et al. [2011] to our estimation problem: The two-dimensional vector of forcing variables X determines whether a household is eligible to receive BFP. For each forcing variable, there is a threshold denoted $c_1 \equiv 120$ and $c_2 \equiv 1$ marking the eligibility cut-off. Only if a household fulfills both conditions, can the household receive the treatment. Thus, the treatment rule can be defined as $T_h = T_{1h} \times T_{2h}$ whereby $T_{1h} = \mathbf{1}[X_{1h} \leq 120]$ and $T_{2h} = \mathbf{1}[X_{2h} \geq 1]$.

Lee and Lemieux [2010] provide an encompassing discussion how RDDs can be implemented in practice and we follow their recommendations. In a sharp RDD set-up, we could estimate the relation between the forcing variable and outcome above and below the threshold. The jump in outcome at the threshold would be a sufficient metric to estimate the treatment effect. A pooled approach to this estimation is written down in equation 22. $X_h \equiv [X_{1h}, X_{2h}]$ refers to the vector of forcing variables income per capita and number of children on which the eligibility rule is based. The forcing variable is deducted by the value of the respective threshold $c \equiv [c_1, c_2]$. T_h is the rule, indicating one if the household is eligible, according to the previously specified relation, and zero otherwise. Treatment is indicated by D_h and γ is the coefficient of interest to us: the local average treatment effect. However, in the case of BFP estimating equation 22 does not suffice. Figure 6 showed that the treatment is not deterministically assigned according to the rule. In this case, Lee and Lemieux [2010] suggest to instrument the treatment D with the rule T. The interaction terms of the forcing variables and treatment are instrumented by interaction terms of the rule and forcing variables respectively. The corresponding first stage equations are outlined in equation 23, 24 and 25. To control for differences in relative prices, we include 549 regional dummies r_j which are indexed from 1 to 549 by j.

Second stage:

$$\begin{aligned} Y_h = \alpha_l + \gamma D_h + \beta_{1l}(X_{1h} - c_1) + \beta_{2l}(X_{2h} - c_2) + (\beta_{1r} - \beta_{1l})D_h(X_{1h} - c_1) \\ + (\beta_{2r} - \beta_{2l})D_h(X_{2h} - c_2) + \sum_{j=1}^{549} \upsilon_j \ r_j + \epsilon \end{aligned} \tag{22}$$

First stage 1:

$$\begin{aligned} D_h = \tau_l + \delta T_h + \phi_1(X_{1h} - c_1) + \phi_1(X_{2h} - c_2) + (\psi_{1r} - \psi_{1l})T_h(X_{1h} - c_1) \\ + (\psi_{2r} - \psi_{2l})T_h(X_{2h} - c_2) + \sum_{j=1}^{549} \Upsilon_{1j} \ r_j + \nu \end{aligned} \tag{23}$$

First stage 2:

$$\begin{aligned} D_h(X_{1h} - c_1) = \eta_l + \omega T_h + \chi_1(X_{1h} - c_1) + \chi_2(X_{2h} - c_2) + (\vartheta_{1r} - \vartheta_{1l})T_h(X_{1h} - c_1) \\ + (\vartheta_{2r} - \vartheta_{2l})T_h(X_{2h} - c_2) + \sum_{j=1}^{549} \Upsilon_{2j} \ r_j + \xi \end{aligned} \tag{24}$$

First stage 3:

$$\begin{aligned} D_h(X_{2h} - c_2) = \iota_l + \varphi T_h + \kappa_1(X_{1h} - c_1) + \kappa_2(X_{2h} - c_2) + (\rho_{1r} - \rho_{1l})T_h(X_{1h} - c_1) \\ + (\rho_{2r} - \rho_{2l})T_h(X_{2h} - c_2) + \sum_{j=1}^{549} \Upsilon_{3j} \ r_j + \zeta \end{aligned} \tag{25}$$

The econometric literature on the estimation of expenditure share equations building on Deaton and Muellbauer [1980] assumes either a linear (AIDS) or a quadratic (QUAIDS) form. In the context of expenditure share equations, a higher order than two is not consistent with consumer theory (see Banks et al. [1997]). In the subsequent analysis, we will mainly rely on the linear model. As a robustness test, we relax the assumption of linearity in income by adding a quadratic term in income (and its interaction term with treatment or the eligibility rule).

The first stage results in Table 9 show that, assuming linearity, there is indeed a strong and significant increase by 0.18 in the probability of treatment for those who are just eligible versus those who are not. When we relax the assumption of linearity by including a polynomial of order two in income, the rule still significantly predicts treatment - the probability of treatment at the threshold increases by 0.14 for those who just fulfill the income eligibility in the quadratic model. The detailed results on all first stage estimations are reported in Table 26.

	Fuzzy RDD	
	Linear	Quadratic
Eligibility rule	0.18	0.14
(s.e.)	(0.016)	(0.018)
X_1	-0.12	-0.19
(s.e.)	(0.0044)	(0.012)
TX_1	0.069	0.077
(s.e.)	(0.013)	(0.027)
X_2	0.074	0.075
(s.e.)	(0.0027)	(0.0027)
TX_2	-0.024	-0.026
(s.e.)	(0.0068)	(0.0069)
X_1^2		0.024
(s.e.)		(0.0035)
TX_1^2		-0.045
(s.e.)		(0.0089)
Constant	0.3	0.32
(s.e.)	(0.0059)	(0.0085)
Socio-economic controls	No	No
Regional dummies	549	549
Standard errors in parentheses. Clustering applied to all models at the level of (550) sampling strata.		

Table 9: Estimation of BFP treatment effect by fuzzy Regression Discontinuity Design, first stage 1.

The summary of results of the basic model are summarized in Table 10.[82,83] We notice a significant and pronounced increase in the expenditure share on food (10 percentage points) and also to a lesser extent on education (0.9 percentage points) and school materials (0.7 percentage points). We see a significant decrease in both the medication and total health expenditure shares by about 3 percentage points each.

In light of the previously presented Engel curves, it appears that the CCT did have an impact on the behavior of the households which goes beyond the pure cash transfer. For food, we find a stark increase in the expenditure share by 10 percentage points while the slope of the Engel curve around the threshold is negative. This finding is in line with evidence from

[82]Detailed results for the linear model are reported in Tables 27, 28 and 29.

[83]In the discussion of the results, we will abstract from the compliance with the conditionalities and focus on the impacts of the program on food, health and education expenditures. Because we do not have a direct measure of the compliance of the households with the conditionalities, we are forced to trust that households widely comply. Previous impact evaluations of Bolsa Família found that overall compliances is very high. Soares [2012] shows that only few households were removed from the program because of not complying with the conditionality. From 2006-2008, 2,092,394 households received a warning message but only 93,231 (corresponding to 4.5% of those who had received a warning letter) had to be excluded from the program due to repeated non-compliance. The high rate of compliance seems in line with observations from the POF data: 95 percent of the children aged 6 to 17 in households which are subject to Bolsa Família are enrolled in school. Although actual school attendance can be expected to be lower, this indication together with the monitoring system described in section 8.1 and the previous findings of the literature do not give us reason to suspect that households disregard the conditionalities on a larger scale.

previous research (see Angelucci et al. [2012] for Mexico and Attanasio et al. [2011] for Colombia) which has found similar results. For education, we would expect a slowly increasing expenditure share with increasing income around the threshold but we notice a considerable increase of 1 percent considering the low level of education expenditure (1 percent around the threshold); this corresponds to a doubling of the expenditure share on education. The results for school materials can be interpreted as analog to food. The findings imply that households increase their expenditure in food, school materials and education disproportionally to the amount of transfer received.

	OLS		Fuzzy Regression Discontinuity Design							
			Linear		Quadratic		Covariates		Subsample	
Expenditure Shares										
Nutrition	0.017	(0.0024)	0.1	(0.024)	0.14	(0.069)	0.1	(0.024)	0.18	(0.069)
Education	-0.0013	(0.00044)	0.0093	(0.003)	0.021	(0.0076)	0.0087	(0.0029)	0.0057	(0.009)
School Materials	0.0014	(0.00016)	0.0071	(0.0018)	0.011	(0.0059)	0.0072	(0.0018)	0.0059	(0.0064)
Pharmaceuticals	-0.00091	(0.00088)	-0.028	(0.0069)	-0.024	(0.018)	-0.026	(0.0068)	-0.023	(0.021)
Health Care	-0.0012	(0.001)	-0.026	(0.0082)	-0.03	(0.022)	-0.027	(0.0081)	-0.039	(0.025)
Perceived Constraints										
Pharmaceuticals	0.14	(0.012)	0.36	(0.13)	-0.083	(0.32)	0.4	(0.12)	-0.11	(0.34)
Health Services	0.018	(0.0032)	0.065	(0.044)	0.083	(0.13)	0.064	(0.043)	-0.081	(0.13)
Socio-economic vars.	No		No		No		Yes		No	
Regional dummies	549		549		549		549		549	

Table 10: Summary of results: The impact of Bolsa Família on private investments in health and education

Note: Standard errors in parentheses. Clustering applied to all models at the level of sampling strata (550 strata), socio-economic controls include: nr. of hh members, nr. of women, female hh head, black hh head, Asian hh head, Pardo hh head, indigenous hh head, hh head illiterate, Universal religion, Catholic religion, Batista religion,Evangelical religion, Assembly of God religion, Lutheran, religion, nb. of whites, nb. of blacks in hh, nb. of Asians in hh, nb. of pardo in hh, nb. of indigenous in hh, Health insurance, child or teen pregnant (10-17), young adult pregnant (18-25), credit card, bank account. Detailed results are reported in tables 26, 30 and 32 for the first stage and Tables 27 , 28, 29, 31 and 33 for the second stage results.

For medicine and health care, we find a decrease in the respective expenditure shares as a reaction to the program. We also observe an increase in the perceived constraint on access to pharmaceuticals for households subject to the program. We do not find a significant effect on the perceived constraint on health services.

The interpretation of the empirical results on health expenditures and constraints in the context of BFP should be undertaken cautiously. A comparison of the treatment effect with the Engel Curves appears unreliable given that the shape of some of the ECs did not prove robust. The baseline ECs would suggest a decrease in the expenditure share of health care, pharmaceuticals and the perceived constraint on pharmaceuticals, while the ECs resulting from the IV procedure suggests an increase in the expenditure shares and the constraint on pharmaceuticals.

What does this decrease in the expenditure shares mean in light of the expansion of the overall household income? For health care and pharmaceuticals, we see a significant decrease in expenditure share. However, the decrease in share does not imply a decrease in absolute terms. In fact, the decrease in the expenditure share on medication by -2.8 percentage points and health care by -2.6 percentage points translates into a net increase in spending on medication, considering that the transfer constitutes a mean increase in income of 18 percent for households around the threshold. Hence, it is more accurate to state that the health expenditure increases disproportionally little compared to the overall expansion of the household budget.

Abstracting from the above, the decrease in the expenditure share on medical expenditures taken together with an increase on the perceived medication constraint seems to be still puzzling. In Brazil health services are available without charge. This is, in general, not the case for medication.[84] The program stimulates demand for health services which in turn could stimulate the demand for medication, which some of the households cannot afford; this channel may constitute a candidate explanation for the observed significant increase in the reported constraint on medication, but not for the decrease in the share of medical expenditure.

In sum, we observe some interesting impacts. In line with previous evidence from the literature on CCTs we find a strong increase in food expenditures; given that food is a necessity around the threshold, this result strongly indicates that transferring cash to women, conditionalities or features other than the pure cash transfer impact household expenditure decisions. We find a similar but weaker effect for spending on school materials and education which increases by proportionally more as would be expected from a pure cash transfer.

The results for health expenditures are harder to interpret: We observe that households

[84] In some instances, medication is provided by the government free of charge.

decrease their relative health expenditures. At the same time, the program imposes them to demand more health services which might result in increased demand for medication. The program may have created a demand in medication which was not there previously and which households possibly cannot or do not want to afford. The perceived health constraint increases for medication whereas it does not decrease for the services which are provided free of charge. Despite this intuitive reasoning, we should take the implications of this finding with caution due to limited information on the usage of public services. It is possible that the beneficiaries do not increase their private expenditure in health due to the possibility of receiving additional services, and potentially also some types of pharmaceuticals, for free.

Moreover, it could be that the behavior around health expenditures is partially explained by the provision of governmental services, improved health status resulting from the increased participation in health services and increased spending on food.

5.3 Robustness tests

To test the validity of our approach, we run several robustness tests following Lee and Lemieux [2010]: 1.) Releasing the assumption of linearity, 2.) inclusion of covariates, 3.) estimation of the fuzzy RDD on a discontinuity subsample around the threshold, 4.) specification test, 5.) test of balanced characteristics around the threshold. Furthermore, we also test our assumptions on fertility and access to credit. In this section, we provide a summary of the results of the above-mentioned tests.

Allowing for nonlinearities in income

The estimation results in a Regression Discontinuity Design set-up can be sensitive to the chosen functional form; for instance, if a truly nonlinear relation is restricted to a linear form, the procedure could indicate a discontinuity at the threshold even though there is none. For this reason, it is important to consider the possibility of a nonlinear relation between the forcing and the outcome variables. Banks et al. [1997] suggest the quadratic logarithmic specification as the best functional form for a demand system[85]; hence, we restrict our analysis to polynomials of order one and two. The third column of Table 10 summarizes the results. Detailed results are reported in Table 26 for the first stage and Tables 27, 28 and 29 for the second stage results.

[85]Gorman [1981] shows that the maximum possible rank of the matrix that is function of prices in any rational, exactly aggregable demand system is three. According to Lewbel [2003], a rank four cubic logarithmic utility function is not consistent utility optimization.

We find that the coefficient estimates for all of the expenditure shares remain robust in terms of their sign and also roughly in terms of their effect size. But the estimates on the expenditure share on pharmaceuticals and health care are rendered insignificant. When we consider the perceived constraints, we notice that the result on the health service constraint appears robust but the coefficient estimate on the pharmaceuticals constraint changes sign and is rendered insignificant.

In sum, while the results on nutrition, education and school materials remain robust to relaxing the assumption of linearity, the estimates on pharmaceuticals and health expenditures are only robust to a lesser extent (coefficient estimate robust, but rendered insignificant), the reliability of the results of the pharmaceuticals constraint should be doubted.

Inclusion of covariates

If effective, the RDD should result in a local randomization around the threshold. As a consequence, it is not necessary to include any more covariates (than the forcing variables) in the econometric model. If this is true, the result should not change with the inclusion of covariates. When including a wide range of socio-demographic and economic covariates (see bottom of Table 10), the results prove indeed robust vis-à-vis this modification as the summary of results in Table 10 shows.[86]

Estimation on subsample

RDD is estimated locally at the threshold. Hence, the results should remain robust if we limit the sample around this area. We choose a bracket of one unit in log income around the threshold and re-estimate our RDD specification. We can see from the first stage results (Table 32) that the eligibility rule still predicts BFP participation; there is a jump of 13 percentage points in the probability of participation at the threshold. The point estimates for the expenditures subject to this analysis remain robust in the subsample estimation in terms of their magnitude and do not change signs (Table 10).[87] The effect for food expenditure is more pronounced for the subsample and remains signficant at the five percent level. The coefficients for the other expenditures, albeit robust in their signs and the magnitude of the effect size, are estimated less precisely in the subsample and are rendered insignificant. The large standard errors may be due to the reduced sample. However, the coefficient estimates on the health service and pharmaceutical

[86] Detailed results are reported in Table 30 for the first stage and Table 31 for the second stage.
[87] Detailed results are reported in Table 32 for the first stage and Table 33 for the second stage.

constraints change considerably and, hence, do not appear to be robust.

Specification test

In the context of polynomial regressions, Lee and Lemieux [2010] suggest a specification test based on unrestricted means whereby bin dummies relating to the forcing variable are added to the polynomial model. If the chosen order of polynomials provides a good fit to the data, the true coefficients for the bin dummies equal zero and should be jointly insignificant. The test can also be interpreted as a test for unexpected discontinuities at the borders of the bins.

The bandwidth for the bins is chosen such that there is no oversmoothing and the bandwidth is sufficiently narrow. The test procedure, described by Lee and Lemieux [2010], suggests that a bandwidth choice of 0.05 is appropriate (Table 34). Overall, the specification test, based on this bandwidth choice, suggests that the linear specification delivers a good fit for the models on the expenditure shares on food, school materials, health, medicine and the health service constraint.

The test rejects the linear and quadratic specification for the expenditure share on education and the medication constraint (Table 34). The rejection can be interpreted as the existence of additional unexpected discontinuities in the relation of the forcing variable and the above outcome variables. When we inspect the discontinuity graphs for these variables (see panels in Figure 35), we can see great dispersion of the unconditional means of those variables; i.e. there is considerable heterogeneity between income brackets. We cannot exclude the possibility that the "jump" at the threshold is caused by the above-mentioned heterogeneity of the variables between income brackets rather than the treatment effect. However, the results on education is in line with theoretical expectations and the results on other similar variables (i.e. the effect on education resembles the effect on school materials). We take this as an indication that the results on education is reliable.

The results on the medication constraint should be interpreted with great caution. Based on the presence of additional discontinuities, indefinite theoretical expectations and a lack of the possibility to test the plausibility of results by comparison with similar variables, we cannot exclude the possibility that the estimated jump at the threshold is a fluke in the data.

Predetermined characteristics, fertility and access to credit

Although we cannot test directly whether the eligibility rule creates exogenous variation in treatment around the threshold, we can test this indirectly. If the local randomization worked, we should find a balanced distribution of characteristics in exogenous/predetermined covariates around the threshold. This can be tested graphically and formally.

In the subsequent analysis, we test for unbalanced characteristics among the following predetermined variables: number of household members, number of women, female household head, black household head, Asian household head, Pardo household head, indigenous household head, household head illiterate, Universal religion, Catholic religion, Batista religion, Evangelical religion, Assembly of God religion, Lutheran religion, number of whites in household, number of blacks in household, number of Asians in household, number of Pardo in household and number of indigenous in household.

Furthermore, in our theoretical framework, we assumed that fertility does not change as a consequence of the program. We test this assumption formally by including the variables child or teen pregnancy (age 10-17), young adult pregnancy (18-25) in the analysis of this section. CCT programs are sometimes criticized for allegedly providing an incentive (through the cash transfer) for poor families to have more children. If this was true, the increased fertility of poor households could lead to a higher household size and reduce per capita income pushing households deeper into poverty (particularly in urban areas), if the real cost of children exceeds the amount of transfer for an additional child (R$ 20 or R$ 30, ca. 10-15 USD).

We will also test the assumption that households do not have access to credit markets. Due to the structure of the BFP program (i.e. the cash is transferred to the beneficiaries bank account), Bolsa Família may have an effect on the rate of access to bank accounts. If the newly acquired access to a bank account also enables households to take out credits to finance human capital investments, one of the assumptions of our conceptual framework (no access to credit markets) would not hold and there would be an additional channel through which BFP could affect investments in child human capital. We test for this formally by including the variables access to a bank account and access to credit (credit card). Access to a bank account does not equal access to credit; we test for the latter with the proxy variable "credit card".

To test sorting into treatment around the threshold (i.e. the assumption of incomplete control over the forcing variable), we inspect the data visually and subsequently estimate formally

whether predetermined characteristics are balanced around the threshold. If we plot the density of the predetermined characteristic against the forcing variable, we should be able to detect sorting into treatment (or out of treatment) which would be a strong indication for systematic manipulation of the rule. The panels in Figures 15, 16, 17, 18 and 19 do not indicate such an effect.

Table 11 reports the result of a more formalized test. We estimate the same RDD specification as previously specified using the respective predetermined characteristics as dependent variable. We find little indication of unbalanced characteristics around the threshold: most coefficients are insignificant, but there is a significant effect on the number of women in the household. Should this be interpreted as systematic evidence of sorting into or out of treatment? Assuming the characteristics are balanced (null hypothesis that there is no true relation between the predetermined characteristics and participation in the program), the probability that between 0 and 1 coefficients show significant on the five percent level is at 76 percent.[88] Therefore, we cannot reject the hypothesis that the characteristics are balanced around the threshold at the five percent level of significance.

When we have a closer look, there are plausible explanations why the number of women in the household shows up as significant. The program mainly targets women and their children; the cash is transferred to the mother of the children. Hence, it is not surprising that the presence of more women in a household may lead to a higher chance of participation. This should not be of concern to us as long as there is no systematic relation between the number of women and household decisions – a question which we will further investigate in the next section of this essay.

Overall, the assumptions on fertility and access to credit seem in line with the results. We do not find support of the critique that Bolsa Família incentivizes poor women to have more children. When we consider the results on child and young adult pregnancies, we do not find a significant effect of the program on observed fertility. The assumption that BFP does not impact fertility cannot be rejected.

We do find an effect of BFP on access to a bank account but not on access to credit (as proxied by the variable access to credit card). BFP participation stimulates the beneficiaries to open a bank account, which would be expected due to the fact that the cash is directly transferred to beneficiaries through a bank account, but we do not find evidence that this also

[88] According to the Bernoulli rule, $P(A) = \sum_{i=a}^{b} \binom{t}{s+i}(p)^{s+i}(1-s)^{t-s-i} = \sum_{i=0}^{1} \binom{19}{i}(0.05)^{i}(0.95)^{(19-i)} = \binom{19}{0} \times (0.05)^{0} \times (0.95)^{19} + \binom{19}{1} \times (0.05)^{1} \times (0.95)^{18} = 0.38 + 0.38 = 0.76$, calculated with: http://www.calcul.com/bernoulli-trials-range, Dec 23, 2013.

increases their ability to obtain credit with a low maturity (credit card). To secure credit for a long period is more difficult; for this reason we believe that their ability to obtain long-term credit to finance human capital investments is not enhanced and the credit constraint is binding for poor households.

	Fuzzy RDD Linear	
Nr. of hh members	-0.29	(0.18)
Nr. of women	-0.29	(0.14)
Female hh head	0.066	(0.06)
Black hh head	-0.046	(0.037)
Asian hh head	0.0042	(0.0058)
Pardo hh head	-0.049	(0.061)
Indigenous hh head	0.019	(0.011)
HH head illiterate	0.063	(0.054)
Universal religion	-0.0043	(0.0084)
Catholic religion	0.09	(0.048)
Batista religion	-0.0084	(0.01)
Evangelical religion	-0.019	(0.012)
Assembly of god religion	-0.021	(0.025)
Lutheran religion	-0.00029	(5e-04)
Nb. of whites in hh	-0.22	(0.19)
Nb. of blacks in hh	-0.11	(0.14)
Nb. of asians in hh	-0.02	(0.022)
Nb. of pardo in hh	0.066	(0.25)
Nb. of indigenous in hh	0.027	(0.039)
Child or teen pregnant (10-17)	0.0034	(0.014)
Young adult pregnant (18-25)	-0.012	(0.016)
Bank account	0.58	(0.033)
Credit card	0.063	(0.055)
Socio-economic controls	No	
Regional dummies	549	
Standard errors in parentheses. Clustering applied to all models at the level of (550) sampling strata.		

Table 11: Testing for balanced predetermined characteristics

Robustness tests: What do we take from this?

Before we proceed further, we briefly summarize the evidence of the robustness tests. Overall, the fuzzy RDD seems a valid approach to identification and also the assumptions taken in our model appear reasonable. The null hypothesis of balanced characteristics around the threshold cannot be rejected which is an indication that "the local randomization around the threshold"

was indeed successful.[89] We do not reject the assumptions of exogenous fertility and no access to credit markets.[90]

For the estimates of the treatment effect, we find varying levels of robustness. We attempt to clarify the validity of the respective results by assigning them to three categories: 1) Result is robust to all of the robustness tests, 2) result is widely robust, 3) result is not robust.

With respect to the first category, we only find the result on food robust to all of the employed robustness tests. In all specifications, households do increase their expenditure share on food by more than can be explained by a pure income effect.

To the second category, we assign the results on education and school materials, which still seem robust although they do not pass all of the robustness tests. While the coefficient signs and effect sizes of the results on school materials and education are invariant to all robustness tests, the coefficients are not estimated with great precision on the discontinuity subsample and driven insignificant. For the expenditure share on education, we also find indications of additional discontinuities, to the one at the eligibility threshold, in the relation with the forcing variable.

Similar to food, although less pronounced, we find an increase in the expenditure shares on education and school materials which goes beyond what would be expected by a pure income effect.[91] Given that the result on education is in line with theoretical expectations as well as with the results on the similar variable school materials, we deem the evidence trustworthy.

In the third category, we place the results on health care, pharmaceuticals, the perceived constraints for pharmaceuticals and health services which did not pass several of the robustness tests.

The coefficient estimates on health care and pharmaceuticals appear robust in terms of their sign and effect size to the robustness tests but are rendered insignificant in the quadratic model and the subsample model. In addition, we should be careful in their economic interpretation given the lack of information regarding the provision of free public services and possibly pharmaceuticals. Taking together limited robustness and the lack of information on public inputs, we place them in the third category.

[89] The only indication of an unbalanced characteristic may be related to the design of the program (program targets women). In the context of our analysis, we do not see this as a major concern because it is not evident how our results would be driven by the number of women.

[90] We observe increased access to a bank account, which seems to go hand-in-hand with the program, but no significant increase in the households' ability to obtain credit. Fertility is not significantly increased (or decreased) as a result of the program.

[91] For education, the EC suggests an increasing expenditure share with income around the threshold. The treatment effect and income effects go into the same directions. While the income effect would only suggest a small increase in the expenditure share, the treatment effect indicates a doubling of the expenditure share on education. Hence, the treatment effect seems to go beyond what would be predicted by the income effect.

The coefficient estimates on the perceived constraints do not appear robust in the subsample estimation (change of signs in coefficient estimate), the quadratic specification (coefficient estimate on pharmaceuticals constraint changes signs) and the constraint on pharmaceuticals also does not pass the specification test.

In sum, due to the varying robustness of our results, we will confine our interpretation of results to the expenditure shares on food expenditures, education and school materials which appear robust. We will abstain from drawing conclusions on the other variables for which we believe the evidence is not robust enough either for econometric reasons and given the lack of information on the usage of free services and goods provided by the government.

6 Beyond the pure cash transfer – which mechanism is at work?

Our theoretical model suggested three potential channels through which BFP could impact household expenditure decisions: a) income effect; b) female empowerment effect; c) effects due to the conditionality and its monitoring.

The previous empirical analysis and discussion has shown that BFP did have an impact on household expenditure decisions which goes beyond the pure cash transfer. A further understanding of the channels is crucial from a policy point of view. Monitoring mechanisms are costly and compete directly with the amount available to be transferred. If the "effects beyond the cash transfer" are driven by a bargaining power change in favor of women, imposing a costly conditionality might be useless. Even though the channels do not necessarily compete (our results could be driven by both b) and c), the rejection of one of these channels would provide support in favor of the other channel.

6.1 The women's empowerment hypothesis

The evidence that CCTs affect household decision making beyond the income effect is in line with previous findings in the literature. For instance, Angelucci et al. [2012] and Attanasio et al. [2011] have also found a strong increase in food expenditures, despite the income effect pointing in the opposite direction. Attanasio et al. [2011] suggest a strengthened bargaining position of women in the household as a candidate explanation but leave tests for further research. In this section, we attempt to further investigate into this channel.

For Brazil, a priori, there is no clear evidence in favor of the women's empowerment channel. For instance, Braido et al. [2012], analyzing a natural experiment[92] in the context of Bolsa Alimentação (a program that was unified with Bolsa Escola to be replaced by Bolsa Família), have not found evidence in support of this hypothesis. This result is contrary to Thomas's (1990) work, which suggests that unearned income in the hands of the mother has positive effects on her family's health status.

For the women's empowerment channel to matter, two conditions must be fulfilled: (i) women have different preferences in household spending and (ii) women's bargaining power increases as money is transferred to her. If (i) is true, we would expect to find significantly different expenditure decisions in households in which men versus women make decisions. We test this formally in two ways. First, we estimate the previously specified demand equations including interaction terms for female-headed households with income on a subsample of untreated households. Second, we estimate an RDD specification which allows for heterogeneous treatment effects by gender through the inclusion of an interaction term of treatment and female-headed household.

If women have different expenditure preferences than men, the interaction terms should show up as significant in both models. We conceive of this as a necessary but not sufficient condition for the gender channel. Hence, the rejection of (i) would provide evidence against the hypothesis that household decisions change when women gain bargaining power in the household.

We now discuss the expenditure behavior of female-headed households in our sample. The detailed results from the linear and quadratic demand models including the interaction terms are reported in Table 12. In the linear and quadratic models with household expenditures as a dependent variable, all interaction terms between the female-headed household dummy and income appear insignificant. This means that female- and male-headed households are not different in their expenditure choices when confronted with a marginal increase or decrease in their incomes. Based on this finding, we cannot reject the assumption that male- and female-headed households have the same preferences in expenditure choices with respect to a marginal increase in income.

Table 12 also reveals two note-worthy differences between female- and male-headed households which deserve further discussion. First, even though, we do not find differences in the expenditure choices with increasing income between female- and male-headed households, we do observe significant differences in the intercepts (i.e. levels) of the expenditure share on food (male-headed

[92]Their identification is based on three different sources of unintentional administrative exclusion of eligible households from the program.

households spend more money on food at the same level of income),[93] health service constraint (higher for female-headed households) and medication constraint (female-headed households are less constrained). The mentioned differences in some of the intercepts could be due to adverse unobserved characteristics of female-headed households which may result from sample selection, i.e. there may be an underlying reason why a household is female-headed which negatively affects outcomes.

Second, while we do not find heterogeneous behavior in expenditure choices with increasing income, we do find differences in the self-reported medical constraints: In the linear model, the perceived health service constraint declines significantly more with increasing income in female-headed households. From the nonlinear model, we see that this relation holds for lower levels of income. For higher incomes, the constraint of female-headed households increases vis-à-vis male-headed households. As for the pharmaceuticals constraint, we do not observe differences in the linear model; this finding changes when we allow for nonlinearity: While for lower levels of income, the constraint increases with income for female-headed households compared to male-headed households for which the constraint decreases with income, the relation is inversed for higher levels of income for which the constraint for female-headed households decreases while the constraint for male-headed households does not significantly change with further increases in income.

Our results suggest that there seem to be only few differences in the Engel curves of female- and male-headed households. Those differences relate to the intercepts of the models and not to their expenditure choices with expanding income. The differences in intercepts (i.e. levels of expenditure) indicate lower spending on food in female-headed households for a given level of income, an higher intercept of the health service constraint and a lower intercept for the pharmaceuticals constraint in the quadratic model. These differences may be explained by adverse unobservable characteristics which could simultaneously determine expenditure share levels as well as that the household is headed by a woman. However, the higher spending on food in male-headed households and different levels of perceived pharmaceutical and health service constraints should not be over interpreted.[94]

Coming back to our null hypothesis of "similar expenditure behavior between female- and male-headed households with an expansion of income", there is no evidence that expenditure

[93] The result holds only in the linear specification.

[94] If anything, the higher level of food expenditures in male-headed households and the higher level of the health service constraint in female-headed households, whereby health services are provided free of charge by the government, counteracts the hypothesis that female-headed households have a stronger preference towards investments in child health and education than male-headed households.

choices are different with expanding income in in female-headed households and male-headed households.

We now proceed to the second test: We re-estimate the fuzzy RDD specification and add an interaction term between treatment and female-headed household. The added interaction term is instrumented by an interaction term of the eligibility rule and female-headed household. The coefficient on the interaction effect in the second stage signifies the joint effect of increased bargaining power by women (the woman is the decision-maker in the household) and BFP participation. Even though we cannot disentangle the effect in the empowerment and BFP components (i.e. we do not know whether the effect is due to an increased number of female household heads or that female-headed households are affected differently), we would expect the coefficient to show up as significant if the empowerment channel matters for expenditure decisions unless the two effects exactly counterbalance each other. The latter is extremely unlikely because, under the gender hypothesis, we would expect them to go in the same direction.

The summary of results are reported in Table 13. The detailed results are reported in Tables 36, 37,38 and 39. When we add the interaction term to the base specification, the treatment effect remains unchanged. Most of the interaction terms are not significant. Female-headed households experience a significantly stronger decline in the expenditure share of medicine and health care, their perceived health care constraint is significantly higher and the perceived constraint on medication is lower. Again, the results may be driven by adverse unobserved characteristics which may determine both the outcome and the status of the household as female-headed. If anything, these results contradict the hypothesis that female-headed households under the program invest more in child human capital than male-headed households when they receive additional income.

Linear demand system with interaction terms for female-headed households (t-values in parentheses)

	Expenditure Share										Perceived Constraint			
	Nutrition		Education		School Materials		Pharmaceuticals		Health Care		Pharmaceuticals		Health Services	
Constant	0.44	(22)	-0.006	(-1.1)	0.011	(8)	0.05	(7)	0.052	(5.5)	0.65	(7.1)	0.09	(3.8)
Female dummy	-0.024	(-2)	-0.0034	(-0.95)	0.00094	(1.1)	0.0045	(1)	-0.0014	(-0.24)	-0.013	(-0.22)	0.06	(4.1)
Income	-0.036	(-26)	0.0046	(11)	-0.0012	(-12)	-0.0037	(-7.3)	-0.00067	(-1)	-0.1	(-16)	-0.0089	(-5.4)
Income*female	0.003	(1.5)	0.00076	(1.3)	-0.00013	(-0.88)	2.5e-05	(0.034)	0.0011	(1.1)	0.0098	(1)	-0.0091	(-3.8)
Socio-economic controls	Yes		Yes		Yes		Yes		Yes		Yes		Yes	
Regional dummies	Yes		Yes		Yes		Yes		Yes		Yes		Yes	

Quadratic demand system with interaction terms for female-headed households (t-values in parentheses)

	Expenditure Share										Perceived Constraint			
	Nutrition		Education		School Materials		Pharmaceuticals		Health Care		Pharmaceuticals		Health Services	
Constant	0.38	(12)	0.015	(1.6)	0.0094	(4)	0.024	(2)	0.025	(1.6)	0.79	(5.3)	0.091	(2.4)
Female dummy	-0.023	(-0.52)	0.002	(0.15)	-0.00069	(-0.21)	-0.0066	(-0.41)	0.0057	(0.26)	-0.53	(-2.6)	0.16	(3.1)
Income	-0.018	(-2.1)	-0.0027	(-1)	-0.00057	(-0.9)	0.0052	(1.6)	0.0087	(2.1)	-0.15	(-3.7)	-0.0097	(-0.95)
Income*female	0.0032	(0.22)	-0.0013	(-0.31)	0.00045	(0.42)	0.0041	(0.77)	-0.0011	(-0.15)	0.19	(2.7)	-0.045	(-2.6)
$Income^2$	-0.0015	(-2.2)	0.00061	(2.9)	-5.6e-05	(-1.1)	-0.00074	(-2.9)	-0.00078	(-2.3)	0.0038	(1.2)	9.1e-05	(0.11)
$Income^2$*female	-5.7e-05	(-0.047)	0.00019	(0.54)	-5.1e-05	(-0.57)	-0.00036	(-0.83)	0.00016	(0.27)	-0.015	(-2.6)	0.003	(2.1)
Socio-economic controls	Yes		Yes		Yes		Yes		Yes		Yes		Yes	
Regional dummies	Yes		Yes		Yes		Yes		Yes		Yes		Yes	

Testing for differences between female and male-headed households, estimation of AIDS/QUAIDS model, t-values in parentheses. 549 regional dummies included, clustering applied at the level of 550 sampling strata. Socio-economic controls: nr. of hh members, nr. of women,female hh head, black hh head, Asian hh head, Pardo hh head, indigenous hh head, hh head illiterate, Universal religion, Catholic religion, Batista religion, Evangelical religion, Assembly of god religion, Lutheran religion, nb. of whites in hh, nb. of blacks in hh, nb. of Asians in hh, nb. of Pardo in hh, nb. of indigenous in hh, health insurance, child or teen pregnant(10-17), young adult pregnant (18-25), credit card, bank account.

Table 12: Testing for gender-specific differences in expenditure choices and perceived constraints

In sum, we have not found evidence that untreated female-headed households or female-headed households under the program invest more in child health and education (i.e. that they have different preferences on expenditures) than male-headed households when confronted with an increase in their income. Based on the previous evidence, we cannot reject the hypothesis that male- and female-headed households have similar preferences with respect to investments in child human capital when confronted with an increase in income. For this reason, one of the two necessary conditions of the gender channel (i) "different preferences between men and women" seems not to be met. Hence, the analysis in this section could not find evidence in favor of the women's bargaining power channel.

Ordinary Least Squares

	Expenditure Share										Perceived Constraint			
	Nutrition		Education		School Materials		Pharmaceuticals		Health Care		Pharmaceuticals		Health Services	
Treatment	0.018	(0.0029)	-0.0017	(0.00048)	0.0013	(0.00019)	0.00024	(0.00094)	0.00052	(0.0012)	0.16	(0.015)	0.0097	(0.0039)
Treatment * Female	-0.0027	(0.0041)	0.0015	(0.00072)	0.00042	(0.00034)	-0.0041	(0.0016)	-0.0061	(0.0018)	-0.049	(0.024)	0.027	(0.0088)

Linear fuzzy Regression Discontinuity Design

	Expenditure Share										Perceived Constraint			
	Nutrition		Education		School Materials		Pharmaceuticals		Health Care		Pharmaceuticals		Health Services	
Treatment	0.1	(0.024)	0.0097	(0.003)	0.0072	(0.0018)	-0.025	(0.0069)	-0.022	(0.0082)	0.41	(0.13)	0.043	(0.044)
Treatment * Female	0.0057	(0.012)	-0.0014	(0.0019)	-0.00032	(0.0012)	-0.014	(0.0038)	-0.018	(0.0043)	-0.19	(0.053)	0.078	(0.03)

Quadratic fuzzy Regression Discontinuity Design

	Expenditure Share										Perceived Constraint			
	Nutrition		Education		School Materials		Pharmaceuticals		Health Care		Pharmaceuticals		Health Services	
Treatment	0.14	(0.069)	0.021	(0.0075)	0.011	(0.0058)	-0.025	(0.018)	-0.03	(0.022)	-0.059	(0.32)	0.069	(0.12)
Treatment * Female	0.0083	(0.013)	-0.00065	(0.002)	-9.4e-05	(0.0013)	-0.013	(0.0039)	-0.019	(0.0044)	-0.21	(0.054)	0.079	(0.031)

Testing for heterogeneous treatment effects between female and male-headed households, estimation of fuzzy RDD model, standard errors in parentheses. The interaction term treatment * female-headed household is instrumented by the interaction term the eligibility rule * female-headed household. Clustering applied at the level of 550 sampling strata. 549 regional dummies are included in the model as controls. The detailed results are reported in Tables 36, 37,38 and 39.

Table 13: Testing for heterogeneity in treatment effect by gender

6.2 Conditionality matters

In the previous analysis, we found that the BFP affects household expenditure decisions in a more fundamental way than through the transfer of cash (income effect). This finding is in line with previous evidence from the literature (see Attanasio et al. [2011], Angelucci et al. [2012]). In particular, Attanasio et al. [2011] have also found a stark increase in the food expenditure share in the context of a Colombian CCT scheme – this effect contradicts Engel's law and does not seem to be accounted for by the expansion of the household budget through the cash transfer. Attanasio et al. [2011] speculated that a strengthening of women's bargaining position may explain this result. In the case of BFP, we have not found evidence in favor of this hypothesis.

Instead, we propose a new explanation based on our theoretical framework: the perception of the household as to whether private investments in human capital are complements or substitutes to the conditionality. Given that households are obliged to send their children to school under the program and school attendance is constantly monitored, it is rational for households to complement schooling as input into child human capital production with private investments such as in school materials. An analog reasoning can be established for health services and for food. Against the background of our conceptual framework, we found evidence that households act as if they perceive food, school materials and education expenditures as complementary inputs to the conditionalities under the CCT.[95] We believe that this is an important finding which deserves more attention in further research efforts. A better understanding of how households act under CCT programs and of their rationales of action may provide important guidance for the design of such programs.

We conclude with stylized facts on our findings. Figure 8 shows the expenditure share on the three critical variables to this essay (food, education and health) by income categories and household composition in terms of child age. The vertical axis indicates the expenditure share, the horizontal axis displays income (up to R$ 500 per capita to focus on households around the threshold).[96] The graphs in the first column show the behavior for families with at least one child or teenager (from zero to 17 years old). The second column shows families with at least one child from zero to five years old. The third column show the same for families with kids from six to 15 years old.

[95] The evidence on health expenditures was inconclusive.
[96] Almost 95% of BFP beneficiaries have income per capita below R$ 500.

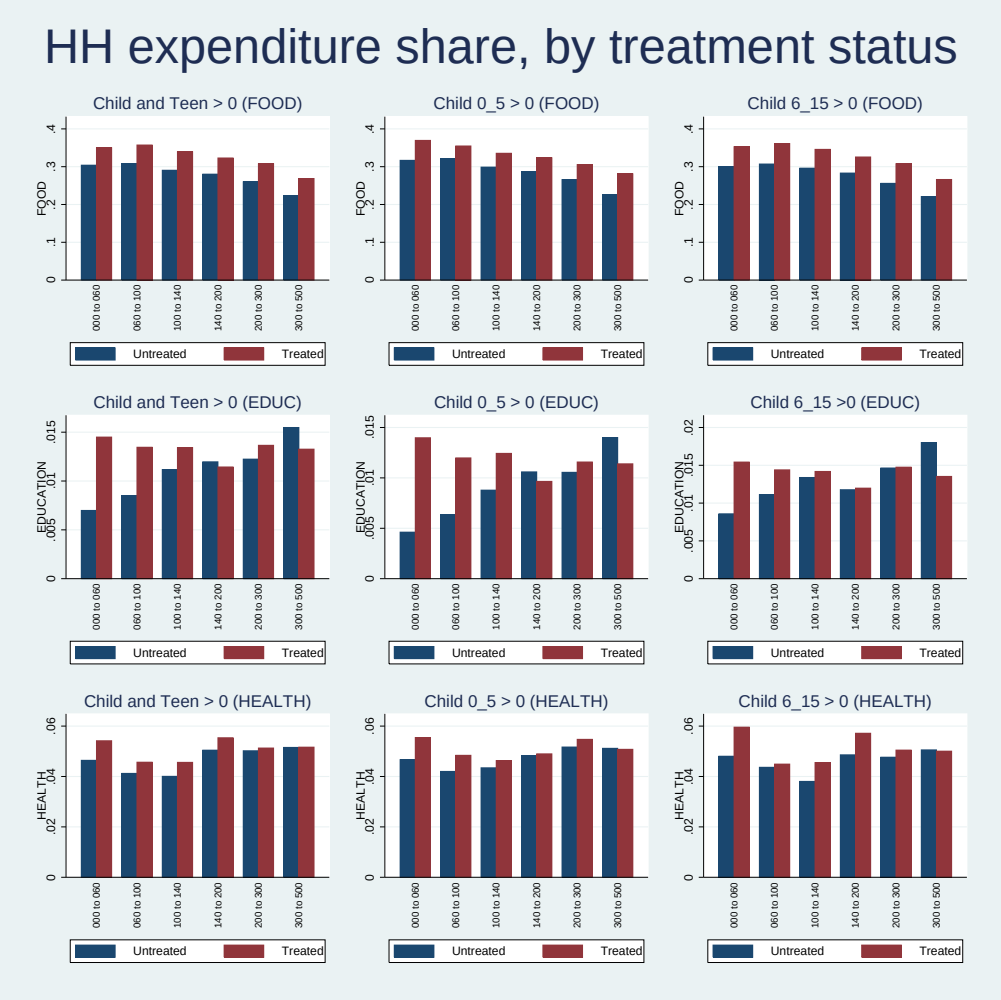

Figure 8: Expenditure share by treatment status

We observe that the expenditure share on food is higher for all levels of income for BFP households. The expenditure share on education is larger for treated households below the threshold (R$ 120), although at a low absolute level of expenditure. As for health, the expenditure share for treated households is also larger than for untreated, but the difference is negligible. These findings are consistent with our empirical findings which indicate a robust and positive impact of BFP on food expenditures. We also found a positive but less robust impact on school materials and education expenditures, but could not find robust results on health expenditures.

The described differences for education (and health) expenditures for treated and untreated households are larger for smaller levels of income per capita. Our identification strategy, a fuzzy RDD approach, implies that we estimate a local average treatment effect, i.e. a treatment effect at the threshold. If children from families with low incomes attend school less frequently than those from families with higher incomes, Bolsa Família is more likely to lead to a switch in school attendance behavior for children of low income households. An analog reasoning can be

established for the usage of health services.[97]

We cannot directly test for this due to lack of data on school attendance and the usage of health services. But, we do have information on school enrollment and do observe lower enrollment rates at lower levels of income for children of school age (Figure 9). It is likely that the lower rates of school enrollment also translate into lower actual school attendance and, hence, a higher chance of switching behavior. In light of this descriptive evidence, the estimated local average treatment effect may understate the true treatment effect for the subpopulation of BFP recipients with lower income levels. We believe that this is an interesting source of impact heterogeneity which should be investigated further in future research.

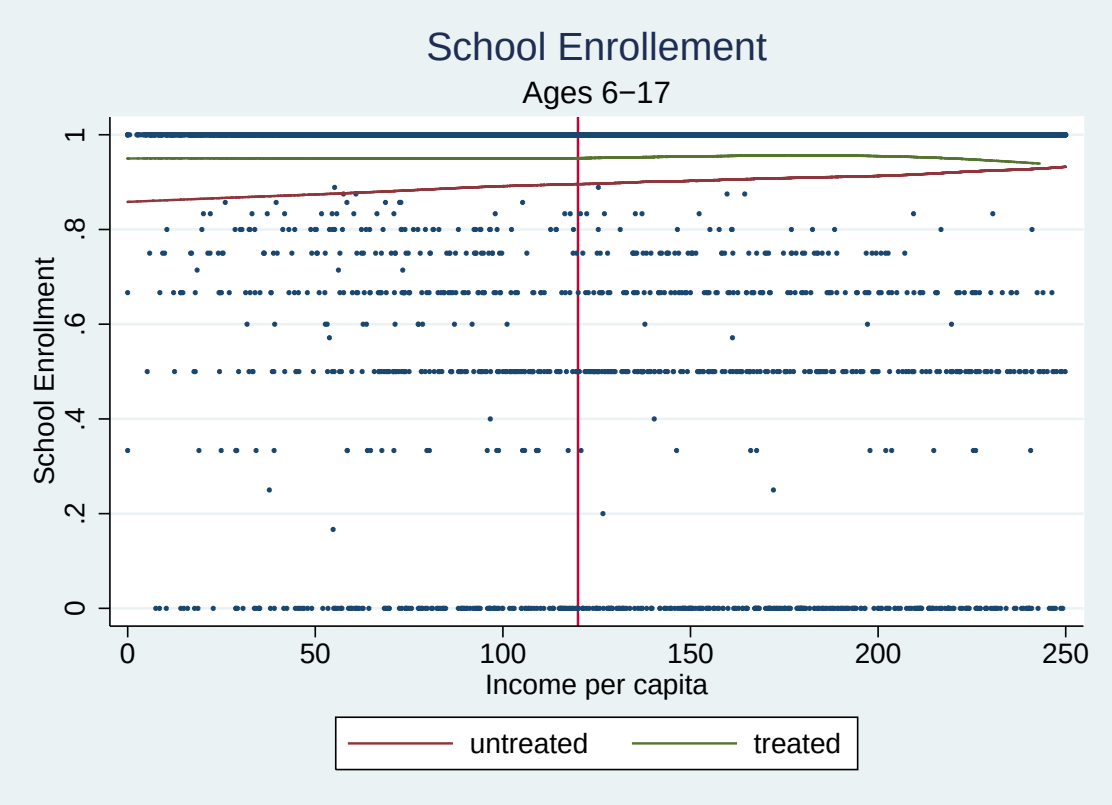

Figure 9: School enrollment of children from 6 to 17 years of age (in percent) plotted against income

7 Conclusion

In many developing and emerging countries, Conditional Cash Transfer programs have become an important instrument to address poverty. While the cash transfer can remedy poverty in the short run, in the long run, investments in human capital are crucial to break poverty transmission.

[97] For a formal derivation of the "switching condition", see section 8.4.

For a conditional social program to be successful in enhancing human capital formation, it is important that its presumably positive effect (through the conditionalities, intra-household allocation and an increase in disposable income) is complemented by private investments or, at least, not undone by changes in private expenditure decisions.

In this essay, we analyze how household expenditure decisions in nutrition, health and education change in the context of the Bolsa Família Program, the largest Conditional Cash Transfer program of which we have knowledge. We first model household behavior under a CCT program and show how intra-household preferences and their perception on the substitutability or complementarity character of inputs to human capital production influence their resource allocation decisions. Subsequently, we empirically test the theoretical implications with respect to private investments in child health and education, using the Brazilian household expenditure survey POF 2008-2009.

Overall, the results indicate an impact of the program which goes beyond the pure income effect of a cash transfer. We, then, investigate whether a gender effect could drive our results (i.e. different preferences between men and women together with increased bargaining power for women resulting from the program) and find no evidence in favor of this hypothesis. In line with our theoretical framework, we suggest that the conditionalities could drive the results through the perception of the nature of the human capital production function. To receive the cash transfer, beneficiary households are obliged to demand certain education and health services. Given the imposed demand for these inputs to human capital formation, households should adapt their expenditure behavior for the other inputs accordingly depending on whether they conceive of them as complements or substitutes. Indeed, we observe that households act in accordance with this theoretical prediction and adjust their expenditures in complementary inputs to health and education. The evidence is most pronounced for food; a positive impact (although less robust) is also found for education and school materials expenditures which households seem to perceive as complementary inputs to education and health services in human capital production. Our results with respect to health are not conclusive.

In conclusion, our findings have great policy relevance for the design of social programs. Firstly, we found that households react differently to a cash transfer provided with conditionalities compared to an expansion of the overall household budget. Secondly, we suggest the household's perception of the nature of inputs to the human capital production function as one possible explanation. Finally, more research is needed to further disentangle the channels through which the conditionalities affect household decisions.

8 Appendix

8.1 Eligibility criteria - Bolsa Família Program

child up to 15	teen 16 and 17	Benefit	Value (R$)
HH p/c income up to R$ 60			
0	0	Basic	62.00
1	0	Basic + 1 Var	82.00
2	0	Basic + 2 Var	102.00
3	0	Basic + 3 Var	122.00
0	1	Basic + 1 BVJ	92.00
1	1	Basic + 1 Var + 1 BVJ	112.00
2	1	Basic + 2 Var + 1 BVJ	132.00
3	1	Basic + 3 Var + 1 BVJ	152.00
0	2	Basic + 2 BVJ	122.00
1	2	Basic + 1 Var + 2 BVJ	142.00
2	2	Basic + 2 Var + 2 BVJ	162.00
3	2	Basic + 3 Var + 2 BVJ	182.00
HH p/c income: R$ 60 - 120			
0	0	No benefit	00.00
1	0	1 Var	20.00
2	0	2 Var	40.00
3	0	3 Var	60.00
0	1	1 BVJ	30.00
1	1	1 Var + 1 BVJ	50.00
2	1	2 Var + 1 BVJ	70.00
3	1	3 Var + 1 BVJ	90.00
0	2	2 BVJ	60.00
1	2	1 Var+ 2 BVJ	80.00
2	2	2 Var + 2 BVJ	100.00
3	2	3 Var + 2 BVJ	120.00

Table 14: BFP eligibility criteria and amount of transfer

Note:(B) Base transfer of R$ 62 is paid to the poorest households irrespective of the number of children; (Var) Variable allowance = R$ 20. This allowance is paid for those households with income of up to R$ 120 (per month) conditional on having children or teenagers up to 15 years old, up to 3 children; (BVJ) Variable allowance related to the number of teenagers (R$ 30). This allowance is paid to those households who have teenagers between 16 and 17 years old who are attending school, up to 2 teenagers (BVJ); (BVCE) Extraordinary variable benefits. This is paid for households to ensure that they are not worse off if they switch from other social programs (Auxilio-Gs, Bolsa Escola, Bolsa Alimentacao e Cartao) to Bolsa Família. The values of the transfers correspond to the period of the PNADs' 2008/2009 survey. Information on the current allowances is available on the official website of Bolsa Família.

8.2 Conditionalities - Bolsa Família Program

- Health
    1. update the immunization card of children under 7 years;
    2. health service check-ups for children under 7 years;
    3. women of 14 to 44 years should regularly participate in certain health services and, if pregnant or lactating (breastfeeding) should carry out pre-natal care;
- Education
    1. children and teenagers of age 6 to 15 years must be enrolled and attending school at least 85% of the time;
    2. students of age 16 and 17 must attend school at a monthly frequency of at least 75%.
- Child labor
    1. children and adolescents under 15 years of age at risk or removed from child labor by the Program to Eradicate Child Labor (PETI), must participate in a special service provided by PETI and attend with a minimum frequency of 85%.
- Punishment for non-compliance
    1. In case a family is considered in a situation of social vulnerability, additional services are provided to the household in order to help them to achieve compliance with the conditionalities;
    2. In case of continued non-compliance with the conditionalities, the family may have the benefit of Bolsa Família suspended or terminated.
- Government commitment
    1. Provide cash transfer according to the eligibility criteria and monitor the compliance.
    2. Provide the basic public health and education services to make the compliance feasible.

State/Region	2004	2005	2006	2007	2008	2009	2010	2011
North	**527,652**	**697,644**	**1,023,507**	**1,081,636**	**1,075,885**	**1,285,567**	**1,348,329**	**1,476,939**
Rondônia	54,942	68,343	94,953	97,270	92,914	116,211	114,112	112,950
Acre	28,851	38,908	53,404	57,354	55,037	62,600	59,779	56,272
Amazonas	104,135	147,266	204,075	216,487	222,542	263,064	278,893	307,285
Roraima	14,522	17,583	31,850	32,344	33,622	41,201	42,213	45,575
Pará	259,641	337,694	506,444	532,755	528,997	635,204	680,804	772,311
Amapá	10,256	11,429	26,244	38,505	39,191	44,678	44,096	50,832
Tocantins	55,305	76,421	106,537	106,921	103,582	122,609	128,432	131,714
Northeast	**3,320,446**	**4,245,574**	**5,442,567**	**5,573,605**	**5,445,428**	**6,207,633**	**6,454,764**	**6,825,997**
Maranhão	380,742	532,126	706,878	737,539	729,610	846,345	871,297	920,048
Piauí	217,931	284,297	366,906	368,612	360,622	413,867	420,392	444,696
Ceará	572,730	742,454	882,220	891,418	870,153	947,720	1,022,259	1,076,764
Rio Grande do Norte	190,116	240,828	298,643	302,720	292,522	321,710	338,424	349,595
Paraíba	273,135	337,001	406,904	416,863	410,707	444,729	450,525	487,779
Pernambuco	518,956	633,500	860,546	905,919	881,591	1,035,989	1,045,268	1,115,851
Alagoas	214,726	253,745	339,921	351,402	347,585	395,459	414,112	425,137
Sergipe	113,147	154,332	189,304	187,470	179,875	220,175	230,418	253,134
Bahia	838,963	1,067,291	1,391,245	1,411,662	1,372,763	1,581,639	1,662,069	1,752,993
Southeast	**1,730,675**	**2,325,379**	**2,875,677**	**2,848,034**	**2,637,339**	**3,105,229**	**3,185,843**	**3,296,258**
Minas Gerais	756,335	998,011	1,128,261	1,080,823	992,739	1,117,946	1,135,715	1,159,172
Espírito Santo	120,911	160,836	191,421	187,927	171,419	190,428	189,983	192,365
Rio de Janeiro	196,330	302,733	441,667	494,051	498,378	658,726	685,301	734,902
São Paulo	657,099	863,799	1,114,328	1,085,233	974,803	1,138,129	1,174,844	1,209,819
South	**700,661**	**987,062**	**1,027,439**	**956,129**	**853,526**	**1,095,986**	**1,064,068**	**1,035,602**
Paraná	308,754	447,186	452,172	410,885	367,247	482,335	466,607	444,050
Santa Catarina	101,247	141,744	139,098	134,704	118,648	150,685	143,700	140,774
Rio Grande do Sul	290,660	398,132	436,169	410,540	367,631	462,966	453,761	450,778
Center-West	**292,405**	**444,786**	**596,620**	**583,672**	**545,818**	**676,500**	**725,216**	**717,510**
Mato Grosso do Sul	32,588	85,098	114,876	112,212	102,433	127,768	132,887	134,447
Mato Grosso	82,116	118,663	136,495	132,798	121,703	166,456	167,693	171,905
Goiás	135,758	186,866	259,524	260,368	245,268	305,949	326,084	333,567
Distrito Federal	41,943	54,159	85,725	78,294	76,414	76,327	98,552	77,591
TOTAL	**6,571,839**	**8,700,445**	**10,965,810**	**11,043,076**	**10,557,996**	**12,370,915**	**12,778,220**	**13,352,306**

Table 15: Distribution of Bolsa Família's beneficiaries (households)

Source: Ministry of Social Development (2012)

State/Region	2004	2005	2006	2007	2008	2009	2010	2011
North	**71,612**	**75,041**	**96,932**	**111,629**	**120,481**	**154,184**	**155,069**	**198,390**
Rondónia	6,710	6,658	8,442	9,388	9,548	12,755	12,056	13,980
Acre	3,950	4,152	4,981	5,858	6,125	7,617	7,061	8,135
Amazonas	14,767	16,332	19,627	22,668	25,335	32,522	33,191	43,194
Roraima	1,924	1,935	3,104	3,329	3,879	5,104	5,010	6,307
Pará	35,649	37,112	49,207	56,392	60,590	77,543	79,226	103,275
Amapá	1,399	1,258	2,475	3,992	4,513	5,600	5,354	7,376
Tocantins	7,213	7,595	9,096	10,002	10,493	13,043	13,171	16,122
Northeast	**444,815**	**446,676**	**495,700**	**549,088**	**573,974**	**696,455**	**690,014**	**823,668**
Maranhão	53,688	59,150	68,600	77,503	82,308	100,936	98,621	118,695
Piauí	29,924	30,406	33,971	36,786	38,422	46,446	44,858	53,178
Ceará	77,036	77,830	79,214	86,418	90,334	104,907	107,653	127,563
Rio Grande do Norte	24,499	24,184	25,611	28,075	29,349	34,596	34,903	40,988
Paraíba	36,496	35,362	36,930	40,987	43,111	49,453	47,693	57,841
Pernambuco	67,288	64,659	76,964	87,757	91,255	114,232	110,272	133,041
Alagoas	28,956	26,737	30,159	33,896	35,917	44,305	44,309	52,355
Sergipe	15,167	16,037	17,517	18,875	19,520	24,980	24,842	30,858
Bahia	111,762	112,311	126,734	138,790	143,760	176,601	176,863	209,150
Southeast	**204,774**	**215,563**	**228,151**	**244,650**	**243,653**	**304,500**	**305,528**	**379,158**
Minas Gerais	91,320	93,746	90,540	93,291	92,296	109,333	108,909	134,347
Espírito Santo	14,226	14,825	15,081	16,064	15,761	18,663	18,337	22,512
Rio de Janeiro	24,023	28,721	36,154	44,156	48,081	68,249	68,382	85,675
São Paulo	75,207	78,272	86,377	91,139	87,516	108,255	109,900	136,623
South	**79,788**	**87,680**	**80,162**	**81,023**	**77,991**	**103,467**	**100,141**	**118,128**
Paraná	34,220	38,469	34,270	33,761	32,555	43,544	42,439	49,790
Santa Catarina	11,736	12,748	10,802	11,211	10,719	13,942	13,202	16,204
Rio Grande do Sul	33,832	36,464	35,091	36,052	34,717	45,980	44,500	52,135
Center-West	**33,267**	**39,092**	**45,619**	**49,209**	**49,780**	**65,924**	**68,869**	**82,736**
Mato Grosso do Sul	4,170	7,521	8,917	9,682	9,627	12,650	13,014	15,947
Mato Grosso	9,616	10,712	10,641	11,427	11,318	16,256	16,263	20,481
Goiás	15,113	16,155	19,416	21,597	22,084	29,662	31,432	38,630
Distrito Federal	4,369	4,704	6,644	6,502	6,750	7,356	8,160	7,678
TOTAL	**834,257**	**864,053**	**946,565**	**1,035,599**	**1,065,879**	**1,324,529**	**1,319,621**	**1,602,080**

Table 16: Amount of Transfer by Brazilian states (in R$ thousand)

Source: Ministry of Social Development (2012). Values in R$ of 2011 based on IPCA (Portuguese acronym for Extended National Consumer Price Index elaborated IBGE). This is the official inflation index used by the Central Bank for inflation targeting. The average nominal exchange rate in 2011 was R$ 1.00 = US$ 0.59.

8.3 Consumer Optimization I

In this appendix, we discuss how the form of transfer of purchasing power, i.e. whether transferred as cash or in-kind, can affect household utility in a one period optimization problem. Let us assume a representative consumer, with a set of affordable bundles (X), local nonsatiation and one period of time (t). The problem can be written as follows:

$$max\ u(x)\ s.t.\ px = m \tag{26}$$

$$B = \{x\ is\ in\ X\} \tag{27}$$

Where: B is the set of affordable bundles.

Let us assume that there are two types of households in this economy separated by an income (m) threshold that is called 'poverty line'.[98] For some reason, society agrees to transfer purchasing power to households that are below the poverty line; the transfer is intended to ensure basic investments in the human capital of their children.[99] The transfer can take the form of cash or an in-kind transfer; in the following, we will discuss the question of the appropriate form of transfer.

In order to answer this question we can reorganize the optimization problem to take into consideration the transfer in form of ΔM or Δx_i to allow us to compare cash and in-kind transfers in terms of indirect consumer utility. Let us assume a Cobb-Douglas utility function given by $u(x_i, x_n) = x_i^{\alpha} x_n^{\beta}$.

$$\underset{\{x_i, x_n\}}{max} (x_i + \Delta x_i)^{\alpha} x_n^{\beta} \tag{28}$$

$$s.t.\ \ p_i x_i + p_n x_n = M + \Delta M \tag{29}$$

where $p_i \Delta x_i + p_n \Delta x_n = \Delta M$.

In order to solve this maximization problem, we can substitute the budget constraint into the utility function to make it an unconstrained optimization problem with respect to x_i.

$$x_n = \frac{(M + \Delta M) - p_i x_i}{p_n} \tag{30}$$

[98] The poverty line is defined in absolute terms

[99] The rationale of transfer could be based on equity or efficiency criteria. There might be some interesting political economy issues related to this kind of agreement such as the size of these cohorts and their bargaining power, but we are not addressing them in this essay. In fact, we are taking the decision of transfer as given.

Replacing x_n into the optimization problem we have:

$$\underset{\{x_i\}}{max}(x_i + \Delta x_i)^{\alpha}\Big(\frac{(M + \Delta M) - p_i x_i}{p_n}\Big)^{\beta} \tag{31}$$

The First Order Condition (FOC) is the following:

$$\frac{du(x_i, x_n(x_i))}{dx_i} = \frac{\partial u}{\partial x_i} + \frac{\partial u}{\partial x_n}\frac{\partial dx_i}{\partial dx_n} = 0 \tag{32}$$

$$\begin{aligned} u'(x_i) &= \alpha(x_i + \Delta x_i)^{\alpha-1}\Big(\frac{(M + \Delta M) - p_i x_i}{p_n}\Big)^{\beta} + \beta(x_i + \Delta x_i)^{\alpha}\Big(\frac{(M + \Delta M) - p_i x_i}{p_n}\Big)^{\beta-1}\Big(-\frac{p_i}{p_n}\Big) \\ &= (x_i + \Delta x_i)^{\alpha}\Big(\frac{(M + \Delta M) - p_i x_i}{p_n}\Big)^{\beta}\Big[\alpha(x_i + \Delta x_i)^{-1} + \beta\Big(\frac{(M + \Delta M) - p_i x_i}{p_n}\Big)^{-1}\Big(-\frac{p_i}{p_n}\Big)\Big] \end{aligned} \tag{33}$$

Therefore, the FOC is satisfied when

$$u'(x_i) = \alpha(x_i + \Delta x_i)^{-1} + \beta((M + \Delta M) - p_i x_i)^{-1}(-\,p_i) = 0 \tag{34}$$

Solving this for x_i, the demand for each good will be

$$x_i = \frac{\alpha}{\alpha + \beta}\left(\frac{(M + \Delta M)}{p_i}\right) + \frac{\beta}{\alpha + \beta}(\Delta x_i) \tag{35}$$

$$x_n = \frac{\beta}{\alpha + \beta}\left(\frac{(M + \Delta M)}{p_n}\right) + \frac{\beta}{\alpha + \beta}\Big(\frac{p_i}{p_n}\Big)(\Delta x_i). \tag{36}$$

Replacing x_i and x_n in the utility function, we obtain the following 'indirect utility function',

$$\begin{aligned} V_{(p,M)} &= \left(\frac{\alpha}{\alpha + \beta}\left(\frac{(M + \Delta M)}{p_i}\right) + \frac{\beta}{\alpha + \beta}\Delta x_i\right)^{\alpha}\left(\frac{\beta}{\alpha + \beta}\left(\frac{(M + \Delta M)}{p_n}\right) + \frac{\beta}{\alpha + \beta}\Big(\frac{p_i}{p_n}\Big)(\Delta x_i)\right)^{\beta} \\ &= \left(\frac{(M + \Delta M)}{p_i} + \Delta x_i\right)^{\alpha}\left(\frac{(M + \Delta M)}{p_n} + \frac{p_i}{p_n}\Delta x_i\right)^{\beta}\frac{\alpha^{\alpha}\beta^{\beta}}{\alpha + \beta^{\alpha+\beta}} \end{aligned} \tag{37}$$

With the indirect utility function at hand, we consider different types of transfer which the government could provide. If the government transfers cash, then $\Delta M > 0$ and $\Delta x_i = 0$.

$$V_{(p,M,\Delta M)} = \left(\frac{(M+\Delta M)}{p_i}\right)^{\alpha}\left(\frac{(M+\Delta M)}{p_n}\right)^{\beta}\frac{\alpha^{\alpha}\beta^{\beta}}{\alpha+\beta^{\alpha+\beta}} \tag{38}$$

If the government decides to provide in-kind transfers, such that $p_i\Delta x_i = M > 0$, then $\Delta x_i > 0$ and $\Delta M = 0$, it implies

$$V_{(p,M,\Delta x_i)} = \left(\frac{M}{p_i}+\Delta x_i\right)^{\alpha}\left(\frac{M}{p_n}+\frac{p_i}{p_n}\Delta x_i\right)^{\beta}\frac{\alpha^{\alpha}\beta^{\beta}}{\alpha+\beta^{\alpha+\beta}} \tag{39}$$

Since $\Delta x_i = \Delta M/p_i$ we can see that the indirect utility function will be the same, irrespective of the transfer which is provided. In this case, the cash transfer ΔM will provide the same utility as the transfer of a good Δx_i such as $\Delta M = p_i\Delta x_i$ and the transfer in form of a good Δx_i cannot provide a level of utility that is strictly inferior in this condition.

However, this conclusion holds under the assumption that there is no additional transaction cost for exchanging x_i by x_n. If there is an additional cost ϕ, then the cash transfer $\Delta M = p_i\Delta x_i$ will provide at least as much utility as the transfer of a good Δx_i, but in this case the level of utility provided by Δx_i can be strictly inferior. The necessary condition for this is that the amount of optimal consumption of x_i after the transfer ($x_i^{'*}$) should be smaller than the amount of x_i transferred in-kind ($\Delta x = x_i^c$). If this condition holds, the consumer would be better off by exchanging x_i by x_n and would incur an additional cost of $\phi^*(\Delta x\text{-}x_i^{'*})$.

Figures 10 and 11 show these different possibilities and their effect on consumer choices in two different situations. In the first situation (Figure 10), given the consumers' preferences, the form of transfer does not affect the optimal choice. In the second situation (Figure 11), there is a deadweight loss in consumer's welfare in the presence of an exchange cost (ϕ), under the condition that $\Delta x > x_i^{'*}$.

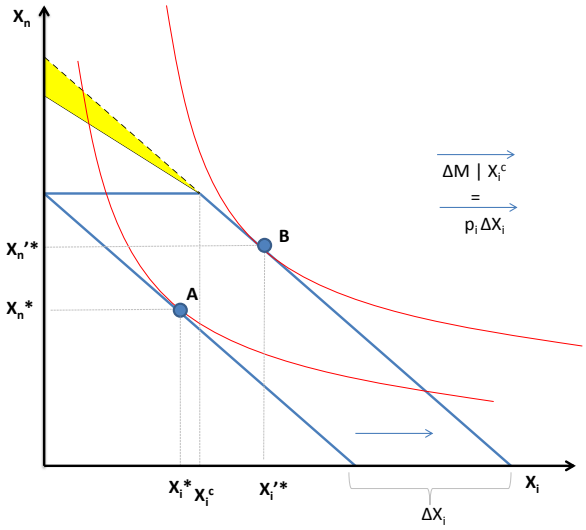

Figure 10: CCT($\Delta M|x_i^c$) or Δx_i for consumers not affected by potential deadweight loss

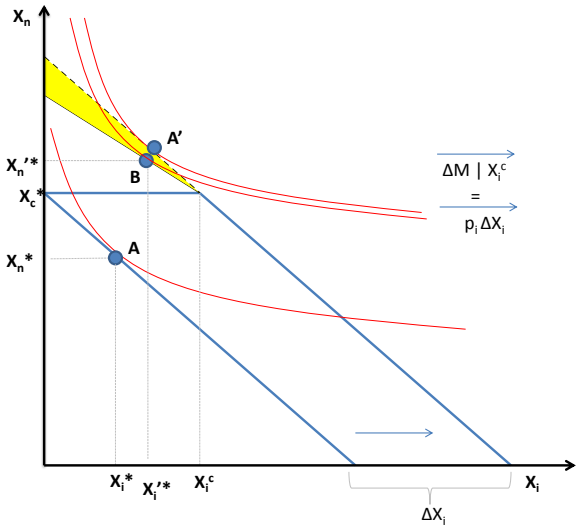

Figure 11: CCT($\Delta M|x_i^c$) or Δx_i for consumers affected by potential deadweight loss in the presence of exchange cost (ϕ)

8.4 Consumer Optimization II

In this appendix, we specify a functional form to the utility function of the optimization problem presented in equation (5). Subsequently, under similar assumptions as described in section (3), we derive the household's optimal choice of consumption and investment in child human capital in the context of a CCT program. The solution for the optimal choice of Z_{it}, the subcomponents of investments in human capital, informs the formulation of the hypotheses in section 3 of this essay.

To solve the optimization problem in eq. (5), we specify a Cobb-Douglas logarithmic form[100] for the utility function and assume[101] $E[V(hc_{t+1})] = log(\theta Z_{gt}^{\rho} + (1-\theta)\ Z_{it}^{\rho})^{(1/\rho)}$. Given that Z_{gt} is provided by the government without an explicit cost to the consumer, the household's maximization problem can be written as (see equations (5) and (6)):

$$\begin{aligned}(c_t^*, c_{t+1}^*, Z_{gt}^*, Z_{it}^*) = \underset{\{c_t^*, c_{t+1}^*, Z_{gt}^*, Z_{it}^*\}}{max} \{log(c_t) + \beta\ log(c_{t+1}) + \beta\alpha\ log(\theta Z_{gt}^{\rho} + (1-\theta)\ Z_{it}^{\rho})^{(1/\rho)})\} \\ s.t\ \ c_t + \frac{c_{t+1}}{(1+r)} + \omega_{it} Z_{it} + \phi Z_{gt}^{+} = wH + \$CT\end{aligned} \tag{40}$$

whereby $0 \geq \theta \geq 1$. By defining a Cobb-Douglas logarithmic form for the utility function we assume that the share of total expenditure on the three components (c_1, c_2 and I_t) is constant and driven by the parameters α and β. Under this condition, the interest rate (r) does not determine the demand for Z_{it} directly. The CES specification of the human capital production function implies that the amount spent on Z_{it} depends on the elasticity of substitution σ of the inputs to human capital production hc_{t+1}, whereby $\sigma = \frac{1}{1-\rho}$ and $\rho \in (-\infty, 1]$. Three cases can be distinguished ($\rho \to -\infty;\ \rho \to 0\ and\ \rho \to 1$) whereby the value of ρ determines different properties with respect to the complementarity or substitutability between the inputs Z_{gt} and Z_{it}.

The household's problem can be solved by the Lagrangian method:

$$\begin{aligned}L(c_t^*, c_{t+1}^*, I_t^*, \lambda) = log(c_t) + \beta\ log(c_{t+1}) + \beta\alpha\ log(\theta Z_{gt}^{\rho} + (1-\theta)\ Z_{it}^{\rho})^{(1/\rho)}) - \\ - \lambda \left(c_t + \frac{c_{t+1}}{(1+r)} + \phi Z_{gt}^{+} + \omega_{it} Z_{it} - (wH + \$CT) \right)\end{aligned} \tag{41}$$

[100] This is equivalent to choosing the more general CES utility function $(ct^{\gamma} + \beta c_{t+1}^{\gamma} + \alpha\beta E[V(hc_{t+1})]^{\gamma})^{1/\gamma}$ with $\gamma \to 0$.

[101] In our theoretical framework, we are interested in parent's choice of Z_{it}. While also other factors (H, hc_t) contribute to children's human capital formation, Z_{it} are the only determinants which parents can control directly – their own human capital H as well as children's initial conditions hc_t are predetermined to period t.

The FOCs are:

$$\begin{aligned}
&\partial L/\partial c_t = \frac{1}{c_t} - \lambda = 0;\\
&\partial L/\partial c_{t+1} = \frac{\beta}{c_{t+1}} - \lambda\frac{1}{(1+r)} = 0;\\
&\partial L/\partial Z_{gt} = \frac{\beta\alpha\theta Z_{gt}^{\rho}}{Z_{gt}(\theta Z_{gt}^{\rho} + (1-\theta)\ Z_{it}^{\rho})^{(1/\rho)})} - \lambda\phi = 0;\\
&\partial L/\partial Z_{it} = \frac{\beta\alpha(1-\theta) Z_{it}^{\rho}}{Z_{it}(\theta Z_{gt}^{\rho} + (1-\theta)\ Z_{it}^{\rho})^{(1/\rho)})} - \lambda\omega_{it} = 0;\\
&\partial L/\partial \lambda = wH + \$CT - c_t - \frac{c_{t+1}}{(1+r)} - \phi Z_{gt} - \omega_{it} Z_{it} = 0.
\end{aligned} \tag{42}$$

Therefore, we obtain:

$$\lambda = \frac{1}{c_t} = \frac{\beta(1+r)}{c_{t+1}} = \frac{\beta\alpha\theta Z_{gt}^{\rho}}{\phi Z_{gt}(\theta Z_{gt}^{\rho} + (1-\theta)\ Z_{it}^{\rho})^{(1/\rho)})} = \frac{\beta\alpha(1-\theta) Z_{it}^{\rho}}{\omega_{it} Z_{it}(\theta Z_{gt}^{\rho} + (1-\theta)\ Z_{it}^{\rho})^{(1/\rho)})} \tag{43}$$

As an example, if we assume that $\rho \to 0$, by substitution, we obtain the following solutions for c_t^*, c_{t+1}^*, Z_{gt}^* and Z_{it}^*:

$$\begin{aligned}
c_t^* &= \frac{(wH + \$CT)}{1 + \beta + \beta\alpha}\\
c_{t+1}^* &= \frac{\beta(wH + \$CT)(1+r)}{1 + \beta + \beta\alpha}\\
Z_{gt}^* &= \frac{\beta\alpha\theta(wH + \$CT)}{(1 + \beta + \beta\alpha)\phi}\\
Z_{it}^* &= \frac{\beta\alpha(1-\theta)(wH + \$CT)}{(1 + \beta + \beta\alpha)\omega_{it}}
\end{aligned} \tag{44}$$

When comparing the determinants of Z_{it}^*, assuming a Cobb-Douglas logarithmic form for the utility function (eq. 40) with $\rho \to 0$, the substitution effect is compensated by the income effect and changes in relative prices (ϕ and ω_{it}) do not affect the demand for Z_{it}. If $-\infty < \rho < 0$ the elasticity of substitution (σ) is $0 < \sigma < 1$, and Z_{it} and Z_{gt} are complements. If $0 < \rho < 1$ the elasticity of substitution is $1 > \sigma > \infty$, and Z_{it} and Z_{gt} are substitutes.

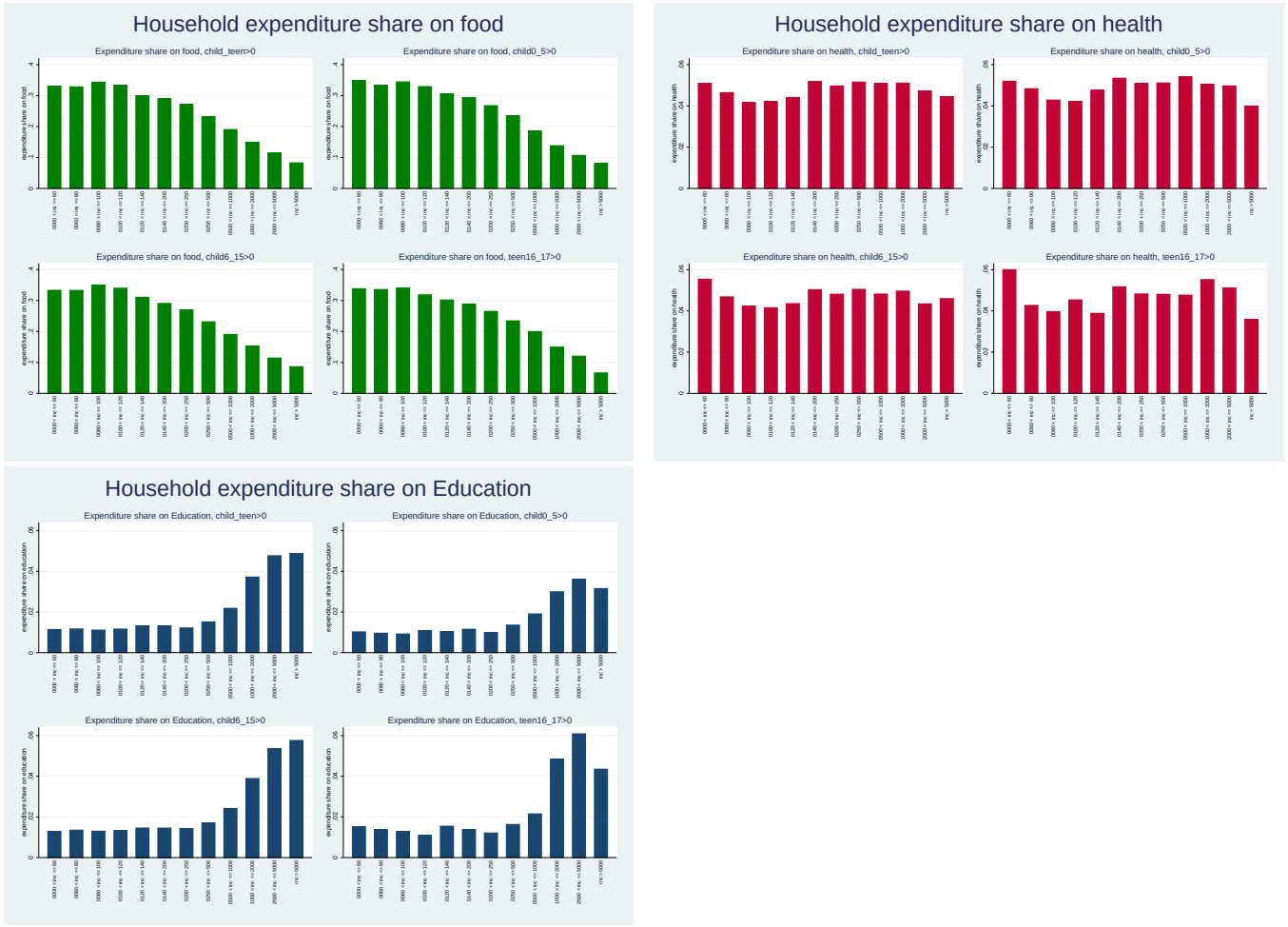

Figure 12: Expenditure share on food, health and education by income brackets

8.5 Descriptive statistics on school attendance

Variable	Untreated (Bolsa Família=0)						Treated (Bolsa Família=1)					
	N	mean	sd	min	max	med	N	mean	sd	min	max	med
Private School												
Average share of children and teenagers attending private school per household, by age cohort												
Children and teenager (0-17)	23,710	0.19	0.37	0	1	0.00	8,434	0.03	0.16	0	1	0.00
Children and teenager (6-17)	18,184	0.19	0.39	0	1	0.00	7,514	0.03	0.15	0	1	0.00
Children (0-3)	7,310	0.09	0.29	0	1	0.00	2,622	0.02	0.15	0	1	0.00
Children (4-5)	4,092	0.26	0.44	0	1	0.00	1,943	0.07	0.25	0	1	0.00
Children (6-15)	15,734	0.20	0.39	0	1	0.00	7,052	0.03	0.16	0	1	0.00
Children (6-9)	7,781	0.21	0.41	0	1	0.00	4,051	0.04	0.19	0	1	0.00
Children (10-15)	10,733	0.18	0.38	0	1	0.00	5,278	0.01	0.12	0	1	0.00
Teenager (16-17)	4,541	0.13	0.34	0	1	0.00	1,973	0.01	0.11	0	1	0.00
Youth (18-25)	15,981	0.14	0.33	0	1	0.00	3,582	0.02	0.13	0	1	0.00
Public School												
Average share of children and teenagers attending public school per household, by age cohort												
Children and teenager (0-17)	23,710	0.58	0.45	0	1	0.80	8,434	0.79	0.32	0	1	1.00
Children and teenager (6-17)	18,184	0.75	0.42	0	1	1.00	7,514	0.93	0.22	0	1	1.00
Children (0-3)	7,310	0.11	0.30	0	1	0.00	2,622	0.14	0.33	0	1	0.00
Children (4-5)	4,092	0.47	0.50	0	1	0.00	1,943	0.68	0.46	0	1	1.00
Children (6-15)	15,734	0.77	0.41	0	1	1.00	7,052	0.95	0.20	0	1	1.00
Children (6-9)	7,781	0.76	0.42	0	1	1.00	4,051	0.94	0.24	0	1	1.00
Children (10-15)	10,733	0.80	0.40	0	1	1.00	5,278	0.96	0.18	0	1	1.00
Teenager (16-17)	4,541	0.69	0.46	0	1	1.00	1,973	0.79	0.40	0	1	1.00
Youth (18-25)	15,981	0.17	0.35	0	1	0.00	3,582	0.26	0.41	0	1	0.00
School Attendance (No)												
Average share of children and teenagers not attending school per household, by age cohort												
Children and teenager (0-17)	23,710	0.23	0.38	0	1	0.00	8,434	0.18	0.29	0	1	0.00
Children and teenager (6-17)	18,184	0.06	0.21	0	1	0.00	7,514	0.05	0.17	0	1	0.00
Children (0-3)	7,310	0.80	0.39	0	1	1.00	2,622	0.84	0.35	0	1	1.00
Children (4-5)	4,092	0.26	0.44	0	1	0.00	1,943	0.25	0.43	0	1	0.00
Children (6-15)	15,734	0.03	0.15	0	1	0.00	7,052	0.02	0.13	0	1	0.00
Children (6-9)	7,781	0.02	0.14	0	1	0.00	4,051	0.02	0.14	0	1	0.00
Children (10-15)	10,733	0.03	0.16	0	1	0.00	5,278	0.02	0.14	0	1	0.00
Teenager (16-17)	4,541	0.18	0.38	0	1	0.00	1,973	0.20	0.39	0	1	0.00
Youth (18-25)	15,981	0.69	0.44	0	1	1.00	3,582	0.72	0.42	0	1	1.00
School Attendance (Never)												
Average share of children and teenagers that never attended school per household, by age cohort												
Children and teenager (0-17)	23,710	0.19	0.35	0	1	0.00	8,434	0.15	0.26	0	1	0.00
Children and teenager (6-17)	18,184	0.01	0.08	0	1	0.00	7,514	0.01	0.07	0	1	0.00
Children (0-3)	7,310	0.79	0.40	0	1	1.00	2,622	0.83	0.36	0	1	1.00
Children (4-5)	4,092	0.24	0.43	0	1	0.00	1,943	0.23	0.42	0	1	0.00
Children (6-15)	15,734	0.01	0.08	0	1	0.00	7,052	0.01	0.07	0	1	0.00
Children (6-9)	7,781	0.02	0.12	0	1	0.00	4,051	0.02	0.12	0	1	0.00
Children (10-15)	10,733	0.00	0.06	0	1	0.00	5,278	0.00	0.03	0	1	0.00
Teenager (16-17)	4,541	0.01	0.07	0	1	0.00	1,973	0.01	0.07	0	1	0.00
Youth (18-25)	15,981	0.01	0.09	0	1	0.00	3,582	0.02	0.12	0	1	0.00
Illiteracy below age 20	46,827	0.21	0.53	0	6	0.00	9,263	0.52	0.76	0	5	0.00

Table 17: Descriptive statistics (education)

8.6 Descriptive statistics by regions

Variable	Untreated (Bolsa Família=0, North)						Treated (Bolsa Família=1, North)					
	N	mean	sd	min	max	med	N	mean	sd	min	max	med
Expenditure / Income (monthly)												
Food	5,926	440.26	395.45	0	5187	337.09	1,698	416.39	476.74	0	13787	340.70
Health	5,890	92.81	215.13	0	5595	32.33	1,693	46.49	79.84	0	1188	21.44
Education	5,890	46.58	156.59	0	2257	1.93	1,693	16.03	44.75	0	942	5.65
Income per capita	5,939	799.75	1,245.95	7	42576	466.11	1,700	267.69	292.52	24	5006	203.39
Transfer (BFP) per capita	5,939	0.00	0.00	0	0	0.00	1,700	19.42	11.05	0	142	18.94
Transfer (BFP)	5,939	0.00	0.00	0	0	0.00	1,700	90.29	41.58	2	517	93.84
Number of household members												
Number of members (total)	5,939	3.53	1.84	1	15	3.00	1,700	5.20	2.14	1	20	5.00
Number of children (0-5)	5,939	0.40	0.71	0	6	0.00	1,700	0.71	0.94	0	6	0.00
Number of children (6-15)	5,939	0.64	0.97	0	8	0.00	1,700	1.72	1.34	0	8	2.00
Number of teenagers (16-17)	5,939	1.17	1.32	0	10	1.00	1,700	2.66	1.69	0	12	2.00
Share of children, teenager and youth attending school												
Children and Teenager (0-17)	3,494	0.70	0.40	0	1	1.00	1,605	0.80	0.29	0	1	1.00
Children and Teenager (6-17)	2,687	0.92	0.25	0	1	1.00	1,428	0.95	0.16	0	1	1.00
Children (0-3)	1,301	0.10	0.29	0	1	0.00	600	0.10	0.28	0	1	0.00
Children (4-5)	707	0.65	0.47	0	1	1.00	436	0.63	0.48	0	1	1.00
Children (6-15)	2,330	0.95	0.21	0	1	1.00	1,357	0.97	0.13	0	1	1.00
Teenagers (16-17)	689	0.80	0.40	0	1	1.00	385	0.83	0.36	0	1	1.00
Youth (18-25)	2,439	0.32	0.43	0	1	0.00	710	0.36	0.44	0	1	0.00
Health Constraint (share)												
Health Services	5,939	0.43	0.73	0	5	0.00	1,700	0.73	0.91	0	7	0.00
Pharmaceuticals	5,939	0.46	0.75	0	7	0.00	1,700	0.86	0.95	0	7	1.00
Reference person												
Woman	5,939	0.30	0.46	0	1	0.00	1,700	0.31	0.46	0	1	0.00
White	5,939	0.24	0.43	0	1	0.00	1,700	0.14	0.35	0	1	0.00
Black	5,939	0.08	0.27	0	1	0.00	1,700	0.08	0.27	0	1	0.00
Pardo	5,939	0.65	0.48	0	1	1.00	1,700	0.74	0.44	0	1	1.00
Illiterate	5,939	0.48	0.50	0	1	0.00	1,700	0.69	0.46	0	1	1.00

Table 18: Descriptive statistics - geographical heterogeneity (region North)

Variable	Untreated (Bolsa Família=0, Northeast)						Treated (Bolsa Família=1, Northeast)					
	N	**mean**	**sd**	**min**	**max**	**med**	**N**	**mean**	**sd**	**min**	**max**	**med**
Expenditure / Income (monthly)												
Food	13,822	358.64	374.04	0	4837	256.88	5,404	291.14	253.69	0	4590	231.91
Health	13,740	112.13	236.92	0	8862	38.27	5,384	47.58	96.92	0	4315	20.15
Education	13,740	51.66	168.25	0	5361	0.34	5,384	12.36	38.48	0	1199	3.19
Income per capita	13,858	765.52	1,217.04	0	52122	446.15	5,412	220.78	296.69	13	11966	173.23
Transfer (BFP) per capita	13,858	0.00	0.00	0	0	0.00	5,412	21.23	10.95	0	154	20.67
Transfer (BFP)	13,858	0.00	0.00	0	0	0.00	5,412	87.27	35.77	1	323	88.40
Number of household members												
Number of members (total)	13,858	3.14	1.58	1	18	3.00	5,412	4.58	1.85	1	17	4.00
Number of members (0-5)	13,858	0.27	0.56	0	6	0.00	5,412	0.54	0.77	0	5	0.00
Number of children (6-15)	13,858	0.45	0.78	0	8	0.00	5,412	1.35	1.20	0	7	1.00
Number of teenagers (16-17)	13,858	0.82	1.04	0	11	1.00	5,412	2.12	1.47	0	11	2.00
Share of children, teenager and youth attending school												
Children and Teenager (0-17)	7,071	0.75	0.39	0	1	1.00	4,809	0.82	0.29	0	1	1.00
Children and Teenager (6-17)	5,217	0.93	0.24	0	1	1.00	4,219	0.95	0.17	0	1	1.00
Children (0-3)	2,271	0.18	0.38	0	1	0.00	1,495	0.17	0.36	0	1	0.00
Children (4-5)	1,236	0.84	0.37	0	1	1.00	1,075	0.81	0.38	0	1	1.00
Children (6-15)	4,454	0.97	0.16	0	1	1.00	3,909	0.98	0.12	0	1	1.00
Teenagers (16-17)	1,343	0.81	0.39	0	1	1.00	1,140	0.84	0.36	0	1	1.00
Youth (18-25)	5,144	0.34	0.45	0	1	0.00	2,161	0.29	0.42	0	1	0.00
Health Constraint (share)												
Health Services	13,858	0.46	0.76	0	9	0.00	5,412	0.82	1.05	0	11	1.00
Pharmaceuticals	13,858	0.42	0.71	0	9	0.00	5,412	0.82	1.00	0	7	1.00
Reference person												
Woman	13,858	0.33	0.47	0	1	0.00	5,412	0.28	0.45	0	1	0.00
White	13,858	0.29	0.45	0	1	0.00	5,412	0.21	0.41	0	1	0.00
Black	13,858	0.11	0.31	0	1	0.00	5,412	0.10	0.31	0	1	0.00
Pardo	13,858	0.59	0.49	0	1	1.00	5,412	0.67	0.47	0	1	1.00
Illiterate	13,858	0.50	0.50	0	1	1.00	5,412	0.74	0.44	0	1	1.00

Table 19: Descriptive statistics - geographical heterogeneity (region Northeast)

Variable	Untreated (Bolsa Família=0, Southeast)						Treated (Bolsa Família=1, Southeast)					
	N	mean	sd	min	max	med	N	mean	sd	min	max	med
Expenditure / Income (monthly)												
Food	12,953	465.86	496.99	0	10304	324.53	1,112	362.29	345.14	0	2412	270.27
Health	12,908	207.69	525.59	0	25996	84.27	1,109	73.49	108.63	0	944	33.46
Education	12,908	90.70	289.18	0	6665	0.17	1,109	18.85	39.63	0	823	5.32
Income per capita	12,996	1,385.31	2,342.83	0	48248	782.21	1,114	316.94	251.66	10	4861	261.15
Transfer (BFP) per capita	12,996	0.00	0.00	0	0	0.00	1,114	17.82	11.11	0	84	16.80
Transfer (BFP)	12,996	0.00	0.00	0	0	0.00	1,114	75.55	40.76	1	304	77.52
Number of household members												
Number of members (total)	12,996	3.04	1.46	1	14	3.00	1,114	4.60	1.70	1	13	4.00
Number of children (0-5)	12,996	0.21	0.49	0	4	0.00	1,114	0.54	0.78	0	5	0.00
Number of children (6-15)	12,996	0.45	0.76	0	7	0.00	1,114	1.59	1.22	0	7	1.00
Number of teenagers (16-17)	12,996	0.76	1.01	0	8	0.00	1,114	2.36	1.44	0	8	2.00
Share of children, teenager and youth attending school												
Children and Teenager (0-17)	6,026	0.80	0.36	0	1	1.00	1,042	0.84	0.27	0	1	1.00
Children and Teenager (6-17)	4,745	0.95	0.20	0	1	1.00	952	0.96	0.16	0	1	1.00
Children (0-3)	1,657	0.23	0.41	0	1	0.00	275	0.18	0.37	0	1	0.00
Children (4-5)	953	0.76	0.43	0	1	1.00	234	0.73	0.44	0	1	1.00
Children (6-15)	4,111	0.98	0.13	0	1	1.00	909	0.98	0.13	0	1	1.00
Teenagers (16-17)	1,178	0.83	0.38	0	1	1.00	224	0.74	0.42	0	1	1.00
Youth (18-25)	4,015	0.29	0.43	0	1	0.00	379	0.20	0.38	0	1	0.00
Health Constraint (share)												
Health Services	12,996	0.19	0.52	0	7	0.00	1,114	0.36	0.66	0	4	0.00
Pharmaceuticals	12,996	0.17	0.49	0	7	0.00	1,114	0.39	0.70	0	5	0.00
Reference person												
Woman	12,996	0.30	0.46	0	1	0.00	1,114	0.37	0.48	0	1	0.00
White	12,996	0.59	0.49	0	1	1.00	1,114	0.37	0.48	0	1	0.00
Black	12,996	0.09	0.29	0	1	0.00	1,114	0.13	0.34	0	1	0.00
Pardo	12,996	0.30	0.46	0	1	0.00	1,114	0.49	0.50	0	1	0.00
Illiterate	12,996	0.28	0.45	0	1	0.00	1,114	0.58	0.49	0	1	1.00

Table 20: Descriptive statistics - geographical heterogeneity (region Southeast)

Variable	Untreated (Bolsa Família=0, South)						Treated (Bolsa Família=1, South)					
	N	mean	sd	min	max	med	N	mean	sd	min	max	med
Expenditure / Income (monthly)												
Food	6,334	452.63	445.16	0	4267	330.07	387	368.97	349.00	0	1942	258.52
Health	6,321	176.29	347.26	0	9982	77.23	386	78.92	125.85	0	1860	39.57
Education	6,321	64.39	202.93	0	3853	0.82	386	15.68	27.02	0	225	6.73
Income per capita	6,343	1,223.98	1,881.69	14	87431	746.65	388	371.68	592.12	25	8764	269.14
Transfer (BFP) per capita	6,343	0.00	0.00	0	0	0.00	388	16.32	9.70	0	58	15.15
Transfer (BFP)	6,343	0.00	0.00	0	0	0.00	388	70.32	40.13	1	247	63.24
Number of household members												
Number of members (total)	6,343	3.02	1.40	1	11	3.00	388	4.56	1.64	1	11	4.00
Number of children (0-5)	6,343	0.24	0.50	0	3	0.00	388	0.45	0.69	0	3	0.00
Number of children (6-15)	6,343	0.45	0.74	0	5	0.00	388	1.61	1.08	0	7	2.00
Number of teenagers (16-17)	6,343	0.79	0.99	0	8	0.00	388	2.29	1.38	0	8	2.00
Share of children, teenager and youth attending school												
Children and Teenager (0-17)	3,189	0.77	0.38	0	1	1.00	369	0.82	0.28	0	1	1.00
Children and Teenager (6-17)	2,478	0.94	0.22	0	1	1.00	348	0.94	0.18	0	1	1.00
Children (0-3)	902	0.24	0.42	0	1	0.00	97	0.14	0.34	0	1	0.00
Children (4-5)	515	0.63	0.48	0	1	1.00	65	0.53	0.50	0	1	1.00
Children (6-15)	2,153	0.97	0.15	0	1	1.00	337	0.97	0.13	0	1	1.00
Teenagers (16-17)	604	0.81	0.39	0	1	1.00	86	0.65	0.48	0	1	1.00
Youth (18-25)	1,899	0.31	0.44	0	1	0.00	129	0.20	0.39	0	1	0.00
Health Constraint (share)												
Health Services	6,343	0.18	0.48	0	4	0.00	388	0.41	0.71	0	3	0.00
Pharmaceuticals	6,343	0.16	0.45	0	5	0.00	388	0.41	0.62	0	3	0.00
Reference person												
Woman	6,343	0.30	0.46	0	1	0.00	388	0.35	0.48	0	1	0.00
White	6,343	0.79	0.40	0	1	1.00	388	0.57	0.50	0	1	1.00
Black	6,343	0.04	0.20	0	1	0.00	388	0.10	0.31	0	1	0.00
Pardo	6,343	0.15	0.36	0	1	0.00	388	0.29	0.46	0	1	0.00
Illiterate	6,343	0.32	0.47	0	1	0.00	388	0.58	0.49	0	1	1.00

Table 21: Descriptive statistics - geographical heterogeneity (region South)

Variable	Untreated (Bolsa Família=0, Center West)						Treated (Bolsa Família=1, Center West)					
	N	**mean**	**sd**	**min**	**max**	**med**	**N**	**mean**	**sd**	**min**	**max**	**med**
Expenditure / Income (monthly)												
Food	7,655	366.09	455.86	0	17008	237.25	648	269.26	279.58	0	2129	195.82
Health	7,632	136.31	302.49	0	6054	49.15	646	62.49	90.11	0	688	31.94
Education	7,632	60.90	212.51	0	4713	0.00	646	19.34	65.69	0	1030	4.57
Income per capita	7,691	1,146.48	1,951.14	0	33044	615.43	649	303.10	260.47	26	2728	234.76
Transfer (BFP) per capita	7,691	0.00	0.00	0	0	0.00	649	20.58	15.86	1	126	19.53
Transfer (BFP)	7,691	0.00	0.00	0	0	0.00	649	79.96	41.12	3	253	82.00
Number of household members												
Number of members (total)	7,691	3.06	1.46	1	15	3.00	649	4.42	1.57	1	13	4.00
Number of children (0-5)	7,691	0.27	0.56	0	4	0.00	649	0.50	0.75	0	4	0.00
Number of children (6-15)	7,691	0.50	0.79	0	7	0.00	649	1.56	1.10	0	5	1.00
Number of teenagers (16-17)	7,691	0.87	1.04	0	9	1.00	649	2.26	1.30	0	8	2.00
Share of children, teenager and youth attending school												
Children and Teenager (0-17)	3,930	0.75	0.39	0	1	1.00	609	0.83	0.29	0	1	1.00
Children and Teenager (6-17)	3,057	0.95	0.21	0	1	1.00	567	0.95	0.17	0	1	1.00
Children (0-3)	1,179	0.13	0.33	0	1	0.00	155	0.16	0.36	0	1	0.00
Children (4-5)	681	0.67	0.47	0	1	1.00	133	0.72	0.45	0	1	1.00
Children (6-15)	2,686	0.98	0.14	0	1	1.00	540	0.97	0.13	0	1	1.00
Teenagers (16-17)	727	0.83	0.38	0	1	1.00	138	0.77	0.41	0	1	1.00
Youth (18-25)	2,484	0.34	0.45	0	1	0.00	203	0.27	0.43	0	1	0.00
Health Constraint (share)												
Health Services	7,691	0.27	0.62	0	5	0.00	649	0.63	0.88	0	6	0.00
Pharmaceuticals	7,691	0.26	0.60	0	5	0.00	649	0.61	0.86	0	6	0.00
Reference person												
Woman	7,691	0.32	0.46	0	1	0.00	649	0.39	0.49	0	1	0.00
White	7,691	0.43	0.50	0	1	0.00	649	0.25	0.44	0	1	0.00
Black	7,691	0.09	0.29	0	1	0.00	649	0.11	0.31	0	1	0.00
Pardo	7,691	0.46	0.50	0	1	0.00	649	0.62	0.49	0	1	1.00
Illiterate	7,691	0.34	0.47	0	1	0.00	649	0.57	0.50	0	1	1.00

Table 22: Descriptive statistics - geographical heterogeneity (region Center West)

8.7 Coefficient estimates for Engel curves (IV and CF approaches)

Table 23 shows the results of the first stage for the instrumental variable (IV) approach using non-labor income (transfer) as an instrument for income. The results for the second stage are available in Table 7. The log of income per capita and its square were instrumented by log of transferred (non-labor) income per capita (first stage 1) and its square (first stage 2), respectively. In the CF procedure, only the first stage (1) was used.

Variables	Linear First Stage (1)	Quadratic First Stage (1)	Quadratic First Stage (2)
Constant	5.6 (0.043)	6.3 (0.06)	42 (0.71)
Income	0.21 (0.0071)	-0.15 (0.024)	-2.9 (0.3)
Income^2		0.042 (0.0027)	0.63 (0.034)
Socio-economic controls	Yes	Yes	Yes
Regional dummies	Yes	Yes	Yes

Table 23: Engel curves estimation - IV approaches using non-labor income (transfer) as an instrument for income, first stage.

Note: 10,918. Standard errors clustered by region in parentheses. 549 regional dummies included, socio-economic controls: nr. of hh members, nr. of women, female hh head, black hh head, Asian hh head, Pardo hh head, indigenous hh head, hh head illiterate, Universal religion, Catholic religion, Batista religion, Evangelical religion, Assembly of god religion, Lutheran religion, nb. of whites in hh, nb. of blacks in hh, nb. of Asians in hh, nb. of Pardo in hh, nb. of indigenous in hh, health insurance, child or teen pregnant (10-17), young adult pregnant (18-25), credit card, bank account. The results for the second stage are available on Table 7.

Table 24 shows the results of the first stage for the instrumental variable (IV) and control function (CF) estimations using income per capita as an instrument for expenditure per capita. The results of the second stage are available in Table 25. The log of expenditure per capita and its square were instrumented by log of income per capita (first stage 1) and its square (first stage 2), respectively. In the CF procedure only (first stage 1) was used.

Variables	Linear First Stage (1)	Quadratic First Stage (1)	Quadratic First Stage (2)
Constant	2.7 (0.071)	4.9 (0.18)	37 (1.6)
Income	0.61 (0.011)	-0.15 (0.056)	-6.9 (0.51)
Income^2		0.064 (0.0044)	1.2 (0.042)
Socio-economic controls	Yes	Yes	Yes
Regional dummies	Yes	Yes	Yes

Table 24: First stage of Engel curves estimation - IV and CF approaches income as an instrument for expenditure.

Note: 28,317. Standard errors clustered by region in parentheses. 549 regional dummies included, socio-economic controls: nr. of hh members, nr. of women, female hh head, black hh head, Asian hh head, Pardo hh head, indigenous hh head, hh head illiterate, Universal religion, Catholic religion, Batista religion, Evangelical religion, Assembly of god religion, Lutheran religion, nb. of whites in hh, nb. of blacks in hh, nb. of Asians in hh, nb. of Pardo in hh, nb. of indigenous in hh, health insurance, child or teen pregnant (10-17), young adult pregnant (18-25), credit card, bank account.

Second Stage

Linear and quadratic Engel curves (based on log of expenditure per capita and using income per capita as an instrument)

Linear demand system, IV procedure (standard errors in parentheses)

	Expenditure Share										Perceived Constraint			
	Nutrition		Education		School Materials		Pharmaceuticals		Health Care		Pharmaceuticals		Health Services	
Constant	0.59	(0.021)	-0.029	(0.005)	0.017	(0.0012)	0.066	(0.0061)	0.052	(0.0083)	1.1	(0.081)	0.16	(0.02)
Expenditure	-0.058	(0.003)	0.008	(0.00071)	-0.0021	(0.00016)	-0.006	(0.00088)	-0.00057	(0.00120)	-0.16	(0.012)	-0.019	(0.003)
Socio-economic controls	Yes		Yes		Yes		Yes		Yes		Yes		Yes	
Regional dummies	Yes		Yes		Yes		Yes		Yes		Yes		Yes	

Quadratic demand system, IV procedure (standard errors in parentheses)

	Expenditure Share										Perceived Constraint			
	Nutrition		Education		School Materials		Pharmaceuticals		Health Care		Pharmaceuticals		Health Services	
Constant	0.78	(0.100)	-0.018	(0.014)	0.023	(0.005)	0.025	(0.024)	-0.012	(0.031)	1.9	(0.30)	0.38	(0.089)
Expenditure	-0.12	(0.03)	0.0043	(0.0045)	-0.004	(0.001)	0.0074	(0.007)	0.02	(0.010)	-0.43	(0.089)	-0.09	(0.027)
Expenditure^2	0.0049	(0.0024)	0.0003	(0.0004)	0.00016	(0.00010)	-0.0011	(0.0006)	-0.0017	(0.0008)	0.022	(0.0068)	0.0058	(0.0020)
Socio-economic controls	Yes		Yes		Yes		Yes		Yes		Yes		Yes	
Regional dummies	Yes		Yes		Yes		Yes		Yes		Yes		Yes	

Engel curves estimation of linear/quadratic model using IV procedure. The log of expenditure per capita and its square were instrumented by log of income per capita and its square, respectively, in the first stages. Standard errors clustered by regions in parentheses. 549 regional dummies included, socio-economic controls: nr. of hh members, nr. of women, female hh head, black hh head, Asian hh head, Pardo hh head, indigenous hh head, hh head illiterate, Universal religion, Catholic religion, Batista religion, Evangelical religion, Assembly of god religion, Lutheran religion, nb. of whites in hh, nb. of blacks in hh, nb. of Asians in hh, nb. of pardo in hh, nb. of indigenous in hh, health insurance, child or teen pregnant (10-17), young adult pregnant (18-25), credit card, bank account.

Linear and quadratic Engel curves (based on log of expenditure per capita and using income per capita as control function)

Linear Engel Curve, CF procedure (standard errors in parentheses)

	Expenditure Share										Perceived Constraint			
	Nutrition		Education		School Materials		Pharmaceuticals		Health Care		Pharmaceuticals		Health Services	
Constant	0.59	(0.021)	-0.029	(0.005)	0.017	(0.001)	0.066	(0.006)	0.052	(0.008)	0.16	(0.020)	1.1	(0.081)
Expenditure	-0.058	(0.003)	0.008	(0.0007)	-0.0021	(0.00016)	-0.006	(0.0009)	-0.00057	(0.0012)	-0.019	(0.003)	-0.16	(0.012)
Socio-economic controls	Yes		Yes		Yes		Yes		Yes		Yes		Yes	
Regional dummies	Yes		Yes		Yes		Yes		Yes		Yes		Yes	

Quadratic demand system, CF procedure (standard errors in parentheses)

	Expenditure Share										Perceived Constraint			
	Nutrition		Education		School Materials		Pharmaceuticals		Health Care		Pharmaceuticals		Health Services	
Constant	0.29	(0.051)	-0.0077	(0.011)	0.028	(0.003)	0.07	(0.014)	0.011	(0.018)	0.3	(0.050)	2	(0.190)
Expenditure	0.048	(0.014)	0.0017	(0.003)	-0.0054	(0.001)	-0.0069	(0.004)	0.013	(0.005)	-0.063	(0.014)	-0.46	(0.055)
Expenditure^2	-0.009	(0.0011)	0.00047	(0.0003)	0.00027	(0.0001)	5.50E-05	(0.0003)	-0.0011	(0.0004)	0.0035	(0.0011)	0.023	(0.0041)
Socio-economic controls	Yes		Yes		Yes		Yes		Yes		Yes		Yes	
Regional dummies	Yes		Yes		Yes		Yes		Yes		Yes		Yes	

Engel curves estimation of linear/quadratic model using control function (CF) procedure. The residual of the first stage regression of log of expenditure per capita on log of income per capita and the other control variables were used in the second stage as control function. In the quadratic model, the residual and the square of the residual were used as control functions. For the linear model, the results are the same as in the IV procedure. The results of the IV procedure and the first stage are available in section 8.7 (CF and IV Engel curves). Standard errors clustered by region in parentheses. 549 regional dummies included, socio-economic controls: nr. of hh members, nr. of women,female hh head, black hh head, Asian hh head, Pardo hh head, indigenous hh head, hh head illiterate, Universal religion, Catholic religion, Batista religion, Evangelical religion, Assembly of God religion, Lutheran religion, nb. of whites in hh, nb. of blacks in hh, nb. of asians in hh, nb. of pardo in hh, nb. of indigenous in hh, health insurance, child or teen pregnant (10-17), young adult pregnant (18-25), credit card, bank account.

Table 25: Engel curves (IV and CF approaches), second stage

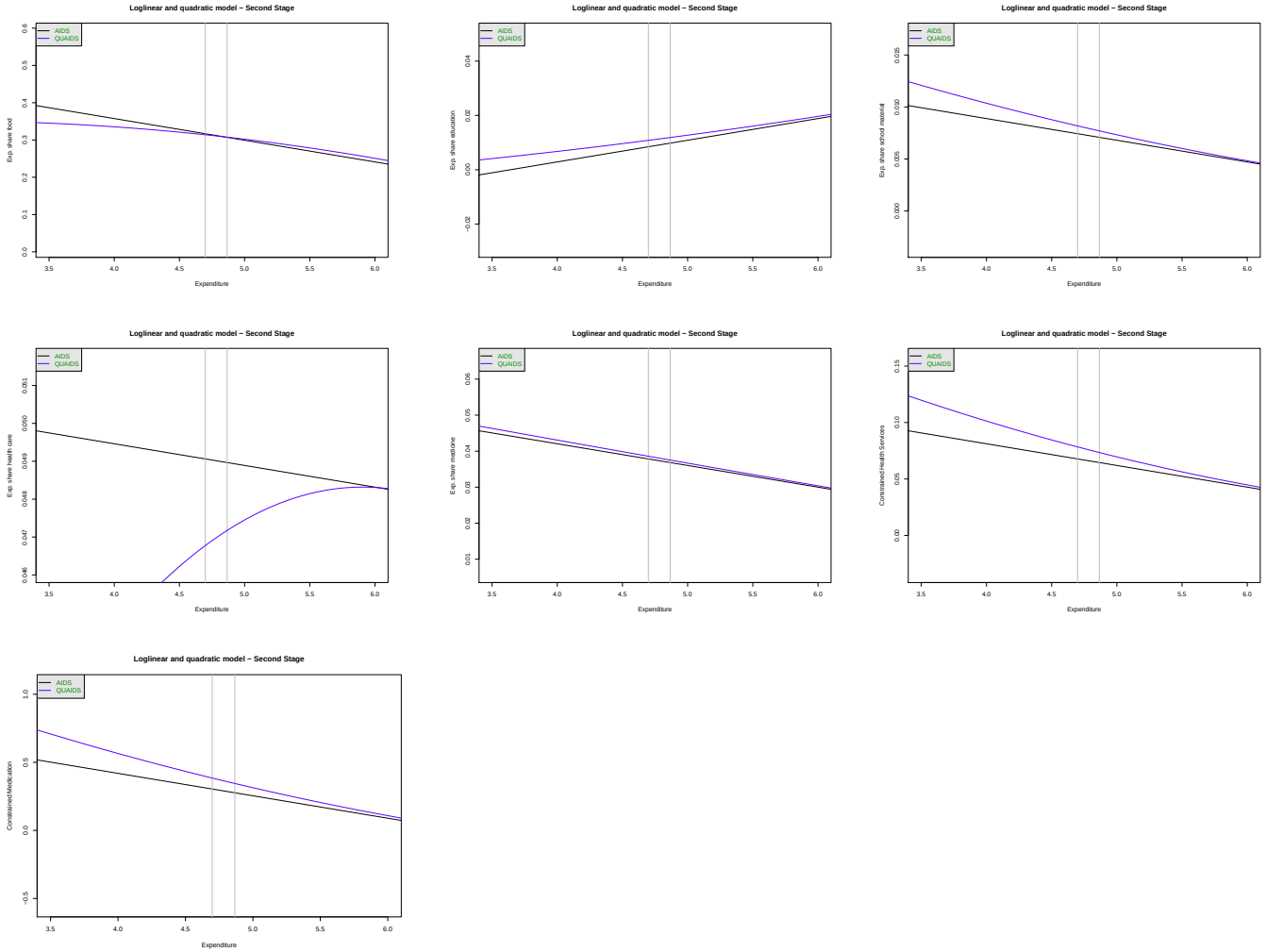

Figure 13: Engel curves estimated on subsample of untreated households (CF approach)

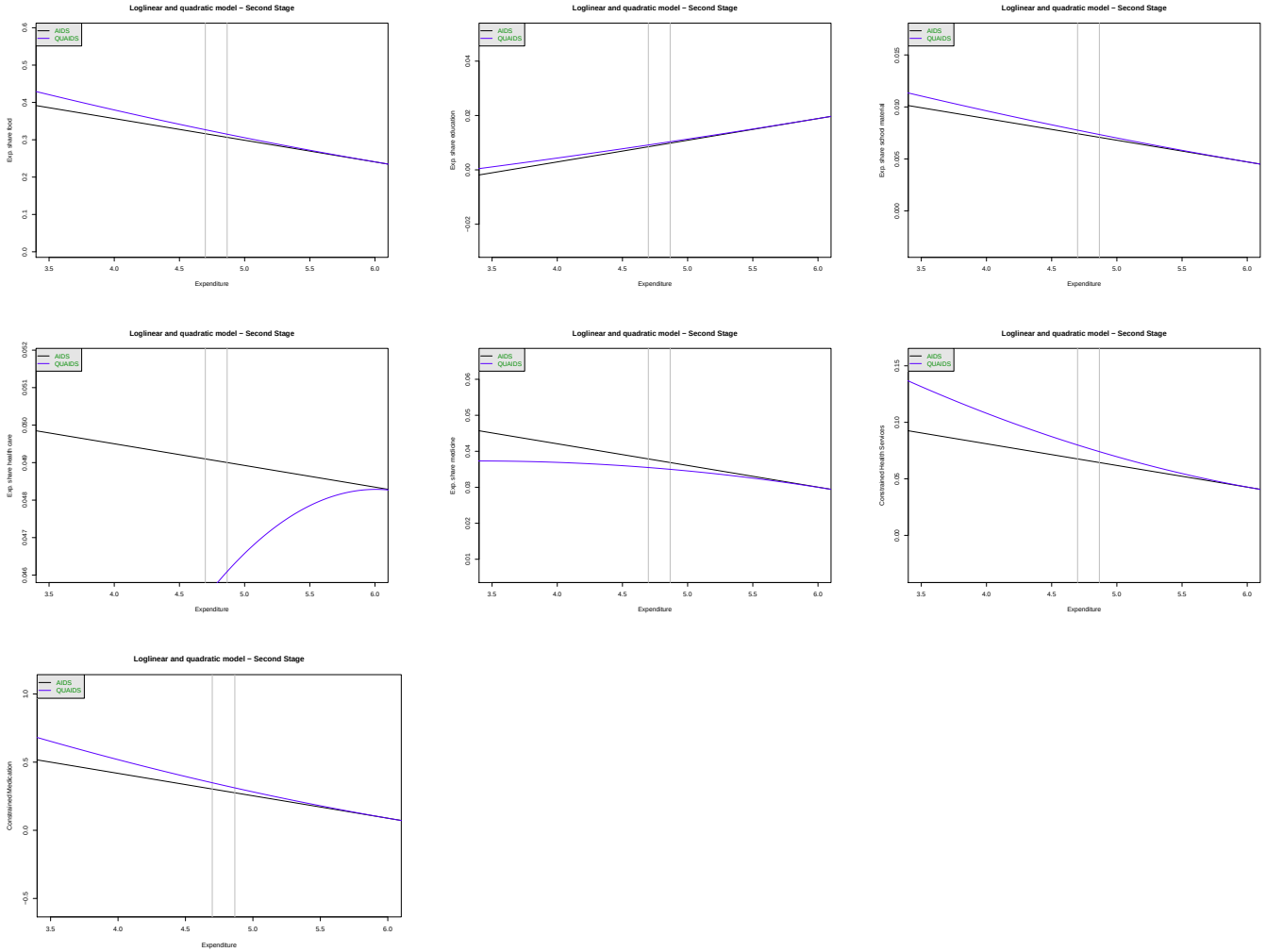

Figure 14: Engel curves estimated on subsample of untreated households (IV approach)

	First stage 1 Dep. var.: D		First stage 2 Dep. var.: $D \times X_1$		First stage 3 Dep. var.: $D \times X_2$		First stage 4 Dep. var.: $D \times X_1^2$
	Order 1	Order 2	Order 1	Order 2	Order 1	Order 2	Order 2
Eligibilityrule	0.18	0.14	-0.013	0.076	-0.37	-0.41	-0.35
(s.e.)	(0.02)	(0.02)	(0.02)	(0.02)	(0.04)	(0.04)	(0.07)
X_1	-0.12	-0.19	0.012	0.18	-0.075	-0.1	-0.1
(s.e.)	(0.004)	(0.01)	(0.01)	(0.02)	(0.005)	(0.01)	(0.05)
TX_1	0.069	0.077	0.73	0.66	-0.042	-0.12	-0.17
(s.e.)	(0.01)	(0.03)	(0.04)	(0.06)	(0.03)	(0.05)	(0.28)
X_2	0.074	0.075	0.057	0.053	0.34	0.34	0.028
(s.e.)	(0.003)	(0.003)	(0.002)	(0.002)	(0.01)	(0.01)	(0.003)
TX_2	-0.024	-0.026	-0.09	-0.085	0.46	0.46	0.0064
(s.e.)	(0.01)	(0.01)	(0.01)	(0.01)	(0.03)	(0.03)	(0.01)
X_1^2		0.024		-0.063		0.0099	0.03
(s.e.)		(0.004)		(0.006)		(0.003)	(0.01)
TX_1^2		-0.045		0.096		-0.052	0.59
(s.e.)		(0.009)		(0.033)		(0.018)	(0.15)
Constant	0.3	0.32	0.068	-0.0082	0.072	0.084	0.18
(s.e.)	(0.006)	(0.009)	(0.008)	(0.012)	(0.008)	(0.010)	(0.03)
Regional dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Socio-economic controls	No	No	No	No	No	No	No

First stage estimation for fuzzy Regression Discontinuity Design, basic specification without socio-economic controls.
Standard errors in parentheses. Clustering applied to all models at the level of sampling strata (550 strata).

Table 26: First stage estimation: fuzzy Regression Discontinuity Design (basic model, without socio-economic covariates)

	Expenditure share food			Expenditure share education			Expenditure share school materials		
	OLS	RDD (linear)	RDD (quadratic)	OLS	RDD (linear)	RDD (quadratic)	OLS	RDD (linear)	RDD (quadratic)
Treatment	0.017	0.1	0.14	-0.0013	0.0093	0.021	0.0014	0.0071	0.011
(s.e.)	(0.002)	(0.024)	(0.069)	(0.0004)	(0.003)	(0.008)	(0.0002)	(0.002)	(0.006)
X_1	-0.038	-0.031	-0.0099	0.0047	0.0062	0.01	-0.00093	-0.00026	0.0011
(s.e.)	(0.001)	(0.003)	(0.015)	(0.0003)	(0.0005)	(0.002)	(0.0001)	(0.000)	(0.001)
DX_1		0.049	0.023		-0.0094	-0.012		-0.0011	-0.0016
(s.e.)		(0.009)	(0.017)		(0.001)	(0.002)		(0.001)	(0.001)
X_2	-2.20E-05	-0.02	-0.021	5.90E-03	0.009	0.008	2.10E-03	0.002	0.0016
(s.e.)	(0.001)	(0.003)	(0.009)	(0.0003)	(0.001)	(0.001)	(0.0001)	(0.0003)	(0.001)
DX_2		0.03	0.027		-0.0097	-0.0093		-0.0008	-0.00065
(s.e.)		(0.005)	(0.008)		(0.001)	(0.001)		(0.0005)	(0.001)
X_1^2			-0.0055			-0.001			-0.0003
(s.e.)			(0.002)			(0.0003)			(0.0002)
DX_1^2			0.007			0.0023			0.00077
(s.e.)			(0.013)			(0.001)			(0.001)
Constant	0.25	0.23	0.21	0.017	0.014	0.0091	0.0048	0.0033	0.0017
(s.e.)	(0.002)	(0.007)	(0.025)	(0.0005)	(0.001)	(0.003)	(0.0001)	(0.000)	(0.002)
Regional dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Socio-economic controls	No	No	No	No	No	No	No	No	No
N	55,825	55,825	55,825	55,595	55,595	55,595	55,595	55,595	55,595

Detailed results: estimation by Ordinary Least Squares and Regression Discontinuity Design, basic specification without socio-economic controls. Standard errors in parentheses. Clustering applied to all models at the level of sampling strata (550 strata).

Table 27: Detailed results (1 of 3): fuzzy Regression Discontinuity Design (basic model, without socio-economic controls)

	Expenditure share pharmaceuticals			Expenditure share health care			Perceived constraint: pharmaceuticals		
	OLS	RDD (linear)	RDD (quadratic)	OLS	RDD (linear)	RDD (quadratic)	OLS	RDD (linear)	RDD (quadratic)
Treatment	-0.00091	-0.028	-0.024	-0.0012	-0.026	-0.03	0.14	0.36	-0.083
(s.e.)	(0.001)	(0.007)	(0.018)	(0.001)	(0.008)	(0.022)	(0.012)	(0.130)	(0.320)
X_1	-0.0052	-0.0084	-0.0027	0.0012	-0.001	0.0014	-0.14	-0.13	-0.21
(s.e.)	(0.0004)	(0.001)	(0.004)	(0.001)	(0.001)	(0.005)	(0.005)	(0.014)	(0.068)
DX_1		0.011	-0.0012		0.0023	-0.0074		0.2	0.071
(s.e.)		(0.002)	(0.005)		(0.003)	(0.006)		(0.037)	(0.075)
X_2	-6.50E-03	-0.0091	-0.008	-6.80E-03	-0.0092	-0.0075	1.90E-02	-0.075	-0.01
(s.e.)	(0.0003)	(0.001)	(0.002)	(0.0004)	(0.001)	(0.003)	(0.004)	(0.018)	(0.041)
DX_2		0.012	0.0098		0.011	0.0093		0.18	0.12
(s.e.)		(0.002)	(0.002)		(0.002)	(0.003)		(0.034)	(0.044)
X_1^2			-0.0017			-0.00091			0.013
(s.e.)			(0.001)			(0.001)			(0.012)
DX_1^2			0.0002			-0.0012			-0.099
(s.e.)			(0.003)			(0.004)			(0.051)
Constant	0.041	0.048	0.045	0.053	0.059	0.059	0.59	0.52	0.68
(s.e.)	(0.001)	(0.002)	(0.006)	(0.001)	(0.002)	(0.008)	(0.009)	(0.035)	(0.110)
Regional dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Socio-economic controls	No	No	No	No	No	No	No	No	No
N	55,595	55,595	55,595	55,595	55,595	55,595	55,976	55,976	55,976

Detailed results: estimation by Ordinary Least Squares and Regression Discontinuity Design, basic specification without socio-economic controls. Standard errors in parentheses. Clustering applied to all models at the level of sampling strata (550 strata).

Table 28: Detailed results (2 of 3): fuzzy Regression Discontinuity Design (basic model, without socio-economic controls)

	Perceived constraint: health services		
	OLS	RDD (linear)	RDD (quadratic)
Treatment	0.018	0.065	0.083
(s.e.)	(0.003)	(0.044)	(0.130)
X_1	-0.0045	0.0019	0.0098
(s.e.)	(0.001)	(0.004)	(0.009)
DX_1		0.0024	-0.0045
(s.e.)		(0.014)	(0.034)
X_2	2.70E-02	0.012	0.011
(s.e.)	(0.002)	(0.007)	(0.018)
DX_2		0.027	0.027
(s.e.)		(0.015)	(0.021)
X_1^2			-0.002
(s.e.)			(0.004)
DX_1^2			0.0035
(s.e.)			(0.026)
Constant	0.029	0.013	0.0053
(s.e.)	(0.002)	(0.012)	(0.045)
Regional dummies	Yes	Yes	Yes
Socio-economic controls	No	No	No
N	55,976	55,976	55,976

Detailed results: estimation by Ordinary Least Squares and Regression Discontinuity Design, basic specification without socio-economic controls. Standard errors in paren-theses. Clustering applied to all models at the level of sampling strata (550 strata).

Table 29: Detailed results (3 of 3): fuzzy Regression Discontinuity Design (basic model, without socio-economic controls)

	First stage 1 Dep. var.: D	First stage 2 Dep. var.: $D \times X_1$	First stage 3 Dep. var.: $D \times X_2$
Eligibilityrule	0.19	0.0068	-0.35
(s.e.)	(0.016)	(0.017)	(0.036)
X_1	-0.11	0.047	-0.042
(s.e.)	(0.0046)	(0.0069)	(0.0053)
TX_1	0.055	0.7	-0.073
(s.e.)	(0.013)	(0.035)	(0.026)
X_2	0.071	0.055	0.33
(s.e.)	(0.0028)	(0.0025)	(0.012)
TX_2	-0.031	-0.097	0.45
(s.e.)	(0.0069)	(0.0057)	(0.027)
Constant	0.23	-0.013	-0.032
(s.e.)	(0.011)	(0.013)	(0.019)
Regional dummies	Yes	Yes	Yes
Socio-economic controls	Yes	Yes	Yes

First stage estimation for RDD model with socio-economic controls. Standard errors in parentheses. Clustering applied to all models at the level of 550 sampling strata.

Table 30: First stage estimation: fuzzy Regression Discontinuity Design (with socio-economic controls)

	Expenditure share food		Expenditure share education		Expenditure share school materials		Expenditure share pharmaceuticals	
	OLS	RDD (linear)	OLS	RDD (linear)	OLS	RDD (linear)	OLS	RDD (linear)
Treatment	0.016	0.1	-0.00085	0.0087	0.0015	0.0072	-0.0013	-0.026
(s.e.)	(0.0024)	(0.024)	(0.0004)	(0.003)	(0.0002)	(0.0018)	(0.001)	(0.007)
X_1	-0.031	-0.026	0.0021	0.0035	-0.001	-0.00036	-0.0014	-0.0044
(s.e.)	(0.0014)	(0.0023)	(0.0003)	(0.0004)	(0.0001)	(0.0002)	(0.001)	(0.001)
DX_1		0.041		-0.0057		-0.00089		0.0066
(s.e.)		(0.0092)		(0.001)		(0.001)		(0.002)
X_2	0.0053	-0.012	3.40E-03	0.0054	2.20E-03	0.002	-4.70E-03	-0.0063
(s.e.)	(0.00093)	(0.0033)	(0.0003)	(0.0006)	(0.0001)	(0.0003)	(0.0004)	(0.0011)
DX_2		0.025		-0.0067		-6.00E-04		0.0089
(s.e.)		(0.006)		(0.001)		(0.001)		(0.002)
Constant	0.26	0.25	0.013	0.01	0.0054	0.0039	0.035	0.041
(s.e.)	(0.004)	(0.006)	(0.001)	(0.001)	(0.0002)	(0.0004)	(0.002)	(0.002)
Regional dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Socio-economic controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	55,825	55,825	55,595	55,595	55,595	55,595	55,595	55,595

	Perceived constraint: pharmaceuticals		Perceived constraint: health services		Expenditure share Health care	
	OLS	RDD (linear)	OLS	RDD (linear)	OLS	RDD (linear)
Treatment	0.12	0.4	0.017	0.064	-0.00096	-0.027
(s.e.)	(0.012)	(0.120)	(0.003)	(0.043)	(0.001)	(0.008)
X_1	-0.076	-0.058	-0.0039	0.0011	0.0026	0.00025
(s.e.)	(0.005)	(0.012)	(0.001)	(0.003)	(0.001)	(0.001)
DX_1		0.11		0.0051		0.0016
(s.e.)		(0.040)		(0.015)		(0.003)
X_2	-4.70E-02	-0.12	2.80E-02	0.014	-6.70E-03	-0.0092
(s.e.)	(0.005)	(0.019)	(0.002)	(0.007)	(0.0005)	(0.0013)
DX_2		0.12		0.027		0.011
(s.e.)		(0.035)		(0.016)		(0.002)
Constant	0.25	0.19	0.037	0.023	0.047	0.052
(s.e.)	(0.018)	(0.031)	(0.005)	(0.010)	(0.002)	(0.003)
Regional dummies	Yes	Yes	Yes	Yes	Yes	Yes
Socio-economic controls	Yes	Yes	Yes	Yes	Yes	Yes
N	55,976	55,976	55,976	55,976	55,595	55,595

Detailed results: estimation by Ordinary Least Squares and Regression Discontinuity Design, basic specification with socio-economic controls. Standard errors in parentheses. Clustering applied to all models at the level of sampling strata (550 strata).

Table 31: Detailed results: fuzzy Regression Discontinuity Design (with socio-economic controls)

	First stage 1 Dep. var.: D	First stage 2 Dep. var.: $D \times X_1$	First stage 3 Dep. var.: $D \times X_2$
Eligibilityrule	0.13	0.044	-0.28
(s.e.)	(0.02)	(0.0078)	(0.046)
X_1	-0.21	0.24	-0.18
(s.e.)	(0.012)	(0.01)	(0.016)
TX_1	0.12	0.48	0.083
(s.e.)	(0.032)	(0.023)	(0.067)
X_2	0.1	0.047	0.5
(s.e.)	(0.0034)	(0.0019)	(0.014)
TX_2	-0.052	-0.062	0.27
(s.e.)	(0.008)	(0.0041)	(0.032)
Constant	0.38	0.0099	0.12
(s.e.)	(0.016)	(0.007)	(0.024)
Regional dummies	Yes	Yes	Yes
Socio-economic controls	Yes	Yes	Yes

First stage estimation for RDD model on discontinuity subsample around the threshold (+/- 1 in log income). Standard errors in parentheses. Clustering applied to all models at the level of sampling strata (550 strata).

Table 32: First stage estimation: fuzzy Regression Discontinuity Design (discontinuity subsample)

	Expenditure share food		Expenditure share education		Expenditure share school materials		Expenditure share pharmaceuticals	
	OLS	RDD (linear)	OLS	RDD (linear)	OLS	RDD (linear)	OLS	RDD (linear)
Treatment	0.022	0.18	0.00077	0.0057	0.0015	0.0059	0.0039	-0.023
(s.e.)	(0.0033)	(0.069)	(0.0004)	(0.009)	(0.0002)	(0.0064)	(0.001)	(0.021)
X_1	-0.04	0.0027	0.0017	0.0033	-0.0016	-0.00014	8.00E-04	-0.002
(s.e.)	(0.0035)	(0.018)	(0.0004)	(0.0022)	(0.0002)	(0.0015)	(0.001)	(0.006)
DX_1		0.00078		-0.0045		-0.0025		-0.0055
(s.e.)		(0.021)		(0.002)		(0.002)		(0.007)
X_2	0.0043	-0.042	3.20E-03	0.0056	2.10E-03	0.0026	-3.50E-03	-0.0013
(s.e.)	(0.0011)	(0.015)	(0.0002)	(0.0021)	(0.0001)	(0.0016)	(0.0004)	(0.0051)
DX_2		0.058		-0.0052		-1.70E-03		0.0013
(s.e.)		(0.017)		(0.002)		(0.002)		(0.006)
Constant	0.33	0.27	0.0052	0.0038	0.0034	0.0018	0.033	0.042
(s.e.)	(0.014)	(0.032)	(0.001)	(0.004)	(0.0003)	(0.0025)	(0.002)	(0.008)
Regional dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Socio-economic controls	No	No	No	No	No	No	No	No
N	18,895	18,895	18,786	18,786	18,786	18,786	18,786	18786

	Perceived constraint: pharmaceuticals		Perceived constraint: health services		Expenditure share health care	
	OLS	RDD (linear)	OLS	RDD (linear)	OLS	RDD (linear)
Treatment	0.11	-0.11	0.012	-0.081	0.0037	-0.039
(s.e.)	(0.017)	(0.340)	(0.004)	(0.130)	(0.001)	(0.025)
X_1	-0.1	-0.093	-0.0046	-0.00091	0.0043	-0.003
(s.e.)	(0.017)	(0.086)	(0.006)	(0.030)	(0.001)	(0.007)
DX_1		-0.12		-0.074		-0.0051
(s.e.)		(0.099)		(0.036)		(0.008)
X_2	5.30E-02	0.054	3.60E-02	0.062	-3.90E-03	0.0019
(s.e.)	(0.007)	(0.080)	(0.004)	(0.032)	(0.0005)	(0.0059)
DX_2		0.045		-0.026		-0.0026
(s.e.)		(0.097)		(0.042)		(0.007)
Constant	0.73	0.79	-0.0026	0.029	0.04	0.056
(s.e.)	(0.033)	(0.130)	(0.007)	(0.051)	(0.002)	(0.010)
Regional dummies	Yes	Yes	Yes	Yes	Yes	Yes
Socio-economic controls	No	No	No	No	No	No
N	18,961	18,961	18,961	18,961	18,786	18,786

Detailed results: estimation by Ordinary Least Squares and Regression Discontinuity Design, discontinuity subsample (sample limited to +/- 1 in log income around the threshold). Standard errors in parentheses. Clustering applied to all models at the level of sampling strata (550 strata).

Table 33: Detailed results: fuzzy Regression Discontinuity Design (discontinuity subsample)

Variables	Model	Binsize for test	H_0: Oversmoothing	Critical Value	H_0: Bins are narrow enough	Critical value	H_0: Good fit	Critical value
Nutrition	Linear	0.05	0.67	1.16	0.71	1.16	0.01	3.84
	Quadratic						0.02	3.84
Education	Linear	0.05	0.59	1.16	0.58	1.16	12.27	3.84
	Quadratic						11.42	3.84
School Materials	Linear	0.05	1.06	1.16	0.87	1.16	0.3	3.84
	Quadratic						0.21	3.84
Pharmaceuticals	Linear	0.05	0.49	1.16	0.58	1.16	3.83	3.84
	Quadratic						3.38	3.84
Health Care	Linear	0.05	0.52	1.16	0.59	1.16	1.48	3.84
	Quadratic						1.03	3.84
Constraint: Pharmaceuticals	Linear	0.05	0.58	1.16	0.63	1.16	5.02	3.84
	Quadratic						6.26	3.84
Constraint: Health Services	Linear	0.05	1.11	1.16	1.1	1.16	0.77	3.84
	Quadratic						0.57	3.84

Specification test: Column 3 indicates the bandwidth of bins for the test, columns 4-5 report the F-statistic and critical value for an oversmoothing test of the binsize definition, columns 6-7 report the F-statistic and critical value for a test whether the bandwidth of bins is defined narrow enough, columns 8-9 report the F-statistic for the specification test and the respective critical value. The test procedure is described in detail in Lee and Lemieux (2009).

Table 34: Specification test for linear and quadratic RDD models

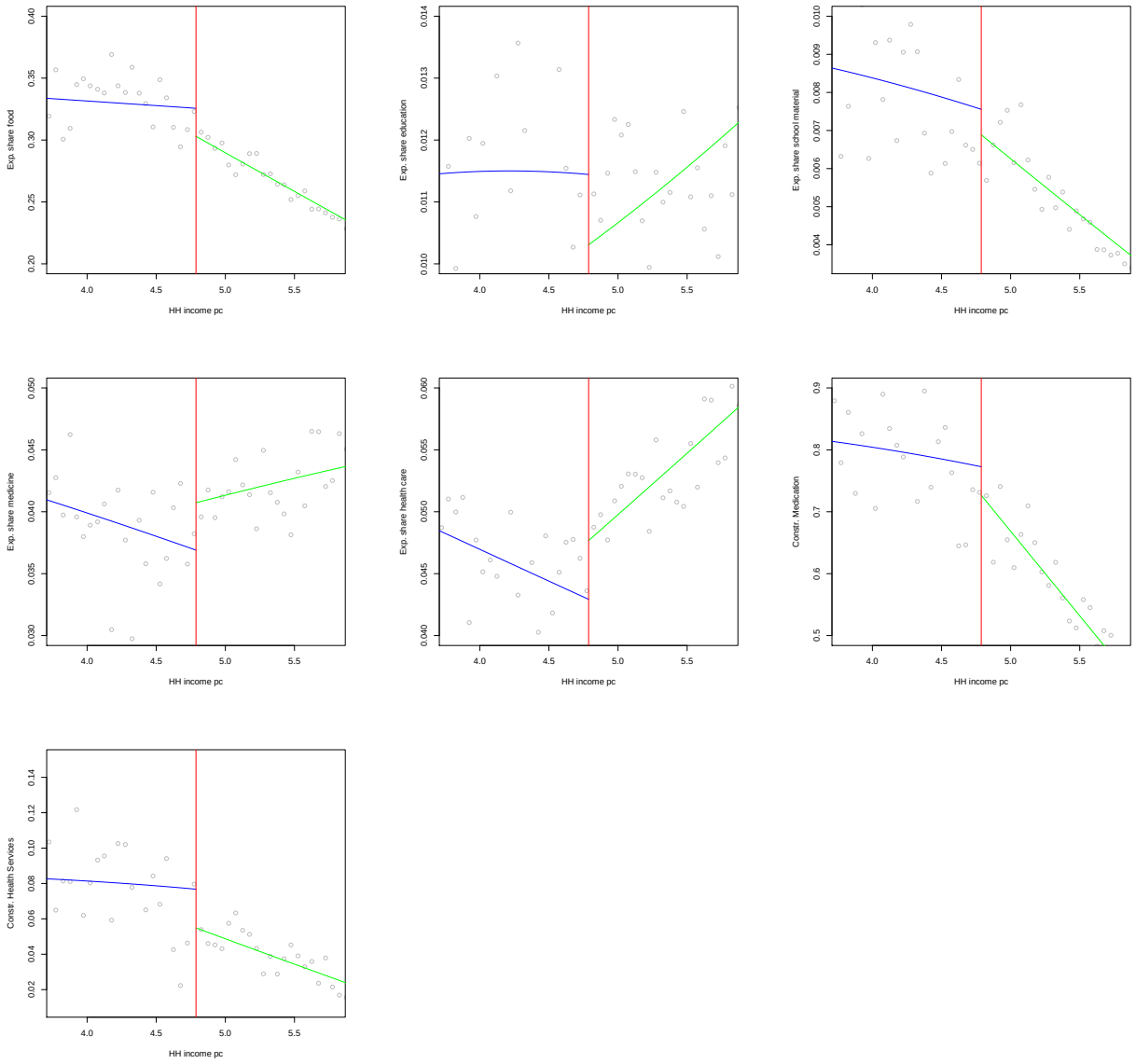

Table 35: Discontinuity graphs, dep. var. aggregated by bins of income plotted against income per capita, locally weighted regressions to the left (predicted values in blue) and right (predicted values in green) of the eligibility threshold.

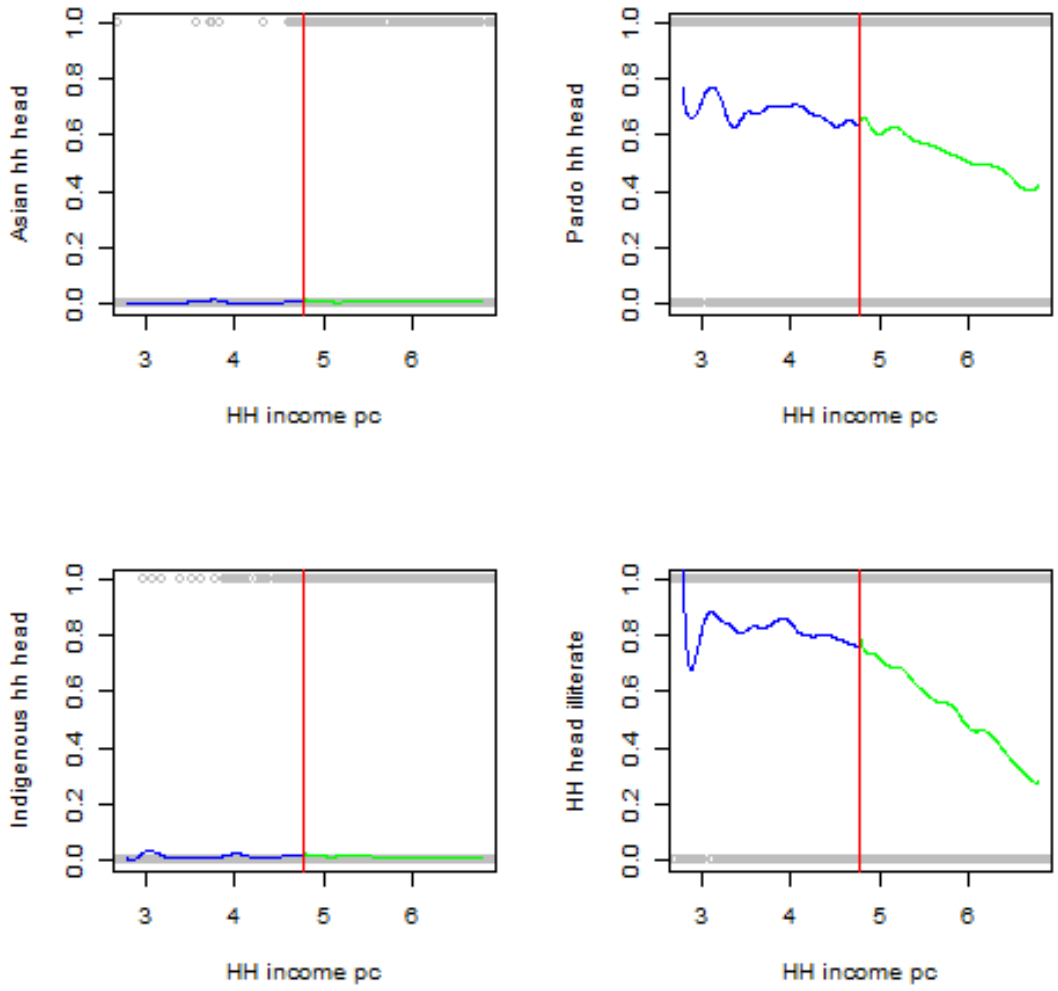

Figure 15: Density of pre-determined characteristics plotted against income (1 of 5)

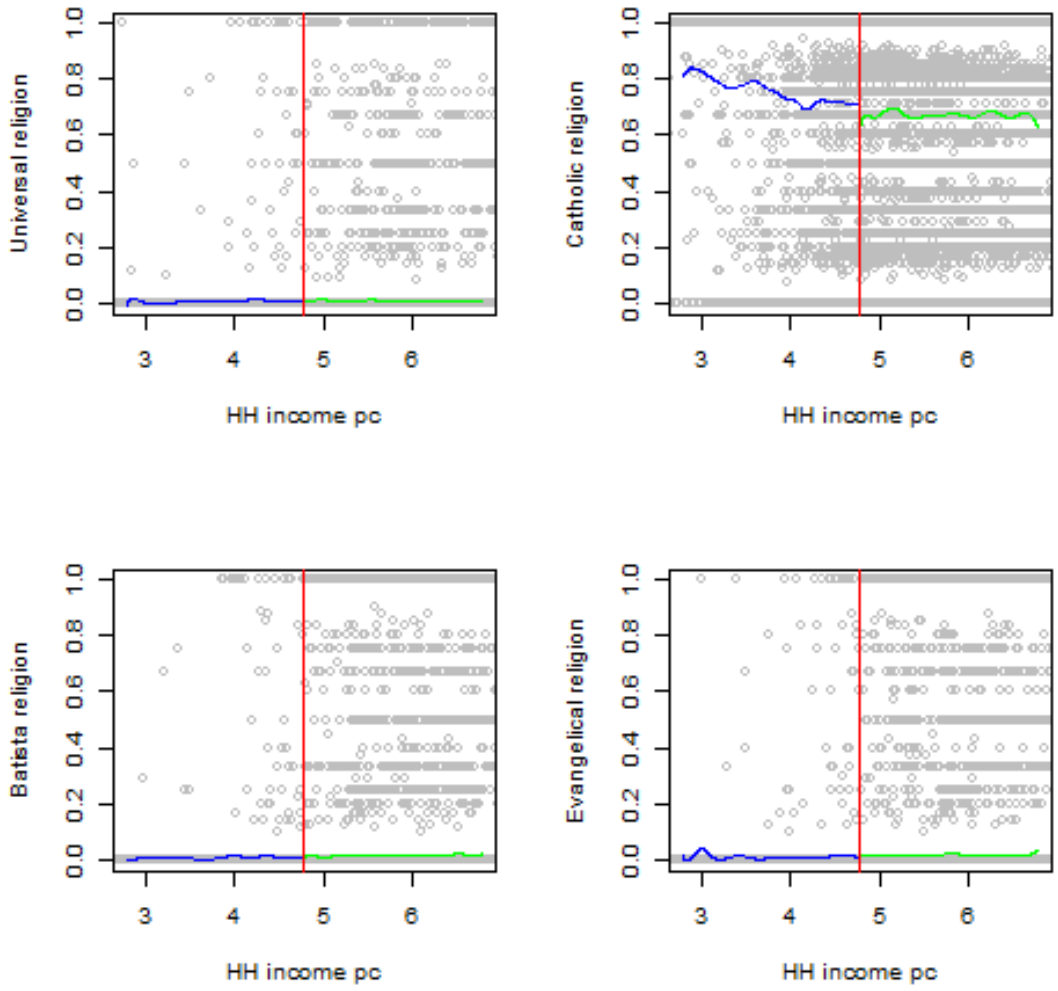

Figure 16: Density of pre-determined characteristics plotted against income (2 of 5)

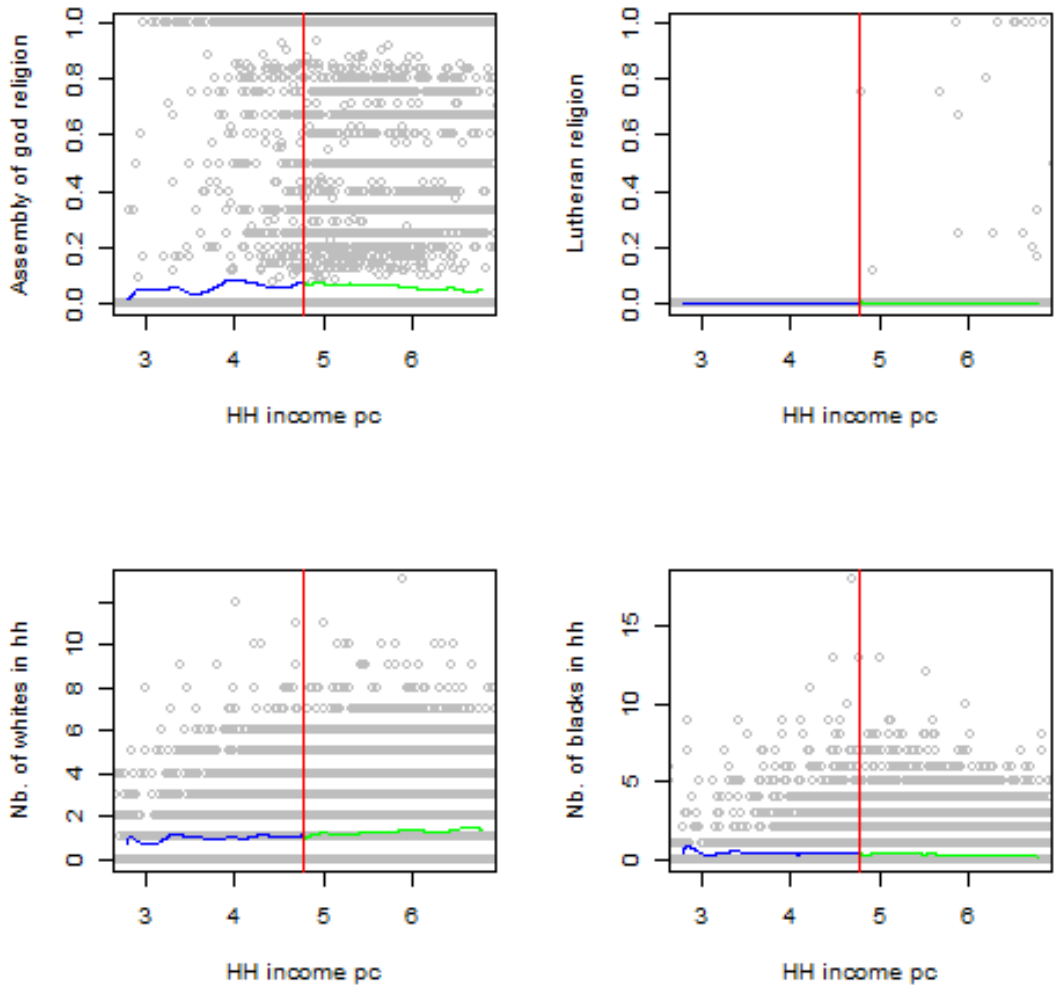

Figure 17: Density of pre-determined characteristics plotted against income (3 of 5)

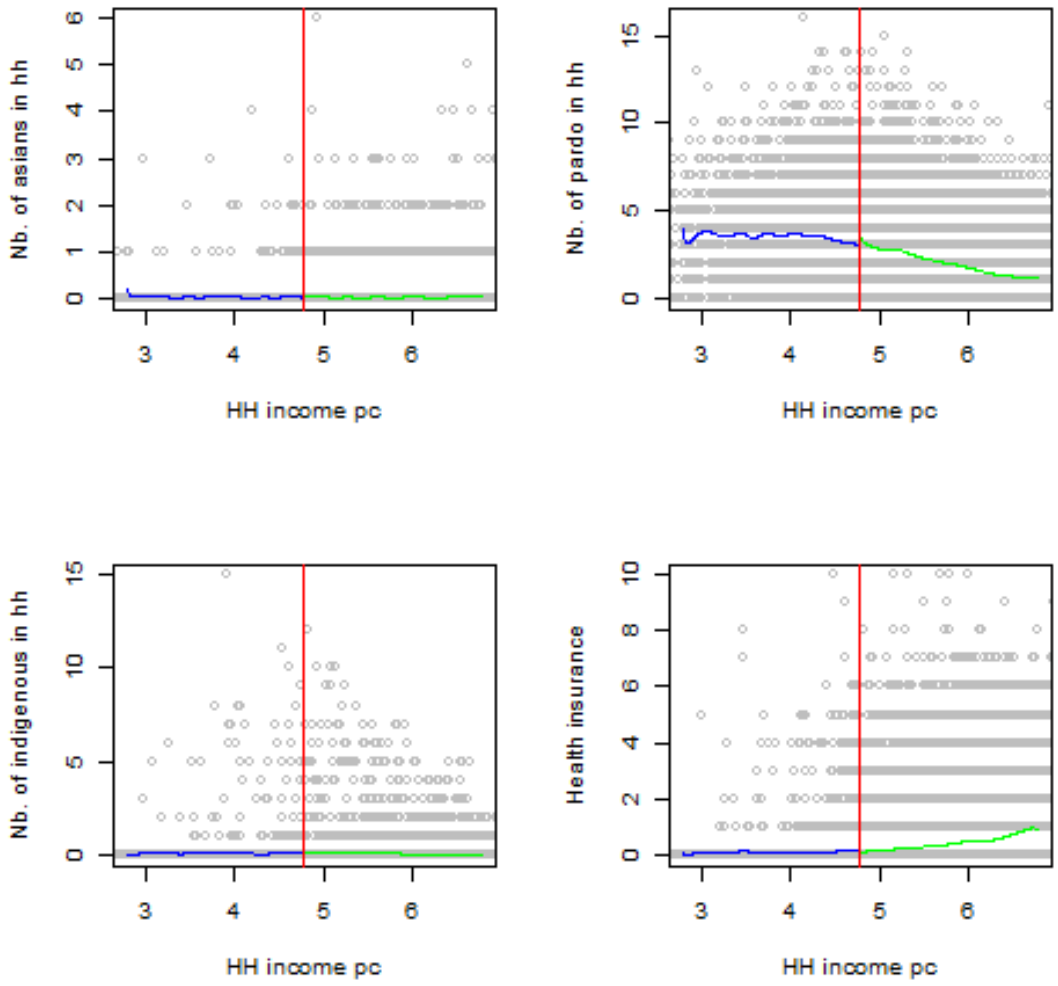

Figure 18: Density of pre-determined characteristics plotted against income (4 of 5)

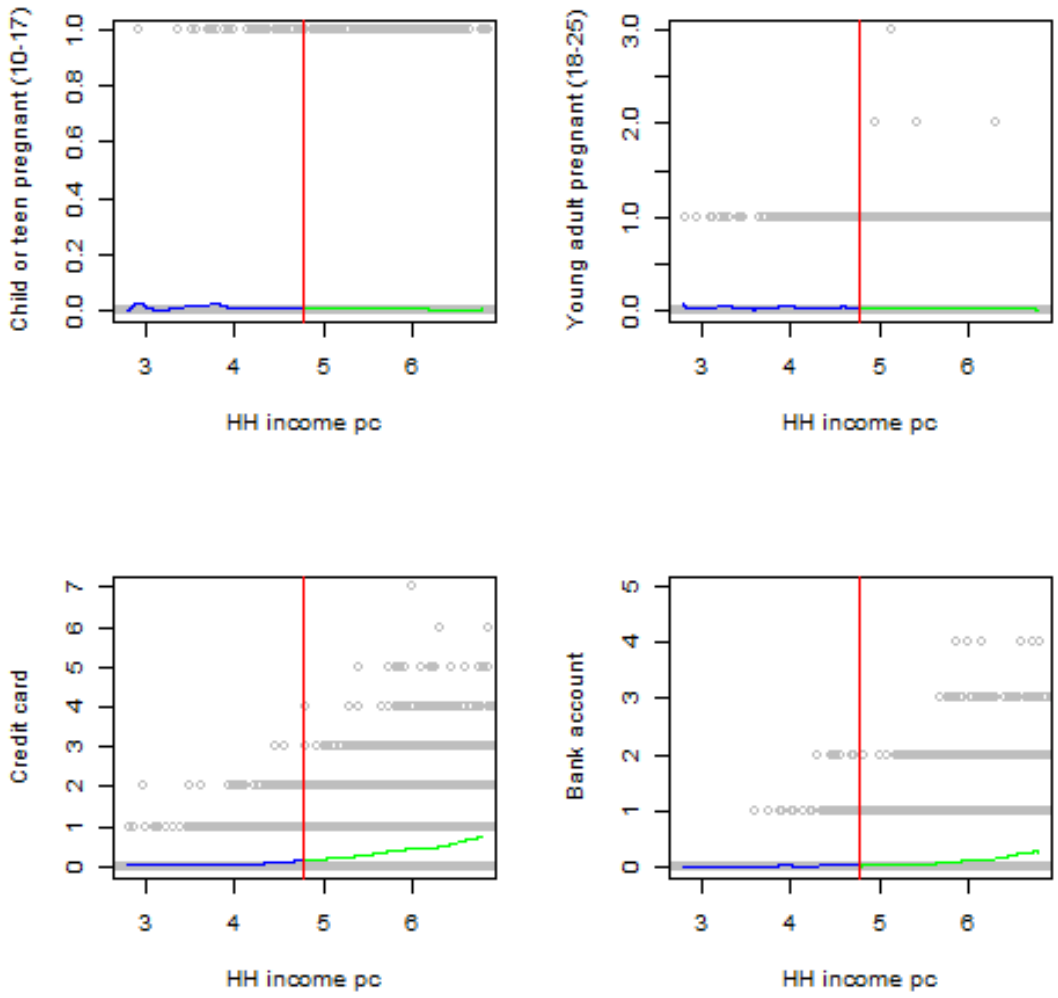

Figure 19: Density of pre-determined characteristics plotted against income (5 of 5)

	First stage 1		First stage 2		First stage 3		First stage 4		First stage 5
	Dep. var.: D		Dep. var.: $D \times X_1$		Dep. var.: $D \times X_2$		Dep. var.: $D \times F$		Dep. var.: $D \times X_1^2$
	Order 1	Order 2	Order 1	Order 2	Order 1	Order 2	Order 1	Order 2	Order 2
Eligibilityrule	0.19	0.15	-0.012	0.074	-0.36	-0.4	-0.096	-0.12	-0.35
(s.e.)	(0.017)	(0.018)	(0.018)	(0.019)	(0.039)	(0.04)	(0.0075)	(0.0089)	(0.07)
$T \times F$	-0.011	-0.014	-0.0016	0.0064	-0.037	-0.038	0.46	0.46	-0.0019
(s.e.)	(0.015)	(0.015)	(0.014)	(0.014)	(0.032)	(0.032)	(0.015)	(0.015)	(0.029)
X_1	-0.12	-0.19	0.012	0.18	-0.075	-0.1	-0.037	-0.064	-0.1
(s.e.)	(0.0045)	(0.012)	(0.0054)	(0.018)	(0.0048)	(0.012)	(0.0019)	(0.0058)	(0.045)
TX_1	0.068	0.077	0.73	0.66	-0.043	-0.12	0.0056	-0.013	-0.17
(s.e.)	(0.013)	(0.027)	(0.035)	(0.063)	(0.026)	(0.051)	(0.0078)	(0.016)	(0.28)
X_2	0.074	0.075	0.057	0.053	0.34	0.34	0.02	0.021	0.028
(s.e.)	(0.0027)	(0.0027)	(0.0023)	(0.002)	(0.012)	(0.012)	(0.0013)	(0.0013)	(0.0027)
TX_2	-0.024	-0.026	-0.09	-0.085	0.46	0.46	-0.0033	-0.0045	0.0063
(s.e.)	(0.0068)	(0.0069)	(0.0056)	(0.0054)	(0.027)	(0.027)	(0.0034)	(0.0034)	(0.01)
X_1^2	0.0049	0.024	0.008	-0.063	0.0047	0.01	0.19	0.01	0.03
(s.e.)	(0.0047)	(0.0035)	(0.0043)	(0.0058)	(0.0067)	(0.0033)	(0.0071)	(0.0016)	(0.014)
TX_1^2		-0.045		0.096		-0.052		-0.028	0.59
(s.e.)		(0.0089)		(0.033)		(0.018)		(0.0063)	(0.15)
F	0.0065	0.0062	-0.041	0.0046	-0.022	0.0052	-0.064	0.19	0.016
(s.e.)	(0.0022)	(0.0047)	(0.0031)	(0.0043)	(0.0036)	(0.0067)	(0.0012)	(0.0071)	(0.0061)
Constant	0.29	0.32	0.064	-0.01	0.071	0.083	0.089	0.1	0.18
(s.e.)	(0.0066)	(0.0088)	(0.0082)	(0.012)	(0.0078)	(0.01)	(0.0029)	(0.0046)	(0.029)
Regional dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Socio-economic controls	No	No	No	No	No	No	No	No	No

First stage estimation for fuzzy fuzzy Regression Discontinuity Design, model to detect heterogenous impacts by gender, specification without socio-economic controls. Standard errors in parentheses. Clustering applied to all models at the level of sampling strata (550 strata).

Table 36: First stage estimation, heterogenous impacts by gender: fuzzy Regression Discontinuity Design

	Expenditure share food			Expenditure share education			Expenditure share school materials		
	OLS	RDD (linear)	RDD (quadratic)	OLS	RDD (linear)	RDD (quadratic)	OLS	RDD (linear)	RDD (quadratic)
$Treatment$	0.018	0.1	0.14	-0.0017	0.0097	0.021	0.0013	0.0072	0.011
(s.e.)	(0.0029)	(0.024)	(0.069)	(0.00048)	(0.003)	(0.0075)	(0.00019)	(0.0018)	(0.0058)
$Treatment \times F$	-0.0027	0.0057	0.0083	0.0015	-0.0014	-0.00065	0.00042	-0.00032	-9.4e-05
(s.e.)	(0.0041)	(0.012)	(0.013)	(0.00072)	(0.0019)	(0.002)	(0.00034)	(0.0012)	(0.0013)
X_1	-0.038	-0.031	-0.0091	0.0048	0.0062	0.01	-0.00092	-0.00026	0.0011
(s.e.)	(0.0013)	(0.0026)	(0.015)	(0.00028)	(0.00045)	(0.0018)	(6.3e-05)	(0.00017)	(0.0012)
DX_1		0.049	0.023		-0.0095	-0.012		-0.0011	-0.0016
(s.e.)		(0.0086)	(0.017)		(0.00082)	(0.0018)		(0.00062)	(0.0014)
X_2	-0.00017	-0.021	-0.022	0.0059	0.009	0.008	0.0021	0.002	0.0016
(s.e.)	(0.00077)	(0.0033)	(0.009)	(0.00025)	(0.00055)	(0.00099)	(7.4e-05)	(0.00027)	(0.00083)
DX_2		0.03	0.028		-0.0097	-0.0094		-0.00081	-0.00066
(s.e.)		(0.0054)	(0.0083)		(0.00084)	(0.001)		(0.00048)	(8e-04)
X_1^2	-0.0085	-0.011	-0.0057	-0.00011	0.00047	-0.00099	0.00015	0.00026	-3e-04
(s.e.)	(0.0014)	(0.0022)	(0.0025)	(0.00043)	(0.00055)	(0.00034)	(8.3e-05)	(0.00018)	(2e-04)
DX_1^2			0.0077			0.0023			0.00076
(s.e.)			(0.014)			(0.0013)			(0.0012)
F	-0.041	-0.092	-0.011	0.009	-0.0057	0.00027	0.0011	-0.0056	0.00019
(s.e.)	(0.00067)	(0.025)	(0.0026)	(0.00015)	(0.0029)	(0.00057)	(3.8e-05)	(0.0018)	(0.00022)
Constant	0.26	0.23	0.21	0.016	0.014	0.0091	0.0047	0.0032	0.0017
(s.e.)	(0.0023)	(0.0065)	(0.025)	(0.00051)	(0.00099)	(0.0028)	(0.00011)	(0.00047)	(0.0021)
Regional dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Socio-economic controls	No	No	No	No	No	No	No	No	No
N	55,825	55,825	55,825	55,595	55,595	55,595	55,595	55,595	55,595

Detailed summary of results: estimation by Ordinary Least Squares and Regression Discontinuity Design, basic specification without socio-economic controls. Standard errors in parentheses. Clustering applied to all models at the level of sampling strata (550 strata).

Table 37: Detailed results, heterogenous impacts by gender (1 of 3): fuzzy fuzzy Regression Discontinuity Design

	Expenditure share pharmaceuticals			Expenditure share health care			Perceived constraint: pharmaceuticals		
	OLS	RDD (linear)	RDD (quadratic)	OLS	RDD (linear)	RDD (quadratic)	OLS	RDD (linear)	RDD (quadratic)
$Treatment$	0.00024	-0.025	-0.025	0.00052	-0.022	-0.03	0.16	0.41	-0.059
(s.e.)	(0.00094)	(0.0069)	(0.018)	(0.0012)	(0.0082)	(0.022)	(0.015)	(0.13)	(0.32)
$Treatment \times F$	-0.0041	-0.014	-0.013	-0.0061	-0.018	-0.019	-0.049	-0.19	-0.21
(s.e.)	(0.0016)	(0.0038)	(0.0039)	(0.0018)	(0.0043)	(0.0044)	(0.024)	(0.053)	(0.054)
X_1	-0.005	-0.0083	-0.0037	0.0015	-0.00095	2e-04	-0.14	-0.13	-0.22
(s.e.)	(0.00044)	(0.00078)	(0.0039)	(0.00054)	(0.00097)	(0.0047)	(0.0052)	(0.013)	(0.068)
DX_1		0.011	-0.0016		0.0019	-0.008		0.19	0.061
(s.e.)		(0.0022)	(0.0047)		(0.0029)	(0.0058)		(0.037)	(0.075)
X_2	-0.0063	-0.0087	-0.0071	-0.0066	-0.0087	-0.0066	0.02	-0.073	-0.0044
(s.e.)	(0.00031)	(0.001)	(0.0024)	(0.00038)	(0.0012)	(0.0029)	(0.0043)	(0.018)	(0.041)
DX_2		0.012	0.0091		0.011	0.0085		0.18	0.12
(s.e.)		(0.0016)	(0.0023)		(0.0019)	(0.0026)		(0.034)	(0.045)
X_1^2	0.011	0.012	-0.0015	0.012	0.014	-0.00063	0.036	0.054	0.015
(s.e.)	(0.00082)	(0.0011)	(0.00067)	(0.00098)	(0.0013)	(8e-04)	(0.007)	(0.01)	(0.012)
DX_1^2			-0.00058			-0.0022			-0.11
(s.e.)			(0.0031)			(0.0036)			(0.051)
F	-0.005	0.019	0.012	-0.0083	0.016	0.014	0.032	-0.3	0.062
(s.e.)	(0.00024)	(0.0068)	(0.0011)	(0.00028)	(0.0081)	(0.0013)	(0.0025)	(0.13)	(0.011)
Constant	0.037	0.044	0.042	0.049	0.055	0.057	0.58	0.52	0.68
(s.e.)	(0.00085)	(0.0019)	(0.0063)	(0.001)	(0.0023)	(0.0076)	(0.0096)	(0.034)	(0.11)
Regional dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Socio-economic controls	No	No	No	No	No	No	No	No	No
N	55,595	55,595	55,595	55,595	55,595	55,595	55,976	55,976	55,976

Detailed summary of results: estimation by Ordinary Least Squares and Regression Discontinuity Design, basic specification without socio-economic controls. Standard errors in parentheses. Clustering applied to all models at the level of sampling strata (550 strata).

Table 38: Detailed results, heterogenous impacts by gender (2 of 3): fuzzy Regression Discontinuity Design

	Perceived constraint: health services		
	OLS	RDD (linear)	RDD (quadratic)
$Treatment$	0.0097	0.043	0.069
(s.e.)	(0.0039)	(0.044)	(0.12)
$Treatment \times F$	0.027	0.078	0.079
(s.e.)	(0.0088)	(0.03)	(0.031)
X_1	-0.0042	0.0024	0.012
(s.e.)	(0.001)	(0.0042)	(0.026)
DX_1		0.0052	-0.00021
(s.e.)		(0.014)	(0.034)
X_2	0.027	0.012	0.01
(s.e.)	(0.0022)	(0.0069)	(0.018)
DX_2		0.027	0.028
(s.e.)		(0.015)	(0.021)
X_1^2	0.0031	-0.0057	-0.0023
(s.e.)	(0.0014)	(0.0041)	(0.0041)
DX_1^2			0.0053
(s.e.)			(0.026)
F	-0.0082	-0.05	-0.0062
(s.e.)	(0.00065)	(0.044)	(0.0048)
Constant	0.026	0.0099	-0.00098
(s.e.)	(0.002)	(0.012)	(0.044)
Regional dummies	Yes	Yes	Yes
Socio-economic controls	No	No	No
N	55,976	55,976	55,976

Detailed summary of results: estimation by Ordinary Least Squares and Regression Discontinuity Design, basic specification without socio-economic controls. Standard errors in paren-theses. Clustering applied to all models at the level of sampling strata (550 strata).

Table 39: Detailed results, heterogenous impacts by gender (3 of 3): fuzzy Regression Discontinuity Design

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