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The Long-term Effects of Conditional Cash Transfers on Child Labor and School Enrollment

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Abstract

This paper investigates the long-term effects of conditional cash transfers on school attainment and child labor. To this end, we construct a dynamic heterogeneous agent model, calibrate it with Brazilian data, and introduce a policy similar to the Brazilian *Bolsa Família*. Our results suggest that this type of policy has a very strong impact on educational outcomes, sharply increasing primary school completion. The conditional transfer is also able to reduce the share of working children from 22% to 17%. We then compute the transition to the new steady state and show that the program actually increases child labor over the short run, because the transfer is not enough to completely cover the schooling costs, so children have to work to be able to comply with the program's schooling eligibility requirement. We also evaluate the impacts on poverty, inequality, and welfare.

1 Introduction

This paper examines the long-term general equilibrium effects of conditional cash transfers (CCTs) on human capital accumulation and child labor. To this end, we construct a dynamic heterogeneous agent model that includes key determinants of child labor

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and school enrollment and then assess the effects of the Brazilian *Bolsa Família*, an extensive conditional cash transfer program adopted in 2002. We calibrate the model using Brazilian data from various sources, including the Brazilian Household Survey *PNAD*, and then compare two steady states: before and after the introduction of *Bolsa Família*. We also evaluate the transition across steady states and provide an alternative policy experiment.

Our model features a closed economy whose overlapping generations of dynasties care about consumption and child leisure. Idiosyncratic shocks to productivity induce families to save through a riskless asset, while borrowing constrains prevent them from investing optimally in human capital accumulation. As a result, a share of households is locked in a poverty trap, choosing to have their children work due to the very high marginal utility of consumption. In this environment, a conditional cash transfer policy can potentially alleviate poverty, induce school enrollment and discourage child labor.

We model a conditional cash transfer program as a schedule of transfers and schooling requirements. Specifically, our transfer policy mimics the *Bolsa Família*, whose incentives depend on both income thresholds and on school enrollment. The schedule is set such that it matches the program's coverage and budget (as a share of GDP) in 2012. Our model is calibrated to match main features of the Brazilian economy in 1997, before the widespread implementation of any conditional cash transfer program in Brazil[1].

Our results suggest that the *Bolsa Família* has a great impact on educational outcomes: over the long-term, the program increases the share of children who complete at least primary school from 52% to approximately 90%. Additionally, the share of children who complete secondary school increases by 30% (from 33% to 41%), child labor hours are reduced by 20.4%, and the share of working children decreases by 22.5% (from 22% to 17%).

However, it is surprising to see that, during the transition to the new steady state, the share of working children *increases* slightly over the short-term, reaching a peak of 23% immediately after the intervention, compared to 22% before the introduction of *Bolsa Família*. This happens because the transfer is not large enough to completely cover schooling costs, so children have to work more to be able to pay for their educations and, thus, be eligible to receive the conditional transfer. As these children will become highly educated adults, their own children will not need to work. We observe that, after a time gap corresponding to one generation, the share of working children decreases to 17%, which is near the share working in the new steady state. This result

[1]See the section 6.1 for a brief presentation of conditional cash transfers programs in Brazil.

is not only consistent with the existing literature based on micro-evidence (Cardoso and Souza (2004), Rocha and Soares (2009)[2]) but also suggests that the impacts of *Bolsa Família* on child labor reduction are forthcoming.

We also provide insights into the macroeconomic and distributional influences of such a transfer program. For instance, in spite of some sluggishness over the short run, the simulations predict that total output could increase by nearly 20% over the long-term. The initial sluggishness can be attributed to the "insurance effect" of a conditional cash transfer, but the benefits of an increasing workforce quality gradually overcome the weaker precautionary motives. There is also a decrease in income inequality, as measured by the Gini coefficient of household income (5 points over the long-run).

Finally, we perform a welfare analysis. Our results suggest that only 33% of the population is better off immediately after the introduction of the new policy, with the welfare of the whole population decreasing by 2.26%. We then provide a counterfactual transfer policy using the same schedule except for a small amount of cash transferred to the very poorest families regardless of their decisions to send their children to school. In this case, the long-term benefits of the cash transfer program are slightly smaller in comparison with the benchmark policy, but the new policy is also able to reduce child labor over the short run and to increase welfare.

There is no lack of studies that examine the effects of conditional cash transfers programs on education, child labor, and poverty. With regard to the Brazilian case, Barros et al. (2006) find that the *Bolsa Família* was responsible for 50% of the reduction in inequality between 2001 and 2005. Additionally, Soares and Sátiro (2009) estimate that this policy was responsible for a reduction of 8% in the poverty headcount ratio (1.7 percentage points), while Barros et al. (2010) claim that it was responsible for 15% of the observed reduction in extreme poverty between 2001 and 2008. In contrast, Cardoso and Souza (2004) and Rocha and Soares (2009) find that the *Bolsa Escola* had no effect on child labor but increased the chances that a poor child attended school[3].

In this work we focus on the impacts of the Brazilian CCT on child labor and education. In our long-term analysis, comparisons with existing works should be made carefully. For instance, many studies note that the *Bolsa Família* slightly increased educational attainment (Souza (2011)), but, to the best of our knowledge, there are

[2]Duryea and Morrison (2004) also observe that a conditional cash transfer in Costa Rica had no impact on child labor.

[3]There are also reported impacts with respect to health (Rocha and Soares (2009)), crime (Chioda et al. (2012)), entrepreneurship (Lichand (2010)), adult labor supply Medeiros et al. (2008), fertility (Rocha and Soares (2009)), which represent a non-exhaustive list of works.

no previous studies that investigate the future effects of the increase in human capital accumulation on the Brazilian economy as a whole[4]. Our work fills this gap, as it looks at differences in the economy across steady states equilibria.

Our work is related to the vast literature that measures the impacts of public policies using simulations with heterogeneous agent models. Our model specifically builds on Restuccia and Urrutia (2004) and Krueger and Donohue (2004). We chose a general equilibrium framework to account for the price movements caused by a continuously implemented new policy, which may play an important role in the programs effects[5].

Our calibration makes use of data that precede the program's existence. We then simulate a conditional cash transfer schedule that approximates the existing policy in terms of income threshold, schooling requirements, total coverage, and total budget. In this spirit, Zilberman and Berriel (2012) inquire about the impacts of *Bolsa Família* on savings, inequality and adult labor supply. Our work differs from theirs because we focus on the effects on human capital accumulation and on child labor over the life cycle, features that are absent from their paper. Our work is closer to Cespedes (2010), who develops a life-cycle model that includes human capital accumulation, calibrating the model with data from Mexico and introducing a conditional cash transfer similar to the Mexican program, PROGRESA.

Another group of studies uses structural estimation to evaluate the effectiveness of public policies and to test them against counterfactual policies. In this context, the work by Todd and Wolpin (2002) stands out as particularly influential. Bourguignon et al. (2003) also perform a micro simulation of *Bolsa Família*. An advantage that these types of works share with ours is that they do not require experimental or quasi-experimental designs. However, our work differs from theirs not only due to the differences in the models used but also because their analysis abstracts from general equilibrium effects. Instead, in our work, price movements driven by aggregate human and physical capital have a considerable influence in the policy's impacts over both the short and the long run.

The remainder of this paper is organized as follows: section 2 presents the model, section 3 describes our calibration strategy, section 4 features the results and provides a counterfactual experiment, and section 5 concludes.

[4]With respect to this issue, Souza (2011) states that the existing studies find no effect on human capital accumulation. In fact, as *Bolsa Família* has only been recently implemented, the data generated until now is insufficient for a definitive analysis (Fiszbein et al. (2009)).

[5]Recently, a law to make the *Bolsa Família* program a "state policy" was proposed by an opposition senator (PLS 448/13). If approved, *Bolsa Família* will become be a mandatory policy regardless of who governs the country. Our model choice is thus consistent with *Bolsa Família* being a "state policy".

2 Model

2.1 Economic Environment

The economic environment consists of overlapping generations with discrete time and no population growth. Individuals live for four periods, one as a child, one as a young adult and two as adult parents. At the beginning of their third period of life, individuals give birth to a child. Thus, each household consists of an adult parent and either a child or a young adult. The dynasty is the relevant agent in this economy. Following Basu and Van (1998), we assume that all decisions are jointly taken within the dynasty, so there is no conflict among its members. Additionally, an individual dies at the end of the fourth period. Figure 1 provides a representation of the life cycle in this economy.

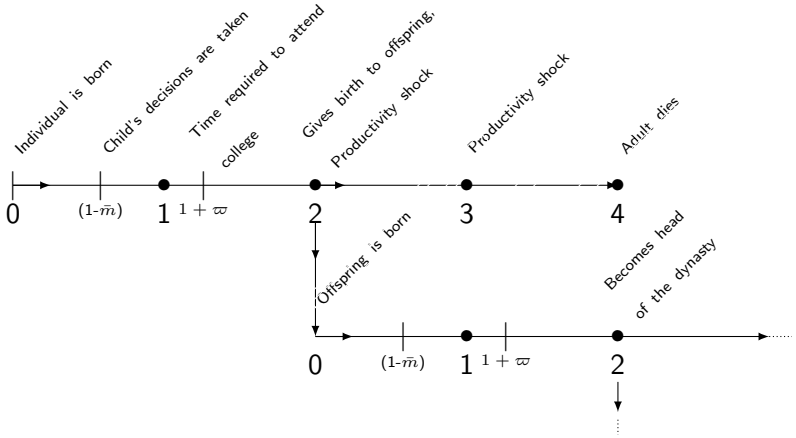
A model period consists of 17 years. However, during his first 9 years of life[6], an individual cannot work. During the other eight years, the child can work, go to school or allocate his time to leisure. It is possible to choose among three levels of schooling in this period: no schooling at all, only primary schooling, and secondary schooling. Schooling has not only explicit costs but also a cost in terms of time endowment, which also depends on the educational level chosen. A young parent of the same dynasty supplies all of his time (which is normalized to one) to the representative firm, in exchange for wages.

At the end of the first period of life, a child becomes a young adult and a young parent becomes an old parent. If a young adult has completed secondary schooling, he can choose to continue to college, which takes 4.5 years of his time time endowment and costs a certain amount of resources. The remainder of a young adult's time is fully devoted to work (an old parent also devotes his full time endowment to work). At the end of this period, a young adult becomes a young parent as the old parent dies. In this way, the dynasty continues as generations overlap.

A dynasty can spend its resources on consumption, schooling or precautionary savings (which, in the second period, take the form of bequests). In this economy, there is is only one way to directly transfer resources over time, which is by lending to the representative firm. The representative firm faces no uncertainty, and thus, in the following period, always pays interest to its lenders.

[6]We assume that an individual does not work during his first nine years of life because we only have data for children who are older than ten.

Figure 1: The Life Cycle



2.2 Preferences

We divide the dynasty's life cycle into two periods. In the first period the dynasty consists of a child and a parent living through its third period of life. In the second, it consists of a young adult and an adult who is living through its fourth period of life.

Each dynasty seeks to maximize its discounted expected utility. In the first period, the utility function is:

$$u_1(c, m) = \log(c) + \phi \log(1 - m) \tag{1}$$

The first term of the r.h.s represents the perceived utility from household consumption, while m represents the amount of time a children works, and $\phi > 0$ weights the utility obtained from child leisure. Note that leisure and schooling time are perfect substitutes in the utility function. The reason is that we assume that households care about their children's education and leisure and dislike child labor[7].

In the second period, there is no child labor decision. Hence, the dynasty utility function is simply represented by:

$$u_2(c) = \log(c) \tag{2}$$

[7]In this spirit, many studies, such as Erosa et al. (2010) and Restuccia and Vandenbroucke (2008), explicitly model individuals that directly care about their offspring's human capital investments.

2.3 Age-Earnings Profile

The effective units of labor an individual can supply to the market are given by his productivity, which depends on his human capital level and on an exogenous shock.

There are four levels of human capital, $h_i \in \{h_0, h_1, h_2, h_3\}$, which refer, respectively, to no schooling[8], primary schooling, secondary schooling and college education. The total supply of labor efficiency units of an individual who is living through his tth period of life and whose level of human capital is h is given by $z\xi(t,h)$, where z is a productivity shock.

Productivity shocks only affect adults. Let z_i be a shock that affects the adult of a household i. We assume that z_i follows a lognormal distribution.

$$\log(z_i') = -\frac{(1-\rho)\sigma^2}{2} + \rho\log(z_i) + \epsilon_i, \qquad \epsilon_i \sim N(0,\sigma^2), \tag{3}$$

where $\rho \in (0,1)$. Note that we normalize the unconditional average of this AR(1) process to be $-\frac{\sigma^2}{2}$, so we have $\mathbb{E}(z) = 1$. There are two underlying assumptions behind this exogenous process. First, the persistence of productivity is considered *within* household, not within individuals. That is, the productivity of the parent who is living through his fourth period of life affects the productivity his son will have in the next period in the same way that the productivity of a parent living through his third period of life affects his productivity during his last period of life[9]. Second, the productivity variance is the same regardless of an individual's age or education.

2.4 Production Technology

The representative firm has the usual constant returns to scale technology:

$$F(K_t, L_t) = AK_t^{\alpha} L_t^{1-\alpha}, \tag{4}$$

where K_t denotes the aggregate level of capital, L_t the aggregate level of labor efficiency units and A is the TFP. All levels of human capital (including child labor) are perfect substitutes (as in Basu and Van (1998)). The firm pays an interest rate r and wages

[8]For calibration purposes, "no schooling" should be considered "incomplete primary schooling". The reason is that, in the calibration procedure, we consider the share of the adult population that has *completed* each level of schooling (primary, secondary, and college). Therefore, the first level of human capital (h_0) includes individuals who did not complete primary schooling. See section 3.1 for more on this issue.

[9]A possible interpretation is that there are unobservable variables that are positively correlated among family members, such as innate abilities or job networks.

w for its inputs.

Since capital depreciates at rate δ, the firm's problem becomes:

$$\max_{\{K_t, L_t\} \geq 0} AK_t^{\alpha} L_t^{1-\alpha} - wL_t - (r + \delta)K_t \tag{5}$$

The firm's problem yields the following competitive labor and capital prices:

$$w_t = A(1 - \alpha) \left(\frac{K_t}{L_t} \right)^{\alpha} \tag{6}$$

and

$$r_t = A\alpha \left(\frac{K_t}{L_t} \right)^{\alpha - 1} - \delta \tag{7}$$

2.5 Schooling Technology

To invest in human capital accumulation, dynasties send their children and young adults to school and college, respectively. We denote by $\kappa(h)$ the cost of obtaining h units of human capital.

Attending school also requires a fraction of an individual time endowment, which cannot be allocated to working. In the first period, this fraction is strictly increasing in the level of education. In the second period, young adults who attend college also forgo a fixed fraction of their time endowment. We will use the function $\varsigma(\cdot)$ and the parameter ϖ to denote the time required to acquire a certain level of human capital[10].

2.6 The Government

The government maintains a balanced budget in each period. Its revenues consist of income taxes, denoted as τ. It rebates its revenues through conditional transfers, subsidies, or both. The transfers may be conditioned on (i) school enrollment and (ii) income thresholds. The transfer is denoted by η and $\mathbb{I} \in \{0, 1\}$ denotes the eligibility indicator. Finally, the government also determines a subsidy schedule, which is represented by the function $\mathcal{S}(h)$.

We assume throughout this paper that the government is fully credible and that its policies are fully observable. Hence,in a steady state equilibrium, policies are constant over time. We also assume that government policies are fully enforceable at no cost.

[10]More details on this issue will be explored in the calibration section.

2.7 The State Space

The state space of a dynasty that is in the first period consists of the bequest it received a, the human capital accumulated by the young adult h, and the productivity shock that affects him z. Let the state space of period one be denoted by $x^1 = \{z, h, a\}$.

For families that are living through the second period, the state space consists of the parent's level of human capital (still denoted by h), the education the young adult has acquired in the first period, denoted by h_c, the parent's observable shock, and their initial level of asset holdings are considered. We define the state space of the second period dynasty as $x^2 = \{z, h, h_c, a\}$.

2.8 The Dynasty's Recursive Problem

To begin, we'll divide the dynasty's problem into three parts. First, we follow the distinction made in section 2.2 and separate two periods of a dynasty: we denote period one as the period during which the parent is living through his third period of life and the child is living through his first period. Period two is defined as the period during which the head of the dynasty is going through his last period of life.

For simplicity, we also divide the dynasty's problem in period two into two parts, depending on whether the dynasty's young individual has completed secondary school.

2.8.1 Period 1

In the first period, the household's problem can be defined as:

$$V_1(x^1) = \max_{c,m,h',a'} \log(c) + \phi \log(1-m) + \beta \sum_{z'} \text{Prob}(z'|z) V_2(z', h, h', a') \tag{8}$$

subject to:

$$0 \leq m + \varsigma(h') \leq \bar{m} \tag{9}$$

$$c + (1 - \mathcal{S}(h'))\kappa(h') + a' = a + (1-\tau)[z\xi(3,h)w + ra] + \xi(1,h')mw + \eta\mathbb{I} \tag{10}$$

$$h' \in \{h_0, h_1, h_2\} \tag{11}$$

$$a' \geq \underline{a} \tag{12}$$

$$m \in [0, \bar{m}]\ ,\ c \geq 0, \tag{13}$$

where β is the discount rate, $\bar{m}$ is the child's available time endowment, $\underline{a}$ is an exogenous credit constraint, and $\mathbb{I}$ equals one if the household is eligible to receive the transfer and 0 otherwise. Note that the argument h reappears in the continuation value of the dynasty, because the adult parent can no longer invest in education, and thus, his current level of human capital is carried into the next period.

Constraint (9) is the fraction of the child's time that can be used to attend school and work (the remainder is implicitly allocated to leisure). Equation (10) represents the dynasty's resource constraint. On the right-hand-side, the expression $[(z\xi(3,h) + \xi(1,h')m)w]$ represents the gross labor income of the family - we assume that only the adult wages are taxed. The term $z\xi(3,h)$ represents the efficiency units of labor supplied by the adult parent, and $\xi(1,h')$ represents the efficiency units of labor supplied by the child. On the left-hand-side, the term $[(1-\mathcal{S}(h'))\kappa(h')]$ represents the net cost of acquiring the level of human capital h', a' is the quantity of the assets that will be carried into the next period, and c is consumption.

Constraint (11) represents the human capital investment possibilities in period 1, which are no schooling, primary, or secondary schooling, while equation (12) represents the credit constraint. Finally, expressions (13) represent time feasibility and consumption non-negativity.

2.8.2 Period 2 - Dynasties whose children attended secondary school

In the second period, a household whose young adult has completed secondary schooling and can thus still attend college, solves:

$$V_{2,s}(x_s^2) = \max_{c,g,a'} \log(c) + \beta \sum_{z'} \text{Prob}(z'|z) V_1(z', h', a') \tag{14}$$

subject to:

$$g \in \{0, 1\} \tag{15}$$

$$h' = h_3 g + h_2(1-g) \tag{16}$$

$$\begin{gathered} c + g(1-\mathcal{S}(h_3))\kappa(h_3) + a' = \\ a + (1-\tau)[(z\xi(4,h) + \xi(2,h_2)(1-g) + g(1-\varpi)\xi(2,h_3))w + ra] + \eta\mathbb{I} \end{gathered} \tag{17}$$

$$a' \geq \underline{a} \tag{18}$$

$$c \geq 0, \tag{19}$$

where $x_s^2 = (z, h, h_2, a)$, ϖ represents the time required to attend college, and g equals one if the young adult attends college and 0 otherwise. As before, restrictions (18) and (19) refer to the credit constraint and to the non-negativity of consumption, respectively.

Equation (17) is the household's resource constraint. On the left-hand-side, $(1 - \mathcal{S}(h_3))\kappa(h_3)$ is the net cost of attending college. On the right-hand-side, $[(z\xi(4, h) + \xi(2, h_2)(1 - g)\varpi + g(1 - \varpi)\xi(2, h_3))w]$ is the total gross labor income of the dynasty, $z\xi(4, h)$ is the efficiency units of labor supplied by the adult parent, $\xi(2, h_2)$ the total labor efficiency units supplied by the young adult who does not attend college, and $\xi(2, h_3)$ represents the efficiency units supplied by the young adult who attends college. Notice that $\xi(2, h_3)$ will be supplied only during a fraction $(1 - \varpi)$ of a period.

2.8.3 Period 2 - Dynasties whose children did not attend secondary school

In the second period, the household whose young adult did not complete secondary schooling and thus cannot attend college solves:

$$V_{2,n}(x_n^2) = \max_{c,a'} \log(c) + \beta \sum_{z'} \text{Prob}(z'|z) V_1(z', h', a') \tag{20}$$

subject to:

$$c + a' = a + (1 - \tau)[(z\xi(4, h) + \xi(2, h_c))w + ra] + \eta\mathbb{I} \tag{21}$$

$$h' = h_c \tag{22}$$

$$a' \geq \underline{a} \tag{23}$$

$$c \geq 0, \tag{24}$$

where $x_n^2 = (z, h, h_c, a)$ and $h_c \in \{h_0, h_1\}$, which, along with (22), states that the young adult cannot make any additional investment in human capital. Note that, in this case, the household's problem is summarized as an asset holdings choice only, with the actual level of the young adult's human capital being carried into the next period.

2.9 Definition of Equilibrium

A stationary recursive competitive equilibrium consists of:

D1 Three groups of functions: (i) $\{V_1, g_1^c, g_1^h, g_1^m, g_1^a\}$, (ii) $\{V_{2,n}, g_{2,n}^c, g_{2,n}^a\}$, and (iii) $\{V_{2,s}, g_{2,s}^c, g_{2,s}^h, g_{2,s}^a\}$ defined as follows:

- i The value function, consumption, the human capital, child's labor supply, and asset holdings policy functions, which all correspond to the first period.
- ii The value function, consumption, and asset holdings policy functions, which all correspond to the second period when the young adult cannot attend college.
- iii The value function, consumption, human capital (college), the asset holdings policy functions, which all correspond to the second period when the young adult has previously attended secondary school.

D2 Factor prices $\{w, r\}$.

D3 A government policy $\{\tau, \mathcal{S}(h), \eta\}$ and an eligibility criterion.

D4 A pair of time-invariant measures over states λ_1 and λ_2 that refer to periods one and two, respectively, and whose laws of motion are:

$$\lambda_2(z', h, h', a') = \sum_{\{(z,h,a):h'=g_1^h, a'=g_1^a\}} Prob(z'|z)\lambda_1(z, h, a) \tag{25}$$

and

$$\begin{aligned}\lambda_1(z', h', a') = \mathbb{I}(h_c < h_2) \left\{ \sum_{\{(z,h,a):h'=h_c, a'=g_{2,n}^a\}} Prob(z'|z)\lambda_2(z, h, h_c, a) \right\} + \\ \mathbb{I}(h_c = h_2) \left\{ \sum_{\{(z,h,a):h'=g_{2,s}^h \cdot h_3 + (1-g_{2,s}^h)\cdot h_2, a'=g_{2,s}^a\}} Prob(z'|z)\lambda_2(z, h, h_c, a) \right\}\end{aligned} \tag{26}$$

where,

1 Given [D2] and [D3], the group of functions [D1] maximize the household problems defined in the previous section.

2 Factor prices are given by (6) and (7).

3 The government operates with a balanced budget:

$$\Gamma = \sum_{z,h,a} \lambda_1(z,h,a)\kappa(g_1^h)\cdot\mathcal{S}(g_1^h) + \sum_{z,h,h_c,a} \lambda_2(z,h,h_c,a)g_{2,s}^h\kappa(h_3)\mathcal{S}(h_3) + \eta\left[\sum_{z,h,a}\mathbb{I}\lambda_1 + \sum_{z,h,h_c,a}\mathbb{I}\lambda_2\right], \tag{27}$$

where Γ represents the government revenues and $\mathbb{I}(eligibility)$ is a function of the households' states and choices. As child labor is not taxed:

$$\Gamma = \tau(rK + wL) - \sum_{z,h,a}\left[\xi(1,g_1^h)mw\right], \tag{28}$$

where L and K will be defined below.

4 Market clearing and consistency conditions hold:

$$\sum_{z,h,a}\lambda_1 g_1^c + \left[\mathbb{I}(h_c < h_2)\sum_{z,h,h_c,a}\lambda_2 g_{2,n}^c\right] + \left[\mathbb{I}(h_c = h_2)\sum_{z,h,h_c,a}\lambda_2 g_{2,s}^c\right] = C, \tag{29}$$

which is total consumption;

$$\sum_{z,h,a}\lambda_1\kappa(g_1^h) + \left[\mathbb{I}(h_c = h_2)\sum_{z,h,h_c,a}\lambda_2\kappa(h_3)\cdot g_{2,s}^h\right] = \mathcal{E}, \tag{30}$$

which represents the total education expenditures;

$$\sum_{z,h,a}\lambda_1 g_1^a + \left[\mathbb{I}(h_c < h_2)\sum_{z,h,h_c,a}\lambda_2 g_{2,n}^a\right] + \left[\mathbb{I}(h_c = h_2)\sum_{z,h,h_c,a}\lambda_2 g_{2,s}^a\right] = K, \tag{31}$$

which represents the aggregate level of capital, and

$$\sum_{z,h,a}\lambda_1(\xi(3,h)zh + \xi(1,g_1^h)g_1^m) + \left[\mathbb{I}(h_c < h_2)\sum_{z,h,h_c,a}\lambda_2(\xi(4,h)zh + \xi(2,h_c)h_c)\right] + \left\{\mathbb{I}(h_c = h_2)\sum_{z,h,h_c,a}\left[\lambda_2(\xi(4,h)zh + (1-g_{2,s}^h)\xi(2,h_2)h_2 + g_{2,s}^h(1-\varpi)\xi(2,h_3)h_3)\right]\right\} = L, \tag{32}$$

which represents the aggregate level of labor supply measured in efficiency units. Finally, the resource constraint is:

$$C + \delta K + \mathcal{E} = F(K,L) \tag{33}$$

3 Calibration

This section describes how we choose the model parameters and functions, which include A, $\underline{a}$, β, α, δ, $\xi(\cdot)$, $\kappa(\cdot)$, ς, ϖ, σ^2, ρ, $\mathcal{S}(\cdot)$, and ϕ.

First, we normalize $A = 1$. We also set the annual rate of depreciation to 0.06, as is standard in the business cycles literature, so $\delta = 0.6507$, and the borrowing constraint to $\underline{a} = 0$.

The time required to attend school is chosen as follows. First, we suppose that schooling takes one-half of the child's non-sleeping daytime. Moreover, we assume that, consistent with Brazilian legislation at the time[11], the minimum number of school days is 200. Dividing this number by the number of non-weekend days means that a child must attend school over 75% of a year's week days[12].

In Brazil, secondary school lasted three years while primary lasted eight in 1997[13]. We assume that every child completes at least the third grade of primary school. Hence, completing primary schooling requires $\frac{1}{2} \cdot 0.75 \cdot \frac{5}{17} = 11\%$[14] of a child's time endowment in that period. Recall that the child's effective time endowment in the first period is only $\frac{8}{17}$, because we only have data for children 10 years or older. Likewise, attending primary and secondary school requires $\frac{1}{2} \cdot 0.75 \cdot \frac{8}{17} = 17\%$[15] of a period's time.

We also assume that college and work are mutually exclusive and that attending college requires 4.5 years[16]. Hence, the young adult who chooses to attend college works for the remaining time, which corresponds to $\frac{12.5}{17} = 73.5\%$ of a period time endowment.

3.1 Age-Earnings Profile

The data source used to estimate $\xi(t, h)$ is the 1997 *Pesquisa Nacional por Amostra de Domicílios*[17]. In order to calculate the age efficiency profile, we restrict the data to

[11] Law 9394/96.

[12] The same legislation states that these days should incorporate **at least** 800 hours of classes, excluding examinations. We also include other transaction costs, such as transportation and exam time, in the time required to attend school; thus, we found it reasonable to assume that schooling requires 50% of a child non-sleeping hours.

[13] According to Law 11274/2006, the number of years of primary schooling increased to nine in 2010.

[14] One-half of the child's daytime multiplied by 75% of the year's days for 5 of 17 years.

[15] One-half of the child's daytime multiplied by 75% of the year's days for 8 of 17 years.

[16] Restuccia and Urrutia (2004) assume that college takes 4 years while Bohacek and Kapicka (2012) assume that it takes 5 years.

[17] The *Pesquisa Nacional por Amostra de Domicílios* is a Brazilian household survey that gathers demographic and socio-economic characteristics of the population such as gender, age, income, and education.

white males who work 40-48 hours per week.

First, to obtain the values of $\xi(1, h')$, we need to take into account the dynasty's decision about the child education. For example, if a child only attends primary school and then works the remaining time, at the end of the period he will have worked part-time over five years with no investment in human capital and full time for three more years, after primary school is completed.

With this fact in mind, our hypothesis is that the (potentially) working child divides his labor hours proportionately to his available time in each condition. In the example above, the child's labor efficiency corresponds to a weighted average of five years of working part time in addition to three years of working full time.

With regard to the remaining values of $\xi(t, h)$, we take the average wages in each age range, conditional on the educational level. We then normalize $\xi(2, h_0) = 1$ and calculate all other productivities relative to this value[18].

Table 1: Age-earnings profile.

ξ	h_0	h_1	h_2	h_3
$t = 1$	0.49	0.56	0.54	-
$t = 2$	1	1.37	2.28	5.42
$t = 3$	1.41	2.3	4.12	7.94
$t = 4$	1.29	4.17	4.47	9.26

To calibrate the exogenous productivity process, we approximate a continuous AR(1) process using ten grid points, following Tauchen (1986). To estimate σ, we estimate a static log-wages regression, whose residual variance[19] equals $\frac{\sigma^2}{1-\rho^2}$. Thus, by finding a value for ρ (see section 3.3), we are able to identify the value of σ.

3.2 Fiscal Policy

In Brazil, schooling is heavily subsidized, at all levels. For instance, in 2000, public expenditures on education, including federal, state and municipality spending, accounted

It has been performed since 1967 on a nearly annual basis, with the exception of census years. In 1997, it surveyed 346,269 individuals out of an estimated population of 163,470,521.

[18]In each human capital category, we only take into account the average wages of individuals who have **completed** that level of schooling. Therefore, h_0 should be seen as "incomplete primary schooling", rather than "no schooling".

[19]The regression only takes into account white males whose ages range from 35 to 51, which corresponds to the third period of our model. The estimated residual variance equals 0.61.

for 3.9% of GDP[20]. In order to estimate the fraction of public education expenditures per student, we use information from two databases: the National Institute for Educational Research and Policy (INEP) and the Brazilian household expenditures survey (POF)[21].

First, the INEP provides an estimate of public expenditures as a fraction of per capita GDP. We use the 2002 estimates, to match the data from the expenditures survey. In 2002-2003, *for each* student in the fifth through eighth grades of primary schooling (10-14 year olds), the expenditures per student corresponded to 12.3% of per capita GDP. The same ratio for secondary students was 8.9%, while for tertiary students it was 121%.

Given these ratios, we estimated the private expenditures in education per student. We use the 2002-2003 POF. For each family in this survey, we have information on education expenditures divided into six categories: (i) expenses for regular courses, which are defined as primary or secondary education expenses, (ii) expenses for tertiary education, (iii) total expenses for other courses, (iv) total expenditures on books and scientific publications, (v) total expenditures on school articles, and (vi) other expenses.

We then separate the families that spend exclusively on either college or regular courses. Therefore, we assume that a family that spends only for one category devotes all other education expenditures to activities or goods linked to that category, which are also considered education expenditures in our model. Finally, to assess the average expenditure per student, we assume that every family has two adults, and hence, we divide the average expenditures for each category by the average household size minus two. Finally, because we do not have separate data for primary and secondary education, we suppose that average private expenditures on both are the same.

Finally, we divide the estimated values by 2002 per capita GDP. We found that each tertiary education student has private costs of 32.9% of the per capita income, while a student in a regular course costs, on average, 11.9%[22]. We use these values to estimate the subsidy function, obtaining $\mathcal{S}(h_1) = 53.4\%$, $\mathcal{S}(h_2) = 50.0\%$ and $\mathcal{S}(h_3) = 54.73\%$.

[20]Source: INEP/MEC

[21]The *Pesquisa do Orçamento Familiar* is a Brazilian household survey that gathers information about household expenditures on a wide range of items. In 2002, this survey included 48.470 households.

[22]The average family size of those who are enrolled in tertiary education is 3.61, while for regular (primary or secondary) the average is 4.13, based on sample sizes of, respectively, 4338 and 1555 observations.

Table 2: Literature and Data Parameters.

Parameter	Value	Description
A	1	Production Function TFP
δ	0.6507	Physical capital depreciation
α	$\frac{1}{3}$	Physical capital share (production function)
ϖ	0.26	Fraction of period required to attend college
$\varsigma(2)$, $\varsigma(3)$	11%, 17%	Fraction of period required to attend primary and secondary school
$\mathcal{S}(1)$, $\mathcal{S}(2)$, $\mathcal{S}(3)$	53.4% 50% 54.7%	Government subsidies
σ^2	0.25	Variance of the productivity process.
$\underline{a}$	0	Borrowing constraint.

3.3 Simulated Method of Moments

Thus far, we have estimated 26 parameters (some of which are part of the same functions) from the literature or using Brazilian data. The remaining six parameters are jointly calibrated using the model to simulate a set of six exactly identified empirical moments. Let the parameter vector be:

$$\Theta = [\phi \ \ \kappa(h_1) \ \ \kappa(h_2) \ \ \kappa(h_3) \ \ \beta \ \ \rho]' \tag{34}$$

The model generates six moments, which are denoted by $M(\Theta)$. The vector of targets is denoted by M_s and summarized in table 3. We find the estimate for $\hat{\Theta}$ by:

$$\hat{\Theta} = \arg\min_{\Theta} \left\{ [M(\Theta)] - M_s]' W [M(\Theta) - M_s] \right\} \tag{35}$$

where W is a weighting matrix. Here, we set $W = \mathcal{I}$, because there is no clear choice of W.

As for the targets, we choose statistics that have a direct relationship with each identified parameter. Initially, we identify ϕ, the parameter that governs the preference for child labor, using PNAD data for the share of children between 10 and 17 years old who were working. To identify the costs of schooling ($\kappa(\cdot)$) we match the shares of the population that have completed each educational level, taking into account only individuals who were 25 to 34 years old. To identify β in this model, we use Brazilian gross fixed capital formation, taking the average from 1992 to 2002. Finally, ρ is identified by the most parsimonious estimate of the Brazilian intergenerational elasticity of earnings obtained by Dunn (2007). The calibration procedure is summarized in tables 2, 3, and 4.

Table 3: Empirical Moments.

$M_{s,i}$	Model	Data	Description
i=1.	22.05%	21.95%	Fraction of children who work (PNAD 1997).
2.	18.81%	19.22%	Fraction of adults who completed only primary education (PNAD 1997).
3.	25.39%	24.92%	Fraction of adults with secondary education but not college (PNAD 1997).
4.	8.39%	7.78%	Fraction of adults who completed tertiary education (PNAD 1997).
5.	17.71%	17.86%	Gross capital formation (IBGE)
6.	0.69	0.69	Intergenerational elasticity of earnings (Dunn (2007))

Table 4: Parameters Obtained through the Simulated Method of Moments.

Parameter	Value	Description
ϕ	1.13	Marginal disutility of child labor.
$\kappa(h_1)$	0.66	Gross cost of primary schooling.
$\kappa(h_2)$	1.60	Gross costs of obtaining both primary and secondary schooling.
$\kappa(h_3)$	6.61	Gross costs of college education.
$\beta^{\frac{1}{17}}$	0.97	Preference rate of discount (annual).
ρ	0.66	Persistence of the exogenous productivity shock process.

4 Results

4.1 Benchmark Policy

We construct the transfer schedule for our benchmark policy by defining a basic transfer and a basic income threshold. The basic income threshold includes net capital and net labor earnings, but excludes child labor earnings. The basic transfer is treated as a normalization, and corresponds to what an extremely poor[23] family would receive if its children finished secondary schooling. All other transfers are proportional to the basic transfer, and we use the same ratios defined by the Brazilian Ministry of Social Development for the *Bolsa Família* Program in 2013. Every household whose income is below the basic threshold that complies with the schooling requirement receives a transfer (in the case of attending only primary school, 5/8 of the basic transfer). Moreover, every household whose earnings are less than two times the basic threshold receives another

[23]See section 6.1 for more information on transfer thresholds and conditionalities.

transfer, also conditional on schooling, as do *Bolsa Família* beneficiaries. The transfer schedule is summarized in table 5. We then set the basic transfer and thresholds such that, in the new steady state equilibrium, the program's total budget corresponds to 0.55% of total output and the program's coverage corresponds to 20.7% of families, following the 2013 figures for *Bolsa Família*.

Table 5: Summary of the Transfer Policy

Threshold	Schooling Conditionality	Transfer
Basic	Primary	0.60
	Secondary	1
2x Basic	Primary	0.29
	Secondary	0.49

Note: The values displayed in the third column correspond to the total transfer received, relative to the transfer received by families below the basic threshold and whose children complete secondary schooling.

Due to the policy design, it is possible that some mistargeting occurs. Mistargeting, in the context of this model, happens when a family whose income is below the threshold does not receive the transfer for some reason. In this model, mistargeting occurs if the transfer is so small that it does not compel a family to bear schooling costs, so the family optimally decides **not to accept** the transfer. Because we have set a transfer coverage goal of 20.7%, the existence of mistargeting means that the very poorest families do not receive the transfer, but some middle income families do. In fact, in the post-CCT steady state equilibrium, 19% of the families that are eligible choose not to accept the transfer. This number is not insignificant, but it is below existing estimates for the *Bolsa Família* program (see Soares et al. (2009)). In section 4.5 we consider an experiment in which mistargeting is not a concern.

4.2 Long Run Results

The most notable influence, by far, of the *Bolsa Família* program is on human capital accumulation. A comparison with the no transfer case is displayed in table 6. Over the long run, the share of the population that does not complete primary schooling decreases from 47% to 10%. The share of adults who have completed up to primary

schooling dramatically increases from 19% to nearly 50%, while the share of the adult population that has completed up to secondary school increases from 25% to 32%. Finally, there is virtually no modification on the tertiary enrollment rate. In fact, because the families whose young adults enter college are among the richest ones (their average incomes are nearly four times the per capita income and ten times greater than the average income of the transfer beneficiaries), the new policy can only affect their decision through general equilibrium effects. For instance, wealthier families maybe benefit from higher interest rates (see table 7). However, equilibrium effects are not so strong, as they only cause a slight increase in tertiary school enrollment (by 5% or 0.45 percentage points).

The new policy's impacts on human capital accumulation can be explained by two

Table 6: Educational and Child Labor Outcomes (Long Run)

	No Transfer	Benchmark Policy
Incomplete Primary	46.9%	9.9%
Primary	19.2%	49.6%
Secondary	24.9%	32.4%
Tertiary	7.8%	8.2%
Primary School Completion Rate	51.9%	90.2%
Share of working children	22.0%	17.0%
Average child labor supply	5.4%	4.3%

mechanisms: direct and indirect. First, the transfer directly affects school enrollment through its eligibility requirements. By itself, this channel is responsible for the largest share of the increase in human capital accumulation - the school eligibility requirement induces the vast majority of children to complete at least primary school. Second, the direct impact on workforce quality increases the marginal return to physical capital and thus induces its accumulation. A higher level of physical capital implies that a given quantity of working hours is able to produce more, which in turn encourages more investment in human capital. In fact, this indirect effect is responsible for the majority of the increase in secondary schooling investment[24].

Over the long run, increased human capital accumulation has important macroeconomic impacts, as shown in table 7. The aggregate labor efficiency units increase

[24]See section 4.3 for more details.

by 22%, while the aggregate physical capital increases by 15.6%, resulting in a nearly 20% increase in per capita output.

Table 7: Macroeconomic Indicators

	No Transfer	Benchmark Policy	% Change
Per Capita Output	4.83	5.78	+20%
Labor Efficiency Units	9.21	11.21	+22%
Aggregate Physical Capital	1.32	1.53	+15.6%
Investment Rate	17.9%	17.3%	-3.4%
Interest Rate	2.67%	2.83%	+6%
Wages	0.349	0.343	-1.7%
Tax Rate	15.4%	17.3%	+12%
Transfer Coverage	0%	20.7%	-
Transfer Budget (% total output)	0%	0.55%	-

To understand the magnitude of these results, we examine the incentives to accumulate physical capital. The conditional transfer serves as insurance, weakening precautionary motives, even for families who *are not* eligible. This happens because every household in the economy has a chance of being affected by a series of negative productivity shocks leading to poverty. As a result, all else equal, every family has some incentive to save less. However, the schooling requirements are able to fully offset the perverse effects implied by weakened precautionary motives. For the sake of comparison, if we kept the transfer schedule but eliminated any schooling requirement[25], the new total labor efficiency units in the steady state would decrease by 17.5%, compared with a 22% increase in the proposed schedule. This difference illustrates the importance of introducing schooling requirements along with a conditional cash transfer policy. As workforce quality increases, the marginal return on physical capital increases, encouraging investment in education, increasing the marginal return on physical capital, and thus increasing physical capital accumulation.

[25]In the simulation we continue to provide transfers only to the families who are living through their first period (with children). The family coverage amounts to 34%, while the transfer budget amounts to 2.6% of total output. The increased coverage and ratio occur because per capita income is 31% lower than in the no CCT case.

Higher workforce quality has a direct effect on child labor. The larger share of parents with higher education and, thus, higher labor incomes, means that there is less need for child labor, as shown in table 6. The share of working children decreases from 22% to 17% and total child working hours decrease by 20%. However, one-half of working children also complete primary schooling, contrary to the non-CCT case, wherein the share of children who work and complete any schooling was less than 1%.

Over the long run, we observe a decrease in net wages, due to higher taxes and the increase in the supply of labor efficiency units. In fact, this could be the driving force of the observed reduction in child labor supply, rather than the human capital accumulation channel. To evaluate the magnitude of the wage reduction effect over child labor, we simulated a version of the model where we provided the same transfer schedule but held the (gross) wages constant at the pre-CCT level, which is higher than the post-CCT equilibrium wages. The share of working children was 16.1%, showing that higher wages actually *reduced* child labor. The reason is that higher wages increased household income overall, alleviating the need for child labor. Therefore, we infer that human capital accumulation is indeed the driving force reducing the share of working children.

4.2.1 Poverty and Inequality

Child labor and education are directly related to poverty, and one of the main goals of the Bolsa Família program is precisely to reduce poverty. So far, we have observed that the *Bolsa Família* effectively increases schooling and reduces child labor over the long run. We now evaluate the program's performance regarding poverty and inequality, which is presented in table 8. We define the poverty line based on the income distribution generated by the model. In 1997, the Brazilian headcount ratio was 20.5%, according to the World Bank. We then set the poverty line to correspond to the 20.5 quantile of the income distribution of the calibrated pre-CCT model.

The CCT policy is able to reduce poverty by 10.9 percentage points from the benchmark, from 20.5% to 9.6%, which represents a 53% decrease. The driving force here is human capital accumulation, a fact that will become even clearer when we analyze the transition. Additionally, there is a decrease in the degree of persistent of earnings, as the intergenerational elasticity of labor earnings falls from 0.695 to 0.653. Thus, in the long run, our results suggest that conditional cash transfers are effective in improving social mobility

The program is very successful in reducing the Gini coefficient of labor income (from 0.526 to 0.475) and of total income (from 0.493 to 0.450). In this sense, our

Table 8: Poverty and Inequality Outcomes

	No Transfer	Benchmark Policy
Income Gini	0.493	0.450
Labor Income Gini	0.526	0.485
Wealth Gini	0.585	0.641
Intergenerational Elasticity of Earnings	0.695	0.653
Poverty Headcount Ratio	20.5%	9.6%

result differs from Cespedes (2010), who predicts that the long-term effects of the Mexican PROGRESA program on inequality are small. A possible explanation is that *Bolsa Família* represents 0.55% of Brazilian output, while in contrast PROGRESA represents only 0.1% of Mexican output. Finally, it is interesting to see that wealth inequality is exacerbated by the new policy. This fact is due to the asymmetric distortion of precautionary motives implied by the conditional cash transfer. Specifically, because there is a positive correlation between asset holdings and total income[26], less wealthy families are relatively more insured than richer ones. This asymmetry causes the poorest families to reduce their savings relatively more than the wealthy, which aggravates wealth inequality.

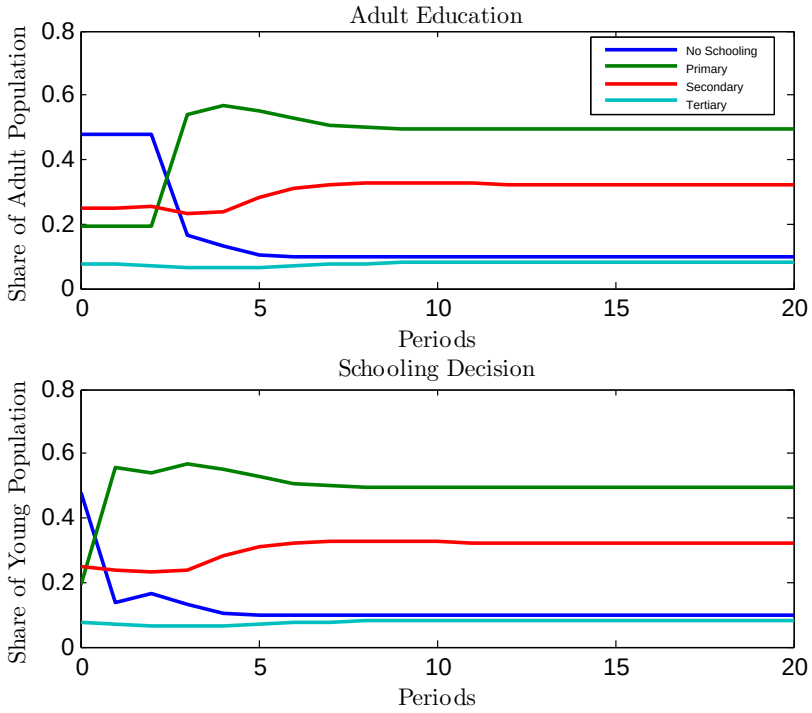
4.3 Transitional Dynamics

In this section, we evaluate the transitional dynamics between the pre-CCT equilibrium and the post-CCT equilibrium. We start by looking at the human capital accumulation dynamics (figure 2). First, note that there is an immediate sharp increase in the share of children that complete up to primary school, from 19% to 54%. However, this increase is not accompanied by secondary enrollment, which even slightly decreases at the beginning of the transition. To understand why this happens, we must examine the price movements (figure 3).

In the first period of the transition, the relative return on human capital investment falls remarkably as wages decrease and the interest rate rises. Because the labor supply (measured in efficiency units) remains constant over the short run (see figure 4), we conclude that the weakened precautionary motives drive this price movement. The reduction of the investment rate corroborates our conclusion (figure 5). There

[26]The observed coefficient of correlation between asset holdings and total income is 0.53 in the post-CCT steady state.

Figure 2: Evolution of Education

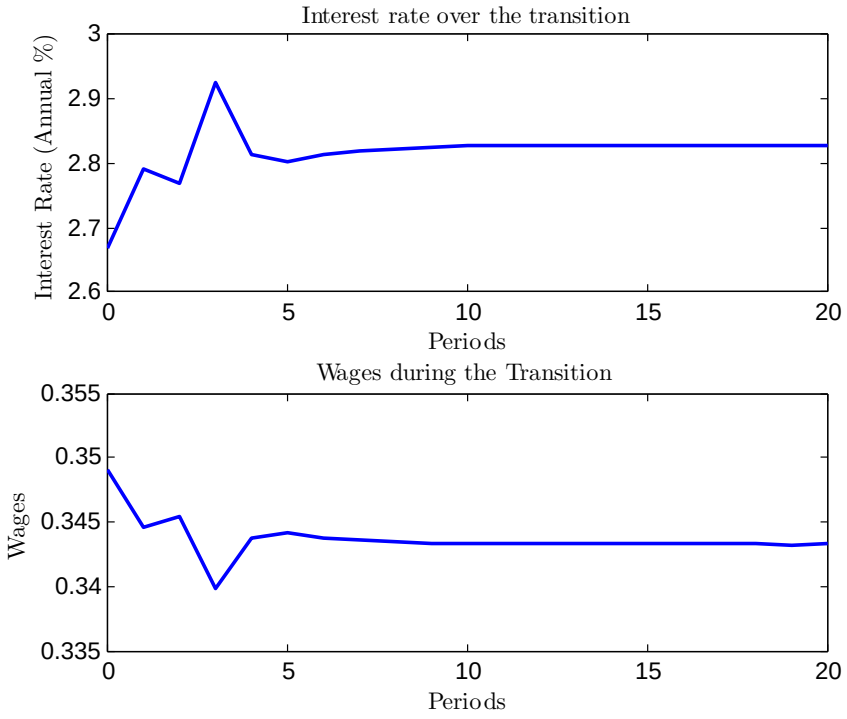


Note: The top graphic displays the share of the adult population that has completed (up to) a certain level of education. The bottom graphic displays the share of the young population that completes a certain level of schooling.

is an overall disincentive to education over the short run, especially in the first and second periods of transition. On the other hand, the conditional transfer also provides an incentive to increase schooling, although only for targeted families. Because the schooling requirements of the transfer policy in the first period are only sufficient to induce households to enroll their children in primary school, secondary school attainment decreases.

As the generation that is born in the first year of the intervention reaches adulthood, workforce quality increases and encourages physical capital accumulation, which, at the first moment, intensifies the price movement. During the third period of the intervention, wages are at their lowest due to the high labor supply while interest rates reach a peak of 2.93% due to the increased demand for physical capital. The schooling requirement plays a crucial role in keeping the share of children who complete at least primary school at 90% despite the low wages, while secondary and tertiary attainment remain barely constant.

Figure 3: Evolution of Wages and Interest Rates

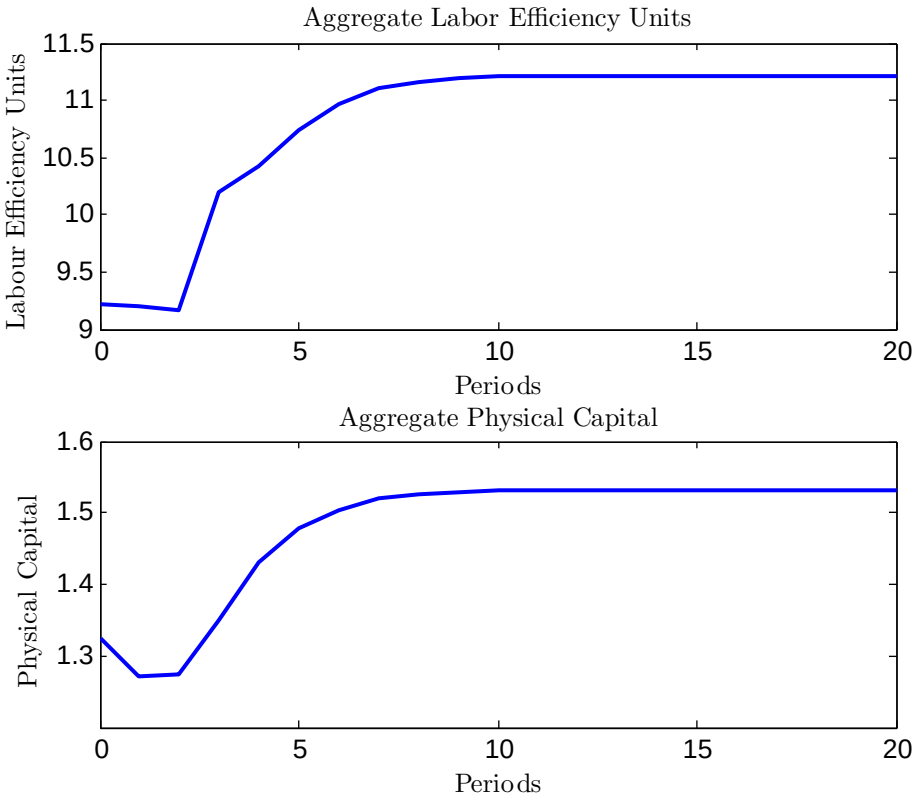


During the fourth period of the intervention, the growth of physical capital stock not only reduces interest rates but also reverses the downward wage trend, attracting investments in human capital. It is also at that point that investments in secondary and tertiary schooling begin to increase, giving a final boost to physical capital accumulation. The complementarity between human and physical capital accumulation continues to take place during the smooth convergence to the new steady state equilibrium.

The dynamics described above emphasize the role of a general equilibrium approach to evaluating the impacts of a conditional cash transfer. Price movements play a crucial role during the first periods of the intervention, but diminish until convergence. As a result, the interest rate is higher than before, but it remains much lower than its peak during the third period of intervention. However, wages remain lower than in the pre-CCT steady state, and not far from their lowest value during the transition.

The downward trend in wages could serve as an incentive for households to decrease their children's labor supply. In spite of this fact, what happens throughout the transition is surprising: during the first period, total child labor increases, both in the

Figure 4: Evolution of Macroeconomic Variables

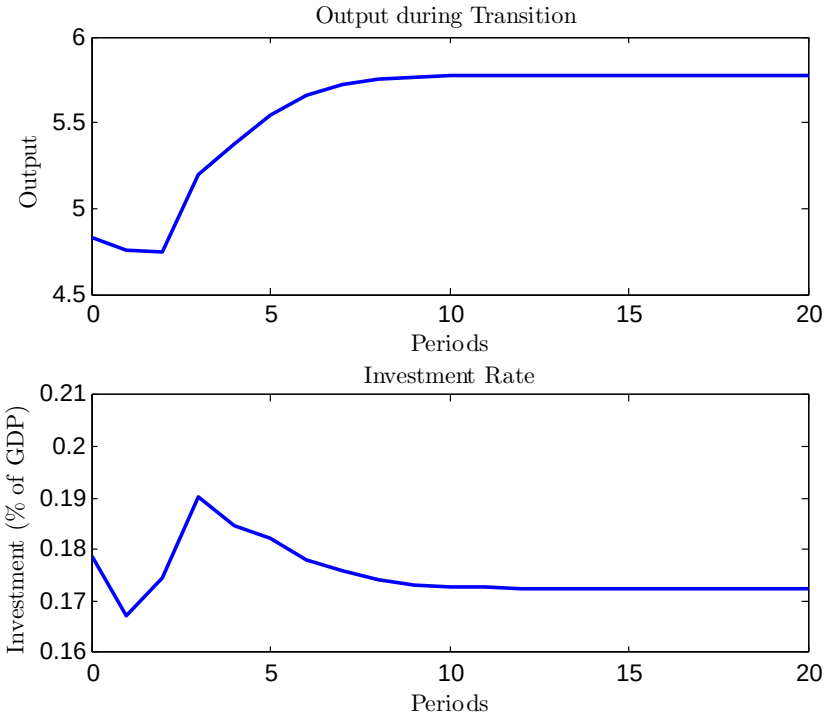


extensive (from 22% to 23%) and intensive margins (an increase of 26% of total hours supplied). This pattern persists during the second period, reversing only after three intervention periods. The transitional dynamics concerning child labor are displayed in figure 6.

During the first two periods of the transition, the majority of parents do not have sufficient income to pay for schooling, even with the conditional transfer. Therefore, families whose income is below the basic threshold find it optimal to receive the transfer and, at the same time, increase their child labor supply to pay the schooling costs. Moreover, there are some families (approximately 21% of eligible households in the first transition period) whose income is below the basic threshold but choose not to accept the transfer. As a result, these families become even more impoverished as taxes increase and wages decrease, increasing their need for child labor.

After the third period of the transition, the upward trend in child labor supply reverses. First, as total output starts to increase, the tax rates, which finance the school

Figure 5: Evolution of Macroeconomic Variables (II)

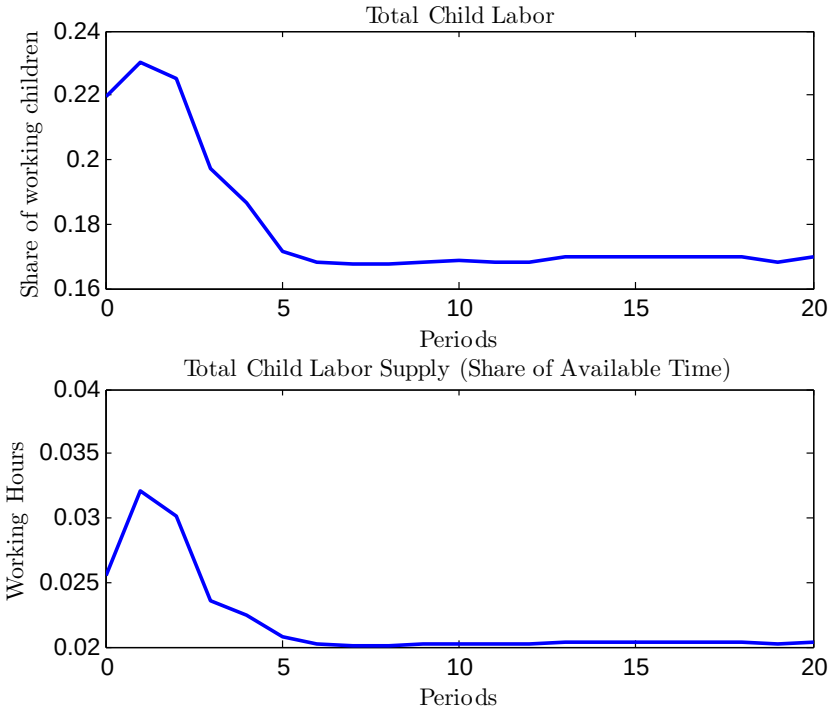


subsidies and transfers, decrease. Second, the new generation of adults is more educated, which, along with increasing wages, provides higher labor income and alleviates poverty. Finally, the number of mistargeted families (those who decide not to accept the transfer) falls to its steady state value (19%), as the most impoverished families are increasingly able to comply with the schooling eligibility. Subsequently, the poorest families are less deprived as before, which reduces their need for child labor.

By the end of the transition, the level of child labor supply reaches its lowest, as only 17% of children work. Therefore, our results suggest that the impact of *Bolsa Família* on child labor occurs mostly through its long-term general equilibrium effects. The fact that a conditional cash transfer, over the short run, is inefficient in addressing child labor is already documented (see Cardoso and Souza (2004) and Rocha and Soares (2009)). Thus, we provide a possible explanation for that fact: Families need child labor in order to be able to afford schooling costs. However, as new generations of educated children become adults, labor income increases overall and child labor is no longer necessary.

To conclude the transitional dynamics analysis, we evaluate the evolution of poverty

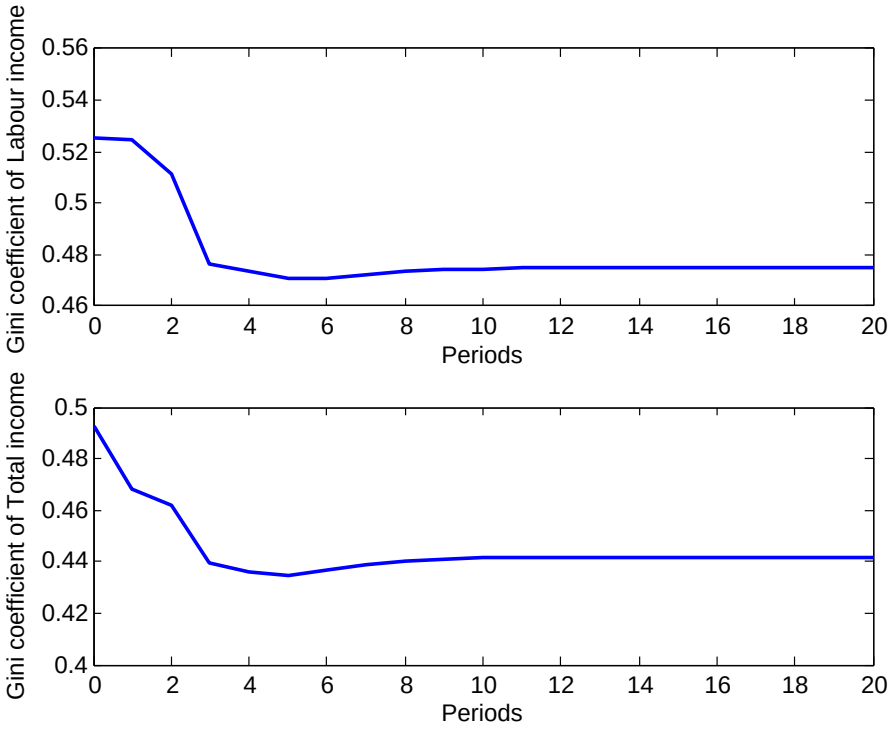
Figure 6: Evolution of Child Labor



and inequality outcomes (figures 7 and 8). The Gini coefficient of labor income remains constant during the first period of transition, which is consistent with the existing data[27]. However, if we consider the Gini coefficient on total earnings (which includes capital rents *and* conditional transfers) we observe a reduction of 1.4 points. The reduction is fully driven by the transfer, because the Gini coefficient of capital income also remains constant over the short run. When the generation born in the first year of the intervention reaches adulthood, inequality is sharply reduced, and the new steady state income distribution is reached within one generation. With regard to poverty, the effects of the new policy arise during the first period of intervention. Therefore, the policy is able to alleviate poverty both directly - through the transfer itself - and indirectly - through the incentives to increase human capital accumulation.

[27]See Soares et al. (2009) for a decomposition of the Brazilian Gini index of household income.

Figure 7: Evolution of Inequality



4.4 Welfare Evaluation

In this section we evaluate the impacts of the transfer policy on welfare. We measure welfare in terms of consumption equivalent units, as is usual in the literature. Let $W_i(x^i)$ be the period i consumption equivalent welfare of a household whose state is x^i. So:

$$W_1(x^1) = \frac{1}{1-\beta}\left[\log g_1^c + \phi \log(1 - g_1^m)\right], \tag{36}$$

for the first period and

$$W_2(x^2) = \frac{1}{1-\beta}\log g_2^c, \tag{37}$$

for the second period, where that g_1^c and g_2^c are the consumption policy functions, while g_1^m is the policy function for child labor supply. To obtain the total welfare of the economy we simply integrate over the possible states, using the invariant measure *before* the introduction of the new policy, which represents precisely the distribution of households during the first transition period.

The results are shown in column (2) of table 9. Only 33% of individuals are better off immediately after the introduction of the policy, while total welfare decreases by 2.26%. This result is driven by the burdens imposed by higher taxes, lower wages, and reduced incentives for physical capital accumulation during the first years of the transition[28]. Over the long run, however, as individuals become more educated and thus increase their labor earnings, the initially heavy burdens translate into massive welfare gains (18.7%). Therefore, the transfer policy imposes a burden on the current generation in exchange for large welfare gains in the future, as we could expect from the long-term results presented in section 4.2.

[28]If we compute the average welfare gains by asset holdings level, we see that those who hold no assets at all *and* those who hold a medium-level amount of assets (say, the middle class) are the segments of the population that mostly dislike the new policy. These are precisely the households that rely on labor income but *do not* receive transfers. The very poorest households choose not to receive the transfer because it would require school enrollment, which imposes costs that surpass the transfer benefits.

Figure 8: Evolution of the Poverty Headcount Ratio

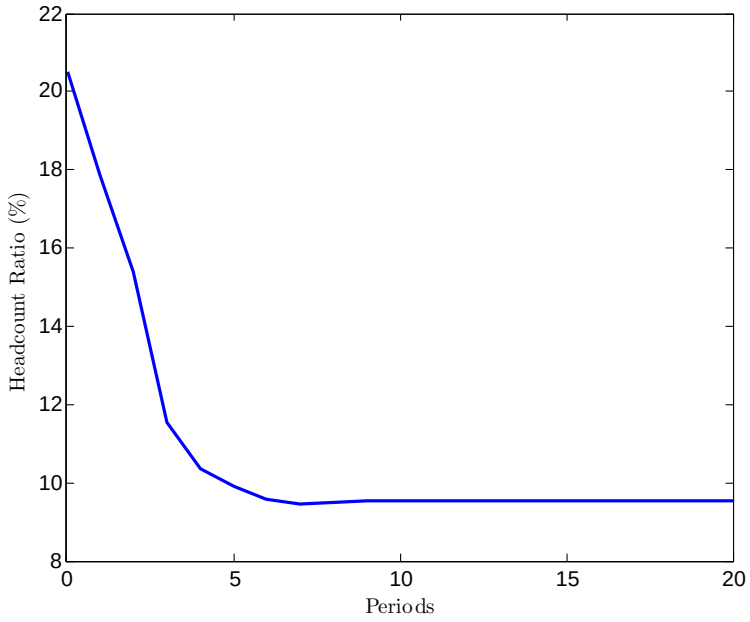


Table 9: Welfare Analysis

	Benchmark Policy
% better-off	33%
% targeted better-off	87%
Total Welfare	-2.26%
Total Welfare in new SS	+18.7%

Note: Welfare is measured in consumption equivalent units. The first row presents the percentage of the entire population that is better off immediately after the introduction of the policy (in comparison to the steady state where no conditional cash transfer policy takes place). The second row presents the share of households who receive the transfer *during the first period of transition* that are better off right after the changing. The third row presents the total welfare modification right after the initiation of the new policy. The fourth row presents the total welfare modification after achieving the new steady state.

4.5 Counterfactual Experiment

In the last section, we have observed that the introduction of a conditional cash transfer policy similar to *Bolsa Família* creates vast benefits in the long run, increasing human and physical capital accumulation, while reducing child labor, poverty and inequality. However, in the short run, a large share of the population is hurt by higher taxes, lower wages and decreased incentives to accumulate physical capital. Based on this scenario, a natural question arises: could we provide a similar transfer scheme that maintains these long-term benefits while reducing the short-term costs?

Thus, we introduce a new policy that maintains the previous thresholds and transfers and introduces an extra transfer that does not require school enrollment and is provided to any[29] household whose total net earnings are below the basic threshold. The extra transfer corresponds to 50% of the basic transfer.

In the long run, the effects are similar to the benchmark policy, but slightly weaker. This fact can be attributed both to the relatively lower incentive to schooling and to

[29]By construction, the benchmark policy specification did not include any households living through the second period. Instead, the counterfactual policy is able to reach most impoverished families that are living through the second period (whose members are a young adult and an old adult parent).

the relatively higher insurance promoted by the transfer that does not require school enrollment. The impacts on educational attainment and child labor are presented in table 10. The transfer raises primary school completion to 83% and reduce the share of working children to 18%. In addition, the macroeconomic impacts of this policy are quite similar to the benchmark case[30], as are the results regarding inequality, which are displayed on table 11.

In the short run, however, there are important differences with respect to the

Table 10: Educational and Child Labor Outcomes (Long Run) - Counterfactual Policy

	No Transfer	Counterfactual Policy
Incomplete Primary	46.9%	16.9%
Primary	19.2%	45.6%
Secondary	24.9%	29.8%
Tertiary	7.8%	7.7%
Primary School Completion Rate	51.9%	83.1%
Share of working children	22.0%	18.0%
Average child labor supply	5.4%	4.0%

Table 11: Poverty and Inequality Outcomes - Counterfactual Policy

	No Transfer	Counterfactual Policy
Income Gini	0.493	0.460
Labor Income Gini	0.526	0.485
Wealth Gini	0.585	0.664
Intergenerational Elasticity of Earnings	0.695	0.628
Poverty Headcount ratio	20.5%	10.8%

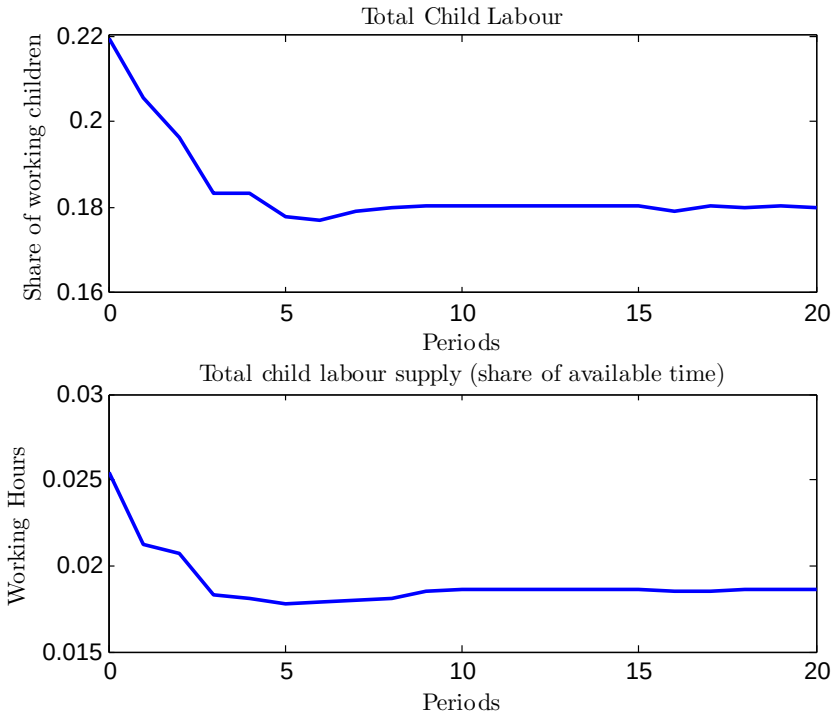
previous case. Figure 9 shows that the share of working children *falls* monotonically towards the new steady state, with a 1.5 percentage point decrease in the first year of

[30]In the new steady state, the transfer covers 29.8% of the households, with a budget that corresponds to 0.83% of the total output. Additionally, output increases by 14.4%, aggregate labor efficiency units increase by 16.7%, and aggregate physical capital increases by 10.1%.

the transition. This fall cannot be explained by differences in price movements, which essentially follow the same path as in the benchmark policy[31].

In fact, because the transfer is able to reach everyone below the threshold regard-

Figure 9: Evolution of Child labor - Counterfactual Policy



less of school enrollment, the very poorest *also* have a slight increase in their income, contrary to what happened in the previous case. This leads to immediate poverty reduction, which discourages child labor right after the intervention. This result suggests that a policy that prescribes a transfer and does not require school enrollment end up being effective in tackling child labor in the short run.

Finally, we examine the welfare impacts of the counterfactual policy. In the counterfactual intervention, 60% of households are better off, with 99% of targeted households benefiting from the new policy, and total welfare increasing by 3.86% immediately after the intervention. The increase in the share of households that are better off is because the new transfer is able to reach, right after its introduction, many households that

[31]Other variables such as investment rate, capital accumulation, total output, and inequality outcomes, also follow transition paths that are very similar to those of the benchmark policy.

were not covered in the benchmark specification, including families whose members are only adults (young and old).

In the long run, however, total welfare only increases by 14.5%. This result shows that, as the economy gets richer, it is preferable, from a welfare point of view, to have a transfer program that requires school enrollment. In fact, we observe a trade-off between short-term and long-term welfare. In the counterfactual experiment, a transfer that was less strict in terms of conditionalities achieved less long-term benefits, in exchange for less welfare costs (in fact more welfare gains). On the other hand, the the "stricter" schedule achieves more long-term benefits, but at a high (welfare) cost to most households.

5 Conclusion

In this paper, we evaluate the long-term effects of conditional cash transfer programs, such as the Brazilian *Bolsa Família*, on human capital accumulation and child labor. In the long run, we find out that a transfer policy that mimics the *Bolsa Família* is able to sharply increase school enrollment and reduce the share of working children. School attainment rose significantly in the primary level, whose completion rate reaches 90% in the long run, as opposed to a previous 53% rate. On the other hand, the program had a smaller effect on secondary school completion (32.7% to 40.6%) and almost no effect on college attainment. The observed impact on child labor is more modest, although far from insignificant - the share of working children decreased from 22% to 17%.

By computing the transition to the new steady state, we are able to both evaluate the short-term welfare impacts stress the importance of considering general equilibrium effects in the analysis. Wage and interest rate movements have substantial impacts over the short run, affecting physical and human capital accumulation, and even increasing child labor. This result suggests that the benefits of *Bolsa Família* with regard to child labor are still forthcoming. Additionally, we show that, in the mid-run, the incentives to schooling provided by the transfer are able to overcome the weakened precautionary motives implied by the conditional transfer. As a result, most of the benefits of the new policy are felt within the time gap corresponding to one generation.

A conditional cash transfer program that requires school enrollment has remarkable impacts over the whole economy, being very successful in tackling poverty and inequality and increasing human capital accumulation, while also having an important impact on child labor. The results are even more impressive if we take into account

that the transfer represents only 0.55% of the total output. All in all, we show that *Bolsa Família* can be a strong poverty alleviating policy that does not only benefit the targeted families, but is also able increase welfare and boost per capita income in the long run.

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6 Appendix

6.1 The *Bolsa Família Program*

In 2004, in order to create the *Bolsa Família* program, former president Lula da Silva combined four previous transfer programs, forming the largest Brazilian conditional cash transfer program. The four previous programs were Bolsa Escola, Bolsa Alimentação, Cartão Alimentação and Auxílio Gás. The first and the second were CCT Programs managed, respectively, by the Ministry of Education and the Ministry of Health, while the latter subsidized gas purchases. Finally, Cartão Alimentação provided food benefits to the poorest families. In sum, the four programs were already CCTs, and the newly elected government then unified them into the Bolsa Família and delegated its administration to the Ministry of Social Development[32].

In less than three years, the program had achieved its initial coverage goal of 11 million families (Soares et al. (2009)). In 2009, the government authorized its expansion to 12.6 million families, which accounts for approximately one fifth of Brazilian households. In December 2012, according to the Brazilian Institute for Applied Economic Research (IPEA), benefits were paid to 13.9 million of nearly 67 million families, with a total of approximately twenty billion Brazilian reais, or 0.55% of Brazilian GDP that year.

[32]In 2005 the *Bolsa Família* also incorporated the PETI (Program for Eradication of Child Labor).

Bolsa Família conditionalities essentially rely on family per capita income, school registration, and regular health check-ups. Beneficiaries are divided into two categories: extremely poor families, whose per capita income is below R$77.00, and poor families, whose per capita income range from R$77.00 to R$154.00[33]. A basic benefit of R$ 77.00 is paid only to extremely poor families. However, both categories are eligible for the following benefits: (i) a monthly variable benefit of R$35.00 per child from 0 to 15 years old[34] (up to 5 children), which is conditional on school registration for children older than 6, (ii) a benefit per (up to two) adolescents (16-17 years old), which is worth R$42.00 (also conditional on school registration), and (iii) a discretionary benefit, paid only to those extremely poor families. The average benefit paid in June 2014 was R$167.00 per family per month, which represented 16% of average Brazilian monthly household income in 2014.[35].

6.2 Computing the Stationary Competitive Equilibrium

The following are the steps to compute the Stationary Equilibrium:

1 Guess a value for the tax rate.

2 Guess a value for the interest rate, which uniquely pins down the values for wages (through the capital to labor ratio).

3 Solve for the policy function in each state: guess an initial value function, maximize over the choice variables and reiterate the value function until convergence.

4 Guess an initial distribution, simulate the economy using the policy functions obtained until the distribution converges to a stationary distribution.

5 Using the stationary distribution and the definition of equilibrium provided, compute the economy-wide aggregate capital and labor efficiency units.

6 Determine the demand-side interest rate. If convergence is not achieved, update the interest rate and return to step (3). If convergence is achieved, proceed to step (7).

7 Determine the government expenses required to finance the subsidies and transfers. Verify whether the tax rate is consistent with the expenses. If not, update the tax rate and restart from step (2) until convergence is achieved.

[33]One Brazilian real was worth roughly $0.3 at the beginning of March 2015.

[34]The monthly variable benefit of R$35.00 is also paid to the families with pregnant mothers. An extra benefit for children ranging from 0-6 months, due to nutritional concerns, also amounts to R$35.00.

[35]Sources: Brazilian Ministry of Social Development and Brazilian Institute of Geography and Statistics (IBGE)

6.3 Computing the Transition

1 Compute both the non-CCT steady state equilibrium and the post-CCT steady state equilibrium and guess a number of transition periods ($T = 20$).

2 Guess an initial sequence of prices $\{r_t\}_{t=1}^{T}$ and taxes $\{\tau_t\}_{t=1}^{T}$.

3 Start with the value function in the post-CCT equilibrium, and proceed backwards, solving for the policy function in each period.

4 Using the non-CCT steady state distribution, use the policy functions to compute the transition paths for the distributions $(\{\lambda_{1t}, \lambda_{2t}\}_{t=1}^{T})$.

5 Compute the aggregates for each transition period and the subsequent paths of prices and taxes.

6 Jointly verify the convergence of prices and taxes. Update taxes and prices and restart from step (3) until convergence is achieved.