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Pobreza Infantil e Sobrevivência: Estimando os Efeitos de Curto e Longo Prazo na Região Metropolitana de Fortaleza

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IPECE INSTITUTO DE PESQUISA E ESTRATÉGIA ECONÔMICA DO CEARÁ

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Nesta Edição

Este estudo investiga a relação entre pobreza infantil e sobrevivência levando em consideração os efeitos de curto e longo prazo. A literatura anterior não encontra efeitos robustos entre pobreza e sobrevivência, provavelmente porque desconsidera o canal de efeito do ambiente da infância em suas estimativas. Portanto, usando dados em painel das Unidades de Desenvolvimento Humano (UDHs) para a Região Metropolitana de Fortaleza, utiliza-se a abordagem bidirecional do modelo de efeitos fixos para fornecer as primeiras estimativas das influências das mudanças na pobreza infantil sobre sobrevivência infantil e expectativa de vida. As principais conclusões do trabalho mostram que as reduções na pobreza infantil desempenham um papel importante na redução da probabilidade de morrer na infância e em melhorar a longevidade, o que aumenta à medida que a linha de pobreza infantil se torna mais abrangente. Embora a elasticidade da pobreza infantil seja semelhante à elasticidade da renda no longo prazo (|0.024|), os resultados da redução da pobreza infantil sobre a sobrevivência são maiores no curto prazo (0.260), demonstrando o tamanho dos ganhos de sobrevivência advindos da redistribuição em favor de famílias com crianças abaixo da linha de pobreza. Além disso, as elasticidades são diferentes, dado o nível de renda per capita da UDH. Por um lado, a Região Metropolitana de Fortaleza apresenta maior sensibilidade à pobreza infantil (0,760) e renda (-0,287). Por outro lado, Fortaleza somente apresenta ganhos de sobrevivência no curto prazo reduzindo a pobreza infantil (0,134). Por fim, são discutidas potenciais explicações para esse resultados, bem como suas implicações de política pública.

Pobreza Infantil e Sobrevivência: Estimando os Efeitos de Curto e Longo Prazo na Região Metropolitana de Fortaleza

Dércio N. Chaves de Assis[1]

O acidente do nascimento é uma das principais fontes de desigualdade na América nos dias de hoje. Segundo Heckman (2013), a sociedade americana está divida em trabalhadores qualificados e não qualificados, e as raízes dessa divisão originar-se-iam nas experiências da primeira infância. Crianças nascidas em ambientes desfavoráveis são mais propensas a enfrentar más condições de saúde e provavelmente terão mais problemas pessoais e sociais ao longo de suas vidas do que crianças nascidas em condições mais saudáveis (Cunha e Heckman (2009); Cunha, Heckman e Schennach (2010); Aizer e Cunha (2012)). Esse diagnóstico encaixa-se perfeitamente também ao contexto de países em desenvolvimento como o Brasil. As crianças nos países em desenvolvimento são mais propensas a serem pobres que os adultos (Batana, Bussolo e Cockburn (2013)). Newhouse, Becerra e Evans (2017), usando uma grande amostra de dados da pesquisa Global Micro Database do Banco Mundial, mostram que 19,5% das crianças de 0-17 anos são extremamente pobres, em comparação com 9,2% dos adultos. Ao longo de todo o ciclo de vida, a prevalência é mais elevada em crianças mais jovens, com menos de 10 anos, com taxas de pobreza de cerca de 21%.

É conceitualmente apelativo que melhorias na renda média de uma sociedade em favor de famílias abaixo da linha de pobreza permitam, por exemplo, que crianças aumentem sua probabilidade de sobrevivência e adquiram importantes atributos de longo prazo em termos de produtividade quando adultas (Case, Lubotsky e Paxson (2002); Aizer et al. (2016)). Portanto, a garantia de um rendimento mínimo para as crianças deve ser um objetivo universal para alcançar o desenvolvimento econômico de uma sociedade. A falta de renda está diretamente ligada a insegurança alimentar, as más condições de higiene, a falta de água limpa, a baixa ingestão de calorias e a condições precárias de saúde em uma família. Existem evidências substanciais mostrando os benefícios de melhorias na renda per capita das famílias pobres nos resultados de saúde das crianças e investimentos em capital humano das crianças, especialmente transferências monetárias condicionadas em países em desenvolvimento (Gertler (2004); Barham (2011); Glewwe e Kassouf (2012); Parker e Todd (2017)).

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Nesse contexto, o presente artigo investigou a relação entre pobreza e sobrevivência numa perspectiva diferente das adotadas na literatura. Neste estudo, usando dados em painel das Unidades de Desenvolvimento Humano (UDHs) para a Região Metropolitana de Fortaleza, são calculadas as primeiras estimativas das influências das mudanças na pobreza infantil sobre sobrevivência infantil e longevidade. A literatura anterior não consegue encontrar efeitos robustos entre pobreza e sobrevivência, provavelmente porque desconsidera o canal de efeito do ambiente da primeira infância em suas estimativas. Portanto, a tarefa aqui desenvolvida leva em consideração a estimativa das elasticidades da pobreza infantil no curto prazo, medida pelos efeitos sobre a mortalidade infantil, e no longo prazo, medida pelos efeitos sobre a expectativa de vida ao nascer.

O painel de dados utilizado nesta pesquisa corresponde ao Atlas do Desenvolvimento Humano para as Regiões Metropolitanas do Brasil que foi produzido pelo Programa das Nações Unidas para o Desenvolvimento (PNUD) em parceria com a Fundação João Pinheiro (FJP) e o Instituto de Pesquisa Econômica Aplicada (IPEA). Criado em 1973, a Região Metropolitana de Fortaleza é composta por 15 municípios e possui uma área de 5.795 km^2. Os indicadores utilizados para cada uma das 380 Unidades de Desenvolvimento Humano (UDHs) da Região Metropolitana de Fortaleza foram construídos a partir de setores censitários do Censo Demográfico de 2000 e 2010. A Região Metropolitana de Fortaleza é subdividida em 380 UDHs com pelo menos 400 residências cada. Conseqüentemente, a amostra consiste em pelo menos 152.000 domicílios. A maior parte das UDH's está na capital Fortaleza: 246 UDHs. As outras 134 UDHs são de 14 municípios da Região Metropolitana.

As variáveis que merecem maior consideração e explicação sobre seu uso e construção são os indicadores de pobreza infantil. A maneira mais comum de medir a pobreza infantil na literatura (Newhouse, Becerra e Evans (2017); Batana, Bussolo e Cockburn (2013); Begum, Deng e Gustafsson (2012)) é definir crianças como pobres se elas vivem em lares pobres. Portanto, a partir dos dados do Atlas do Desenvolvimento Humano (2013) para a Região Metropolitana de Fortaleza, neste trabalho são utilizados três indicadores de pobreza infantil definidos como: Extrema Pobreza Infantil ($\leq$R\$ 70), Pobreza Infantil ($\leq$R\$ 140) e Criança Vulnerável à Pobreza ($\leq$R\$ 255). O universo dos indivíduos é limitado aos que têm até 14 anos e vivem em domicílios particulares permanentes.

Os principais resultados, obtidos do modelo bidirecional de efeitos fixos com erros padrão robustos, mostraram que reduções na pobreza infantil tiveram um papel importante na redução da probabilidade de morrer na infância e na melhoria da longevidade, aumentando à medida que a linha de pobreza infantil se torna mais

abrangente. Ademais, embora a elasticidade da pobreza infantil seja semelhante à elasticidade da renda per capita no longo prazo ($|0.024|$), os resultados da redução da pobreza infantil sobre a sobrevivência são maiores no curto prazo (0.260), demonstrando o tamanho dos ganhos de sobrevivência advindos da redistribuição em favor de famílias com crianças abaixo da linha de pobreza.

A primeira implicação de política pública que emerge desses resultados é que um programa de transferência de renda incondicional que visa melhorar os resultados de saúde precisa levar em consideração o nível da linha de pobreza infantil. Os resultados demonstraram que, de acordo com parâmetros estabelecidos pelo Ministério do Desenvolvimento Social e Combate à Fome do Brasil, apenas a medida da pobreza infantil chamada de Criança Vulnerável à Pobreza ($\leq$R\$ 255) teve efeitos significativos sobre a sobrevivência. Este valor está aproximadamente de acordo com as novas linhas internacionais de pobreza adotadas pelo Banco Mundial para medir a pobreza nos países em desenvolvimento, US\$ 5,50 por dia.

Além disso, os efeitos da redução da pobreza infantil apresentam respostas heterogêneas e conseqüências distribucionais. Já que, o seu efeito sobre a mortalidade infantil e expectativa de vida é desigual dado o nível de renda média inicial. Por um lado, a Região Metropolitana de Fortaleza tem maior sensibilidade à pobreza infantil (0,760) e a renda ($-0{,}287$). Em média, uma redução de 10% na pobreza infantil (Criança Vulnerável à Pobreza) na Região Metropolitana reduziria a mortalidade infantil em aproximadamente 7,6%. Por outro lado, Fortaleza somente apresenta ganhos de sobrevivência no curto prazo reduzindo a pobreza infantil (0,134). Portanto, as conclusões oriundas deste documento chamam a atenção para a necessidade de desenvolver políticas espacialmente diferenciadas, bem como enfatiza a urgência de um olhar específico sobre a infância como prerrogativa para melhorar a saúde e o bem-estar social na Região Metropolitana de Fortaleza.

Apesar da forte relação estatística observada neste estudo, é possivel que ocorra desigualdades na alocação de recursos intra-domiciliar. Entretanto, esse é um problema padrão presente nesta literatura e está além do escopo desse estudo. Uma extensão natural desta pesquisa é medir a pobreza infantil em vários coortes e levar em consideração as diferenças na alocação domiciliar. Além disso, é claro, expandir a fonte de dados para todas as áreas metropolitanas brasileiras. Em conclusão, apesar dessas limitações, de acordo com as estimativas elaboradas, este trabalho empírico acrescenta novas perspectivas de avaliação e análise dos ganhos de sobrevivência advindos da redução da pobreza infantil.

Child Poverty and Survival: Estimating the Short-Run and Long-Run Effects

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Abstract

This paper investigates the relationship between child poverty and survival taking into accounting the short-run and long-run effects. Previous literature fails to find robust effects between poverty and survival probably because disregard the effect channel of early-life environment in their estimates. Using Human Development Units (HDU's) panel data for a Metropolitan Region of Brazil, I take advantage from two-way fixed effects model approach to provide the first estimates of the influences of changes in child poverty on child survival and life expectancy. The main findings showed that reductions in child poverty played an important role on reducing the likelihood of dying in childhood and improving longevity, which increases as the child poverty line becomes more comprehensive. Although the child poverty elasticity is similar to income elasticity in the long-run ($|0.024|$), the outcomes of child poverty reductions on survival are greater in the short-run (0.260), pointing out the size of survival gains from redistribution in favour of households with children below the poverty line. Moreover, the elasticities are different given the HDU's per capita income level. On the one hand, Fortaleza Metropolitan Region has greater sensitivity to child poverty (0.760) and income (-0.287). On the other hand, Fortaleza only improves survival in the short-term by reducing child poverty (0.134). Finally, I discuss potential explanations of these findings as well as their policy implications.

Key-words: Child Poverty, Survival, HDU's, Fixed Effects, Brazil

JEL: H150, I150, I320

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1 Introduction

The accident of birth is a principal source of inequality in America today. American society is dividing into skilled and unskilled, and the roots of this division lie in early childhood experiences [Heckman (2013)]. Children born into disadvantage environments are more likely to face poor health conditions and probably will face more personal and social problems throughout their lives than children born into healthier conditions [Cunha e Heckman (2009)] [Cunha, Heckman e Schennach (2010)] [Aizer e Cunha (2012)]. This diagnosis fits perfectly also into the context of developing countries. Children in developing countries are more likely to be poor than adults [Batana, Bussolo e Cockburn (2013)]. Using a large sample of survey data from the World Bank's Global Micro Database, Newhouse, Becerra e Evans (2017) showed that 19.5% of children (aged 0-17) are extremely poor[1], compared with 9.2% of adults. Across the whole life cycle, prevalence is highest for younger children, those aged less than 10, who have poverty rates of around 21%.

It is conceptually appealing that improvements in a society's average income in favor of families below the poverty line allow, for example, children increase her/his probability to survival and acquire important long-term attributes in terms of productivity when in their adulthood [Case, Lubotsky e Paxson (2002)] [Aizer et al. (2016)]. Therefore, the guarantee of a minimum income for children should be a universal goal to achieve the economic development of a society. The lack of income is directly linked to food insecurity, the poor hygienic conditions, lack of clean water, low calorie intake and poor health conditions in a family. There is substantial evidence showing the benefits of improvements in poor households per capita income on children's health outcomes and investments in children's human capital, especially conditional cash transfers in developing countries [Gertler (2004)] [Barham (2011)] [Glewwe e Kassouf (2012)] [Parker e Todd (2017)].

For Bradbury, Jenkins e Micklewright (2001), the focus on child poverty as opposed to any other group in the population needs little justification. Children represent the future of a country, an obvious reason for social concern for the well-being of this group. There are innate feelings of protection towards the young and assumptions of their innocence for the situation in which they find themselves. Children are unable to take full responsibility for their circumstances and are dependent on adults for their care. In this sense, I aim to provide the first estimates of the influences of changes in child poverty on child survival and longevity. Previous literature

[1] Newhouse, Becerra e Evans (2017) set children as poor if they live in poor households. Extreme poor households are those with per capita income or consumption lower than $1.9 per day, the international poverty line measured in purchase power parity (PPP) of 2011.

fails to find robust effects between poverty and survival probably because disregard the effect channel of early-life environment in their estimates. Bhalotra (2012), using state-level panel data for 15 major states of India, suggests to estimate the impact of changes in poverty on infant survival. The article find that the poverty elasticity of mortality is not robust to controls for omitted trends. However, poverty rates are calculated using poverty lines applied to household-level disregarding the effects of children's presence and the poverty lines levels. Thus, this paper provides four new contributions to this literature.

First of all, I investigate the relationship between child poverty and survival taking into accounting the short-run and long-run effects. Bhalotra (2012) exploits the relationship between poverty and survival only in the short-run, by measuring the poverty elasticity of infant mortality. The assignment developed here takes into account the estimation of child poverty elasticities in the short-run, as measured by the effects on child mortality, and in the long-run, as measured by the effects on life expectancy. Moreover, it is extremely important to study new channels of influence on survival. Since, as stated by Soares (2005), reductions in child mortality are the main force behind economic development.

Secondly, the data-set used in this paper are of higher quality. I take in advantage the subdivision of metropolitan regions, called Human Development Units (HDU's), which was defined as the smallest geographical unit in the 2013 Brazilian Atlas of Human Development for the Metropolitan Regions. This data-set was produced by the United Nations Development Program (UNDP) in Brazil. Noteworthy, a Human Development Unit (HDU) is a cluster of census tracts of the 2000 and 2010 Demographic Census, which are homogeneous in terms of per capita household income. Additionally, it was selected one of the most unequal metropolitan areas in Brazil and the world: Fortaleza Metropolitan Region. According to a United Nations report, five Brazilian cities are among the twenty most unequal in the world, being the capital of the state of Ceará (Fortaleza) the 13th in this group and the first in the Northeast region of Brazil[2]. Assis e Linhares (2018) showed that historically more than half of individuals in poverty in Brazil are concentrated in the Northeast region.[3] Besides, although poverty rates are higher in rural settings, in absolute terms most of the people in poverty are in metropolitan areas. For instance, Fort-

[2] The report *"State of the World's Cities 2010/2011: Cities for All, Bridging the Urban Divide."* also reported that Brazil is the country with the largest social distance in Latin America.

[3] In addition, according to a report of the United Nations General Assembly on the Millennium Project, the Northeast region of Brazil, along with western China, northern India and southern Mexico, are defined as some of the notable regions for having poverty pockets on a global scale. *"United Nations Millennium Project 2005. Investing in Development: a practical plan for achieving the millennium development goals."*

aleza Metropolitan Region had 260,929 (17.36%) people in extreme poverty in 2010. The highest number among all macro regions of the state of Ceará. Therefore, this environment is a good source to exploit the relationship between child poverty and survival. Cutler, Deaton e Lleras-Muney (2006) show that life expectancy is much lower and mortality rates are much higher in poor countries than in rich countries.

Thirdly, the size of the poverty line adopted to measure the child poverty headcount ratio may have different effects. Ravallion e Lokshin (2006) argues that people living at the poverty line in different demographic or geographic groups arguably do not have the same level of welfare. Hence, according to parameters established by the Ministry of Social Development and Fight against Hunger of Brazil, I use three lines to measure child poverty: R$ 70.00 (US$ 40.00), R$ 140.00 (US$ 80.00) and R$ 255.00 (US$ 145.00) in Brazilian Reais of August 2010[4]. These values are roughly in agreement with the new international poverty lines adopted by the World Bank.

Finally, despite the fact that the data-set used is from a Metropolitan Region, there is a huge income inequality between the capital and the municipalities outside the capital. Fortaleza has more than double the average income of the other 14 municipalities in the Metropolitan Region[5]. Thus, it is important to estimate if this income-level inequality generates different child poverty elasticities. Begum, Deng e Gustafsson (2012), who analyzes child poverty in Bangladesh and China, illustrates that economic growth and differences in income levels affect child poverty differences across time and across countries. It also shows that economic growth does not automatically lead to less child poverty.

In addition to this introduction, this study is divided into five more sections. The following section summarizes the data-set used and presents the stylized facts. The third section describe the identification strategy divided into the short-run effects and the long-run effects. In the fourth, there is the analysis of the results. The robustness checks are displayed in the fifth. Finally, the concluding remarks of the article are made.

[4] Amounts in dollars were calculated using the commercial exchange rate for the purchase of R$ 1.75 to US$ 1.00 in 2010.

[5] The exception is the municipality of Eusébio, which has an average income of R$ 1005.04 in this sample. That was higher than the capital Fortaleza: R$ 735.16.

2 Data

The panel data used in this research corresponds to the 2013 Brazilian Atlas of Human Development for the Metropolitan Regions. It was produced by the United Nations Development Program (UNDP) in partnership with the João Pinheiro Foundation (FJP) and the Institute of Applied Economic Research (IPEA). Created in 1973, Fortaleza Metropolitan Region[6] is composed of 15 municipalities and has an area of 5,795 km^2. The indicators used for each of the 380 Human Development Units (HDU's) of Fortaleza Metropolitan Region were constructed from census tracts of the 2000 and 2010 Demographic Census. Fortaleza Metropolitan Region is subdivided into 380 HDU's with at least 400 households each. Consequently, the sample consists of at least 152,000 households. The most part of the HDU's are in the capital Fortaleza: 246 HDU's. The other 134 HDU's are from 14 municipalities in the Metropolitan Region.

Table 1 shows descriptive statistics and definition of all variables used. The variable that deserves further consideration and explanation on its use and construction are the child poverty indicators. The most common way to measure child poverty in literature [Newhouse, Becerra e Evans (2017)] [Batana, Bussolo e Cockburn (2013)] [Begum, Deng e Gustafsson (2012)] is to define children as poor if they live in poor households[7]. Therefore, from the data of 2013 Brazilian Atlas of Human Development for Fortaleza Metropolitan Region, in this paper are used three child poverty indicators defined as: Extreme Child Poverty (≤R$ 70.00), Child Poverty (≤R$ 140.00) and Vulnerable Child to Poverty (≤R$ 255.00). The universe of individuals is limited to those up to 14 years old and living in permanent private households.

Furthermore, it is emphasized that the choice of control variables to compose the model has its importance highlighted in the literature. The income level indicator [Soares (2007)]: household income per capita; a proxy for infrastructure conditions [Rocha e Soares (2015)]: the ratio of people living in households whose water supply does not come from a general network and whose sanitary sewage is not carried out by sewage collection system or septic tank and the total population in the HDU living in permanent private households; and a measure of mother's education [Currie e Moretti (2003)]: the ratio between the number of women who are heads of

[6] In 2010, Fortaleza Metropolitan Region had a degree of urbanization of 96% and about 43% of the state population resided in the Metropolitan Region. The population of the capital Fortaleza corresponded to 68% of the metropolitan population.

[7] Although inequalities in the allocation of resources intra-household are possible, due to data restrictions this paper does not address the possibility of within-household inequality.

Table 1 – Descriptive Statistics and Definition of Variables

List of Variables						
Variable	Mean	Std. Dev.		Min	Max	Definition
Child Mortality	30.95	Overall	14.3	8.48	81.2	Probability of dying between birth and the exact age of 5 years per 1000 live births.
		Between	9.94	8.48	55.6	
		Within	10.3	5.36	56.5	
Life Expectancy	71.72	Overall	4.26	64.2	81.3	Average number of years that people are expected to live from birth if the level and age-specific mortality pattern prevailing in the year of the Census remain constant throughout life.
		Between	3.71	65.8	81.3	
		Within	2.15	68.7	74.7	
Extreme Child Poverty	13.07	Overall	12.0	0.00	56.8	Proportion of individuals under 14 years old who living in households with per capita income equal to or less than R$ 70.00 monthly, in Brazilian Reais of August 2010.
		Between	9.60	0.50	39.6	
		Within	7.11	-4.4	30.5	
Child Poverty	34.20	Overall	21.0	0.00	85.4	Proportion of individuals under 14 years old who living in households with per capita income equal to or less than R$ 140.00 monthly, in Brazilian Reais of August 2010.
		Between	18.1	1.40	73.6	
		Within	10.8	14.1	54.3	
Vulnerable Child to Poverty	59.65	Overall	24.1	1.60	97.6	Proportion of individuals under 14 years old who living in households with per capita income equal to or less than R$ 255.00 monthly, in Brazilian Reais of August 2010, equivalent to half the minimum wage on that date.
		Between	22.7	3.36	95.3	
		Within	8.47	42.1	77.2	
Income	591.2	Overall	591.7	108.8	4959	Ratio between the sum of the income of all individuals living in permanent private households and the total number of these individuals. Amounts in Brazilian Reais of August 2010.
		Between	596.3	148.1	4959	
		Within	136.8	-138.5	1321	
Sanitation and Clean Water	09.18	Overall	12.4	0.00	66.1	Ratio of people living in households whose water supply does not come from a general network and whose sanitary sewage is not carried out by sewage collection system or septic tank and the total population, multiplied by 100.
		Between	11.3	0.00	53.4	
		Within	5.09	-13.5	31.8	
Mother's Education	27.05	Overall	15.4	0.00	73.9	Ratio between the number of women who are heads of household, do not have completed elementary school and have at least one child aged under 15 living in the household, and the total number of female heads of household with a child under 15 years old, multiplied by 100.
		Between	13.4	2.05	56.8	
		Within	7.52	7.89	46.2	

Source: Own elaboration. Notes: Only permanent private households are considered.

household, do not have completed elementary school (four years of study) and have at least one child aged under 15 living in the household, and the total number of female heads of household with a child under 15 years old[8]. Finally, I emphasize that

[8] Another important variable used in the literature is the total public expenditure per capita on health care [Bhalotra (2007)]. However, since the metropolitan region shares some federal resources and it is feasible to assume that individuals can move fairly easily among HDU's to consume public health services, the absence of this control does not cause problems for model specification. In addition, there is no data on health expenditures available at the HDU level, only at the municipal level.

the choice of survival variables (Child Mortality and Life Expectancy) to compose the model followed the standard literature. Besides, this sub-state investigation has the further advantage that state institutions are constant and probably there are no differences in medical technology among HDU's.

Table 2 shows the averages of the variables in the 15 municipalities of Fortaleza Metropolitan Region.[9] The municipalities of Chorozinho (50.34) and Pindoretama (50.33) stand out as the ones with the highest averages of childhood mortality. Guaiúba has the highest average of vulnerable child to poverty (87.77%). On the other hand, Fortaleza has the best provision of sanitation and clean water and the lowest rate of mothers with low education who are heads of households (22.42%).

Table 2 – Averages of the variables in the 15 municipalities of Fortaleza Metropolitan Region.

Municipalities	Child Mort.	Life Exp.	Child $Pov.^1$	Child $Pov.^2$	Child $Pov.^3$	Income pc	San./ Water	Mother's Educ.
Aquiraz	36.31	69.56	19.62	48.18	76.64	355.1	25.15	35.71
Cascavel	43.24	67.60	28.41	57.88	82.44	236.9	29.45	40.72
Caucaia	36.16	69.83	18.46	45.10	71.42	386.2	17.57	33.42
Chorozinho	50.34	68.03	25.43	51.82	76.84	261.8	36.18	36.09
Eusébio	27.46	72.92	14.03	37.41	61.38	1005	14.41	31.42
Fortaleza	26.82	73.19	8.682	26.06	50.57	735.1	3.229	22.42
Guaiúba	42.68	69.79	34.24	65.92	87.77	190.3	22.33	34.52
Horizonte	39.91	68.39	23.86	51.60	81.39	270.2	27.92	37.97
Itaitinga	39.20	68.53	19.94	51.21	80.40	248.9	7.735	38.69
Maracanaú	34.50	69.99	12.50	39.24	69.39	322.7	8.387	32.69
Maranguape	42.26	67.75	24.80	55.59	83.05	232.5	21.35	37.41
Pacajus	42.54	67.98	28.01	56.36	80.71	253.5	37.82	39.01
Pacatuba	37.55	68.93	18.93	45.91	75.94	283.5	11.96	34.27
Pindoretama	50.33	67.79	30.67	60.74	84.76	233.1	44.61	39.46
São Gonçalo	41.38	68.03	27.69	54.84	80.95	242.0	24.26	37.99

A first inspection of the data reveals that, as shown in Figures 1 and 2 respectively, there is a directly proportional relationship between child mortality rate and child poverty indicator (corr = 0.925), as well as an inversely proportional relationship between life expectancy and child poverty rate (corr = −0.927) across HDU's in 2000 and 2010. Given that child mortality has been declining in Brazil since the 1960s[10] and how the accelerated process of reducing child poverty began only during the 2000s, it is salutary to question whether the reduction in child mortality in the 2000s and life expectancy gains would in fact be related to the income gains of the poorest families. Figures 3 to 5 illustrate the behavior of these variables in the HDU's with a focus on the capital Fortaleza. Soares (2007) advocates that the reduction of child mortality in Brazil between the years of 1970 and 2000

[9] Exponents 1, 2 and 3 in the Child Poverty variable represent the variables: Extreme Child Poverty, Child Poverty and Vulnerable Child to Poverty, respectively.

[10] Soares (2007) shows that Latin America in general reduced child mortality by 70% between 1960 and 2000. Brazil followed this tendency according to the author.

would be strongly related to the educational gains of its population, more specifically decreases in illiteracy rates.

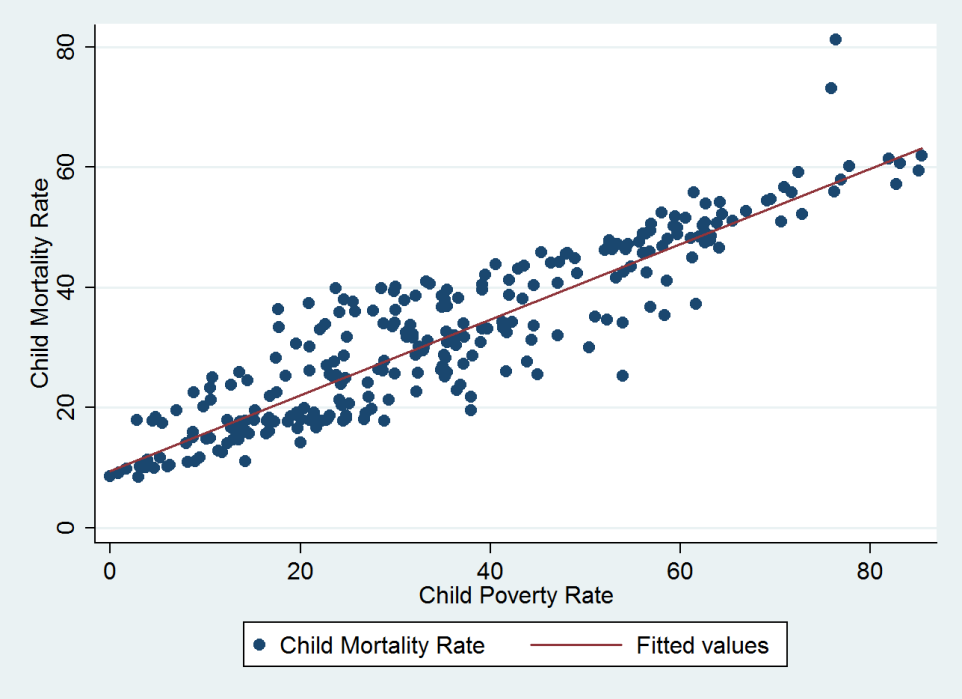

Figure 1 – The relationship of Child Mortality and Child Poverty by Human Development Units, 2000-2010.

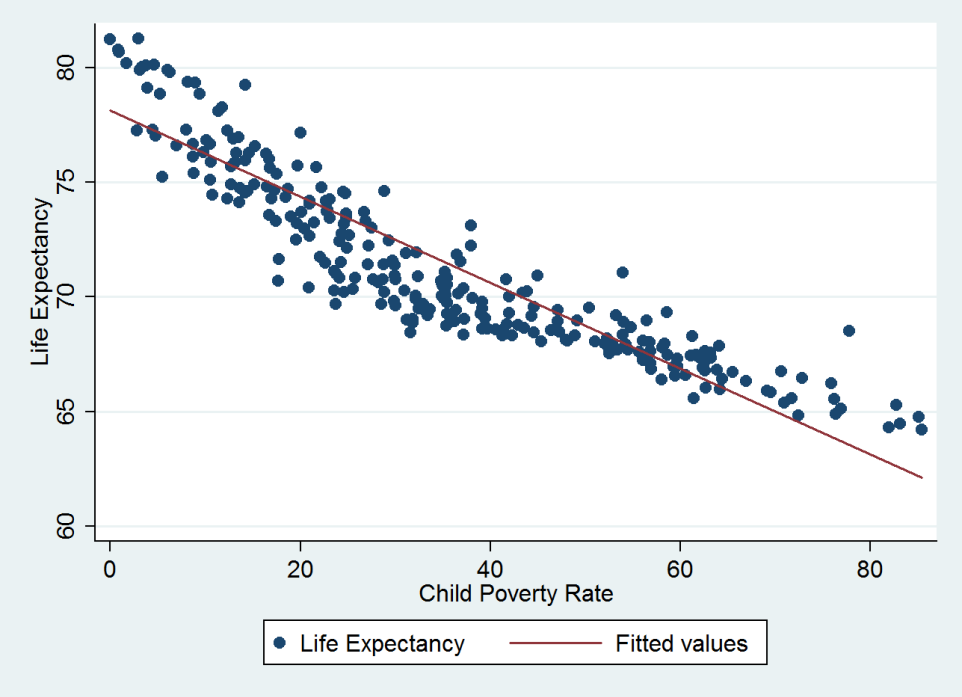

Figure 2 – The relationship of Life Expectancy and Child Poverty by Human Development Units, 2000-2010.

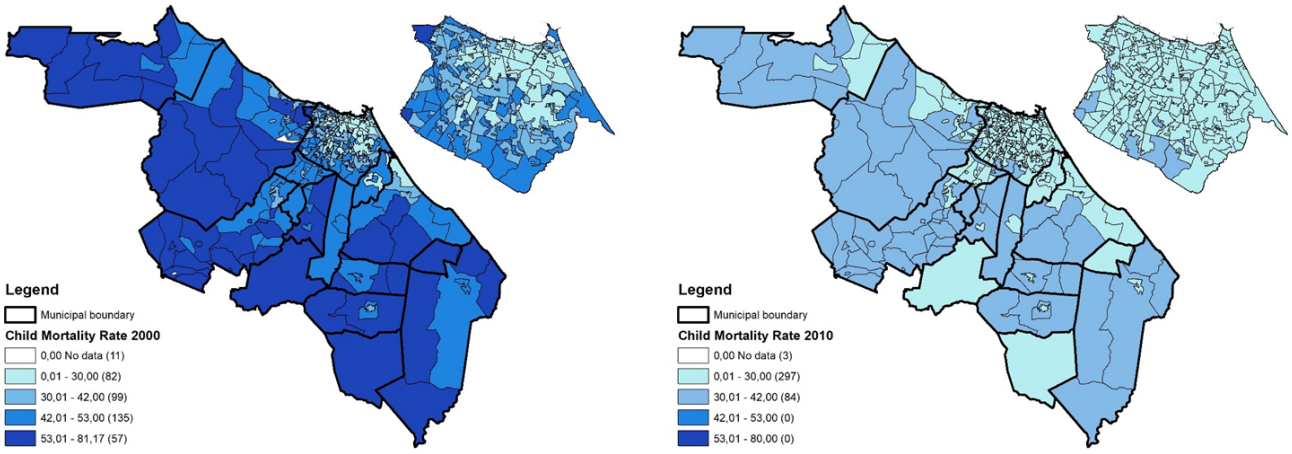

Figure 3 – Evolution of Child Mortality across Human Development Units, 2000-2010.

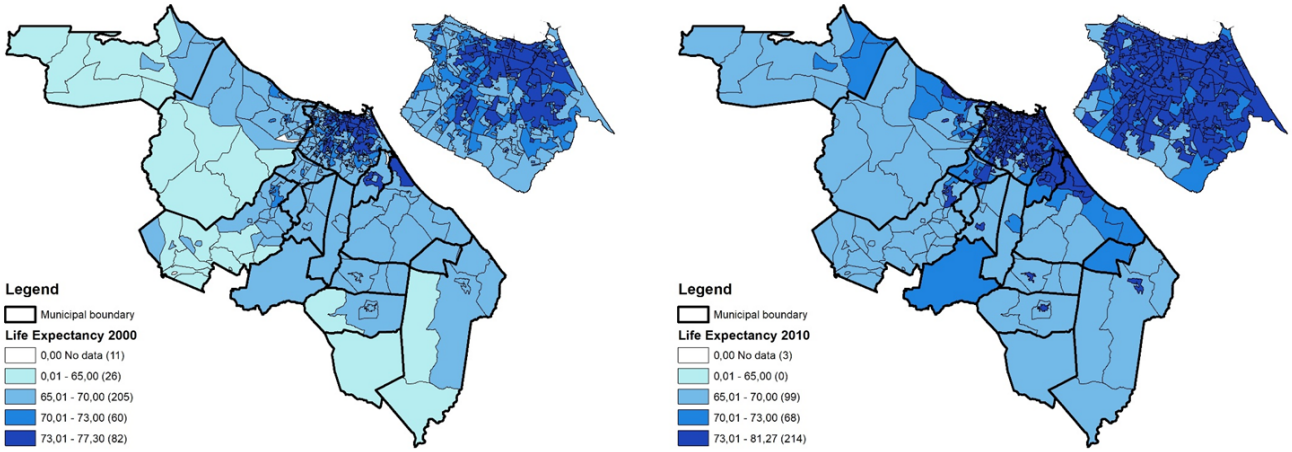

Figure 4 – Evolution of Life Expectancy across Human Development Units, 2000-2010.

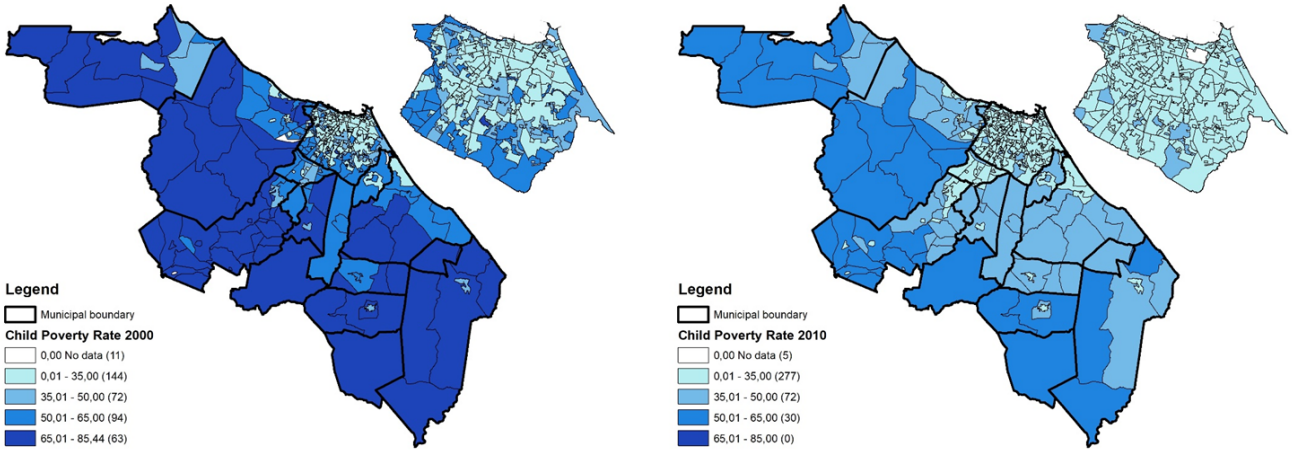

Figure 5 – Evolution of Child Poverty across Human Development Units, 2000-2010.

3 Identification Strategy

3.1 The Short-Run Effects

The identification strategy for estimating the poverty elasticities of child survival is a log-log specification in which the poverty measures are variables of child poverty. Following the approach of Bhalotra (2012) and given the data structure, the estimation method employed to test the direction and size of the effects of child poverty on child mortality was the two-way fixed effects model with robust standard errors. Therefore, the models used to capture the short-run effects can be described as follows:

$$Child\ Mortality_{it} = \alpha_1 + \beta_1 Extreme\ Child\ Poverty_{it} + \beta X_{it} + \gamma_i + \theta_t + \varepsilon_{1it} \quad (1)$$

$$Child\ Mortality_{it} = \alpha_2 + \beta_2 Child\ Poverty_{it} + \beta X_{it} + \gamma_i + \theta_t + \varepsilon_{2it} \quad (2)$$

$$Child\ Mortality_{it} = \alpha_3 + \beta_3 Vulnerable\ Child\ to\ Poverty_{it} + \beta X_{it} + \gamma_i + \theta_t + \varepsilon_{3it} \quad (3)$$

The dependent variable denotes the child mortality rate (under 5 years). The explanatory variables of major interest are measures of child poverty: Extreme Child Poverty (≤R$ 70.00), Child Poverty (≤R$ 140.00) and Vulnerable Child to Poverty (≤R$ 255.00); resulting in three different specifications. The vector X of control variables is composed of the following variables: $Income$, household per capita income; $Sanitation\ and\ Clean\ Water$, the rate of people living in households whose water supply does not come from a general network and whose sanitary sewage is not carried out by sewage collection system or septic tank; $Mother's\ Education$, the rate of mothers who are heads of household and have less than four years of study.

The term γ_i are the idiosyncratic effects that do not vary over time associated with each Human Development Unit (HDU) and that could affect mortality levels, such as natural characteristics, climatic conditions, etc. As a result, it can be understood as a representative of omitted variables which, although not observable, affect local mortality rates. The term θ_t represent a full set of year dummies, which measure common shocks to the HDU's in a specific year. For instance, a state vaccination campaign implemented by the Secretary of Health.

Finally, the component ε_{it} is a random term with zero mean and constant variance. Subscriptions i and t are the HDU and the time of observation, respectively. Furthermore, taking into account the possibility of autocorrelated and heterocedastic errors, which could lead to an overestimation of the significance of the estimated coefficients, I adjusted and clustered standard errors at the HDU level.[11]

3.2 The Long-Run Effects

The empirical approach used to measure the long-run effects of child poverty is similar to the previous sub-section. A log-log specification to test the direction of the effects of child poverty on life expectancy. Life expectancy is a traditional measure of survival and is defined as the average number of years that people are expected to live from birth, if the level and age-specific mortality pattern remain constant. Thus, the three basic models for estimating the long-term effects can be identified as follows:

$$Life\ Expectancy_{it} = \alpha_4 + \beta_4 Extreme\ Child\ Poverty_{it} + \beta X_{it} + \gamma_i + \theta_t + \varepsilon_{4it} \quad (4)$$

$$Life\ Expectancy_{it} = \alpha_5 + \beta_5 Child\ Poverty_{it} + \beta X_{it} + \gamma_i + \theta_t + \varepsilon_{5it} \quad (5)$$

$$Life\ Expectancy_{it} = \alpha_6 + \beta_6 Vulnerable\ Child\ to\ Poverty_{it} + \beta X_{it} + \gamma_i + \theta_t + \varepsilon_{6it} \quad (6)$$

The specifications change from equation (4) to (6) according to the child poverty indicators: Extreme Child Poverty (≤R$ 70.00), Child Poverty (≤R$ 140.00) and Vulnerable Child to Poverty (≤R$ 255.00). The remaining of the model follow the same approach described before. Although it is very important quantify long-term effects of poverty on health and survival, the most part of previous studies focus on short-term effects. Probably because it is difficult to find robust effects in the long-run, since several issues might influence survival in adulthood. Therefore, I suggest estimating the consequences of child poverty on longevity, which is computed by life expectancy at birth in years.

[11] According to Baltagi (2013), cross-sectional dependence is a problem in macro panels with long time series (over 20-30 years). This is not much a problem in micro panels like this, with two years and large number of HDU's.

4 Results

4.1 Main Findings

In this section, I present the results of the estimates arranged in six different ways. Table 3 shows in columns (1) to (3) the short-run effects of early-life environment, calculated by the child poverty elasticity of child mortality. Columns (4) to (6) present the long-run effects of poverty conditions, which were measured by the child poverty elasticity of life expectancy. The specifications change from equations (1) to (3) and (4) to (6), respectively, according to the child poverty indicators: Extreme Child Poverty, Child Poverty and Vulnerable Child to Poverty. All models were controlled by household per capita income, unsuitable conditions of access to clean water and sanitation, mothers heads of households with low education, as well as a full set of HDU's dummies and year dummies which allow reduce problems arising from the omission of relevant variables.

It can be observed that the results in column (2) shows expected results that higher child poverty indicates higher child mortality. Similarly, the results in column (5) demonstrates that greater child poverty implies lower life expectancy. Nonetheless, the main finding of these estimates is that the size of the impact of child poverty on survival increases as the child poverty line becomes more comprehensive. On the one hand, Extreme Child Poverty ($\leq$R\$ 70.00) has no statistical impact on child mortality and longevity. On the other hand, Vulnerable Child to Poverty ($\leq$R\$ 255.00) has the most considerable impact on survival. The models (3) and (6), respectively, reveals an average effect of the Vulnerable Child to Poverty of 0.260 on child mortality and -0.024 on life expectancy at birth, which demonstrate a greater importance of early-life environment on survival in the short-term. Those coefficients are statistically significant at the 1% level and the models are globally significant ($Prob \geq F = 0.00$), as well as exhibit a high adjustment ($R^2 = 0.98$). Bhalotra (2012) finds a coefficient similar to the poverty elasticity of infant mortality (0.280) conditioned to state fixed effects, but insignificant and close to zero once that year dummies are added. Therefore, the approach developed in this paper points out a possible causal effect between child poverty and survival.

In addition, although the child poverty (Vulnerable Child to Poverty) elasticity of survival is lower in the long-run than in the short-run, the child poverty (Vulnerable Child to Poverty) elasticity of life expectancy is similar to income elasticity ($|0.024|$), which is commonly pointed out in the literature as one of the key variables in determining life expectancy. The first policy implication that emerges from these findings is that a unconditional cash transfer program that aims to im-

prove health outcomes needs to take into account the level of the child poverty line. For instance, the well-known "Bolsa Família" program[12] established in Brazil during the 2000s follow as poverty line the amounts of R$ 70.00 (US$ 40.00) and R$ 140.00 (US$ 80.00) for extreme poverty and poverty, respectively.

Table 3 – Results

(Ln) Dependent Variable	Child Mortality Rate			Life Expectancy		
(Ln) Regressors	(1)	(2)	(3)	(4)	(5)	(6)
Extreme Child Poverty	−0.002			−0.001		
	(0.013)			(0.002)		
Child Poverty		0.087***			−0.007**	
		(0.020)			(0.003)	
Vulnerable Child to Poverty			0.260***			−0.024***
			(0.060)			(0.006)
Income	0.000	−0.035	0.005	0.024***	0.027***	0.024***
	(0.082)	(0.080)	(0.079)	(0.009)	(0.008)	(0.008)
Sanitation and Clean Water	0.018*	0.016*	0.015*	−0.002*	−0.002*	−0.002*
	(0.010)	(0.009)	(0.008)	(0.001)	(0.001)	(0.001)
Mother's Education	0.123***	0.071**	0.025	−0.009**	−0.006	0.001
	(0.030)	(0.031)	(0.031)	(0.002)	(0.004)	(0.004)
Constant	3.229***	3.29***	2.46***	4.13***	4.13***	4.20***
	(0.350)	(0.339)	(0.360)	(0.036)	(0.035)	(0.036)
HDU FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Prob $\geq F$	0.00	0.00	0.00	0.00	0.00	0.00
N	753	753	753	753	753	753
R^2	0.98	0.98	0.98	0.98	0.98	0.98

Notes: Robust Standard Errors in parenthesis adjusted for 380 clusters in HDU.
* p≤ 10%,** p≤ 5%,*** p≤ 1%.

Finally, the regressions in columns (1), (2) and (4) confirm the importance of mother's education in reducing the probability of dying in childhood and increasing life expectancy at birth. Furthermore, all regressions show the role that access to clean water and sanitation play as important home infrastructure factors that affected child mortality and longevity in HDU's. This could give rise, in terms of policy implications, to the implementation of full access coverage of the Metropolitan Region's households to clean water and sanitation. It can be highlighted the deficiency of this factors in Fortaleza Metropolitan Region citing, for instance, the municipality of Pindoretama that in the average of the sample presented 44.61% of their households without access to clean water or sanitation. The importance of these vectors is also confirmed by the results of Soares (2007).

[12] Glewwe e Kassouf (2012) provide a good assessment of the impacts of the Bolsa Família conditional cash transfer program on enrollment, dropout rates and grade promotion in Brazil.

4.2 Accounting for the Effects of Income-Level Inequality

In spite of the fact that the data-set used is from a Metropolitan Region, there is a large income inequality between Fortaleza and the municipalities outside Fortaleza. The capital has more than twice the average income of the other 14 municipalities in the Metropolitan Region, with the exception of the municipality of Eusébio. Hence, it is important to estimate if this income-level inequality generates different child poverty elasticities. Assis, Medeiros e Nogueira (2017) estimating the growth elasticity and the income inequality elasticity of extreme child poverty, across Ceará's municipalities, find that Fortaleza Metropolitan Region presents a high growth elasticity of extreme child poverty. Nevertheless, the capital Fortaleza was classified in the group of high inequality elasticity and low income elasticity of extreme child poverty.

Table 4 presents the results of child poverty elasticity and income elasticity of child mortality divided for HDU's into Metropolitan Region's municipalities and capital Fortaleza. The regression in column (3) shows the highest impact of changes in child poverty (Vulnerable Child to Poverty) on changes in child mortality (0.760). The estimates in column (3) show that, on average, a 10% reduction in child poverty (Vulnerable Child to Poverty) in the Metropolitan Area would reduce child mortality by approximately 7.6%, pointing out the size of survival gains from redistribution in favour of households with children below the poverty line. Moreover, the Metropolitan Region has a significant and expressive income elasticity (-0.287) of child mortality. On the other hand, columns (4) to (6) display that Fortaleza does not have effects of changes in income on mortality. Fortaleza only improves survival in the short-term by reducing child poverty with the most expressive impact from the measure so-called Vulnerable Child to Poverty (0.134).

Furthermore, Table 5 shows the long-run effects of changes in child poverty on longevity also divided for HDU's into Metropolitan Region's municipalities and capital Fortaleza. The main findings of these regressions are the greater effect of Vulnerable Child to Poverty (-0.051) on life expectancy in the Metropolitan Region compared to the effect of Vulnerable Child to Poverty (-0.017) on life expectancy in Fortaleza. These results can be seen in columns (3) and (6), respectively. Nonetheless, in this approach the most important variable to explain longevity was household income per capita. Finally, it is emphasized again that the outcomes of child poverty reductions on survival are greater in the short-run. It is noteworthy that all estimates developed in this section follow the same identification strategy used in the previous section, which consist to control for unsuitable conditions of access

to clean water and sanitation, mother's education, as well as HDU's dummies and year dummies.

Table 4 – Results

(Ln) Dependent Variable	Child Mortality Rate					
Sample	Metropolitan Region			Fortaleza		
(Ln) Regressors	(1)	(2)	(3)	(4)	(5)	(6)
Extreme Child Poverty	−0.091			0.001		
	(0.064)			(0.001)		
Child Poverty		0.115			0.055**	
		(0.128)			(0.025)	
Vulnerable Child to Poverty			0.760***			0.134***
			(0.173)			(0.051)
Income	−0.397***	−0.303**	−0.287**	−0.102	−0.125	−0.085
	(0.147)	(0.151)	(0.141)	(0.085)	(0.083)	(0.083)
HDU FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes
$Prob \geq F$	0.00	0.00	0.00	0.00	0.00	0.00
N	265	265	265	488	488	488
R^2	0.97	0.97	0.98	0.99	0.99	0.99

Notes: Robust Standard Errors in parenthesis adjusted for 134 clusters in HDU to Metropolitan Region, and for 246 clusters in HDU to Fortaleza.
* p≤ 10%,** p≤ 5%,*** p≤ 1%.

Table 5 – Results

(Ln) Dependent Variable	Life Expectancy					
Sample	Metropolitan Region			Fortaleza		
(Ln) Regressors	(1)	(2)	(3)	(4)	(5)	(6)
Extreme Child Poverty	0.009			−0.002		
	(0.006)			(0.001)		
Child Poverty		−0.003			−0.005	
		(0.013)			(0.004)	
Vulnerable Child to Poverty			−0.051***			−0.017**
			(0.016)			(0.007)
Income	0.077***	0.070***	0.068***	0.024**	0.026**	0.022**
	(0.014)	(0.014)	(0.013)	(0.010)	(0.010)	(0.010)
HDU FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes
$Prob \geq F$	0.00	0.00	0.00	0.00	0.00	0.00
N	265	265	265	488	488	488
R^2	0.98	0.98	0.98	0.98	0.98	0.98

Notes: Robust Standard Errors in parenthesis adjusted for 134 clusters in HDU to Metropolitan Region, and for 246 clusters in HDU to Fortaleza.
* p≤ 10%,** p≤ 5%,*** p≤ 1%.

5 Robustness

I consider the robustness check of these results to two categories of challenges. First, I introduce a new control variable to fertility. Following Bhalotra (2012), who proxied fertility by a mother's age at first birth, I used a measure of Teenage Pregnancy: ratio of women 10-17 years old who have had children and the total number of women in this age group, multiplied by 100. This is striking as popular and academic debates concerning the impact of growth or poverty on health or survival have tended to neglect the role of fertility [Bhalotra (2012)]. Second, I change the dependent variables by Infant Mortality Rate (under 1 year old) and Population Aging Rate: ratio of the population aged 65 years and over to the total population, multiplied by 100.

Table 6 shows all the results of robustness divided into twelve columns. It is possible to emphasize that, although the teenage pregnancy variable presents the expected signs (Child Mortality is higher and life expectancy is lower when a relatively high proportion of women have their children in adolescence.), its inclusion did not modify the results of the regressions. The changes in child poverty (Vulnerable Child to Poverty) remained the main variable explaining changes on child mortality (0.264) and life expectancy (-0.024). Another constant evidence is that when the child poverty line is very low (Extreme Child Poverty), the most important variable in explaining child survival is the mother's education. All in all, these results confirm the main findings of the paper.

Additionally, columns (7) to (12) exhibit the results of changing the dependent variables: Child Mortality by Infant Mortality and Life Expectancy by Population Aging Rate. Firstly, in columns (7) to (9), the key results display a greater effect of Child Poverty (0.119) and Vulnerable Child to Poverty (0.295) on Infant Mortality. Once again showing the importance of the size of survival gains from redistribution in favour of households with children below the poverty line. On the other hand, in columns (10) to (12), when the Population Aging Rate is used to proxy the long-term effects of child poverty, no robust results were found. Only mother's education explain population to achieve the aging. Probably, this variable is not a good proxy to capture the long-run effects of changes in child poverty, because it is very sensitive to demographic conditions.[13] In summary, the results from this section corroborate the main conclusions of the study.

[13] Perhaps, another better option to measure the long-run effects of child poverty is follow the assignment developed by Oliveira e Quintana-Domeque (2014) who estimated the impact of economic conditions at birth on the height of the Brazilian adult population.

Table 6 – Robustness

(Ln) Dependent Variable	Child Mortality Rate			Life Expectancy			Infant Mortality Rate			Population Aging Rate		
(Ln) Regressors	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Extreme Child Poverty	−0.003			−0.001			−0.002			0.027		
	(0.014)			(0.002)			(0.015)			(0.030)		
Child Poverty		0.089***			−0.007**			0.119***			0.001	
		(0.029)			(0.003)			(0.034)			(0.062)	
Vulnerable Child to Poverty			0.264***			−0.024***			0.295***			−0.061
			(0.061)			(0.006)			(0.074)			(0.112)
Income	−0.006	−0.046	−0.004	0.026***	0.029***	0.026***	0.153	0.101	0.156	0.032	0.031	0.031
	(0.086)	(0.084)	(0.082)	(0.009)	(0.009)	(0.009)	(0.099)	(0.008)	(0.096)	(0.157)	(0.158)	(0.157)
Sanitation and Clean Water	0.018*	0.016*	0.015*	−0.002*	−0.002*	−0.002*	0.019*	0.017*	0.016*	−0.016	−0.011	−0.010
	(0.010)	(0.009)	(0.008)	(0.001)	(0.001)	(0.001)	(0.011)	(0.010)	(0.010)	(0.018)	(0.018)	(0.018)
Mother's Education	0.124***	0.069**	0.024	−0.010**	−0.006	−0.001	0.145***	0.072*	0.032	−0.165***	−0.149***	−0.125**
	(0.032)	(0.033)	(0.032)	(0.004)	(0.004)	(0.004)	(0.038)	(0.004)	(0.037)	(0.050)	(0.060)	(0.063)
Teenage Pregnancy	0.003	0.002	0.004	−0.000	−0.000	−0.000	0.009	0.006	0.009	−0.027	−0.026	−0.026
	(0.013)	(0.012)	(0.012)	(0.001)	(0.001)	(0.001)	(0.014)	(0.014)	(0.013)	(0.019)	(0.020)	(0.019)
Constant	3.28***	3.37***	2.50***	4.12***	4.12***	4.19***	2.10***	2.22***	1.22**	1.77**	1.78**	1.96**
	(0.506)	(0.490)	(0.520)	(0.052)	(0.051)	(0.053)	(0.576)	(0.554)	(0.600)	(0.914)	(0.912)	(0.989)
HDU FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
$Prob \geq F$	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
N	745	745	745	745	745	745	744	744	744	744	744	744
R^2	0.98	0.98	0.98	0.98	0.98	0.98	0.97	0.97	0.97	0.92	0.92	0.92

Notes: Robust Standard Errors in parenthesis adjusted for 380 clusters in HDU.
* p≤ 10%,** p≤ 5%,*** p≤ 1%.

6 Concluding Remarks

The present article investigated the relationship between poverty and survival under a perspective different from those ones adopted in the literature. In this study, using Human Development Units (HDU's) panel data for a Metropolitan Region of Brazil (Fortaleza Metropolitan Region), I provide the first estimates of the influences of changes in child poverty on child survival and longevity. Previous literature fails to find robust effects between poverty and survival probably because disregard the effect channel of early-life environment in their estimates. Therefore, the assignment developed here takes into account the estimation of child poverty elasticities in the short-run, as measured by the effects on child mortality, and in the long-run, as measured by the effects on life expectancy at birth.

The main findings, obtained from the two-way fixed effects model approach with robust standard errors, showed that reductions in child poverty played an important role on reducing the likelihood of dying in childhood and improving longevity, which increases as the child poverty line becomes more comprehensive. Besides, although the child poverty elasticity is similar to per capita income elasticity in the long-run ($|0.024|$), the outcomes of child poverty reductions on survival are greater in the short-run (0.260), pointing out the size of survival gains from redistribution in favour of households with children below the poverty line.

The first policy implication that emerges from these findings is that a unconditional cash transfer program that aims to improve health outcomes needs to take into account the level of the child poverty line. The results demonstrated that, according to parameters established by the Ministry of Social Development and Fight against Hunger of Brazil, only the measure of child poverty so-called Vulnerable Child to Poverty ($\leq$R\$ 255.00; $\leq$US\$ 145.00) had robust effects on improving survival. This value is roughly in agreement with the new international poverty lines adopted by the World Bank to measure poverty in developing countries, US\$ 5.50 per day.

Moreover, the effects of child poverty reduction presents heterogeneous responses and distributional consequences. Since its effect on child mortality and life expectancy is uneven given the initial average income level. On the one hand, Fortaleza Metropolitan Region has greater sensitivity to child poverty (0.760) and income (-0.287). On the other hand, Fortaleza only improves survival in the short-term by reducing child poverty (0.134). Therefore, the conclusions drawn in this paper call attention to the need of developing spatially differentiated policies as well as to emphasize the urgency for a specific look at childhood as a prerogative to improve

health and welfare in developing countries.

Despite the strong statistical relationship observed in this study, inequalities in the allocation of resources intra-household are possible.[14] However, this is a standard problem present in this literature. A natural extension of this research is to measure child poverty in various cohorts and take into account differences in within-household allocation. In addition, of course, to expand the data source for all Brazilian metropolitan areas. In conclusion, in spite of these limitations, according to estimates this empirical work adds new perspectives of evaluation and analysis of survival gains from the reduction of child poverty.

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[14] Bargain, Donni e Kwenda (2014) and Dunbar, Lewbel e Pendakur (2013) highlighted the importance to address the intra-household allocation. Unfortunately, due to data restrictions it lies outside the scope of this paper.

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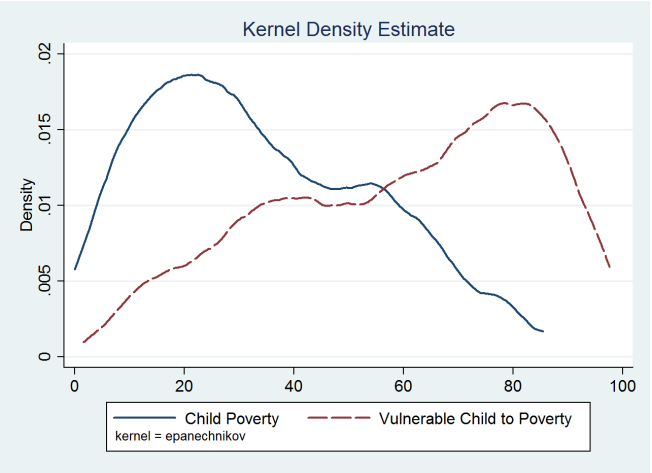
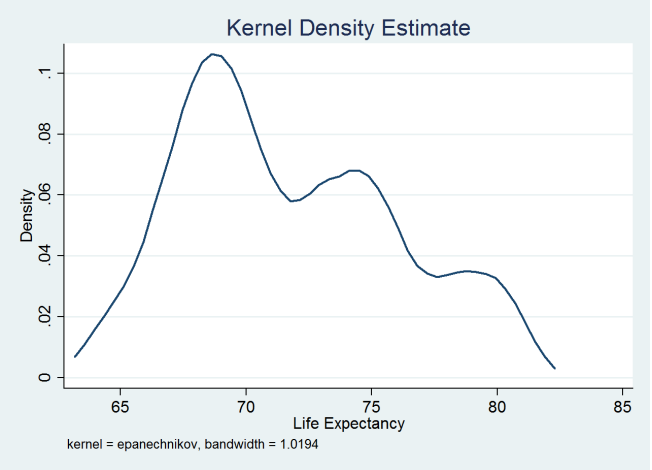
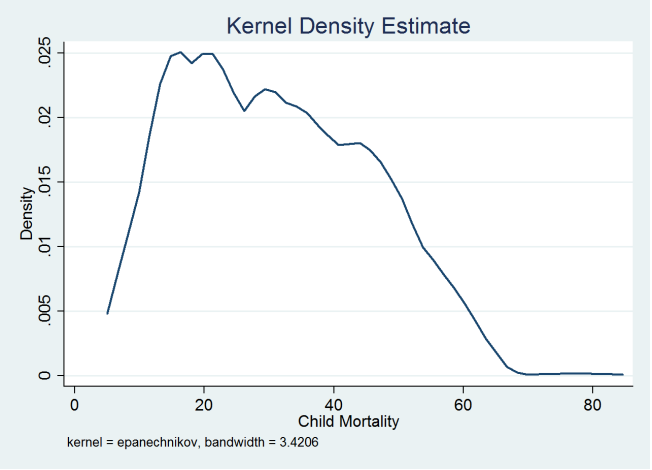
ANNEX A – Figures







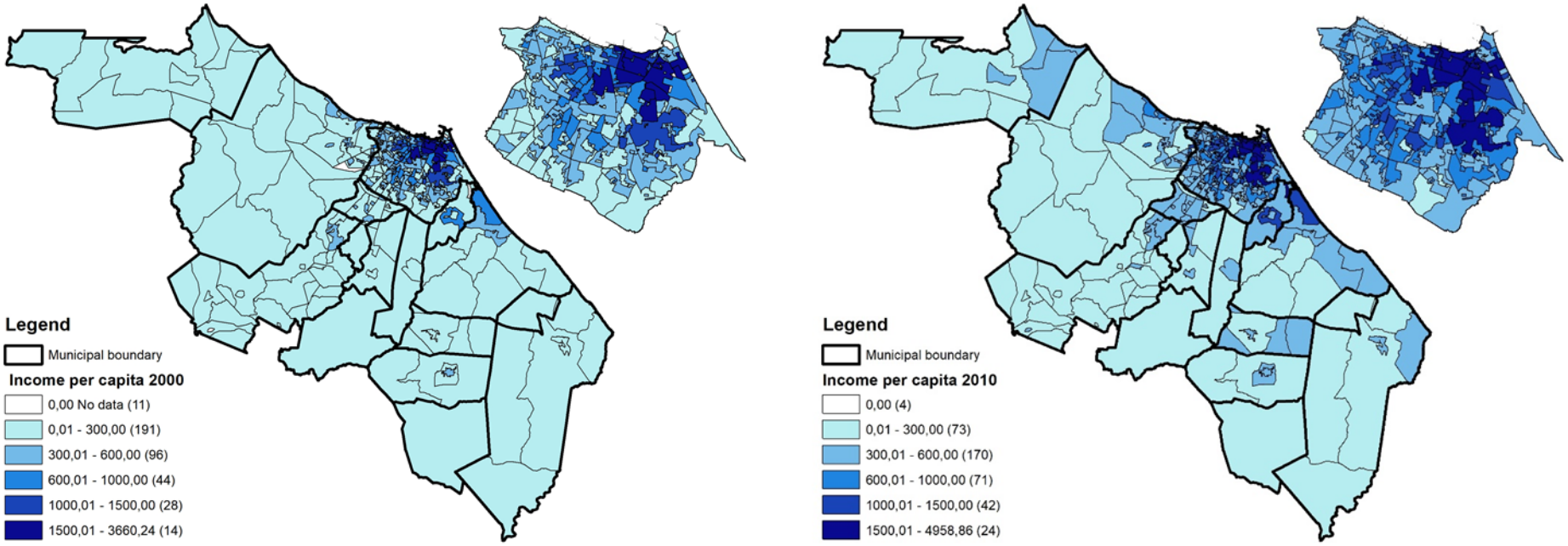


Figure 6 – Evolution of Household Income per capita across Human Development Units, 2000-2010.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W
E
S
Atlantic Ocean
Ceará
Northeast
Brazil
South America
Pacific Ocean
Fortaleza Metropolitan Region