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The Changing Effects of Fertility on Women's Education and Labor Supply: Natural Experiments at Different Parities in Brazil*

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Abstract

The rapid decline in fertility and, at the same time, the increasing female education and labor force participation in the past few decades motivated studies focusing on the relationship between fertility and female labor supply and fertility and educational achievements among women. As each child may present a different effect upon mothers' labor supply and educational achievements, we estimate the effects of the first, the second and the third (or more) children separately. Also, once "having children" and "studying/working" are, in general, simultaneous decisions for women, we estimated the effects of children based on five alternative events as fertility proxies: miscarriage, stillbirth and child mortality (early neonatal, neonatal and infant mortality). The assumption is that, even though the decision of "having children" is endogenous, the loss of a child is an unplanned, random event. We used the 1984 Brazilian Household Survey (PNAD) which, although some would consider it as an old source of information, it is indeed a rare and underused dataset containing the complete birth history of Brazilian women. We have found that children reduce female labor force participation and that the effects are stronger for the first and third (or more) children. Our preliminary analysis also shows heterogeneity between the wealthiest and the poorest regions of Brazil, with the previous ones revealing stronger negative effects of having children on women's labor supply than the last ones. In the analysis concerning the effects of children on women's educational achievements, we found that the second child increases the probability of mothers having completed at least completed 8 or 12 years of schooling. We speculate that this result is compatible with economies of scale in the care of two children and with the possibility that siblings may help taking care of each other. As we believe these results may be changing over time, we additionally intend to compare these results based on the PNAD 1984 with the 2013 Brazilian National Health Survey (PNS), since important social and demographic change took place in Brazil over this period.

Keywords: Children, Parity, Women, Work, Education, Brazil

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Introduction

Although we are interested in measuring the impact of having the first, second and third (or more) children on labor force participation and on educational achievements, it is worth highlighting that, in this version of the paper, the literature review and the methods section is focused on the effects of having children on women's labor force participation. Regarding the regional and over time analysis as well as the impacts of becoming/being a mother on women's educational variables, we mainly present preliminary results as we are currently developing this part of the paper.

The relation between fertility and women's labor force participation

Economic theory suggests that labor supply and fertility decisions, for females, are not independent and seem to be related to other household decisions (BECKER, 1991). In some sense, one can expect that the decision whether or not to have children to be correlated to the participation and the status of the women in the labor market. This relation might have been strengthened by economic development and social and cultural changes that had a significant impact on the labor supply of females not only regarding entering the labor force but also in labor intensity (hours worked per week) and wages (LUNDBERG; ROSE, 2000; PAZELLO, 2006).

While the empirical literature on men have reported heterogeneity in the association between their labor force participation and fatherhood (ANGRIST; EVANS, 1998; DERMOTT, 2006; KAUFMAN; UHLENBERG, 2000; WAITE; HAGGSTROM; KANOUSE, 1986), studies centering on women have generally confirmed the theoretical prediction that having children is negatively related to being in the labor market on both developing (CRUCES; GALIANI, 2007; PAZELLO, 2006) and developed countries (ANGRIST; EVANS, 1998; MEULDERS et al., 2007).

Despite this body of evidence, some have shown that not only maternity is an important determinant of mother's work decision but the inverse is also true (ANGRIST; EVANS, 1998), indicating the simultaneity of this decision-making process. In addition to this simultaneity, there may be women who would rather prefer working than having children as well as some who highly value maternity and therefore decide not to work or at least to have a more flexible job (HERR; WOLFRAM, 2012; FORTIN, 2005). This means that women with different preferences regarding children and work would explain the negative association found in past studies, even without any causal effect of fertility on women's work status. While long recognizing that fertility and labor supply are probably jointly determined, only lately have researchers empirically examined if this association reflects a truly causal effect of fertility on female labor force participation.

A relatively recent wave of research focuses on the use of natural (or quasi-natural) experiments to deal with the endogeneity bias between female labor supply and fertility. Alternatively, since fertility

variables are not exogenous in female labor supply models, estimations of the causal effects of children on work decisions are, in general, based on variables that work as a source of exogenous variability in family size. In general, this literature has analyzed the effect of fertility on women's labor force participation using exogenous variation in family size induced by twins (ANGRIST; EVANS, 1998; BRONARS; GROGGER, 1994; CÁCERES-DELPIANO, 2008; JACOBSEN; PEARCE III; ROSENBLOOM, 1999; ROZENZWEIG; WOLPIN, 1980a; 1980b), parents' preferences for a mixed sibling-sex composition (ANGRIST; EVANS, 1998; IACOVOU, 2001), miscarriage (HOTZ; MCELROY; SANDERS, 2005), stillbirths (PAZELLO; FERNANDES, 2004) and fertility problems/limitations (AGÜERO; MARKS, 2008; CRISTIA, 2008).

Additionally, based on the fact that parents' familiar resources/time allocation is directly related to parents' time spent on labor market and/or at home, mothers can react differently depending on the size of her offspring. A three-children mother may decide to allocate less hours to the labor market in order to spend more time with children, while it can be more feasible for a one- or two-children mother to increase her labor supply in order to provide funds to a larger family size. There is a large body of research showing the impacts of birth order on children's health and education (BLACK; DEVEREUX; SALVANES, 2005), but not on mothers' decisions to work and/or study. There are reasons to believe, for example, that the first child is the one with the strongest effect on women's labor market decisions (VERE, 2008). Cáceres-Delpiano (2008) took into account different birth orders in the children effects estimation on female labor force participation in developing countries. He found negative effects of the first and third (or more) birth on female employment probability, while the second birth increases this likelihood (a result that can be compatible with economies of scale in the care of two children). However, besides using a sample of 42 developing countries to enhance sample size, the author used the occurrence of twins as an instrumental variable (a more well-known event, therefore, frequently employed in this sort of estimation) and there was no focus on the differences between countries/regions.

Fertility decline and rising female labor supply in Brazil

Brazil is facing a steady and fast decline in fertility. The average number of children per woman fell from 5.8 in 1970 to 2.4 in 2000 (BERQUÓ; CAVENAGHI, 2006), to below replacement levels by 2006 (Ministério da Saúde, 2008) to 1.77 in 2014 (IBGE, 2014), reflecting the rapid fertility decline in the country. Although there are still regional differences, there is a clear convergence across regions. In the 1970s, fertility decline concentrated in the more developed areas of the country, since the early 1980s, the least developed and poorest groups started showing intense fall in fertility rates (POTTER; SCHMERTMANN; CAVENAGHI, 2002; POTTER et al., 2010).

At the same time, female labor force participation rates began to rise continuously from 26.63% in 1980 to 44.14% in 2000 (ABEP; UNFPA, 2009). In the early 1980s, some argued that the

increase in female activity rates in Brazil was caused by economic cyclical factors in a male breadwinning model, husbands' unemployment and lower wages would force wives to look for jobs as a strategy to complement family income (MONTALI; PATARRA, 1986). Studies carried out in the following decade have shown that there was a long term trend stronger than the short term adjustments previously mentioned (BRUSCHINI; LOMBARDI, 1996; CONNELLY; DEGRAFF; LEVISON, 1996; COSTA, 1990; SANTOS; MORETTO, 2001; WAJNMAN; LIBERATO; QUEIROZ, 1998). There is also huge socioeconomic differences in female labor supply, the more developed regions of the country have very high female labor force participation (and low fertility), but in recent years it is been observed a convergence process (Costa, 1990; Wajnman, Queiroz & Liberato, 1998; Bruschini & Lombardi, 1996).

The increasing female labor force participation in Brazil is marked by an important rise in the participation of married women. Bruschini (1998) shows that female workers in the 1970s were mostly young, unmarried and childless, while in the mid-1990s female labor force was composed by older, married and mothers. Male breadwinning income effect could explain some short term fluctuations, but the long term trend is clearly a result of an intense process of modernization interacted with technological and cultural change that has occurred in the Brazilian society since the late 1970s. Changes in female identity and family relations, as well as smaller family ideals, and greater access of women to education are important components of this process (BRUSCHINI, 1998; RIOS-NETO; WAJNMAN, 1994).

Objectives

This paper has an important methodological contribution to the extent that it estimates the effects of the three first birth orders on female labor force participation (and on educational achievements) using five natural experiments – which works by itself as important robustness checks for the effects of children on women's labor supply and educational attainment. Especially in developing countries – where longitudinal databases are virtually nonexistent (as is the case of Brazil), methodological strategies that allow us to estimate not only the association between two variables, but the effect on each other (eliminating the problem of reverse causality) become essential tools. Accordingly, we propose the use of the occurrence of early neonatal mortality, infant and child mortality as proxies for fertility in female labor supply and educational attainment models.

We aim to estimate the impact of motherhood on women's participation in the labor market and educational outcomes, based on five events used as a natural experiments. The main difficulty to perform this exercise is data availability, since it is necessary to know if the women experienced fetal loss or child mortality, and it is also necessary to know when it happened. We use a nationally representative data on Brazil, which not only contains enough sample size, but also has information on the whole women's reproductive history.

Although, we intend to make an analysis in two points in time (1984 and 2013), in this version, we only show the results of our extensive use of the National Household Sample Survey (PNAD) carried out in 1984. As mentioned earlier, in that year, PNAD carried out a special supplement focused on the birth history of all women aged 15 to 54. The questionnaire includes questions on number of births, child mortality, dates of birth and deaths, as well as information on miscarriage and stillbirth (including the period when it happened). This special feature of this dataset allows us to investigate whether different birth orders have different effects on women's labor supply.

Additionally, as Brazil is a large country with sizeable demographic and socioeconomic differences between its regions (especially between the North and Northeast versus the South and Southeast regions), we found important to include an analysis of the effects of children on women's educational and work status separately by regions as follows: Southern regions (South + Southeast) and Northern regions (North + Northeast). The disparities between these regions are large in several aspects of social life but, particular to this research, are staggering in terms of women's fertility, educational attainment and work status. Below, we show some of these regional differences that motivated our decision of including a regional analysis to our main results.

Although the Brazilian educational context has improved enormously in the last decade, bringing in higher levels of school access and educational attainment, and smaller regional gaps (Marteleto e De Souza, 2012), considerable Southern-Northern disparities still remain.

Formal education was a limited practice in Brazil until the mid- to late 1990s and has clearly expanded and incorporated the populations of all areas of the country, at least in terms of access to primary schooling (Veloso 2009; Marteleto e De Souza, 2012). Even more recently, there were changes in the Brazilian educational legislation (the Constitutional Amendment No. 59, dating from 11.11.2009, was made official by Law No. 12,796, dating from 04.04.2013), making basic education compulsory from 4 to 17 years of age. Only between 2000 and 2010, the access to school became virtually universal particularly for the ones aged 6 to 14 years old (IBGE, 2014). However, when one analyses some educational indicators for the adult population, the disparities between the Northern and Southern regions become are striking. In 2010, the illiteracy rate of those women (aged at least 15 years old) living in the Northeast region was almost 3 times higher than that found for residents in the Southeast region (8.5% and 23%, respectively). Also, the proportion of women aged 25 (and over) with no schooling or incomplete Elementary School is 28.7% higher in the Northeast compared to the Southeast. With regard to higher education, only 17.5% of women living in the Northeast of the country had completed College, while in the Southeast and South, this percentage reaches 28% in 2010 (IBGE, 2014).

Regarding women's labor force participation, despite the general rise in their participation in the Brazilian labor market, while only 48% of women (aged 16 or more) living in the Northeast region is working, this figure reaches almost 61% in the South region of Brazil in 2010 (IBGE, 2014).

Equally important are the regional differences on the level of fertility in Brazil. IBGE (2014) compares the percentage of women (by five-year age groups between ages 15 to 49) living in the rural areas who had at least one child in 2010 to their counterparts in the urban areas. As a matter of fact, the urbanization rate in the Northeast and North is 73% while this rate is 85 and 93% for the South and Southeast regions, respectively. Despite the decreasing proportion of younger women with live births, especially those aged up to 34 years, the differentials in this indicator were visible when analyzed according to the area of residence. In urban areas, in 2010, 11.1% of young women aged 15 to 19 had at least one child born alive, while in rural areas this indicator was 15.5%. The most significant difference was found in the group of women aged 25-29 years old. Regarding these women, the proportion of those with a child was 57.9% in urban areas and 75.4% in rural areas in 2010.

Also, we are currently working on the data derived from the National Health Survey (PNS) carried out in 2013. PNS 2013 is a nationally representative household survey conducted by the Brazilian Institute of Geography and Statistics (IBGE) and Ministry of Health. Besides all the socioeconomic and demographic information, PNS 2013 has also information on the performance of the national health system; the health conditions of the Brazilian population; surveillance of chronic non-communicable diseases and associated risk factors (MALTA et al., 2008); which includes important information on women's birth histories. Between 1984 and 2013, Brazilian society experienced important social, economic and demographic changes, so that it is important to analyse in what extend the effects of maternity on women's educational and work status have also changed.

Methods and Data

Determining how motherhood affects female labor force participation (and vice-versa) is not a simple task. First, especially in developing countries, the available data sources do not provide women histories of childbirth and work, which complicates the cause and effect identification in the relationship between fertility and female labor supply. Furthermore, a woman's current occupational situation is the result of a career marked not only by plans and desires, but also by misfortunes. In this context, a planned or a non-planned child may have different effects on women's labor history (DIAS-JÚNIOR, 2010).

The identification of the causal direction between having children and work is also difficult for two more reasons: 1) these decisions are made simultaneously, which makes both endogenous events (ANGRIST; EVANS, 1998); 2) work and child women's preferences may greatly vary, so that there are women who prefer having children instead of working and vice-versa and, simply

comparing women with different preferences would imply a negative relationship between fertility and labor supply even if there is no causal effect of children on women's work decision (PAZELLO; FERNANDES, 2004).

Many observational empirical studies ignore causality and the endogeneity problem. There are labor supply models considering children's characteristics as explanatory variables in parents' hours worked equations (MARON; MEULDERS, 2008; SCORZAFAVE; MENEZES-FILHO, 2001), but there are also models where wages and other work engagement measures are considered explanatory variables in equations of fertility (PAPAPETROU, 2004). These conventional methods, however, only provide a measure of the association between female labor supply and motherhood, they do not allow for any causality inference.

We use data derived from the PNAD 1984, which is a nationally representative household survey collected annually by the Brazilian Institute of Geography and Statistics (IBGE). In addition to the socioeconomic and demographic information, the 1984 PNAD has a fertility supplement, which asks about complete birth history to all women aged 15 to 54 who had a child. In other words, it asks in which day, month and year each child was born, and in case of death, when it happened (day, month and year). Based on this information, it is possible identifying (in case of death) early neonatal (up to 7 days), neonatal (up to 28 days) and infant (up to 1 year) mortality. In addition, the 1984 PNAD also includes information on how many stillbirths and abortions these women have experienced in the previous two years, so that we have information on these events for women in different parities.

The empirical evidence in Brazil and Latin America shows that fertility decisions have affected female status in the labor market, the labor intensity – hours worked per week (Pazello, 2006), and the decision to enter the labor market (Lérida, 2006). In common, all the previous studies do not consider different birth orders. But, there are reasons to believe, for example, that the first child is the one with the strongest effect on women's labor market decisions (Lérida, 2006).

Given that we use five events related to the loss of a gestational or born child (stillbirth, miscarriage, death of a child before completing 7, 28 and 365 days of life), taking into consideration that each event works as a proxy for fertility in each of the three parity progressions (from 0 to 1 child, from 1 to 2 children and from 2 to 3 or more children), in total, we have 15 estimations of children effects for each of the three variable related to female educational and work status: 'labor supply', 'having at least 8 years of schooling' and 'having at least 12 years of schooling'.

Focusing on the occurrence of stillbirth as a proxy for fertility, the specification of the model go behind the following reasoning. When estimating the first child effect on female labor force participation, the treatment group (women who have had a stillbirth) is comprised by women aged 15 to 54 without children, who had had a pregnancy in two years prior to the interview, and who had

had a stillbirth. The control group is comprised by women (in the same age group and who also had had a recent pregnancy) with one child who never had lost a child (neither experiencing fetal nor infant death). In estimating the second child effect on the female labor supply, the treatment group is comprised by one-child mothers aged 15 to 54 who recently became pregnant, and who have had at least one stillbirth, whereas the control group is comprised by women with similar characteristics (in terms of age and pregnancy), but who had two children and never had lost a child. Finally, in the estimation of the third (or more) child effect, the treatment group is comprised by mothers with two children, aged 15 to 54 years, who had had a pregnancy in the last two years and who had had a stillbirth, while the control group is comprised by those who had three or more children and had never lost a child. In the other models, using alternative events selected as fertility proxies, we construct the samples and variables in an analogous way.

In all models we assume that for both groups of women (control and treatment) pregnancy was a planned event, thus it could have impact their labor decisions. We also control for several variables that might be related to the occurrence of child mortality or interrupted pregnancy (Pazello & Fernandes, 2004; Eller et. al., 2006, among others). Based on the fact that abortion/stillbirth occurrence as well as child mortality are, in general, associated with socioeconomic conditions (França et. al., 2001; Schoeps et. al., 2007; Assis, Machado & Rodrigues, 2008; PAZELLO; FERNANDES 2004; ELLER; BRANCH; BYRNE, 2006), we control for variables related to these conditions, such as income (familiar mensal income ignoring the proper women earnings), schooling, residence area and household infrastructure. With these controls, we expect that the process determining a child loss becomes random. We emphasize the fact that the indicator variables for the occurrence of fetal loss or infant mortality enter directly in the logistic models, not as instrumental variables.

In addition to these control variables, all models include a variable that indicates the occurrence of a child or fetal mortality. This is our variable of interest, which means that, with a mathematical transformation, its coefficient provide us the marginal effect of having a kid (first, second or third – or more – kid, depending on the parity analysed) on mother's labor supply decision.

For example, regarding the marginal effect interpretation, if we compare women with no children to women with one child, a positive effect (of the 'mortality event' indicator) means that women without children present a larger probability of being in the labor force than the one who experienced the event. In other words, it means that having a child (first) may reduce female labor force participation in Brazil.

In this preliminary version, we focus our analysis on the 'labor force participation' indicator variable (which takes value "1" if women is working or looking for a job and "0" otherwise) and report estimates of the childbearing effects on women's labor supply using logistic regression models. We also show preliminary results on: 1) two educational attainment variables: 'having at least 8 years of

schooling' and 'having at least 12 years of schooling', with both variables taking value "1" for the ones who have it and "0" otherwise; and 2) regional analysis: additionally, we estimate the previous models separately for the Southern and Northern regions.

The construction of the samples

In order to accurately estimate the effect of children on female labor force participation, we restrict the sample to women who are household heads or spouses, so that we can be sure about the identification of their children. We restrict our analyses to children whose mothers were younger than age 40 to ensure they are less likely to have older children outside the household and who are old enough to have had children. Table 1 shows the treatment and control groups definition in each case.

TABLE 1 – Samples Restrictions and sizes: Brazil, 1984

Samples		Restrictions	[N]
Basic sample		Women	232,627
		Household head or spouse	109,858
		Unmarried or in a heterosexual union	108,610
		Aged 15-54	89,591
		Age at first child (if mother) equal or higher than 14	88,508
		Informed race, schooling, labor force participation, income and household characteristics	84,335
		Pregnancy in the last two years and informed if the child born alive	26,512
		Control group: One-, two- or three (or more)-children mothers that had never experienced child loss	16,941
		Treatment group: Non-, one- or two-children mothers that experienced some child loss	3,085
Final Samples	Parity progression	Sample 1: Natural experiment used as fertility *proxy*: Stillbirth	
	0 to 1 child	Control: one-child mothers that never experienced any kind of child loss	5,734
		Treatment: non-mothers that experienced a stillbirth	118
	1 to 2 children	Control: two-child mothers that never experienced any kind of child loss	4,908
		Treatment: one-child mother that experienced a stillbirth	150
	2 to 3+ children	Control: three or more-child mother that never experienced any kind of child loss	6,299
		Treatment: two-child mother that experienced a stillbirth	98
	Parity progression	Sample 2: Natural experiment used as fertility proxy: Abortion (miscarriage)	
	0 to 1 child	Control: one-child mothers that never experienced any kind of child loss	5,734
		Treatment: non-mothers that experienced a abortion	489
	1 to 2 children	Control: two-child mothers that never experienced any kind of child loss	4,908
		Treatment: one-child mother that experienced a abortion	606
	2 to 3+ children	Control: three or more-child mother that never experienced any kind of child loss	6,299
		Treatment: two-child mother that experienced a abortion	522
	Parity progression	Sample 3: Natural experiment used as fertility proxy: Early neonatal mortality (before 7 days)	
	0 to 1 child	Control: one-child mothers that never experienced any kind of child loss	5,734
		Treatment: non-mothers that had a child dead before completing 7 days	56
	1 to 2 children	Control: two-child mothers that never experienced any kind of child loss	4,908
		Treatment: one-child mother that had a child dead before completing 7 days	140
	2 to 3+ children	Control: three or more-child mother that never experienced any kind of child loss	6,299
		Treatment: two-child mother that had a child dead before completing 7 days	175
	Parity progression	Sample 4: Natural experiment used as fertility proxy: Neonatal mortality (before 28 days)	
	0 to 1 child	Control: one-child mothers that never experienced any kind of child loss	5,734
		Treatment: non-mothers that had a child dead before completing 28 days	82
	1 to 2 children	Control: two-child mothers that never experienced any kind of child loss	4,908
		Treatment: one-child mother that had a child dead before completing 28 days	217
	2 to 3+ children	Control: three or more-child mother that never experienced any kind of child loss	6,299
		Treatment: two-child mother that had a child dead before completing 28 days	255
	Parity progression	Sample 5: Natural experiment used as fertility proxy: Infant mortality (before 365 days)	
	0 to 1 child	Control: one-child mothers that never experienced any kind of child loss	5,734
		Treatment: non-mothers that had a child dead before completing 365 days	149
	1 to 2 children	Control: two-child mothers that never experienced any kind of child loss	4,908
		Treatment: one-child mother that had a child dead before completing 365 days	436
	2 to 3+ children	Control: three or more-child mother that never experienced any kind of child loss	6,299
		Treatment: two-child mother that had a child dead before completing 365 days	561

Source: IBGE (PNAD, 1984).

Preliminary Results

Descriptive Statistics

In Table 2 we compare selected socio-demographic characteristics among women aged 15 to 54 who had experienced a stillbirth (treatment) with those who never lost a child (control) – columns 1 to 3. We also compare women aged 15 to 54 who had a son who died before being one year old (treatment) with women who never lost a child (control) – columns 4 to 6. Women in the control group are more educated, have higher family income, a higher proportion of them are white, live in the more developed regions (South and Southeast), and they live in households with at least one component of basic infrastructure. These factors demonstrate the association of stillbirth and infant mortality with poverty characteristics as it was prior identified in the literature (PAZELLO, 2004; ELLER; BRANCH; BYRNE, 2006). Descriptive analysis of women whose children died in the first 7 and 28 days of life (not shown) allows us to reach similar conclusions.

TABLE 2 – Summary statistics of women aged 15 to 54, according to the experience of stillbirth or infant mortality by control (never experienced any kind of child loss) and treatment (experienced either one or the other depending of the natural-experiment used) groups: Brazil, 1984

Variable	Natural-experiment											
	Stillbirth						Infant mortality					
	C		T		Dif		C		T		Dif	
	(1)		(2)		(3) = (2) - (1)		(1)		(2)		(3) = (2) - (1)	
Socio demographic												
Average number of children	2.50	(1.75)	0.94	(0.76)	-1.56	**	2.50	(1.75)	1.37	(0.70)	-1.13	**
White (%)	0.55	(0.50)	0.50	(0.50)	-0.05	*	0.55	(0.50)	0.46	(0.50)	-0.09	**
Married or living in consensual union (%)	0.10	(0.30)	0.08	(0.28)	-0.01		0.10	(0.30)	0.11	(0.31)	0.01	
Household head (%)	0.10	(0.30)	0.09	(0.29)	-0.01		0.10	(0.30)	0.11	(0.31)	0.01	
Average age	26.71	(6.09)	26.66	(6.53)	-0.05		26.71	(6.09)	25.78	(5.53)	-0.93	**
Average years of education	5.23	(4.01)	4.32	(3.86)	-0.90	**	5.23	(4.01)	3.56	(3.40)	-1.67	**
Geographic (%)												
Residence region												
South	0.15	(0.36)	0.14	(0.34)	-0.02		0.15	(0.36)	0.11	(0.32)	-0.04	**
Southeast	0.45	(0.50)	0.44	(0.50)	-0.01		0.45	(0.50)	0.33	(0.47)	-0.12	**
North	0.04	(0.19)	0.03	(0.16)	-0.01		0.04	(0.19)	0.03	(0.16)	-0.01	*
Northeast	0.28	(0.45)	0.31	(0.46)	0.03		0.28	(0.45)	0.47	(0.50)	0.19	**
Center West	0.08	(0.27)	0.08	(0.28)	0.01		0.08	(0.27)	0.06	(0.24)	-0.02	**
Residence situation												
Urban	0.75	(0.43)	0.68	(0.47)	-0.07	**	0.75	(0.43)	0.63	(0.48)	-0.12	**
Residence area												
Metropolitan	0.32	(0.47)	0.27	(0.44)	-0.05	*	0.32	(0.47)	0.25	(0.44)	-0.07	**
Household (in the household you live, there is...) (%)												
At least, one bathroom	0.82	(0.38)	0.76	(0.43)	-0.06	**	0.82	(0.38)	0.65	(0.48)	-0.17	**
General water system	0.65	(0.48)	0.56	(0.50)	-0.09	**	0.65	(0.48)	0.48	(0.50)	-0.17	**
Garbage collection service	0.53	(0.50)	0.48	(0.50)	-0.05	*	0.53	(0.50)	0.38	(0.48)	-0.16	**
Electricity	0.79	(0.41)	0.69	(0.46)	-0.10	**	0.79	(0.41)	0.63	(0.48)	-0.16	**
Occupational (%)												
EAP	0.27	(0.44)	0.32	(0.47)	0.05	*	0.27	(0.44)	0.28	(0.45)	0.01	
Average familiar income [1]	1331	1999	997	1403	-334	**	1331	1999	793	1293	-538	**
Average non-working income [1, 2, 3]	1155	1733	806	1072	-349	**	1155	1733	689	1104	-466	**
Works, at least, 40 hours by week (%) [3]	0.15	(0.35)	0.18	(0.39)	0.04		0.15	(0.35)	0.14	(0.35)	-0.01	
[N]		16,941		366				16,941		1,146		

Source: IBGE (PNAD, 1984).

Notes: ** p<0.01, * p<0.05, + p<0.1. Standard deviation in parentheses. [1] In 2002 Reais. [2] Non-working income = familiar income minus woman earnings. [3] We considered null income and working hours for women that were not working.

In Table 3 the comparison is between the women who observed a miscarriage (treatment) and the alternative as control. Contrary to what we found in the occurrence of a stillbirth, women who had had an abortion are, on average, in better living conditions than those who never had lost a child, that is to say, they have a higher family income, live in higher proportion in the more developed regions, and they live in households with better infra-structure. The socio-demographic differences among women in the treatment and control group, although significant, have much lower magnitudes compared to those found when dealing with stillbirth and infant mortality. While the literature points to studies that find no association between the socio-economic conditions and the occurrence of miscarriage (PARAZZINI et al., 1991; AL-ANSARY; BABAY, 1994), there are also studies that relate to a higher incidence of abortions to women undergoing assisted reproduction techniques (WANG; NORMAN; WILCOX, 2004) – these are associated with women living in better conditions.

TABLE 3 – Summary statistics of women aged 15 to 54, according to the experience of abortion (miscarriage) by control (never experienced any kind of child loss) and treatment (experienced an abortion) groups: Brazil, 1984

Variable	C (1)		T (2)		Dif (3) = (2) - (1)	
Socio demographic						
Average number of children	2.50	(1.75)	1.04	(0.79)	-1.46	**
White (%)	0.55	(0.50)	0.57	(0.49)	0.02	
Married or living in consensual union (%)	0.10	(0.30)	0.10	(0.30)	0.00	
Household head (%)	0.10	(0.30)	0.11	(0.31)	0.01	
Average age	26.71	(6.09)	27.30	(6.74)	0.59	**
Average years of education	5.23	(4.01)	5.98	(4.25)	0.75	**
Geographic (%)						
Residence region						
South	0.15	(0.36)	0.15	(0.36)	0.00	
Southeast	0.45	(0.50)	0.51	(0.50)	0.06	**
North	0.04	(0.19)	0.02	(0.14)	-0.02	**
Northeast	0.28	(0.45)	0.25	(0.43)	-0.03	**
Center West	0.08	(0.27)	0.07	(0.25)	-0.01	
Residence situation						
Urban	0.75	(0.43)	0.81	(0.39)	0.06	**
Residence area						
Metropolitan	0.32	(0.47)	0.40	(0.49)	0.08	**
Household (in the household you live, there is...) (%)						
At least, one bathroom	0.82	(0.38)	0.88	(0.33)	0.05	**
General water system	0.65	(0.48)	0.72	(0.45)	0.07	**
Garbage collection service	0.53	(0.50)	0.61	(0.49)	0.08	**
Electricity	0.79	(0.41)	0.87	(0.34)	0.08	**
Occupational (%)						
EAP	0.27	(0.44)	0.37	(0.48)	0.11	**
Average familiar income [1]	1331	1999	1720	2948	389.25	**
Average non-working income [1, 2, 3]	1155	1733	1404	2431	248.74	**
Works, at least, 40 hours by week (%) [3]	0.15	(0.35)	0.20	(0.40)	0.06	**
[N]	16,941		1,617			

Source: IBGE (PNAD, 1984).

Notes: ** p<0.01, * p<0.05, + p<0.1. Standard deviation in parentheses. [1] In 2002 Reais. [2] Non-working income = familiar income minus woman earnings. [3] We considered null income and working hours for women that were not working.

The validity and limitations of using fetal loss and early child mortality as natural experiments

The occurrence of stillbirth, miscarriage, or infant mortality can be natural experiments because they represent an unexpected event leading to the reduction in the number of children. This would eliminate the endogeneity between children and female labor supply. It is important to acknowledge that the consequences of these events on women's mental and emotional health may discourage them to perform their usual activities, thus forcing them to intensify these activities or even encouraging them to try conceiving another child to replace the loss. For all these reasons, the fact that a woman had a stillbirth can affect her work decisions (WOLFF; NIELSON; SCHILLER, 1970; LAMMERSLEY; DRINKWATER, 1997).

In order to minimize this selectivity problem, we restricted our control group to women who have never experienced a stillbirth or infant mortality. In the treatment groups, we observed that the events occurred on average after the first or second children (within each sample analyzed). The average age of the youngest child of women in the treatment group, mothers of children 1 or 2, indicates that they were born, on average, before the fetal/child death used as natural experiment (Table 4). We have restricted our treatment and control sample to women who became pregnant in the previous 2 years. The youngest child average age is (almost) always greater than 2.

TABLE 4 – Younger child average age of mothers aged 15-54 years old, according to number of children and natural-experiment occurred (only treatment groups of 1 to 2 and 2 to 3 or more children parity progressions): Brazil, 1984

One- and two-children mother / Natural experiment	Younger child average age		[N]
One-child mother that had...			
... a stillbirth	4.94	(5.11)	15
... an abortion (miscarriage)	5.10	(4.31)	72
... a child dead before completing 7 days	3.31	(5.56)	14
... a child dead before completing 28 days	2.91	(4.15)	25
... a child dead before completing 365 days	2.20	(2.97)	55
... at least, one of these events	4.00	(4.23)	135
Two-children mother that had...			
... a stillbirth	5.79	(4.89)	13
... an abortion (miscarriage)	4.73	(4.56)	51
... a child dead before completing 7 days	2.51	(3.32)	15
... a child dead before completing 28 days	2.09	(2.72)	28
... a child dead before completing 365 days	1.92	(2.39)	71
... at least, one of these events	3.25	(3.94)	127

Source: IBGE (PNAD, 1984).
Notes: Standard deviation in parenthesis.

Another issue is our sample restriction. We excluded from the control group, mothers who had lost child(ren) to avoid losses associated with problems related to fecundity in this group. However, young women, who had an abortion or stillbirth and who still can have children, can be erroneously excluded from the control group. Because of this, we also estimate the effects of second and third (or more) children, using the occurrence of miscarriage and stillbirth as proxies for fertility in samples of women aged 30 to 54, 35 to 54, 40 to 54 (not shown). In fact, although the coefficients are not estimated with the same precision probably due to the (smaller) sample sizes, they become larger in magnitude with analytical samples of older women, confirming the results found in the full samples.

Fetal losses and infant deaths are rare events. Thus, there is a problem of external validity of the estimates. In addition, the variation in fertility induced by these events can not be generalized to variations in fertility caused by other causes or women with little propensity to experience them (MOFFITT, 2003). A simulation exercise through time may help to verify the prediction power of our estimates of first, second and third effects over female labor force participation rates.

As previously mentioned, there are some characteristics that increase the probability of experiencing miscarriage, stillbirth and infant mortality. Potentially, these events also have an internal validity problem. Simply put, the association of these events to family income may indicate that they are not exogenous. Therefore, we control for observable characteristics that determine family income. We also conducted the Haussmann Exogeneity Test, comparing OLS models to 2SLS models – the variables indicating the occurrence of stillbirth or infant death (treatment status indicators) entered as an instrument for fertility. In all cases the p-values were very close to zero, thus the estimations of the effect of children on labor force participation of women based on the use of these events is likely to solve the endogeneity problem.

Children estimated effects on Women's Labor Force Participation

First, we analyze the relationship between motherhood and women's labor force participation through traditional logistic models with pure observational data with no natural experiment, this is the naïve estimation. Then, we use the natural experiments related to the early loss of a child in the logistic models to establish the causal effect of parity, that is to say, the first, second and third (or more) children ever born on female participation. Our female labor force participation measure is a dummy variable assuming value one for women classified as economically active (employed or unemployed) and value zero for inactive women. We control for age, age squared, educational level, presence of spouse, area (whether urban or not), type of area (metropolitan or not), place of residence, clusters by State, non-work income (family income minus women income), family income quintile at which women belong, and four household characteristics variables (if there is general water supply, at least one bathroom, garbage collection and electricity).

Table 5 presents children marginal effects (estimated with each of the proxies for fertility transitions in the three maternity) on the probability of women aged 15 to 54 being economically active in 1984. All estimated effects are positive, as expected by the literature review and found in the scarce empirical literature for Brazil (FERNANDES; PAZELLO, 2004; PAZELLO, 2006; CAMPÊLO; SILVA, 2005). The last row shows the naïve model results (endogenous indicator). They suggest that having a child reduces women's probability of being in the labor force by .10 (first birth order) to .28 (third). The most important difference between this conventional model and the natural experiment approach is observed on the third child effect, where the magnitude of the marginal effect is much larger on the conventional model, suggesting a much larger negative effect of the third child on women's labor supply decisions in comparison to the first and second child effects.

Table 5 - Effects of First, Second and Third (or more) Children on Female Labor Force Participation according to the fetal/child loss used as proxy for fertility, Women aged 15-54: Brazil - 1984

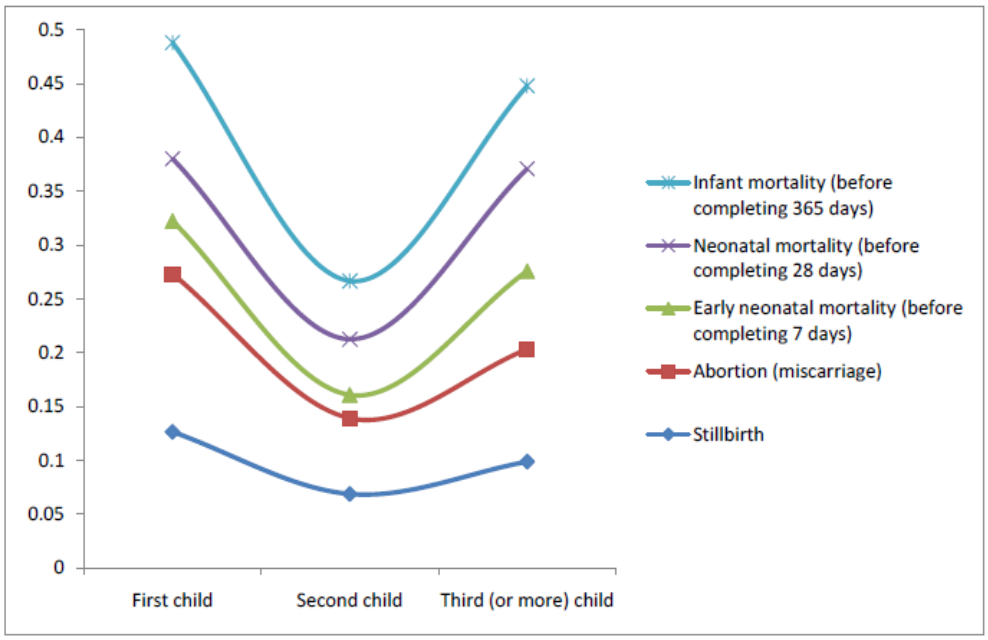
Fetal/child loss used as proxy for fertility	Brazil		
	Fst child	Snd child	Trd child
Stillbirth	0.0959	0.0559	0.0802
p value	0.0181	0.1070	0.0443
N obs	5852	5058	6397
Abortion	0.1100	0.0578	0.0855
p value	0.0000	0.0001	0.0000
N obs	6223	5514	6821
Early neo.	0.0391	0.0187	0.0611
p value	0.4513	0.4724	0.0084
N obs	5790	5048	6474
Neonatal	0.0460	0.0433	0.0780
p value	0.1872	0.0693	0.0027
N obs	5816	5125	6554
Infant mort.	0.0828	0.0455	0.0649
p value	0.0052	0.0028	0.0016
N obs	5883	5344	6860
Naive Model (logistic model using endogenous indicator variable of the number of children in each parity)	0.1031	0.0375	0.2791
p value	0.0000	0.0000	0.0030
N obs	9755	14447	16757

Source: IBGE (PNAD, 1984).

Considering only significant effects (p-values of less than .10) in the models using proxies for fertility, we observe that the first child effects (reduction) on female labor force participation (Table 5, column 1) range from .0828 (in the proxy for fertility death of a child before one year of age) to .1100 (abortion as proxy for fertility). Concerning the second child effects (column 2), we found that having a second child reduces mothers' probability of being in the EAP (Economically Active Population) in the interval between .0433 (neonatal mortality) and .0578 (abortion/miscarriage). Finally, when considering the third child effects, it reduces mothers' labor force participation ranging from .0611 (early neonatal death) to .0855 (abortion/miscarriage).

Analyzing these marginal effects by parity, there is a downward trend from the first child to the second, and an upward trend from the second to the third (or more) child. This means that, the marginal children effect of parity on women's participation in the EAP curve presents a 'U' shape as illustrated in Figure 1. Taking miscarriage as an example for a proxy for fertility, the estimated first child effect was a (reduction of) .1100, while the second child effect fell reaching .0578 and the third (or more) child effect increased again to .0855 (without, however, recovering the magnitude of the first child effect).

FIGURE 1 – The U-shape format: Estimated effects of First, Second and Third (or more) Children on Female Labor Force Participation according to five proxies for fertility, Women aged 15-54 – Brazil, 1984



Source: IBGE (PNAD, 1984).

Two aspects can be highlighted in the analysis of Table 5. First, regarding the magnitude of the estimated effects of parity on female labor force participation, there is a similar magnitude among the alternative proxies for fertility. In absolute values, the magnitude of the marginal effect was generally smaller in the proxies associated with neonatal mortality (both early neonatal and regular). Stillbirth and miscarriage presented similar results regarding the magnitude of marginal

effects, while infant mortality was the third proxy regarding consistency of the marginal effect. Concerning statistical significance, stillbirth was significant only in the case of third birth – the same with both neonatal mortality proxies. Abortion (miscarriage) and infant mortality were statistically significant in the three marginal effects (first, second, and third or more parities).

Children estimated effects on Women's Educational attainments

Firstly, we highlight the fact that women's age interval is more restricted when analysing children effects on women's educational achievements (25-54 years old) than the one used in the analysis of labor force participation (15-54 years old). This is so because as educational levels can increase over the life cycle, it is important for us that both groups of women (treatment and control) had completed their schooling years. In Brazil, particularly in the early 1980's there is a high probability that this was the case for women aged at least 25 years old.

Table 6 shows the estimated effects for both educational indicators: 'having completed 8 years of schooling' and 'having completed 12 years of schooling'. We highlight two aspects. First, the effects of children on women's education seem not to be as strong as they are regarding women's labor force participation (since fewer marginal effects are significant). Once again (as in women's work status estimations), the first and third child seem to have larger effects on reducing the chance of a mother completing 12 or even 8 years of schooling.

Secondly, we have actually found robust positive effects of a second children on mother's education (this was the case for all proxies for fertility, except for the abortion). More specifically, our estimations suggest that a second child can increase the probability of the mother completing 8 years of schooling; the increase in this probability varied between .0784 and .1295. Because of this finding, we proceeded to examine if regional differences would be playing a role (next subsection). This is so because there are important differences in the socioeconomic development of the Northern compared to the Southern regions. The industrialization and urbanization concentrated in the Southern regions were followed by the Northern regions only more than a decade later, resulting in considerable differences across those regions in Brazil (Diniz, 2002; Marteleto and De Souza, 2012) in the sense that the Northern regions are less developed/poorer and the Southern ones are more developed/wealthiest.

According to Caldwell (1982), in pre-demographic transition societies, children were seen as providers of resources to the family. This way, when families face financial constraints, children may contribute largely to family resources not only by working outside the home but also by working inside the home (performing domestic work which can include taking care of other members of the household). In the context of the poorer Northern regions, it may be the case that siblings may contribute to the family by working for pay and by taking care of younger children (Marteleto and De

Souza, 2012) and this would explain the positive effects of having a second child on the probability of completing 8 years of schooling.

Table 6 - Effects of First, Second and Third (or more) Children on Female '12 years of schooling attainment' and '8 years of schooling attainment' according to the fetal/child loss used as proxy for fertility, Women aged 25-54: Brazil - 1984

Fetal/child loss used as proxy for fertility	12 years of schooling			8 years of schooling		
	Fst child	Snd child	Trd child	Fst child	Snd child	Trd child
Stillbirth	-0.0377	0.0127	0.0188	-0.0284	-0.0784	0.0421
p value	0.5478	0.7275	0.4392	0.6333	0.0747	0.2923
N obs	1799	2254	3211	1950	2860	5330
Abortion	0.0382	-0.0211	0.0312	0.0474	-0.0105	0.0651
p value	0.2227	0.1206	0.0634	0.3466	0.5280	0.0001
N obs	1967	2473	3467	2130	3125	5662
Early neo.	0.1964	0.0054	0.0195	0.2413	-0.1214	0.0252
p value	0.0421	0.9340	0.4165	0.1716	0.0234	0.3968
N obs	1772	2240	3228	1917	2842	5379
Neonatal	0.1337	-0.0703	0.0139	0.1429	-0.0965	0.0337
p value	0.0657	0.3365	0.5655	0.2935	0.0017	0.1688
N obs	1781	2262	3249	1928	2879	5432
Infant mort.	0.0752	-0.0965	0.0102	0.0559	-0.1295	-0.0028
p value	0.2220	0.1437	0.6059	0.6112	0.0003	0.8729
N obs	1792	2301	3322	1943	2966	5611

Source: IBGE (PNAD, 1984).

Regional analysis of children effects: Northern X Southern regions

As we would expect, the results for the effects of children on both work and educational status of women are different depending on the region analysed.

According to our estimates (Table 7), the first child may reduce the probability of women's participation in the labor force by at least .0893 and at most .1474 in the Southern regions, while the first child seems to have smaller effect on their counterparts residing in the Northern regions (the only significant effect was found with the abortion proxy for fertility: .0818). The Northern regions can still be considered as a very patriarchal society, so that becoming a mother or not may have no or little influence on women's working status. However, a more careful analysis still needs to be done in this regard.

Table 7 - Effects of First, Second and Third (or more) Children on Female Labor Force Participation according to the fetal/child loss used as proxy for fertility, Women aged 15-54: Brazil, Southern and Northern regions - 1984

Fetal/child loss used as proxy for fertility	Brazil			Southern regions			Northern regions		
	Fst child	Snd child	Trd child	Fst child	Snd child	Trd child	Fst child	Snd child	Trd child
Stillbirth	0.0959	0.0559	0.0802	0.1412	0.0767	0.1134	0.0792	0.0226	0.0468
p value	0.0181	0.1070	0.0443	0.0094	0.1665	0.0324	0.1459	0.6945	0.4883
N obs	5852	5058	6397	3070	2646	2773	2112	1798	2834
Abortion	0.1100	0.0578	0.0855	0.1474	0.0536	0.0957	0.0818	0.0658	0.0397
p value	0.0000	0.0001	0.0000	0.0000	0.0284	0.0000	0.0133	0.0007	0.1335
N obs	6223	5514	6821	3277	2909	3036	2233	1941	2963
Early neo.	0.0391	0.0187	0.0611	0.1232	0.0122	0.0461	-0.1048	-0.0150	0.0573
p value	0.4513	0.4724	0.0084	0.0015	0.4076	0.3607	0.2603	0.7875	0.0142
N obs	5790	5048	6474	3037	2644	2800	2087	1803	2872
Neonatal	0.0460	0.0433	0.0780	0.0893	0.0298	0.0471	-0.0303	0.0263	0.0990
p value	0.1872	0.0693	0.0027	0.0021	0.1247	0.3508	0.5977	0.5550	0.0016
N obs	5816	5125	6554	3044	2663	2826	2103	1855	2921
Infant mort.	0.0828	0.0455	0.0649	0.1263	0.0098	0.0456	0.0289	0.0577	0.0648
p value	0.0052	0.0028	0.0016	0.0000	0.6457	0.2874	0.5605	0.0247	0.0138
N obs	5883	5344	6860	3063	2739	2935	2149	1981	3086

Source: IBGE (PNAD, 1984).

There is no significant regional differences between the effects of the second child as for women in the Northern regions may face a reduction (on their probability of being in the labor force) of .0226-.0658 and the ones living in the Southern regions may face a reduction of .0536. Concerning the third child, the effects on mother's work status may be stronger for the ones in the Southern regions (varying from .0957 to .1134) compared to the ones in the Northern regions (varying between .0573 and .0990).

When analysing the regional differences in the effects of children on mother's educational attainments, we found no effects of children on the probability of the mother having attained at least 12 years of schooling in the Northern regions (Table 8). We speculate that women having at least 12 years of schooling were much less usual back in the year of 1984 compared to the past years, and this may be affecting our results.

Table 8 - Effects of First, Second and Third (or more) Children on Female '12 years of schooling attainment' according to the fetal/child loss used as proxy for fertility, Women aged 25-54: Brazil, Southern and Northern regions - 1984

Fetal/child loss used as proxy for fertility	Brazil			Southern regions			Northern regions		
	Fst child	Snd child	Trd child	Fst child	Snd child	Trd child	Fst child	Snd child	Trd child
Stillbirth	-0.0377	0.0127	0.0188	-0.0293	-0.0063	0.0299	0.0000	0.0408	0.0000
p value	0.5478	0.7275	0.4392	0.6714	0.8499	0.3514	.	0.6469	.
N obs	1799	2254	3211	1094	1400	1445	437	537	1184
Abortion	0.0382	-0.0211	0.0312	0.0514	-0.0119	0.0502	-0.0547	-0.0426	-0.0240
p value	0.2227	0.1206	0.0634	0.1443	0.3830	0.0701	0.4408	0.3841	0.2759
N obs	1967	2473	3467	1206	1555	1612	479	581	1247
Early neo.	0.1964	0.0054	0.0195	0.2697	-0.0749	0.0271	0.0375	0.1629	0.0197
p value	0.0421	0.9340	0.4165	0.0098	0.3520	0.5261	0.8456	0.3094	0.3930
N obs	1772	2240	3228	1076	1396	1452	442	535	1199
Neonatal	0.1337	-0.0703	0.0139	0.2193	-0.1951	0.0172	0.0285	0.0181	0.0278
p value	0.0657	0.3365	0.5655	0.0035	0.0471	0.6960	0.8782	0.8946	0.2435
N obs	1781	2262	3249	1078	1405	1461	444	544	1208
Infant mort.	0.0752	-0.0965	0.0102	0.1859	-0.2457	0.0149	-0.0976	0.0125	0.0143
p value	0.2220	0.1437	0.6059	0.0147	0.0015	0.6901	0.4823	0.9048	0.4377
N obs	1792	2301	3322	1083	1427	1493	448	557	1229

Source: IBGE (PNAD, 1984).

Concerning the effects of children in the Southern regions, we found that the first and third children may reduce the probability of completing 12 years of schooling and the second may increase this probability. This feature for women in the Southern regions is also found when analysing the probability of attaining 8 years of schooling (Table 9). Although we believed we would find that the second child would increase the probability of attaining "certain" years of schooling only for women in the poorer Northern regions, it is also possible that over 30 years ago, even in the wealthier Southern regions it could be "normal" having children collaborate with the parents/mother on the household duties. Marteleto e De Souza (2013) provide evidence that larger families in Brazil lead to higher chances of household work for daughters, particularly early-born.

Table 9 - Effects of First, Second and Third (or more) Children on Female '8 years of schooling attainment' according to the fetal/child loss used as proxy for fertility, Women aged 25-54: Brazil, Southern and Northern regions - 1984

Fetal/child loss used as proxy for fertility	Brazil			Southern regions			Northern regions		
	Fst child	Snd child	Trd child	Fst child	Snd child	Trd child	Fst child	Snd child	Trd child
Stillbirth	-0.0284	-0.0784	0.0421	0.0046	-0.1045	0.0538	-0.1626	-0.0078	0.0207
p value	0.6333	0.0747	0.2923	0.9659	0.1263	0.3247	0.0011	0.9102	0.8138
N obs	1950	2860	5330	1132	1651	2403	647	904	2298
Abortion	0.0474	-0.0105	0.0651	0.1181	0.0148	0.0585	-0.0872	-0.0660	0.0671
p value	0.3466	0.5280	0.0001	0.0420	0.5734	0.0250	0.0553	0.0141	0.0000
N obs	2130	3125	5662	1244	1827	2619	702	975	2388
Early neo.	0.2413	-0.1214	0.0252	0.2683	-0.0648	0.0387	0.0545	-0.2035	-0.0200
p value	0.1716	0.0234	0.3968	0.3002	0.0785	0.4383	0.4971	0.1690	0.6725
N obs	1917	2842	5379	1113	1643	2419	636	906	2330
Neonatal	0.1429	-0.0965	0.0337	0.2272	-0.1218	0.0601	-0.0579	-0.0746	-0.0131
p value	0.2935	0.0017	0.1688	0.3440	0.0026	0.0808	0.4798	0.2155	0.7589
N obs	1928	2879	5432	1116	1655	2437	643	927	2362
Infant mort.	0.0559	-0.1295	-0.0028	0.1602	-0.1643	0.0227	-0.1180	-0.0785	-0.0463
p value	0.6112	0.0003	0.8729	0.4139	0.0001	0.3177	0.0836	0.1016	0.1035
N obs	1943	2966	5611	1121	1687	2509	652	978	2448

Source: IBGE (PNAD, 1984).

Final Considerations

There are several studies dealing with the effect of children on women's participation in the labor market. Some of these are observational studies that do not control for endogeneity. Even among the ones controlling for that, in general they do not take into account the fact that birth order can affect this participation differently. The estimation of the marginal effects by parity or the order of child birth was a contribution of this paper.

The estimated marginal effects of children by birth order on female labor force participation is negative, as predicted by theory and estimated by the literature, including the studies that do not distinguish between correlation and causation. The use of different natural experiments in the same data basis confirms that there is a causal component in this result.

In the estimation of the children effect on women's labor supply and educational attainment, we adopted five alternative variables that acted in the models as fertility proxies: miscarriage, stillbirth and child mortality (early neonatal, neonatal and infant mortality). Results indicated that miscarriage and stillbirth present results that are similar. Economists and some demographers traditionally considered infant mortality as an endogenous variable but, at least regarding the labor supply decision, infant mortality has proven to be a robust alternative natural experiment.

We also found an interesting trend of the children effect on female labor force participation rates according to the number of children: the first and third (or more) children cause a larger reduction in the 'mother's probability of participating in the labor force' than the second child. This feature makes sense especially if we think that the first child represents a new reality to which parents still have to adapt. When a second child is born, however, experience with the first must make this adjustment easier (which is also related to economies of scale). Having a third (or more) child, however, may have a greater effect compared to the second child since it means a larger family (CAMPÊLO; SILVA, 2005). This result is in line with Cáceres-Delpiano (2008), using data from 42 developing countries, the author also found that the first and third children affect more negatively more women's work decisions (concerning the second child, the effect was even positive, as we have found regarding women's educational attainment indicator). The discussion about the effects of children on mothers' education will be improved in the next version of this paper.

The discussion about the relationship between children and female educational and work status is important not only in the context of the traditional specialization hypothesis as suggested by Becker, but also in the context of developing countries where women's bargaining power and high labor force participation stimulate a debate on gender issues regarding the care of children. If this natural experiment is replicated in other contexts and countries, then it will reinforce the need of policies aiming at the reconciliation between between fertility and educational aspirations and between fertility and women's labor decisions.

References

ABEP; UNFPA. Brasil, 15 anos após a Conferência do Cairo. Campinas, SP, 2009.

AGÜERO, J. M.; MARKS, M. S. Motherhood and female labor force participation: evidence from infertility shocks. The American Economic Review, US, v. 98, n. 2, p. 500-504, 2008.

AL-ANSARY, L. A.; BABAY, Z. A. Risk factors for spontaneous abortion: a preliminary study on Saudi women. Journal of the Royal Society of Health, London, v. 114, n. 4, p. 188-193, 1994.

ALLEN, V. M. et al. The effect of hypertensive disorders in pregnancy on small for gestational age and stillbirth: a population based study. BMC Pregnancy Childbirth, v. 4, n. 1, p. 17, 2004.

ANGRIST, J. D.; EVANS, W. N. Children and their parent's labor supply: evidence from exogenous variation in family size. The American Economic Review, US, v. 88, n. 3, p. 450-477, 1998.

ASSIS, H. M.; MACHADO, C. J.; RODRIGUES, R. N. Perfis de mortalidade neonatal precoce: um estudo para uma Maternidade Pública de Belo Horizonte (MG), 2001-2006. Revista Brasileira de Epidemiologia, São Paulo, SP, v. 11, n. 4, p. 675-686, 2008.

BECKER, G. A treatise on the family. Cambridge: Harvard University Press, 1991.

_____. A theory of the allocation of time. Economic Journal, Inglaterra, v. 75, n. 299, p. 493-517, 1965.

BERQUÓ, E.; CAVENAGHI, S. Breve nota sobre a redução no número médio de filhos por mulher no Brasil. Novos Estudos Cebrap, São Paulo, SP, n. 74, p. 11-15, 2006.

BLACK, S. E.; DEVEREUX, P. J.; SALVANES, K. G. The more the merrier? The effect of family size and birth order on children's education. Quarterly Journal of Economics, US, v. 120, p. 669-700, 2005.

BLAU, F.; KAHN, L. Changes in the labor supply behavior of married women: 1980-2000. Journal of Labor Economics, Chicago, v. 25, n. 3, p. 393-438, 2007.

BRASIL. Ministério da Saúde. Pesquisa Nacional de Demografia e Saúde da Mulher e da Criança (PNDS) 2006: relatório final. Brasília, DF, 2008.

BRONARS, S. G.; GROGGER, J. The economic consequences of unwed motherhood: using twin births as a natural experiment. The American Economic Review, US, v. 84, n. 5, p. 1141-1156, 1994.

BRUSCHINI, M. C. A. Trabalho feminino no Brasil: novas conquistas ou persistência da discriminação? In: LATIN AMERICAN STUDIES ASSOCIATION, 1998, Chicago, Illinois. Anais… LASA, 1998.

_____; LOMBARDI, M. O trabalho da mulher brasileira nos primeiros anos da década de noventa. In: ENCONTRO NACIONAL DE ESTUDOS POPULACIONAIS, 10., 1996, Natal, RN. Anais… Belo Horizonte, MG: ABEP, 1996.

CÁCERES-DELPIANO, J. Keeping the best for last. Impact of fertility on mother's employment. Evidence from developing countries. Technical Report, Madrid, 2008.

CAMPÊLO, A. K.; SILVA, E. N. Filhos e renda familiar: uma aplicação do efeito quantílico de tratamento. Pesquisa e Planejamento Econômico, Rio de Janeiro, RJ, v. 35, n. 3, p. 355-377, 2005.

CHIAPPORI, P. A. Rational household labor supply. Econometrica, Chicago, v. 56, n. 1, p. 63-89, 1988.

CONNELLY, R.; DEGRAFF, D. S.; LEVISON, D. Women’s employment and child care in Brazil. Economic Development and Cultural Change, Chicago, v. 44, n. 3, p. 619-656, 1996.

COSTA, L. Aumento da participação feminina: uma tentativa de explicação. In: ENCONTRO NACIONAL DE ESTUDOS POPULACIONAIS, 7., 1990, São Paulo, SP. Anais... Belo Horizonte, MG: ABEP, 1990.

CRISTIA, J. P. The effect of a first child on female labor supply: evidence from women seeking fertility services. The Journal of Human Resources, US, v. 43, n. 3, p. 487-510, 2008.

CRUCES, G.; GALIANI, S. Fertility and female labor supply in Latin America: new causal evidence. Labor Economics, Chicago, v. 14, n. 3, p. 565-573, 2007.

DIAS-JÚNIOR, C. S. Diferenciais no comportamento reprodutivo das mulheres brasileiras: uma análise a partir dos grupos ocupacionais. Dados, Rio de Janeiro, RJ, v. 53, n. 1, p. 233-266, 2010.

DERMOTT, E. What’s parenthood got to do with it?: men’s hours of paid work. The British Journal of Sociology, London, v. 57, n. 4, p. 619-634, 2006.

Caldwell, J. Theory of fertility decline. London, UK: Academic Press; 1982.

Diniz, C. A nova configuração urbano-industrial no Brasil [The new urban-industrial configuration of Brazil]. In: Kon, A., editor. Unidade e fragmentação: A questão regional no Brasil. São Paulo, Brazil: Perspectiva; 2002.

ELLER, A. G.; BRANCH, D. W.; BYRNE, J. L. B. Stillbirth at term. Obstetrics & Gynecology, v. 108, n. 2, p. 442-447, 2006.

ESPING-ANDERSEN, G. The incomplete revolution: adapting to women's new roles. Cambridge: Polity Press, 2009.

FOLBRE, N. The invisible heart: economics and family values. New York, NY: The New Press, 2001.

_____. Who pays for the kids? gender and the structures of constraint. London and New York, NY: Routledge, 1994.

FORTIN, N. Gender role attitudes and the labour-market outcomes of women across OECD countries. Oxford Review of Economic Policy, Inglaterra, v. 21, n. 3, p. 416-438, 2005.

FRANÇA, E. et al. Associação entre fatores sócio-econômicos e mortalidade infantil por diarréia, pneumonia e desnutrição em região metropolitana do Sudeste do Brasil: um estudo caso-controle. Cadernos de Saúde Pública, Rio de Janeiro, RJ, v. 17, n. 6, p. 1437-1447, 2001.

GOLDIN, C.; KATZ, L. F. The power of the pill: oral contraceptives end women's career and marriage decisions. Journal of Political Economy, Chicago, v. 110, n. 4, p. 730-770, 2002.

_____. Career and family: college women look to the past. In: BLAU, F.; EHRENBERG, R. (Ed.). Gender and family issues in the workplace. New York, NY: Russell Sage Press, 1997.

GORNICK, J. C.; MEYERS, M. K. (Org.). Gender equality: transforming family division of labor. Rio de Janeiro, RJ: Verso, 2009. (The Real Utopias Project).

_____; MEYERS, M. K.; ROSS, K. E. Public policies and the employment of mothers: a cross-national study. Social Science Quarterly, US, v. 79, n. 1, p. 35-54, 1998.

HERR, J. L.; WOLFRAM, C. D. Work environment and OPT-out rates at motherhood across high-education career paths. ILR Review, v. 65, n. 4, p. 928-950, 2012.

HOFFMAN, R.; LEONE, E. T. Participação da mulher no mercado de trabalho e desigualdade da renda domiciliar per capita no Brasil: 1981-2002. Nova Economia, Belo Horizonte, MG, v. 14, n. 2, p. 35-58, 2004.

HÖGBERG, L.; CNATTINGIUS, S. The influence of maternal smoking habits on the risk of subsequent stillbirth: is there a causal relation? BJOG: An International Journal of Obstetrics and Gynecology, v. 114, n. 6, p. 699-704, 2007.

HOTZ, V. J.; McELROY, S. W.; SANDERS, S. G. Teenage childbearing and its life cycle consequences: exploiting a natural experiment. Journal of Human Resources, US, v. 40, n. 3, p. 683-715, 2005.

IACOVOU, M. Fertility and female labour supply. ISER Working Papers n. 19, United Kingdom, 2001.

IBGE. Estatísticas de Gênero: Uma análise dos resultados do censo demográfico 2010. Rio de Janeiro: Ibge, 2014.

IBGE. Síntese de indicadores sociais: uma análise das condições de vida da população brasileira. Informação Demográfica e Socioeconômica 27, Rio de Janeiro, RJ, 2010.

_____. Pesquisa Nacional por Amostra de Domicílios (PNAD): notas metodológicas: pesquisa básica e suplementares de segurança alimentar, vitimização e justiça. Rio de Janeiro, RJ, 2009.

_____. Pesquisa Nacional por Amostra de Domicílios (PNAD). Rio de Janeiro, RJ, 1984.

JACOBSEN, J. P.; PEARCE III, J. W.; ROSEMBLOOM, J. L. The effects of child-bearing on married women's labor supply and earnings: using twin births as a natural experiment. Journal of Human Resources, US, v. 34, n. 3, p. 449-474, 1999.

KAUFMAN, G.; UHLENBERG, P. The influence of parenthood on the work effort of married men and women. Social Forces, US, v. 78, n. 3, p. 931-947, 2000.

KESMODEL, U. et al. Use of alcohol and illicit drugs among pregnant Danish women, 1998. Scandinavian Journal of Public Health, v. 31, n. 1, p. 5-11, 2003.

LAMMERSLEY, L.; DRINKWATER, C. The prevention of psychological morbidity following perinatal death. British Journal of General Practitioners, v. 47, n. 422, p. 583-586, 1997.

LAVINAS, L.; NICOLL, M. Atividade e vulnerabilidade: quais os arranjos familiares em risco? Dados, Rio de Janeiro, RJ, v. 49, n. 1, p. 67-97, 2006.

LÉRIDA, J. L. The impact of exogenous variation in family size on women's labor force participation. In: CONFERENCE OF THE EUROPEAN SOCIETY FOR POPULATION ECONOMICS, 20., 2006, Verona, Itália. Anais… ESPE, 2006.

LUNDBERG, S.; ROSE, E. Parenthood and the earnings of married men and women. Labour Economics, Amsterdam, v. 7, n. 6, p. 689-710, 2000.

LUNDBERG, S.; POLLAK, R. A. Non-cooperative bargaining models of marriage. American Economic Review, US, v. 84, n. 2, p. 132-137, 1994.

MALTA, D. C. et al. Inquéritos nacionais de saúde: experiência acumulada e proposta para o inquérito de saúde brasileiro. Revista Brasileira de Epidemiologia, Rio de Janeiro: Associação Brasileira de Saúde Coletiva - Abrasco, v. 11, supl. 1, p. 159-167, maio 2008. Disponível em: <http://www.scielosp.org/pdf/rbepid/v11s1/16.pdf>. Acesso em: dez. 2014.

Marteleto, L.J. and de Souza, L.R. (2012). The changing impact of family size on adolescents' schooling: Assessing the exogenous variation in fertility using twins in Brazil. Demography 49(4): 1453?1477. doi:10.1007/s13524-012-0118-8.

Marteleto, L. J., & de Souza, L. R. (2013). The implications of family size for adolescents' education and work in Brazil: Gender and birth order differences. Social Forces, 92(1), 275-302. DOI: 10.1093/sf/sot069.

MACINTOSH, M. C. et al. Perinatal mortality and congenital anomalies in babies of women with type 1 or type 2 diabetes in England, Wales, and Northern Ireland: population based study. British Medical Journal, London, v. 333, n. 7560, p. 177, 2006.

MANSER, M.; BROWN, M. Marriage and household decision-making: a bargaining analysis. International Economic Review, US, v. 21, n. 1, p. 31-44, 1980.

MARON, L.; MEULDERS, D. Having a child: a penalty or bonus for mother's and father's employment in Europe? Working Paper Series n. 08-05, Bruxelles (DULBEA), 2008.

MCELROY, M. B.; HORNEY, M. J. Nash-bargained household decisions: toward a generalization of the theory of demand. International Economic Review, US, v. 22, n. 2, p. 333-349, 1981.

MEULDERS, D. et al. Trabalho e maternidade na Europa, condições de trabalho e políticas públicas. Cadernos de Pesquisa, São Paulo, SP, v. 37, n. 132, p. 611-640, 2007.

MOFFITT, R. Remarks on the analysis of casual relationships in population research. Baltimore: Johns Hopkins University, 2003.

Ministério da Saúde. Pesquisa Nacional de Demografia e Saúde da Mulher e da Criança (PNDS) 2006: Relatório Final [Final Report of the National Demographic and Health Survey 2006]. Brasília, Brazil: Ministério da Saúde; 2008.

MONTALI, L.; PATARRA, N. L. Emprego e condições de vida. São Paulo, SP: Fundação SEADE, 1986. (Série São Paulo 80, v. 3).

PAPAPETROU, E. Does female employment affect fertility? Evidence from the United Kingdom. Social Science Journal, Paris, v. 41, n. 2, p. 235-249, 2004.

PARAZZINI, F. et al. Risk factors for spontaneous abortion. International Journal of Epidemiology, Inglaterra, v. 20, n. 1, p. 157-161, 1991.

PAZELLO, E. T. A maternidade afeta o engajamento da mulher no mercado de trabalho?: um estudo utilizando o nascimento de gêmeos como um experimento natural. Estudos Econômicos, São Paulo, SP, v. 36, n. 3, p. 507-538, 2006.

_____; FERNANDES, R. A maternidade e a mulher no mercado de trabalho: diferença de comportamento entre mulheres que têm e mulheres que não têm filhos. In: MEETING OF THE BRAZILIAN ASSOCIATION OF GRADUATE STUDIES IN ECONOMICS, 32., 2004, João Pessoa, PB. Anais… Niteroi, RJ: ANPEC, 2004.

POTTER, J. E. et al. Mapping the timing, pace, and scale of the fertility transition in Brazil. Population and Development Review, New York, NY, v. 36, n. 2, p. 283-307, 2010.

_____; SCHMERTMANN, C. P.; CAVENAGHI, S. M. Fertility and development: evidence from Brazil. Demography, Chicago, v. 39, n. 4, p. 739-761, 2002.

RIOS-NETO, E. L. G. O impacto das crianças sobre a participação feminina na PEA: o caso das mulheres casadas urbanas.In: ENCONTRO NACIONAL DE ESTUDOS POPULACIONAIS, 10., 1996, Caxambu, MG. Anais... Belo Horizonte, MG: ABEP, 1996.

_____; WAJNMAN, S. Participação feminina na população economicamente ativa no Brasil: alternativas para projeções de níveis e padrões. Pesquisa e Planejamento Econômico, Rio de Janeiro, RJ, v. 24, n. 2, p. 203-234, 1994.

ROSENZWEIG, M.; WOLPIN, K. Testing the quantity-quality fertility model: the use of twins as a natural experiment. Econometrica, Chicago, v. 48, n. 1, p. 227-240, 1980a.

_____. Life-cycle labor supply and fertility: causal inference from household models. Journal of Political Economy, Chicago, v. 88, n. 2, p. 328-348, 1980b.

SANTOS, A. L.; MORETTO, A. Desemprego e participação feminina no mercado de trabalho: um estudo exploratório sobre os anos 90. São Paulo, SP: Secretaria do Emprego e Relações de Trabalho do Estado de São Paulo; Fundação Economia de Campinas, 2001. (Final Report: Mercado de trabalho, políticas públicas de emprego e renda, e o futuro do emprego no Estado de São Paulo).

SCHOEPS, D. et al. Fatores de risco para mortalidade neonatal precoce. Revista de Saúde Pública, São Paulo, SP, v. 41, n. 6, p. 1013-1022, 2007.

SCORZAFAVE, L. G. D. S.; MENEZES-FILHO, N. A. Participação feminina no mercado de trabalho brasileiro: evolução e determinantes. Pesquisa e Planejamento Econômico, Rio de Janeiro, RJ, v. 31, n. 3, p. 441-478, 2001.

SOUTO-MAIOR, H. P. Mulher, família e trabalho no nordeste (1970-1987): o que dizem os dados publicados dos Censos Demográficos e PNADS. In: ENCONTRO NACIONAL DE ESTUDOS POPULACIONAIS, 7., 1990, Caxambu, MG. Anais... Belo Horizonte, MG: ABEP, 1990.

VERE, J. P. Dragon children: identifying the causal effect of the first child on female labour supply with the chinese lunar calendar. Oxford Bulletin of Economics and Statistics, Inglaterra, v. 70, n. 3, p. 303-325, 2008.

WAITE, L. J.; HAGGSTROM, G.; KANOUSE, D. E. The effects of parenthood on the career orientation and job characteristics of young adults. Social Forces, US, v. 65, n. 1, p. 43-73, 1986.

WAJNMAN, S.; QUEIROZ, B. L.; LIBERATO, V. O crescimento da atividade feminina nos anos noventa no Brasil. In: ENCONTRO NACIONAL DE ESTUDOS POPULACIONAIS, 11., 1998, Caxambu, MG. Anais... Belo Horizonte, MG: ABEP, 1998.

WANG, J. X.; NORMAN, R. J.; WILCOX, A. J. Incidence of spontaneous abortion among pregnancies produced by assisted reproductive technology. Human Reproduction, Inglaterra, v. 19, n. 2, p. 272-277, 2004.

WISBORG, K. et al. Maternal consumption of coffee during pregnancy and stillbirth and infant death in first year of life: prospective study. British Medical Journal, London, v. 326, n. 7386, p. 420, 2003.

WOLFF, J. R.; NIELSON, P. E.; SCHILLER P. The emotional reaction to a stillbirth. American Journal of Obstetrics & Gynecology, New York, NY, v. 108, n. 1, p. 73-77, 1970.