ISSN 1413-9243

TEXTOS NEPO

81

CAMPINAS, DEZEMBRO DE 2017

THE IMPACT OF FERTILITY ON FEMALE LABOR SUPPLY IN BRAZIL: NATURAL EXPERIMENTS AT DIFFERENT PARITIES

LAETÍCIA R. DE SOUZA
EDUARDO LUIZ GONÇALVES RIOS-NETO
BERNARDO LANZA QUEIROZ

FICHA CATALOGRÁFICA: Adriana Fernandes

Souza, Laetícia R.

The impact of fertility on female labor supply in Brazil: natural experiments at different parities / Laetícia R. de Souza; Eduardo Luiz Gonçalves Rios-Neto; Bernardo Lanza Queiroz. – Campinas, SP: Núcleo de Estudos de População “Elza Berquó” / Unicamp, 2017.

32p.

(The impact of fertility on female labor supply in Brazil: natural experiments at different parities, TEXTOS NEPO 81).

1. Female labor supply. 2. Fertility. 3. Brazil. 4. Rios-Neto, Eduardo Luiz Gonçalves. 5. Queiroz, Bernardo Lanza. 6. Título. 7. Série.

S É R I E T E X T O S N E P O

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Dra. **Maísa Faleiros da Cunha**
Coordenadora Associada

SUMÁRIO

ABSTRACT

The rapid decline in fertility and, at the same time, the increase of female labor force participation in the last few decades motivated studies focusing on the relationship between fertility and labor force decisions. In this context, the goal of this paper is to estimate the effect of children on female labor force participation. Moreover, based on the fact that each child may present a different effect upon the mothers' labor supply decision, we have estimated, separately, the effect of the first, the second and the third (or more) children on female labor force participation. Considering that "having children" and "working" are, in general, simultaneous decisions for women, we have estimated the effects of children based on five alternative variables that acted in the models 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 have found that children reduce female labor force participation and that this effect is stronger for the first and third (or more) children.

Keywords: Female labor supply. Fertility. Brazil.

RESUMO

O rápido declínio da fecundidade e, ao mesmo tempo, o aumento da participação feminina no mercado de trabalho nas últimas décadas motivou pesquisas focadas na relação entre a maternidade e o trabalho feminino. Neste contexto, o objetivo do estudo é estimar o efeito dos filhos sobre a participação feminina no mercado de trabalho. Além disso, com base no fato de que cada filho possa apresentar um efeito diferente sobre a decisão de oferta de trabalho das mães, estimamos, separadamente, o efeito do primeiro, segundo e terceiro (ou mais) filhos sobre a participação feminina na força de trabalho. Considerando que "ter filhos" e "trabalhar" são, em geral, decisões simultâneas para as mulheres, estimamos o efeito dos filhos com base em cinco variáveis alternativas que atuaram nos modelos como *proxies* para a fecundidade: a ocorrência de aborto, de natimorto e de mortalidade infantil (mortalidade neonatal precoce, neonatal e infantil). A hipótese assumida com o uso destas variáveis é que embora a decisão de ter filhos seja endógena, a perda de um filho é um evento não planejado, aleatório. De maneira geral, nossos resultados indicam que ter filhos tende a reduzir a participação das mulheres no mercado de trabalho e que esse efeito é mais forte para a primeira e terceira (ou mais) crianças.

Palavras chave: Oferta de trabalho feminina. Fecundidade. Brasil.

INTRODUCTION

The relation between fertility and labor supply decision of parents, especially married women, is widely discussed in the literature in developed (GOLDIN, 1997; ANGRIST; EVANS, 1998; MARON; MEULDERS, 2008) and developing nations (SOUTO-MAIOR, 1990; CRUCES; GALIANI, 2007). The interest in the fertility impacts on labor supply is motivated by changes in women's socioeconomic and cultural status in recent decades (BECKER, 1991; SCORZAFAVE; MENEZES-FILHO, 2001; BLAU; KAHN, 2007). Also, in several countries, such as Brazil, female labor supply increased at the same time total fertility rate declined rapidly, increasing the debates on the possible causal effects between the two variables (RIOS-NETO, 1996). In less than four decades the total fertility rate dropped from 6 children per woman to about 1.94 children per women (IBGE, 2010), in Brazil. During the same time, female labor force participation rates went from less than 30% to over than 60% (COSTA, 1990; WAJNMAN; QUEIROZ; LIBERATO, 1998; BRUSCHINI; LOMBARDI, 1996; LAVINAS; NICOLL, 2006).

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 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 (AGÜERO; MARKS, 2008; CRISTIA, 2008).

The main contribution of this paper is the use of a new event as a source of exogenous variation in fertility: child mortality. 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 as proxies for fertility in female labor supply models. 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. 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) is the only paper which 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 well-known event, therefore, frequently employed in this sort of estimation).

This paper aims to estimate the impact of motherhood on women's participation in the labor market, based on a new event employed as a natural experiment. 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, but it is also necessary to know when it happened. So, besides proposing a new *proxy* for fertility, 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.

We make extensive use of the National Household Sample Survey (PNAD), carried out in 1984. 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). The special feature of this data set allows us to investigate whether different birth orders have different effects on women's labor supply.

Brazilian women are an interesting case to be studied. Brazil is a developing country that faced a steady and fast decline in fertility from 1970 to 2000. Also, female labor force participation rates began to rise continuously since the 1980's.

We estimate the effects of first, second and third (or more) children on the labor supply of Brazilian women actually using five different events that are related to the early death of a child: occurrence of miscarriage, stillbirth and child mortality (early neonatal, neonatal and infant mortality). The use of miscarriage and stillbirth are working as robustness checks, since these are events that have been used in the literature.

In total, we produce fifteen estimations of fertility effects on female labor force participation (three different birth orders times five natural experiments). The choice of events that represent an early child loss is based on the idea that the death of a child is an unexpected decrease in family size since the women had the intention to have this child (once, not only she got pregnant, but also took the pregnancy to term). The use of these events as a proxy variable for fertility could isolate the causal effect of fertility on women's labor force participation. Others could argue that the occurrence of fetal loss or child mortality is correlated with socioeconomic conditions (FRANÇA et al., 2001; SCHOEPS et al., 2007; ASSIS; MACHADO; RODRIGUES, 2008) and, therefore, that the events chosen as proxy for exogenous fertility would not actually be exogenous. The control for observable characteristics of the mothers and the use of losses at different times of the event might enable an assessment of exogeneity.

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 using five natural

experiments – which works by itself as important robustness checks for the effects of children on women's labor supply. Child mortality is also included as a new natural experiment for fertility, traditionally child mortality is treated as endogenous to fertility, but the control for the timing of the death event entails an important methodological comparison with the other natural experiments. In contexts that mortality decline and the epidemiological transition is on the way this may serve as good instrument variable for the natural experiment.

FERTILITY DECLINE AND RISING FEMALE LABOR SUPPLY IN BRAZIL

Brazil is facing a steady and fast decline in fertility from 1970 to 2000. The average number of children per woman fell from 5.8 to 2.4 (BERQUÓ; CAVENAGHI, 2006). 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).

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).

THE RELATIONSHIP BETWEEN MOTHERHOOD AND FEMALE LABOR FORCE PARTICIPATION: THEORETICAL AND EMPIRICAL BACKGROUND

Theoretical background

Gender specialization is part of Becker's model (BECKER, 1965; 1991) explaining the traditional sexual labor division, namely the determination of time allocation to labor market and household activities. In addition to providing a model for labor division and specialization based on absolute and comparative advantage, this can be regarded also as a model of labor supply and human capital investment among family members. We do not intend to test Becker's theory against alternative hypotheses. Becker's classic model is mentioned to highlight the centrality of fertility and parity in the time allocation of married women both to household task and the labor market. For the purpose of the natural experiment exercises in the empirical analysis it is sufficient to recall two key points. First, the number of children in the household increases the demand for time allocation in household tasks and thus reduces the availability of time to market activities. Second, the fertility decision made by women (number of children) is simultaneously determined with the women's decision to participate in the labor force.

We mention two strands of criticism to Becker's gender specialization model. First, there is an internal criticism comprised by economists questioning the beckerian decision making model. They suggest a departure from the unitary model, with a unique decision making and pooling of economic resources inside the household, towards a model of collective choice where the members of the household may have different interests. In this case, it is possible to model the decision making process as cooperative or even a non-cooperative game (McELROY; HORNEY, 1981; MANSER; BROWN, 1980; LUNDBERG; POLLAK, 1994; CHIAPPORI, 1988; among others). The traditional labor division based on specialization can be undermined under these models, the bargaining power of the husbands and wives in the family will determine their allocation of time in market and household activities. The traditional sexual labor division is explained by aspects affecting the bargaining power within the household such as the ideal of separate spheres between husbands and wives in the family. Second, there is an external critical school with a gender conflict perspective. A related gender perspective views that the male breadwinning context reinforces the dependency on male providers and the specialization of women as care givers. Patriarchal systems reinforce the traditional sexual labor division and they also contribute to the diffusion of the separate spheres ideology, promoting the idea that men are specialized with the provision of family income and women are specialized with the provision of care to family members. In addition to reinforce the traditional labor division, the patriarchal system also encouraged high fertility. Several societies observed a historical increase in female participation in the labor force and a steady fertility decline, factors that tend to empower women and undermine the patriarchal system (FOLBRE, 1994; 2001).

The developed societies are now witnessing a transition from family care of children to the provision of child care through market (private child cared) and the state. A feminist criticism to the welfare state asks for the provision of services that would replace female time in the household aiming the reconciliation of household time allocation and market work. It also promotes a dual care/dual career ideology (GORNICK; MEYERS, 2009). The transformations in the traditional labor division have been stressed by the main specialists in the analysis of the welfare state, the increase in female's education attainment reduced sex differentials of labor productivity in the labor market, with a revolution in women's roles (ESPING-ANDERSEN, 2009).

The brief theoretical review described above is not aimed to test alternative hypotheses empirically. Rather, the review shows that the relationship between female labor force participation is central to both the traditional sexual labor division and the alternative theories. All theories assume explicitly or informally that these two dimensions are simultaneously determined by a decision making model, price fluctuations, or historical trends in parameters such as women's education. Therefore, the empirical component will try to estimate the exogenous component of fertility in the determination of female employment.

The endogeneity problem

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.

Empirical background

The causal simultaneity between motherhood and women's work and, therefore, the recognition that fertility is a matter of choice (endogenous), has stimulated the search for instrumental/*proxy* variables that provide an unplanned (exogenous) variation in fertility.

These variables work as quasi-experiments in the sense that although we cannot randomly distribute women in different groups according to fertility levels, we can find variables that affect fertility in an exogenous way, constituting themselves as *proxies* for fertility in female labor supply models. In the literature that examines the causal relationship between children and female labor force participation, the few available variables are mostly natural experiments. In practical terms, the use of natural experiments is a strategy of estimating a causal effect using a random variable (often related to individual biological characteristics) as an explanatory variable (MOFFITT, 2003).

In order to estimate the effect of children on female labor force participation, it is important to mention four natural experiments that have been used as sources of exogenous variation in family size: birth of twins (ANGRIST; EVANS, 1998; BRONNARS; GROGGER, 1994; CÁCERES-DELPIANO, 2008; JACOBSEN; PEARCE III; ROSENBLOOM, 1999; PAZELLO, 2006), occurrence of stillbirth (PAZELLO; FERNANDES, 2004), occurrence of miscarriage (HOTZ; McELROY; SANDERS, 2005), parents' preference for children of both sexes (ANGRIST; EVANS, 1998; CAMPÊLO; SILVA, 2005; CRUCES; GALIANI, 2007; IACOVOU, 2001) and female infertility (AGÜERO; MARKS, 2008; CRISTIA, 2008).

Although in most cases, the natural experiment approach leads to smaller effects of children on women's participation in the labor market compared to the ones estimated by conventional models (as, for example, the OLS models), in general, they confirm the well-established negative relationship between motherhood and women's work (AGÜERO; MARKS, 2008) observed both in developed and developing countries.

Angrist and Evans (1998) showed that an unplanned child reduced American women's labor force participation in about 10 percentage points in 1980 and 1990. Gornick; Meyers y Ross (1998) found negative effects of children on women's labor supply in the late 1980 for six other developed countries besides the United States, Australia, Canada, Germany, Netherlands, Norway and the United Kingdom. In the latter (United Kingdom), where motherhood affects more negatively women's participation in the labor market, the presence of children 0 to 2 and 3 to 6 years old decreased the likelihood of women's employment by 45 and 31 percentage points, respectively.

In the case of developing countries, Cruces and Galiani (2007) found that having a child reduced the likelihood of women being in the labor market by about 7 percentage points in Argentina in 1991 and by about 6 percentage points in Mexico in 2000. Pazello and Fernandes (2004) and Pazello (2006), in Brazil, using data from the 1990s, found a negative impact of motherhood on female participation of about 10 percentage points.

Cáceres-Delpiano (2008) estimated the effect of having a non-planned child on women's labor force participation (among other work-related variables) in a sample of 42 developing countries. He found a reduction of about 6 percentage points considering women with one or more children and about 10 percentage points for women with four or more children. The birth order approach is a common feature in studies of the impact of fertility on child investment, but not in studies of the impact of fertility on women's decisions. This paper contributes to fill this gap, considering not only the effects of the presence of children on female work decisions but also taking into account the birth order children effects. Parents' familiar resources allocation is directly related to parents' time spent on the labor market and/or at home. In this context, mothers can react differently to having one, two or three or more children. 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.

THE EFFECTS OF FIRST, SECOND AND THIRD (OR MORE) CHILD: ESTIMATION STRATEGY

It is not trivial to find a *proxy* for fertility to be included in models to estimate the effect of each child in the three parity progressions we are interested – progression from 0 to 1 child (first child effect), 1 to 2 children (second child) and 2 to 3 or more children (third or more child). While the birth of twins in the first pregnancy only allow us estimating the effect of the second child on female labor in comparison with the first child, on the other hand, the preference of parents for children of both sexes is an event that allows us only to estimate the effect of the third (or more) child in comparison to women having two children.

The occurrence of stillbirth represents another proxy indicating the absence of a child intentionally conceived by a mother. Thus, it is possible to assume that both groups of women – the ones who had a child and those who had a stillbirth – had in common the desire to have a child. In order to obtain the first child effect we compare childless women who had experienced stillbirth(s) to women with one child who have never experienced one. We follow a similar procedure to estimate the second (women who have experienced stillbirths after the first parity in comparison with women at the second parity) and third or more children (women who have experienced stillbirths after the second parity in comparison with women at third or more parity) effects.

It is important to stress that such exercise is only possible if there is some information about the timing that stillbirth occurred. This is so because the effect of having a stillbirth on the probability of a woman entering/being in the labor market tends to reduce over time (PAZELLO; FERNANDES, 2004). According to Wolff; Nielson and Schiller (1970) and Lammersley and Drinkwater (1997), after losing a child a woman can stop or intensify work or even try to have another child in an attempt to forget what happened. Most household surveys in developing countries ask only the number of stillbirths that a woman has had, without controlling for birth order. Thus, in addition to the timing of stillbirths, the control for birth order is crucial.

The event of stillbirth is considered a good natural experiment to the extent that it is hard to accept the idea that a voluntary abortion (endogenous) would generate a fetal loss after 7 months of gestation. It is correct to assume that stillbirth is affected by socioeconomic factors, but this is different from the endogeneity assumption, furthermore, this type of observed selectivity can be controlled with the use of observational variables.

Although stillbirth is our benchmark variable, we also estimated four other events somewhat related to a child premature loss (pre or post natal) as alternative fertility *proxies* to facilitate a robustness assessment of our estimations. These variables are abortion (miscarriage: fetal loss before 7 months of gestation), the death of a child before completing 7 days of life (early neonatal mortality), or before completing 28 days of life (neonatal mortality), or before 365 days of life (infant mortality). When using the occurrence of miscarriage as *proxy* for fertility, we need the same information required for the use of stillbirth, but this variable is sometimes criticized as confounding with induced abortion (endogenous). In the case of variables associated with post natal loss, related to the death of a child born alive, we need to know the child's age at death (a rare information in Brazilian data sources). The availability of proper information enables us to create *proxies* for fertility that can be employed in samples of women in all parities.

We expect a variation in the children effect on women's participation in the labor market with respect to their birth order. There is evidence that the first child is the one with the strongest effect on mothers' work decisions (VERE, 2008) – for being a completely new experience. In the case of a third child, it can be considered a threshold between small and large families (CAMPÊLO; SILVA, 2005), so that one would expect that from that parity on, motherhood becomes an increasing obstacle to the women entry/permanence in the labor market. Cáceres-Delpiano (2008) supports this logic. He found negative effects of the first and third (or more) children on female employment probability, while the second child increases this likelihood (a result that can be compatible with economies of scale in the care of two children).

DATA AND METHODS

Data

Our data set is the 1984 PNAD (National Household Sample Survey). PNAD 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 a 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 last two years, so that we have information on these events in a recent period for women in different parities.

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 on female labor supply.

Focusing on the occurrence of stillbirth as a *proxy* for fertility, the specification of the model follows the reasoning below. 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 order to accurately estimate the effect of children on female labor force participation, we restrict the sample 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).

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)[1].

[1] Descriptive analysis of women whose children died in the first 7 and 28 days of life 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.

Methods

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 in the household).

In all models we assume that both groups of women (control and treatment) have the same preferences in relation to having children (once they became pregnant). We control for several variables that might be related to higher chance of observing a child death in the household, mainly related to income (PAZELLO; FERNANDES 2004; ELLER; BRANCH; BYRNE, 2006), 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.

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 last 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 (upon request)[2]. 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

[2] We did not estimate first child effect due to an even smaller control group sample.

family income[3]. 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.

RESULTS

Estimated Effects

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 negative, 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.

Considering only significant effects (p-values less than .10) in the models using *proxies* for fertility, we observe that the first child effects on female labor force participation (Table 5, column 1) range from –.1079 (in the *proxy* for fertility death of a child before one year of age) to –.1468 (miscarriage 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 –.0518 (child death before 28 days of life) and –.0705 (miscarriage). Finally, when considering the third child effects, it reduces mothers' labor force participation ranging from –.0770 (child death before one year of age) to –.1045 (miscarriage).

[3] There are also some behaviors – such as coffee consumption, alcohol and cigarettes (KESMODEL et al., 2003; HÖGBERG; CNATTINGIUS, 2007; WISBORG et al., 2003) – and diseases – such as hypertension, diabetes and obesity (ALLEN et al., 2004; ELLER; BRANCH; BYRNE, 2006; MACINTOSH, 2006) – that increase especially fetal death probability. However, as this information is not available in 1984 PNAD, this is a limitation of this study.

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

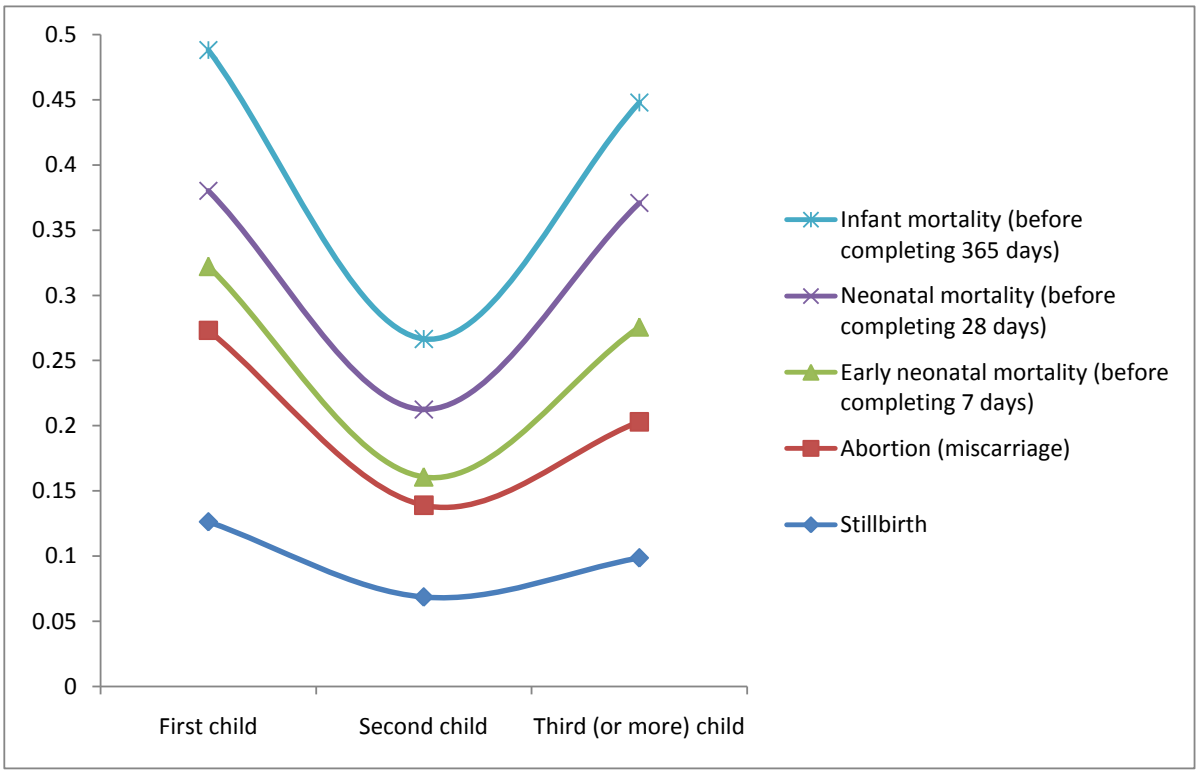
Fetal/child loss used as proxy for fertility	First child	Second child	Third (or more) child
Stillbirth	-0.1263	-0.0685	-0.0985
	(0.0300)	(0.1360)	(0.0700)
	[-0.0121 -0.2406]	[0.0215 -0.1585]	[0.0081 -0.2051]
[N]	5,852	5,058	6,397
Abortion (miscarriage)	-0.1468	-0.0705	-0.1045
	(0.0000)	(0.0000)	(0.0000)
	[-0.0852 -0.2084]	[-0.0334 -0.1077]	[-0.0667 -0.1422]
[N]	6,223	5,514	6,821
Child dead before completing 7 days	-0.0490	-0.0216	-0.0727
	(0.4710)	(0.4860)	(0.0160)
	[0.0843 -0.1822]	[0.0392 -0.0825]	[-0.0136 -0.1317]
[N]	5,790	5,048	6,474
Child dead before completing 28 days	-0.0580	-0.0518	-0.0951
	(0.2100)	(0.0900)	(0.0070)
	[0.0326 -0.1487]	[0.0080 -0.1117]	[-0.0265 -0.1638]
[N]	5,816	5,125	6,554
Child dead before completing 365 days	-0.1079	-0.0541	-0.0770
	(0.0100)	(0.0050)	(0.0040)
	[-0.0260 -0.1897]	[-0.0164 -0.0919]	[-0.0249 -0.1291]
[N]	5,883	5,344	6,860
Naive Model (logistic model using endogenous indicator variable of the number of children in each parity)	-0.1031	-0.0375	-0.2791
	(0.0000)	(0.0000)	(0.0030)
	[-0.1349 -0.0714]	[-0.0579 -0.0170]	[-0.0464 -0.0094]
[N]	9,755	14,447	16,757

Source: IBGE (PNAD, 1984).

Notes: P-value in parenthesis. Coefficient interval in brackets.

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– .1468, while the second child effect fell reaching –.0705 and the third (or more) child effect increased again to –.1045 (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 could 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).

CONCLUSIONS AND DISCUSSION

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 participation in the labor force, we adopted five alternative variables that acted in the models as fertility *proxies*: miscarriage, stillbirth and child mortality (early neonatal, neonatal and infant mortality). From our knowledge, the last three proxies have not yet been used in the literature. Furthermore, they were experiments available in the same data set. 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 find 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 being in the EAP 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).

The discussion about the relationship between children and female work 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 fertility and women's market work.

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