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Article

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Teenage motherhood, education, and labor market outcomes of the mother: Evidence from Brazilian data

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Abstract

This paper studies the effects of teenage motherhood on later educational and labor market achievement of the mothers. We construct a pseudo panel from the Brazilian Household Surveys (the 1992–2004 PNADs) and from the Health Ministry data (DATASUS 1981–1992) by state of birth and cohort. We find that the effects of teenage pregnancy are much stronger for high school completion and labor market participation than for schooling or wages. A reduction in teenage pregnancy by one standard deviation explains (i) 9.2% of the increase in high school completion and (ii) 5.4% of the increase in women's labor market participation, as observed over 10 cohort years. Lifecycle results show that the gains in terms of high school education are greater for younger than for older women, suggesting that women who give birth as teenagers tend to catch up with high school education while young but not as they become older. The results on labor market participation show persistent teenage motherhood effects.

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JEL classification: O10; O54; J13; J22

Keywords: Teenage fertility; Education achievement; Female labor supply; Wages; Economic development

Resumo

Este artigo analisa os efeitos da maternidade na adolescência sobre os níveis de escolaridade e resultados no mercado de trabalho dessas mães. Foi construído um pseudo painel a partir das Pesquisas Nacionais por Amostra de Domicílios (PNADs 1992–2004) e dos dados do Ministério da Saúde (DATASUS 1981–1992) por Estado de nascimento e coorte. Os resultados indicam que os efeitos da gravidez precoce são muito mais fortes para a conclusão do ensino médio e participação no mercado de trabalho do que para anos de estudo ou salários. Um redução na gravidez na adolescência de um desvio-padrão explica (i) 9,2% do aumento na conclusão do ensino médio e (ii) 5,4% do aumento na participação feminina no mercado de trabalho, como observado ao longo de 10 anos de coortes. Resultados da análise do ciclo de vida mostram que os ganhos em termos de conclusão do ensino médio são maiores para adolescentes mais jovens do que para as mais velhas, o que sugere que as mulheres que são mães na adolescência tendem a concluir o ensino médio, quando são mais jovens, mas não quando são mais

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velhas. Os resultados sobre a participação no mercado de trabalho mostram que os efeitos da maternidade na adolescência são persistentes.

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Palavras-chave: Fertilidade na adolescência; Resultados educacionais; Oferta de trabalho feminina; Salários; Desenvolvimento Econômico

1. Introduction

While fertility in Brazil has declined sharply in the past decades, teenage fertility is still considerably high. Data from the World Health Organization¹ shows that in 2008 about 16 million girls aged 15–19 gave birth; this roughly corresponds to 11% of all births worldwide. Half of the births by teenage mothers occurred in the following seven countries: Bangladesh, Brazil, the Democratic Republic of Congo, Ethiopia, India, Nigeria, and the United States.

According to the World Bank² there were 75 births per 1000 women aged 15–19 in Brazil in 2008. This figure is higher than those of similar or even less developed countries in the region, such as Argentina (56), Paraguay (71), and Peru (54). For comparison this indicator is much higher in African countries such as Niger (209) and Angola (188). Among developed countries, the United States (38) and the United Kingdom (26) have the highest results. Data from the Demographic Health Survey (DHS, 1986 and 1996) and the National Survey on Demography and Health of Women and Children (PNDS, 2006) show that Brazil has experienced increases in teenage pregnancy, as measured by the percentage of teenagers who became pregnant (13.1% in 1986, 17.9% in 1996 and 23.1% in 2006). Azevedo et al. (2012) mentions another study that uses DHS data for 59 countries from 1990 to 2002. Their results suggest that the increase in Brazilian teenage pregnancy is largely due to the increase in the proportion of sexually active teenagers.

Early evidence on the consequences of early motherhood has found a strong association between childbearing at young ages and the mother's subsequent economic and social indicators. Young mothers are less likely to complete high school, less likely to participate in the labor force, more likely to have lower earnings, and at higher risk of welfare dependency than women who did not bear children as teenagers.³

These studies have attempted to disentangle the effect of teenage childbearing per se and the effect driven by the previous socioeconomic status of the teenage mothers. They sought to eliminate the bias that arises from endogenous fertility by using methods such as family fixed effects (siblings)⁴ and instrumental variables (twins, sibling sex composition, miscarriages, sisters' fertility, and local access to reproductive health services).⁵

Geronimus and Korenman (1992) use family fixed-effect and a sample of sisters from various data sources in the US. Their results suggest that the effects of teen childbearing on measures of future socioeconomic well-being are lower or insignificant compared to those obtained by previous cross-section studies that do not account for unobserved family background. Goodman et al. (2004) found zero effects on labor supply, experience and earnings in the UK, using miscarriages as instrument. On the other hand, positive impacts were obtained by Hotz et al. (2005) using the same instrument and US data. Conversely, negative effects on completed years of schooling and future family income were found by Ribar (1999) using both family fixed effects and family fixed effects with sister's fertility as instrument, with the last being even stronger in magnitude than the OLS estimate. Fletcher and Wolfe (2009) use a sample from the National Longitudinal Study of Adolescent Health (Add Health) of women who became pregnant as teens. As the comparison group they consider those women who had a miscarriage, since these probably did not voluntarily terminate the pregnancy. The study also includes community fixed effects; it finds that teenage childbearing leads to large reductions in wages and income as well as to a modest reduction in the probability of completing high school.

Early childbearing is often associated with (i) financial resources (family income), (ii) the mother's time cost of childbearing and how it varies over the life cycle (this includes cross-price effects of education or direct child care costs), (iii) birth control, and (iv) infant mortality (Schultz, 1997).

¹ See: http://www.who.int/maternal_child_adolescent/documents/mpsnnotes_2_lr.pdf.

² See: <http://data.worldbank.org/indicator/SP.ADO.TFRT/countries?display=default>.

³ Among the studies about overall fertility and future education and labor market achievement in Brazil, see for example Pazello and Fernandes (2005) and Rios-Neto and Wajnman (1996).

⁴ See, for example, Geronimus and Korenman (1992), Bronars and Grogger (1994), Ribar (1999).

⁵ See, for example, Hotz et al. (1997), Goodman et al. (2004), Ribar (1994, 1999) and Klepinger et al. (1999).

More recently, the literature has also considered the role that expectations about future economic achievement play in the decision of current teenagers to have children. They assume that these expectations are formed in the environment in which teenagers were raised. For example, if they lived in places with high poverty and inequality rates, then they are likely to have low expectations about future success in the labor market, which raises the propensity to early childbearing.

Kearney and Levine (2012) present a detailed survey of teenage childbearing in the US. The main conclusion is that both actual and perceived lack of economic opportunities influence early motherhood. After these factors have been taken into account, teenage motherhood does not appear to cause additional difficulties later in their lives. The authors discuss their main hypothesis that the combination of being poor and living in an unequal and less mobile society contributes to a low expectation of success, thus leading to choices that favour short-term satisfaction such as the decision to have a baby when young. They conclude that teenagers in very unequal states are 5 percentage points more likely to give birth than teenagers in the least unequal states. The authors included other variables, such as poverty concentration and absolute levels of deprivation; none of these additional factors altered the estimated relationship between inequality and teen fertility among women with low socioeconomic status. In another study, Kearney and Levine (2014) analyzed both theoretically and empirically the role of income inequality in teenage nonmarital childbearing among poor women. They also found a positive relationship.

Berquó et al. (2012) reached similar conclusions using Brazilian data, although the authors also claim that lack of knowledge about contraception and contraceptive failure are important factors associated with teenage pregnancy, independently of educational and economic status. They argue that pregnancy is often the result of an absence of a life plan: access to better education, better living conditions, and greater enhance options during youth. In absence of good options for the future, pregnancy is a contingent decision made by the teenager today.

The arguments presented by Kearney and Levine (2012, 2014) and Berquó et al. (2012) strengthen the role of low future expectations of teenagers as a trigger mechanism for actions that result in teenage pregnancy.

Another factor that may influence early fertility is birth control. The increased availability of contraception after the 60s, with the introduction of innovative methods such as pills, IUDs, and improvement in sterilization, may have reduced the costs as well as improved the efficiency of contraceptive methods (Schultz, 1997). Hotz and Miller (1988) found a significant variation in the impact of the cost of children on female labor supply when considering different contraceptive behaviors.

According to Caetano (2004), the starting point of official family planning policies in Brazil was 1985, when the government implemented the Programa de Assistência Integral a Saude da Mulher (PAISM). This program stimulated the public debate on women's health, including fertility. It was also at this point that the Demographic Health Survey (DHS) in Brazil began; it has been carried out in 1986, 1996, and 2006.⁶

Table 1 shows data on the contraception trends both among all teenagers (15–19) and among all women of reproductive age (15–44 in 1986, and 15–49 in 1996 and 2006), by region. For the country as a whole we observe an increase in the prevalence rate from 43.7 to 81.5% among all women and from 7.7 to 75.8% for teenagers. This rate varied across regions, with the Northeast having the lowest rate in 1986 (34.8%), but the highest increase (48.2 percentage points) over the 1986–2006 period. By contrast, the South presented the highest prevalence in 1986 (50.3%) but a small variation over the same period (31.9 percentage points).⁷ Among all women using any method of contraception, sterilization was the most practiced method in 1986, followed by the pill and condoms, with little relevance. The trends show increased use of condoms (from 2.4% in 1986 to 21.5% in 2006) as well as increased use of female sterilization from 1986 (39.4%) to 1996 (49.4%) followed by a strong decrease in 2006 (32.2%). The use of pills decreased from 38.9% in 1986 to 29% in 2006. The trend in contraceptive methods used by teenagers was completely different: ster-

⁶ In 2006 the DHS was replaced by the National Survey on Demography and Health of Women and Children (PNDS). Following a design similar to that of the Brazilian Household Surveys (PNAD), the 1986 and the 1996 DHSs and the 2006 PNDS rely on random samples of women from the 1980, 1991, and 2000 Censuses, respectively. The sample selection process, the strata, and the type of sampling defined in PNDS 2006 differed in some aspects from previous years. For example, the 10 strata of the PNDS 2006 were constructed by combining each of the major regions (North, Northeast, Southeast, South and Midwest) with the residential location type (urban or rural). The 1996 DHS strata consist of seven regions (Rio de Janeiro, São Paulo, South, Central-Eastern (Minas Gerais and Espírito Santo), Northeast, North (only urban areas) and Midwest, also combined with the residential location type (urban or rural).

⁷ These indicators varied widely across regions, suggesting that contraception access and family planning programs were not uniformly implemented in the country.

Table 1
Contraception prevalence in Brazil, 1986, 1996 and 2006.

Region	All teenagers (15–19)											
	Using any method			Female sterilization			Pill			Condom		
	1986	1996	2006	1986	1996	2006	1986	1996	2006	1986	1996	2006
North	7.4	13.8	70.0	0.0	0.0	0.0	74.6	23.0	21.8	0.0	33.2	69.5
Northeast	6.9	10.8	80.7	0.0	2.4	0.0	76.7	48.8	43.4	0.0	21.3	44.4
Southeast	7.3	16.3	73.2	4.0	0.0	0.1	77.9	63.4	34.6	5.9	22.1	50.4
South	10.2	19.1	78.2	0.0	0.0	0.0	88.9	65.2	53.6	0.0	25.0	39.1
Center west*	–	14.4	74.0	–	0.0	0.5	–	80.9	38.3	–	15.1	52.6
Brazil	7.7	14.7	75.8	1.7	0.5	0.1	80.0	59.4	39.5	2.5	22.6	48.6
All women**												
North	44.6	50.4	79.4	60.2	64.9	47.6	26.1	15.0	14.9	1.0	8.0	25.3
Northeast	34.8	46.4	83.0	46.3	62.7	44.0	31.9	18.4	24.7	0.8	6.1	18.5
Southeast	46.0	57.6	80.3	40.2	44.5	25.3	35.9	29.6	28.6	3.5	9.3	24.0
South	50.3	61.9	82.2	24.3	33.1	20.8	56.4	44.2	44.6	2.1	8.0	18.6
Center west*	–	64.0	84.0	–	66.2	43.3	–	21.9	26.5	–	4.3	19.5
Brazil	43.7	55.4	81.5	39.4	49.4	32.2	38.9	28.5	29.0	2.4	7.8	21.5

Source: Microdata from DHS (1986 and 1996) and PNDS (2006).

* In DHS 1986, data from Center West states were included in the North Region.

** In DHS 1986 data includes women aged 15–44. For 1996 and 2006, data includes women aged 15–49 years.

ilization was virtually nonexistent in this group during the whole period, while the pill was the most used method in 1986 (80% of prevalence), but has since declined (to 39.5% in 2006). On the other hand, the prevalence of condoms increased dramatically, from 2.5% in 1986 to 48.6% in 2006. It is interesting to note the contrast: while the prevalence of contraception rates grew enormously in the period, the percentage of teenagers (15–19 years) who were or have ever been pregnant increased from 13.1% in 1986 to 17.9% in 1996, and then to 23.1% in 2006.⁸

Analysing the 2006 PNDS data, Berquó et al. (2012) argue that part of this apparent paradox is related to two factors. Firstly, there is method failure or lack of knowledge on contraceptive use: among all women aged 25 or less, 71% who were familiar with a method reported that its failure or lack of knowledge on how to use it was a reason for pregnancy. The second factor is a desire to be a parent: 52.6% of women under 25 mentioned the wish to become a mother as a reason for early pregnancy. They conclude that the wish to become a parent associated with low education and economic status is the best explanation of teenage pregnancy.

Given that contraception resources varied across regions and states, the costs of contraception are likely to have changed accordingly. In this paper, due to lack of data on price or public provision of contraception, we use data on abortion. Abortion is in effect a form of birth control insofar as in the absence of access to or effectiveness of various contraception methods abortion is often practiced in cases of unwanted pregnancies. Ministry of Health records obtained from hospitals and death certificates are the source of teenagers abortion estimates in Brazil and of the population of teenagers (15–19 years). The rates of abortion correspond to child deaths per 1000 teenagers. In order to match this data with available data on contraception, consider for the moment only the years 1986, 1996, and 2006. Table 2 shows that in Brazil the abortion rates per 1000 teenagers was 0.82 in 1986, 0.73 in 1996, and 0.55 in 2006. Additionally, during this period there is a sharp drop in rates in all regions, except the Northeast.

Simple correlation coefficients between the variation in contraception prevalence and in abortion rates over the 1986–1996, 1996–2006 and 1986–2006 periods show that these are strongly and inversely related (–0.98). Abortion rates therefore potentially reflect the lack of access or the high price of contraception in the country and hence may have an impact on the timing of fertility.

⁸ Own calculations from DHS (1986 and 1996) and PNDS (2006).

Table 2
Abortion rates 1986, 1996 and 2006 – teenagers (15–19 years).

Region	1986	1996	2006
North	1.59	1.03	0.91
Northeast	0.84	0.62	0.69
Southeast	0.77	0.79	0.40
South	0.62	0.68	0.41
Center West	0.79	0.61	0.52
Brazil	0.82	0.73	0.55

Source: Number of abortions in women aged 15–19 from Health Ministry data (DATASUS), 1986 and 1996. Population of women aged 15–19 from DATASUS.

There is a strong association between fertility and infant mortality in developing countries. In particular, pregnancy during adolescence is linked to higher infant mortality.⁹ On the one hand, recent declines in infant mortality could be interpreted as an exogenous improvement of public infrastructure dedicated to reproductive health care. In this case, lower infant mortality rates among teenage women would cause an exogenous shift in number of births to teenagers. On the other hand, the household production theory views infant mortality as a consequence of the preferences of parents or women regarding the number of children (or their longevity). An exogenous reduction in infant mortality reduces both the cost of producing a survivor and the number of births needed to have a survivor.¹⁰ In the empirical analysis, to the extent that age-specific child survival and infant death are endogenously related, we consider infant mortality among adult women to be related to early motherhood. Moreover, because infant mortality is an important indicator of development, it should also be related to women's future education and labor supply. This is thus not excluded from the outcome regressions.

In this paper we use a sample of women aged 23–30 from the Brazilian Household Surveys, the 1992–2004 PNADs. Our goal is to determine the causal effects of teenage fertility on their later educational achievement, labor market participation, and earnings. The PNAD is a time series of independent cross-sections which surveys individuals in all of the country's 26 states. The basic questionnaire contains information regarding education, labor market participation, and demographic variables. Starting from 1992 a question about which state the person was born in was included. In the absence of historical data at the individual level, we use information on the state of birth in order to keep track of past social and economic conditions of individuals in the state where they were born.

To take advantage of this extra source of information available from 1992, we constructed a panel with averages by state of birth (26 states) and cohorts (1961–1981). The idea here is to obtain a two-dimensional panel by grouping individual data by state and by birth cohort. We then have fixed effects in these two dimensions, and can control for interactions between them by using data from each state and birth cohort to account for endogenous variations in teenage fertility.¹¹

We specify teenage motherhood, later labor market participation, and educational decisions in their reduced forms. The empirical equations are estimated using data on education and labor market outcomes of teenagers calculated from the 1992–2004 PNADs as well data on several explanatory variables found in the 1981–1992 PNADs, in IBGE (National Statistics) records, and in IPEA (Economic Research Institute) records for the same period. Abortion and infant mortality rates were gathered from external data using DATASUS (Health Ministry Records) for the 1981–1992 period.

Two additional variables were included: the poverty rate and income inequality, as measured by the 90/10 ratio. The purpose here is to test the hypothesis discussed by [Kearney and Levine \(2012, 2014\)](#) and [Berquó et al. \(2012\)](#) that the combination of being poor and living in a more unequal society leads to choices that favour short-term satisfaction – in this case, the decision to become a mother as a teenager.

⁹ See [Restrepo-Méndez et al. \(2011\)](#) for Brazilian results confirming this hypothesis.

¹⁰ Reductions in child mortality increase the returns to investment in children and thus increase the returns to time spent at home [[Soares and Falcão \(2008\)](#)].

¹¹ For a discussion on the use of pseudo panels, see [Deaton \(1985\)](#).

This paper is particularly concerned with the consequences of teenage childbearing on women's education and labor market status in Brazil. We estimate separate regressions of the fraction of high school graduates, completed years of schooling, labor force participation, and log-hourly-wages on teenage pregnancy at the state of birth and cohort level. In all estimations we use fixed effects for state of birth and cohort, as well as a rich set of control variables characterizing the demographic and economic conditions experienced by women in their states and cohorts of birth.

Our main findings show statistically significant and inverse relationships between teenage pregnancy and all outcome variables. This is consistent with the results obtained in many previous studies.¹² We show that a decrease in teenage fertility by one standard deviation increases high school completion by 0.8 percentage points, meaning that 9.2% of the increase in high school completion observed in the 1966–1975 cohort can be explained by the decrease in teenage pregnancy. On the other hand, the number of years of schooling would increase by just 0.08 years, which explains less than 1% of the growth in years of schooling between cohorts 1966 and 1975. We also found that a one standard deviation decline in teenage pregnancy causes a 0.3 percentage point increase in labor market participation. This figure is small but corresponds to 5.4% of the increase in participation from cohort 1966 to cohort 1975. We found small effects for wages of participating women: a one standard deviation lower teenage fertility implies a 1.1% hourly-wage raise, which is less than 1% of the variation observed between cohorts 1966 and cohorts 1975.

Conducting the same analysis for women at different ages (23–26 and 27–30 years), we find statistically significant effects which vary across age groups. Reducing teenage pregnancy by one standard deviation in each group explains 15.1% and 4.9% of the increase in high school graduation observed from cohort 1966 and 1975, in ages 23–26 and 27–30 respectively. The effects on years of schooling are smaller: respectively 0.12 and 0.07% of the changes in schooling. In terms of labor market outcomes, we find that lower teenage fertility improves participation, explaining 4.1 and 4.7% of the change in each age group respectively. This shows that effects improve over the life cycle, albeit only slightly. As occurs in the regression over all women, the effects of teenage motherhood on hourly wages are small, 0.04 and 0.05% of the change in hourly wages between cohorts 1966 and 1975. In sum, we find stronger impacts on high school graduation and labor market participation. While a drop in teenage fertility improves high school completion considerably for younger women and less so for older ones, its effects tend to persist in terms of labor market participation.

The remainder of this paper is organized as follows. Section 2 describes the econometric model. Section 3 explains the sources and samples. Section 4 reports and comments on the estimation results. Section 5 discusses the lifetime impact of teenage motherhood. Section 6 concludes.

2. Empirical model

The previous section explained the mechanisms through which teenage motherhood affects the mother's later outcomes. Teenage motherhood decision is clearly endogenously related to other economic decisions of the mother, such as to go to attend school or work; this section outlines our identification strategy.

Assume that for each teenager i the impact of teenage motherhood (TM) on her education and labor market outcomes (Y) is obtained from the linear equation:

$$Y_{isc} = \alpha TM_{isc} + X_{isc}\delta_1 + I_{sc}\gamma_1 + \varepsilon_{isc} \quad (1)$$

where Y_{isc} is the outcome for a teenage woman i who was born in state s and belongs to a particular age cohort c ; TM_{isc} is an indicator for early childbearing (1 if she had a child before the age of 17; 0 otherwise); X_{isc} is a set of controls including past socioeconomic status, labor market conditions (wage of unskilled women, child labor), and development indicators (infant mortality, poverty and inequality); I_{sc} denotes public investment in education and health; $E(\varepsilon_{isc} | TM_{isc}, X_{isc}, I_{sc}) = \mu_s + \mu_c + \mu_i + E(\xi_{isc} | TM_{isc}, X_{isc}, I_{sc})$ is the mean error term assumed as an additive function of state of birth, cohort and individual specific factors with a possibly not zero component $E(\xi_{isc} | TM_{isc}, X_{isc}, I_{sc})$; and α is the parameter of interest.

We allow for fixed effects of cohorts and state of birth to affect the outcomes through μ_s and μ_c . The indicator TM_{isc} , however, can still be correlated with the woman's unobserved heterogeneity μ_i . To account for this, we construct a pseudo panel with observed means by state of birth and cohort using the PNAD household survey.

¹² Bronars and Grogger (1994), Ribar (1999), Hotz et al. (1997, 2005), Goodman et al. (2004), among a number of papers.

The PNAD is a time series of independent cross-sections; most control variables obtained from external data which can be found at the state level but not at the individual level. We use the PNAD to build a pseudo panel of states of birth and cohorts.¹³ This methodology closely follows the approach used by Meghir and Whitehouse (1996). The following equation was estimated considering cohort and state of birth:

$$\bar{Y}_{sc} = \alpha \bar{TM}_{sc} + \bar{X}_{sc} \delta_1 + \bar{I}_{sc} \gamma_1 + \mu_s + \mu_c + \xi_{sc} \quad (2)$$

This procedure rules out the individual specific component from the empirical equation, while cohort and state of birth heterogeneity are accounted for using fixed effects.

We estimate Eq. (2) using weights determined by the number N_{sc} of observations (individuals) per cell. We use White's consistent standard errors in order to deal with the problem of heteroskedasticity in grouped data.¹⁴

3. Data sources and sample

The main source of data is the Brazilian Household Survey, the 1981–2004 PNADs. The data are a series of independent cross-sections of individuals. Each year, the national sample comprises around 300,000 individuals who are interviewed across all of the country's 26 states, covering both urban and rural areas.¹⁵ This survey encompasses demographic and current socioeconomic information including data on education and labor market status for individuals aged 10 or more. From 1992 onwards, the PNAD has included which state the individual was born in.

Due to the lack of past information at the individual level, we use the state of birth to link individuals with some past characteristics of the state where they were born and to thereby construct a panel of average individual characteristics by date and state of birth.

We use outcome variables and teenage fertility from the recent 1992–2004 PNADs in order to build the panel. For some control variables (namely child labor, percentage of whites, wage of the unskilled women, and number of live births), we use past data obtained from the 1981–1992 PNADs and average the data by state and year. Other controls, also by state and year (public spending in primary and secondary education and in health from 1985–1997, GDP per capita 1985–1997, inflation and currency changes from 1992 to 2004), were gathered from IBGE and IPEA (National Statistics and Economic Research Institute).

We match these data as follows. For women aged 23–30 who were born in state X and year 1992, we use the information on control variables from the PNAD in state X and year 1981, that is 11 years earlier, when these women were in their teenage years 12–19. Similarly, for women aged 23–30 and born in state X and year 1993, we use the PNAD controls in state X at a year later, 1982. We follow this process until year 2004, which is matched with past information using year 1992.¹⁶

Data on GDP per capita and public spending were gathered from the 1985–1997 period because before 1985 data was unavailable for some states. For example, we match outcomes and the main explanatory variables by state of birth X and year 1992 to data on GDP per capita and public spending in state X and year 1985, that is, 7 years before, when these women were aged 16–24. This was the best we could do with the available data on control variables.¹⁷ Finally, considering individual data in 1992–2004 (268,670 observations) and control variables by state and year already merged with it as explained, we group the data by state of birth and cohort (survey year minus age). The grouped data is a panel of 567 observations classed into 21 cohorts (1961–1981) and 27 states of birth. Table A.1 in the appendix provides the mean, standard deviation, source, and sample period of each variable.

¹³ Pseudo panels have been used with series of cross section data. See Deaton (1985).

¹⁴ We do not report clustered standard errors because we have a small number of clusters (27 states), which could bias our results (Cameron and Miller, 2015). The results with clustered standard errors are available upon request.

¹⁵ The 1981–2003 PNADs do not include the rural part of states in the North Region.

¹⁶ There is no PNAD data for the years 1991, 1994 and 2000. Instead of interpolating with data from adjacent years, we preferred to keep only available years. We match contemporaneous PNAD data by state of birth and year to past PNAD by state and year as follows: 1992–1981, 1993–1982, 1995–1983, 1996–1984, 1997–1985, 1998–1986, 1999–1987, 2001–1988, 2002–1989, 2003–1990, and 2004–1992.

¹⁷ Because of this, we did not go as far as in the past as would be needed to recover information about exactly when the women aged 23–30 were born. We instead captured these when they were aged 12–19 and 16–24 for the first and second sets of variables. In our data, though, 82% women aged 23–30 reside in the same state where they were born. They therefore probably lived in the same state from birth until the survey year. Hence grouping the data by state of residence instead of by state of birth should not make much of a difference.

The measure of teenage motherhood is defined as the share of women aged 23–30 who had their first child before the age of 18 (not inclusive). Fig. A.1 in the appendix displays average values of this variable by cohort and age-group and by region and year. We see that teenage motherhood is highest for the oldest cohort (1961), then decreases up to cohort 1965. After this, it oscillates with an increasing trend up to the youngest cohorts. The pattern is similar across age groups.

Here we explain the construction of the key control variables. The poverty variable was constructed from data on poverty line as defined in Rocha (1997).¹⁸ For some years there was no information available. Thus, we adjust the values in the 1981–1984 period for inflation using the poverty line for year 1985, and the values in the years 1986, 1988 and 1989 using the poverty line for 1987. The values were adjusted via the National Consumer Price Index (INPC).¹⁹ The poverty rate (the share of poor in the total population) was obtained by dividing the number of individuals whose income was lower than the poverty line by the total population in each state and year.

To measure inequality we use the most common quantile ratio: the ratio between per capita income at the top of the distribution (the 90th percentile) and at the bottom (the 10th percentile); this is usually known as the 90–10 ratio.

Infant mortality (up to age one) was constructed using the number of live births from the 1981–1992 PNADs and the number of deaths from DATASUS 1981–1992 (Health Ministry Records). By dividing the latter by the former we obtain the infant mortality indicator for the 1981–1992 period. For this study we use infant mortality in adult women aged 20–44. This is done in order to account for possible endogeneity problems due to the mechanical relationship between infant mortality in women under 20 and teenage fertility.

The number of deaths due to abortion and the number of women aged 15–19 (teenagers) are also provided by DATASUS for the period 1981–1992.²⁰ The abortion rate is obtained by dividing the number of abortions by the number of teenagers.²¹

To evaluate the impact of early childbearing on the teenage mother's subsequent outcomes, we chose the sample of women aged 23–30. We chose women aged up to 30 because in the PNAD data we only observe individuals of the same family if they live in the same domicile. This is a serious issue because the PNAD does not contain any question about the age in which the woman started having children, but we do know the age of her children if these live in the same household as the mother. By subtracting the age of the oldest child from the age of the mother we obtain the age at which she gave birth the first child. The validity of this construction is guaranteed until the mother is 30 years old. Up to this age, about 97% of children still live with their mothers.

We look at the outcomes of women when they are older than 23, at which point they are likely to have their completed education. The outcome variables used are the fraction of high school completion, completed years of schooling, labor force participation, and log-hourly wage. Fig. A.2 in the appendix shows the average outcomes by cohort and age groups. We generally see an improvement in all these outcomes, over the generations.

4. Estimation results

The main results of the teenage motherhood regression are shown in the first column of Table 3. The second column displays the impact of teenage motherhood on the share of high school graduates, completed years of schooling, labor force participation, and log-wages. In all models we have added fixed effects for state of birth and cohort as well as controls that vary in both dimensions.

Some of the coefficients obtained for the controls are significant in almost all regressions. They generally have the expected signs.²² Child labor negatively affects women's future outcomes. Public investment in education up to the high

¹⁸ Available at <http://www.iets.org.br/dados/>.

¹⁹ The state of Tocantins was created in 1992 and therefore first appears in the 1992 PNAD. We used the Central-West region poverty line to calculate the poverty variable for this state. Later, all of the observations from Tocantins were merged with those from Goiás state to generate the panel of averages.

²⁰ The source of population data reported by DATASUS was IBGE (Demographic Census) and estimates for years between censuses were prepared by DATASUS.

²¹ The issue of measurement error due to underreported abortions is a concern here. One could easily argue that this is probably due to the fact that abortion is illegal in Brazil. There is a long debate in the Public Health literature which proposes corrected estimates for abortion constructed via the Demographic and Health Surveys. In the this paper, although we do not make any correction, we acknowledge a possible attenuation bias caused by classical error in this measure.

²² Standard errors are robust to heteroskedasticity.

Table 3

Teenage birth regression and models for the mothers' education and labor market outcomes.

	(1) Teenage birth	(2) High school completion	(3) Years of schooling	(4) Labour force participation	(5) Log-wage
Teenage birth	–	–0.301*** (0.00772)	–3.290*** (0.0754)	–0.102*** (0.00691)	–0.413*** (0.0228)
State of birth dummies	Inc.	Inc.	Inc.	Inc.	Inc.
Cohort dummies	Inc.	Inc.	Inc.	Inc.	Inc.
% Whites	0.0049 (0.0047)	0.0450*** (0.0057)	0.687*** (0.0467)	–0.0954*** (0.0047)	0.306*** (0.0145)
Child labour	–0.105*** (0.0108)	–1.112*** (0.0149)	–10.24*** (0.133)	–0.240*** (0.0124)	0.184*** (0.0405)
Education spending/GDP	–0.568*** (0.0437)	–0.876*** (0.0496)	–7.707*** (0.472)	–1.284*** (0.0449)	1.062*** (0.151)
Health spending/GDP	0.963*** (0.0449)	1.711*** (0.0516)	16.10*** (0.503)	0.662*** (0.0509)	–2.263*** (0.157)
Doctors/1000 pop.	0.0226*** (0.0024)	–0.00707*** (0.0024)	0.511*** (0.0259)	0.0251*** (0.0026)	–0.0608*** (0.0079)
Log-wage unskilled women	–0.0191*** (0.0024)	0.188*** (0.00316)	1.495*** (0.0300)	0.201*** (0.00302)	–0.103*** (0.0094)
Log-GDP per capita	–0.0115*** (0.0030)	0.0154*** (0.0035)	–0.567*** (0.0423)	–0.0030 (0.0047)	0.0064 (0.0133)
Infant mortality (adult women)	–0.265*** (0.0612)	0.13 (0.0903)	11.81*** (0.762)	0.420*** (0.0655)	1.253*** (0.274)
Abortion rates (15–19)	0.0060*** (0.001)	–0.00648*** (0.0013)	0.343*** (0.0113)	–0.0352*** (0.0012)	0.113*** (0.0035)
Poverty	–0.141*** (0.0072)	–0.658*** (0.0103)	–4.953*** (0.0924)	0.0296*** (0.00980)	–0.0889*** (0.0308)
Inequality	0.0013*** (0.0001)	–0.0130*** (0.00016)	–0.0169*** (0.0016)	–0.0037*** (0.0002)	0.00722*** (0.0004)
# of cells	565	565	564	565	564
# of obs	268,670	268,670	268,669	268,670	268,669
R-squared	0.685	0.946	0.958	0.818	0.963

Robust standard errors in parentheses.

* Significant at 10%.

** Significant at 5%.

*** Significant at 1%.

school level is associated with reduced accumulated schooling, which in turn is associated with negative results in terms of future participation. The wages of women who participate in the labor market respond positively to public investment in early education. Public health investment improves education outcomes, which is consistent with a dominant income effect. The wages of unskilled women (less than 4 years of schooling) correspond to an opportunity cost of completing high school and to pursuing further education. This variable, however, positively affects both education outcomes (high school completion and completed schooling years) and participation in the labour force. Therefore, the wages of unskilled women (as defined previously) do not seem to correspond to a cost of having children, as they must be capturing other factors such as local labor market conditions. Finally, the effect of GDP per capita is positive for high school completion but negative for years of schooling. The result on high school completion is consistent with a dominant substitution effect observed during economic growth. As society becomes wealthier teenage women choose to invest in their own education (and consequently in their children's education).

Most of the explanatory variables of the teenage motherhood regression are significant. Expenditures in primary and secondary schooling are associated with lower teenage motherhood, while expenditure in health increases teenage motherhood. The fact that poverty rate, inequality, child labor and infant mortality are statistically important in the teenage motherhood regression matters in understanding how teenage pregnancy affects future labor market outcomes. Only inequality, however, is positively associated with early motherhood. This indicates that low socioeconomic conditions do not form expectations about future labor market outcomes and/or that expectations are not important for the decision of teenagers to become pregnant. After accounting for several factors (demography, health and education

Table 4
Estimates at different age group: women aged 23–26.

	(1) Teenage birth	(2) High school completion	(3) Years of schooling	(4) Labour force participation	(5) Log-wage
Teenage birth	–	–0.370*** (0.0101)	–3.749*** (0.0850)	–0.0667*** (0.0135)	–0.195*** (0.0315)
State of birth dummies	Inc.	Inc.	Inc.	Inc.	Inc.
Cohort dummies	Inc.	Inc.	Inc.	Inc.	Inc.
% Whites	–0.0002 (0.0067)	0.0669** (0.006)	1.250*** (0.0477)	–0.0692*** (0.0063)	0.181*** (0.0181)
Child labour	0.0477*** (0.0143)	–0.967*** (0.0192)	–8.455*** (0.229)	–0.0737*** (0.0205)	–0.534*** (0.0722)
Education spending/GDP	0.148 (0.106)	–1.559*** (0.112)	–14.89*** (1.551)	–1.095*** (0.110)	2.788*** (0.460)
Health spending/GDP	–0.054 (0.0776)	2.114*** (0.109)	24.26*** (1.080)	1.691*** (0.111)	–4.834*** (0.332)
Doctors/1000 pop.	–0.00255 (0.0058)	0.0883*** (0.0072)	1.149*** (0.0737)	–0.00441 (0.0066)	–0.138*** (0.0233)
Log-wage unskilled women	–0.0132*** (0.0041)	0.0273*** (0.0052)	0.795*** (0.0564)	0.214*** (0.0058)	0.0591*** (0.0173)
Log-GDP per capita	0.0612*** (0.0076)	–0.0570*** (0.0074)	–1.197*** (0.0846)	0.0154* (0.008)	0.283*** (0.0222)
Infant mortality (adult women)	–0.499*** (0.135)	1.812*** (0.113)	32.86*** (2.230)	3.387*** (0.106)	–1.132*** (0.569)
Abortion rates (15–19)	–0.0048*** (0.0015)	–0.0040** (0.002)	0.440*** (0.0184)	–0.0600*** (0.0016)	0.131*** (0.0057)
Poverty	–0.0081 (0.0163)	–0.951*** (0.0165)	–6.926*** (0.237)	0.355*** (0.0154)	–0.377*** (0.0653)
Inequality	0.0009*** (0.0002)	–0.0151*** (0.0003)	–0.0121*** (0.0027)	–0.0004 (0.0003)	0.0215*** (0.0009)
# of cells	458	458	458	458	456
# of obs	138,083	138,083	138,083	138,083	138,073
R-squared	0.611	0.936	0.949	0.791	0.954

Robust standard errors in parentheses.

* Significant at 10%.

** Significant at 5%.

*** Significant at 1%.

infrastructure, abortion rates as proxies for the price of contraception, GDP per capita, price of labor as proxy for opportunity costs, and state of birth and cohort fixed effects), poverty, infant mortality and child labor are found to be inversely related to teenage pregnancy. This suggests that even though teenagers wish to have children in an environment with high poverty (low opportunity costs), they are lifetime constrained and so work sooner.²³

The teenage motherhood regression shows that is important to control for all these factors in the outcome regressions, as they may be part of or the whole explanation for the effects of teenage pregnancy on labor market and education achievement. The second to fourth columns of Table 4 show that teenage pregnancy is significant in most outcome regressions.

All coefficients have negative signs, which is consistent with the results obtained in many studies.²⁴ We show that a decrease in teenage fertility by one standard deviation increases high school completion by 0.8 percentage points, meaning that 9.2% of the increase in high school completion from cohort 1966–1975 can be explained by the decrease in teenage pregnancy. By contrast, years of schooling would increase by 0.08 percentage points, which explains less than 1% of the growth in years of schooling between cohorts 1966 and 1975. We also found that a one standard deviation

²³ We unfortunately do not have retrospective data on working status, so we could not confirm this hypothesis.

²⁴ Bronars and Grogger (1994), Ribar (1999), Hotz et al. (1997, 2005), Goodman et al. (2004), among a number of papers not mentioned here.

Table 5

Estimates at different age group: women aged 27–30.

	(1) Teenage birth	(2) High school completion	(3) Years of schooling	(4) Labour force participation	(5) Log-wage
Teenage birth	–	–0.191*** (0.00960)	–2.790*** (0.0961)	–0.106*** (0.00981)	–0.648*** (0.0329)
State of birth dummies	Inc.	Inc.	Inc.	Inc.	Inc.
Cohort dummies	Inc.	Inc.	Inc.	Inc.	Inc.
% Whites	–0.0082 (0.0059)	0.0873*** (0.0066)	1.247*** (0.0538)	–0.115*** (0.007)	0.448*** (0.0188)
Child labour	0.009 (0.0110)	–0.274*** (0.0122)	–4.380*** (0.117)	–0.0827*** (0.0132)	–0.210*** (0.0390)
Education spending/GDP	–0.326*** (0.0574)	0.235*** (0.0657)	3.401*** (0.563)	–0.991*** (0.0558)	–0.764*** (0.215)
Health spending/GDP	0.330*** (0.0529)	1.095*** (0.0594)	11.75*** (0.555)	1.313*** (0.0692)	0.082 (0.223)
Doctors/1000 pop.	0.0136*** (0.0029)	–0.0377*** (0.0027)	0.235*** (0.0272)	7.14e–05 (0.0040)	0.0127 (0.0096)
Log-wage unskilled women	–0.0336*** (0.0026)	0.201*** (0.0033)	1.271*** (0.0279)	0.122*** (0.0037)	–0.160*** (0.0116)
Log-GDP per capita	–0.0493*** (0.0035)	–0.0713*** (0.0040)	–1.229*** (0.0469)	–0.0532*** (0.0061)	–0.120*** (0.0149)
Infant mortality (adult women)	–0.221*** (0.0729)	–0.256*** (0.106)	6.519*** (0.847)	0.498*** (0.0785)	1.134*** (0.316)
Abortion rates (15–19)	0.0034*** (0.0015)	0.0009 (0.0019)	0.383*** (0.0180)	–0.0279*** (0.002)	0.150*** (0.0051)
Poverty	–0.280*** (0.0126)	–0.558*** (0.0198)	–4.741*** (0.171)	–0.0636*** (0.0183)	–0.318*** (0.0569)
Inequality	0.0017*** (0.0002)	–0.0108*** (0.0003)	–0.0166*** (0.0026)	–0.0022*** (0.0003)	–0.0078*** (0.0008)
# of cells	457	457	456	457	454
# of obs	130,587	130,587	130,586	130,587	130,575
R-squared	0.595	0.923	0.947	0.757	0.95

Robust standard errors in parentheses.

* Significant at 10%.

** Significant at 5%.

*** Significant at 1%.

decline in teenage pregnancy causes a 0.3 percentage point increase in labor market participation. This figure is small but represents 5.4% of the increase in participation from cohort 1966 to 1975.²⁵

The effects on wages of participating women, though statistically significant, are small. One standard deviation lower teenage fertility implies a 1.1% wage raise, which is less than 1% of the variation observed between cohorts 1966 and 1975.^{26 27}

²⁵ One may ask whether this result might change if we use hours instead of participation. For this reason, regressions of ln(average hours worked) were run and similar results were found. When averaging the quantity of weekly hours worked, we assigned zero hours worked to the unemployed and to those out of the labor force.

²⁶ Using NLSY data and miscarriages as instruments, Hotz et al. (2005) also obtained small and non-significant IV estimates. The authors point out that there are possible measurement errors in the instruments. If the error is i.i.d. then the IV understates the teenage fertility impact. They suggest the use of bounds for the instruments so as to account for this possible bias.

²⁷ This result is similar to the one obtained by Goodman et al. (2004) using British Cohort Studies data and miscarriages as instrument. Ribar (1999) finds a negative impact of teenage childbearing, significant at 1% and greater than OLS. He uses the NLSY data, applies fixed effects on sisters, and uses the sister's fertility an instrument for women's own fertility.

5. Analysing effects over the life-cycle

We have shown estimates using the full sample of women aged 23–30. It is not a priori clear, however, whether those effects would hold across different age groups or whether they are just averages. We therefore subdivide the sample into two groups: women aged 23–26 and women aged 27–30. Tables 4 and 5 display the main results from the fixed effects regressions for the two groups. The empirical equations are the same for both age groups, but the sample of younger women includes more younger cohorts because the number of survey years is the same. Likewise, the sample of older women includes more older cohorts.

There is a significant negative impact on the proportion of high school graduates for both groups. The impact is greater for the younger women. A decrease in teenage fertility by one standard deviation in each group increases high school completion by 1 percentage point for women aged 23–26 and 0.6 percentage points for women aged 27–30 (Table 5). Although these are small changes in absolute terms, these numbers correspond to 15.1 and 4.9% of the change in high school completion that took place between cohorts 1966 and 1975 for each group, respectively. These are important changes that also show more impact for younger than for older women, which is expected insofar as adult women who did not graduate in high school are likely to catch up with high school education while relatively young, that is, aged about 23–26.

When we look at years of schooling, which is more of an intensive margin of changes in education, we observe smaller but still significant effects. The results show that the effect of reducing early fertility weakens as women get older. Decreasing teenage fertility by one standard deviation increases schooling by 0.11 and 0.08 year for women 23–26 and 27–30 years old, respectively. These are equivalent to 0.12 and 0.07% of the changes in schooling that occurred between cohorts 1966 and 1975. These declining effects over the life cycle are related to the timing of education catch-up. They are very small, however. We cannot of course determine whether this pattern would remain the same for women older than 30.

Regarding female labor force participation, teenage motherhood is associated with negative effects, which are greater for the older group. They are statistically significant in both cases. One standard deviation lower teenage fertility increases participation by 0.2 percentage point for women aged 23–26 and 0.3 percentage point for women aged 27–30. This accounts for a significant share of the variation in participation that occurred between cohorts 1966 and 1975: 4.1 and 4.7% of the change in each group, respectively. This shows that the effects increase over the life cycle, albeit by a small amount.

As in the overall regression, the results on hourly wages of participating women are negative and statistically significant but small. A decrease in teenage fertility by one standard deviation increases hourly wages by 0.6 and 1.9% for women aged 23–26 and 27–30 respectively. However, these values are small relative to the large increases in wages that occurred considering during the period. They respectively correspond to 0.04 and 0.05% of the changes in wages.

The estimates using fixed effects and cohort-state of birth varying controls indicate that reducing early childbearing improves high school completion for younger women but less so for older ones. They also display relevant and persistent impact on labor market participation.

6. Conclusion

According to the World Health Organization, half of the births by teenage mothers occurred in the following countries: Bangladesh, Brazil, Congo, Ethiopia, India, Nigeria, and the US. In Brazil, the teenage birth rate was 75 (per 1000 women aged 15–19) in 2008. In other Latin American countries, this rate was for example 71 for Paraguay and 54 for Peru. Brazil is therefore performing worse than some less developed countries in the same region.

Whilst in many developed countries there is well-documented evidence of the effects of early motherhood on mothers' educational achievement and labor market performance, little is known about Brazil. This paper seeks to identify the exogenous impact of early motherhood on future education and labor market outcomes of the mother. In addition to state of birth and cohort fixed effects, we use a rich set of control variables characterizing the demography and economic conditions experienced by the teenagers before pregnancy.

Teenage motherhood, later labor market participation, and educational achievement are specified and estimated in their reduced forms. Our main findings do not reject the hypothesis that early motherhood is detrimental to high school completion, to years of completed schooling, and to labor force participation of women in subsequent years. We found evidence, moreover, that these effects are much more important for high school completion and labor market

participation. A one standard deviation decline in teenage pregnancy is associated with a 9.2% increase in high school completion compared to the change observed in this indicator between cohorts 1966 and 1975. It is also linked with an increase of 5.4% in women's labor market participation in relation to how participation grew over these 10 cohort years. Lifecycle results show that the gains in terms of high school education are greater for younger than for older women, suggesting that women who gave birth as teenagers tend to catch up with high school education while young but not so much as they age. The results on labor market participation show persistent teenage motherhood effects. Policies to reduce teenage pregnancy have long-lasting positive effects on future female labor supply as well as an even greater impact on the education of young women.

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Appendix A.

Table A.1
Descriptive statistics from the grouped data.

	Mean	Std. deviation	Source of data
Teenage birth	0.106	0.027	PNAD 1992–2004
Teenage birth: 23–26 age group	0.109	0.304	PNAD 1992–2004
Teenage birth: 27–30 age group	0.102	0.029	PNAD 1992–2004
<i>Mother's outcomes</i>			
High school completion	0.345	0.104	PNAD 1992–2004
Completed years of schooling	7.731	1.147	PNAD 1992–2004
Labour force participation	0.652	0.052	PNAD 1992–2004
Log-hourly wages	0.398	0.314	PNAD 1992–2004, IPEA (R\$ 2004)
<i>Controls</i>			
% Whites	0.506	0.212	PNAD 1981–1992
Child labour	0.166	0.051	PNAD 1981–1992
Education spending/GDP	0.023	0.01	IBGE, IPEA 1985–1997
Health spending/GDP	0.012	0.008	IBGE, IPEA 1985–1997
Doctors/1000 people	0.221	0.158	PNAD 1981–1992
Log-wage unskilled women	4.461	0.385	PNAD 1981–1992 (R\$ 2004)
Log-GDP per capita	8.532	0.542	IPEA 1985–1997 (R\$ 2004)
Infant mortality (over living births to women 20–44)	0.032	0.017	DATASUS/health ministry 1981–1992, PNAD 1981–1992
Abortion rate (to 1000 women 12–19)	0.562	0.334	DATASUS/Health Ministry 1981–1992, PNAD 1981–1992
Poverty rate	0.365	0.146	PNAD 1981–1992
Inequality (90–10 ratio)	13.269	1.856	PNAD 1981–1992

Statistics are based on panel of averages by 27 states of birth and 21 cohorts (1961–1981), which totalises 567 observations. This panel uses information on teenage birth and outcomes of 268,670 women aged 23–30 using the 1992–2004 PNADs. Teenage fertility is the fraction of women who gave birth to the first child before the age of 18 over the total number of women. Labour force participation is the fraction of women who participate in the labour market. Log-wages is the logarithm of hourly wages of women after adjustments for inflation and currency changes. Child labour is the fraction of children aged 10–14 working in the labour market. Log-wage of the unskilled women is the log-wage for women who had 4 or less years of education. Log-GDP per capita is adjusted for inflation and currency changes. Infant mortality is given by the proportion of deaths up to the first year of age over living births (women aged 20–44). Abortion rate is defined by number of foetal deaths to 1000 women aged 12–19. Poverty rate is the proportion of poor people to total population disaggregated by state. The poverty line used is defined in Rocha (1997). Inequality is the ratio between per capita income at the top of the distribution (the 90th percentile) and at the bottom (the 10th percentile).

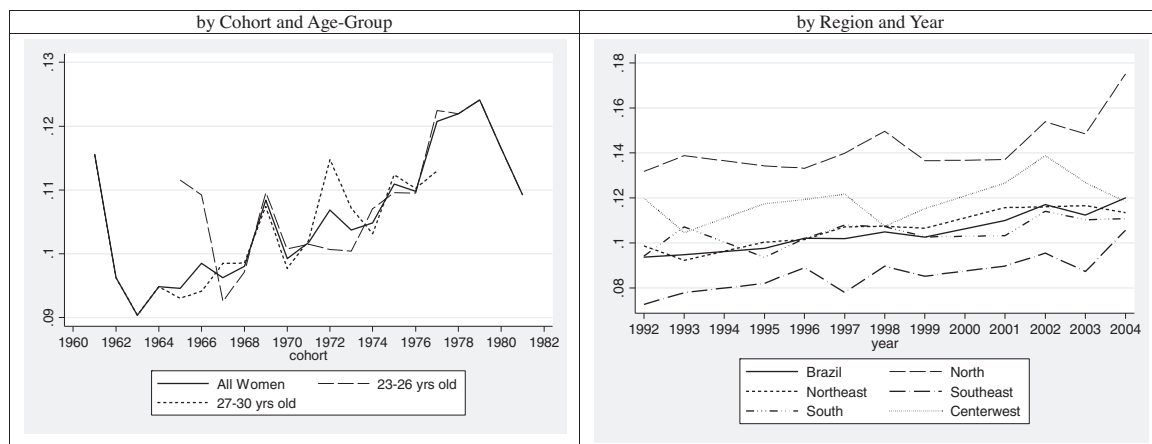


Fig. A.1. Teenage motherhood.

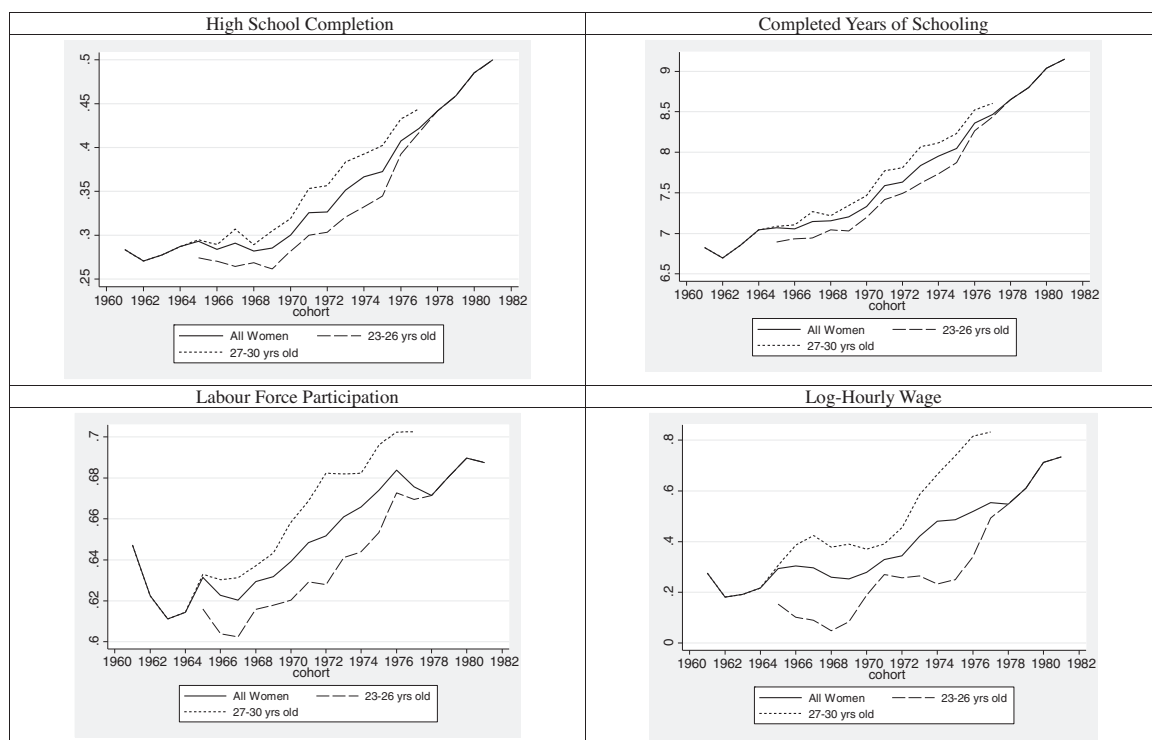


Fig. A.2. Outcomes of interest.

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