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Estimating the effects of teen motherhood in Chile: a family fixed effects approach*

*Estimando los efectos de la maternidad adolescente en Chile
mediante un modelo de efectos fijos a nivel de familia*

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Abstract

We study the effect of adolescent motherhood on education and labor outcomes among 20-24 year old women in Chile. We identify causal effects of motherhood with family fixed effects using a large data set covering the 1990-2011 period. Teen motherhood has negative effects on education and labor outcomes, and timing of motherhood matters: teen births reduce education outcomes, while young motherhood reduces labor force participation. Labor outcome effects are present among the non-poor, and effects changed between 1990 and 2011. Results highlight the important role of adolescent motherhood in women's human capital accumulation and income inequality.

Key words: *Adolescent motherhood, education, labor market, teen pregnancy, Chile.*

JEL Classification: *I15, J13, I25, O15.*

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Resumen

Estudiamos el efecto de la maternidad adolescente respecto de varios indicadores educacionales y laborales de mujeres de 20-24 años en Chile. Identificamos el efecto causal de la maternidad mediante un modelo de efecto fijo familiar, usando datos de hogares entre 1990 y 2011. La maternidad adolescente tiene efectos negativos en ambos tipos de indicadores, y el momento de la maternidad importa: embarazos adolescentes afectan indicadores educacionales, mientras que embarazos juveniles afectan participación laboral. El efecto en indicadores laborales es prevalente en madres de mayor ingreso y los efectos cambian entre 1990 y 2011. Los resultados destacan la importancia de la maternidad adolescente en la acumulación de capital humano y la desigualdad del ingreso.

Palabras clave: *Maternidad adolescente, educación, mercado del trabajo, embarazo adolescente, Chile.*

Clasificación JEL: *I15, J13, I25, O15.*

1. INTRODUCTION

Adolescent motherhood has become an important policy concern in Latin America, as the region has among the highest adolescent motherhood rates in the world and has experienced the slowest rate of decline (Azevedo *et al.*, 2012a). While the fertility rate of women aged 20-24 in high income countries declined from 95 to 66 births per 1000 women between 1990 and 2015, for Chile, the respective numbers are 123 in the first half of the nineties, and 85 during the last 5 years.¹

Early motherhood is negatively correlated with women's educational attainments, which can lead to worse labor outcomes—at least in the short run. This association is worrisome because women's increasing labor force participation and employment in the last decades has led to important reductions in poverty, higher incomes, and improved socio-economic outcomes and welfare for women and families in most developing countries. The economic rationale of the effects of early childbearing on mothers' human capital outcomes rests in the theories of household production and human capital investments (Becker 1965 and 1993; Gronau 1973). Both propose that the childcare responsibilities of motherhood increase the opportunity cost of mothers' formal education and labor market activities, and thus their participation in such activities are reduced. In a household production setting, the effects may be temporary because as children age the time demands of motherhood decrease; in the human capital investment scenario, the reduced levels of education due to early motherhood may have enduring negative impacts on mothers' future labor productivity and therefore on their earnings.

¹ UN Population Division, World Population Prospects (2015).

In addition to individual impacts, other policy concerns include the impact of teen motherhood on income inequality, which stems from the fact that adolescent motherhood is more prevalent—and its negative effects are stronger—among poorer women. The picture is bleak if one considers that the most affected groups of women have lower education and worse labor market outcomes to begin with. Furthermore, teenage motherhood worsens gender inequality, as there is evidence that the negative implications of teenage motherhood on education and labor market outcomes are concentrated on mothers *vis-à-vis* fathers (Assini-Meytin and Green, 2015). Finally, research has revealed that adolescent motherhood and its negative consequences are transmitted across generations, since daughters of adolescent mothers are more likely to become teen mothers themselves.

In Chile, one of every five women became a mother by age 19 during the 1990-2011 period, with significant differences between the non-poor and the poor, where one of every three women was a teenage mother. Furthermore, despite large public expenditures that have increased enrollment, high school completion remains a challenge, since only 79 percent of youths complete their secondary education by age 20. Among girls of high school age, teenage motherhood and pregnancy are the most important reasons for not attending school, suggesting that having a child in adolescence may truncate mothers' educational attainment and their future labor market opportunities.

Despite the widespread recognition that teen motherhood and women's education and labor outcomes are strongly correlated, it is very difficult to establish a causal relationship because motherhood is endogenous. Women that become mothers in adolescence may be different from those that postpone it in both observable and unobservable characteristics, so that the differences in their economic outcomes are not necessarily due to the young age of their first birth, but to unmeasured factors. Various econometric strategies have been implemented to address the self-selection problem, including: quasi experiments such as giving birth to twins (Grogger and Bronars, 1993) or miscarriages (Ashcraft *et al.* 2013; Hotz *et al.*, 2005; Fletcher and Wolfe, 2008), propensity score matching based on observables (Assini-Meytin and Green 2015; Kane *et al.*, 2013; Lee, 2010; Levine and Painter, 2003), and sisters' fixed effects (Webbink *et al.* 2008, 2011; Holmlund, 2005; Hofferth *et al.*, 2001; Geronimus and Korenman, 1992, 1993; Hoffman *et al.* 1993). The majority of studies find that the causal effects of motherhood on a diverse range of socio-economic outcomes are not zero after accounting for selection, so that teen births are responsible—at least partly—for mothers' lower human capital investments.

Most of the literature that identifies causal effects of teen motherhood has focused almost exclusively on developed countries, although some recent research has focused on Latin America, applying estimation methodologies that control for selection to identify causal effects. For instance, Arceo-Gomez and Campos-Vasquez (2014) used a propensity score matching methodology and found that in Mexico, teenage pregnancy decreases school attendance, years of educational attainment, and hours of work. Using miscarriage as an instrument for motherhood, Azevedo, *et al.* (2012b) find unexpected positive effects of teen motherhood in Mexico: teen mothers have 0.34 more years of education, and are 21 percentage points more likely to be employed, compared to adolescent women that became pregnant but had miscarriages. However, this result can

partly be attributed to the instrument used in their I.V. methodology, which underestimates the negative impacts of teenage motherhood.²

Focusing on a country such as Chile –transitioning from a developing economy to a developed country– may shed some lights about how the effects of teen motherhood evolve during this transition, and may bridge the research carried out in developing and developed nations. Our paper makes several contributions to the existing literature on the human capital effects of teen motherhood. First, it is a contribution to the fairly recent literature for Latin American countries that attempts to identify a causal effect of teenage motherhood on mothers' education and labor market outcomes. Ours is the first to analyze the causal impacts in Chile, where it is a relevant policy issue. We address selection bias by constructing a large sample of sisters aged 20-24 years that is representative of young women in the country, and we include family fixed effects that control for within-family unobservables. Identification of the effect of teen childbearing comes from comparing education and labor outcomes of sisters that were and were not teen mothers. Since young motherhood (during ages 20 to 24) is a common occurrence in Chile, we also explore whether the timing of motherhood –having a child during or shortly after adolescence– is relevant for mothers' education and labor outcomes.

We also take advantage of the Latin American cultural context and overcome one of the methodological challenges of the family fixed effects methodology –small, unrepresentative samples– by constructing a large dataset of sisters living with their parents that is representative of most young women aged 20-24 in Chile.³

Finally, we analyze whether there are heterogeneous effects across poverty groups and across time. The first analysis is important if we consider that teen motherhood is more prevalent among poor women. Additionally, our data set covers a 21-year period of time, from 1990 through 2011, when Chile underwent important social, political, and economic changes. We define four different periods (1990-1994, 1996-2000, 2003-2006 and 2009-2011) and test whether the effects of teenage motherhood on mothers' human capital outcomes have changed over time.

Our findings reveal that in Chile, adolescent motherhood reduces mothers' education attainments, but their labor market outcomes are not different from women that delay motherhood. Teenage mothers are less likely to finish high school, less likely to enroll in higher education, and have 0.45 years less of education compared to a sister that was not a teenage mother. In terms of labor market outcomes, we do not find overall negative effects. It's important to point out that since we are studying women aged 20 to 24 years old, our estimations on labor market outcomes should be taken as short-term effects of teenage

² There is a growing literature that uses miscarriage as an instrument for teenage motherhood; however, teenagers who miscarry are not a random sample of teen mothers. Many women perform abortions before a miscarriage occurs, so that observed miscarriages over-sample women from worse socioeconomic backgrounds who have less access to abortions, thereby underestimating the negative impacts of teenage motherhood. For a clear summary, see Ashcraft *et al.*, 2013.

³ In section 4, and specifically Table 6, we compare women and mothers living with their parents with women and mothers living on their own, and discuss the virtues and limitations of our sample composition.

motherhood, and not long term effects, as this period represents the beginning of women's labor market life. Additionally, it is possible that our measured effects underestimate the long-term impacts of a teen birth, because at ages 20 to 24, many women are enrolled in higher education and not in the labor force.

When we separate the effect by adolescent and young motherhood, we find that becoming a young mother (between ages 20 to 24) also has negative causal effects on enrollment in higher education, educational attainment and high school completion compared to non-mothers. The magnitudes of these effects are smaller than teen motherhood because women that delay motherhood into their 20s accumulate more human capital. However, the effects of young motherhood on labor outcomes are stronger than for teen mothers, probably because women's labor status is being measured during the same period they become mothers or shortly afterwards, and motherhood has large time requirements during the child's early years.

Our estimations of heterogeneous effects by poverty status indicate that there are no significant differences in the effects of teen motherhood between poor and non-poor women; however, there have been important changes in the effects on some outcomes over time. Our sample allows us to estimate the effects for different periods, and when we compared the effects of the earliest period (1990-1994) with the most recent one (2009-2011), we found that the negative effect of teen motherhood evolved from mainly affecting secondary education outcomes to mostly affecting tertiary education, and consequently labor market outcomes.

This remainder of the paper is organized as follows: the next section contains background information regarding recent trends in teenage motherhood and high school completion in Chile, followed by sections that describe our empirical methodology and data and variables. We discuss our results in Section 5, with concluding comments and a discussion of policy implications in the final section.

2. ADOLESCENT MOTHERHOOD, EDUCATION, AND LABOR MARKET OUTCOMES IN CHILE

During the 1990-2011 period, one of every five women became a mother by age 19 (Table 1), with significant differences between poor and non-poor households: while about 30 percent of poor girls become mothers, the incidence is almost half among the non-poor, 17 percent. Furthermore, motherhood is common among young women in Chile. By the time they reach 24 years of age, 55 percent of women have become mothers, with important differences across poverty groups: on average, approximately 74 percent of poor women were mothers by age 24, compared to 49 percent of non-poor women. The gap across poverty groups in both teen and young motherhood declined rapidly between 1990 and 2011. For ease of exposition, henceforth in this paper we refer to women who gave birth before age 20 as teenage or adolescent mothers, and young mothers are women who gave birth to their first child between age 20 and 24.

Chile has made important advances regarding secondary school attendance and completion. During the 1990-2011 period, the rate of high school attendance among adolescents increased from 70 to 85 percent, with only slight differences by sex (Table 2). This can be attributed to large increases in educational invest-

TABLE 1
ADOLESCENT MOTHERHOOD 1990-2011 AT AGES 19 AND 24,
BY POVERTY STATUS

Year	Women aged 19 years old			Women aged 24 years old		
	Total	Not poor	Poor	Total	Not poor	Poor
1990	21.7	15.9	29.9	57.4	45.8	76.0
1992	22.8	18.2	29.8	57.3	46.0	77.4
1994	22.4	18.0	29.8	58.8	47.5	78.5
1996	20.6	16.7	31.2	57.8	52.1	74.4
1998	23.8	20.6	32.9	58.3	52.6	77.0
2000	23.2	19.3	32.8	57.0	51.5	73.6
2003	21.2	17.8	30.8	57.3	52.3	73.6
2006	17.9	16.1	25.8	52.1	48.7	74.0
2009	16.6	14.9	23.2	46.4	44.2	57.7
2011	19.6	17.6	28.3	47.8	44.8	64.4
Average	20.6	17.4	29.5	54.7	48.6	73.6

Source: CASEN surveys. Percent of women that are mothers. Poverty status based on poverty line defined by the Ministry of Social Development.

TABLE 2
CHILE: HIGH SCHOOL ATTENDANCE AND COMPLETION 1990-2011,
BY SEX AND POVERTY STATUS

Year	High school attendance rate (%)				High school completion rate (%)			
	Men	Women	Not poor	Poor	Men	Women	Not poor	Poor
1990	69.8	70.8	73.0	66.9	39.3	41.5	50.1	24.8
1992	68.3	69.5	71.4	65.1	39.5	46.6	50.1	29.3
1994	69.6	70.4	72.0	66.9	43.8	47.7	52.6	31.2
1996	74.4	75.3	78.0	68.2	46.5	53.2	56.0	29.9
1998	76.2	77.2	79.3	70.6	50.1	55.4	59.0	33.0
2000	77.0	78.4	79.2	74.6	50.0	58.0	59.1	38.6
2003	82.5	82.6	83.4	80.6	59.4	67.3	68.2	45.6
2006	82.2	84.4	84.0	80.3	68.5	73.7	73.7	53.8
2009	81.8	83.5	83.2	80.5	71.5	77.4	76.7	64.1
2011	84.5	85.9	85.4	84.3	76.1	81.8	80.9	67.9
Average	77.8	79.1	80.4	73.8	57.1	63.0	65.7	40.8

Source: CASEN surveys. Attendance: percent of high school-aged youths (15-18 years old) that attend high school. Completion: percent of youths aged 20 years that finished high school. Poverty status based on poverty line defined by the Ministry of Social Development.

ment and to compensatory programs targeted at the more vulnerable population, which is reflected by the narrowing gap between the poor and non-poor over the 20-year period.

Yet despite large public expenditures to increase households' demand for secondary education, high school completion remains a challenge, especially among underprivileged youths. While 85 percent of high-school aged teens attended school in Chile in 2011, only 79 percent had completed their secondary education by age 20. A greater proportion of girls complete high school relative to boys, and even though it has been substantially reduced during the last 20 years, a gap still remains between the poor and non-poor: 68 percent of poor youths finished high school in 2011, compared to 81 percent among non-poor families.

Teenage motherhood is negatively related to the attendance and high school completion outcomes of young girls, which may truncate future education and labor market opportunities. According to household surveys during the 1990-2011 period, the most important reason for not attending school among high-school aged girls was motherhood or pregnancy (Table 3). In the most recent survey, 30 percent of girls cite pregnancy and motherhood as the most important reason for leaving school.⁴

In terms of educational outcomes, our data strongly suggests that they are negatively correlated with motherhood, and furthermore, that the timing of giving birth matters. Table 4 summarizes education and labor outcomes of women at age 24, by their motherhood status: non-mothers, teen mothers and young mothers. By the time women are aged 24 years-old, those who delayed motherhood beyond the mid-20s are more likely to have completed their secondary education relative to young mothers: 79 percent of non-mothers finished high school, compared to 66 percent of young mothers and only 47 percent of teenage mothers. Additionally, non-mothers were four times more likely to enroll in post-secondary education: 46 percent compared to 20 percent of young mothers and 12 percent of teenage mothers, and they obtained over 1 and 2 years of additional schooling relative to young and teen mothers, respectively.

Since fertility also reduces female labor participation, we expect that the timing of motherhood is correlated with mothers' labor market outcomes (Table 4). The labor force participation rate is 60 percent among non-mothers, 50 percent among young mothers, and 54 percent among teenage mothers. This is sensible because a woman who became a teen mother is more able to participate in the labor force at age 24 *vis-à-vis* a more recent mother, because her child is older and the time constraints from motherhood are less binding as children grow. A similar relationship is observed for women's likelihood of employment and weekly hours worked. However, even though the negative relationship between teen motherhood on labor participation and employment declines over time, the impact of their lower educational attainment persist into the future: monthly income of teenage mothers is about 6% lower than young mothers and about 30% lower than non-mothers.

⁴ Source: author's estimates based on the 2011 CASEN survey.

TABLE 3
WHY DIDN'T YOU ATTEND SCHOOL? ADOLESCENT GIRLS, 1990-2011

Reason	% Valid responses
Maternity/pregnancy	19.6
Economic difficulty	18.0
Helps with domestic chores	15.4
Works/seeks employment	15.1
Other	10.0
Not interested	9.2
Disability, illness, or special needs	5.9
Academic problems	4.2
No schools/difficult access	2.7

Source: CASEN surveys 1990-2011. Most important reason for not attending high school among high-school aged girls (15 to 18 years.)

TABLE 4
EDUCATION AND LABOR OUTCOMES OF YOUNG WOMEN 1990-2011, BY
MOTHERHOOD STATUS

Variable	Mothers			Non-mothers
	Total	Teen mother ^a	Young mother ^b	
Obtained high school diploma (fraction)	0.59	0.47	0.67	0.79
Ever enrolled in post-secondary education (fraction)	0.17	0.12	0.20	0.46
Years of schooling	10.9	10.3	11.3	12.6
Participates in labor force (fraction)	0.52	0.54	0.50	0.60
Employed (fraction)	0.42	0.43	0.41	0.48
Hours worked (last week)	50.0	51.2	49.2	50.6
Income (thousand CLP)	131.8	127.0	134.7	180.0

Source: CASEN surveys. Includes women aged 24 years old. ^a: women who became mothers in adolescence. ^b: women who became mothers as youths aged 20-24.

3. EMPIRICAL METHODOLOGY

We are primarily interested in estimating the effect of giving birth as an adolescent on the mother’s short-term education and labor market outcomes. Our estimation strategy, based on a within-family estimator can be represented as:

$$(1) \quad Y_{ij} = \alpha + \beta M_{ij} + X'_{ij}\gamma + \rho_j + \varepsilon_{ij}$$

where Y_{ij} is the education or labor outcome of interest of woman i of family j ; M_{ij} is an indicator variable that equals one if woman i in family j is an adolescent mother; X_{ij} is a set of variables that measure individual characteristics, ρ_j is and unobserved family effect common to all sisters within the household, and ε_{ij} is an i.i.d. error term. Estimation of equation (1) removes the unobserved family effect ρ_j , as well as all the bias due to common unobservables across sisters. The underlying idea is that because they grew up in the same household and were exposed to similar experiences, sisters may develop similar preferences regarding education and fertility. The identifying assumption is that exogeneity holds within each household, which means that adolescent motherhood is distributed randomly across sisters in a household, conditional on the set of individual observable characteristics (X_{ij}).

This methodology improves on the OLS estimates by controlling for within-family unobservables; yet it also has two drawbacks. The first is that in most studies that use this approach (all in developed countries), data sets are small and unrepresentative. We overcome this problem by constructing a large sample of sisters aged 20 to 24 years living with their parents that is representative of young women in that age group, over a long period of time. We are able to do so because our data source is a national survey that collects information on all household members. In addition, in a Latin American country such as Chile, it is very common for sons and daughters to remain living with their parents into adulthood: according to the a recent National Survey of Youth, 74 percent of 20 to 24 year olds live with their parents, only 12 percent live independently in their own home, and the remaining 14 percent live with either other relatives, in-laws, or friends (INJUV, 2010). Furthermore, among those that still live with their parents, more than 30 percent has never considered the possibility moving away from home. This cultural context allows us to construct a sample of sisters that is large (over 8,500 sisters over the period) and representative—at least of 73 percent of young adults in Chile.⁵

The second limitation of this methodology is that family-level fixed effects do not control for sisters' individual heterogeneity within the family. It is reasonable to expect that family characteristics have important influences on daughters' preferences, but they do not account for all of the differences in unobserved traits between her and her siblings. To the extent that the unobserved factors that vary across sisters could affect both the likelihood of becoming an adolescent mother and the outcomes of interests, the family fixed effect model would not fully account for the potential bias that may arise.⁶ In our estimates,

⁵ The selection of age range (20-24 years) is done to maximize the comparability of the sample of women living with their parents with the whole population of women of the same ages. This relatively narrow range implies that we are only able to study the short term effects of adolescent motherhood, particularly for labor market outcomes.

⁶ For instance, Webbink *et al.* (2011) control for individual unobservables by estimating the effect of teen motherhood on education outcomes among samples of Australian twins and their siblings. Although our sample does not allow us to identify twins perfectly, we

we account for individual heterogeneity by controlling for differences arising due to the order of birth between sisters.

In a detailed, methodological paper, Ribar (1999) develops a model that strongly suggests that the family fixed effects methodology appropriately measures the causal effect of teenage motherhood on mothers' future outcomes, and if individual heterogeneity is stronger than family-level heterogeneity—which is a very reasonable assumption—then the sisters-based methodology provides a *lower* bound estimate of the effect of teen motherhood. Furthermore, Holmlund (2005) estimated the effect of teen motherhood among 1,890 groups of sisters in Sweden, and found that the effect of adolescent motherhood on years of schooling was not substantially different with and without a control for individual ability.⁷ For these reasons, we believe that the effects of motherhood on education and labor outcomes in Chile are appropriately identified with our methodology.

4. DATA, VARIABLES, AND SAMPLE CONSTRUCTED

To estimate the short-run effects of becoming a mother in adolescence, we need information about a young woman's family background characteristics when she was an adolescent, the age when she first became a mother, and her subsequent education and labor market outcomes. Ideally, this information would come from longitudinal data where the woman and her family are observed in her adolescence, gathering information on her family background, and again when she is an adult and her motherhood status, education, and labor outcomes are observed. In Chile and most developing countries, longitudinal data with such information on the woman and her family of origin is not available.

However, we construct a large sample from ten repeated rounds of Chilean CASEN household surveys spanning the 1990-2011 period,⁸ which contain information about education, health, demographics, employment and income on all members of the household. In order to be able to measure the woman's individual outcomes, as well as family of origin's characteristics, we select women aged 20-24 who still live with their mothers. Since we have information on all household members still living at home, we observe sisters' characteristics, including their motherhood status. The sections below describe the variables used in our estimations.

analyzed whether the effects of teen motherhood changed when comparing sisters of the same age (see section 5, results). We thank an anonymous referee for this suggestion.

⁷ Our results in this paper are similar to those found by Holmlund (2005) in the sense that point estimates are almost identical with and without controlling for individual heterogeneity measured by sisters' birth order. Results without controlling for birth order are available from the authors upon request.

⁸ CASEN is the abbreviation for National Socioeconomic Characterization surveys (*Caracterización Socioeconómica Nacional*). This paper uses all CASENs available, fielded in 1990, 1992, 1994, 1996, 1998, 2000, 2003, 2006, 2009 and 2011.

Individual Variables

The dependent variables we analyze are (i) high school completion, which is a binary variable that equals one if the woman has finished her high school education; (ii) whether she has ever enrolled in a post-secondary education program (either at a college, university, or technical institute); and (iii) years of education completed. In addition we also construct four labor market outcomes: (i) whether she participates in the labor force; (ii) whether she is employed; (iii) the number of hours worked during the previous week; and (iv) her total income (excluding transfers and subsidies), measured in logs.

In terms of women's fertility information and history, CASEN surveys are designed to measure socio-economic status and access to social programs in Chile, so they do not contain women's complete fertility history; however, we construct a woman's motherhood status from the survey's household composition section.⁹ We also include the young woman's age in the estimations and an indicator variable for the oldest sisters living at the household at the time of the survey. Since our data covers a long period of time, we include a set of dummies for the mothers' year of birth to control for cohort effects.

Family characteristics

Family variables include information about the education attainment of the head of the household and of the woman's mother—henceforth referred to as the grandmother. We also include two variables that describe the grandmother: her age at first birth, and her age when she gave birth to the woman in our sample,¹⁰ as well as a variable for whether the head of the household is female and one that includes total adult household income (of adults aged 25 years or older).

We include a set of variables to control for household's demographic composition: number of teenagers, number of other young adults aged 20-24, number of adults and number of elderly in the household.¹¹ We also control for:

⁹ Multi-family households are common in Chile (17% of households had more than one family unit), so that individuals are asked to identify their relationship to the head of the household and to the head of their nuclear family unit. Mothers are women aged 20 to 24 years of age who are either: (i) the head or spouse of their household and sons/daughters are present in their household, or (ii) they are the head/spouse of their nuclear family within a larger household, and sons/daughters are present in their nuclear family unit. We estimate the woman's age at first birth considering her age and the age of her oldest child, and we define a teenage mother if her first child was born before she was aged 20 and young mother if her first child was born between age 20 and 24.

¹⁰ Grandmother's age at first birth is estimated as the difference between the age of the young woman's mother and the age of the oldest child in the household, so that the variable potentially underestimates the grandmother's age at first birth if older sons or daughters have moved away from the household at the time of the survey. Age of the grandmother when she gave birth to the woman in our sample is estimated as the difference in the age of the young woman and her mother at the time of the survey.

¹¹ We exclude number of young children aged 12 or younger because this is potentially endogenous to the motherhood variable.

household density as a proxy for household wealth,¹² household's poverty status, and geographic location (a dummy for rural location and full set of municipality fixed effects).¹³ Additionally, to control for changes in economic conditions and for long-term trends in education, labor markets and motherhood, we included a set of region-year effects in all estimations.

Table 5 reports summary statistics for all variables. In our sample of approximately 47,000 women aged 20-24 years old, 14 percent were teen mothers and 13 percent were young mothers. In terms of the outcomes of interest, 72 percent have obtained a high school diploma, 36 percent have enrolled in post-secondary education, and they have completed an average of 11.9 years of schooling. Additionally, 47 percent of the women in our sample participate in the labor force, and 36 percent are employed. Among those employed, they worked 49.8 hours during the week prior to the survey, and they earned an average monthly income of 131.6 thousand Chilean pesos, equivalent to US\$ 235/month.¹⁴

When we implement our family fixed effects model to control for unobservables at the household level, there might be a concern with the external validity of the findings, as the group of sisters living with their parents –and thus households with more than one sibling– might differ systematically from the average woman aged 20 to 24 that lives at home. Table 5 also reports summary statistics for our sample of sisters, which indicate that women in the sisters' sample have very similar household and individual characteristics relative to the average for all 20 to 24 year olds living with their parents. Our sample of sisters is therefore representative of the population of women aged 20-24 that live with their parents.

As our sample includes women who still live with their parents, there might also be concerns regarding (i) how representative are women that stay home of the population aged 20-24 years, and (ii) how different are women that moved away from their parent's home relative to those who still live with them. Table 6 report summary statistics according to whether women stayed or left their parents' home, for all women and by motherhood status. The table reveals that motherhood is correlated to whether girls live with their parents: in the overall population about 73.5 percent of women aged 20 to 24 live with their parents, however only 47.5 of mothers live with their parents. These differences are not surprising given that the most important reason for moving away from parents' homes is to form a family: according to the 2009 National Youth Survey, 68 percent of young women that moved away from home did so to form their own home (INJUV, 2010).¹⁵

¹² We define household density as the number of persons in the household per number of bedrooms.

¹³ Chile is divided into 15 administrative regions, which is each then sub-divided into provinces and a total of 345 municipalities.

¹⁴ All monetary variables are measured in 2009 pesos. The average exchange rate in 2009 was CLP\$560/US\$.

¹⁵ Own estimates based on valid responses in Table 106 of INJUV (2010). Additionally, the National Youth Survey finds that among youths still living at home, almost 80 percent of those who have one child wish to move away from their parents' home, compared to 58 percent of those who do not have children (see Table 103 of INJUV, 2010).

TABLE 5
SUMMARY STATISTICS: ALL WOMEN AND SISTERS AGED 20 TO 24 YEARS, 1990-2011

	All Women		Sisters	
	Mean	Std. Dev.	Mean	Std. Dev.
Adolescent motherhood (fraction)	0.14	0.35	0.12	0.33
Young motherhood (fraction)	0.13	0.34	0.12	0.32
<i>Outcomes</i>				
Obtained high school diploma (fraction)	0.72	0.45	0.70	0.46
Ever Enrolled in post-secondary education (fraction)	0.36	0.48	0.33	0.47
Years of schooling	11.9	3.1	11.7	3.2
Participates in labor force (fraction)	0.47	0.50	0.49	0.50
Employed (fraction)	0.36	0.48	0.38	0.48
Hours worked (last week)	49.8	20.9	51.6	31.2
Income (thousand CLP)	131.6	162.5	126.7	239.7
<i>Observed characteristics</i>				
Age	21.8	1.4	21.9	1.4
Education-Head of Hhold. (years)	8.0	4.4	8.0	4.6
Education-Grandmother (years)	7.9	4.3	7.8	4.4
Grandmother's age at first birth (years)	25.0	6.3	24.1	5.5
Grandmother's age at woman's birth (years)	27.1	7.0	26.5	6.2
Female-headed household (fraction)	0.25	0.43	0.21	0.41
Adult income per capita (thousand CLP) a	107.1	214.1	96.4	207.9
Number Teenagers in household	5.09	1.79	6.17	1.97
Number young adults in household	0.65	0.81	0.67	0.87
Adults in household	0.41	0.61	1.25	0.51
Number elderly in household	2.08	0.82	2.12	0.86
Number Persons per bedroom	0.09	0.33	0.07	0.28
Rural household (fraction)	1.86	0.97	2.16	1.12
Poor household (fraction)	0.29	0.46	0.30	0.46
Number Persons in Household	0.22	0.41	0.25	0.43
Maximum Num. Obs.	47,158		8,563	

Source: Chile's CASEN surveys (1990, 1992, 1994, 1996, 1998, 2000, 2003, 2006, 2009 and 2011). Observed characteristics include woman's age, education of head of household, education of grandmother, age at first birth of grandmother, grandmother's age when woman was born, dummy variable for female head of household, number of teens in household (age 13-19), number of youth (age 20-24) in household, number of adults (age 25-59) in household, and number elderly (age 60+) in household, household density (persons per bedroom), dummy for rural location, and household poverty status. a Monthly adult income per capita includes income earned by household members aged 25 and older, divided by total household members, in 2009 Chilean pesos. Exchange rate 2009: CLP560/US\$.

Table 6 also reveals that among the complete sample of women, those that stay with their parents have better educational and labor market outcomes (all differences in means across living arrangements are statistically significant). In the group of non-mothers, those that stay in their parents' home have better educational outcomes, and those that live on their own have higher labor force participation, employment rates, and income levels (as is expected, because they become economically responsible for their own household).

TABLE 6
SUMMARY STATISTICS: WOMEN AGED 20 TO 24 YEARS BY MOTHERHOOD STATUS
AND LIVING ARRANGEMENT, 1990-2011.

	All Women		Not mothers		Mothers	
	Moved away	Live with parents	Moved away	Live with parents	Moved away	Live with parents
Adolescent motherhood (fraction)	0.49	0.14	-	-	0.58	0.52
Young motherhood (fraction)	0.35	0.13	-	-	0.42	0.48
<i>Outcomes</i>						
Obtained high school diploma (fraction)	0.43	0.72	0.71	0.78	0.38	0.55
Ever Enrolled in post-secondary education (fraction)	0.10	0.35	0.31	0.43	0.06	0.15
Years of schooling	10.0	11.9	11.8	12.3	9.7	10.8
Participates in labor force (fraction)	0.30	0.47	0.55	0.48	0.25	0.44
Employed (fraction)	0.25	0.36	0.48	0.37	0.21	0.35
Hours worked (last week)	48.2	49.8	49.6	49.8	47.5	49.6
Income (thousand CLP)	127.9	131.2	191.1	136.7	107.2	117.3
<i>Observed characteristics</i>						
Age	22.4	21.8	22.2	21.7	22.5	22.1
Education-Head of Hhold. (years)	10.0	8.0	11.7	8.4	9.7	7.0
Education-Grandmother (years)		7.9		8.2	9.7	6.9
Grandmother's age at first birth (years)		25.0		25.1	19.0	24.7
Grandmother's age at woman's birth (years)		27.0		27.2	0.2	26.6
Female-headed household (fraction)	0.13	0.24	0.28	0.22	0.10	0.28
Adult income per capita (thousand CLP) a	56.6	107.7	88.9	125.8	50.5	60.0
Number Persons in Household	3.2	5.1	1.8	4.8	3.4	5.9
Number Teenagers in household	0.02	0.65	0.01	0.65	0.02	0.63
Number young adults in household	0.24	0.40	0.25	0.41	0.24	0.38
Adults in household	0.68	2.05	0.51	2.09	0.71	1.97
Number elderly in household	0.00	0.10	0.00	0.09	0.00	0.10
Number Persons per bedroom	1.96	1.85	1.03	1.72	2.13	2.20
Rural household (fraction)	0.34	0.29	0.23	0.28	0.36	0.32
Poor household (fraction)	0.31	0.22	0.09	0.18	0.35	0.31
Maximum Num. Obs.	17,731	49,134	2,792	35,637	14,939	13,497

Source: Chile's CASEN surveys (1990, 1992, 1994, 1996, 1998, 2000, 2003, 2006, 2009 and 2011). Observed characteristics include woman's age, education of head of household, education of grandmother (for those living with parents), age at first birth of grandmother (for those living with parents), grandmother's age when woman was born (for those living with parents), dummy variable for female head of household, number of teens in household (age 13-19), number of youth (age 20-24) in household, number of adults (age 25-59) in household, and number elderly (age 60+) in household, household density (persons per bedroom), dummy for rural location, and household poverty status. a Monthly adult income per capita includes income earned by household members aged 25 and older, divided by total household members, in 2009 Chilean pesos. Exchange rate 2009: CLP560/US\$.

Finally, mothers that live with their parents have better educational outcomes than those that moved away: they are more likely to have finished high school, enroll in tertiary education and have more years of education. They are also more likely to participate in the labor force and be employed, work more hours and earned more income. This suggests that living with parents provides economic, logistic and personal support to young mothers.¹⁶

5. RESULTS

We estimated equation (1) without the family component on the sample of all women aged 20-24 years in our data, to obtain a conditional correlation between teen motherhood and the outcomes of interest. With this, we establish a benchmark with which we can assess the reduction in bias achieved with the family fixed effect. We present results of the correlation of teenage motherhood and all outcomes of interest in panel A of Table 7.

One of the limitations of sisters' studies in developed countries is that they rely on small, unrepresentative samples.¹⁷ In our case, for instance, we found that women in our sisters' sample come from larger families with lower income per capita. If our sample of sisters is unrepresentative of young women aged 20-24 years, then re-estimating (1) on the sample of sisters without the family fixed effect will yield significantly different estimates compared to OLS on the full sample. This exercise serves two purposes: first, estimating (1) with OLS on the sisters sample serves as a baseline estimate, and second, we can determine whether our sisters' estimates are biased due to sample composition.

Table 7 shows that OLS estimates for the full and sisters' samples are similar in all but one outcome, labor force participation (panels A and B). Consistent with most of the literature, in our full sample (panel A) we find a negative and statistically significant conditional correlation of adolescent motherhood with all outcomes, except with hours worked (which is conditional on being employed). Large negative effects of teen motherhood are found on the probability of obtaining a high school diploma, which is 0.21 lower, which corresponds to a marginal effect of 29 percent (henceforth we discuss marginal effects).¹⁸ Teen motherhood also has negative effects on the probability of attending post-secondary education (47 percent); on years of schooling (1.1 year less); and on income (13.5 percent).

¹⁶ Since women included in our sample have better education and labor outcomes than those excluded, it is unclear whether our estimated results would be biased upward or downward from an effect on the entire population. The direction of the bias would depend on the assumptions regarding the correlation between individuals' unobservable characteristics, and their decision to leave the household and the outcomes we analyze.

¹⁷ We assess whether our sisters sample is representative following the approach in Holmlund (2005).

¹⁸ Marginal effects are computed dividing the estimated coefficient by the outcomes' mean. For instance, in the case of teen mothers and high school diploma, the marginal effect of 29.7 percent is obtained as $(-0.2147/0.7241) \times 100$.

TABLE 7
EFFECT OF ADOLESCENT MOTHERHOOD ON EDUCATION AND LABOR MARKET OUTCOMES: OLS AND FAMILY FIXED EFFECTS ESTIMATES

Outcome	High school diploma (1)	Post-secondary education (2)	Years of schooling (3)	Labor force participation (4)	Employed (5)	Hours worked (6)	Income (7)
A. OLS - all women aged 20-24							
Adolescent motherhood	-0.2145*** (0.006)	-0.1687*** (0.005)	-1.0691*** (0.032)	-0.0132* (0.007)	-0.0052 (0.007)	0.3435 (0.449)	-0.1348*** (0.019)
Nr. Observations	47,210	47,210	47,158	47,210	47,210	13,634	18,279
R-squared	0.274	0.323	0.345	0.074	0.070	0.154	0.442
Outcome mean	0.7241	0.3552	11.9093	0.4687	0.3638	49.8033	11.5118
B. OLS - sisters aged 20-24							
Adolescent motherhood	-0.2118*** (0.017)	-0.1473*** (0.012)	-1.0882*** (0.096)	-0.0130 (0.020)	0.0000 (0.021)	1.7598 (1.277)	-0.1761*** (0.049)
Nr. Observations	8,188	8,188	8,188	8,188	8,188	2,357	3,218
R-squared	0.327	0.400	0.397	0.147	0.136	0.194	0.605
Outcome mean	0.6994	0.3338	11.7599	0.4891	0.3796	51.6032	11.4816
C. Family fixed effects - sisters aged 20-24							
Adolescent motherhood	-0.1124*** (0.018)	-0.0983*** (0.015)	-0.4516*** (0.113)	-0.0310 (0.022)	-0.0195 (0.023)	0.1868 (1.756)	-0.0421 (0.064)
Nr. Observations	8,568	8,568	8,549	8,568	8,568	2,463	3,361
R-squared	0.027	0.023	0.025	0.043	0.040	0.043	0.059
Outcome mean	0.6957	0.3301	11.7442	0.4869	0.3779	51.6512	11.4715
D. "Twin" Sisters - sisters aged 20-24a							
Adolescent motherhood	-0.0750 (0.066)	-0.1250** (0.052)	-0.5128 (0.503)	0.1750* (0.093)	0.0750 (0.095)	8.6000* (4.767)	0.2422 (0.169)
Nr. Observations	422	422	420	422	422	78	102
R-squared	0.008	0.024	0.009	0.027	0.005	0.111	0.013
Outcome mean	0.7204	0.3507	11.9143	0.4526	0.3412	48.2546	11.6110

Data: Chile's CASEN surveys (1990, 1992, 1994, 1996, 1998, 2000, 2003, 2006, 2009 and 2011). Robust standard errors in parentheses: mean of outcome variable in italics. ***, **, and * indicate statistical significance at the 1%, 5% and 10% levels, respectively. Sample includes women aged 20-24 years living with their parents. Additional controls in OLS estimates include: woman's age, dummy variable if she is oldest sister in household, education of head of household, and of grandmother, grandmothers' age at first birth, grandmother's age when woman was born, whether female headed household, adult income per capita, household composition (num. teens, other young adults, adults aged 25-60, and elderly aged 61+ in household), num. persons/bedroom in household, rural location, year of birth fixed-effects, municipality (comuna) fixed effects and full set of region-year controls. Additional controls in family FE estimates: woman's age, dummy variable if she is oldest sister. a: Includes sisters with a reported age difference of 0.

Panel C reports estimates for our model with family fixed effects, which accounts for contemporaneous and pre-treatment unobservables at the family level. In this model, the magnitudes of the effects on education are reduced in half relative to OLS estimates on the same sample; nonetheless, the effects remain large and statistically significant. Our point estimates indicate that teen mothers are 16 percent less likely to have completed high school when aged 20-24 years, they are 30 percent less likely to attend post-secondary education and, on average, they have 0.45 fewer years of schooling. Our estimates are close to those reported by Holmlund (2005), who in addition to estimating a family fixed effect model, is able to control for pre-motherhood school performance. She finds that the including controls for sister's heterogeneity reduces the family fixed effects point estimates by about 20 percent; thus, we believe that our estimates (at least) closely identify the causal effect of adolescent motherhood on education. In terms of labor market outcomes, we find that becoming a mother during adolescence does not affect mothers' employment between ages 20 to 24 years, revealing that the effects on labor outcomes are temporary, as predicted by the a household production model where the effects of motherhood are due to the mothers' time constraint.

Given the nature of our data, we cannot control for individual unobservable characteristics. One possible approach would be, for instance, to compare twins' outcomes (since twins are genetically similar). We implemented an indirect approach of comparing outcomes on a sample of pseudo twins, *i.e.*, we estimated our regressions on a sample of sisters with the same age.¹⁹ We report our results among "twin" sisters in panel D of Table 7. Relative to the larger sample of sisters, we find that the point estimates of the effects of motherhood on education outcomes are similar, but that statistical significance disappears in some cases; the lack of significance is probably due to low identification power in our small "twins" sample. Furthermore, we tested whether the effects of teen motherhood for sisters and for twins are statistically different and found that for all outcomes, except labor force participation, the differences in coefficients are not statistically significant.²⁰ Our "twin" estimates must be taken with caution given their small sample size, yet they provide suggestive evidence of the robustness of our family fixed effect results, at least in terms of the direction of the effects.²¹

Timing of motherhood

In our fixed effects estimates, the control group is composed of sisters that delayed motherhood beyond age 19, *i.e.*, they either become mothers between ages 20 to 24, or they are not yet mothers in our sample. Thus our estimates compare outcomes of teen mothers to sisters in either of those two groups. We

¹⁹ We thank an anonymous referee for suggesting this exercise.

²⁰ Z-statistics are not reported in the table but are available upon request.

²¹ These results differ from those in Webbink *et al.* (2011) who find that the negative effects of a teen birth were reduced to zero when comparing outcomes of identical twins vis-à-vis sisters or non-identical twins. Although we agree that, methodologically, using twins' samples is an appropriate way of generating a genetically similar control group, Webbink's results—same as our "twins" results—should also be interpreted with caution, as they are based on a small sample, which in their case is composed of 72 pairs of twins.

can also investigate whether timing motherhood timing is relevant in shaping those effects by creating a categorical variable for women that became mothers between ages 20-24 (referred as young mothers), and re-estimating the family fixed effect model controlling for both adolescent and young motherhood. In this specification, the group of reference is women aged 20-24 who are not (yet) mothers, and the estimated coefficients capture the causal effects of adolescent and young motherhood relative to sisters that are non-mothers.

These results are reported in Table 8 and they show that women that become mothers during adolescence have worse education and labor outcomes than sisters who are young mothers and non-mothers. Teen mothers are 17 percent less likely to have completed high school relative to non-mothers, whereas young mothers are 4 percent less likely to finish high school (column 1). In terms of their likelihood of attending post-secondary education, mothers are 34 percent and 21 percent less likely to attend if they are teen and young mothers, respectively (column 2 of Table 8). On average teen mothers have 0.5 less years of schooling than non-mothers, while young mothers have 0.25 less years (column 3). Thus, in terms of their educational outcomes, results indicate that not only motherhood is relevant but also that the timing of motherhood matters for the magnitude of the effects.

In terms of labor market outcomes, separating motherhood by its timing reveals that teen and young mothers are less likely to participate in the labor market compared to non-mothers. Our estimates show that adolescent and young mothers are 14 and 35 percent less likely to participate in the labor force, respectively; they are also 12 and 30 percent less likely to work compared to a sister that is not yet a mom (Table 8, columns 4 and 5). We find no effects on hours worked for both groups of mothers, and income is reduced by 13.5 percent by young motherhood only (column 7). Overall, these results are in line with what previous literature has found in developed countries. Since we control for the selection on family unobservables, there are important changes in the estimated effect of both teen and young motherhood for the outcomes we analyzed.

Are effects different by poverty status?

In addition to estimating the average effect of adolescent and young motherhood, we performed an estimation of the family fixed effect model across women's poverty status to see if there are heterogeneous effects of early motherhood by income levels.²² Results for non-poor women are presented in Panel A of Table 9, while results for poor women are found in Panel B. We find that high school completion appears to be more affected among poor women (panel B) than non-poor ones (panel A). Having a child in adolescence reduces the likelihood of completing high school by 32 percent in poor households, compared to a 12 percent effect among women from non-poor households. For enrollment in post-secondary education, the effect is slightly larger for non-poor families in terms of point estimates, but the marginal effect is greater among poor women, who are 69% less likely to enroll in college as a result of a teen birth compared

²² We also estimated results by educational attainment of the grandmother, with similar findings as poverty status. Results are available upon request.

TABLE 8
EFFECTS OF ADOLESCENT AND YOUNG MOTHERHOOD ON EDUCATION AND LABOR MARKET
OUTCOMES: FAMILY FIXED EFFECTS

Outcome	High school diploma (1)	Post- secondary education (2)	Years of schooling (3)	Labor force participation (4)	Employed (5)	Hours worked (6)	Income (7)
Adolescent mother	-0.1186*** (0.018)	-0.1134*** (0.015)	-0.5091*** (0.114)	-0.0682*** (0.023)	-0.0446* (0.023)	-0.0581 (1.730)	-0.0761 (0.066)
Young mother	-0.0278* (0.016)	-0.0680*** (0.013)	-0.2580*** (0.085)	-0.1674*** (0.023)	-0.1127*** (0.022)	-1.0203 (2.486)	-0.1373** (0.058)
Observations	8,568	8,568	8,549	8,568	8,568	2,463	3,361
R-squared	0.027	0.028	0.026	0.059	0.048	0.043	0.063
Number of households	4,182	4,182	4,177	4,182	4,182	1,752	2,353
Outcome mean	0.6957	0.3301	11.7442	0.4869	0.3779	51.6512	11.4715
P-value F test equality of Motherhood	0.000	0.004	0.059	0.000	0.014	0.734	0.415
Fraction correctly predicted	0.6964	0.6699	0.0008	0.5532	0.6194	0.0008	0.0000

Data: Chile's CASEN surveys (1990, 1992, 1994, 1996, 1998, 2000, 2003, 2006, 2009 and 2011). Robust standard errors in parentheses; mean of outcome variable in italics. ***, **, and * indicate statistical significance at the 1%, 5% and 10% levels, respectively. Sample includes sisters aged 20-24 years living with parents. Additional controls include: woman's age, whether she is oldest sister, year of birth fixed-effects, and family fixed-effects. Constant not shown.

TABLE 9
EFFECTS OF ADOLESCENT AND YOUNG MOTHERHOOD ON EDUCATION AND LABOR OUTCOMES,
BY POVERTY GROUP - FAMILY FIXED EFFECTS

Outcome	High school diploma (1)	Post-secondary education (2)	Years of schooling (3)	Labor force participation (4)	Employed (5)	Hours worked (6)	Income (7)
A. Non-poor women (sisters aged 20-24)							
Adolescent motherhood	-0.0940*** (0.021)	-0.1198*** (0.021)	-0.5409*** (0.141)	-0.0981*** (0.028)	-0.0503* (0.028)	-0.0397 (1.957)	-0.0765 (0.075)
Nr. Observations	6,443	6,443	6,428	6,443	6,443	2,133	2,846
R-squared	0.022	0.028	0.035	0.066	0.050	0.053	0.065
Number of households	3,152	3,152	3,148	3,152	3,152	1,500	1,956
Outcome mean	0.7678	0.3938	12.3	0.5106	0.4242	51.6851	11.5912
B. Poor women (sisters aged 20-24)							
Adolescent motherhood	-0.1518*** (0.032)	-0.0945*** (0.020)	-0.3690* (0.217)	-0.0167 (0.040)	-0.0384 (0.038)	-0.0705 (4.798)	0.0452 (0.136)
Nr. Observations	2,125	2,125	2,121	2,125	2,125	330	515
R-squared	0.070	0.056	0.039	0.063	0.062	0.301	0.319
Number of households	1,038	1,038	1,037	1,038	1,038	253	399
Outcome mean	0.4772	0.1369	10.2	0.4151	0.2376	51.4324	10.8100

Data: Chile's CASEN surveys (1990, 1992, 1994, 1996, 1998, 2000, 2003, 2006, 2009 and 2011). Robust standard errors in parentheses; mean of outcome variable in italics. ***, **, and * indicate statistical significance at the 1%, 5% and 10% levels, respectively. Sample includes women aged 20-24 years living with their parents. Constant not shown. Additional controls: young motherhood, woman's age, dummy variable for whether she is oldest sister, year of birth fixed effects, and family fixed effects. Poverty is based on official poverty line definition.

to non-poor women, who are 30% less likely to enroll. For years of schooling we find a negative effect of 0.52 and 0.38 years among non-poor and poor households, respectively, as a result of a teen birth. Although point estimates are apparently different for all three educational outcomes across poor and non-poor households, they are not different statistically, which indicates that adolescent motherhood has similar effects on both groups of women.

In terms of labor market outcomes, we find evidence of heterogeneous effects on labor force participation and employment: while there are no significant effects of teen motherhood on labor force participation or employment of poor women, it reduces LFP and employment of non-poor women by 19 and 12 percent, respectively (these differences across poverty groups are statistically significant). These results indicate that the negative effect of adolescent motherhood on labor outcomes—at least on the extensive margin—is present only among non-poor mothers. Overall, this exercise reveals that adolescent motherhood has similar effects on education outcomes of women regardless of their poverty status, yet the negative effects on labor force participation and employment are only present for the non-poor.

Have effects changed through time?

One of the contributions of our paper is to use the span of the data, a 20-year period from 1990 until 2011, to study if the effects have change over time. In this period, Chile underwent significant political, economic and social changes that transformed the context in which adolescents make decisions regarding their human capital investments and their fertility. For instance, policies to increase secondary education coverage and higher education access were successfully implemented. The government augmented coverage and financial aid availability for students of tertiary education. Concurrently, access to public health services also increased, as well as access to childcare, which facilitated mothers' participation in the labor force (Contreras and Sepulveda, 2016; Berthelon *et al.* 2015).

To analyze whether and how the effects of teenage motherhood changed through time, we defined four different time periods (grouped as roughly 5-year periods that correlate with the waves of the CASEN surveys): 1990-1994 (3 waves in 5 years), 1996-2000 (3 waves in 5 years), 2003-2006 (2 waves in 4 years), and 2009-2011 (2 waves in 4 years). Then, we estimated family fixed-effects regressions in each of these different periods; results for all periods are reported in Table 10.

We find that during this 20-year period, the effect of adolescent motherhood on high school graduation disappeared: the difference in the probability of completing high school in the early 1990s was 0.17 lower (28 percent lower) for sisters that were teenage mothers compared to a non-mother sister, whereas by 2011, sisters that were teen moms and those without children had the same likelihood of finishing high school (Table 10, column 1).²³ The fact that the effect of teen motherhood on the probability of completing high school decreased over time and that by 2011 was not significant may be attributed to several institutional developments that occurred in Chile during this period. First, in July of 2000 a

²³ The decrease of estimated coefficient from -0.1665 to -0.0575 was statistically significant.

TABLE 10
EFFECTS OF ADOLESCENT AND YOUNG MOTHERHOOD ON EDUCATION AND LABOR OUTCOMES, BY PERIOD - FAMILY FIXED EFFECTS

Outcome	High school diploma (1)	Post-secondary education (2)	Years of schooling (3)	Labor force participation (4)	Employed (5)	Hours worked (6)	Income (7)
A. Period 1990-1994							
Adolescent motherhood	-0.1665*** (0.031)	-0.0844*** (0.023)	-0.6005*** (0.207)	-0.1557*** (0.044)	-0.1084** (0.045)	3.6888 (5.172)	-0.1680 (0.203)
Nr. Observations	3,020	3,009		3,020	3,020	587	1,256
R-squared	0.045	0.013	0.017	0.075	0.054	0.054	0.055
Outcome mean	0.5924	0.248	11.1	0.5179	0.4123	54.5585	10.987
B. Period 1996-2000							
Adolescent motherhood	-0.1518*** (0.032)	-0.0945*** (0.020)	-0.3690* (0.217)	-0.0167 (0.040)	-0.0384 (0.038)	-0.0705 (4.798)	0.0452 (0.136)
Nr. Observations	1,883	1,883	1,875	1,883	1,883	673	746
R-squared	0.032	0.03	0.027	0.066	0.054	0.038	0.066
Outcome mean	0.6612	0.2942	11.5	0.4965	0.3808	55.704	11.6546
C. Period 2003-2006							
Adolescent motherhood	-0.0897** (0.037)	-0.0786*** (0.027)	-0.2932 (0.244)	-0.0395 (0.049)	-0.0350 (0.048)	-3.8463 (3.249)	-0.1407 (0.116)
Nr. Observations	1,916	1,916	1,916	1,916	1,916	674	762
R-squared	0.035	0.021	0.023	0.047	0.053	0.064	0.064
Outcome mean	0.7677	0.3466	12.1	0.4932	0.3873	53.6355	11.7606
D. Period 2009-2011							
Adolescent motherhood	-0.0575 (0.044)	-0.2245*** (0.037)	-0.5895*** (0.239)	0.0218 (0.046)	0.0452 (0.046)	3.1049 (2.225)	0.1165 (0.129)
Nr. Observations	1,749	1,749	1,749	1,749	1,749	529	597
R-squared	0.015	0.072	0.065	0.063	0.047	0.075	0.118
Outcome mean	0.8325	0.4923	12.7	0.4162	0.3053	40.741	11.893

Data: Chile's CASEN surveys (1990, 1992, 1994, 1996, 1998, 2000, 2003, 2006, 2009 and 2011). Robust standard errors in parentheses. ***, **, and * indicate statistical significance at the 1%, 5% and 10% levels, respectively. Sample includes sisters aged 20-24 years living with their parents. Constant not shown. Additional controls: young motherhood, woman's age, dummy variable for whether she is oldest sister, whether she was a young mother at ages 20 to 24, year of birth fixed effects, and family fixed effects.

law was passed in Chile that gave pregnant and lactating adolescents the right to access and to remain in all educational institutions, which were obliged to make academic accommodations for pregnant and lactating students. This law led to a gradual decline of former practices of discrimination across Chilean high schools, whereby pregnant girls were expelled or where teenage mothers were not given flexibility to breast-feed their infants.²⁴ Additionally, in 2000 a scholarship program to retain low-income and at-risk students was initiated (*Beca de Apoyo a la Retención Escolar*, BARE), and low-income adolescent mothers and fathers were given priority in access to a wide network of public support programs, with the objective of promoting their high school completion.²⁵

Our by-period estimations also reveal that the negative effect of teen motherhood on higher education enrollment increased (*i.e.*, became more negative) during the period: in the early 1990s, women that became mothers in adolescence were 34 percent less likely to enroll in higher education compared to her sisters that were not teen mothers; by 2011, a teen birth reduced higher education enrollment by 46 percent (Table 10, column 2). As Table 10 reveals, the enrollment rate in higher education increased, from 25 percent in the 1990-1994 period to almost 50 percent in the 2009-2011 period. The increase in the negative effect of a teen birth could be due to the different income composition of the college population in the late 2010s compared to the early 1990s. In the earlier period, most women who were enrolled in higher education were from higher-income households, so that if they became teen mothers, they had the economic and logistic support of their (wealthier) extended family members and they could more easily enroll in a college or university. By 2011, due to greater access to higher education (higher coverage and more sources of financial aid), a greater proportion of college and university students were from lower-income households, who probably lacked the same levels of financial support of their family members if they became teenage mothers. Indeed, CASEN surveys reveal that in 1992, 60 percent of women aged 20-24 that were enrolled in a technical institute or university were from the top 20% of the income distribution; by 2011, the proportion of women from this income group had declined to 40 percent. Our estimations also show that the average effect of teenage motherhood on years of schooling completed did not change over the period; in both the earlier and latter periods, sisters who were teenage mothers had approximately 0.6 fewer years of education compared to non-mother sisters (Table 10, column 3).

The increase in university enrollment during this period was accompanied by lower labor force participation and employment rates of women in the age group we study (20 to 24 years). Our estimates reveal that in the earlier period, teenage motherhood reduced the likelihood of labor force participation and employment by 30 and 26 percent, respectively (Table 10, Panel A, columns 4 and 5), and by the latter period, teenage motherhood had no effect on mothers'

²⁴ See Law Number 19.688.

²⁵ These include subsidies (high school retention scholarship *Beca de Apoyo a la Retención Escolar*, BARE, and a family subsidy *Subsidio Unico Familiar*); specialized health services (*Espacios Amigables*), integral support program for low-income children, from ages 0 to 4; public child care centers; and several psychological and personal support groups (Mujer y Maternidad, SERNAM; Casas Integrales de Juventud, INJUV).

labor outcomes.²⁶ This change could be due to the large expansion of various publicly-provided child care services during the period, such as the full-day school reform that extended school days (began in 1997) and the public day care expansion policy that began in 2006. Greater access to child care makes motherhood and employment more compatible, so that by 2011, a teen birth—or any birth—in Chile does not affect mother's labor participation or employment. Finally, our results do not find significant changes in the effect of teenage motherhood on hours of employment or income over the period of study.

6. CONCLUDING COMMENTS

This paper analyzed the effect of adolescent motherhood on education and labor market outcomes of women aged 20 to 24 during the 1990-2011 period in Chile. Adolescent motherhood is an important public policy issue because of its high incidence: one of every five women—and one of every three poor women—in Chile becomes a mother before age 20. In addition, motherhood and pregnancy are the most important reasons that high-school aged women drop out of school.

Estimating the causal effects of teen pregnancy is challenging because motherhood is endogenous, and although there is a vast line of research in developed countries, only recently has research for Latin American countries begun to carefully identify the causal effects of teen motherhood. This is the first paper to do so for Chile.

Our identification strategy relies on estimating a model with family-level fixed effects that control for within family unobservables. Sisters exposed to the same family will have similar backgrounds and also similar unobservable characteristics. One limitation of this approach in developed countries to date is that samples of sisters' data are small and unrepresentative. We overcome this problem constructing a large sample of sisters from repeated rounds of CASEN household surveys, and given the cultural context, our sample is representative of about 75 percent of young women in the country. The other potential problem of the family fixed effects methodology is that it does not control for individual heterogeneity, however, existing evidence suggests that controlling for individual heterogeneity does not significantly change the estimated effects from a family fixed effects model (Holmlund, 2005); our estimates on a small sample of pseudo-twins confirm this finding.

Our results are similar to those in the existing literature: in as much as there exists a significant role for unobservables, OLS estimates cannot be viewed as capturing the causal effect of teen motherhood. When we control for selection into motherhood, the magnitude of the OLS estimates is reduced in half; nonetheless, even after controlling for selection, we find important, negative effects of teenage motherhood on mothers' education and labor outcomes.

We also explored whether the timing of motherhood—*i.e.*, during adolescence or shortly after—matters in terms of education and labor market effects. We find that the negative effects of motherhood on education outcomes are larger for teen-

²⁶ The difference in the estimated coefficients is statistically significant.

age mothers than for women who become mothers in their early 20s, yet having a child in the early 20s has larger negative effects on employment outcomes.

We analyze whether the effects of a teen birth were heterogeneous across poverty groups and whether they have changed through time. Our estimates suggest that the negative effects of adolescent motherhood on education outcomes are more negative for the poor, yet the point estimates are not statistically different from non-poor women. We find heterogeneous effects on labor market outcomes, at least for the extensive margin: teen motherhood has important negative impacts on participation and employment among the non-poor, but no effects among poor women.

We also find that the effects of teenage motherhood have changed through time. The negative impact of having a child in adolescence on secondary schooling outcomes declined or disappeared between the early period of our study (1990/1994) and the more recent years (2009/2011), which could be due to a greater number of public programs aimed at high school retention among high-risk teens, including teen mothers and fathers. In contrast, the negative effects on college and university enrollment are greater today than 20 years ago. These effects could be explained by the increase in coverage and financial aid for tertiary education. In other words, institutional changes move the timing of most dropouts from secondary to tertiary education, and consequently, the effect of teenage motherhood changed accordingly.

Additionally, the negative effects of adolescent motherhood on labor force outcomes disappeared between the first and last period we study, which are likely due to the growth in supply of various child care services—many of them publicly provided—during the 1990s and 2000s.

Overall, our results support the general consensus that teenage motherhood has important, negative effects on mothers' education and labor outcomes, and we extend this conclusion to a developing country context. Interestingly, our point estimates from both the OLS and family fixed effects strategies are very similar to the ones reported in Holmlund (2005) for Sweden and by Webbink *et al.* (2011) for Australia (for the sample of sisters).²⁷

Our results suggest that if adolescent motherhood could be delayed into the early twenties, the likelihood that mothers finish high school and enroll in post-secondary education—which has high private returns—would greatly improve, which would in turn improve their labor market opportunities. Delaying motherhood could also halt intergenerational transmissions of poverty, since children of adolescent mothers are more likely to be poor, engage in risky behaviors, and in the case of girls become teen mothers as well.

From this study we find that several questions require further research. First, our fixed effects estimation strategy would benefit from the inclusion of more variables that control for within-family heterogeneity, especially of factors that could affect educational and labor outcomes. Second, given our sample (women aged 20-24) our results provide insights on to the short-term effects of a teenage birth, particularly on labor market outcomes, however, it would also be interesting to learn about the effects in later periods of women's life (longer-term

²⁷ Holmlund (2005) preferred point estimates for years of schooling is -0.59, and in Webbink *et al.* (2011), depending on the estimated model, are around -0.3.

effects). Regrettably, for now, we lack the appropriate data to address both of these lines of research.

Another interesting line of research that our results point out is a more in-depth study on the causes of the disappearance of the negative effect of adolescent motherhood on high school graduation. In this paper we propose possible institutional explanations for this change, but further analysis is needed to determine which factors actually led to those changes. Finally, while the literature on the effects of teenage motherhood on mothers' and children's outcomes is large, less is known about the effect on fathers' outcomes, which could shed light on the extent of gender inequality and help shape appropriate policy interventions.

Although authorities recognize adolescent motherhood as a serious concern, Chile lacks a comprehensive, national public health policy to address the issue, and some of the sectoral policies are ineffective in practice—for example, all adolescents are legally entitled to zero-cost birth control options at public health centers, yet in practice teens are often discriminated and denied access (Casas and Ahumada 2009). Age-specific primary care centers oriented to adolescent health exist, but they are often inaccessible to the targeted population, their supply is limited, and the services offered have received mixed reviews. Additionally, qualitative studies reveal that adolescents in Chile don't seek timely guidance or contraceptive methods in the public health sector because of their perception that the primary care centers will not respect their requests for privacy.

Policies should be integrated across the public education and health sectors, and aim to educate adolescents to make informed fertility decisions, as well as provide adequate health services. Examples of education policies include programs on information about the health services available to adolescents, on contraceptive options, on the responsibilities of reproductive health choices, and on the benefits of remaining in school. Beyond providing information, any barriers teens face in acquiring reproductive health services—such as lack of access to age-specific services and lack of privacy and confidentiality—should be removed.

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