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Research Article

Adolescent fertility and high school completion in Chile: Exploring gender differences

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Abstract

OBJECTIVE
This study has two objectives: first, to estimate the effect of adolescent fertility on high school completion for Chilean adolescents, considering selectivity due to socioeconomic background and prior academic achievement, and, second, to explore the gender differences that exist in this effect.

METHODS
We use propensity score weighting and regression adjustment to estimate the average treatment effect on the treated groups. We employ a rich dataset built on several administrative sources, covering a cohort of students attending publicly funded schools from 2011 to 2018.

RESULTS
Considering the samples of men and women separately, we find that a teenage girl who experiences adolescent fertility is 13% less likely to complete high school, whereas the corresponding probability for a teenage boy is only 3%. As compared to boys, girls who experience adolescent fertility also have higher probabilities of delayed high school graduation and dropping out of school.

CONCLUSIONS
Our analyses indicate that the detrimental effect of adolescent fertility on high school completion is larger for girls than boys in Chile, after taking into consideration the selectivity due to socioeconomic origin and prior academic performance.

CONTRIBUTION
This is the first study in Chile, and probably the first in Latin America, that directly estimates the difference in the effect of adolescent fertility on educational outcomes for young men and women, considering issues of endogeneity due to treatment selection.

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Our results point to continuing gender inequity because adolescent mothers suffer more negative effects of fertility than adolescent fathers.

1. Introduction

Research on the consequences of adolescent fertility has been carried out for decades. Early studies show that adolescent fertility reduced educational attainment and suggested that consequent low human capital led to worse outcomes in terms of employment and income for those impacted (Card, Wise, and Morgan 1987; Moore and Waite 1977; Waite and Moore 1977). These interpretations were questioned because teenagers who get pregnant are typically not a random sample of adolescents but rather a selective group with limited socioeconomic resources. Thus, socioeconomic disadvantage, as opposed to adolescent fertility, was posited as the cause of poor educational outcomes for this group (Geronimus and Korenman 1992; Hotz, McElroy, and Sanders 2005). Indeed, initial research on adolescent fertility and educational outcomes did not include all the variables that determine educational outcomes, therefore overestimating the effect of adolescent fertility (Diaz and Fiel 2016; Kane et al. 2013).

The problem is complex: Getting pregnant (or having a child) and completing high school are endogenous events (Herrera and Pavicevic 2016), are both determined by the same variables. Yet, many of these variables are omitted from analyses because the available datasets do not include them – they are unobservable. Several techniques have been used to address this problem. In general, the research finds that the effect of adolescent fertility on educational outcomes is smaller than estimated in the initial articles on this subject, although it is still observable (Kane et al. 2013).

Most prior research on the association between adolescent fertility and educational outcomes focuses solely on women and is US-based. Indeed, research applying the techniques that deal with the selectivity of adolescent fertility in Latin America is scarce, even though the region has one of the highest rates of adolescent fertility in the world, exceeded only by sub-Saharan Africa (Rodríguez Vignoli, Di Cesare, and Páez 2017). Accordingly, to broaden the scope of research in this area, we investigate the association between adolescent fertility and high school completion considering both boys and girls in Chile. We use propensity score techniques to handle selectivity into adolescent fertility, and we consider selectivity due to prior educational performance and socioeconomic status, two variables that determine both high school completion and adolescent fertility.

In Section 2 we discuss previous research on adolescent fertility and educational outcomes, addressing the topic of endogeneity due to treatment selection, and we introduce the Chilean context under study. In Section 3 we describe the data sources and the analytical strategy we employ, and we present our results in Section 4. In Section 5 we highlight our main findings and discuss their implications.

2. Literature review

2.1 Educational outcomes and adolescent fertility: The issue of selectivity

Understanding fertility is one of the major goals of demography. Bongaarts's (1978) classic framework distinguished between proximate determinants – behavioral and biological factors that influence fertility directly – and a series of more distant determinants of fertility, including cultural, economic, and environmental variables that influence fertility through the proximate determinants. Buhr and Huinink (2014), in a more recent paper, make the distinction between external determinants of fertility that encompass contextual variables that determine fertility (such as economic or institutional constraints at the national or regional level, or social relationships) and internal determinants that encompass individual characteristics (such as values and aspirations). Similarly, Balbo, Billari, and Mills (2013) distinguish between macro-, meso-, and micro-determinants of fertility.

In terms of adolescent fertility, Pantelides (2004) proposes a four-level framework that distinguishes between macrosocial factors (such as the system of stratification in a society on the basis of socioeconomic status, gender, or race and ethnicity), meso-factors (such as urban or rural status, family structure, and the influence of peers), individual features that are directly observable (such as age, race and ethnicity, and educational attainment), and subjective features (such as perceptions, attitudes, and knowledge about gender roles, sexual behaviors, or contraception).

Pantelides (2004) highlights that most research has dealt with the meso-, individual, or subjective determinants of fertility. For instance, research shows that Latin American teens living in rural areas are more likely to get pregnant than those living in urban areas (Rodríguez Vignoli 2014; Santos 2009). Vast literature focused on US cases indicates that adolescents from nonintact families (i.e., any family structure in which both parents are not present) are more likely to bear children (Kane et al. 2013; Pantelides 2004). Other literature shows that the likelihood of teenagers becoming parents increases as they get older (Elo, Berkowitz, and Furstenberg 1999) and that adolescent fertility is more probable among ethnic minorities (Almeida, Aquino, and Barros 2006; Buhr and Huinink 2014). Note that all the variables examined in these studies are also related to educational achievement.

There is abundant research addressing the issue of the endogenous relation between adolescent fertility and educational outcomes due to treatment selection. Notably, the selection into the 'treatment' (teen childbearing) and 'control' (childlessness) groups is not random because adolescent fertility is more frequent among the most socially disadvantaged adolescents, who tend to perform worse academically and are more likely to have poor educational outcomes even if they do not experience adolescent fertility. As a result, estimates of the treatment effect on educational outcomes that do not deal with this problem are typically biased (Kane et al. 2013). In one of the first studies to point to this bias, and using analytic samples of sisters from a nationally representative US survey (where one sister became a mother in adolescence and the other did not), Geronimus and Korenman (1992) show that the consequences of adolescent fertility on several domains of variables, including high school graduation, are largely reduced after controlling for preexisting family and socioeconomic backgrounds.

More recent studies control for a broad domain of variables related to the adolescents' skills and backgrounds. These include different measures of family socioeconomic status (SES), such as the income-to-needs ratio, parents' education, or parents' occupational status; family-related variables, such as an intact or nonintact family background, having a mother who experienced adolescent fertility, or having a sister who became a teenage mother; and skills-related variables, typically measured using standardized tests of either cognitive, verbal, or mathematical abilities (Diaz and Fiel 2016; Ferre et al. 2013; Kane et al. 2013; Lee 2010; Marteleto, Lam, and Ranchhod 2008; Ranchhod et al. 2011).

Beyond controlling for correlated predictors, several strategies have been proposed to address selectivity and more adequately estimate the effect of adolescent fertility on educational outcomes. Both the instrumental variable approach and fixed-effect models are more appropriate for causal analysis because they not only handle selectivity due to observable variables but also take unobservable variables into consideration. Instrumental variable models involve a two-stage least squares estimation. In the first stage several exogenous predictors and at least one instrumental variable (such as miscarriage or spontaneous abortion) are used to model the endogenous variables (teen childbearing). In the second stage predicted values from the first model are used instead of pregnancy to model educational attainment, controlling for other exogenous variables.

Fixed-effect models typically use samples of siblings to include the effect of unobserved variables before the pregnancy, which are shared between sisters and determine both adolescent fertility and educational attainment. This strategy requires samples of siblings where one experienced adolescent fertility and the other(s) did not. The data requirements for both these approaches are often difficult to meet – either because the data does not include information about potential instruments or because the samples of sisters are not available. Moreover, data restrictions limit the generalizability of these types of models (Lee 2010).

Propensity score matching (PSM) is another technique used to estimate the effect of adolescent fertility on educational outcomes. It also involves a two-stage procedure. First, the probability of becoming a teen parent for each adolescent in a given sample is predicted using a propensity score, which summarizes the effect of a set of preexisting determinants of adolescent fertility. Second, matched 'pairs' of treated and control cases are formed using their predicted propensity scores. The effect of the treatment on educational outcomes is estimated by averaging differences within pairs (Diaz and Fiel 2016), comparing the attainment of similar adolescents who did and did not become parents. PSM does not, however, solve the problem of selectivity due to unobserved variables – it can only handle the bias in the estimation of the treatment effect due to the observed variables included in the estimation (Stuart and Rubin 2007). That said, the PSM approach makes fewer parametric assumptions, and the data requirements are less complex than the other approaches, which is an advantage in terms of the generalizability of the results (Diaz and Fiel 2016).

Most of the research on adolescent fertility and educational outcomes that addresses selectivity into treatment has been conducted on girls. There are several studies, however, that either focus on the association between adolescent parenthood and education for men or consider both sexes. In general, these studies show that the variables associated with parenthood and poor educational outcomes tend to be the same among men and women (Pirog and Magee 1997; Assini-Meytin and Green 2015; Futris et al. 2012; Mollborn 2010).

Futris and colleagues (2012) find a socioeconomic gradient among teen fathers who dropped out of school and stayed out, dropped out and returned, and did not dropout – the latter being more common among young men with more socioeconomic resources. Some studies point out that the effects of parenthood are harsher on young women than men, although it is not clear if this gender disadvantage persists over time. Pirog and Magee (1997) find that the probability of completing high school at age 19 is lower for girls who became teenage mothers than for boys who became teenage fathers; however, they also find that by age 26 the probability of having completed high school after becoming a parent in adolescence is actually lower for men than women, which suggests that adolescent mothers are more able to catch up than adolescent fathers. Conversely, Mollborn (2010) finds no gender differences in the probability of having graduated from high school at age 26 between men and women who experienced adolescent fertility.

Assini-Meytin and Green (2015), using PSM and a sample of low SES African Americans between the ages of 6 and 42, conclude that women experience the most severe consequences of adolescent fertility, both in young adulthood and in midlife, not only in terms of educational attainment but also in terms of poverty, unemployment, and welfare dependence. Moreover, the study suggests that, when considering disadvantaged ethnic minorities, the effects associated with adolescent fertility (and the gender gap in those effects) may be enduring over time. Johansen, Nielsen, and Verner (2020), studying a quite dissimilar population sample, reach a different conclusion. Using fixed-effect models to compare Danish boys and girls who did experience adolescent fertility with those who did not, they find that the effects of adolescent fertility are more severe for girls than for boys in the short term. By age 35, however, they find evidence of adolescent mothers having been able to catch up in educational outcomes but no evidence of educational catch-up among adolescent fathers.

Notably, the literature also reveals that gender norms may intervene in the association between adolescent fertility and educational outcomes. Mollborn (2010) finds that gender moderates the association between parenting responsibilities and educational outcomes. Specifically, primary caregiving responsibilities are associated with lower chances of graduating from high school for mothers but not for fathers; and working is associated with lower chances of finishing high school for fathers but not for mothers. A similar result is presented in a Brazilian study by Almeida, Aquino, and Barros (2006). They find that teen pregnancy is a frequent antecedent of becoming a school dropout for both boys and girls, but the reasons for justifying dropping out are gender-specific. The main reason for dropping out reported by mothers is pregnancy, whereas the main reason reported by fathers is work. Luttges and colleagues (2021), in a qualitative study, and considering only adolescent mothers in Chile, report that the girls in the study tended to view fathers as secondary help with the daily tasks of childcare and deemed the most important type of support from the father to be financial.

2.2 The Chilean context

In this section we briefly summarize recent adolescent fertility trends in Chile, we characterize the country's educational system, and we discuss previous research on adolescent fertility and educational outcomes at the national level.

Adolescent fertility in Chile consistently declined between 2008 and 2018, decreasing from 53 to 23 births per 1,000 girls aged 15 to 19 years old (Rodríguez Vignoli and Roberts 2020).[3] As a point of comparison the average adolescent fertility rate for Latin America between 2015 and 2020 was 61 (Pan American Health Organization 2020). In Chile the decline in adolescent fertility began in the mid-1960s (together with the total fertility rate); however, the evolution of the decline has been irregular, with periods of increase and decrease, as has been the case in Latin America as whole. Chile

[3] This decline is certainly related to increased contraceptive use among adolescents. See Rodríguez Vignoli and Roberts (2020) and Nuevo-Chiquero and Pino (2019).

and the region also show marked socioeconomic inequality in adolescent fertility (Rodríguez Vignoli 2011). Although the recent and persistent decline in adolescent fertility is impressive in regional terms, the 2018 adolescent fertility rate in Chile was still higher than in the United States (18.6), the United Kingdom (12.6), and Spain (7.5), and it was much higher than countries like the Netherlands (3.7), Switzerland (2.6), and North Korea (0.3), which are among the lowest rates in the world (World Bank n.d.).

Despite the overall decline in the adolescent fertility rate, social inequality in this realm persists. Using data from representative household surveys in Chile, Rodríguez Vignoli and Roberts (2020) estimate that in 2011 a girl aged between 15 and 19 years from a household in the first (lowest) income decile was 11 times more likely to become a mother than one from a household in the tenth (highest) income decile. In 2017 this probability had increased to over 60 times more likely. The widening gap can be explained because, although the rate decreased across the board during the 2010s, the decline in adolescent fertility was more pronounced among well-off teens.

Access to abortion is restricted in Chile for women from any age group. All forms of abortion were prohibited until Law 21030 was passed in 2017, which allowed the procedure on three grounds: a severe threat to the women's health, fetal unviability, and rape. Adolescents are overrepresented among women who request an abortion due to rape (Corporación Humanas 2020). Using data collected prior to the abortion reform, a study by Huneeus et al. (2020) estimates that about 5% of Chilean women aged between 15 and 29 have had an induced abortion. It also suggests that access to abortion is socioeconomically determined, as women from high SES backgrounds were five times more likely to declare they had an abortion than women from low SES backgrounds.

The picture is less clear regarding cohabitation among adolescent parents. Our own estimates (available upon request) made using the Encuesta de Caracterización Socioeconómica Nacional (CASEN 2017), the main household survey in Chile, indicate that only 14% of adolescent mothers cohabit with the father of their child. Out of these cohabiting fathers, 30% are adolescent and 53% are between 20 and 24 years old. The most common situation is for adolescent mothers to live with extended family (i.e., their own parents). Only 11% of adolescent mothers live in nuclear households. Given this context, adolescent mothers are more likely to rely on their own mother than on the child's father for help with childrearing (Salinas 2010; Moore and Brooks-Gunn 2002). In addition, public policy in Chile does not reward adolescent fathers for living with their children or facilitate this circumstance. On the contrary, women who do not live with their child's father rank higher in the eligibility criteria for social programs because they are considered to be more vulnerable (Ramm 2016).

This situation is quite different in other countries. Johansen, Nielsen, and Verner (2020) report that adolescent parents in Denmark have access to state-subsidized free childcare and grants to help them attend high school. And fathers are obligated to support the child until they turn 18, either by living with the child at least half of the time or by paying child support. If one or both parents are the beneficiaries of social programs, parents living with their children receive extra child benefit payments. Plainly speaking, the institutional setting matters when considering the family arrangements of adolescent parents.

Access to secondary and higher education has been steadily increasing in Chile in recent decades (Hofflinger and von Hippel 2020). Secondary education comprises the ninth to twelfth grades and has been compulsory since 2006. According to the 2017 census, 75% of the population aged 25 years or older has at least a high school diploma (National Statistics Institute of Chile 2018). Consequently, a high school diploma is a minimum requirement for most jobs, even ones that involve routine tasks. In addition, considering the two educational levels that are compulsory (primary and secondary education), secondary schooling has the highest rates of return to education and the provides the best prospects for social mobility in Chile (Améstica, Llinas-Audet, and Sánchez 2014).

School dropout rates are relatively low as compared to other Latin American countries (CEPAL 2002). Dropout rates were between 1.4% and 2.4% in 2018.[4] Dropping out is more likely during secondary school, with the highest rates in grades 9, 11, and 12 (Ministry of Education of Chile [MINEDUC] 2020). Dropping out is more common among low-income students and students living in rural areas (Santos 2009), and it is more prevalent among boys than girls (MINEDUC 2020).

There are three types of schools in Chile, categorized by the type of funding and administration: public, private subsidized, and private nonsubsidized schools. The first two types are state funded through education vouchers – a subsidy paid according to student attendance. Public schools are administered by local municipalities, and private subsidized schools are administered by private parties. Private nonsubsidized schools are funded entirely by tuition fees (Bellei and Cabalin 2013). About half of the enrolled students attend private subsidized schools, one-third attend public schools, and less than one-tenth attend private schools (MINEDUC 2019). Students in private schools obtain much higher scores on standardized assessments of learning (Bellei and Cabalin 2013) and have higher chances of attending the country's best universities (OECD 2017). Accordingly, Bellei (2013) defines the Chilean school system as hyper-segregated. The association between adolescent fertility and education is therefore quite relevant in Chile because adolescents with higher chances of becoming parents in their teens are more likely to be receiving an education of inferior quality.

Most of the prior research on adolescent fertility and educational outcomes in Chile has not addressed issues of selectivity into treatment. Past studies rely mainly on cross-

[4] A student is considered to have dropped out if he or she was enrolled one year but is not enrolled the next year and has not obtained a high school diploma.

sectional data, either from censuses, surveys, or clinical, nonrandom samples. Rodríguez Vignoli and Roberts (2020), using survey data and focusing on women who had just finished their adolescence (aged 19 and 20 years old), show that 60% of women who did not obtain a high school diploma were mothers. Clinical studies also note the lower educational attainment of adolescent mothers, with some authors arguing that the probable cause is social vulnerability as opposed to fertility. For instance, interviewing teenagers who had given birth in a maternity ward, Molina et al. (2004) find that, of the teen mothers that had dropped out of school, 40% did so before getting pregnant because of financial difficulties or problems at home, whereas the remaining 60% dropped out during pregnancy because of the stigma attached to teen pregnancy or due to pregnancy complications.

To our knowledge, three previous studies on the relation between adolescent fertility and educational outcomes in Chile address the issue of endogeneity due to treatment selection. Berthelon, Kruger, and Eberhard (2017) employ a fixed-effect approach on a sample of sisters using longitudinal data from CASEN household surveys between 1999 and 2011. They find that adolescent motherhood reduces the probability of completing high school by 16% among women aged between 20 and 24. The study makes an important contribution to the understanding of the causal relation between adolescent fertility and educational outcomes in Chile, but it has limitations in terms of the generalizability of the results. The analysis is restricted to siblings (women between 20 and 24 years old) living with their parents in families in which one sister had a child during adolescence and the other did not. This selection method likely excludes young women not living with their parents (perhaps because they gave birth during their adolescence), as well as women from families in which both (or all) sisters had a child during adolescence.

Using the same (CASEN 1999–2011) data with the addition of the 2013 CASEN survey data, Berthelon and Kruger (2017) conduct a similar study, but they use PSM. They estimate that the chances of completing high school are 23% lower for women who had a child during adolescence as compared with those who did not.

Salinas and Jorquera (2021) use the Chilean government's National Youth Survey from 2015 and implement another propensity score analysis technique – namely, propensity score weighting. They analyze both young men and women and conclude that the probability of dropping out of high school for young women who become mothers in adolescence is 16% higher than it would have been if they had remained childless. The corresponding effect for young men is 10%.

The gender difference that Salinas and Jorquera find is in line with previous descriptive analyses focusing on Chile, which compare the life course trajectories of men and women after having a child during adolescence and suggest that adolescent fertility has a stronger impact on the educational careers of women than men. Using survey data, Madrid (2006) reports that half of the teenage fathers interviewed said they dropped out of school in order to work and that more than half of the teenage mothers said they stopped schooling in order to look after their child. Molina et al. (2004), in another study based on survey data, conclude that motherhood is the main reason that young women drop out of school, whereas the main reason for young men is economic issues.

Qualitative evidence from Chile points in the same direction. Sadler and Aguayo (2006) find that young men and women who had a child in their teens face difficulties continuing their educational careers but for different reasons. Teen fathers associate fatherhood with the necessity to financially provide for their children, whereas teen mothers associate motherhood with domestic tasks and childcare. These findings are consistent with Mollborn's (2010) interpretation of US-based qualitative research. Increased adherence to traditional gender roles occurs as a reaction against the increased societal acceptance of the involvement of men in childcare, a perspective that is strongly diffused through the mass media (Miller 2011; Olavarría 2001; Valdés and Godoy 2008; Mollborn and Jacobs 2015). Young men may therefore perceive changes (and contradictions) in societal expectations relating to their role as a father, which could produce some discomfort – that is, they may find it difficult to combine their desire to be a present and loving father with the expectation (and the reality) as regards providing for and protecting their families.

This cumulative evidence provokes certain questions regarding gender differences in the association between adolescent fertility and high school completion in Chile. Our approach brings several novelties to this area of research. Instead of using PSM to address the issue of endogeneity due to treatment selection using propensity score techniques, we use a combination of propensity score weighting and regression adjustment. This allows us to use the full sample and avoid the biases that often emerge as a result of the PSM technique. Moreover, we bring men into the discussion, and we explore these issues in a Latin American setting, a region with few studies that estimate the effect of adolescent fertility on educational outcomes considering the issue of selectivity. We also directly test for gender differences in the effect of adolescent fertility on educational outcomes, which Salinas and Jorquera (2021) did not do. And, whereas most previous studies on the association between adolescent fertility and educational outcomes have relied on survey data, we use a large and rich dataset built from several administrative sources. Finally, we follow a complete cohort of young Chileans who attended publicly funded schools (i.e., public and private subsidized) over a period of up to eight years. Given the segregated nature of the Chilean education system, this means we are able to focus on the groups with the highest chance both of experiencing adolescent fertility and of dropping out of high school.

3. Data and methods

3.1 Data

We used a rich dataset built from three administrative sources: the SIMCE (Sistema Nacional de Medición de la Calidad de la Educación [National System for the Measurement of Education Quality]), the Center for Research at the Ministry of Education (MINEDUC), and the JUNAEB (Junta Nacional de Auxilio Escolar y Becas [National School Support and Scholarships Board]). SIMCE is a national student testing system that assesses student performance using standardized tests in various grades and subjects. Tests are carried out in all schools in Chile and are taken by every student present on the day of test. In addition, questionnaires are sent to primary caregivers as part of the SIMCE, collecting sociodemographic information and other data about the students' families. We used the 2011 test scores obtained by eighth-grade students and the questionnaire information from the same year. MINEDUC's Center for Research provided grade-level datasets covering 2011 to 2018, which include information about each enrolled student's attendance and end-of-year status (e.g., passed grade, held back, dropped out), as well as school-level information. JUNAEB is a public body that provides scholarships, grants, and other types of support to Chilean students. It keeps registers of all students who receive benefits, which are provided only to students attending publicly funded schools. We used data from the JUNAEB's National Register of Pregnant Students, Mothers and/or Fathers, covering the 2011–2018 period, and their School Vulnerability Index (explained below).

The three data sources use the same variable to identify the students, which allows the sources to be combined. Because JUNAEB does not provide benefits to students who attend private schools or retain data on these students, we limit our analysis to students in publicly funded schools (i.e., public and private subsidized). Given that adolescent fertility is strongly associated with SES in Chile, most teen mothers, teen fathers, and pregnant students are more likely to attend publicly funded schools. Hence, even though our data excluded high SES teens because the sample included public and private subsidized schools, we still had variability in terms of the socioeconomic resources of the sample. And we were therefore able focus on the groups in which adolescent fertility and poor educational outcomes are more likely to occur.

We started by selecting the sample of eighth-grade students who achieved a valid score in the 2011 SIMCE math test and attended a public or private subsidized school (n = 98,610 girls and 98,034 boys). This data was combined with the questionnaire information. We then merged the data with the 2011 grade-level dataset to obtain baseline characteristics of the schools these students attended, and that data was merged with the 2011 JUNAEB National Register of Pregnant Students, Mothers and/or Fathers to exclude the students who already had a child before 2011 or were pregnant at the time (n = 124 girls and n = 21 boys). Next, we tracked the students in this cohort through the 2012–2018 JUNAEB and grade-level registers to obtain information about the students' fertility and their status in the system (passed grade level, held back, dropped out). Provided they advanced as expected, with no repetition or interruptions, the expected high school graduation year for students for this cohort was 2015. Because we had data until 2018, however, we were able to observe temporary interruptions and returns to school.

Our main dependent variable was high school completion status (up to 2018, completed/noncompleted). We also considered an outcome distinguishing between students who graduated on time (in 2015), who graduated with some delay, who dropped out, and who were still enrolled in the system in 2018.[5] This variable allowed us to measure the ability of young parents to catch up in educational terms – building on previous research – although over a shorter time frame. Our treatment variable was the fertility measure, a dichotomous indicator identifying students who were included in the JUNAEB National Register of Pregnant Students, Mothers and/or Fathers for any year between 2012 and 2018. The covariates were prior academic performance, student family characteristics, student school characteristics, and a few control variables for student individual characteristics. All variables were measured in 2011.

Prior academic performance was a categorical variable classifying the students' math test scores as advanced, intermediate, or basic (this variable was derived from the SIMCE, which defines the thresholds for each category with the aim of translating student scores into achievement levels). The family variables were family structure, parental education, and ethnicity. Family structure was a dichotomous indicator identifying students who lived with both parents (i.e., in an intact family) in 2011. Parental education measured the educational achievement of the student's mother or father (whichever parent had the highest attainment) using three categories: did not graduate from high school, graduated from high school, and attended a higher education institution, including technical institutions (irrespective of whether the course was completed or not). We proxied student ethnicity using answers from the SIMCE questionnaire. If a primary caregiver reported that the mother or father of the student identified as a member of an indigenous group, the student was deemed to be indigenous.[6]

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[5] We considered dropouts to be those who (a) had not been enrolled during the previous three years, and (b) who were enrolled in 2016 or 2017 but were not enrolled during 2018 (the last observation year).

[6] Caregivers were asked whether the student's mother or father belonged to any of the following indigenous communities in Chile: aymara, quechua, rapa nui, mapuche, atacameño, coya, kaweskar, diaguita, and yagán. The SIMCE questionnaires provided information about only parental indigenous identification, not about the students' own identity. We recognize that indigenous self-identification and categorization by others is a complex and somewhat problematic issue.

The school variables came from the 2011 grade-level dataset and from the JUNAEB records. From the grade-level dataset, we obtained the following variables: type of school (public or private subsidized), location of school (urban or rural), size of school (small, midsize, or large, as measured by the number of students enrolled in each school and defined by tertiles of the number of students enrolled), and geographic region of school (Northern Chile, Central Chile, or Southern Chile). For the school vulnerability variable, we used the School Vulnerability Index complied and published annually by JUNAEB to classify schools. To create the index, students are classified into three levels (called "priorities") according to their poverty level and their likelihood of scholastic failure.[7] The first priority level identifies students in severe poverty; the second and third priority levels identify students that may be prone to scholastic failure. The final index adds up the number of students in each of the three priority levels and divides it by the total number of students enrolled in the school to determine the school's vulnerability. The results are multiplied by a hundred to ease interpretation (JUNAEB n.d.). We classified the schools in the index as low, medium, and high vulnerability by tertile using the 2011 index. We controlled for student sex, year of birth, and special educational need status. The latter was a dummy variable that identified students registered as having 'special educational needs' or being in a 'differential group' within the classroom. These student variables were obtained from the 2011 grade-level dataset.

A few covariates from the SIMCE questionnaires had missing values. This was mainly because 7,041 caregivers of girls and 8,614 caregivers of boys did not return a completed questionnaire. The highest number of missing answers were for the indigenous parent indicator (16,395 in the girls' sample and 18,653 in the boys' sample), then parental education (8,240 and 10,019), and then family structure (7,041 and 8,614). There were also a few missing cases in the School Vulnerability Index (568 and 563).

To reduce missingness in the parental education and parental indigenous identification covariates, we used the 2007 SIMCE standardized assessments and questionnaires for primary caregivers, which provided data on the same student cohort when they were in the fourth grade. In this way, we recovered a significant number of cases in the sample of girls (4,027 for mother's education, 4,762 for father's education, and 5,943 for parental indigenous identification) and in the sample of boys (4,410 for mother's education, 4,884 for father's education, and 6,169 for parental indigenous identification). In cases where missing values were not able to be filled, our statistical approach dealt with missing variables in the covariates (explained below).

[7] Scholastic failure is defined by three components: low grades, high nonattendance, and a high probability of dropping out of school.

3.2 Analytical strategy

We began our analysis with a description of the sample according to gender. We then proceeded to the propensity score analysis. Specifically, we used propensity score weighting and regression adjustment. Although propensity score weighting is not as frequently used as PSM, it overcomes one of its noted weaknesses – namely, PSM does not use the complete sample. When performing PSM, subjects in the control group may be excluded because of the use of a caliper and because of balance-related decisions made by the researcher regarding the number of control cases that are to be matched to a treatment case. Moreover, treated subjects may be discarded if a control group match cannot be found (Stone 2013).

Using propensity scores to weight the data and run different types of models – the strategy we adopted – means that all the subjects in the sample are included and that the statistical power to detect treatment effects is maintained. By using the propensity scores as weights, we downsized the importance of certain cases based on their propensity scores (Olmos and Govindasamy 2015). If there are missing values in the covariates, this procedure constructs weights that also balance missingness in the treatment and control groups (Ridgeway et al. 2021). Although this feature makes propensity score weighting a more attractive technique, we estimated different PSM models in order to better assess the difference and provide a comparison. We chose propensity score weighting as our preferred strategy because it yielded the best balance.

Our procedure was undertaken in three stages. In the first stage we used a generalized boosted regression for modeling the probability of being in the treatment group (adolescent fertility), and we obtained propensity scores from that model. It has been argued that generalized boosted regression is superior to logistic regression as an estimation model for propensity scores (Ridgeway et al. 2021). We used the covariates listed in Section 3.1 (prior academic performance, family structure, parental education, parental ethnicity, school type, school size, school vulnerability, school location [urban or rural], school geographical location [Northern, Southern, or Central Chile], student birth, and differential educational needs) for the generalized boosted regression model.

In the second stage we assessed balance, defined as the similarity of the distributions of the full set of covariates between the treatment and control groups (Stuart 2010), and we compared standardized effect sizes, computed for each covariate as the difference between the mean for the treatment group and the mean for control group, divided by the standard deviation of the full treated group.[8] The balance of covariates with missing values was assessed separately. As mentioned, we compared our results to the balance obtained using other propensity score strategies (nearest neighbor matching with different calipers, pair matching, and full matching) and verified that our strategy had the best

[8] We also checked the Kolmogorov-Smirnov (KS) statistics. Results are available upon request.

balance. When the balance had been assessed, the estimated propensity scores were used to obtain weights. The weight of each treatment case was 1 and the weight of each control case was $w_i = 1 / (1 - p(x_i))$. Thus, control cases with features that were dissimilar to treatment cases were given small weights, whereas control cases with features that were very similar to treatment cases were given larger weights (Ridgeway et al. 2021).

In the third stage, we modeled the outcome – high school completion – by implementing a generalized linear model (GLM) and using the identity link function.[9] We included the same covariates in this outcome model as those used in the propensity score model. The combination of propensity score weighting and regression adjustment is known as doubly robust estimation (Funk et al. 2011). Using covariate adjustment allows the models to account for small residual biases and increases efficiency in the estimates (Stuart and Rubin 2007), whereas the propensity score weighting helps to account for any nonlinearities or functional form problems in the regression controls (Curtis et al. 2007). Our models were estimated using clustered standard errors by school.

In addition to obtaining an estimate of the effect of adolescent fertility on high school completion for young men and women that handles the issue of selectivity, we investigated whether this effect is stronger among boys or girls. Following the work of Green and Stuart (2014) on how to combine propensity score methods with moderation analysis, we performed two sets of analyses.[10] The first analysis estimated the propensity score separately for men and for women and estimated the average treatment effect on the treated (ATT) separately. The second analysis estimated a propensity score on the pooled sample of men and women, and the ATT was estimated for the joint sample. It also included an interaction between the treatment effect (adolescent fertility) and gender. The first specification allowed for a more direct dialogue with previous results about the effect of adolescent fertility on educational outcomes in Chile, which have focused only on women. The second specification allowed for testing to determine whether the effect of adolescent fertility on high school completion is higher among girls than boys.

As specified previously, an alternative outcome was also considered: high school status at the end of the observational period (i.e., 2018). Because it was a four-category variable (timely graduation, delayed graduation, dropped out, and enrolled in 2018), we implemented the same analysis as with high school completion, but in the last stage we applied a multinomial logistic regression model using those who graduated on time as

[9] A GLM with an identity link function is equivalent to a linear probability model. The developers of the package we used in R (twang) use the GLM terminology. We maintained their terms for consistency. We estimated the same models using the logit link. The results are consistent and are available in the Appendix (Table A-4).

[10] Green and Stuart, however, explore moderation with full matching, not propensity score weighting, and they estimate five combinations for the estimation of the propensity scores and matching, either within subgroups or jointly, and with or without interactions. We did not follow their procedure exactly, but their ideas were a starting point to test our two specifications.

the reference category. For these models, we present relative risk ratios (RRRs) for ease of interpretation. We conducted a sensitivity analysis[11] for all results to assess how robust the estimated treatment effect was to unmeasured confounders.

Given that the administrative data covered practically all the students attending publicly funded (public and private subsidized) schools in Chile, we did not use sample weights in our analyses. All the analyses were performed using the statistical software R (Ridgeway et al. 2021).

4. Results

Table 1 synthetizes the characteristics of our sample according to sex. Three-quarters of the cohort under study obtained a high school diploma within the seven years we observed, and 3% experienced adolescent fertility. Our main outcome – high school completion, either timely or delayed – was higher among girls than boys. When looking at the high school status at the end of the observed period, the most noticeable differences between boys and girls are in timely graduation (as opposed to with a delay) and in dropping out. Girls were less likely to drop out and more likely to graduate on time than boys. Notably, the percentage of boys and girls in this cohort still enrolled in high school in 2018 was marginal; we do not, therefore, devote much attention to being enrolled in 2018 in the rest of the analysis.

We found adolescent fertility to be higher among girls than boys. Even though only 5% of the adolescent girls in the cohort we studied became mothers – consistent with the declining adolescent fertility rate in Chile – that figure is more than three times the percentage of adolescent boys who became fathers. This could imply that adolescent fathers share a minority of births with teen mothers. For context, Vital Statistics data administered by the National Statistics Institute of Chile (INE) indicates that 39% of the fathers of the babies born in 2019 to adolescent mothers were adolescents themselves, but 44% were between 20 and 24 years old.[12] US-based research has also found that adolescents father a minority share of births with teen mothers and that most men who father children with teenage mothers are in their early twenties (Elo, Berkowitz, and Furstenberg 1999; Futris et al. 2012). Still, our results could reflect some misreporting and perhaps even unawareness of paternity on the part of fathers.

In Chile it is mandatory for the birth certificate of a child to include information about the baby's father. If paternity is not acknowledged at birth, the father is determined through civil proceedings, which includes the use of DNA tests to prove paternity. That said, our own calculations on the basis of INE Vital Statistics for 2019 indicate that no

[11] Available upon request
[12] Calculations available upon request

information about the baby's father is provided for about 20% of births. It is certainly possible that some of those unregistered fathers are adolescents.

Table 1: Sample description (n = 196,499)

	Male	Female	Total
High school completion***	72.4	80.2	76.3
High school status (2018)***			
Graduated on time	62.5	70.3	66.4
Delayed graduation	9.8	10.0	9.9
Still in system	2.5	1.9	2.2
Dropped out	25.2	17.8	21.5
Motherhood/fatherhood***	1.41	5.1	3.3
Prior achievement***			
Basic	65.3	70.4	67.9
Intermediate	25.1	22.2	23.6
Advanced	9.6	7.4	8.5
Total	100.0	100.0	100.0
Intact family***	51.7	50.5	51.1
Parents' education***			
Less than high school	30.5	31.6	31.1
High school graduate	39.6	39.2	39.4
Some higher education	29.9	29.2	29.6
Total	100.0	100.0	100.0
Indigenous parents*	9.5	9.2	9.3
Public school***	48.3	46.5	47.4
School in rural area***	10.7	9.8	10.3
School size***			
Small	33.4	30.3	31.9
Midsize	33.3	34.1	33.7
Large	33.3	35.6	34.4
Total	100.0	100.0	100.0
Region			
Northern	13.3	13.4	13.4
Central	71.4	71.0	71.2
Southern	15.3	15.6	15.4
Total	100.0	100.0	100.0
School's index of vulnerability			
Low	34.1	34.2	34.1
Medium	33.9	33.9	33.9
High	32.0	31.9	32.0
Total	100.0	100.0	100.0
Mean year of birth***	1997.1	1997.2	1997.2
(std. dev.)	(0.003)	(0.002)	(0.002)
Differential needs**	9.5	9.1	9.3

Note: Chi square tests of statistical independence for all covariates but year of birth (which corresponds to a t test for differences in means).

Prior academic achievement was slightly higher among boys than girls, and most Chilean boys and girls achieved only a 'basic' level of performance in the 2011 SIMCE math test. Regarding family structure, half of the sample lived with both parents at baseline. And, in terms for parental education, 40% of parents held a high school diploma, and less than one-third had attended a higher education institution. Around 10% of the students' parents identified as belonging to an indigenous group, a similar percentage of students attended schools located in rural areas (i.e., 90% attended school in an urban area), and about half of the students were enrolled in a municipal public school at baseline. Most of the students attended schools located in Central Chile, where most of the country's population is concentrated. Because of the way we incorporated the school size and the School Vulnerability Index variables, the sample was equitably distributed between the small, midsize, and large school size categories and the low, medium, and high vulnerability categories (recall these variables were tertiles). Finally, the average birth year for the adolescents in our sample was 1997, and about 10% of the students were labeled as students with special educational needs at baseline (the percentage was slightly higher for boys).

We found statistically significant differences between boys and girls in nearly all the variables we considered, the exceptions being the variables that used tertiles. These statistically significant differences are not surprising given the size of our sample; however, the magnitude of the differences was too small to be considered substantial. For the outcome variables (i.e., high school completion and high school status in 2018) and prior academic achievement, besides being statistically significant, the differences found between boys and girls were relatively large.

Table 2 shows the differences between the adolescents who became parents (the treated group) and those who did not (the control group). There were significant differences between the two groups in most of the variables we considered. High school completion was 14 percentage points (pp) higher for the control group than the treatment group: 77% of control group members completed high school compared to 63% of members of the treatment group. This result was reaffirmed by the extended data on student high school status up to 2018; here, the largest gap between the treatment and control group was in the timely graduation category (25 pp). The gaps for the delayed graduation and dropout categories were of relatively similar size – about 10 pp in both cases.

The percentage of women was higher in the treatment than in the control group, meaning that more girls than boys experienced fertility in their adolescence. And prior academic achievement was higher among control group members – that is, more students in the control group attained the intermediate and advanced SIMCE levels compared to the treatment group.

Table 2: Association between teen parenthood, high school completion status, and other covariates, complete sample (n = 196,499)

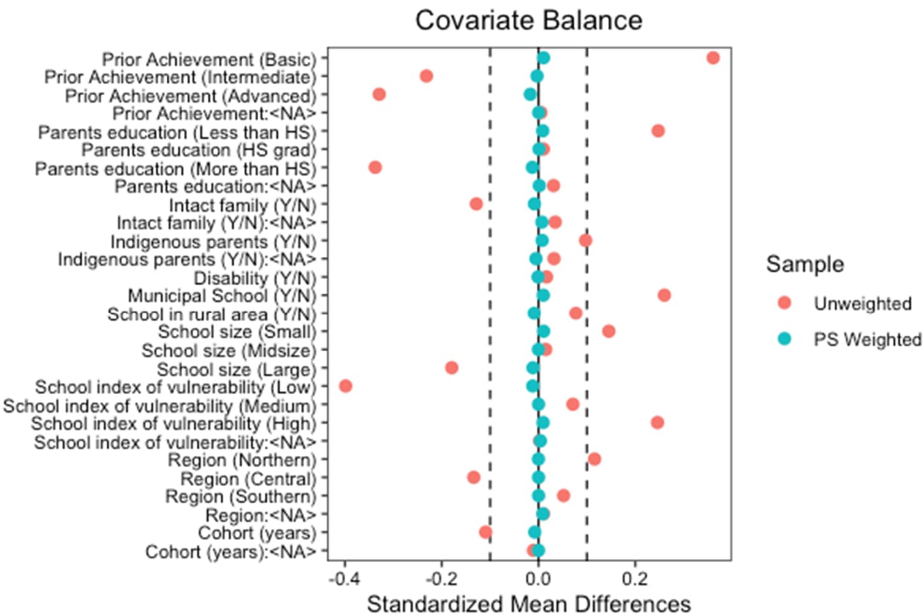
	Treated (Teen parent)	Control (Not teen parent)	Total
High school completion***	62.5	76.8	76.3
High school status (2018)***			
Graduated on time	42.3	67.2	66.4
Delayed graduation	20.0	9.5	9.9
Still in system	4.4	2.1	2.2
Dropped out	33.1	21.2	21.5
Female***	49.2	78.4	50.1
Prior achievement***			
Advanced	3.0	8.7	8.5
Intermediate	15.5	23.9	23.6
Basic	81.4	67.4	67.9
Total	100.0	100.0	100.0
Intact family***	44.9	51.3	50.4
Parents' education***			
Less than high school	42.9	30.7	31.0
High school graduate	39.9	39.4	39.4
Some higher education	17.2	29.9	29.6
Total	100.0	100.0	100.0
Indigenous parents***	12.4	9.2	9.3
Public school***	59.8	47.0	47.4
School in rural area*	12.8	10.2	10.3
School size***			
Small	40.3	33.2	33.4
Midsize	34.0	33.3	33.4
Large	25.7	33.5	33.3
Total	100.0	100.0	100.0
Region***			
Northern	17.7	13.2	13.4
Central	65.1	71.4	71.2
Southern	17.3	15.4	15.4
Total	100.0	100.0	100.0
Differential needs	9.8	9.0	9.0
Mean year of birth	1997.1	1997.2	1997.2
(st.dev.)	(0.003)	(0.002)	(0.002)

Notes: *** $p \leq 0.001$; ** $p \leq 0.01$; * $p \leq 0.05$. Chi square tests of statistical independence for all covariates but year of birth (which is a t test for differences in means).

Regarding the family-related variables, adolescents in the control group were slightly more likely to live in intact families at baseline and have parents with a higher educational attainment. And they were slightly less likely to have parents who identified as indigenous. Adolescents that did not experience fertility (control group) were more likely to have attended a private subsidized (as opposed to a public) school at baseline, and they were more likely to have attended a school located in an urban area. Adolescents who experienced fertility (treatment group) were slightly more likely to live in Northern or Southern Chile at baseline and thus less likely to live in Central Chile – this is in line with previous research showing that adolescent fertility is higher in the geographically extreme regions of Chile (Lavanderos et al. 2019). There were no differences between the treated and control groups in terms of school size, year of birth, or special educational needs.

Regarding the propensity score analysis, in terms of balance, Figure 1 displays the standardized effect size for each covariate before and after implementing the generalized boosted model to generate the propensity score. Table A-1, in the Appendix, presents the means in the treatment and control groups, together with the standardized effect size for each covariate before and after reweighting on basis of the propensity score.

Figure 1: Comparison of absolute standardized bias before and after propensity score weighting



Before reweighting there were significant differences in all the variables under consideration, as shown by the blue circles. Considering the magnitude of the effect size, the largest differences were in prior academic achievement, parental education, the dummy identifying children who attended municipal public schools, and the School Vulnerability Index – that is, the indicators that accounted for prior educational and socioeconomic selectivity. All the original differences became nonsignificant after reweighting to balance the propensity scores, as indicated by the red circles, showing that the standardized effect sizes approach zero. Results for the separated samples of men and women can be found in the Appendix (in Tables A-2 and A-3 and in Figures A-1 and A-2).

Table 3 presents the ATT results. The complete results of these models are included in the Appendix (Table A-3). Columns 2 and 3 in Table 3 show the ATT for the female and male samples. The probability of completing high school for girls who experienced fertility in their teen years was 13.5% lower than it would have been if they had not become pregnant or had a child. For boys, the probability was 3.4% lower. As a direct test on whether the effect of adolescent fertility on high school completion is greater for teenage boys than teenage girls, Column 4 in Table 3 shows the results for the joint sample. The treatment × gender interaction was significant and negative. Our results indicate that the effect of adolescent fertility on high school completion is different for boys and girls: adolescent fertility lowers the probability of obtaining a high school diploma for girls more than it does for boys. In this specification, the probability of completing high school for a girl who experienced adolescent fertility was 13.5% lower (0.034 + –0.101) than the high school completion probability of a boy who experienced no fertility. The corresponding probability for a boy (high school completion with adolescent fertility) was 3.4% lower than a boy who experienced no fertility. That is, the effect of adolescent fertility for girls was four times the effect for boys, after the selectivity associated with the adolescents' socioeconomic status and prior academic performance had been taken into account.

Table 3: Estimates of average treatment effect on the treated (ATT), adolescent fertility on high school completion

	Women (95% CI)	Men (95% CI)	Complete sample (95% CI)
Adolescent fertility	–0.135*** (–0.150 – –0.012)	–0.034* (–0.062 – –0.006)	–0.034* (–0.062 – –0.006)
Female			0.082*** (0.077 – 0.088)
Female × adolescent fertility			–0.101*** (–0.133 – –0.069)

Notes: Standard errors clustered by school; ***$p \leq 0.001$; *$p \leq 0.05$.

Table 4 displays the ATT results when high school status in 2018 is the outcome. All the RRRs are larger than 1; thus, for those who experienced adolescent fertility, delayed graduation, dropped out, and were still enrolled in 2018 were all more likely than a timely graduation. For girls, as seen in Column 2 of Table 4, the effect of adolescent fertility on the probabilities of a delayed graduation and still being enrolled in 2018, as compared to the probability of a timely graduation, were similar. The effect of adolescent fertility on the probability of dropping out was a little smaller (than the effect of adolescent fertility on delayed graduation or still being enrolled in 2018). For boys it was a different story: the effect of adolescent fertility on the probability of a delayed graduation was larger than the effect of adolescent fertility on the probabilities of being still enrolled in 2018 or dropping out. And the RRR point estimate for dropping out is about half the RRR of delayed graduation. These results suggest that, once the issues of selectivity by socioeconomic status and prior academic performance have been accounted for, adolescent fertility is more strongly associated with a delayed graduation than with dropping out among adolescent fathers than it is among adolescent mothers.

Column 4 in Table 4 shows the results for the interaction between sex and adolescent fertility. This direct test of the differential effects for young men and young women provides evidence that the gender differences are significant for the probability of dropping out as compared to timely graduation and that these effects are larger for women. Specifically, for young women who experienced adolescent fertility, the probability of dropping out is 3.2 (1.503 + 1.710 = 3.213) times the probability of having a timely graduation. The corresponding RRR for boys is 1.5.

Table 4: Estimates of average treatment effect on the treated (ATT), adolescent fertility on high school status 2018

	Women RRR (95% CI)	Men RRR (95% CI)	Complete sample RRR (95% CI)
Adolescent fertility			
Delayed graduation	2.975 *** (2.713 – 3.261)	3.386*** (2.888 – 2.969)	3.372*** (2.876 – 3.955)
Still enrolled	3.087*** (2.602 – 3.662)	2.685 *** (2.016 – 3.577)	2.727*** (2.043 – 3.639)
Dropped out	2.587 *** (2.381 – 2.810)	1.480 *** (1.264 – 1.732)	1.503*** (1.283 – 1.762)
Female			
Delayed graduation			0.818*** (0.783 – 0.854)
Still enrolled			0.625*** (0.572 – 0.682)
Dropped out			0.599*** (0.579 – 0.619)
Female × adolescent fertility			
Delayed graduation			0.877 (0.731 – 1.054)
Still enrolled			1.121 (0.805 – 1.560)
Dropped out			1.710*** (1.432 – 2.042)

Notes: The reference category is graduating timely. RRR shown. Standard errors clustered by school; ****p* ≤ *0.001*.

5. Discussion

This study examines gender differences in the effect of adolescent fertility on high school completion among young Chilean students, considering selectivity due to the socioeconomic status of origin and prior academic achievement. Our results indicate that the effect of adolescent fertility on the probability of completing high school is larger for women than men. When considering the ATT in the samples separated by sex, we find that the probability of completing high school for a girl who experiences adolescent fertility is 13% lower than it would have been if she had not become a parent. The corresponding probability for a boy is 3% lower. When directly testing for gender differences using the joint sample, we find a significant and negative treatment × gender interaction, which indicates that the effect of adolescent fertility is more detrimental to high school completion for women. Our analysis of high school status at the end of the observational period (up to 2018) shows that, besides having a positive effect on the risk of dropping out, adolescent fertility has a positive effect on the risk of delayed graduation and that girls who experience adolescent fertility have more detrimental effects than boys who experience adolescent fertility when considering dropping out. That said, an increased risk of a delayed graduation may be seen as a positive outcome if the alternative was dropping out. Indeed, it suggests that adolescents who become parents can catch up, at least in terms of obtaining their high school diploma, within a few years. On the other hand, our results confirm a gender gap in terms of the detrimental effects of adolescent fertility on high school graduation, where women suffer most of the negative consequences of childbearing in early life.

Our study is not without limitations. The data we use does not include adolescents that attend private nonsubsidized schools. These students represent less than 10% of the population enrolled in the Chilean school system, they are better-off in economic terms, and they obtain better scores on standardized tests, such as the one we use to measure prior academic achievement. Adolescent fertility in Chile, though declining, remains highly stratified according to socioeconomic status. By excluding adolescents in private schools, we exclude those least likely to experience adolescent fertility. Moreover, students in this social stratum may feel more compelled to deny an unwanted pregnancy and may have more resources to access an abortion. And because of their favorable socioeconomic and prior academic profile, they are also more likely to graduate from high school. Therefore, had this group been included in the sample, our estimates of the effect of adolescent fertility on the probability of completing high school may have been smaller.

One way to explore the gravity of omitting students from private nonsubsidized schools from this study is through a sensitivity analysis. Accordingly, we tested our models excluding the SES and prior academic achievement indicators – that is, the main sources of selectivity we were trying to control for. The full results of this analysis are available upon request. Briefly, the results indicate that for women the analysis is unlikely to be sensitive to unobserved confounders. The evidence for men and for the joint sample is weaker: Specifically, we find that a hypothetical unobserved covariate as strongly associated with high school completion and adolescent fertility as prior academic achievement could tip the estimated ATT toward nonsignificance. The sensitivity analysis shows the importance of including indicators of SES and prior academic achievement when trying to obtain a precise estimator of the association between adolescent fertility and high school completion.

Another limitation is that we are not able to account for parity. Our data allows for the identification of mothers, fathers, and pregnant students, but it does not include any measure of the numbers of children ever born to the students. Most teen mothers will probably not experience another pregnancy within the period we observe; however, there is no upper limit in the case of male fertility (they may not even be aware of their paternity). The estimated gender differences in the effect of adolescent fertility on high school completion would perhaps be different if we used a more precise measure of adolescent fatherhood. Our results show the effect of having at least one child, but the effect of having several children may be different.

To the best of our knowledge, this is the first study in Chile that tests the difference in the effect of adolescent fertility on educational outcomes for young men and women. Furthermore, few previous investigations have considered Latin American countries when examining the issue of selectivity due to treatment selection in a study of the educational effect of adolescent fertility, despite the region’s relatively high rates of adolescent fertility. We use a rich set of administrative data that comprises virtually an entire cohort – about 90% – of Chilean students who attended publicly funded (public and private subsidized) schools during an eight-year period between 2011 and 2018. We highlight that even though our results indicate that the effect of adolescent fertility on high school completion is more negative for girls than for boys and that girls have a higher probability than boys of delaying graduation and dropping out if they experience adolescent fertility, becoming a parent in adolescence also has negative effects on high school outcomes for boys.

When combined with qualitative research that illustrates the pressure that young Chilean fathers feel to provide for their children after having a child in adolescence (Herrera and Pavicevic 2016; Olavarría 2017; Valdés and Godoy 2008), this finding raises questions about what happens after high school to the educational careers of young men and women that become parents as teenagers, particularly in terms of their ability to continue accumulating human capital and whether the gender difference a few years after high school graduation may dissolve or even reverse.

Finally, our results reveal the need for policies that are not exclusively directed toward girls when dealing with the adolescent fertility prevention or human capital recovery for teens who dropped out of school because they became parents.

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Appendix

Table A-1: Covariate balance with propensity score weighting, women and men

	Unadjusted				Adjusted			
	T	C	Std. effect size	p-value	T	C	Std. effect size	p-value
Prior achievement				0.000				0.614
Basic	0.814	0.674	0.361		0.814	0.810	0.010	
Intermediate	0.155	0.239	–0.232		0.155	0.156	–0.003	
Advanced	0.030	0.087	–0.329		0.030	0.033	–0.017	1.000
Intact family	0.449	0.513	–0.128	0.000	0.449	0.453	–0.008	–0.531
Missingness	0.101	0.091	0.035	0.006	0.101	0.099	0.007	0.584
Parents education								
Less than high school	0.398	0.287	0.227	0.000	0.398	0.394	0.008	0.794
High school graduate	0.370	0.369	0.003		0.370	0.370	0.001	
Some higher education	0.160	0.281	–0.329		0.160	0.164	–0.012	
Missingness	0.072	0.064	0.056		0.031	0.071	0.002	
Indigenous parents	0.104	0.078	0.088	0.000	0.104	0.104	0.000	0.997
Missingness	0.183	0.166	0.044		0.183	0.183	–0.001	
Public school	0.607	0.458	0.306	0.000	0.607	0.607	–0.001	0.935
School in rural area	0.130	0.097	0.100	0.000	0.130	0.131	–0.001	0.923
School size								
Small	0.409	0.330	0.162	0.000	0.409	0.409	0.001	0.996
Midsize	0.338	0.334	0.010		0.338	0.339	0.000	
Large	0.252	0.337	–0.194		0.252	0.253	–0.001	
Region								
Northern	0.178	0.132	0.122	0.000	0.178	0.178	0.000	0.995
Central	0.645	0.714	–0.143		0.645	0.646	–0.001	
Southern	0.176	0.155	0.056		0.176	0.176	0.001	
Differential needs	0.105	0.084	0.066	0.000	0.105	0.105	0.001	0.972
Mean year of birth	1,997.1	1,997.2	–0.162	0.000	1,997.1	1,997.1	–0.001	0.948
Index of school vulnerability								
Low	0.180	0.348	–0.437	0.000	0.180	0.180	0.000	0.999
Medium	0.365	0.335	0.062		0.365	0.365	0.000	
High	0.449	0.311	0.278		0.449	0.449	0.000	

Table A-2: Covariate balance with propensity score weighting, women only

	Unadjusted				Adjusted			
	T	C	Std. effect size	p-value	T	C	Std. effect size	p-value
Prior achievement								
Advanced	0.027	0.077	–0.308	0.000	0.027	0.027	0.002	0.999
Intermediate	0.140	0.226	–0.248		0.140	0.140	0.001	
Basic	0.833	0.697	0.364		0.833	0.834	–0.001	
Missingness								
Intact family	0.426	0.503	–0.156	0.000	0.426	0.426	–0.001	0.963
Missingness	0.084	0.071	0.048	0.001				
Parents' education								
Less than high school	0.399	0.288	0.227	0.000	0.399	0.399	0.000	0.999
High school graduate	0.353	0.360	–0.014		0.353	0.354	0.000	
Some higher educ.	0.148	0.269	–0.342		0.148	0.148	–0.001	
Missingness	0.100	0.083	0.056		0.100	0.099	0.002	
Indigenous parents	0.104	0.078	0.088	0.000	0.104	0.104	0.000	0.996
Municipal school	0.607	0.458	0.306	0.000	0.607	0.608	–0.002	0.898
School in rural area	0.130	0.097	0.100	0.000	0.130	0.131	–0.002	0.904
School size								
Small	0.409	0.330	0.162	0.000	0.409	0.409	0.002	0.996
Midsize	0.338	0.334	0.010		0.338	0.339	0.000	
Large	0.252	0.337	0.194		0.252	0.253	–0.001	
Region								
Northern	0.178	0.132	0.122	0.000	0.178	0.178	0.000	0.995
Central	0.645	0.714	–0.143		0.645	0.646	–0.001	
Southern	0.176	0.155	0.056		0.176	0.176	0.001	
Differential needs	0.105	0.084	0.066	0.000	0.105	0.104	0.001	0.923
Mean year of birth	1,997.1	1,997.2	–0.162	0.000	1,997.1	1,997.1	–0.001	0.948
School's index of vulnerability								
Low	0.180	0.348	–0.437	0.000	0.180	0.181	–0.001	0.999
Medium	0.365	0.335	0.062		0.365	0.365	0.000	
High	0.449	0.311	0..278		0.449	0.449	0.000	

Table A-3: Covariate balance with propensity score weighting, men only

	Unadjusted				Adjusted			
	T	C	Std. effect size	p-value	T	C	Std. effect size	p-value
Prior achievement								
Advanced	0.043	0.097	0.216	0.000	0.043	0.745	0.000	0.898
Intermediate	0.211	0.252	–0.100		0.211	0.211	0.001	
Basic	0.745	0.651	–0.261		0.745	0.043	0.002	
Missingness								
Intact family	0.496	0.509	–0.026	0.360	0.496	0.495	0.003	0.917
Missingness	0.093	0.088	0.016	0.546	0.093	0.093	–0.001	0.956
Parents' education								
Less than high school	0.360	0.277	0.174	0.000	0.360	0.359	0.002	0.997
High school graduate	0.364	0.357	0.016		0.364	0.365	0.000	
Some higher education	0.169	0.265	–0.254		0.169	0.168	0.002	
Missingness	0.106	0.102	0.013		0.106	0.108	–0.006	
Indigenous parents	0.101	0.079	0.073	0.001	0.101	0.100	0.005	0.986
Missingness	0.211	0.190	0.052		0.211	0.212	–0.001	
Municipal school	0.563	0.482	0.164	0.000	0.563	0.564	–0.001	0.979
School in rural area	0.119	0.107	0.036	0.182	0.119	0.121	–0.006	0.812
School size								
Small	0.379	0.333	0.094	0.000	0.379	0.376	0.006	0.972
Midsize	0.347	0.333	0.030		0.347	0.350	–0.006	
Large	0.274	0.334	–0.134		0.274	0.274	0.000	
Region								
Northern	0.169	0.133	0.097	0.000	0.169	0.168	0.004	0.989
Central	0.670	0.714	–0.095		0.670	0.671	–0.003	
Southern	0.161	0.153	0.023		0.161	0.162	–0.001	
Differential needs	0.105	0.084	0.066	0.000	0.072	0.073	–0.004	0.895
Mean year of birth	1,997,1	1,997,2	–0.162	0.000	1,997,0	1,997,0	–0.002	0.951
School's index of vulnerability								
Low	0.180	0.348	–0.437	0.000	0.221	0.218	0.006	0.996
Medium	0.365	0.335	0.062		0.388	0.388	0.001	
High	0.449	0.311	0..278		0.385	0.388	–0.006	

Table A-4: Estimates of average treatment effect on the treated (ATT), linear link

Variable	Women (95% CI)	Men (95% CI)	Complete sample (95% CI)
Intercept	–265.246*** (–286.641 – –243.852)	–284.028 *** (–322.798 – –245.258)	– 269.803*** (–288.787 – –250.819)
Adolescent fertility	–0.135*** (–0.150 – –0.120)	–0.034* (–0.062 – –0.006)	– 0.034* (–0.062 – –0.006)
Female			0.082*** (0.077 – 0.088)
Female*motherhood			– 0.101 *** (–0.133 – –0.069)
Prior achievement (ref=basic)			
Advanced	0.184*** (0.150 – 0.219)	0.206*** (0.148 – 0.264)	0.190*** (0.160 – 0.220)
Intermediate	0.139*** (0.120 – 0.159)	0.111 *** (0.078 – 0.144)	0.132*** (0.115 – 0.149)
Intact family	0.065*** (0.050 – 0.080)	0.059*** (0.3 – 0.087)	0.063*** (0.050 – 0.077)
Parents' education (ref=less than high school)			
High school graduate	0.030*** (0.012 – 0.047)	0.038* (0.05 – 0.071)	0.032*** (0.016 – 0.047)
Some higher education	0.051*** (0.028 – 0.075)	0.048* (0.07 – 0.09)	0.052 *** (0.030 – 0.071)
Indigenous parents	0.029* (0.005 – 0.053)	0.003 (–0.042 – 0.048)	0.023* (0.002 – 0.044)
Municipal school	0.006 (–0.012 – 0.025)	–0.021 (–0.054 – 0.011)	0.002 (–0.006 – 0.010)
School in rural area	0.052*** (0.027 – 0.077)	0.076*** (0.030 – 0.122)	0.0057*** (0.035 – 0.079)
School size (ref=small)			
Midsize	0.039*** (0.019 – 0.059)	0.038* (0.002 – 0,073)	0.039*** (0,021 – 0.056)
Large	0.029* (0.006 – 0.053)	0.021 (–0.020 – 0.062)	0.028** (0.007 – 0.048)
Region (ref=Northern)			
Central	–0.021(*) (–0.043 – 0.000)	–0.028 (–0.067 – 0.010)	– 0.023** (–0.042 – –0.004)
Southern	–0.003 (–0.030 – 0.025)	–0.001 (–0.050 – 0.050)	– 0.003 (–0.027 – 0.022)
Differential needs	–0.059*** (–0.085 – –0.033)	–0.041 (–0.101 – 0.018)	–0.055*** (–0.080 – –0.031)
Mean year of birth	0.133*** (0.122 – 0.144)	0.143*** (0.123 – 0.162)	0.135*** (0.126 – 0.145)
School's index of vulnerability (ref=low)			
Medium	–0.008 (–0.032 – 0.016)	–0.018 (–0.057 – 0.021)	– 0.112 (–0.031 – 0.009)
High	–0.036** (–0.062 – –0.009)	–0.053* (–0.099 – –0.007)	– 0.041 *** (–0.064 – –0.018)

Notes: Standard errors clustered by school; ****p* ≤ *0.001; **p* ≤ *0.01; *p* ≤ *0.05; (*) p* ≤ *0.1.*

Table A-5: Estimates of average treatment effect on the treated (ATT) from multinomial logistic regression, women sample

Variable	Dropped out RRR (95% CI)	Still in system RRR (95% CI)	Graduated with delay RRR (95% CI)
Adolescent fertility	2.587***	3.087***	2.975***
	(2.381 – 2.810)	(2.602 – 3.662)	(2.713 – 3.261)
Prior achievement (ref=basic)			
Advanced	0.207***	0.222*	0. 278***
	(0.138 – 0.312)	(0.060 – 0.814)	(0.173 – 0.447)
Intermediate	0.368***	0.283 ***	0.439***
	(0.316 – 0.429)	(0.181 – 0.445)	(0.368 – 0.524)
Intact family	0.675***	0.596***	0.795***
	(0.618 – 0.737)	(00.480 – 0.741)	(0.714 – 0.884)
Parents' education (ref=less than high school)			
High school graduate	0.832***	0.821(*)	0.861*
	(0.755 – 0.917)	(0.651 – 1.035)	(0.762 – 0.973)
Some higher education	0.789***	0.410***	0.979
	(0.686 – 0.908)	(0.278 – 0.607)	(0.835 – 1.147)
Indigenous parents	0.844*	1.221	1.135
	(0.735 – 0.969)	(0.907 – 1.645)	(0.969 – 1.331)
Municipal school	1.009	0.987	1.176*
	(0.908 – 1.123)	(0.764 – 1.274)	(1.037 – 1.333)
School in rural area	0.744***	0.664*	0.845*
	(0.646 – 0.857)	(0.460 – 0.960)	(0.715 – 0.999)
School size (ref=small)			
Midsize	0.772***	0.979	0.882(*)
	(0.690 – 0.864)	(0.767 – 1.249)	(0.770 – 1.010)
Large	0.813**	0.962	0.853(*)
	(0.713 – 0.928)	(0.695 – 1.332)	(0.727 – 1.001)
Region (ref=Northern)			
Central	1.188**	0.762(*)	1.016
	(1.048 – 1.348)	(0.578 – 1.005)	(0.876 – 1.179)
Southern	1.108	0.689*	1.098
	(0.943 – 1.302)	(0.488 – 0.972)	(0.913 – 1.321)
Differential needs	1.398***	1.301	1.152
	(1.218 – 1.605)	(0.948 – 1.786)	(0.963 – 1.377)
Mean year of birth	0.524***	0.579***	1.139**
	(0.493 – 0.558)	(0.500 – 0.671)	(1.047 – 1.239)
School's index of vulnerability (ref=low)			
Medium	1.008	1.668*	0.973
	(0.869 – 1.169)	(1.1.06 – 2.514)	(0.824 – 1.179)
High	1.129	2.179***	0.954
	(0.963 – 1.324)	(1.419 – 3.345)	(00.793 – 1.149)

Notes: Standard errors clustered by school; ****p ≤ 0.001; **p ≤ 0.01; *p ≤ 0.05; (*) p ≤ 0.1*.

Table A-6: Estimates of average treatment effect on the treated (ATT) from multinomial logistic regression, men sample

Variable	Dropped out RRR (95% CI)	Still in system RRR (95% CI)	Graduated with delay RRR (95% CI)
Adolescent fertility	1.479*** (1.264 – 1.732)	2.685*** (2.016 – 3.578)	3.386 *** (2.888 – 3.969)
Prior achievement (ref=basic)			
Advanced	0.235*** (0.141 – 0.390)	0.179* (0.131)	0.174 *** (0.065)
Intermediate	0.503 *** (0.413 – 0.614)	0.449** (0.127)	0.610*** (0.082)
Intact family	0.723 *** (0.623 – 0.845)	0.648* (0.449 – 0.936)	0.867 (0.713 – 1.055)
Parents' education (ref=less than high school)			
High school graduate	0.820 * (0.692 – 0.973)	1.038 (0.697–1.547)	1.067 (0.842 – 1.352)
Some higher education	0.792 * (0.631 – 0.993)	0.804 (0.459 – 1.405)	1.048 (0.778 – 1.412)
Indigenous parents	1.077 (0.852 – 1.363)	1.197 (0.687 – 2.085)	1.489 ** (1.124 – 1.973)
Municipal school	1.105 (0.928 – 1.315)	1.639 * (1.031 – 2.604)	1.163 (0.920 – 1.469)
School in rural area	0.769* (0.604 – 0.981)	0.410** (0.214 – 0.787)	1.148 (0.830 – 1.587)
School size (ref=small)			
Midsize	0.870 (0.724 – 1.045)	0.568* (0.359 – 0.899)	0.967 (0.756 – 1.237)
Large	0.910 (0.730 – 1.135)	0.611(*) (0.366 – 1.020)	0.828 (0.6248 – 1.098)
Region (ref=Northern)			
Central	1.181 (0.957 – 1.458)	1.079 (0.671 – 1.737)	1.063 (0.805 – 1.403)
Southern	0.962 (0.729 – 1.270)	0.761 (0.385 – 1.505)	0.752 (0.526 – 1.075)
Differential needs	1.382** (1.028 – 1.859)	0.888 (0.448 – 1.764)	1.35 1(0.911 – 2.004)
Mean year of birth	0.538*** (0.482 – 0.599)	0.676 ** (0.523 – 0.874)	1.465 *** (1.274 – 1.684)
School's index of vulnerability (ref=low)			
Medium	1.081 (0.869 – 1.347)	1.242 (0.679 – 2.270)	0.990 (0.749 – 1.308)
High	1.278(*) (0.996 – 1.642)	1.600 (0.829 – 3.090)	1.041 (0.756 – 1.143)

Notes: Standard errors clustered by school; ***$p \leq 0.001$; **$p \leq 0.01$; *$p \leq 0.05$; (*) $p \leq 0.1$.

Table A-7: Estimates of average treatment effect on the treated (ATT) from multinomial logistic regression, complete sample

Variable	Dropped out RRR (95% CI)	Still in system RRR (95% CI)	Graduated with delay RRR (95% CI)
Adolescent fertility	1.503*** (1.283 – 1.762)	2.727*** (2.043 – 3.639)	3.372*** (2.876 – 3.955)
Female	0.599*** (0.579 – 0.619)	0.625*** (00.572 – 0.682)	0.818*** (0.783 – 0.854)
Female*Motherhood	1.710*** (1.432 – 2.042)	1.121 (0.805 – 1.560)	0.877 (0.731 – 1.054)
Prior achievement (ref=basic)			
Advanced	0.215*** (0.167 – 0.296)	0.198*** (0.074 – 0.533)	0.240*** (0.160 – 0.360)
Intermediate	0.403*** (00.357 – 0.455)	0.332*** (0.235 – 0.469)	0.481*** (0.417 – 0.556)
Intact family	0.685*** (0.636 – 0.739)	0.609*** (0.507 – 0.733)	0.810*** (0.738 – 0.891)
Parents' education (ref=less than high school)			
High school graduate	0.830*** (0.763 – 0.902)	0.859 (0.702 – 1.051)	0.901(*) (00.808 – 1.004)
Some higher education	0.790*** (00.701 – 0.889)	0.499*** (0.363 – 0.688)	0.989 (0.858 – 1,139)
Indigenous parents	0.892(*) (0.792 – 1.005)	1.222 (0.944 – 1.585)	1.204** (1.048 – 1.383)
Municipal school	1.029 (0.939 – 1.128)	1.105 (0.878 – 1.391)	1.168** (1.045 – 1.306)
School in rural area	0.746*** (0.660 – 0.845)	0.596** (0.432 – 0.823)	0.896 (0.773 – 1.039)
School size (ref=small)			
Midsize	0.792*** (0.718 – 0.873)	0.856 (0.687 – 1.067)	0.896(*) (0.794 – 1.009)
Large	0.835** (0.745 – 0.936)	0.848 (0.641 – 1.122)	0.846* (0.734 – 0.974)
Region (ref=Northern)			
Central	1.187** (1.064 – 1.325)	0.829 (0.650 – 1.057)	1.027 (0.897 – 1.176)
Southern	1.079 (0.936 – 1.244)	0.712* (0.520 – 0.974)	1.026 (0.867 – 1.213)
Differential needs	1.392*** (1.227 – 1.580)	1.229 (0.922 – 1.638)	1.182* (1.008 – 1.387)
Mean year of birth	0.527*** (0.499 – 0.556)	0.599*** (0.527 – 0.683)	1.205*** (01.120 – 1.296)
School's index of vulnerability (ref=low)			
Medium	1.033 (0.912 – 1.170)	1.527* (1.090 – 2.139)	0.977 (0.847 – 1.128)
High	1.171** (1.022 – 1.342)	1.987*** (1.394 – 2.833)	0.969 (00.825 – 1.138)

Notes: Standard errors clustered by school; ****p ≤ 0.001; **p ≤ 0.01; *p ≤ 0.05; (*) p ≤ 0.1.*

Table A-8: Estimates of average treatment effect on the treated (ATT), logit link

Variable	Women OR (95% CI)	Men OR (95% CI)	Complete sample OR (95% CI)
Adolescent fertility	0.478*** (0.446 – 0.514)	0.842* (0.736 – 0.963)	0.837** (0.731 – 0.958)
Female			1.647*** (1.601 – 1.694)
Female*Motherhood			0.561*** (0.482 – 0.653)
Prior achievement (ref=basic)			
Advanced	3.765*** (2.595 – 5.461)	3.499*** (2.177 – 5.626)	3.812 *** (2.858 – 5.085)
Intermediate	2.399*** (2.079 – 2.766)	1.817*** (1.507 – 2.190)	2.188*** (1.962 – 2.439)
Intact family	1.429*** (1.318 – 1.550)	1.319*** (1.148 – 1.517)	1.400 *** (1.308 – 1.499)
Parents' education (ref=less than high school)			
High school graduate	1.166*** (1.067 – 1.275)	1.175* (1.002 – 1.377)	1.163*** (1.078 – 1.254)
Some higher education	1.304*** (1.148 – 1.482)	1.278* (1.934 – 1.581)	1.303 *** (1.171 – 1.443)
Indigenous parents	1.169* (1.030 – 1.326)	1.030 (0.821 – 1.290)	1.142 * (1.026 – 1.272)
Municipal school	1.031 (0.941 – 1.130)	0.882 (0.752 – 1.034)	0.993 (0.919 – 1.073)
School in rural area	1.273*** (1.120 – 1.448)	1.514*** (1.212 – 1.892)	1.295 *** (1.163 – 1.443)
School size (ref=small)			
Midsize	1.203*** (1.091 – 1.326)	1.190* (1.001 – 1.414)	1.186 *** (1.092 – 1.288)
Large	1.178** (1.050 – 1.322)	1.123 (0.927 – 1.374)	1.159** (1.052 – 1.278)
Region (ref=Northern)			
Central	0.911(*) (0.817 – 1.015)	0.864 (0.715 – 1.043)	0.897 * (0.818 – 0.983)
Southern	0.997 (0.867 – 1.146)	0.970 (0.758 – 1.241)	0.974 (0.865 – 1.096)
Differential needs	0.745*** (0.658 – 0.844)	0.781(*) (0.598 – 1.021)	0.754 *** (0.676 – 0.842)
Mean year of birth	1.935*** (1.829 – 2.049)	1.973*** (1.786 – 2.180)	1.916 *** (1.825 – 2.010)
School's index of vulnerability (ref=low)			
Medium	0.946 (0.831 – 1.077)	0.915 (0.748 – 1.120)	0.928 (0.834 – 1.031)
High	0.823** (0.716 – 0.946)	0.772* (0.616 – 0.968)	0.804 *** (0.717 – 0.903)

Notes: ***p ≤ 0.001; **p ≤ 0.01; *p ≤ 0.05; (*) p ≤ 0.1.

Figure A-1: Comparison of absolute standardized bias before and after propensity score weighting, women only

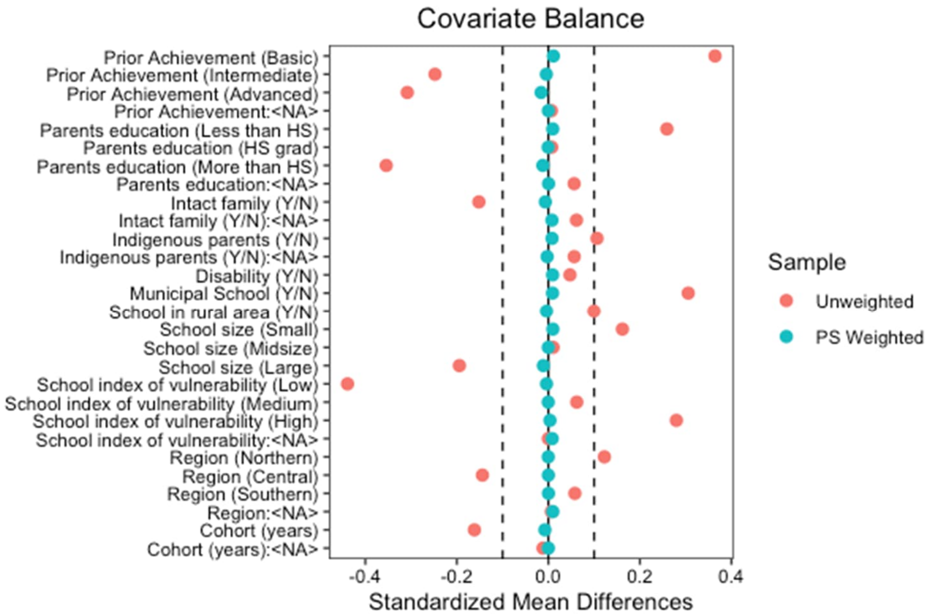

Figure A-2: Comparison of absolute standardized bias before and after propensity score weighting, men only