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Abstract

In this study, we exploit the differential timing in minimum marriageable age laws in Mexico to estimate the impact of these civil law reforms on child marriage, adolescent fertility, girls' school attendance and the likelihood of engaging in a consensual union. Using a difference-in-differences methodology, the results show that states adopting minimum marriageable age laws exhibited a 49% and 44% decrease in child marriage rates and the likelihood of girls being in consensual unions respectively. Contrary to what was expected however, the law had no impact on total teenage birth rates and girls' school attendance. Additional findings reveal that the fall in child marriage rates was mainly driven by 16-17-year-old girls, and states where child marriage was less rampant prior to the law. We also find evidence of a decrease in teenage birth rates among girls living in rural areas by approximately 14% as a result of the law.

JEL Code: J12, J13, J18, K15
Keywords: Adolescent fertility, child marriage, minimum marriageable age laws, consensual unions

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I. Introduction

Child marriage is defined as a formally or informally recognized union in which either or both parties involved are below the age of 18.[1] The United Nations (UN) Convention on the Rights of the Child condemns child marriage as it prematurely ends girls' childhood, which is a fundamental violation of human rights, and aims to eradicate child marriage by 2030 as part of the Sustainable Development Goals (SDGs). In correspondence with international guidelines to eliminate this practice, the 2014 General Law on the Rights of Children and Adolescents ('Ley General de los Derechos de Niñas, Niños y Adolescentes') was introduced in Mexico to raise the minimum marriageable age to 18 without exceptions.[2] Since then, all 32 Mexican states were advised to harmonize family and civil law codes that previously allowed marriages below 18 with federal law.

Prohibiting early marriages is important as it has been linked to early childbearing. In a cross-sectional study on 12 Sub-Saharan African countries, Maswikwa et al. (2015) found that women who married younger than 18 were more likely than their counterparts to be teenage mothers. In Arceo-Gomez and Campos-Vasquez's (2014) study on Mexico, the authors confirmed a positive relationship between teenage pregnancy and early marriage, and a negative association between early childbearing and educational and labour market outcomes. Across literature, adolescent fertility has additionally been linked to weaker intra-household decision making power and poorer health outcomes like malnutrition, intimate partner violence, psychological distress, sexually transmitted diseases as well as infant and maternal mortality (Jensen and Thornton, 2003; Field and Ambrus, 2008; Heath and Mobarak, 2015). Because of these negative impacts of early parenthood, girls face a high likelihood of being trapped in the poverty cycle which could in turn have severe implications for their children. Children of teenage mothers for instance, have been found to have lower educational attainment and more behavioural issues. Research also shows that daughters of teenage mothers are more likely to become teenage mothers themselves, which further perpetuates the cycle of intergenerational poverty (Meade et al., 2008; Martinez et al., 2011).

[1] The National Institute for Statistics and Geography (INEGI) defines informal unions ('union libre') as both common law marriages ('concubinatos') and non-common law marriages in which couples are involved in a consensual union or domestic partnership. In this study, we refer to informal unions as consensual unions, domestic partnerships and cohabitation interchangeably, which carry the same meaning.

[2] For official documentation of the policy, see: https://www.gob.mx/cms/uploads/attachment/file/339082/LGDNNA__Con_ltimas_reformas_2018__hasta_la_del_20_de_junio_.pdf.

Adolescent fertility is a serious concern in Mexico. According to 2018 UNICEF data, 71 out of every 1,000 adolescent girls aged between 15 and 19 were teenage mothers in Mexico. While the situation is direst in West and Central Africa, Latin American and Caribbean (LAC) countries still have relatively high adolescent fertility rates compared to other regions in the world with an average of 63 per 1,000 teenage mothers, above the global mean rate of 44 per 1,000 adolescents. Comparatively, Mexico lies above the average in terms of the number of teenage births (71 out of 1,000 girls) in the LAC region, and has much higher adolescent fertility rates than developed countries like Germany for instance, where 8 out of 1,000 adolescents have children. Based on household survey data, UNFPA estimates additionally show that LAC has been the only region to have experienced a growing trend in birth rates for the under-15 age group, with 2% of women of reproductive age in LAC countries having their first child before the age of 15 (UNFPA, 2017).

Figure A displays trends in teenage births disaggregated by girls' marital status from 1985 to 2017, and shows a steady decline in the share of births among married girls. On the other hand, the proportion of births to single girls and girls in consensual unions have increased over the same time period. Specifically, the percentage of births to married teenage mothers decreased from approximately 58% in 1985 to 4% in 2017, while the share of births to single and consensual union mothers increased from 11% to 21% and 28% to 68% respectively.

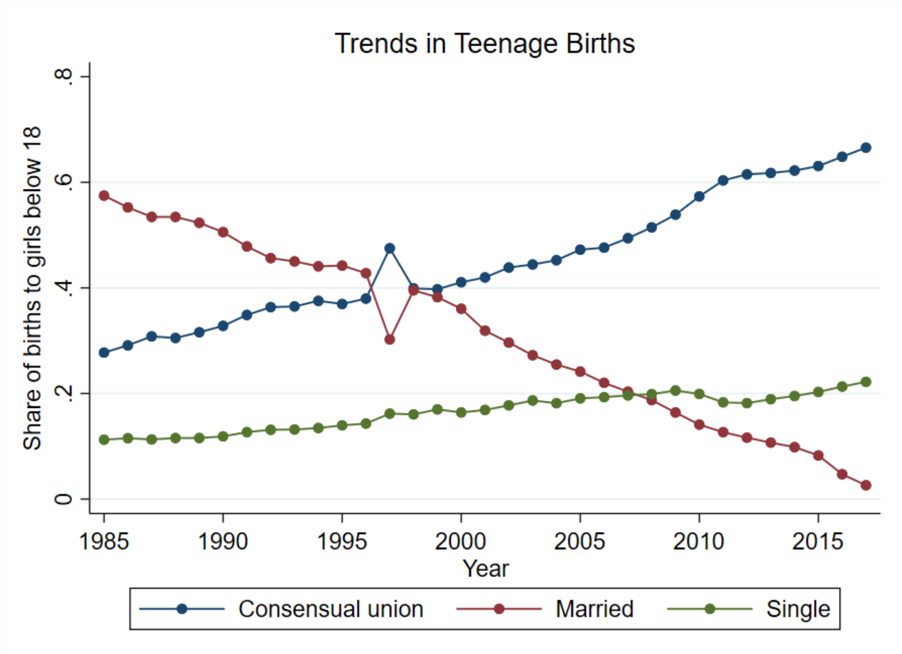

Figure A. Trends in teenage births among girls below 18 (1985 – 2017). *Notes*: This figure plots the share of births to girls below 18 according to marital status (consensual union, married and single) from 1985 to 2017. Data come from Birth administrative records provided by the National Institute for Statistics and Geography's (INEGI) Vital Statistics edition. 1985 is the earliest year for which micro-level data is available.

An examination of the trends in marriages among girls below 18 explains this phenomenon. Figure B plots the share of married girls below 18 from 1993 to 2017, and demonstrates a decline in the proportion of married girls in this age group over time. Over the entire period, the share of married girls below 18 fell significantly from 17% in 1993 to 0.4% in 2017, amounting to a reduction in the number of underaged married girls by a factor of approximately 39. Given these evolving patterns in adolescent fertility and marriage in Mexico, it is unclear whether raising the minimum age of marriage would be effective in mitigating teenage pregnancies, especially since the number of births to married teenage mothers has been falling as a result of decreasing marriage rates among this age group.

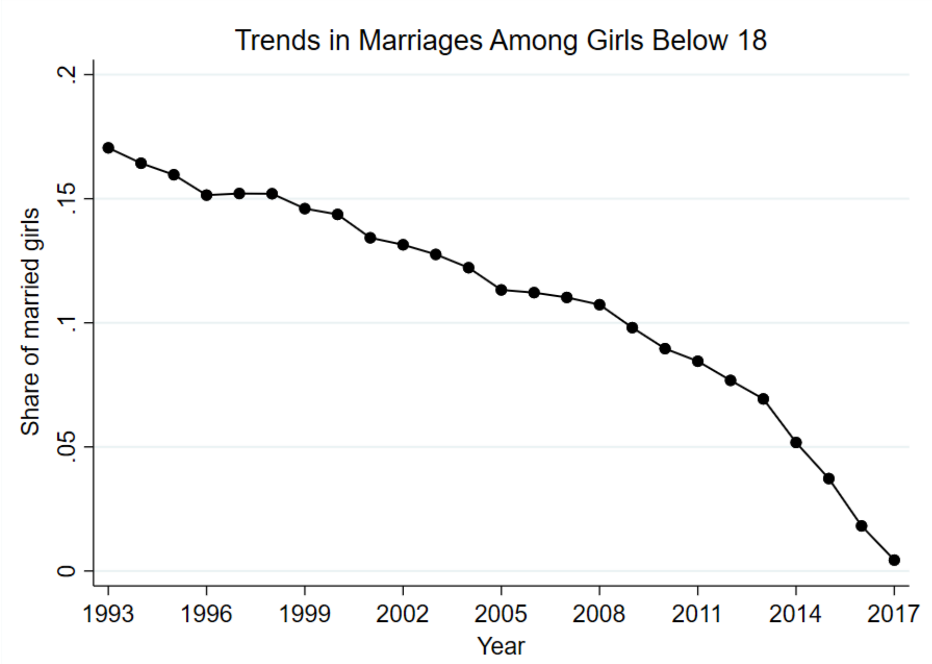

Figure B. Trends in marriages among girls between 12-18 years of age (1993 – 2017). *Notes*: This figure plots the share of girls who were married before age 18 from 1993 to 2017. Data on marriages come from the Nuptiality administrative records provided by the National Institute for Statistics and Geography's (INEGI) Vital Statistics edition. 1993 is the earliest year for which micro-level data is available.

Literature abounds about the potential benefits of marriageable age law reforms in reducing the incidence of child marriage and associated adolescent fertility, yet very few studies have explicitly examined the relationship between these factors. A majority of the papers that have specifically examined this relationship, however, conduct cross-country analyses with data at the aggregate level and fail to provide local insight into the mechanisms that underlie the correlation (Kim et al., 2013; Maswikwa et al., 2015). The general finding across these cross-country studies is that civil law reforms to the marriageable age have been effective in abating child marriage and teenage pregnancy. A study by Bharadwaj (2015) which relates closely to this paper, examined the impact of the 1957 marriage law amendment which raised the marriageable age to 18 in Mississippi, U.S, on child marriage rates and crude birth rates. Similar to the cross-country studies, the author found that both child marriage rates and crude birth rates decreased by 75% and 2-6% respectively. In developing countries like Indonesia, marriageable age law changes have been shown to be less effective in mitigating child marriage rates. Cammack, Young and Heaton (1996) demonstrated that while there was a steady decline in the number of girls marrying below the age of 16 as a result of Indonesia's 1974 National Marriage Act, the law did not have an appreciable effect on the trend.

In this study, we challenge the notion that minimum marriageable age laws are useful in reducing adolescent fertility through the support of two formalized models based on Rasul (2006, 2008), in which couples bargain over fertility without commitment. The evolving socio-cultural trends and underlying economic conditions in Mexico suggest that the relationship between child marriage and teenage motherhood is not as straightforward and predictable. Unlike regions like Africa, consensual unions have thrived in Latin America due to growing acceptance towards this practice over time. Across various African countries, cohabitation before marriage is typically socially unacceptable due to strong traditional values and beliefs. A recent study by Duyilemi, Tunde-Awe and Lois (2018) found that 71.8% of Nigerian undergraduate students perceived domestic partnerships without marriage as a key factor of moral decadence in society, indicating that the act of cohabitation would violate religious and cultural codes and that marriage was important for legitimizing ones' societal standing. Legally restricting the age of marriage to above 18 should thus be effective in reducing child marriage rates and its associated consequences like teenage pregnancy in societies where consensual unions are less of an option.[3]

This paper makes several contributions to the literature. First, contrary to existing studies which postulate that teenage birth rates decline along with child marriage rates, the results from this paper show otherwise. Using a staggered difference-in-differences (D-I-D) approach, we find that notwithstanding the criminalization of underage marriage which lowered child marriage rates and the likelihood of girls' engaging in consensual unions, the law had no effect on total teenage birth rates and girls' school attendance. Second, the results potentially help to shed more light on the effect of laws against early marriage on teenage pregnancy in the Latin American region, where consensual unions have become increasingly more common than formal unions characterized by marriages. According to DHS surveys from the 1990s, consensual unions make up a large proportion of partnerships throughout Latin America with rates of up to 61.5% in Dominican Republic (Castro-Martín, 2002). The findings from this paper using Mexico as a case study may therefore be generalizable to other countries in Latin America, assuming similar socio-cultural, economic and political climates.

Lastly, this paper may be interesting for policy-makers who aim to improve the lives and welfare of adolescent girls through international guidelines and policies. The results from this study underscore the importance of accounting for country-specific socio-cultural trends, prior to adopting global policies that may not

[3] An analysis of the trends in consensual unions in Mexico using INEGI's Population and Housing Census data from 1960 - 2010 reveals an increase in the proportion of girls aged 12-19 in consensual unions (2.9% in 1960 and 5.1% in 2010). Statistics from the 2010 Population and Housing Unit Censuses further indicate that the number of girls between 12 and 19 in consensual unions in Mexico was approximately 2.4 times more than those in formal unions characterized by marriage.

turn out to be a one-size-fits-all solution. The rest of the paper is organized as follows: section II provides a background on minimum marriageable age law reforms, and also discusses the conceptual framework for the topic in question; section III describes the data used in this study; section IV focuses on the use of difference-in-differences (D-I-D) as an empirical strategy, and discusses various identifying assumptions associated with the D-I-D approach; sections V, VI, VII, and VIII present the main results of the paper, report a set of robustness checks, discuss various heterogeneous effects of the law, and present additional results on schooling and consensual unions respectively; section IX finally concludes.

II. Background and Conceptual Framework

Legal Conditions

Exactly three decades ago in November 1989, the Convention on the Rights of the Child was unanimously approved by the United Nations General Assembly. Participating members of the United Nations, including Mexico, were constitutionally bound to streamline legislative frameworks to protect children and adolescents' rights without exceptions. The convention asserted that the onus was on policy-makers, governments and individuals to take into account the best interest of the child, which included a life free from discrimination and violence, the right to proper survival and development as well as respect for children's views, opinions and individuality. Since Mexico's ratification of the convention in 2000 which entailed various constitutional amendments, momentous progress has been made in alleviating malnutrition and infant mortality rates, and implementing compulsory primary school education among other advances.

On 4 December, 2014, significant extensions were made to the Law on Protection of the Rights of Girls, Boys and Adolescents, formally enacted in 2000. The reforms to the law in 2014 represented the largest milestone in legislative progress towards achieving greater child rights in Mexico over the last 25 to 30 years. Under the previous version of the law, only 56 articles were stipulated to preserve child rights and did not include legal changes to the minimum marriageable age of girls and boys. The updated 2014 version of the law consisted of a total of 154 articles, divided into 6 chapters. Specifically, chapter 2 on "The rights of children and adolescents" had been modified to include article 45, which banned marriage below the age of 18 for all boys and girls without exceptions (Martín et al., 2016). While federal state guidelines to raise the minimum marriageable age to 18 were officially introduced in December 2014, 2 out of 32 Mexican states had enacted the law prior to this date, namely Veracruz in February 2014 and Baja California Sur in June 2014. By the end of 2017, 27 of 32 states had modified their family and civil law codes to abide to federal law, albeit in a staggered fashion (see Table 1).[4]

[4] Figure B1 of the Appendix illustrates the geographical and temporal variation in the enactment of the law across Mexican states.

Table 1. Date of Enactment of Minimum Age Laws

State	Minimum Marriage Age (> 18)	Exceptions
Aguascalientes (AG)	22 February 2016	No
Baja California (BC)*	-	-
Baja California Sur (BS)	30 June 2014	No
Campeche (CM)*	15 May 2016	No
Coahuila (CO)	4 September 2015	No
Colima (CL)	10 September 2016	No
Chiapas (CS)	6 April 2016	No
Chihuahua (CH)	23 December 2017	No
México City (DF)	13 July 2016	No
Durango (DG)	26 February 2017	No
Guanajuato (GT)	-	-
Guerrero (GR)	9 May 2017	No
Hidalgo (HG)	31 December 2016	No
Jalisco (JA)	4 April 2015	No
Mexico (EM)	14 March 2016	No
Michoacán (MI)	25 April 2016	No
Morelos (MO)	17 August 2016	No
Nayarit (NA)	11 March 2016	No
Nuevo Leon (NL)	-	-
Oaxaca (OA)	31 December 2015	No
Puebla (PU)	28 March 2016	No
Queretaro (QT)	-	-
Quintana Roo (QR)	19 December 2014	No
San Luis Potasi (SL)	17 September 2015	No
Sonora (SO)*	-	-
Sinaloa (SI)	19 August 2016	No
Tabasco (TB)	1 July 2017	No
Tamaulipas (TM)	23 June 2016	No
Tlaxcala (TL)	30 December 2016	No
Veracruz (VE)	3 February 2014	No
Yucatan (YU)	12 June 2015	No
Zacatecas (ZA)	29 March 2017	No

* 'Marry-your-rapist' laws were implemented in these states in May 2016, and exonerates the perpetrator of the crime, 'estupro' (consensual sex with a minor through seduction or deceit) in cases of marriage to the victim. We therefore exclude the 3 states from the analysis as they serve neither as control nor treatment, and could potentially confound the outcomes studied. See: http://www.congresoson.gob.mx:81/Content/InformacionPublica/Articulo17bisA/5/LXI/Dictamenes16/DECRETO93.pdf for legal documentation.

Conceptual Framework

The United Nations Population Fund (UNFPA) identifies child marriage as one of the key drivers of adolescent fertility, especially in regions like South Asia and Sub-Saharan Africa. Prohibiting early marriages in these regions could therefore reduce teenage births, as girls are protected from entering unions at a young age, and hence are less likely to become teenage mothers (UNFPA, 2013). In Latin American countries like Mexico however, this mechanical relationship between early marriage and childbearing is clouded by a rising (falling) trend in informal consensual unions (formal marriages). The fundamental theoretical question in the context of this study, is therefore how fertility differs when couples are in a consensual union as opposed to a marriage, rather than how fertility changes when girls are no longer in early unions. Subsequently, although it is often contended that minimum marriageable age laws are effective in reducing adolescent fertility, this is not a prediction that necessarily follows from economic theory. A particular case in point are models where family decisions over fertility, and investments in household public goods, are subject to a hold-up problem. A hold-up problem arises when part of the return on an individual's relationship-specific investments is expropriated *ex post* by her partner. Household models that feature hold-up problems have been proposed by Rasul (2006), Rainer (2007), and Rasul (2008). In this section, we present and discuss the implications of two models that bring the insights of this literature to bear on the context of this study. Subsequently in Appendix A, these models are formally derived.

A key feature of both models is that couples are unable to commit *ex ante* to their future actions within their relationship. Non-commitment implies that marital bargains are subject to *ex post* renegotiation after investments in fertility are sunk. Formally, non-commitment gives rise to a dynamic decision-making process in which couples interact over two periods—a first when fertility investments are chosen and a second after these investments are sunk, and bargaining over the division of the marital surplus takes place. To generate comparative statics, both models assume that the prohibition of early marriages compels young couples to make their fertility decisions in an informal, consensual union instead of formal marriage, with the former being less costly to dissolve than the latter.

In the first model which draws upon Rasul (2008), the shift from marriage to a consensual union is assumed to change the relevant threat point when couples bargain over the division of marital surplus. Before the implementation of age-of-marriage laws, divorce among married girls below 18 was extremely rare in Mexico, and was therefore not a credible threat in marital bargains.[5] In this case, the relevant threat point for household bargaining is instead an inside option given by some non-cooperative outcome within marriage. Since the prohibition of early marriage in Mexico lowers the cost of a union dissolution, it is plausible to assume that exiting a relationship, now becomes a credible threat. Thus, consider the thought-experiment of replacing, as the threat point, the inside option with the outside option of dissolving the relationship and possibly re-matching. In equilibrium, the model predicts that this increases investments in fertility among couples where men have a preference for more children than their female partners.

[5] The average proportion of married girls below 18 who got divorced between 2009-2013 was only 0.21% (INEGI, 2020).

By contrast, if women have a preference for more children than their male partners, equilibrium investments in fertility decrease.[6]

The second model, reminiscent of Rasul's (2006) work, extends the first model to a setting where the probability of a relationship breakdown is positive, and endogenously determined by couples' fertility investments. Since the age-of-marriage laws in Mexico compels young couples to form consensual unions instead of formally marrying, and since it is easier and less costly to dissolve an informal union than a formal marriage, the comparative static of interest is a decrease in the costs associated with the dissolution of a relationship. A key feature of the model is that high dissolution costs and investments in fertility are substitutable reasons for why relationships remain intact. Thus, in order to safeguard against dissolution, couples increase fertility investments to make up for the loss in formal commitment stemming from the reduction in the costs of union dissolution. In essence, as long as economic or legal barriers to exiting a partnership are high, the model predicts that couples are effectively locked into relationships irrespective of how much they invest in it. Once exit barriers are lowered, couples have the incentive to counteract the loss of this 'lock-in' mechanism, by increasing their investments in relationship-specific capital such as children. In summary, the two models suggest that the effects on teenage fertility due minimum marriageable age laws largely remain an empirical question rather than a straightforward prediction from economic theory.

III. Data

Prior to the 2014 General Law on the Rights of Children and Adolescents, family and civil law codes on the minimum marriageable age in the majority of the states were inconsistent with federal law codes. In Aguascalientes for instance, federal law had established 18 as the minimum age at which one was allowed to marry, while 16 was the minimum age established by family and civil law codes. Starting from December 2014 however, all states were advised to harmonize family and civil law codes with federal law, which strictly prohibited marriage below the age of 18 without exceptions. Accordingly, this study defines the timing of the law enactment as the date which states had modified their family and civil law codes to complement federal law. Information on the respective dates which states revised their family and civil law codes was provided by the Executive Secretariat of the National System for the Integral Protection of Children and Adolescents, under the Mexican Office for Domestic Affairs (SEGOB).[7]

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[6] As discussed in more detail in Appendix A, and as also highlighted by Rasul (2008), the underlying intuition for this result is that a change in the threat point from an inside to an outside option affects how the fertility preferences of each partner translate into fertility outcomes: in the inside-option bargaining environment, equilibrium investments in fertility depend more strongly on the female partner's fertility preferences than on those of the male partner, while under the outside-option bargaining protocol, equilibrium investments in fertility depend equally on both partners' fertility preferences.

[7] Information regarding the dates of law implementation were drawn by the Mexican Office for Domestic Affairs (SEGOB) from the National Supreme Court of Justice.

The National Institute for Statistics and Geography (INEGI) provides unit-level data on registered marriages and births per annum from the *Vital Statistics* edition which include basic demographic characteristics such as age, marital status, education level, employment and rural residential status of both the girl and her partner. The registration of marriages and births is mandatory and free of charge, and can be done by submitting a soft or hard copy of a marriage or birth certificate to any local civil registry office. Fortunately, information on the state in which a marriage was registered as well as the state in which girls resided at the time of the marriage registration is also available. Accordingly, in section IV., we test if the law generated selective marriage registration in states where the law had not been implemented, as this could potentially upward bias child marriage estimates and associated fertility effects. The marriage certificate data however does not allow for the segregation of whether girls' state of residences was pre- or post-marriage, implying that the law could still have stimulated girls to move from their previous state of residence to the state of residence recorded in the marriage certificates.[8]

Another major concern of analysing demographic information is the discrepancy of vital statistics due to underreporting. For marriages, this would be manifested in the form of informal partnerships such as consensual unions which are typically not recorded by definition. To account for this potential issue, we subsequently draw from a separate *Child Labor Module (MTI)* survey conducted by the INEGI containing information on girls' marital statuses (including consensual unions). The results presented in section VIII. indicate that underreporting of marriages was not likely to be severe given the observed decrease (rather than increase in the case of underreporting due to the law) in the likelihood of girls being in consensual unions after the law.[9] With regard to births, existing demography literature on Mexico document relatively high birth coverage across the country, with the exception of 3 states - Chiapas, Guerrero and Puebla.[10] Reconstructing births in Mexico for the period of 1990-2005 using INEGI's *Population and Housing Censuses*, Perez and Meneses (2010) confirmed that most Mexican states have a relatively complete record of their births (over 95% of the births were registered). Welti-Chanes's (2012) study on Mexican fertility data also showed an improvement in the quality of fertility records over the last few decades,

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[8] In this regard, while the ITT approach addresses concerns related to selective marriage registration, it is not possible to rule out selective migration which is distinct from the former, as girls could have still relocated to another state in order to legally register their marriages. This is unlike the issue of selective marriage registration, where girls register their marriages in a state different from the one they reside in.

[9] While the results show that the law was not likely to have led to the underreporting of formal marriages, it is not possible to rule out measurement errors arising from the lack of marriage registrations in rural areas where registering matrimonies may be geographically more challenging. Bunting (2005) also highlights another potential issue of the possibility of age fabrication during marriage registration. In general, the falsification of one's age is made easier when birth certificates are not properly registered. According to the INEGI however, the majority of births (about 95%) occur in hospitals which register these births, leaving less room for bias arising from this issue.

[10] Perez and Meneses (2010) note that the poor records of births in Chiapas, Guerrero and Puebla are a result of economic, social, geographical and cultural factors associated largely with the marginalization of these states. In the robustness analysis, we exclude these 3 states with poorer birth records to check if the impact of the law on teenage birth rates was underestimated.

with a steady decrease in the percentage of women with no data on the number of children born alive, or the date of birth of their child. Specifically, in the 2010 Housing and Population Census, only 1.4% and 0.7% of women aged 12 years and older had no information about their total number of children born alive or their child's date of birth respectively.

Yet despite the unlikelihood of large underreporting in fertility data, another concern could be that the law led to delays in birth registrations. Even though teenage birth rates are calculated according to the month and year in which the child was born rather than the date the birth was registered, delays in birth registrations as a result of the law would mean that these births, including information on when they occurred, would not be recorded till later (as INEGI's yearly data set on fertility captures births based on the year in which they were registered, which subsequently also contains information on when the actual birth occurred). In order to check if the law significantly influenced the timing of birth registrations, we regress the proportion of births that were registered in a different year from the actual birth occurrence year, on the law, a year after the law was introduced (to account for the gestational length of a pregnancy and possible information lags about the law).[11] The results are presented in Table C2 of the Appendix, and do not demonstrate evidence that minimum marriageable age laws increased the percentage of girls registering their births later. Altogether, estimates are small in magnitude and statistically insignificant indicating that lags in birth registrations due to the law was unlikely. Additionally, timely registration of births is required by law in most states where 180 days is the maximum number of days since the actual date of birth that a parent has to register the birth (INEGI, 2015). This means that if the birth occurred in the first half of the year, it is likely to be recorded in the birth register in the same year. If the birth occurred in the second half of the year however, it is possible that the birth would only be recorded in the following year's birth register. Since 2017 is the last year of this study, we also include births that occurred in 2017 which were recorded in the 2018 birth register in order to minimize measurement issues arising from late birth registrations.

Following standard calculations of marriage and fertility rates in existing literature, we define child marriage rates (CMRs) as the absolute number of girls who married below the age of 18 per 1,000 of the population of girls between 12 and 17 years of age. Similarly, teenage birth rates (TBRs) are defined as the absolute number of births to girls below the age of 18 per 1,000 of the population of girls between 12 and 17 years of age.[12] Since the law prohibits marriages below the age

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[11] In this respect, early birth registrations are not possible since birth certificates which are usually provided during the time of birth are required for the official registration of a birth. If a birth was recorded in a different year from the actual year in which it occurred, this would count as a late registration.

[12] According to the National Health Service (NHS), the average age at which a girl typically reaches fecundity is 12 (National Health Service, UK, 2016). However, since it is possible that girls may start fecundity as early as 10, we also use the population of girls between 10-17 years old as a robustness check. The significance of the results is unchanged, although the magnitude of the coefficients is smaller as expected since 12 is the minimum age one is allowed to marry in any state

of 18, it is of interest to examine girls in this particular age group who would have been most affected by such legislative changes. In order to examine possible heterogeneous marriage and fertility behaviour among different age groups, we also calculate monthly age-specific and marriage and fertility rates. For simplicity, child marriage rates and teenage birth rates will be referred to as CMRs and TBRs respectively in the following sections. These rates can be constructed for all 29 states included in the sample from 2009 through 2017 on a monthly level, and should thus be sufficient to properly differentiate the causal effects of minimum marriageable age laws from pre-existing trends in marriage and fertility rates. Accordingly, we calculate CMRs and TBRs for all represented states using monthly data from 2009 to 2017 which allows for the controlling of pre-treatment time trends of up to 60 months (5 years) prior to the first law implementation date in the state of Veracruz in February 2014. As data ends in 2017 for the sample of analysis, post-treatment trends of up to 47 months are observed.

Data for state-level covariates are mostly acquired from the National Institute for Statistics and Geography (INEGI), Mexico's national statistical database. Specifically, baseline controls like the Gross Domestic Product (GDP) are obtained from INEGI's GDP and *National Accounts* database, and the male unemployment rate is taken from the *National survey of Occupation and Employment (ENOE)*. Yearly level socio-demographic controls including the male-female sex ratio, population growth rate, proportion of indigenous language speakers and the share of girls aged between 12-13, 14-15 and 16-17 are from the *Population and Housing Census*.[13] We also control for a confounding event, the ENAPEA ('*Estrategia Nacional para la Prevención del Embarazo en Adolescentes')* campaign which was introduced in 2015. Specifically, ENAPEA was initiated to combat the high rate of teenage pregnancies across the country. The implementation of the program however, took place in a staggered manner across states between 2015 and 2017, and the exact dates which each state enacted ENAPEA was provided by the *National Population Council (CONAPO).*[14] In separate specifications, we additionally include the proportion of junior high school dropouts to proxy for educational attainment, an indisputably important, yet potentially endogenous determinant of early marriage and adolescent pregnancy. Junior high school drop outs data is from the *2017 Annual Statistical and Geographical Yearbook* which contains information on socio-economic, economic and geographical aspects of the country, disaggregated by federal entities. Due to

across Mexico, and any associated births below that age should thus not be affected by the legal reforms.

[13] Yearly socio-demographic controls are used as the INEGI does not provide monthly level information for socio-demographic controls. Notwithstanding, these variables are unlikely to change significantly month by month.

[14] ENAPEA is a multi-sectoral response to combating teenage pregnancy nationwide. To strengthen its implementation, strategic partnerships and cooperation with the Mexican government were established for each of the 32 states. The dates provided by CONAPO therefore signify the first effort and commitment made by each state government to reduce and eradicate teenage pregnancies. For official documentation of the ENAPEA program, see: http://www.gob.mx/cms/uploads/attachment/file/328094/Informe_Ejecutivo_2017_ENAPEA.pdf.

the ongoing Mexican drug war which has led to an increase in national crime rates since 2007, we include the sex crime rate as a control to isolate possible changes in TBRs due to sexual offenses from changes in TBRs as a result of the minimum marriageable age law. Crime data is obtained from INEGI's administrative statistical register on *Law Enforcement and Criminal Matters* which provides information on the verdict of the crime committed, the type of crime committed, the location where the crime was reported and the month and year in which the crime was committed.

Lastly, we draw from a separate *Child Labor Module (MTI)* survey conducted by the INEGI to examine the effect of marriageable age law reforms on additional outcomes such as girls' school attendance and their probability of being in a consensual union. The *MTI* survey interviews children aged between 5-17 in Mexico and is collected on a biennial basis starting from 2007 with the latest survey conducted in 2017, indicating four pre-treatment survey years and two post-treatment survey years. It interviewed over 53,000 households with nearly 100,000 individuals in each round, and contains information on girls' conjugal statuses and school attendance, and a set of other individual and household level characteristics such as age, number of children, level of education, household size, household head's educational attainment and employment status, single-parent household, female-headed household and rural residential status.

IV. Empirical Framework

This study relies on the differential timing in the passing of minimum marriageable age laws across states to identify the impact of such legislative reforms on CMRs and TBRs in Mexico. Using both geographical and temporal variation in the timing of legal reforms over time, the identification strategy is based on a staggered difference-in-differences (D-I-D) approach which estimates the local average treatment effect (LATE). Consequently, the LATE will be estimated through the comparison of states that had and had not implemented the law, before and after the implementation of the law. Treatment is defined as states that had enacted the law in a respective month and year between February 2014 to December 2017, and control states are defined as otherwise. In order to sufficiently account for pre-existing CMR and TBR trends prior to the time the law was first enacted in February 2014, we include data from February 2009 to January 2014 which accounts for pre-treatment periods of up to 60 months. The baseline D-I-D regression is subsequently the following:

$$CMR_{s,t} = B_0 + \beta_1 Law_{s,t} + \beta_2 X_{s,t} + \theta_s + \lambda_t + \gamma_{st} + \varepsilon_{s,t} \qquad (1)$$

$$TBR_{s,t+12} = C_0 + C_1 Law_{s,t} + C_2 X_{s,t} + \sigma_s + \tau_t + \rho_{st} + \mu_{s,t} \qquad (2)$$

where the dependent variables $CMR_{s,t}$ is the child marriage rate in state *s*, during a respective month, *t*, and $TBR_{s,t+12}$ is the teenage birth rate in state *s*, 12 months (1 year) after the law was implemented at time t to account for the gestational length of a typical pregnancy and possible information dissemination lags about the enactment of the law.[15] $Law_{s,t}$ is a dichotomous variable equal to 1 in the months and years after state s passed the law in time t, and null otherwise. θ_s and σ_s are the state fixed effects which control for any time-invariant inter-state differences that influence CMRs or TBRs, and that may also be correlated with the timing of law enactment. Month fixed effects, λ_t and τ_t are included to account for aggregate shocks that could have impacted CMRs and TBRs in the absence of the legal reform. The inclusion of month fixed effects is crucial in eliminating bias that may arise from unobservable factors that change over time but are constant across states. We also include state-specific time trends γ_{st}, and ρ_{st} to account for any divergence in pre-existing state-specific trends due to the law.

$X_{s,t}$ is a vector of time-varying state level controls that influence the CMRs or TBRs. Specifically, we include the GDP per capita growth rate to account for changes in a state's economy over time and include the male unemployment rate as a proxy for the labour market situation and the 'quality' of men. Greene and Rao (1995) among others have suggested that informal unions are typically preferred over marriages during bad economic times, attributing this trend to lower costs and the fact that women favour engaging in relationships with financially stable men. $X_{s,t}$ also contains various socio-demographic characteristics such as the population growth rate, male-female sex ratio, the proportion of indigenous language speakers, and the share of girls aged between 12-13, 14-15 and 16-17 to account for any compositional changes in the population. In the baseline regressions, we additionally control for the timing of the ENAPEA campaign aforementioned, which undoubtedly had a direct effect on TBRs. We also include a proxy for education represented by the proportion of junior high school dropouts in a separate specification, due to possible endogeneity to the main outcome variable. As part of the 2006 Secondary Education Reform (RES), the Secretariat of Public Education (SEP) introduced a new RES Programme which included sex education in seventh-grade biology textbooks in Mexico (SEP, 2018). Since grade seven corresponds to the start of junior high ('secundaria'), individuals leaving school before that grade would have had less exposure to sex education, which would inevitably affect TBRs. Lastly, amidst the ongoing Mexican drug war, we control for the sex crime rate measured as the absolute number of sex-related offenses per 1,000,000 of the population, due to its possible correlation with the timing of the law and impact on TBRs (Tsaneva and Gunes, 2018). $\varepsilon_{s,t}$ and $\mu_{s,t}$ are the usual disturbance terms.

Timing of Law Enactment

[15] While this is a standard measure across economic literature on fertility rates, we also examine the effect of the law on TBRs 9,10 and 11 months after the implementation of the law. The results remain significant, although the magnitude of coefficients is smaller for the 9th, 10th and 11th month compared to the 12th month. This indicates some delay in fertility responses, possibly due to lags in behavioural changes or information dissemination about the law. Additionally, the policy reform does not have an impact on TBRs prior to 9 months providing additional support that other confounding factors or events were unlikely to precede the law.

One of the main identifying assumptions of the difference-in-differences estimation method is that the timing of law implementation was orthogonal to the expected changes in marriage and fertility rates. In order to provide supporting evidence of the independence of these events, we first examine the influence of political parties on the speed of law enactment. There may be concerns for instance, that political parties that were more progressive (conservative) in nature could have implemented the law sooner (later). Since the rate at which bills are passed as laws mostly depends on the approval of the president of the state, we examine the influence of the political party affiliation of each state's president on the timing of law implementation.[16] In 2013, one year prior to when the law was first enacted in any state, the presidents of 27 Mexican states that had introduced the law by 2017 belonged to 5 different political parties. Accordingly, we plot the relationship between these political parties and the year in which minimum marriageable age laws were implemented across states. As shown in Figure C, states with presidents affiliated to the Institutional Revolutionary Party (PRI), the same party as Mexico's president in 2014, President Peña Nieto, on average enacted minimum marriageable age laws in 2016.

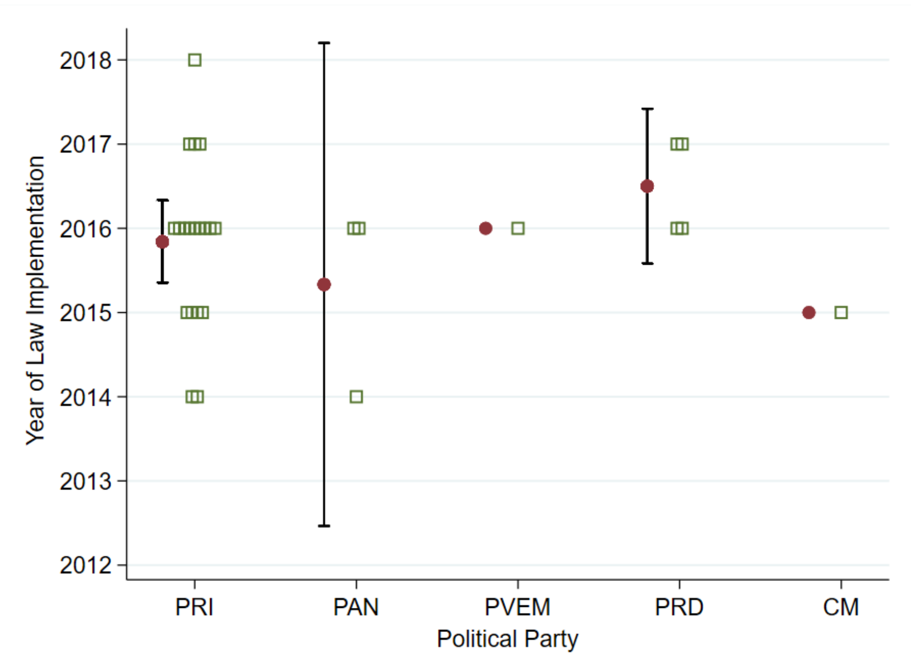


Figure C. A graphical representation of states presidents' political party affiliations and the timing of law implementation. *Notes*: This figure uses data on state presidents' political party affiliation in 2013, one year before the law was first implemented. PRI, PAN, PVEM, PRD and MC are the 5 political parties that governed Mexican states represented in the sample. The black bars represent 95% confidence intervals and mean point estimates are represented by the maroon dots. Each green point represents a state. 3 states, Baja California, Campeche and Sonora with 'marry-your-rapist' laws are excluded. Data is from the Mexican Centre for Research and Development (CIDAC).

Overall, Figure C shows that most states affiliated with the PRI party implemented the law between 2015 and 2017. Interestingly, the mean

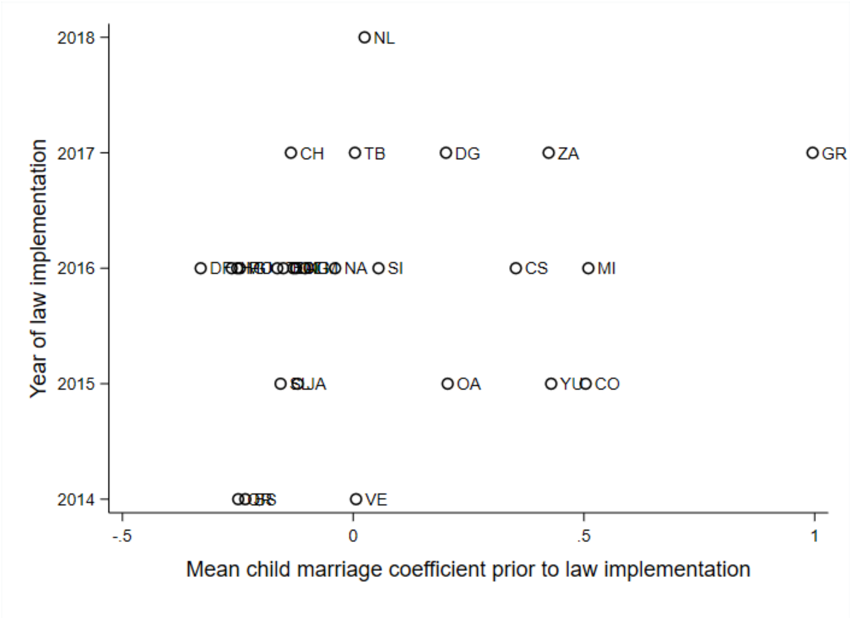
[16] See Article 40 of the Political Constitution of the United Mexican States on the enactment of federal laws: https://www.dof.gob.mx/nota_detalle.php?codigo=5280961&fecha=30/11/2012.

implementation year for the PAN party, which has been known to be relatively more conservative on social issues and focused on foreign matters was between 2015 and 2016, around the same time as PRI affiliated states. Since only one state was affiliated with each of the PVEM and the MC party, inferences on the average year of law implementation cannot be made due to low statistical power. Finally, although states affiliated with the PRD party appear to have enacted the law slightly later, the average difference in the timing of law implementation was only roughly half a year. Taken together, we argue that the approval of minimum marriageable age laws by state governments was likely to be random and unrelated to the pre-existing trends in child marriage and adolescent fertility.

To provide further support for the exogeneity in the timing of law implementation across states, we examine the effect of the mean child marriage rate in 2013 on the date of law enactment, and perform the same analysis for changes in the mean child marriage rate. Panels A and B in Figure D show that neither child marriage rates nor child marriage growth rates explain the timing of marriageable age law reforms across states. As seen in both graphs, there appears to be no defined pattern in the timing of law implementation in states with average levels of child marriage or child marriage growth rates above the median and below the median. Specifically, Panel A shows that states with similar positive mean child marriage coefficients like Zacatecas ('ZA'), Chiapas ('CS') and Yucatan ('YU') for instance implemented laws in 2017, 2016 and 2015 respectively. A similar pattern is observed for states with negative mean child marriage coefficients where the law appears to have been introduced across various years, though many states had enacted the law in 2016. Guerrero ('GR'), an outlier in the data with higher average child marriage levels than other states had minimum marriageable age laws enacted relatively later in 2017. Considering the negative implications of child marriage and the subsequent urgency to eliminate the practice, it is conceivable that states with higher child marriage rates and growth rates would have implemented the law sooner.

Coincidentally, Panel B shows no clear relationship between growth rates in the mean child marriage rate and the year in which the minimum marriageable age laws were enacted. The states of Quintana Roo ('QR') and Oaxaca ('OA') with negative changes in the average child marriage rate for example, appear to have implemented the law sooner (2014 and 2015 respectively) than other states like Zacatecas ('ZA') and Nuevo Leon ('NL') that also experienced negative mean child marriage growth rates (law was only implemented in 2017 and 2018 respectively). There is additionally little evidence demonstrating that states with positive changes in the mean child marriage rate like Guerrero ('GR') and Michoacan ('MI') implemented the law sooner than others, although the state of Coahuila ('CO'), an outlier with particularly high mean child marriage growth rates introduced the law in 2015, a year after age-of-marriage laws were first implemented. Lastly, we regress the year in which the law was enacted on the child marriage rate, and rate of change in child marriage, and observe statistically insignificant estimates with small *t*-statistics of 1.41 and 0.10 respectively.[17]

Panel (A)



Panel (B)

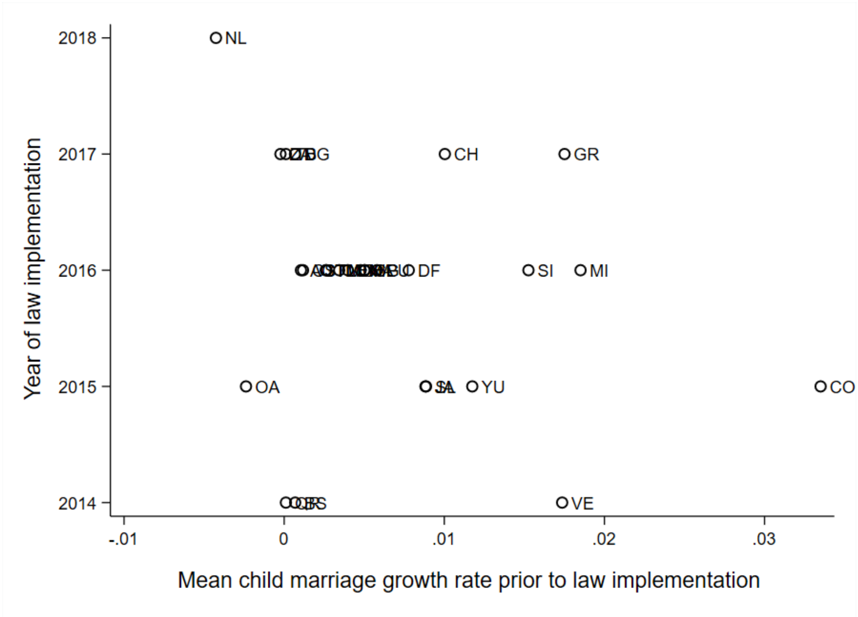


Figure D. A graphical analysis of the relationship between average child marriage levels in 2013 (Panel A) and 2013 child marriage growth rates (Panel B), and the year of law enactment. *Notes*: Panels A and B show a scatter plot of the relationship between mean child marriage rates and the timing of law implementation, and mean child marriage growth rates and the timing of law implementation respectively. Abbreviation for states are represented by two-letter codes. 3 states, Baja California, Campeche and Sonora with 'marry-your-rapist' laws are excluded. Child marriage

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[17] In correspondence with confidential sources at the Mexican Research Institute for Health and Demography (INSAD), the rate at which age-of-marriage laws were introduced in Mexico was barely related to the degree of severity of child marriage across states. It is noted that in rare cases, more conservative political parties could implement the law later. Figure C however demonstrates little evidence that political parties played a major role in determining when minimum marriageable age laws were enacted across states.

rates are calculated from the Nuptiality administrative records provided by the National Institute for Statistics and Geography (INEGI).

In order to provide further support that covariates included in Eqs. (1) and (2) are exogenous to the timing of the law, we perform a regression of $Law_{s,t}$ on the vector of controls described above. The results show that three of the covariates, namely the share of girls between 14-15, the share of girls between 16-17, and the male unemployment rate have a statistically significant relationship with the timing of the law enactment. As a robustness test, we subsequently exclude these three covariates from baseline regressions, and find that estimates are not altered by a large magnitude and maintain statistical significance. As a final robustness test, we regress $Law_{s,t}$ on CMRs 1,2 and 3 years prior to when the law was implemented in each state to check that CMRs were not influenced by other confounding events that may have preceded the minimum marriageable age law reforms. Table C3 of the Appendix shows the results from this analysis, which produces estimates that are small in magnitude and statistically insignificant.

Selective Marriage Registration

Despite the inclusion of month and state fixed effects, state-specific time trends, and a set of controls that influence CMRs and TBRs, a potential threat to identification remains due to selective marriage registration across states. For example, girls who resided in a state where marriage below the age of 18 was banned could have registered their marriages in states that had yet to introduce the law. Neglecting such responses could subsequently bias estimates upwards as states in which the law was implemented would have lower than actual CMRs and associated TBRs, and the opposite would be true for states where the law had not yet been enacted. To test for such behavioural responses, I estimate the proportion of girls who registered their marriages in states different from the one that they resided, in the absence of the law. More formally, I estimate the following fixed effects model:

$$Share^{*}_{s,t} = D_0 + D_1 No\_Law_{s,t} + D_2 X_{s,t} + \varphi_s + \omega_t + \partial_{st} + \epsilon_{s,t} \quad (3)$$

Where $Share^{*}_{s,t}$ is calculated as the number of girls in state *s*, who resided in a different state from the one where their marriage was registered, out of the total number of girls who were married below the age of 18 in that state. $No\_Law_{s,t}$ is a binary variable equal to one for the years *before* state s, implemented the law at time t, $X_{s,t}$ are the same set of time-varying state level covariates described in Eqs. (1) and (2) above, φ_s and ω_t are the state and month fixed effects respectively, ∂_{st} is the state-specific time trend, and $\epsilon_{s,t}$ is the error term. The results from Eq. (3) are shown in Table 2, where column (I) is a stripped-down version which includes no controls, column (II) includes baseline covariates like the population growth rate, the male-female sex ratio, the proportion of indigenous language speakers, the share of girls aged 12-13, 14-15 and 16-17, the GDP per capita growth rate and the male unemployment rate. Column (III) additionally includes the proportion of junior high school dropouts and the sex crime rate per 1,000,000 people.

Table 2 provides evidence of selective marriage registration across states, in response to the staggered implementation of minimum marriageable age laws. The results suggest that migration was possibly driven by the difference in the timing of legal reforms on the marriageable age as the share of girls below 18 who registered their marriages in a state, and who did not reside in that state increased by approximately 70% (0.033/0.047) in states where the law had not been enacted (column II). The inclusion of potentially endogenous covariates in column (III) does not change the results. Coefficients are significant at the 5% level and are positive across all three specifications.

Table 2
The effect of the law on the share of girls below 18 who got married in state in which they do not reside in.

	(I)	(II)	(III)
Share of girls	0.033**	0.033**	0.032**
	(0.012)	(0.012)	(0.012)
	[0.012]	[0.012]	[0.012]
Controls	No	Yes	Yes
Sex crime rate, share of high school dropouts	No	No	Yes
State FE	Yes	Yes	Yes
Month FE	Yes	Yes	Yes
State-Specific Time Trends	Yes	Yes	Yes
Wild-Cluster Bootstrapped SE [.]	Yes	Yes	Yes
Observations	3103	3103	3103
Mean (share of girls)	0.047	0.047	0.047

Notes: Standard errors clustered at the state level and reported in parentheses (.). As a robustness check, wild cluster bootstrapped standard errors are reported in parentheses [.] as recommended by Cameron et al. (2008) when the number of clusters is below 40. Controls include the population growth rate, proportion of indigenous language speakers, male-female sex ratio, GDP per capita growth rate, male unemployment rate, the share of girls aged between 12-13, 14-15, 16-17 and the ENAPEA program. 3 states, Baja California, Campeche and Sonora with 'marry-your-rapist' laws are excluded. *** $p < 0.01$ ** $p < 0.05$ * $p < 0.1$.

As a consequence of selective marriage registration, CMRs and TBRs are calculated based on the state of *residence* of girls, as opposed to the state in which their marriages or births were registered in order to circumvent the issue of selective marriage registration across states. By fixing individuals to their states of residence, any migration influenced by the date of the law enactment should not affect their assigned subjection to the law. The results presented in the following sections should therefore be interpreted as intent-to-treat (ITT) estimates rather than the LATE, and albeit this approach potentially attenuates estimates, it reduces the possibility that selective marriage registration across states drives the results.

V. Results

Child Marriage Rates (CMRs)

The validity of a difference-in-difference (D-I-D) set up is contingent upon the common trend assumption, which is that treated and untreated states follow similar CMR and TBR trends in the absence of minimum marriageable age laws. The fulfilment of this condition should in theory, strengthen the causal interpretation of estimates. To test if this identifying assumption holds, I consider a 72-month window, ranging from 36 months before the enactment of the law to 36 months after the law was introduced, and estimate the impact of minimum marriageable age laws on CMRs in the following regression:[18]

$$CMR_{s,t} = B_0 + \beta_1 Law_{s,t}^{-36} + \beta_2 Law_{s,t}^{-35} + \cdots + \beta_{54} Law_{s,t}^{+36} + \theta_s + \lambda_t + \gamma_{st} + \varepsilon_{s,t} \quad (4)$$

Where $CMR_{s,t}$ is the child marriage rate in state *s* during month *t*, regardless of the state where marriages were registered. $Law_{s,t}^{-k}$ equals to one in the k^{th} month before the law was enacted, and $Law_{s,t}^{+k}$ is equal to one in the k^{th} month after restrictions on the minimum marriageable age were imposed. To illustrate the effect of the policy distinctly and dynamically, the month in which the law was implemented is excluded to de-trend and centre estimates around month 0, defined as the month of the policy change. θ_s and λ_t are vectors of state and year dummies which control for time-constant and time-specific factors that may influence CMRs across states. In order to account for any deviations from pre-existing state-specific trends caused by the law, we include state-specific linear time trends, γ_{st}. $\varepsilon_{s,t}$ is the error term. Accordingly, Figure E plots the results from Eq. (4), and includes 95% confidence intervals.

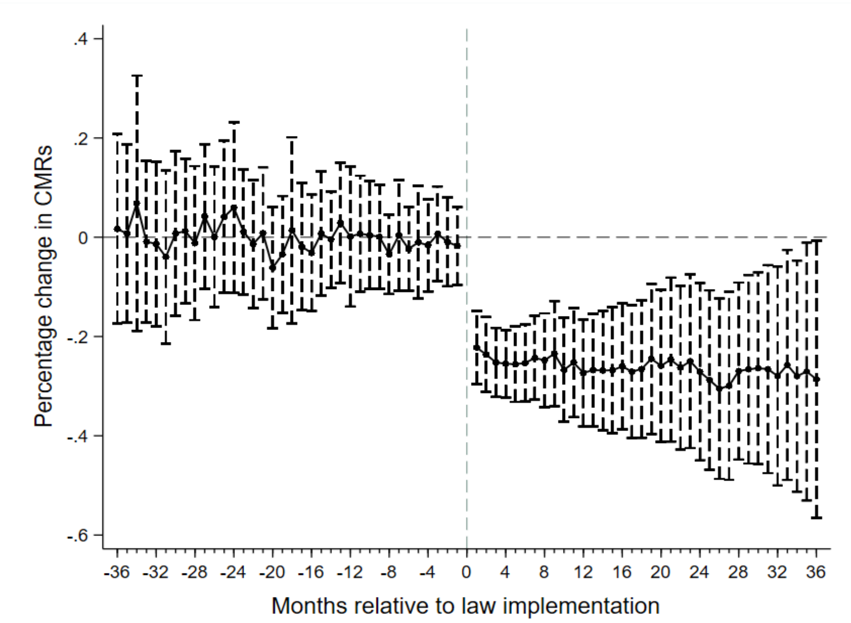

Figure E. The dynamic evolvement of CMRs before and after the law. *Notes*: This figure plots trends in the child marriage rate 36 months prior to the implementation of the law up to 36 months after the law was enacted. CMRs are calculated according to girls' state of residence (ITT approach) and regressions include baseline controls, state, and month fixed effects, and state-specific time trends. The dashed bars represent 95% confidence intervals and monthly point estimates are adjusted for clustering at the state-level. 3 states, Baja California, Campeche and Sonora with 'marry-your-rapist' laws are excluded. Data come from Nuptiality administrative records provided by the National Institute for Statistics and Geography (INEGI).

As can be seen, the average percentage change in CMRs prior to the policy change is centred around zero, indicating that a decline in CMRs did not precede the implementation of minimum marriageable age laws. The dramatic fall in CMRs immediately after the legislative reforms suggests the effectiveness of legal restrictions on the marriageable age in curbing child marriage practices. Point estimates a month before and after the law show that CMRs fell by about 22% due to legal reforms on the marriageable age. The impact of the policy also appears to persist for at least 36 months after its official implementation. Table 3 presents results from the first-order outcome of interest, which estimates Eq. (1) of the relationship between age-of-marriage laws and CMRs.

Table 3
Effect of the law on child marriage rates.

	(I)	(II)	(III)
Law	-0.219***	-0.216***	-0.218***
	(0.056)	(0.053)	(0.053)
	[0.060]	[0.057]	[0.057]
Controls	No	Yes	Yes
Sex crime rate, share of high school drop outs, proportion of indigenous language speakers	No	No	Yes
State FE	Yes	Yes	Yes
Month FE	Yes	Yes	Yes
State-Specific Time Trends	Yes	Yes	Yes
Wild-Cluster Bootstrapped SE [.]	Yes	Yes	Yes
Observations	3103	3103	3103
Mean (CMRs)	0.443	0.443	0.443
Control mean (CMRs)	0.533	0.533	0.533

Notes: Standard errors clustered at the state level and reported in parentheses (.). As a robustness check, wild cluster bootstrapped standard errors are reported in parentheses [.] as recommended by Cameron et al. (2008) when the number of clusters is below 40. Controls include the population growth rate, proportion of indigenous language speakers, male-female sex ratio, GDP per capita growth rate, male unemployment rate, the share of girls aged between 12-13, 14-15, 16-17 and the ENAPEA program. Child marriage rates are calculated according to girls' state of residence (ITT approach). 3 states, Baja California, Campeche and Sonora with 'marry-your-rapist' laws are excluded. *** $p < 0.01$ ** $p < 0.05$ * $p < 0.1$.

Column (I) includes state and month fixed effects, and state-specific time trends without the inclusion of controls, column (II) adds baseline controls that are conceivably exogenous to the timing of the law implementation and CMRs, and column (III) incorporates potentially endogenous covariates such as the proportion of junior high school dropouts, and the sex crime rate per 1,000,000 people. Using column (II) as the benchmark specification which includes baseline controls, the enactment of minimum marriageable age laws appears to have decreased CMRs by 49% (0.216/0.443) with significant estimates at the 1% level. In comparison to the control mean indicating the average CMR in the absence of the law, the effect is slightly smaller with a reduction in CMRs by about 41%. The coefficient from the regression of CMR on $Law_{s,t}$ without the inclusion of any controls shows that CMRs had declined by the same amount of about 49%. Baseline estimates barely differ with the addition of potentially endogenous covariates in column (III).

Teenage birth rates (TBRs)

Considering the strong positive relationship that has been documented between early unions and premature childbearing, raising the minimum marriageable age should lower the incidence of teenage births. Table 4 presents results from the second-order outcome of interest which estimates Eq. (2) of the relationship between minimum marriageable age law reforms and adolescent fertility.

Table 4
Effect of law on teenage birth rates (TBRs).

	(I)	(II)	(III)
Total TBRs	-0.017	-0.020	-0.015
	(0.039)	(0.039)	(0.040)
	[0.039]	[0.041]	[0.044]
Controls	No	Yes	Yes
Sex crime rate, share of high school dropouts	No	No	Yes
State FE	Yes	Yes	Yes
Month FE	Yes	Yes	Yes
State-Specific Time Trends			
Wild-Cluster Bootstrapped SE [.]	Yes	Yes	Yes
Observations	2755	2755	2755
Mean (Total TBRs)	0.931	0.931	0.931
Control mean (Total TBRs)	0.954	0.954	0.954

Notes: Standard errors clustered at the state level and reported in parentheses (.). As a robustness check, wild cluster bootstrapped standard errors are reported in parentheses [.] as recommended by Cameron et al. (2008) when the number of clusters is below 40. Controls include the population growth rate, proportion of indigenous language speakers, male-female sex ratio, GDP per capita growth rate, male unemployment rate, the share of girls aged between 12-13, 14-15, 16-17 and the ENAPEA program. Teenage birth rates are calculated according to girls' state of residence (ITT approach). 3 states, Baja California, Campeche and Sonora with 'marry-your-rapist' laws are excluded. *** $p < 0.01$ ** $p < 0.05$ * $p < 0.1$.

Contrary to expectations that curbing early unions should also preclude teenage births, the results from Table 4 show otherwise. Estimates across all three specifications are negative, but not significant. Moreover, the magnitude of TBR coefficients are small and zero-bound, suggesting that the age-of-marriage reforms in Mexico did not have an impact on adolescent fertility rates, despite the documented positive correlation between child marriage and teenage pregnancy.

To provide further support for a causal relationship between total TBRs and marriage law reforms, I repeat the analysis of the common trend assumption in Eq. (4), but replace the dependent variable with TBRs calculated as the absolute number of births to girls below 18 per 1,000 of the population of girls between 12 and 17 years of age. Figure F exhibits pre- and post-reform monthly TBR trends with 95% confidence intervals.

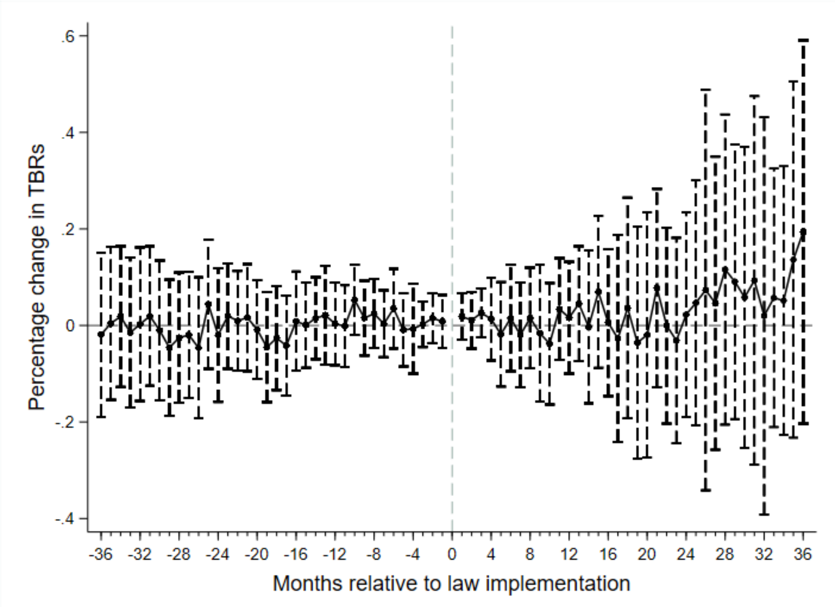

Figure F. The dynamic evolvement of TBRs before and after the law. *Notes*: This figure plots trends in the teenage birth rate 36 months prior to the implementation of the law and 36 months after the law was enacted. TBRs are calculated according to girls' state of residence (ITT approach) and regressions include baseline controls, state, and month fixed effects, and state-specific time trends. The dashed bars represent 95% confidence intervals and monthly point estimates are adjusted for clustering at the state-level. 3 states, Baja California, Campeche and Sonora with 'marry-your-rapist' laws are excluded. Data come from Birth administrative records provided by the National Institute for Statistics and Geography (INEGI).

Similar to CMR trends, the overall average change in TBRs is centred around zero prior to the enactment of the law with mean percentage changes in TBRs spanning from -0.05% to 0.05% during the 36-month pre-reform period. Taking into account the gestational length of a typical pregnancy and possible information dissemination lags about the minimum marriageable age laws, Figure F shows that TBRs barely changed a year (12 months) after the age-of-marriage laws were introduced at time period 0. On the contrary, nearly 2 years (23 months) after the implementation of the law, the percentage change in TBRs appears to be on an appreciable trend up to the 36th month. Taken together, the results suggest that minimum marriageable age laws were not effective in mitigating adolescent pregnancies, although they did decrease child marriage rates in Mexico. This result confirms the theoretical argument that *a priori*, it is not clear how age-of-marriage laws would affect teenage birth rates.

VI. Robustness

Heterogeneous Treatment Effects

While Figures E and F show parallel trends in CMRs and TBRs in the absence of the legal reform, thereby satisfying the identifying assumption of a difference-in-differences empirical strategy, de Chaisemartin and D' Haultfœuille (2019) note that treatment effects may not always be constant and estimates could still be biased if this is the case.[19] For example, the effect of age-of-marriage laws on child marriage practices and associated fertility may vary across states, and could change over time as a result of differences in law enforcement. In a cross-country analysis on the effectiveness of age-of-marriage laws, Collin and Talbot (2017) found that in the majority of the countries in their sample, such laws were typically not properly enforced. In the event that laws are weakly imposed in some states, girls would therefore still be allowed to marry below 18 and the intended effect of the law on child marriage rates would be smaller than in states with proper legal enforcement.

In order to shed more light on the issue of law enforcement in the Mexican context, we plot separate CMRs for girls belonging to age groups of between 12 and 24 as shown in Figure G, to compare CMRs among age groups below 18 and those above 18.[20] If the law was properly enforced, one should see a significant decline in the CMRs from 2013, one year before the law was first implemented in any state, to 2017, when 27 states had already introduced age-of-marriage laws. The graph shows that the difference between CMRs for girls aged 17 and 18 increased by about 0.66 between 2013 and 2017. In 2013, the difference in CMRs between these two age groups was 0.94 and by 2017, this difference had increased to 1.60. CMRs especially for girls aged 16 and 17 fell drastically from 1.11 to 0.07 and 1.40 to 0.08 respectively. The remaining above zero CMRs for girls below 18 are likely to be from the 5 states that had yet to implement the law by the end of 2017. Taken together, these statistics lend support to the proper enforcement of the minimum marriageable age laws in Mexico, as the CMRs of target age groups (those below 18) decreased sharply to nearly 0.

[19] Using Gentzkow et al.'s (2011) data set, de Chaisemartin and D' Haultfœuille (2019) show that approximately 40% of the weights attached to the fixed effects coefficient of interest are negative when the treatment effect varies across groups and periods. Since the coefficient of interest is a weighted sum of several difference-in-differences (across time and groups), negative weights are an issue as coefficients would appear negative, even if the actual average treatment effect (ATE) is positive.

[20] We do not plot the CMRs for girls aged between 10 and 11 because 12 was the earliest age at which one could get married in any state before the legal reforms. Notwithstanding, we examine CMRs for these two age groups as a robustness check and observe zero-bound effects.

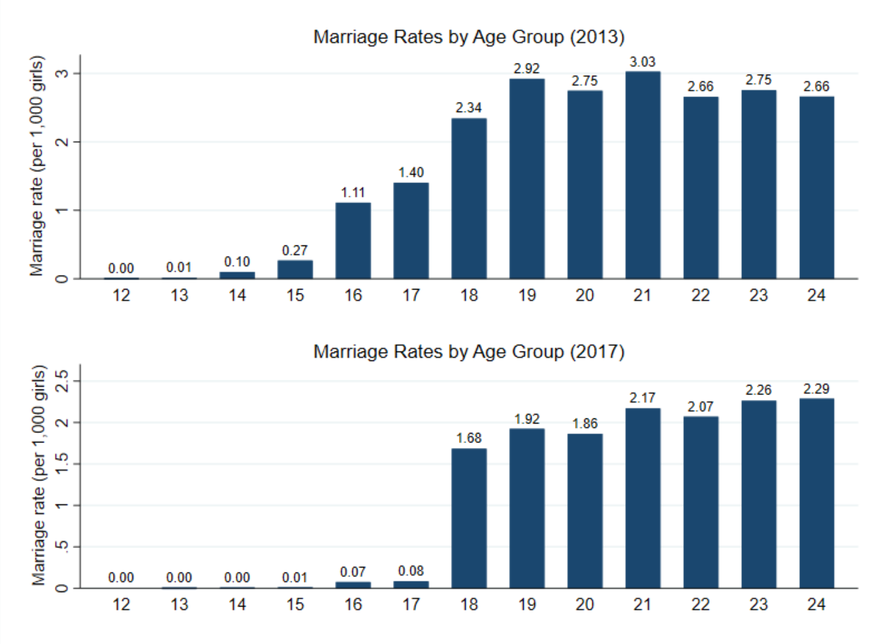

Figure G. A comparison of age-specific CMRs in 2013 and 2017. *Notes*: This figure presents CMRs calculated for each age group between 12 to 24 for 2013, one year before the law was first implemented and 2017, the last year for the sample of analysis. Each blue bar represents the CMR for the respective age group. Three states, Baja California, Campeche and Sonora with 'marry-your-rapist' laws are excluded. Data come from Nuptiality administrative records provided by the National Institute for Statistics and Geography (INEGI).

An alternative method to test how well marriageable age laws were imposed in Mexico is to examine the mean of CMRs calculated according to the state where marriages were registered, both in the presence and absence of the law. If the law was appropriately enforced, CMRs should be zero in states where child marriage is banned, as the registration of marriages among girls below 18 would no longer be permitted. The results from the descriptive analysis are presented in Table 5 and provide evidence that minimum marriageable age laws were by and large properly enforced, albeit not perfectly.

Table 5. Law Enforcement

	Child marriage rates according to state of registration				
	Mean	SD	Min	Max	N
Law = 1	0.0	0.1	0	0.7	552
Law = 0	0.5	0.4	0	3.1	2,551

Notes: Law=1 for months after state banned marriage below 18. Law=0 for months before state banned marriage below 18. Three states, Baja California, Campeche and Sonora with 'marry-your-rapist' laws are excluded.

As can be seen, the mean CMR after the implementation of the law is 0, compared to the mean CMR before the law was introduced with a rate of 0.5. The above zero value (0.7) of the upper bound in states where the law had been enacted however indicates that while the policy was enforced in general, it was not strictly imposed.

Given the possibility of heterogeneous treatment effects across states due to improper legal enforcement, de Chaisemartin and D' Haultfœuille (2019) suggest calculating the weights of baseline regressions and the ratio of the explanatory variable of interest, $Law_{s,t}$, divided by the standard deviation of weights. To do so, we use de Chaisemartin and D'Haultfoeuille's (2019) Stata command '*twowayfeweights*' to check the ratio of negative weights in the baseline regression of CMRs on $Law_{s,t}$. It is recommended that if a large number of weights are negative, an alternative difference-in-differences estimator ('Wald-DID') which accounts for heterogeneous treatment effects across states and time should be used (see de Chaisemartin and D'Haultfoeuille (2019)). Altogether, the results from the weights analysis reveal that only 12% of the weights are negative (66 out of 552 weights) in the baseline specification, while the remainder are positive. Additionally, the test shows that the corresponding weights of the main explanatory variable of interest, $Law_{s,t}$, are barely correlated with the treatment effect of minimum marriageable age laws (correlation coefficient is -0.017). Because laws were generally properly enforced with some minor exceptions (see Table 5), it is unlikely that states would re-enter the 'untreated' position (and thus increase the probability of getting negative weights), since minimum marriageable age laws were likely to remain in place once they were imposed.[21] The small proportion of negative weights from the baseline specification is therefore plausible, and supports the fact that the fixed effects difference-in-differences estimator used in the baseline regressions is likely to be an unbiased estimator of the overall intent-to-treat (ITT) effect.

Sensitivity Analyses

In this section, I check the sensitivity of the main results to various specifications and conduct a falsification test to provide support for the internal validity of the baseline estimates. Table 6 presents the findings from 5 different sensitivity analyses, and compares the estimates from each specification to the main TBR coefficient (-0.020) in Table 4. First, one may argue that states with relatively higher population growth rates have different TBR patterns, which could have driven the main results. To check the robustness of the estimates to the exclusion of such states, we omit three states with the highest population growth rates as reported in the INEGI's 2015 Intercensal Survey: Quintana Roo (+13.3%), Baja California Sur (+11.8%) and Queretaro (+11.5%). As shown in column (I), the results are not sensitive to the omission of these states, albeit the coefficient increases in magnitude by 0.023. Second, there may be concerns that the higher rate of underreporting of births that has been documented in 3 states: Chiapas, Guerrero and Puebla, would suppress the effect of the age-of-marriage laws on total TBRs. Accordingly, we omit these 3 states from the main analysis and find that the resulting estimate is close to the baseline estimate of -0.020 (see column (II)). Considering that over 95% of births are registered in Mexico (see Perez and

[21] To provide additional support for the proper legal enforcement, we further investigate the effect of the policy change on CMRs calculated according to where marriages were registered rather than the state where girls resided. If the law was properly enforced, the decrease in CMRs due to the law should be larger for CMRs calculated according to the state of registration rather than state of residence. As expected, CMR coefficients from the analysis are larger, negative and significant at the 1% level (see Table C4 of the Appendix).

Meneses, 2010), excluding the 3 states with relatively lower birth registrations is unlikely to influence the main results to a large extent.

Next, in column (III), we exclude 3 states with the highest proportion of proclaimed Catholics between the ages of 10 and 19: Aguascalientes (93.6%), Zacatecas (94.3%) and Guanajuato (94.5%). Due to the paucity of regular data on religion or other proxies for religion such as church attendance, the inclusion of religion as a control in the main regressions is not feasible. Yet, religion plausibly plays a major role in teenage pregnancy as pre-marital sex for instance is frowned upon, especially in Catholicism. The results show that the omission of relatively more religious states increases the baseline estimate of -0.020 by a magnitude of 0.004, and remains statistically insignificant. This suggests that the effect of minimum marriageable age laws on TBRs was not likely to have been affected by the degree of religiosity across states.

Table 6
Sensitivity analysis of the effect of the law on teenage birth rates (TBRs) among girls in consensual unions.

	(I)	(II)	(III)	(IV)	(V)
Total TBRs	-0.043	-0.019	-0.024	-0.022	-0.026
	(0.045)	(0.041)	(0.041)	(0.040)	(0.036)
	[0.049]	[0.045]	[0.047]	[0.044]	[0.037]
Excludes high population growth rate states	Yes	No	No	No	No
Omit underreporting states	No	Yes	No	No	No
Excludes religious states	No	No	Yes	No	No
Excludes Mexico City	No	No	No	Yes	No
Includes 'marry-your-rapist' states	No	No	No	No	Yes
Observations	2470	2470	2470	2660	3040
Mean (Total TBRs)	0.931	0.931	0.931	0.931	0.931
Control mean (Total TBRs)	0.954	0.954	0.954	0.954	0.954

Notes: Standard errors clustered at the state level and reported in parentheses (.). As a robustness check, wild cluster bootstrapped standard errors are reported in parentheses [.] as recommended by Cameron et al. (2008) when the number of clusters is below 40. Controls include the population growth rate, proportion of indigenous language speakers, male-female sex ratio, GDP per capita growth rate, male unemployment rate, the share of girls aged between 12-13, 14-15, 16-17 and the ENAPEA program. All regressions include state and month fixed effects, and state-specific time trends. Teenage birth rates are calculated according to girls' state of residence (ITT approach). All specifications other than (V) exclude 3 states: Baja California, Campeche and Sonora, with 'marry-your-rapist' laws. *** $p < 0.01$ ** $p < 0.05$ * $p < 0.1$.

Another law that could have possibly confounded the effect of the age-of-marriage reforms is legalization of abortion in the Federal District of Mexico in 2007. Under this law, women could demand abortion services upon request in the first 12 weeks of the pregnancy, and up till 2017, the Federal District of Mexico remained the only state where abortion was legal while abortion continued to be restricted across other states.[22] Consequently, we exclude the Federal District of Mexico from the analysis as coefficients could be downward bias if girls who had access to abortion decided to terminate their pregnancies. The omission of Mexico City results in an increase in the main coefficient of total TBRs minimally by 0.002 (column (IV)) as expected, given that girls may have taken the opportunity to abort their child since it was legal to do so. Lastly, we probe the robustness of our main estimates by including the 3 states with 'marry-your-rapist' laws that are omitted from the main analyses. Doing so increases the main TBR coefficient by a magnitude of 0.006, an arguably insignificant amount, similar to what was observed across all other specifications (I – IV).[23]

To further demonstrate that the results are not spurious, we run a falsification test to check the validity of the common trend assumption by simulating a random month and year of law implementation between 2009 and 2017, which are the first and last years in the sample. By doing so, states are assigned a placebo legal reform date, different from their actual date of law enactment. If the fall in CMRs truly came from legal changes to the minimum marriageable age and no other events, one should expect the CMR coefficients of this placebo test to be zero or at least close to zero. Accordingly, the main specification in Eq. (2) is re-estimated with the placebo dates of law implementation. This exercise is repeated 20,000 times and point estimates from each regression are stored. As shown in Figure H, the distribution of the estimated coefficients from the 20,000 simulations in the probability density plot is centred around zero. Specifically, the mean CMR estimate from this exercise is approximately equal to 0 (0.00102) and the red line representing the benchmark estimate of -0.216 in column (II) of Table 3 clearly lies outside of the range of coefficients from the 20,000 simulations generated by this placebo experiment.

[22] Prior to 2016, Mexico City was officially called the 'Federal District of Mexico'. For clarification, the legalization of abortion did not take place in the State of Mexico (state code 'EM', see Table 1), which is a separate entity from the Federal District of Mexico (state code 'DF').

[23] CMR results with the inclusion of the 3 'marry-your-rapist' states are presented in Table C5 of the Appendix, and show minimal changes (increase in magnitude of 0.01) to the main CMR estimate. Coefficients remain significant at the 1% level and are negative.

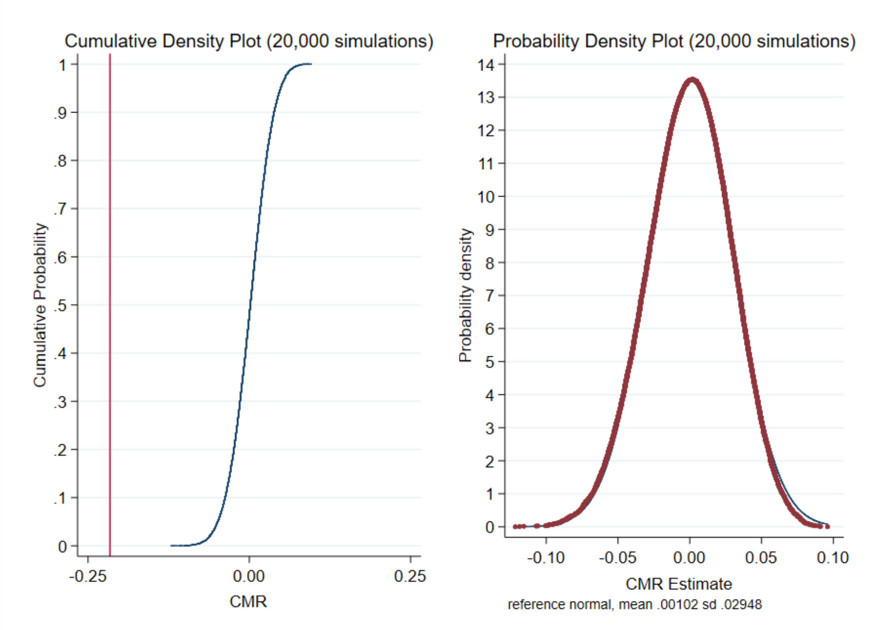

Figure H. Results from 20,000 simulated placebo law enactment dates. *Notes*: This figure plots the cumulative distribution function (left) and the probability density function (right) of the estimated CMR coefficients from 20,000 simulations using a randomly generated law implementation date. 3 states, Baja California, Campeche and Sonora with 'marry-your-rapist' laws are excluded.

VII. Heterogeneous Effects

Age-Specific Effects

It is interesting to examine how age-of-marriage laws impacted various target age groups differently as this could have important implications for educational attainment for example. It is reported that the highest drop out rate is registered in high school ('preparatoria'), which consists of grades 10-12 and children aged between 15-18 years old. According to the Mexican National Institute for the Evaluation of Education (INEE), the dropout rate between 2014-2015 for all of those enrolled at this level of schooling was approximately 14.4%, compared to 4.4% for those enrolled in junior high school ('secundaria') (INEE, 2018). Correspondingly, we re-estimate Eq. (1) and replace the dependent variable with CMRs of each age group between 12-17 years old. The results are presented in a coefficient plot in Figure I, and show that girls in the 16-17-year-old age group were most affected by the legal reform out of all other age groups. In particular, estimates for the two age groups are significant at the 1% level, with large negative coefficients (*t*-statistics are -3.66 and -4.37 respectively for 16- and 17-year olds), while CMR estimates for those aged between 12-15 are negative, but not statistically significant (see Table C1 of the Appendix).[24]

[24] Table C1 of the Appendix also shows that CMRs for girls between 18-20 were not affected by the age-of-marriage reform. This indicates that delays in unions due to the law was unlikely, and that the law achieved its intended effect on the target age group (only those below 18), providing further support for the exogeneity of the law.

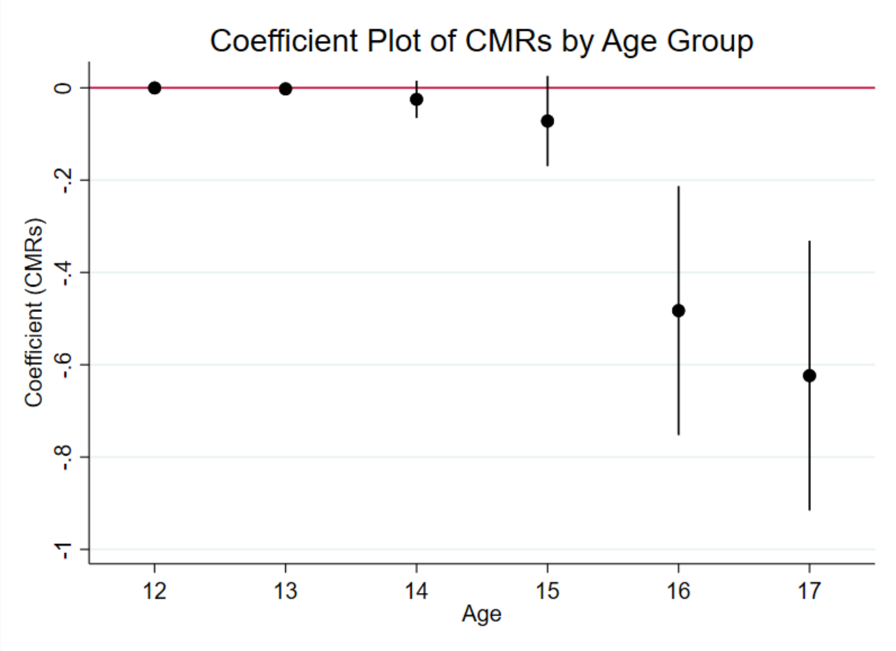

Figure I. Coefficient plot of age-specific CMRs. *Notes*: This graph presents coefficient estimates of the regression of age-specific CMRs on the law with the inclusion of baseline controls, state and month fixed effects, and state-specific time trends. CMRs are calculated according to girls' state of residence (ITT approach). The straight-lined bars represent 95% confidence intervals and point estimates are adjusted for clustering at the state-level. Three states, Baja California, Campeche and Sonora with 'marry-your-rapist' laws are excluded. Data come from Nuptiality administrative records provided by the National Institute for Statistics and Geography (INEGI).

To check for age-specific effects of the law on TBRs, we re-estimate Eq. (2), and replace the dependent variable with age-specific TBRs. Estimates from the analysis reveal that while minimum marriageable age laws did not lower total TBRs, it appears to have decreased TBRs among girls in the 12-year old age group by about 140% (-0.007/-0.005), with significant estimates at the 5% level (see Table C6 of the Appendix). Because a simultaneous decline in CMRs among 12-year old girls is not observed however, this indicates that the fall in TBRs among 12-year old girls was unlikely to be due to a reduction in child marriage rates, and was likely to come from other sources correlated with legal reforms to the marriageable age. In Figures B2 and B3 of the Appendix, we additionally plot the pre-trends of CMRs and TBRs by age group to check that age-specific marriage and birth patterns were not on diverging paths in the absence of law implementation. Altogether, the event-study graphs of age-specific CMRs and TBRs provide support for the common-trend assumption and demonstrate that both the percentage change in marriage and birth rates were centred around zero prior to law implementation.

Socio-Economic Status

Next, it is important to examine if age-of-marriage laws impacted the fertility choice of girls from various socio-economic groups differently. Especially since poorer girls are more susceptible to teenage pregnancy as a result of inter alia, a lack of education and destitution, it would be useful to check if raising the minimum age of marriage was effective in reducing the incidence of teenage births among girls from lower socio-economic status (SES), which is arguably the highest risk group. Accordingly, we use information on girls' partner's education and rural residential status provided in the *Vital Statistics* edition of INEGI's fertility records, to calculate TBRs according to girls' partner's education level and rural-urban residential status. Albeit the birth registers also provide information on the employment status (but not income level) and education level of girls, we do not use these variables as proxies for SES since whether a girl is employed or is in school, may not just reflect her income-earning potential, but could also be influenced by whether her parents for instance, are economically dependent on her for subsistence.[25]

Table 7 presents the findings from the analysis and show that minimum marriageable age laws did not have a significantly different impact on adolescent fertility among girls with low educated and high educated partners.[26]

Table 7
Effect of the law on teenage birth rates (TBRs), according to socio-economic status.

	(I)	(II)	(III)	Mean
TBRs (*high educated partner*)	-0.014	-0.015	-0.011	
	(0.061)	(0.059)	(0.057)	0.450
	[0.024]	[0.024]	[0.026]	
TBRs (*low educated partner*)	-0.004	-0.002	0.001	
	(0.023)	(0.023)	(0.022)	0.187
	[0.016]	[0.017]	[0.017]	
TBRs (*urban*)	0.023	0.024	0.021	
	(0.044)	(0.043)	(0.041)	0.543
	[0.042]	[0.045]	[0.045]	
TBRs (*rural*)	-0.046	-0.048*	-0.039*	
	(0.029)	(0.028)	(0.022)	0.335
	[0.028]	[0.028]	[0.023]	
Controls	No	Yes	Yes	
Sex crime rate, share of high school dropouts	No	No	Yes	
State FE	Yes	Yes	Yes	
Month FE	Yes	Yes	Yes	
State-Specific Time Trends	Yes	Yes	Yes	
Wild-Cluster Bootstrapped SE [.]	Yes	Yes	Yes	
Observations	2755	2755	2755	

Notes: Standard errors clustered at the state level and reported in parentheses (.). As a robustness check, wild cluster bootstrapped standard errors are reported in parentheses [.] as recommended by Cameron et al. (2008) when the number of clusters is below 40. Controls include the population

[25] It could be argued that a girl's partner's educational status could also be affected by the law if underaged teenage boys now return to school due to the marriage ban. Due to the paucity of data on more suitable proxies for SES such as a mother's education for example, TBR estimates for girls' partner's education should be interpreted with some caution. In these cases, however, it is more likely that girls rather than boys exit schooling due to marriage, which has been well documented across existing literature on child marriage.

[26] Low educated partners are defined as individuals who had completed primary school but not junior high school ('secundaria'). As the Secretariat of Public Education (SEP) only introduced sex education in seventh-grade biology textbooks corresponding to the start of junior high ('secundaria'), boys who dropped out of school before that level would have had less exposure to sex education which could have in turn affected TBRs (SEP, 2018).

growth rate, proportion of indigenous language speakers, male-female sex ratio, GDP per capita growth rate, male unemployment rate, the share of girls aged between 12-13, 14-15, 16-17 and the ENAPEA program. Teenage birth rates are calculated according to girls' state of residence (ITT approach). Three states, Baja California, Campeche and Sonora with 'marry-your-rapist' laws are excluded. *** $p < 0.01$ ** $p < 0.05$ * $p < 0.1$.

TBR estimates for both education groups are insignificant and negative, although the magnitude of the coefficients is larger for girls with high educated partners. Interestingly, we find that the age-of-marriage law reforms decreased TBRs among rural girls, defined as those who live in areas with less than 2,500 inhabitants, in line with INEGI's definition of rural residence. The benchmark estimate in column (II) reveals that TBRs among girls living in rural areas decreased by about 14% (0.048/0.335), with significant coefficients at the 10% level. On the other hand, TBR estimates for urban girls are positive, although not statistically significant. Theoretically, the opposite signed estimates for rural and urban TBRs are consistent with model 1 in Appendix A, provided that rural girls have a stronger preference for fertility than urban girls, *ceteris paribus*. Taken together, these results demonstrate that while raising the minimum age of marriage did not lower aggregate TBRs on average, it appears to have been successful in mitigating adolescent fertility in rural communities. This finding is encouraging, as early motherhood has been linked to the perpetuation of the poverty cycle, particularly among those from lower socio-economic classes. Lowering teenage birth rates in poorer areas could therefore decrease the likelihood that girls remain trapped in acute destitution in the long-run.

High versus Low CMR States

In order to gain a more holistic overview of the heterogeneous effects of Mexico's minimum marriageable age law reforms, we perform a sample split of states in which CMRs were higher prior to when the law was first introduced in 2014, and those for which CMRs were lower. Specifically, we sort states according to the average CMR over 60 months (2009 – 2013) before the law was first implemented in February 2014 in the state of Veracruz. States with CMRs above 1.0 (approximately 75th percentile) are considered 'high CMR' states, and those with rates below 1.0 are classified as 'low CMR' states. Subsequently, we examine the effect of the age-of-marriage reforms on the 2 separate samples, with results shown in Table 8. Altogether, the estimates indicate that the minimum marriageable age laws in Mexico disproportionately benefitted states where child marriage was not as rampant to begin with. As can be seen, the law decreased CMRs by the same magnitude as the main results (49% (0.156/0.318)) in 'low CMR states', whereas no impact of the age-of-marriage law reforms on 'high CMR states' is observed. The magnitude of CMR coefficients for 'high CMR states' is more than twice the 'low CMR states', but not statistically significant. These findings are consistent with Wodon et al.'s (2017) study on child marriage laws which concluded that legal reforms to the marriageable age alone are not sufficient for ending the practice of child marriage in the long run, particularly in places where early unions may be more common and socially accepted. The results from this analysis also confirm that the total decline in CMRs was driven mainly by states where child marriage was less commonly practiced. Finally, we perform the same analysis for TBRs and do not observe significant changes in TBRs as a result of the law in 'low CMR states' or 'high CMR states', further confirming that the age-of-marriage laws in Mexico had no impact on teenage pregnancies (see Table C7 of the Appendix).

Table 8
Effect of the law on child marriage rates in states with low and high average child marriage rates prior to the law.

	(I)	(II)	(III)
CMRs (*low* CMR states)	-0.156***	-0.156***	-0.156***
	(0.044)	(0.043)	(0.043)
	[0.048]	[0.051]	[0.048]
Observations	2354	2354	2354
Mean	0.318	0.318	0.318
Control Mean	0.379	0.379	0.379
CMRs (*high* CMR states)	-0.366	-0.364	-0.361
	(0.194)	(0.188)	(0.189)
	[0.228]	[0.223]	[0.227]
Observations	749	749	749
Mean	0.836	0.836	0.836
Control Mean	1.029	1.029	1.029
Controls	No	Yes	Yes
Sex crime rate, share of high school drop outs, proportion of indigenous language speakers	No	No	Yes
State FE	Yes	Yes	Yes
Month FE	Yes	Yes	Yes
State-Specific Time Trends	Yes	Yes	Yes
Wild-Cluster Bootstrapped SE [.]	Yes	Yes	Yes

Notes: Standard errors clustered at the state level and reported in parentheses (.). As a robustness check, wild cluster bootstrapped standard errors are reported in parentheses [.] as recommended by Cameron et al. (2008) when the number of clusters is below 40. Controls include the population growth rate, proportion of indigenous language speakers, male-female sex ratio, GDP per capita growth rate, male unemployment rate, the share of girls aged between 12-13, 14-15, 16-17 and the ENAPEA program. 3 states, Baja California, Campeche and Sonora with 'marry-your-rapist' laws are excluded. *** $p < 0.01$ ** $p < 0.05$ * $p < 0.1$.

VIII. Additional Results

A study by the World Bank and the International Centre for Research on Women (ICRW) suggests that early marriage reduces educational prospects for girls (Wodon et al., 2017). This is especially the case in many developing countries where girls often have to choose either formal schooling or marriage, but not both, making it challenging for them to remain in school after getting married. In turn, this could hamper their long-run human capital accumulation and leave them trapped in a poverty cycle. UNICEF additionally asserts that young women in consensual unions are equally, if not more vulnerable than those in formal unions characterized by marriage (UNICEF, 2005). Because of the informal nature of consensual unions, girls are not protected by civil or customary laws. In cases of domestic violence for example, girls in consensual unions may not be able to seek protection by exiting the union as divorce laws would not apply. In the event that minimum marriageable age laws in Mexico generate a rise in consensual unions among girls who consider these unions to be good substitutes for marriage, raising the minimum age of marriage would still be futile in protecting adolescent girls from entering early unions.

Accordingly, in this section, we draw from a separate *Child Labor Module (MTI)* survey conducted by the INEGI, to test if the law had positive spillover effects on these additional outcomes that undoubtedly affect girls' long-run well-being. As previously discussed in section III., the *MTI* contains information on girls' conjugal statuses and school attendance, including a set of other individual and household level characteristics such as age, number of children, level of education, school attendance, household size, household head's educational attainment and employment status, single-parent household, female-headed household and rural residential status. Using information on girls' school attendance and consensual union status as the dependent variables in separate regressions, we estimate a linear probability model of the following form:

$$Y_{i,t} = B_0 + B_1 Law_{s,t} + B_2 X_{i,s,t} + \emptyset_s + \delta_t + \omega_{st} + \varepsilon_{i,s,t} \quad (5)$$

where $Y_{i,t}$ is a binary variable equal to one if a girl attends school or if she is in a consensual union, and zero otherwise for both cases. $Law_{s,t}$ is a dummy equal to one for the survey years after minimum marriageable age laws were introduced in state *s*. Since the *MTI* was conducted on a biennial basis from 2007-2017, there are 4 pre-treatment survey years and 2 post-treatment survey years. $X_{i,s,t}$ is a vector of time-varying individual and household level covariates as described above that could influence girls' school attendance or probability of being in a consensual union. We additionally control for the timing of ENAPEA given its direct influence on TBRs. $\emptyset_s$ and δ_t are the state and survey year fixed effects respectively, which account for any time-constant state level factors that may affect the dependent variable of interest, and any aggregate shocks that could influence girls' schooling and consensual union status. State-specific time trends, ω_{st}, are also included to control for any deviations from pre-existing state-specific trends due to the law. $\varepsilon_{i,s,t}$ is the usual disturbance term.

Taken together, the results from Eq. (5) presented in Table 9 show that the law did not have any effect on the likelihood of girls attending school, although it did decrease the probability of girls being in consensual unions. Specifically, estimates for girls' school attendance are close to zero and statistically insignificant across all specifications. This finding is however plausible in the Mexican context. According to INEGI's 2014 *National Survey on Demographic Dynamics*, the lack of financial resources rather than marriage is the main reason for leaving school among all age groups between 12-17. The survey shows that the proportion of girls who dropped out of school due to marriage was less than 20% across all age groups, compared to 30-45% who left school due to poverty. In this regard, prohibiting adolescent marriages is not likely to have a significant impact on schooling outcomes since marriage is not the main reason as to why girls drop out of school in Mexico.

On the other hand, the minimum marriageable age law reform appears to have lowered the probability of a girl being in a consensual union by approximately 1.2 percentage points (or 44% when compared to the mean). As shown in Table 9, the coefficient of the consensual union variable in the baseline specification (II) is negative with a magnitude of 0.012 and significant at the 1% level. Estimates from the probit model are reported in {.} parentheses, and reflect the similar coefficients as those from the linear probability model. In column (III), the inclusion of potentially endogenous covariates such as the number of children and level of education decreases the size of the effect of the law on the likelihood of being in a consensual union to roughly 0.9 percentage points. To the best of our knowledge, only one cross-country study by Wodon et al., (2017) has examined the effectiveness of child marriage laws in curbing informal early unions. The authors note that they do not distinguish between formal and informal unions for some countries in their data set, due to the way child marriage is measured in the DHS and MICS surveys used in their study.[27] In this particular case study on Mexico, the detailed information on girls' marital statuses provided by the *MTI* allows the distinction between marriages and consensual unions. Specifically, the socio-demographic questionnaire contains 7 different categories of conjugal statuses: *Consensual union*, *Married*, *Separated*, *Divorced*, *Single*, *Widowed and Unspecified,* which enables the analysis of the effect of the law on girls' consensual union status explicitly.

The decrease in the likelihood of girls being in consensual unions by a similar magnitude to the fall in child marriage rates (44% versus 49%), potentially reflects positive spillover effects of minimum marriageable age laws. This could be attributed to changing attitudes towards early unions, or improved knowledge and awareness of child marriage due to the law for instance. To date however, a limited number of studies have examined the relationship between marriageable age policies and evolving knowledge and attitudes towards child marriage practices. The International Center for Research on Women (ICRW) documents that only 23 out of 150 potentially relevant efforts to curb child marriage attempted to measure changes in child marriage-related behaviours, knowledge, or attitudes among corresponding stakeholders (Malhotra et al., 2011). Consequently, given the dearth of data on changing knowledge and attitudes towards child marriage, girls' perceptions on the ideal age for marriage, or the perceived costs of marriage and consensual unions in Mexico for example, it is not possible to confirm that the observed fall in the probability of girls in consensual unions was due to any of these

[27] After accounting for exceptions to the legal age of marriage with parental or judicial consent, Wodon et al. (2017) found that about 7.5 million girls still marry illegally each year, accounting for 68% of all child marriages. They concluded that while raising the minimum age of marriage is useful in preventing early unions in places with proper legal enforcement, it is not sufficient for ending the practice in the long run.

changing societal trends as a result of legal reforms to the marriageable age. Notwithstanding, community-based policies that aim to raise awareness on the negative consequences of early marriage have been shown to positively impact attitudes, knowledge and beliefs about child marriage practices in Ethiopia, Yemen and Afghanistan, which could potentially be generalized to Mexico (Malhotra et al., 2011).

Table 9
Effect of law on the probability of school attendance and being in a consensual union.

	(I)	(II)	(III)
School attendance	0.005 {0.006}	0.005 {0.005}	0.010 {0.009}
	(0.004)	(0.004)	(0.008)
	[0.005]	[0.005]	[0.010]
Observations	260,819	260,819	124,106
Mean	0.924	0.924	0.924
Control Mean	0.921	0.921	0.921
Consensual union	-0.013*** {-0.012}	-0.012***{-0.011}	-0.009**{-0.007}
	(0.004)	(0.004)	(0.004)
	[0.005]	[0.004]	[0.004]
Observations	124,119	124,119	124,098
Mean	0.027	0.027	0.027
Control Mean	0.027	0.027	0.027
Controls	No	Yes	Yes
Endogenous Controls	No	No	Yes
State FE	Yes	Yes	Yes
Survey Year FE	Yes	Yes	Yes
State-Specific Time Trends	Yes	Yes	Yes

Notes: Standard errors clustered at the state level and reported in parentheses (.). As a robustness check, wild cluster bootstrapped standard errors are reported in parentheses [.] as recommended by Cameron et al. (2008) when the number of clusters is below 40. Marginal effects from the probit model are reported in parentheses {.}. Controls include age, household size, household head's educational attainment and employment status, a dummy denoting if the individual belongs to a single-parent household or female-headed household and rural residential status. Endogenous controls include the number of children. State and month fixed effects, and state-specific linear time trends are included in all specifications. Three states, Baja California, Campeche and Sonora with 'marry-your-rapist' laws are excluded. *** $p < 0.01$ ** $p < 0.05$ * $p < 0.1$.

XI. Conclusion

This paper was mainly motivated by the need for a greater understanding of country-specific socio-cultural contexts in global policy adoption. The complete prohibition of marriage below the age of 18 is undoubtedly a positive step towards protecting adolescent girls from the consequences of child marriage such as teenage pregnancy among others, although the effectiveness of such policies may differ across places. It is important to consider that international standards and guidelines may not necessarily be a one-size-fits-all solution. Given evidence of the declining marital trends and associated fertility among girls below 18 in Mexico, the role of religion, underlying economic conditions and heterogenous behavioural responses, it is not completely clear that minimum marriageable age law reforms would be effective in reducing teenage birth rates.

In this study, we show that while minimum marriageable age law reforms in Mexico were successful in mitigating child marriage rates by 49%, it had no apparent impact on total teenage birth rates, contrary to what had been postulated in existing literature. Our findings also indicate evidence of large positive spillover effects of raising the minimum marriageable age in curbing consensual unions, which are more informal in nature. The estimates from our analyses show that age-of-marriage laws decreased the probability of girls being in consensual unions about 44%, a similar magnitude to the fall in child marriage rates. No effects of the law on girls' school attendance however, are observed. Given that the lack of financial resources rather than marriage is the main reason for dropping out of school in Mexico, this result is plausible. We also find that 16-17-year-old girls, and not other age groups drove the decrease in aggregate child marriages in response to the age-of-marriage laws. Additionally, the law appears to have disproportionately benefitted states where child marriage practices were not as prominent before, suggesting that legal reforms to the age of marriage are not sufficient for ending child marriage in places where this practice may be more common and socially accepted. Finally, teenage birth rates among girls residing in rural areas declined by approximately 14% as a result of the minimum marriageable age law reforms. This suggests that age-of-marriage laws have the potential to mitigate teenage pregnancies in destitute areas, where girls may be more vulnerable to becoming teenage mothers. If this effect is sustained in the long run, the odds of girls escaping the poverty cycle are likely to be higher.

Lastly, while this study is able to shed light on the relationship between age-of-marriage laws, early marriage and adolescent fertility using a Latin American middle-income country like Mexico as a case study, more research on how such policies alter the dynamics between formal and informal unions is required. It would be interesting for example, to examine the causal effect of minimum marriageable age laws on the composition of girls across marital status groups and the associated fertility effects. This would however depend on the availability of data on fertility choice, changes in the perceived costs of formal and informal unions, evolving attitudes and knowledge towards early unions, and more formal documentation of consensual unions for instance, that is currently lacking. The findings from this paper could also potentially be extended to countries in the Latin American region where marriages among adolescent girls have been declining in popularity, assuming similar legal, socio-cultural and economic conditions. Considering the widespread practice of cohabitation without marriage among other pre-existing socio-cultural trends, age-of-marriage laws should be accompanied by other policies aimed at discouraging early unions in order to be fully effective in protecting girls from the consequences of child marriage.

Appendix

A. Conceptual Framework

This section presents two models that produce the results described in Section II. The two models bring some of the findings of Rasul (2006, 2008) to bear on the context of our study. Our notation largely follows that of Rasul's (2008).

Basic Model

Consider a couple that is comprised of two decision-makers, one female (f) and one male (m). The two partners interact over two periods. In period 1, each partner i (i=f,m) makes a sunk investment, q_i, to produce children. This leads to $N(q_f, q_m)$ children being born. Each partner bears a cost of investing, $c(q_i)$, which is assumed to be non-negative and convex. In period 2, the couple decides whether or not to continue their relationship. In the case that they remain as a couple,renegotiation over whatever relationship surplus has been created takes place. Here, we use the Nash bargaining solution to describe the outcome of these renegotiations, with the assumption that utility is transferable across partners.

The payoffs to f and m, if they remain as a couple in period 2 and renegotiate over the division of the relationship surplus are respectively:

$$U^f = v_f + V^f\left(N\left(q_f, q_m\right), \pi_f^*\right) + t \tag{1}$$

$$U^m = v_m + V^m\left(N\left(q_f, q_m\right), \pi_m^*\right) - t, \tag{2}$$

where v_i denotes some private gain from the relationship, $V^i(.)$ is i's utility from her/his children, and t is the renegotiated utility transfer, which can be positive (if it is from m to f) or negative (if it is from f to m). Each partner's utility from her/his children depends both on the number of children, $N(q_f, q_m)$, and her/his desired number of children, π_i^*.

On the other hand, the payoffs to f and m if the relationship dissolves in period 2 is:

$$\bar{U}^i = \bar{V}^i\left(N\left(q_f, q_m\right), \pi_i^*\right) - 0.5\kappa, \tag{3}$$

where $N\left(q_f, q_m\right)$ is the number of children produced within the relationship, and κ is the cost of relationship dissolution assumed to be split equally between partners. In what follows, we characterize the subgame-perfect equilibrium of this two-stage game using the backwards induction procedure.

Model 1: A change in the threat point from an inside to an outside option

In our first model, we follow Rasul (2008) in assuming that the gains to being in a relationship are greater than being single (i.e., $U^f + U^m > \bar{U}^f + \bar{U}^m$). Thus, in period 2, there is a positive relationship surplus to be bargained over.

Applying the Nash bargaining solution with the dissolution payoffs ($\bar{U}^f, \bar{U}^m$) as the threat point, the equilibrium Nash bargained transfer is given by:

$$t^e = (1-\theta)\left[v_m + V^m\big(N(q_f,q_m),\pi_m^*\big) - \bar{V}^m\big(N(q_f,q_m),\pi_m^*\big) - 0.5\kappa\right]$$
$$-\theta\left[v_f + V^f\big(N(q_f,q_m),\pi_f^*\big) - \bar{V}^f\big(N(q_f,q_m),\pi_f^*\big) - 0.5\kappa\right], \qquad (4)$$

where θ and $(1-\theta)$ denotes the bargaining power of the male and female partner respectively.

In period 1, the equilibrium fertility investments q_f and q_m are chosen non-cooperatively and simultaneously to maximize $v_f + V^f\big(N(q_f,q_m),\pi_f^*\big) + t^e - c(q_f)$ and $v_m + V^m\big(N(q_f,q_m),\pi_m^*\big) - t^e - c(q_m)$, respectively. Thus, the Nash equilibrium fertility investments made by f and m, denoted by $\left(q_f^e, q_m^e\right)$, are the solutions to the following first-order conditions:

$$N_{q_f}\left[\bar{V}_N^f + (1-\theta)(V_N^f + V_N^m - \bar{V}_N^f - \bar{V}_N^m)\right] = c'(q_f) \qquad (5)$$
$$N_{q_f}\left[\bar{V}_N^m + \theta(V_N^f + V_N^m - \bar{V}_N^f - \bar{V}_N^m)\right] = c'(q_m), \qquad (6)$$

where subscripts indicate partial differentiation with respect to the indexed variables, and where the arguments of all functions have been dropped for notational convenience.

Let us now turn to the question of how age-of-marriage laws affect equilibrium investments in fertility. One way of capturing this in our model is to assume that the relevant threat point in household bargaining changes from an inside to an outside option. Since divorce among married girls below 18 was extremely rare in Mexico prior to the implementation of the law, it was not a credible threat in marital bargains. In this case, the relevant threat point for household bargaining is instead an inside option given by some non-cooperative outcome within marriage. Given that the prohibition of early marriages in Mexico lowered the cost of a union dissolution, it is a plausible assumption that exiting a relationship, now becomes a credible threat. Thus, consider the thought-experiment of replacing, as the threat point, an inside option with an outside option of dissolving the relationship and possibly re-matching.

To this end, we first specify functional forms for payoffs within a relationship, and if relationship bargaining breaks down. Accordingly, let the utility that partner i derives from children when the relationship remains intact be given by:

$$V^i\big(N(q_f,q_m),\pi_i^*\big) = N(q_f,q_m) - 0.5\left[N(q_f,q_m) - \pi_i^*\right]^2, \qquad (7)$$

where the second term captures a utility loss that each partner suffers if she/he does not achieve her/his preferred fertility level in the case that household bargaining breaks down

Second, let the utility that partner i derives from children if bargaining breaks down be given by:

$$\bar{V}^i\left(N(q_f, q_m), \pi_i^*\right) = \delta N(q_f, q_m) - 0.5\eta\left[N(q_f, q_m) - \pi_i^*\right]^2, \qquad (8)$$

where the interpretation of the parameter pair (δ, η) depends on what the relevant threat point in household bargaining is (see Rasul, 2008). If couples dissolve their union if bargaining breaks down (i.e., by using their outside option), partners are free to re-match and pursue their fertility goals with future partners. Thus, they are assumed to no longer suffer disutility from any divergence between their fertility preference and the number of children in their previous relationship, so that $\eta = 0$. If instead, union dissolution is not a credible threat, the relevant threat point in household bargaining would be some non-cooperative outcome within the relationship (i.e. an inside option). In this case, partners are unable to pursue their fertility goals in a new relationship, and therefore continue to suffer a loss from not having achieved their desired fertility level in the current relationship. Thus, $\eta = 1$ if the relevant threat point is a non-cooperative outcome in the existing relationship. For both the inside and outside option bargaining, we assume that $\delta < 1$, i.e., the value of benefits from children are lower if they are brought by parents that either act non-cooperatively (inside option) or are no longer a couple (outside option).

Third, to obtain closed-form solutions, let the cost of investing in fertility be given by $c(q_i) = 0.5q_i^2$, and the number of children produced in the relationship be given by:

$$N(q_f, q_m) = q_f + \gamma q_m, \qquad (9)$$

where γ captures the importance of the male partner's fertility investment relative to that of the female partner's. We make the plausible assumption that the female partner's fertility investment is more important than that of the male partner's, such that $\gamma < 1$.[28] Finally, to keep derivations as simple as possible, we assume that f and m have equal bargaining power, so that $\delta = 1 - \delta = 0.5$.

In order to solve for the equilibrium number of children, $N(q_f^e, q_m^e)$, under the inside and outside option bargaining environment, we substitute the relevant derivatives of the specific payoffs in Eqs. (7) to (9) into Eqs. (5) and (6), and solve them simultaneously for the equilibrium fertility investments q_f^e and q_m^e which we use to calculate $N(q_f^e, q_m^e)$. Subsequently, we obtain:

[28] As noted by Rasul (2008), the female partner's investments in fertility include those related to biology of child rearing, such as time devoted to pregnancy, childbirth and lactation over the fertility period. While male partners also contribute their time in these phases, these investments are assumed to be less crucial in determining the fertility outcome.

$$N\left(q_f^e, q_m^e\right) = \begin{cases} \frac{\pi_f+\gamma^2\pi_m+1+\gamma^2}{2+\gamma^2} & if\ \eta = 1\ (inside\ option) \\ \frac{(1+\gamma^2)[0.5(\pi_f+\pi_m)+1]}{2+\gamma^2} & if\ \eta = 0\ (outside\ option) \end{cases}$$

Note that a switch in the threat point from an inside to an outside option affects how the fertility preferences of each partner translate into fertility outcomes: in the inside option bargaining environment, equilibrium fertility depends more strongly on the female partner's fertility preferences than on the male partner's fertility preferences, while under the outside option bargaining protocol, equilibrium fertility depends equally on both partners' fertility preferences. Comparing the two cases, it is verifiable that:

$$N\left(q_f^e, q_m^e | n = 0\right) \gtreqless N\left(q_f^e, q_m^e | n = 1\right) \quad \Leftrightarrow \quad \pi_m \gtreqless \pi_f.$$

Thus, a change in threat point from an inside option to an outside option increases equilibrium fertility among couples where men have a preference for more children than their female partners. By contrast, if women have a preference for more children than their male partners, equilibrium investments in fertility decrease.

Model 2: The commitment value of children with endogenous relationship breakdown

In our second model, we follow Rasul (2006) in letting the probability of relationship breakdown be positive, and endogenously determined by couples' fertility investments. To this end, we extend the basic model by assuming that the private gain from being in a relationship, v_i, is randomly drawn from a known distribution. This gain is unknown when couples invest in fertility in period 1, but is realized at the beginning of period 2 before partners decide whether or not to remain as a couple.

The equilibrium fertility outcome is subsequently derived through backwards induction. If the couple remains married, they renegotiate over the division of the relationship surplus, with dissolution as the relevant threat point. In this case, the partners' Nash-bargained payoffs are as in model 1 and are given by:

$$U^f = v_f + V^f\left(N\left(q_f, q_m\right), \pi_f^*\right) + t^e \tag{10}$$

$$U^m = v_m + V^m\left(N\left(q_f, q_m\right), \pi_m^*\right) - t^e, \tag{11}$$

where the equilibrium-negotiated transfer, t^e, is characterized in Eq. (4). If instead, the couple dissolves their union, each partner's payoff would be as in Eq. (5)., i.e., $\bar{U}^i = \bar{V}^i\left(N\left(q_f, q_m\right), \pi_i^*\right) - 0.5\kappa$.

Next, consider the couple's decision of whether or not to remain married. We assume that a dissolution occurs if and only if it is efficient to do so, that is, if and only if $U^f + U^m > \bar{U}^f + \bar{U}^m$. Substituting in the payoffs above and after rearranging, partners will remain as a couple if their joint private gains from the relationship, $\phi = v_f + v_m$, are sufficiently large:

$$\phi > \phi^* = -\kappa - \sum_{i=f,m} \left[\mathrm{V}^{\mathrm{i}}\left(N\left(q_f, q_m\right), \pi_f^*\right) - \bar{V}^i\left(N\left(q_f, q_m\right), \pi_i^*\right) \right].$$

In what follows, we let $-\phi^* = S(N(q_f, q_m), \pi_f^*, \pi_m^*)$ for notational convenience, where $S(\cdot)$ captures the relationship surplus net of the joint private gains from the relationship. We follow Rasul (2008) in assuming that the joint private gains from marriage are distributed according to a log-concave probability distribution $g(\phi)$, with support $(-\infty, \infty)$, and an associated cumulative density function $G(\phi)$.

Moving backwards to period 1, partner i's *ex ante* payoff before she/he invests in fertility is:

$$P^i = \mathbb{E}_\phi\left(U^i \middle| \phi > \phi^*\right) + \mathbb{E}_\phi\left(\bar{U}^i \middle| \phi \leq \phi^*\right),$$

where the first term captures i's expected payoff within the relationship conditional on the relationship surviving, and the second term is i's payoff in case the relationship breaks down. After substituting in Eqs. (10), (11), and (4), each partners' *ex ante* payoffs can be written as:

$$\begin{aligned} P^f &= \bar{V}^f\left(N\left(q_f, q_m\right), \pi_f^*\right) - 0.5\kappa \\ &+(1-\theta)\left[h(\phi^*) + \left(1 - G(\phi^*)\right) S\left(N\left(q_f, q_m\right), \pi_f^*, \pi_m^*\right)\right], \end{aligned} \quad (12)$$

$$\begin{aligned} P^m &= \bar{V}^m\left(N\left(q_f, q_m\right), \pi_m^*\right) - 0.5\kappa \\ &+\theta\left[h(\phi^*) + \left(1 - G(\phi^*)\right) S\left(N\left(q_f, q_m\right), \pi_f^*, \pi_m^*\right)\right], \end{aligned} \quad (13)$$

where $h(\phi^*) = \int_{\phi^*}^{\infty} \phi g(\phi) d\phi$ are the expected joint private gains from the relationship, conditional on the relationship remaining intact. Following Rasul (2008), we impose four assumptions that guarantee the existence of a pure strategy Nash equilibrium in partners' fertility investments: (i) $S_{q_i} = N_{q_i}\left(V_N^i - \bar{V}_N^i\right) > 0$ for all i, which ensures that the returns to fertility investments are higher in an intact relationship than in singlehood; (ii) $g'(\phi^*) > 0$, which implies that the marginal relationship is likely to break up; (iii) $1 - G(\phi^*) > h'(\phi^*)$, which imposes an upper bound on how quickly the expected private gains in marriage decline in fertility investments; and (iv) $\phi^* < -[2g(\phi^*) + h''(\phi^*)]/g'(\phi^*)$, which ensures that partners' *ex ante* payoffs are concave in each partner's fertility investment.

Let us now characterize one partner's, say f's, fertility investment (symmetrical arguments apply to the other partner's investment). The first-order condition for f's fertility investment is given by:

$$P_{q_f}^f = \bar{V}_N^f N_{q_f} + (1-\theta) S_{q_w}[(1 - G(\phi^*)) - h'(\phi^*) + g(\phi^*) S] = c'\left(q_f\right),$$

where subscripts indicate partial differentiation with respect to the indexed variables, and where the arguments of all functions are dropped for simplicity. By investing in children, each partner: (i) increases her/his payoff if the union dissolves (first term); (ii) increases the relationship surplus in case they remain as a couple (second term); (iii) lowers their expected private gains from the relationship, conditional on the relationship remaining intact (third term); and (iv) increases the probability that their marriage remains intact (fourth term).

The comparative static of interest is a decrease in the costs associated with the dissolution of a relationship. Since by assumption, partners' *ex ante* payoffs are concave in each of their investments in fertility, this comparative static is obtained by differentiating the first-order condition for f's fertility investment with respect to the cost of union dissolution, κ:

$$P^f_{q_f,\kappa} = (1-\theta)(S_{q_w})^2[2g(\phi^*) + h'(\phi^*) + g'(\phi^*)\phi^*] < 0$$

Accordingly, investments in fertility *increase* as the costs of dissolving a relationship fall. It should be noted however, that this overall result is driven by two opposing/competing effects. On the one hand, as κ falls, a relationship is more unstable *ceteris paribus* and this decreases incentives to invest in children. On the other hand, with a lower κ, investments in children gain influence relative to dissolution costs in stabilizing the marriage, which increases incentives to invest in children. Overall, in equilibrium, the latter effect dominates so that fertility increases as κ falls. Intuitively, high dissolution costs and investments in fertility are substitutable reasons for why relationships remain intact. Thus, as long as economic or legal barriers to exiting a partnership are high, the model postulates that couples are effectively locked into relationships irrespective of how much they invest in it. Once exit barriers are lowered, couples have the incentive to counteract the loss of this 'lock-in' mechanism, by increasing their investments in relationship-specific capital such as children.

B. Figures

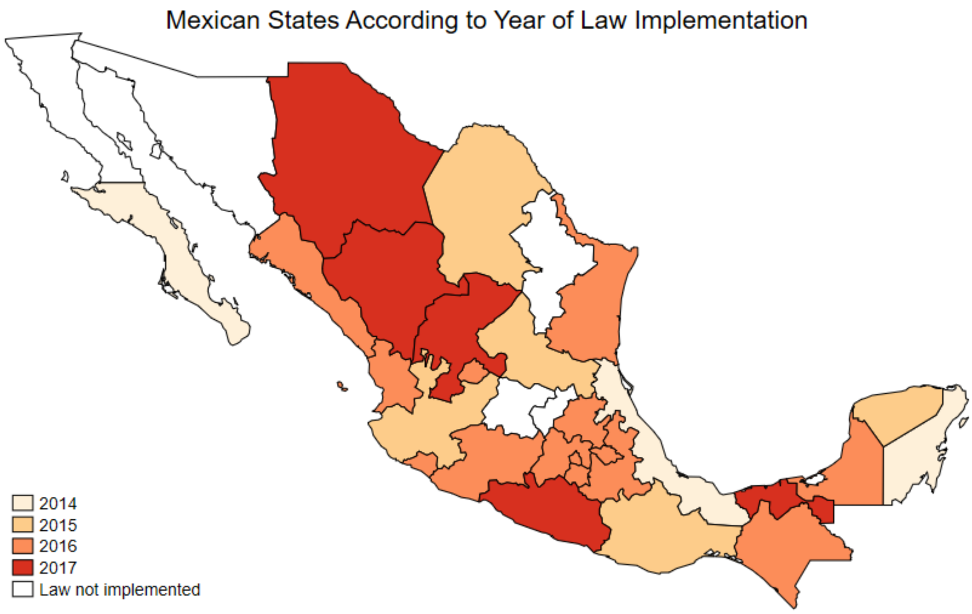

Figure B1. Geographical and temporal variation in the timing of the law enactment. *Notes*: This figure illustrates the year in which states across Mexico implemented minimum marriageable age laws. Unshaded areas represent states where the policy has not been implemented.

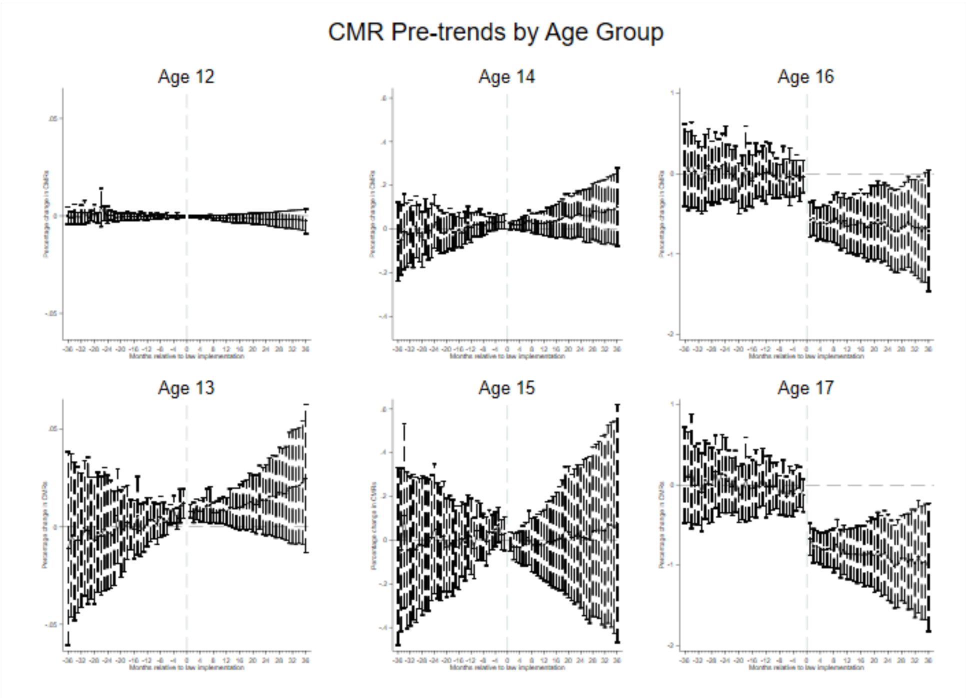

Figure B2. The dynamic evolvement of age-specific CMRs before and after the law. *Notes*: This figure plots trends in the child marriage rate for age groups 12-17 36 months prior to the implementation of the law and 36 months after the law was enacted. CMRs are calculated according to individuals' state of residence (ITT approach) and regressions include baseline controls, state, and month fixed effects, and state-specific time trends. The dashed bars represent 95% confidence intervals and monthly point estimates are adjusted for clustering at the state-level. Three states, Baja California, Campeche and Sonora with 'marry-your-rapist' laws are excluded. Data come from Nuptiality administrative records provided by the National Institute for Statistics and Geography (INEGI).

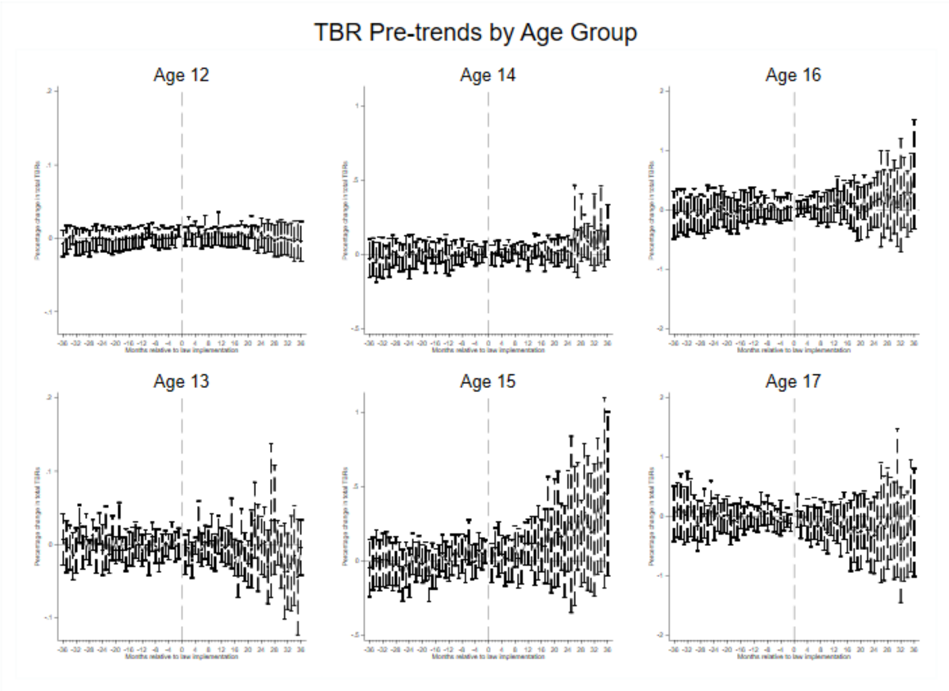

Figure B3. The dynamic evolvement of age-specific TBRs before and after the law. *Notes*: This figure plots trends in the teenage birth rate for age groups 12-17 36 months prior to the implementation of the law and 36 months after the law was enacted. TBRs are calculated according to individuals' state of residence (ITT approach) and regressions include baseline controls, state, and month fixed effects, and state-specific time trends. The dashed bars represent 95% confidence intervals and monthly point estimates are adjusted for clustering at the state-level. Three states, Baja California, Campeche and Sonora with 'marry-your-rapist' laws are excluded. Data come from Nuptiality administrative records provided by the National Institute for Statistics and Geography (INEGI).

C. Tables

Table C1
Effect of the law on child marriage rates (CMRs) by age group.

	(I)	(II)	(III)
CMRs (age 12)	-0.000	-0.000	-0.000
	(0.000)	(0.000)	(0.000)
	[0.000]	[0.000]	[0.000]
CMRs (age 13)	-0.002	-0.002	-0.002
	(0.002)	(0.002)	(0.002)
	[0.002]	[0.002]	[0.002]
CMRs (age 14)	-0.028	-0.025	-0.026
	(0.020)	(0.020)	(0.020)
	[0.022]	[0.022]	[0.020]
CMRs (age 15)	-0.077	-0.072	-0.076
	(0.050)	(0.048)	(0.048)
	[0.053]	[0.052]	[0.052]
CMRs (age 16)	-0.486***	-0.482***	-0.482***
	(0.138)	(0.132)	(0.132)
	[0.151]	[0.151]	[0.143]
CMRs (age 17)	-0.626***	-0.624***	-0.631***
	(0.149)	(0.143)	(0.143)
	[0.158]	[0.156]	[0.157]
CMRs (age 18)	0.036	0.004	-0.003
	(0.081)	(0.080)	(0.082)
	[0.087]	[0.084]	[0.091]
CMRs (age 19)	0.031	0.006	0.002
	(0.080)	(0.073)	(0.074)
	[0.084]	[0.082]	[0.081]
CMRs (age 20)	-0.021	-0.058	-0.060
	(0.069)	(0.067)	(0.068)
	[0.076]	[0.070]	[0.072]
Controls	No	Yes	Yes
Proportion of high school drop outs, sex crime rate	No	No	Yes
State FE	Yes	Yes	Yes
Month FE	Yes	Yes	Yes
State-Specific Time Trends	Yes	Yes	Yes
Observations	3103	3103	3103

Notes: Standard errors clustered at the state level and reported in parentheses (.). As a robustness check, wild cluster bootstrapped standard errors are reported in parentheses [.] as recommended by Cameron et al. (2008) when the number of clusters is below 40. Controls include the population growth rate, proportion of indigenous language speakers, male-female sex ratio, GDP per capita growth rate, male unemployment rate, the share of girls aged between 12-13, 14-15, 16-17 and the ENAPEA program. Child marriage rates are calculated according to girls' state of residence (ITT approach). 3 states, Baja California, Campeche and Sonora with 'marry-your-rapist' laws are excluded. *** $p < 0.01$ ** $p < 0.05$ * $p < 0.1$.

Table C2

The effect of minimum marriageable age laws on late birth registrations.

	(I)	(II)	(III)
Share of late birth registrations	0.025	0.035	0.031
	(0.020)	(0.022)	(0.023)
	[0.021]	[0.023]	[0.025]
Controls	No	Yes	Yes
Sex crime rate, share of high school dropouts	No	No	Yes
State FE	Yes	Yes	Yes
Month FE	Yes	Yes	Yes
State-Specific Time Trends	Yes	Yes	Yes
Wild-Cluster Bootstrapped SE [.]	Yes	Yes	Yes
Observations	2755	2755	2755
Mean dep. var	0.484	0.484	0.484

Notes: Standard errors clustered at the state level and reported in parentheses (.). As a robustness check, wild cluster bootstrapped standard errors are reported in parentheses [.] as recommended by Cameron et al. (2008) when the number of clusters is below 40. Controls include the population growth rate, proportion of indigenous language speakers, male-female sex ratio, GDP per capita growth rate, male unemployment rate, the share of girls aged between 12-13, 14-15, 16-17 and the ENAPEA program. 3 states, Baja California, Campeche and Sonora with 'marry-your-rapist' laws are excluded. *** $p < 0.01$ ** $p < 0.05$ * $p < 0.1$.

Table C3

Effect of the law on child marriage rates 1,2 and 3 years prior to law implementation.

	(*t*-1)	(*t*-2)	(*t*-3)
CMRs	-0.002	0.026	0.020
	(0.030)	(0.038)	(0.035)
	[0.031]	[0.041]	[0.039]
Baseline controls	Yes	Yes	Yes
State FE	Yes	Yes	Yes
Month FE	Yes	Yes	Yes
Wild-Cluster Bootstrapped SE [.]	Yes	Yes	Yes
Observations	2755	2407	2059

Notes: Standard errors clustered at the state level and reported in parentheses (.). As a robustness check, wild cluster bootstrapped standard errors are reported in parentheses [.] as recommended by Cameron et al. (2008) when the number of clusters is below 40. Controls include the population growth rate, proportion of indigenous language speakers, male-female sex ratio, GDP per capita growth rate, male unemployment rate, the share of girls aged between 12-13, 14-15, 16-17 and the ENAPEA program. Child marriage rates are calculated according to girls' state of residence (ITT approach). 3 states, Baja California, Campeche and Sonora with 'marry-your-rapist' laws are excluded. *** $p < 0.01$ ** $p < 0.05$ * $p < 0.1$.

Table C4

Effect of the law on child marriage rates, based on state of registration.

	(I)	(II)	(III)
CMRs	-0.233***	-0.232***	-0.234***
	(0.060)	(0.057)	(0.057)
	[0.064]	[0.062]	[0.062]
Controls	No	Yes	Yes
Sex crime rate, share of high school drop outs, proportion of indigenous language speakers	No	No	Yes
State FE	Yes	Yes	Yes
Month FE	Yes	Yes	Yes
State-Specific Time Trends	Yes	Yes	Yes
Wild-Cluster Bootstrapped SE [.]	Yes	Yes	Yes
Observations	3103	3103	3103
Mean	0.442	0.442	0.442
Control Mean	0.532	0.532	0.532

Notes: Standard errors clustered at the state level and reported in parentheses (.). As a robustness check, wild cluster bootstrapped standard errors are reported in parentheses [.] as recommended by Cameron et al. (2008) when the number of clusters is below 40. Controls include the population growth rate, proportion of indigenous language speakers, male-female sex ratio, GDP per capita growth rate, male unemployment rate, the share of girls aged between 12-13, 14-15, 16-17 and the ENAPEA program. 3 states, Baja California, Campeche and Sonora with 'marry-your-rapist' laws are excluded. *** $p < 0.01$ ** $p < 0.05$ * $p < 0.1$.

Table C5

Effect of the law on child marriage rates (CMRs), including 3 'marry-your-rapist' states.

	(I)	(II)	(III)
CMRs	-0.228***	-0.226***	-0.227***
	(0.053)	(0.052)	(0.052)
	[0.057]	[0.056]	[0.059]
Observations	3424	3424	3424
Mean	0.441	0.441	0.441
Control Mean	0.523	0.523	0.523
Controls	No	Yes	Yes
Sex crime rate, share of high school drop outs, proportion of indigenous language speakers	No	No	Yes
State FE	Yes	Yes	Yes
Month FE	Yes	Yes	Yes
State-Specific Time Trends	Yes	Yes	Yes

Notes: Standard errors clustered at the state level and reported in parentheses (.). As a robustness check, wild cluster bootstrapped standard errors are reported in parentheses [.] as recommended by Cameron et al. (2008) when the number of clusters is below 40. Controls include the population growth rate, proportion of indigenous language speakers, male-female sex ratio, GDP per capita growth rate, male unemployment rate, the share of girls aged between 12-13, 14-15, 16-17 and the ENAPEA program. *** $p < 0.01$ ** $p < 0.05$ * $p < 0.1$.

Table C6

Effect of law on teenage birth rates (TBRs) by age group.

	(I)	(II)	(III)
TBRs (age 12)	-0.006*	-0.007**	-0.008**
	(0.003)	(0.003)	(0.004)
	[0.004]	[0.003]	[0.004]
TBRs (age 13)	-0.000	-0.001	-0.003
	(0.005)	(0.005)	(0.005)
	[0.005]	[0.006]	[0.006]
TBRs (age 14)	-0.017	-0.017	-0.015
	(0.020)	(0.018)	(0.017)
	[0.021]	[0.019]	[0.018]
TBRs (age 15)	0.015	0.010	0.018
	(0.050)	(0.048)	(0.048)
	[0.053]	[0.052]	[0.052]
TBRs (age 16)	-0.035	-0.035	-0.028
	(0.070)	(0.068)	(0.068)
	[0.070]	[0.072]	[0.071]
TBRs (age 17)	-0.068	-0.079	-0.066
	(0.115)	(0.115)	(0.119)
	[0.117]	[0.126]	[0.131]
Controls	No	Yes	Yes
Proportion of high school drop outs, sex crime rate	No	No	Yes
State FE	Yes	Yes	Yes
Month FE	Yes	Yes	Yes
State-Specific Time Trends	Yes	Yes	Yes
Observations	2755	2755	2755

Notes: Standard errors clustered at the state level and reported in parentheses (.). As a robustness check, wild cluster bootstrapped standard errors are reported in parentheses [.] as recommended by Cameron et al. (2008) when the number of clusters is below 40. Controls include the population growth rate, proportion of indigenous language speakers, male-female sex ratio, GDP per capita growth rate, male unemployment rate, the share of girls aged between 12-13, 14-15, 16-17 and the ENAPEA program. Child marriage rates are calculated according to girls' state of residence (ITT approach). 3 states, Baja California, Campeche and Sonora with 'marry-your-rapist' laws are excluded. *** $p < 0.01$ ** $p < 0.05$ * $p < 0.1$.

Table C7

Effect of the law on child marriage rates in states with low and high average child marriage rates prior to the law.

	(I)	(II)	(III)
TBRs (*low* CMR states)	-0.007	0.002	0.003
	(0.049)	(0.049)	(0.050)
	[0.049]	[0.050]	[0.055]
Observations	2090	2090	2090
Mean	0.872	0.872	0.872
Control Mean	0.893	0.893	0.893
TBRs (*high* CMR states)	0.003	-0.035	-0.037
	(0.078)	(0.056)	(0.051)
	[0.078]	[0.062]	[0.058]
Observations	665	665	665
Mean	1.118	1.118	1.118
Control Mean	1.149	1.149	1.149
Controls	No	Yes	Yes

Sex crime rate, share of high school drop outs, proportion of indigenous language speakers	No	No	Yes
State FE	Yes	Yes	Yes
Month FE	Yes	Yes	Yes
State-Specific Time Trends	Yes	Yes	Yes
Wild-Cluster Bootstrapped SE [.]	Yes	Yes	Yes

Notes: Standard errors clustered at the state level and reported in parentheses (.). As a robustness check, wild cluster bootstrapped standard errors are reported in parentheses [.] as recommended by Cameron et al. (2008) when the number of clusters is below 40. Controls include the population growth rate, proportion of indigenous language speakers, male-female sex ratio, GDP per capita growth rate, male unemployment rate, the share of girls aged between 12-13, 14-15, 16-17 and the ENAPEA program. 3 states, Baja California, Campeche and Sonora with 'marry-your-rapist' laws are excluded. *** $p < 0.01$ ** $p < 0.05$ * $p < 0.1$.

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Declarations of Interest

The authors declare no conflict of interest.

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