Essays in Applied Microeconometrics: Evidence from Mexico

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Audrey Au Yong Lyn
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Abstract

Prohibition without Protection?: Marriageable Age Law Reforms and Adolescent Fertility in Mexico

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.

Keywords: Adolescent Fertility; Child Marriage; Minimum Marriageable Age Laws; Consensual Unions
JEL-Codes: J12, J13, J18, K15

Male Employment and Female Intra-Household Decision-Making: A Mexican Gold Mining Case Study

This study explores the effect of economic booms in male-dominated industries like mining on female intra-household decision-making power. Using the 2007-2008 global financial crisis as an exogenous event which led to a gold mining boom in Mexico, I find that women living in gold endowed municipalities experienced higher decision-making power contrary to some theoretical predictions. These results appear to be consistent with unitary household bargaining models which assume income pooling, as female decision-making power increased despite no changes in female labour force participation and an observed increase in male employment. Findings from a separate survey additionally show that while women residing in gold endowed states had higher decision-making power, they were also more likely to suffer from intimate partner violence (IPV). This suggests that a woman's intra-household decision-making authority is not necessarily negatively correlated with her risk of IPV as posited in feminist theory.

Keywords: Gold mining; Intra-household decision making; Global income shocks**;** Male employment
JEL-Codes: J12, D13, F62, L72

How Violence Dis-Empowers Women: Evidence from the Mexican Drug War

This paper examines the effect of violent living conditions on various forms of female empowerment in Mexico. Exploiting the exogenous rise in homicides between 2007 and 2011 as a source of variation and proxy for unsafe surroundings, the findings suggest that violence hampers women's intra-household bargaining power, employment, mobility and emotional and mental well-being. Higher

homicide rates also appear to have a weaker impact on poorer women's labor supply even though these women remain fearful amidst increasingly homicidal surroundings, indicating a trade-off between income and emotional stability among those who are financially constrained. The negative effects of the drug war are also more salient among women who live in relatively more dangerous municipalities that face a higher risk of violence, and those who had previously experienced assault.

JEL-Codes: J12, J16, I31
Keywords: Female Empowerment; Mexican Drug War; Violent Crime; Outside Option

Contents

Introduction

Gender equality begins at a micro-level of society: in the home. Understanding the determinants of intra-household female well-being and empowerment, is therefore crucial in expediting societies' progress towards achieving Sustainable Development Goal (SDG) 5 on gender equality. Specifically, SDG 5 identifies the need to 'enhance women's ability to participate in intra-household decision making processes as one of the necessary factors required to achieve gender equality by 2030. Because a woman's household bargaining power also has the potential to influence children's long-term welfare and household production, a good understanding of the determinants of household decision-making has potentially important implications for poverty alleviation, and both social and economic development (Duflo, 2003; Quisumbing and Maluccio, 2003; Gitter and Barham, 2008).

Non-unitary household bargaining models in economics scholarship predict that external shift parameters such as the conditions of a woman's living environment are key determinants of her bargaining power. These external environmental factors termed as 'outside options' affect the threat point in a marriage or domestic partnership, and are a function of an individual's decision-making authority (Lommerud 2003; Lundberg and Pollak 1994, McElroy and Horney 1981). Subsequently, the theory suggests that a change in a woman's outside option is sufficient to alter her bargaining power within the household, which could in turn influence her risk of intimate partner violence (IPV). This is in line with feminist theory which predicts that wife abuse is a consequence of weak intra-household decision-making authority (Goode, 1971; Jewkes, 2002). Unitary household bargaining models on the other hand, while widely rejected across more recent economic literature, have been found to be relevant in traditional societies like India (Neff et al., 2012; Klasen and Pieters, 2015). Unitary bargaining models assume income pooling where ultimately a woman's intra-household decision-making power is dependent on changes in the total household wealth, rather than on changes in her absolute or relative income prospects. Under these premises, extra-household factors that benefit males but not females for instance, could still generate an improvement in female decision-making outcomes at home.

Drawing from both unitary and non-unitary household bargaining models as well as two exogenous events: the 2007 Mexican drug war and the 2007-2008 global financial crisis, two of the dissertation chapters endeavour to uncover the effect of violence and booms in male-dominated sectors on inter alia, female decision-making power and IPV risk. Given that Mexico has undergone major societal and economic changes over the last two decades, this thesis uses Mexico as a case study to examine the changes in women's intra-household welfare over this time period. In particular, between 2007 and 2011, the country experienced a sharp spike in violence as a result of the Mexican Drug War initiated by the newly elected President, Felipe Calderón. Concurrently, the 2007-2008 global financial crisis which led to rising prices of precious metals like gold contributed to Mexico's

gold mining boom. Shortly after in 2014, in accordance with the United Nations 2014 agenda on the rights of girls, boys and adolescents, Mexico implemented laws that prohibited marriage below the age of 18 without exceptions. Subsequently, in light of Mexico's high child marriage and teenage pregnancy rate where 1 in 4 girls were married before the age of 18, and 71 out of every 1,000 adolescent girls aged between 15 and 19 were teenage mothers in 2018, the third dissertation chapter accesses the impact of age-of-marriage reforms on additional factors of female well-being like early unions, adolescent fertility and schooling outcomes. Among various other legal reforms and socio-economic shifts that had happened over the last two decades, Mexico therefore provides an ideal country-specific setting to answer the research questions of this dissertation: a). *Are minimum marriageable age laws truly effective in decreasing teenage birth rates?* b). *How does violence disempower women?,* and c). *How do economic booms in male-dominated sectors like mining affect women's intra-household decision-making power and risk of IPV?*

Accordingly, **Chapter One:** "**Prohibition without Protection?: Minimum Marriageable Age Law Reforms and Adolescent Fertility in Mexico**" (joint with Helmut Rainer), examines the effect of the banning of marriages below the age of 18 on child marriage rates (CMRs) and teenage birth rates (TBRs) in Mexico. The findings from this study are useful in shedding light on the relationship between early marriage and early childbearing in the country, and the generalizability of international guidelines and policies to local contexts. This is especially important due to Mexico's high teenage birth rate, and the subsequent need to abate this issue. Yet, the relationship between minimum marriageable age laws and teenage pregnancy is not as straightforward in the Mexican context considering declining popularity of marriages and associated fertility over time. Using a staggered difference-in-differences approach which exploits the temporal and geographical variation in law implementation, we observe some interesting results. The findings show that as expected, CMRs decreased by about 49%, but we also find positive spill over effects of the law on curbing informal unions characterized by consensual unions, with the likelihood of girls being in consensual unions decreasing by a similar magnitude (44%) to CMRs. Contrary to what was postulated in theory, we do not observe any impact of age-of-marriage laws on total TBRs and girls' school attendance. To explain these findings, we present a formal model based on Rasul (2006, 2008), in which couples bargain over fertility without commitment. Additional results from our empirical findings show that the fall in CMRs was mainly driven by 16-17 year old girls, and states where child marriage was not as rampant prior to the introduction of the law. This indicates 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. Lastly, we find that the minimum marriageable age laws decreased TBRs by approximately 14% among rural girls, suggesting 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. Altogether, this study demonstrates

that global policies and guidelines may not be a one-size-fits-all solution to local societal issues. In particular, taking into consideration local cultures and contexts in policy-making, and implementing complementary policies aimed at discouraging early unions are imperative to fully protect girls from the consequences of child marriage.

Chapter Two: "**Male Employment and Female Intra Household Decision-Making: A Mexican Gold Mining Case Study**", explores the impact of economic booms in male-dominated industries like gold mining on women's decision-making authority and risk of intimate partner violence (IPV). Notwithstanding efforts to increase female labour force participation in the mining sector, the proportion of Mexican women engaged in mining-related work has remained low (between 6% to 13%). Using the 2007-2008 global financial crisis as an exogenous event which led to rising gold prices and subsequently a gold mining boom in Mexico, I estimate a difference-in-differences model of the relationship between the gold mining boom and the two determinants of intra-household female well-being aforementioned. Four main results are obtained from the analysis. First, women in gold endowed municipalities experienced increases in their decision-making power index by about 0.02%, with a two standard deviation increase in the price of gold. This is the first study to my knowledge to have established a positive relationship between mining and women's bargaining power within the household. Previous papers by Kotsadam et al. (2016) and Tolonen (2018) have found no impact of mining on female bargaining power in the context of Sub-Saharan Africa. Subsequently, I demonstrate that the observed increase in women's decision-making authority was likely to have been driven by an improvement in male employment probabilities during the gold mining boom. This result is consistent with unitary rather than non-unitary models of the household which assume income pooling, since only male employment prospects increased but not females', and women may have therefore experienced higher bargaining power at home through an increase in their partners' employment opportunities. Third, the study presents some striking evidence of a positive relationship between a woman's probability of IPV and her intra-household bargaining power, against feminist theory predicting that wife abuse decreases with higher intra-household decision-making authority (Goode, 1971; Jewkes, 2002). The findings from the analysis show that women in gold endowed states experienced approximately 3.0%, 3.4%, 3.8% and 5.5% more emotional abuse, threats of violence, physical abuse and sexual abuse respectively, despite having greater decision-making power. Lastly, the empirical results suggest that poorer women are more likely to suffer from hard forms of IPV like physical abuse, while their wealthier counterparts are subject to softer types of IPV like threats of violence. To explain these findings, I draw from theories on stresses related to male trepidation and fear, differences in reporting domestic abuse between poorer and wealthier women, and the male-backlash effect. Taken together, this study highlights the importance of balancing male psychological and emotional shifts along with female empowerment. For instance, it calls for more efforts in cushioning the fall in male socio-economic status (through counselling

services or community-based gender awareness campaigns for example), such that an increase in a woman's household decision-making power would not be accompanied by higher IPV risk as demonstrated in the study.

Lastly, **Chapter Three:** "**How Violence Dis-empowers Women: Evidence from the Mexican Drug War**" examines the effect of violent living conditions characterized by homicide rates on spousal intra-household decision-making power. Although there is a considerable amount of literature studying the relationship between the Mexican Drug War and human capital accumulation, health, and political outcomes, much less attention has been paid to its effect on female welfare, specifically a woman's decision-making power within the household. Drawing from non-unitary cooperative household bargaining models, I postulate that changes in a woman's outside option through an increasingly dangerous milieu lowers a woman's bargaining power at home. Similar to chapter two, I use three waves of a panel data set (the Mexican Family Life Survey (MxFLS)) to track changes in a woman's decision-making power over time through a difference-in-differences model, utilizing the 2007 Mexican Drug War as an exogenous event. I obtain four main insights from the analysis. First, higher homicide rates decreased women's relative bargaining power by about 30%, particularly over children's goods and services. This finding can be juxtaposed against a body of household bargaining literature documenting gender differences in preferences towards the allocation of income resources to children's consumption (Duflo 2003; Quisumbing and Maluccio 2003; Gitter and Barham 2008). Second, I observe changes in female psychological and physical behaviour, where women were respectively 8.7%, 5.3% and 11.1% more likely to fear assault, change transportation routes as a security measure, and distrust neighbours in the midst of violent living conditions. Third, I find that a percentage point increase in the homicide rate lowered women's employment probability and hours worked in a week by 4.8% and 2.6 hours respectively. These findings suggest that women's reduced work effort potentially as a result of fear, weaker social capital and decreased mobility led to a fall in their relative bargaining power over their children's goods and services. Finally, the results reveal that poorer and more vulnerable women, as well as those living in high-risk areas are disproportionately affected by violence. Specifically, economically disadvantaged women appear to face a trade-off between emotional stability and income earnings, likely due to their compulsion to work despite violent surroundings.

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Chapter I

Prohibition without Protection?: Marriageable Age Law Reforms and Adolescent Fertility in Mexico*

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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.

Keywords: Adolescent Fertility; Child Marriage; Minimum Marriageable Age Laws; Consensual Unions
JEL-Codes: J12, J13, J18, K15

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).

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

[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.

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.

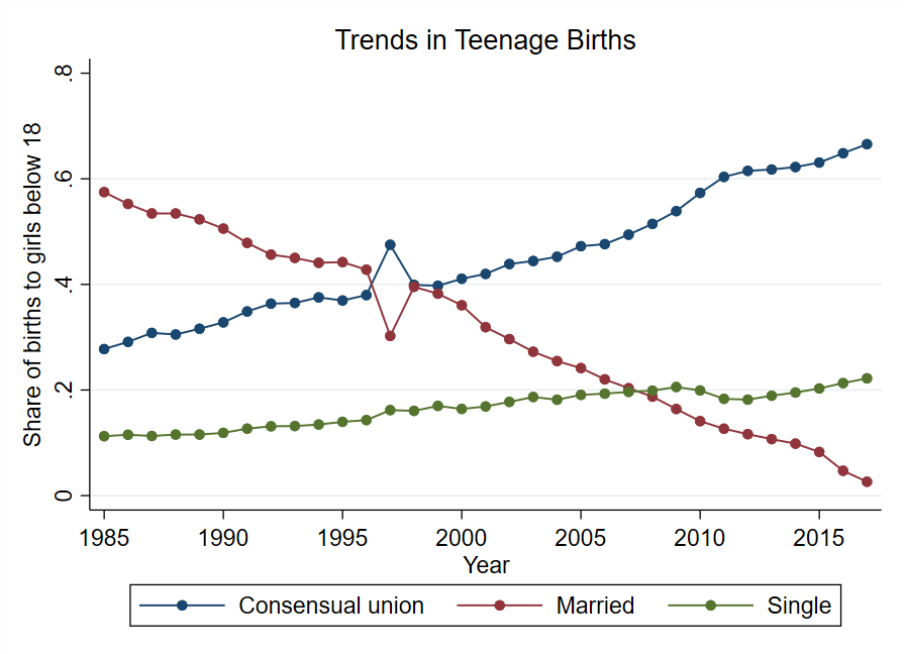

Figure A. Trends in teenage births among girls below 18 (1985 – 2017). *Notes*: This figure plots the share of births to girls below 18 according to marital status (consensual union, married and single) from 1985 to 2017. Data come from Birth administrative records provided by the National Institute 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.

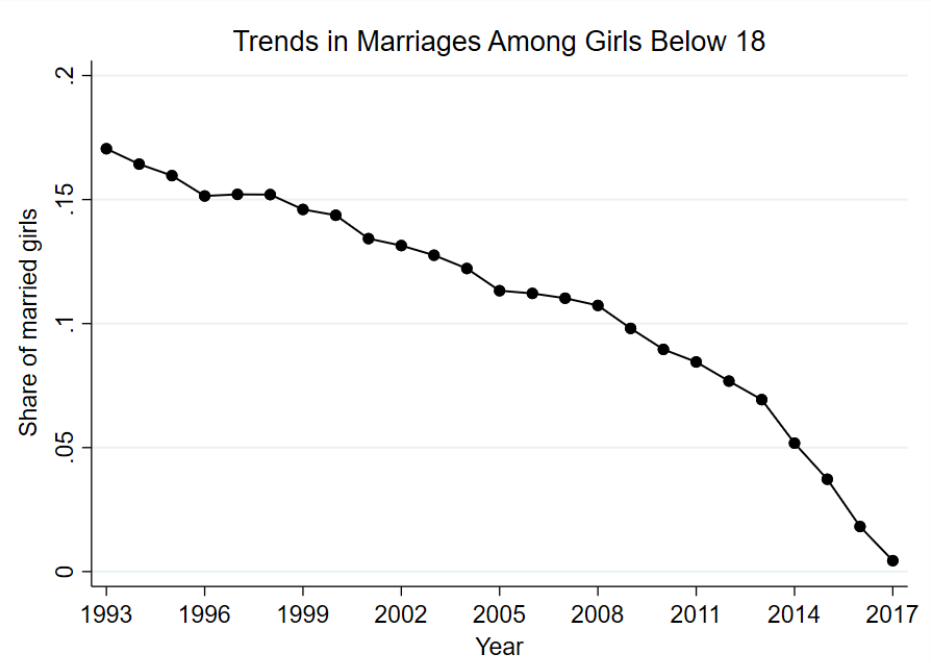

Figure B. Trends in marriages among girls between 12-18 years of age (1993 – 2017). *Notes*: This figure plots the share of girls who were married before age 18 from 1993 to 2017. Data on marriages come from the Nuptiality administrative records provided by the National Institute for Statistics and Geography's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

[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.

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]

[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

[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.

showed an improvement in the quality of fertility records over the last few decades, 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

[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

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

coefficients is smaller as expected since 12 is the minimum age one is allowed to marry in any state 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.

and geographical aspects of the country, disaggregated by federal entities. Due to 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:

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

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

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

[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.

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

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.

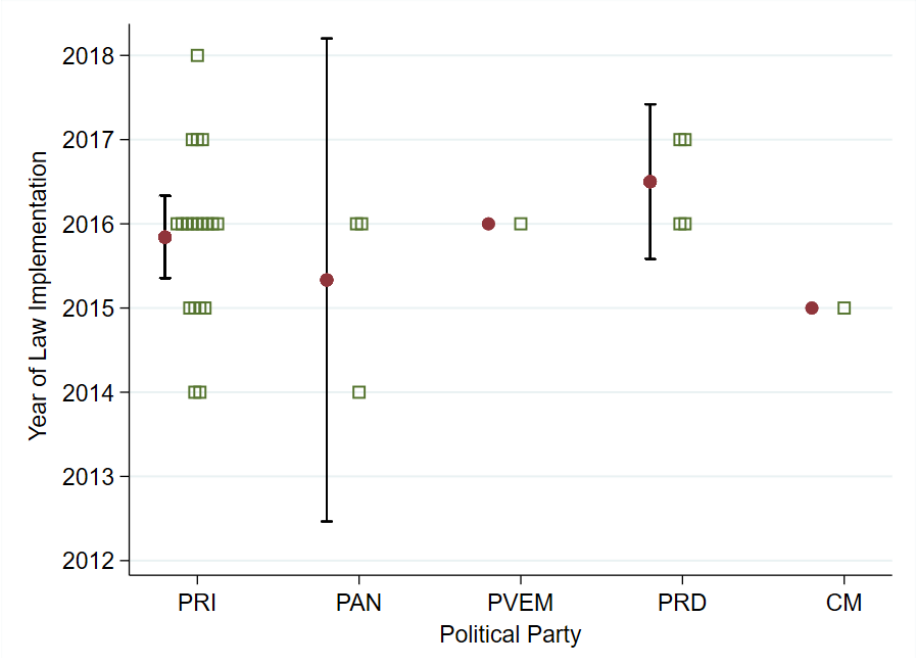

Figure C. A graphical representation of states presidents' political party affiliations and the timing of law implementation. *Notes*: This figure uses data on state presidents' political party affiliation in 2013, one year before the law was first implemented. PRI, PAN, PVEM, PRD and MC are the 5 political 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

[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.

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 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]

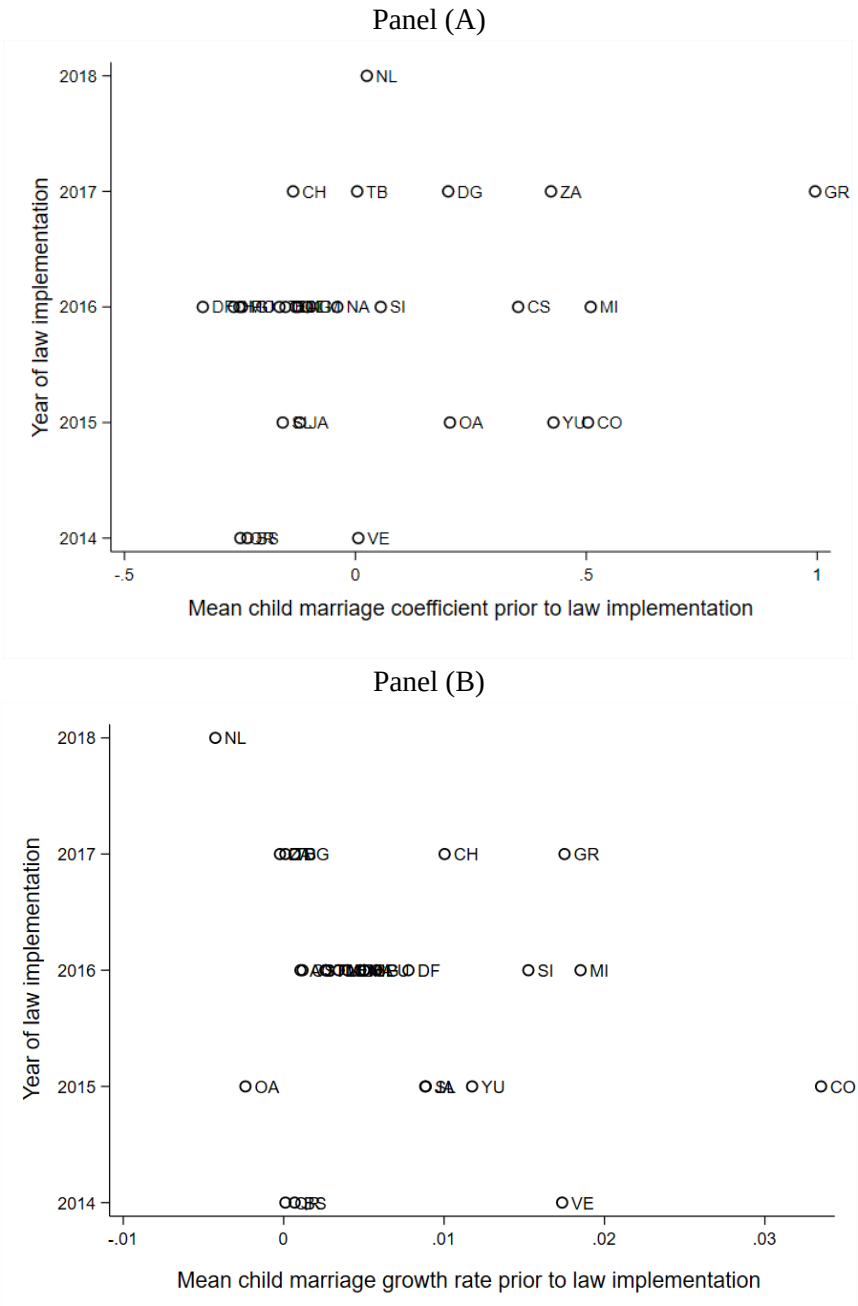

Figure D. A graphical analysis of the relationship between average child marriage levels in 2013 (Panel A) and 2013 child marriage growth rates (Panel B), and the year of law enactment. *Notes*: Panels A and B show a scatter plot of the relationship between mean child marriage rates and the

[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.

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 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:

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

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.

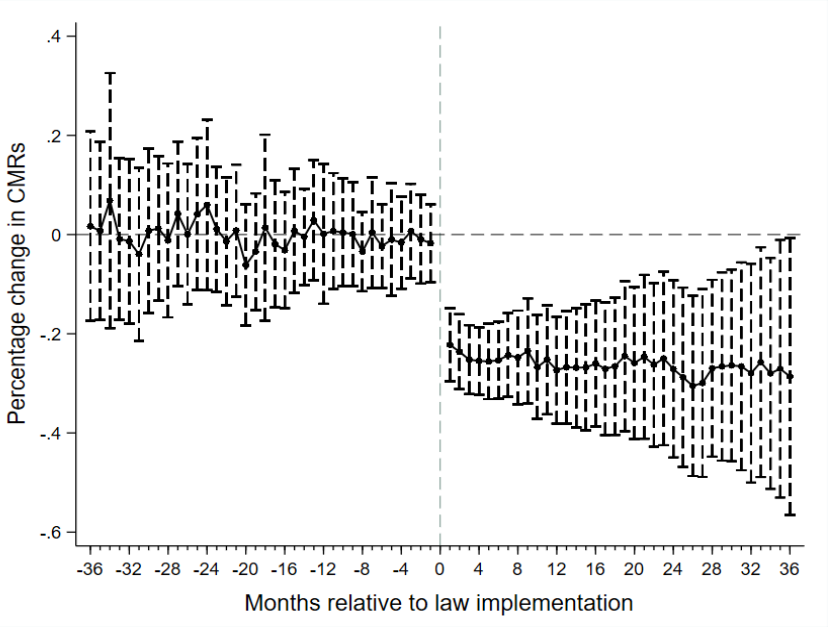

Figure E. The dynamic evolvement of CMRs before and after the law. *Notes*: This figure plots trends in the child marriage rate 36 months prior to the implementation of the law up to 36 months after the law was enacted. CMRs are calculated according to girls' state of residence (ITT approach) and regressions 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.

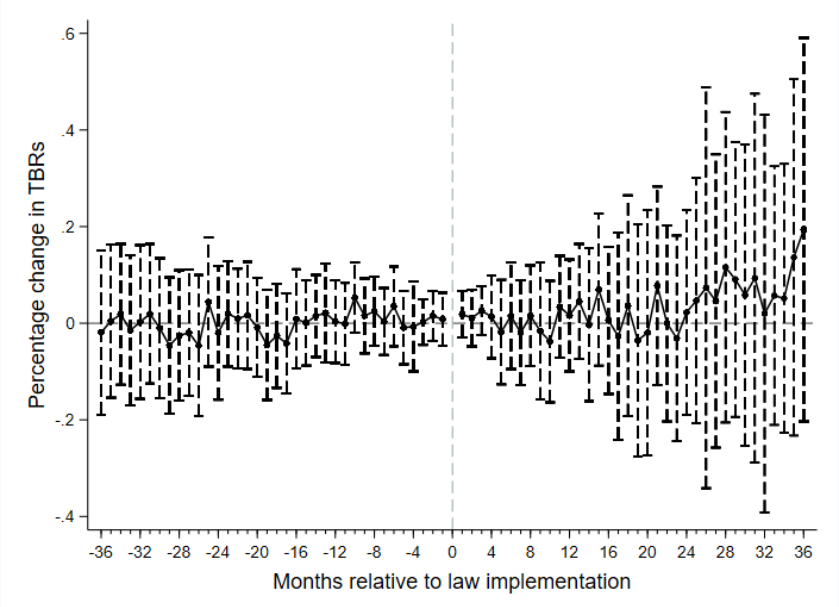

Figure F. The dynamic evolvement of TBRs before and after the law. *Notes*: This figure plots trends in the teenage birth rate 36 months prior to the implementation of the law and 36 months after the law was enacted. TBRs are calculated according to girls' state of residence (ITT approach) and regressions 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.

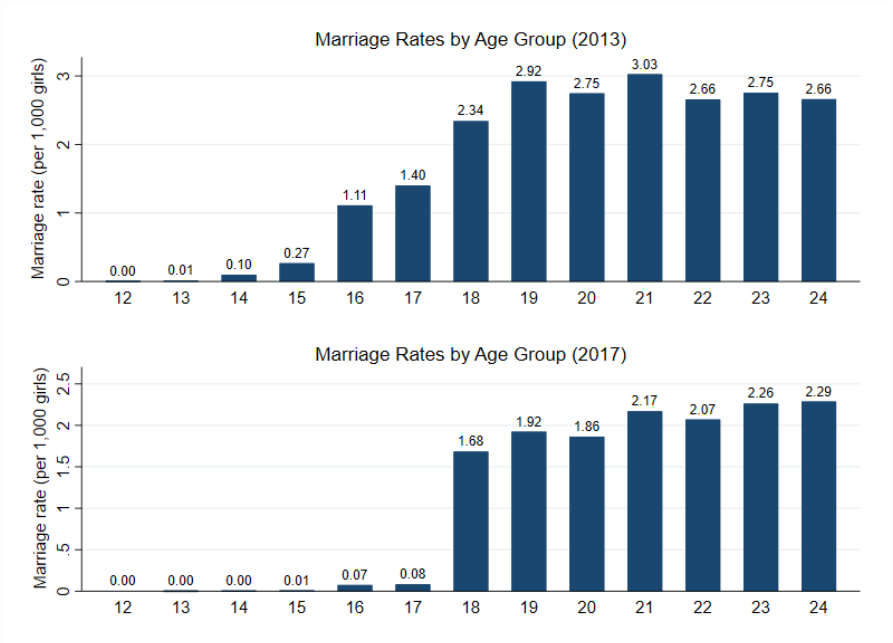

Figure G. A comparison of age-specific CMRs in 2013 and 2017. *Notes*: This figure presents CMRs calculated for each age group between 12 to 24 for 2013, one year before the law was first implemented and 2017, the last year for the sample of analysis. Each blue bar represents the CMR for the respective 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)).

[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).

Considering that over 95% of births are registered in Mexico (see Perez and 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.

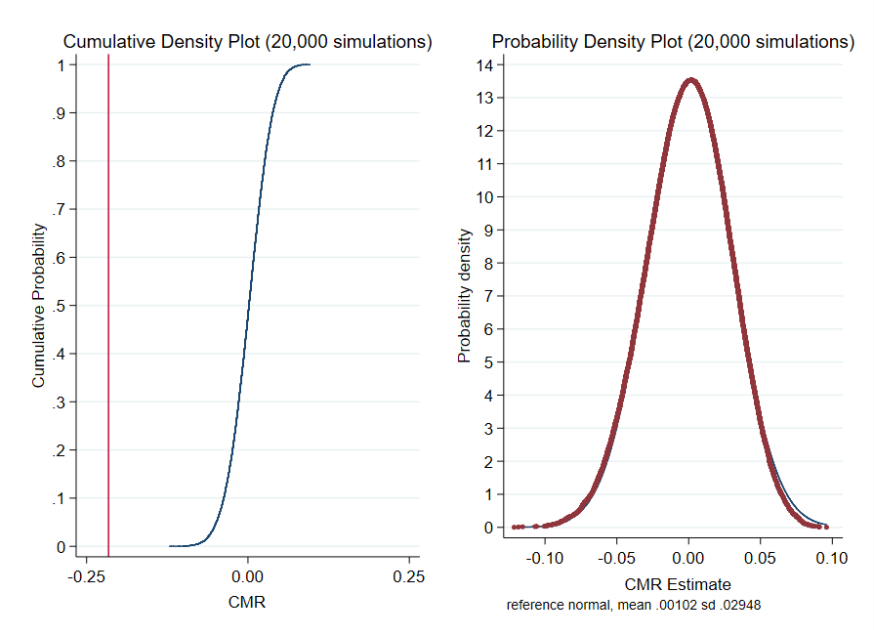

Figure H. Results from 20,000 simulated placebo law enactment dates. *Notes*: This figure plots the cumulative distribution function (left) and the probability density function (right) of the estimated CMR coefficients from 20,000 simulations using a randomly generated law implementation date. 3 states, 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.

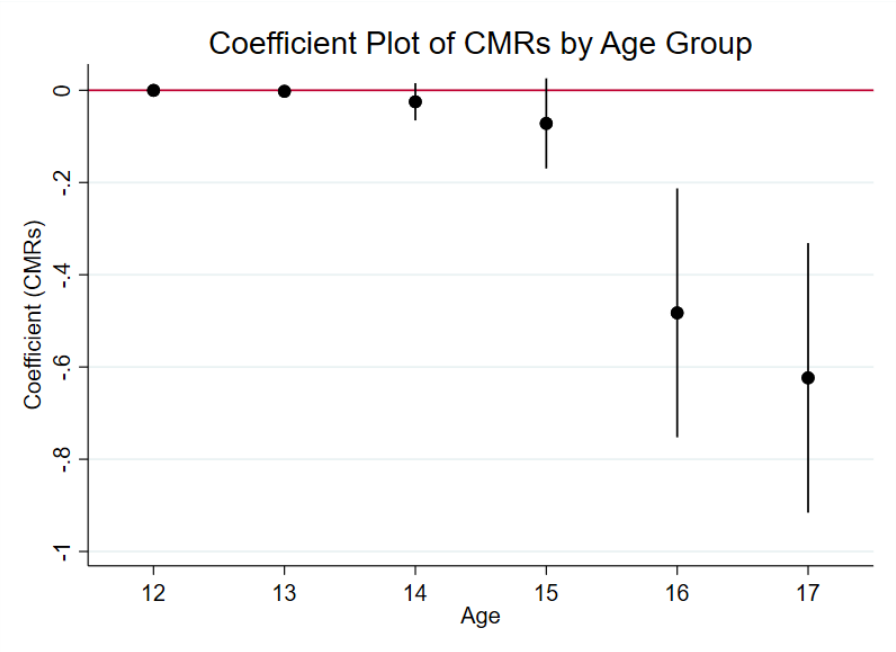

Figure I. Coefficient plot of age-specific CMRs. *Notes*: This graph presents coefficient estimates of the regression of age-specific CMRs on the law with the inclusion of baseline controls, state and month fixed effects, and state-specific time trends. CMRs are calculated according to girls' state of 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	

[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).

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). 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:

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

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

[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.

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 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:

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

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

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:

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

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:

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

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

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

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

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:

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

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:

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

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:

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

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, $N\left(q_f^e, q_m^e\right)$, 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

[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.

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:

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

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:

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

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:

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

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

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

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 re-arranging, 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:

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

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

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:

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

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:

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

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

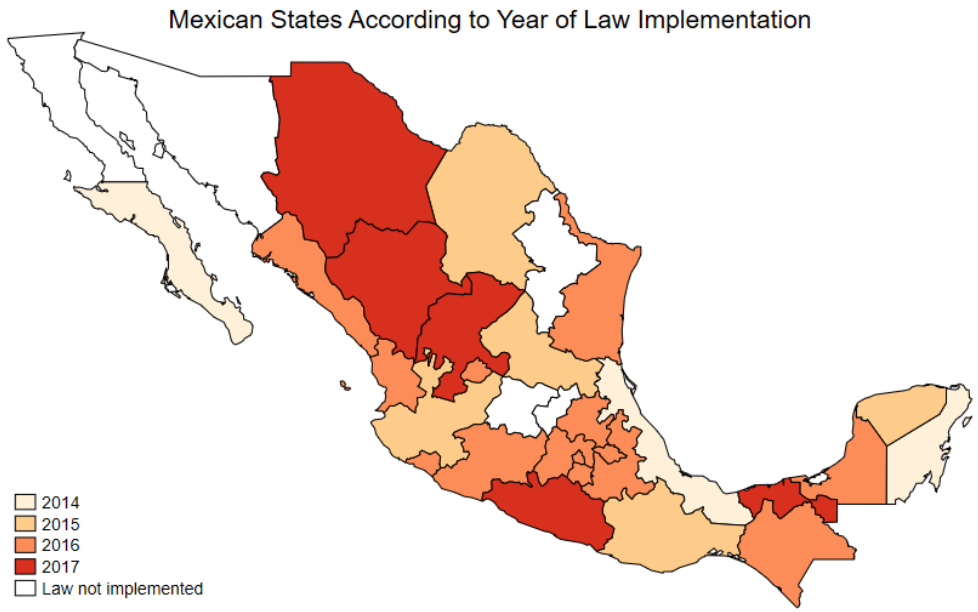

Figure B1. Geographical and temporal variation in the timing of the law enactment. *Notes*: This figure illustrates the year in which states across Mexico implemented minimum marriageable age laws. Unshaded areas represent states where the policy has not been implemented.

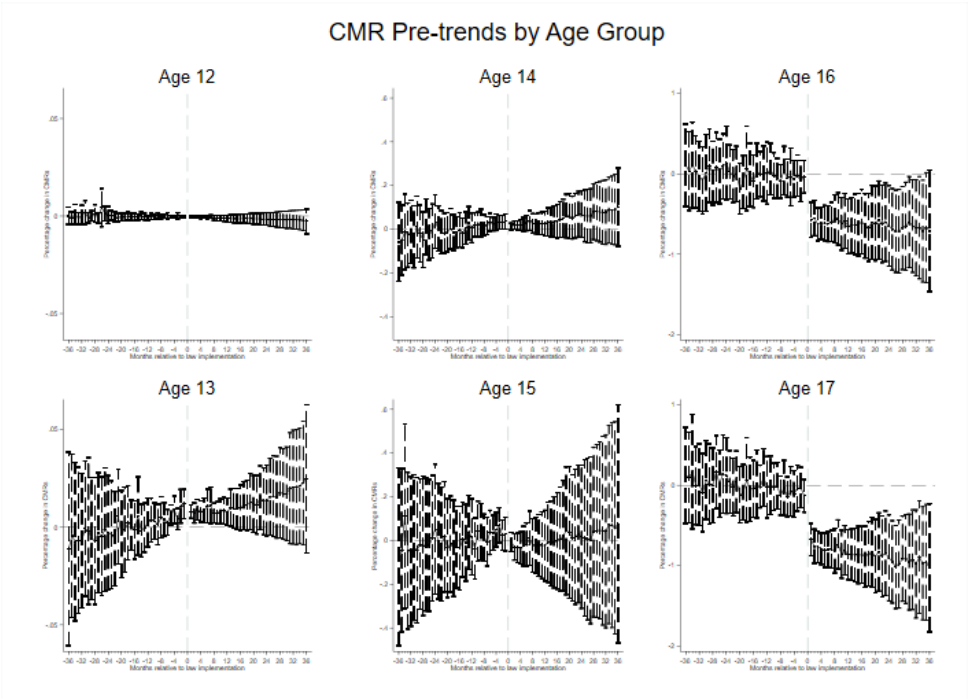

Figure B2. The dynamic evolvement of age-specific CMRs before and after the law. *Notes*: This figure plots trends in the child marriage rate for age groups 12-17 36 months prior to the implementation of the law and 36 months after the law was enacted. CMRs are calculated according to individuals' state 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).

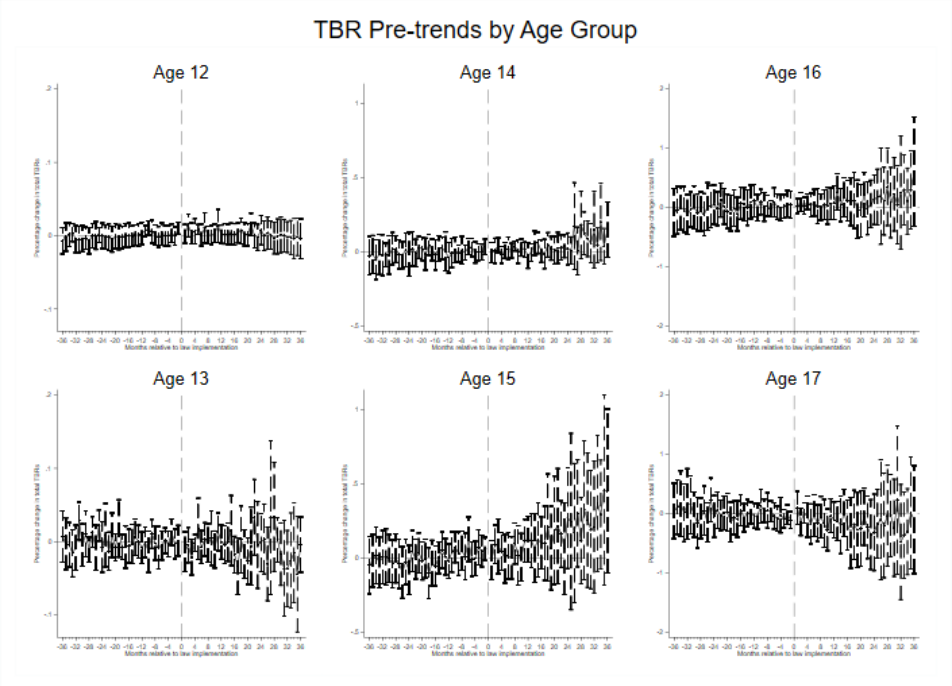

Figure B3. The dynamic evolvement of age-specific TBRs before and after the law. *Notes*: This figure plots trends in the teenage birth rate for age groups 12-17 36 months prior to the implementation of the law and 36 months after the law was enacted. TBRs are calculated according to individuals' state 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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Chapter II

Male Employment and Female Intra-Household Decision-Making: A Mexican Gold Mining Case Study *

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Abstract

This study explores the effect of economic booms in male-dominated industries like mining on female intra-household decision-making power. Using the 2007-2008 global financial crisis as an exogenous event which led to a gold mining boom in Mexico, I find that women living in gold endowed municipalities experienced higher decision-making power contrary to some theoretical predictions. These results appear to be consistent with unitary household bargaining models which assume income pooling, as female decision-making power increased despite no changes in female labour force participation and an observed increase in male employment. Findings from a separate survey additionally show that while women residing in gold endowed states had higher decision-making power, they were also more likely to suffer from intimate partner violence (IPV). This suggests that a woman's intra-household decision-making authority is not necessarily negatively correlated with her risk of IPV as posited in feminist theory.

Keywords: Gold mining; Intra-household decision making; Global income shocks**;** Male employment
JEL-Codes: J12, D13, F62, L72

I. Introduction

Mexico has a long-standing history of gold mining, where the practice of mining gold dates back to the pre-Hispanic times and contributed greatly to Latin America's economic expansion during the colonial era. It was not until the last two decades however, that the Mexican gold mining industry took off. Prior to the 2000s, Mexico predominantly focused on silver production, as the country had traditionally been the number one producer of the world's silver. Due to market speculation of the impending 2007-2008 financial crisis, global gold prices starting increasing in 2003 and spiked sharply between 2006 and 2011, with Mexican gold production following the same trend. This event, together with the influx of foreign direct investments (FDI) for mining explorations, inevitably generated a shift in focus from silver to gold mining in Mexico during this time period (The Mexican Ministry of Economy, 2013).[1] According to the National Institute for Statistics and Geography (INEGI), the production of gold in Mexico increased three-fold at an average rate of about 5.3% each year between 2000 and 2011. Relative to the world however, Mexico's global share in gold production during the mining boom only increased from about 0.3% in 2000 to 2.8% in 2011 (The Observatory of Economic Complexity (OEC)). Notwithstanding, Mexico's rich endowment in precious metals like gold in addition to the gold mining boom due to the 2007-2008 global financial crisis, provides an ideal setting for studies that aim to understand how male employment stimulated by mineral-led activities, impact female intra-household welfare outcomes like decision-making and intimate partner violence (IPV).

For many centuries, superstition has kept Latin American women away from mining as it was believed that if a woman went near a mine, it would become jealous, hide its wealth and cause catastrophes (Arcos et al., 2018). Lutz-Ley and Beuchler (2020) additionally note that because mining takes place in remote areas, miners are subject to long journeys, uncomfortable settings, and risky conditions. For these reasons, the mining industry has typically been male-dominated. In Mexico, despite efforts to increase female participation in the mining sector, the proportion of women in mining only increased from about 6% in 2004 to 13% in 2009, and subsequently decreased to 11% in 2014 (National Institute for Statistics and Geography (INEGI), 2020).[2] Figure A1 of the appendix also plots the absolute number of employees in gold mining by gender, between 1994 and 2014. The graph shows that while male employment in gold mining increased sharply especially between 2009 and 2014, female employment in gold mining only rose marginally during the same time period. Subsequently, in a mining report by the African Union (2009), it was suggested that booms in such male-dominated sectors would result in a decrease in women's intra-household decision-making power. The underlying

[1] S & P Global (2018) estimates that the Latin American region receives approximately 28-30% of the global budget in mining explorations each year, with six mining powerhouses, Peru, Brazil, Chile, Argentina, Ecuador and Mexico accounting for the lion's share (90%) of the region's budget.
[2] INEGI Data on the share of men and women in mining is only available for the years 1999, 2004, 2009 and 2014 since the economic census is only conducted once every five years.

logic is that as the mining sector flourishes and more men than women gain employment, women become increasingly reliant on their partners' incomes. Alternatively, busts in the mining industry could also decrease women's decision-making power through poorer employment prospects related to industrial crowding out effects. In a study on the U.K. by Aragon et al. (2018), coal mine closures were found to be associated with an increase (decrease) in male (female) employment due to the crowding out of female-dominated sectors like manufacturing. In the context of oil extraction in the U.S. however, Maurer and Potlogea (2020) did not observe any gender-biased crowding out effects, contrary to Aragon et al.'s (2018) findings. Ultimately, the impact of changes in extractive industries (EI) on female employment and in turn, intra-household decision-making outcomes remains inconclusive and renders further investigation.

To date, only one paper by Tolonen (2018), has explicitly explored the relationship between mining and spousal decision-making dynamics. In a cross-country study on Sub-Saharan Africa, the author found no effect of local gold mine openings on women's intra-household bargaining outcomes. This in turn raises the question of whether the commonly assumed negative relationship between gold mining and intra-household female decision-making power is consistent with real world data. This paper therefore endeavours to further test the hypothesized negative relationship between booms in male-dominated industries like mining, and female decision-making power in a Latin American country like Mexico. From a cultural and socio-economic perspective, the Sub-Sahara African region and Latin America are highly distinct, and could influence decision-making outcomes generated by a mining boom.[3] Tolonen's (2018) findings from her cross-country study on Sub-Saharan Africa may therefore not be generalizable to countries like Mexico in the Latin American region. In addition, since more indigenous women in Mexico have been documented to live in mining communities and are simultaneously poorer and subject to traditional gender stereotypes, understanding the impact of economic booms in male-dominated sectors like mining is important for enhancing and facilitating gender equality efforts among these particular demographic groups (Lutz-Ley and Buechler, 2020).

This paper contributes to existing literature in additional ways. First, no previous studies to my knowledge have used exogenous movements in global commodity prices to evaluate the effect of a mining boom on female intra-household decision-making power and intimate partner violence (IPV). In particular, this study exploits the sharp rise in world gold prices between 2003 and 2011, as well as the differences in gold endowment across municipalities and states in Mexico as sources of variation. The paper also utilizes two different data sources, one at the municipality level (*MxFLS*) and the other at the state level (*ENDIREH*),

[3] For instance, in Latin America, the *machismo* culture is particularly strong and had origins during colonial times, where women were perceived as weak, naive, and had to be protected by men as they could not fend for themselves (Bridges, 1980). *Machoism* is therefore often associated with an increased risk of intimate partner violence (IPV) perpetration, and implies that men of Latino origin engage in harmful behaviours such as drunkenness, violence and infidelity (Gutmann and Viveros, 2005; Mancera et al., 2015).

to identify changes in not only female bargaining power, but also IPV outcomes during the gold mining boom respectively. To date, only two studies on Sub-Saharan Africa have analysed the impact of mining on IPV. In a cross-country analysis on Sub-Saharan Africa, Kotsadam et al. (2016) found no significant relationship between both factors, whereas in a more location-specific study on Eastern Democratic Republic of Congo (DRC), Rustad et al. (2016) discovered that women who lived closer to artisanal and small-scale mining were more likely to experience sexual violence. In this study on Mexico, due to the detailed information on IPV provided by a state-level (*ENDIREH*) data set, I am able to segregate IPV into four different forms (physical, sexual and emotional abuse and threats of violence), unlike previous studies by Kotsadam et al. (2016) and Rustad et al. (2016) that only examined harder types of IPV like physical and sexual violence.

The results from the analyses show that women living in gold endowed states were more likely to suffer from various forms of IPV, though the types of IPV experienced by women were different for those who were poorer and wealthier. Given the spike in domestic violence during COVID-19, this study is therefore particularly relevant as it helps to shed some light on how changes in male employment as a result of economic booms or busts (in the context of COVID-19) affect women's risk of IPV, especially in low-middle income countries like Mexico. The findings also reveal that women residing in gold endowed municipalities experienced an increase in their decision-making power at home, which was likely to be driven by a rise in male employment probabilities. Contrary to non-unitary household bargaining models (see McElroy and Horney, 1981, Lundberg and Pollak, 1994 and Lommerud, 2003) that predict a decline in a woman's household bargaining power along with a concurrent increase in male employment opportunities generated by a mining boom for instance, the results from this study suggest that an increase in a husband's outside option through better employment prospects relative to his wife's, may not necessarily hamper her intra-household decision-making power ability. This finding can be juxtaposed against unitary household bargaining models that predict the pooling of household income (Samuelson, 1956). From a policy standpoint, it subsequently elucidates how income resources are distributed within the household, which carries important implications for the evaluation of future cash-transfer programs for example.

The rest of the paper is organized as follows: section II provides a background on gold mining in Mexico and discusses relevant theories relating income-generating opportunities to intra-household female decision-making; section III describes the data and empirical method used in this study; section IV presents the main results of the paper, discusses possible channels and additional outcomes like IPV, and reports a set of robustness checks; section V finally concludes.

II. Background and Existing Literature

II.1 *Gold Mining in Mexico*

This study specifically focuses on gold mining in Mexico. Due to market speculation of the 2007-2008 global financial crisis, the global demand for gold began increasing in the few years leading up to the crisis in 2003. Figure A1 of the appendix supports this phenomenon, and shows an increased demand for labour in the gold mining sector particularly for men, between 2004 and 2014. By 2011, the price of gold was approximately six times higher than pre-shock levels in 2002, with the steepest increase occurring between the end of 2006 and 2011.[4] This event subsequently stimulated a gold mining boom across many mineral-led countries like Mexico, as gold production intensified in response to the spike in global gold prices (Engineering and Mining Journal, 2011). Figure A shows the natural log of the prices and production of gold through these shocks between 1998 and 2011.

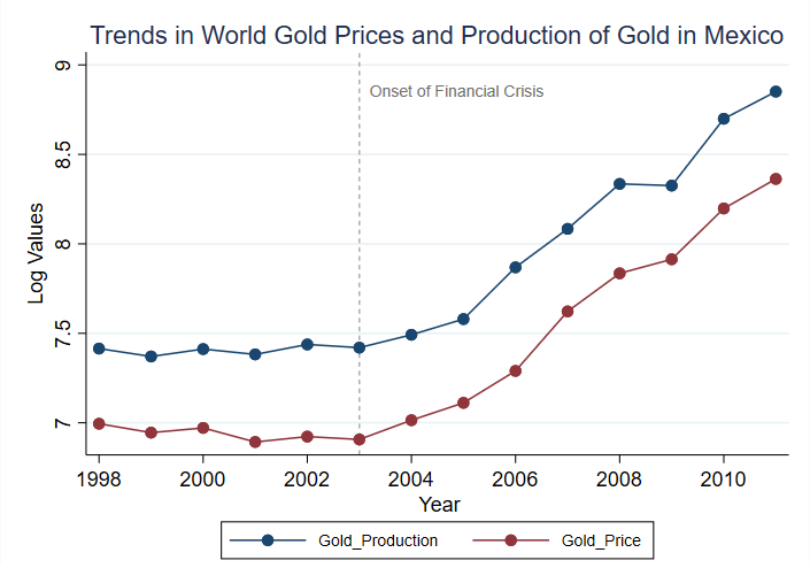

Figure A. Trends in world gold prices and gold production in Mexico. *Notes*: This figure plots trends in global gold prices and the production of gold in Mexico. Each point is the logged value of average prices over each year and the total production in each year. The blue (red) line denotes production (price). Data on Mexico's gold production come from the National Institute for Statistics and Geography (INEGI), and data on world gold prices is from the London Metal Exchange's (LME) monthly historical price series.

As can be seen, global gold prices increased steadily from 2003 to 2011, and gold production in Mexico followed the same trend. It is worth noting that although the prices of other precious metals like silver rose as well, the increase was not as substantial as compared to gold. While the prices and production of silver nearly

[4] Given Mexico's economic ties and dependence on the U.S. as an export market, all economic sectors including mining took the hit during the 2007-2008 global financial crisis. This explains the slight fall in gold production between 2008 and 2009. Mining was however the first industrial sector in Mexico to recover from the crisis as the economy started to recover in 2009, which is depicted by the sharp increase in gold production and prices between 2009 and 2011 (Engineering and Mining Journal, 2011). Moreover, the panel *MxFLS* data used in this study was conducted in 2002, 2005-2006 and 2009-2010, which does not overlap with the dip in gold production between 2008-2009.

doubled between 2009 and 2011, they were relatively constant before that period (see Figure A2 in the appendix). Moreover, silver has a much lower value to weight ratio than gold, where the gold-silver price ratio was 84:1 at the depth of the global financial crisis.[5] Therefore despite Mexico being a large producer and exporter of silver, there is little temporal variation to exploit in silver mining production for this study. Accordingly, I test if the production of gold in Mexico responded to world gold prices, by conducting a first-stage analysis of the relationship between the two variables. The *t*-statistics of the effect of current prices on future production 1,2 and 3 months after (*t*+1 to *t*+3) are highly statistically significant (18.09, 20.98, 20.96 respectively), indicating that local production responded strongly to global prices.[6] Figure A additionally shows that local gold production and world prices followed highly similar trends during the sample period.

Most of the gold mining in Mexico is conducted by large-scale companies located in the north and central regions. Figure B illustrates the geographical variation in gold production across the respective Mexican states between 2003 and 2011 specifically. As can be seen, three northern states: Sonora, Chihuahua and Durango contribute to the largest shares of gold produced in the country. While there is some gold mining activity in south-eastern states like Guerrero and Oaxaca, the average volume of gold produced in the north is approximately 4.5 times more than in these states. In total, about 14 out of 32 Mexican states are actively involved in the mining and production of gold, albeit the remaining 18 states also do produce gold but in much smaller quantities, contributing to only 0.4% of the total gold produced in Mexico.

Typically, the mining of gold is done through open-pit operations that use capital intensive technology, and many gold mining businesses in Mexico are owned by large international corporations or businesses rather than by locals.[7] Much of the Mexican soil is also favourable for the practice of mining exploration and exploitation, where approximately two-thirds of the national territory contain mineral resources that are suitable for mining purposes (Hurtado and Salazar, 1999). On average, it is estimated that exploration activities of a mining area take 10 years, and an additional 20 to 30 years for exploitation (The Mexican Geological Service (SGM), 2020).[8] In the Mexican context, the relationship between *ejidos* and miners has also played a major role in mining production over the last three decades. *Ejidos* are essentially areas of land that are used for collective agricultural practices, whereby community members are assigned allotments on which they farm on, and have joint ownership over the land with other community members. In 1993, the mining law reform allowed *ejidos* and properties of agrarian communities to be

[5] Data for the gold and silver price ratio was from the London Bullion Market Association (LBMA) and ICE Benchmark Administration (IBA).
[6] Estimation output for the regression is not listed; but available upon request.
[7] Open-pit mining is often used for extracting "hard rocks" such as metal ores like gold, silver, copper, iron, among others. The process begins by excavating large surface areas of the ground to expose and mine the metal ore beneath. Specifically, holes are drilled into the ground using explosives, and hard rock material is then removed layer-by-layer through controlled demolitions.
[8] Information on the timeline of mining exploration and exploitation activities was provided by the Mexican Geological Service (SGM) through a public information request system.

privatized, meaning that in order for miners to carry out exploitation work on *ejidos*, they would have to have an agreement with the owners of the land, and have it registered with the agrarian registry (Penman, 2016). Under these circumstances, if a consensus between the owner of an *ejido* and prospective mining business was not reached, miners would not be able to conduct exploitation activities.[9]

Figure B. A graphical representation of gold production across Mexican states between 2003 and 2011. *Notes*: The graph shows the total production of gold (in kilograms) in each state between 2003-2011. The darker the shaded area, the greater the quantity of gold produced in the state. Data on gold production come from the National Institute for Statistics and Geography (INEGI): Banco de Información Económica (BIE) series.

II.2 *Mining, Employment and Female Decision-Making Power: Conceptual Framework*

II.2a *Non-Unitary Household Bargaining Models*

Non-unitary household bargaining models in economics predict that external shift parameters such as an increase in female job opportunities for instance, are key determinants of a woman's bargaining power.[10] These external environmental factors are typically termed as the 'outside option', and are a function of an individual's decision making authority (McElroy and Horney, 1981; Lundberg and Pollak, 1994; Lommerud, 2003). Subsequently, the theory suggests that a change in a woman's outside option is sufficient to alter her aggregate bargaining power within the household. Improvements in relative or absolute job opportunities for women due to gold mining for example, should thus increase female bargaining power through the outside option. In regions like Sub-Saharan Africa, Kotsadam and Tolonen (2016) found that the intensification of mining activities generated more jobs for women in complementary sectors like the service

[9] For legal documentation of *ejidos* and mining concessions, see article 27 of the mining law: http://www.diputados.gob.mx/LeyesBiblio/pdf/151_110814.pdf.

[10] This study follows the theoretical framework of a non-unitary rather than unitary household bargaining model. A majority of empirical studies find little evidence in support of the unitary household model framework, which has been criticized for its over-simplicity and lack of applicability to real world data (Lundberg and Pollak, 1994; Browning and Chiappori, 2006; Bobonis, 2009; Cherchye et al., 2012).

industry. However, in a subsequent study on Sub-Saharan Africa by Tolonen (2018) the author found no impact of gold mining on spousal decision-making power, indicating that an improvement in a woman's outside option through an increase in job opportunities may not necessarily guarantee an increase in her intra-household bargaining power. Whether the Mexican gold mining boom affected female decision-making power through employment, therefore remains an empirical question.

The extent to which an improvement in a woman's outside option can be leveraged to her advantage also depends on how male income or employment changes relative to females' during a gold mining boom. The prediction of non-unitary household bargaining models is that if relative male income or employment increases, the intra-household gender wage gap widens and in turn lowers women's decision-making power. In several studies on the Middle East and the U.K, booms in industries like crude oil and coal decreased female labour force participation due to higher male wages and increased household wealth, which subsequently crowded out female-dominated sectors like manufacturing (Ross, 2008; Aragon et al., 2018). Considering that mining is still a male-dominated activity, economic booms in the sector in theory, could disproportionately increase employment prospects for men and decrease female intra-household decision-making power (African Union, 2009).

II.2b *Unitary Household Bargaining Models*

Unitary household bargaining models on the other hand, assume the pooling of household income which implies that the household demand for goods and leisure are not dependent on the sources of income (i.e. the individual income contribution of the wife and the husband to household wealth), but rather the aggregate household income. Samuelson (1956) suggested that as long as there is a general consensus among household members on the aggregation of household income and preferences, the income pooling assumption is satisfied. Though the unitary model has been widely criticized for its over-simplicity and lack of applicability to real world data (see Lundberg and Pollak, 1994; Browning and Chiappori, 2006; Bobonis, 2009; Cherchye et al., 2012), there is evidence that some developing countries like India, still follow the unitary framework (see Neff et al., 2012; Klasen and Pieters, 2015). Consequently, under the unitary household bargaining model, a woman's intra-household decision-making authority is dependent on changes in the total household wealth, rather than on changes in her absolute or relative income prospects. In this regard, the outside option characterized by better employment opportunities in gold mining for instance, will not affect her intra-household decision-making power over the consumption of goods and services, unlike what is predicted by non-unitary household bargaining models. A total increase in household finances is therefore sufficient to increase her intra-household decision-making power over consumption goods and services.

III. Data and Empirical Method

III.a *Data*

III.a1 *Dependent Variables*

This study draws from a panel data set to elicit the effect of the gold mining boom on female decision-making power in Mexico. Specifically, it utilizes the Mexican Family Life Survey (MxFLS), which fortuitously overlaps with the timing of the gold mining boom as a result of the 2007-2008 global financial crisis. The *MxFLS* is a nationally representative panel survey containing information on the decision-making power of married or cohabiting couples, and interviewed approximately 8,400 households and 35,000 individuals in more than 150 municipalities across Mexico.[11] It also boasts low attrition rates with virtually 90% of households re-interviewed and tracked across all three survey waves.

To capture the differences in women's intra-household decision-making power before and after the spike in gold mining production, I use all three waves of the *MxFLS* conducted in 2002, 2005-2006 and 2009-2010. In particular, I utilize the first wave of the MxFLS (2002) as the pre-treatment sample, and the last two waves (2005-2006, and 2009-2010) as the post-treatment sample given that gold prices only started increasing from 2003 onwards (see Figure A). Decision-making questionnaires specifically ask couples within a household about who made the decisions over twelve types of goods and services (children's goods, private goods, spouse's goods and household expenditures).[12] Accordingly, I construct an average decision-making power index over all twelve decision-making questions, where each decision-making question is normalized with a mean of 0 and standard deviation of 1.[13] The *MxFLS* additionally provides detailed information about an individual's indigenous status, education, age, employment, month and year of interview, perception of safety, the number of kids at home, indicators of community and transport network quality, and most importantly, it notes the presence of a woman's spouse during an interview which is included as a control to mitigate measurement errors resulting from possible reporting biases.[14]

III.a2 *Explanatory Variables*

In order to examine the effect of the gold mining boom on female decision-making power outcomes, I use exogenous global commodity shocks characterized

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[11] In this study, the *MxFLS* sample excludes women who got divorced (and who may or may not have changed partners). The same women (and partners) are therefore followed over time across all three survey waves to attenuate concerns relating to possible endogenous marriage formation.

[12] Data and documentation are available at http://www.ennvih-mxfls.org/. An example of the household decision making questionnaire can be found in Figure A3 of the appendix.

[13] Specifically, I assign a value of 3 if a woman responded that she was the sole decision-maker over that category of goods and services, 2 if the decision was made jointly with her husband, and 1 if her husband was the sole decision-maker of that category of goods and services. Each decision-making question is then normalized with a range of 0 to 1. Using this information, I then construct an average decision-making power index over all twelve decisions.

[14] Reporting biases may arise from the 'Hawthorne effect', a psychological term referring to the alteration of one's behaviour or survey response due to the cognizance of being observed (Landsberger, 1957).

by movements in gold prices. Considering that local prices of gold are likely to be endogenous to female intra-household bargaining power outcomes, for instance, mine openings or exploitation activities, could have been influenced by local gold prices, I use world gold prices instead, which is taken from the *United States Geological Survey (USGS)* historical statistics for mineral and material commodities. In this context, the exogeneity assumption holds reasonably as world gold prices are unlikely to be influenced by women's intra-household decision-making behaviour in Mexico. Moreover, during the sample time frame, Mexico was not a major global exporter and producer of gold. Between 2002-2011, Mexico contributed to only 1.63% and 1.66% of the world's total gold exports and production respectively (The Observatory of Economic Complexity (OEC), 2019). Given the country's small open gold economy, the issue of endogenous global gold prices is thus less of a concern due to Mexico's insignificant share of global gold production and exports, which arguably has a negligible effect on world gold prices.

Next, since the drug war initiated by President Felipe Calderón in 2007 reportedly encouraged drug cartels to switch from trafficking to gold mining, one cannot rule out the possibility that gold mining projects during the sample time frame were influenced by levels of violence, which in turn could have impacted female bargaining power outcomes (Global Initiative against Transnational Organized Crime (GIATOC), 2016). To circumvent this potential endogeneity, I use historical mining concessions data from 1973 to 1983 as a proxy for gold mineral endowment.[15] In essence, mining concessions are land areas that are allocated and permitted by the government for the extraction of minerals such as gold.[16] The data contains information on the land area granted for the exploitation of gold, and is taken from *Mexican Ministry of Economy* which provides information on the intended gold mining land area (in hectares). Location information such as the municipality, and the date during which the gold mining concession was granted is also provided. I omit concessions that listed the mining of other minerals such as copper and lead, among other minerals, to elicit and isolate changes in gold mining activities between 2003-2011, the period when gold prices started increasing. Two states: Mexico City ('Federal District of Mexico') and Quintana Roo, are also excluded from the analysis, as information on historical mining concessions for these states are not available.[17] Summary statistics of dependent and independent variables are presented in Tables B1 and B2 of the Appendix.

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[15] Since exploitation activities last on average between 20-30 years, I subtract 20-30 years from the time market speculation about the impending global financial crisis began in 2003, and thus use historical mining concessions from the 1973-1983 time period.

[16] For legal documentation, see articles 15 and 19 of the mining law: http://www.diputados.gob.mx/LeyesBiblio/pdf/151_110814.pdf.

[17] The Federal District of Mexico and Quintana Roo are not known to be 'mining' states in general. Data on the production of gold and silver is available on the state level, but only specifically for states that are major producers of the two metals. States that produce relatively less of these minerals (such as the Federal District of Mexico and Quintana Roo) are grouped together under 'others' in the data. It is therefore not possible to know the exact amount of gold and silver produced in the two states, in addition to the lack of historical mining concessions data which is used as a proxy for endowment in this study.

III.a3 *Additional Data Sources*

In the baseline regressions, I include the homicide rate per 100,000 people as a control to account for the Mexican drug war that overlapped with the gold mining boom. Data on homicides is drawn from the death registry of the *Vital Statistics* edition provided by the National Institute for Statistics and Geography (INEGI). Public death certificates are released by the INEGI annually, and contain details on the cause of death, the day, month and year of death as well as the municipality and state in which the death occurred for the years 1990-2011. The availability of this data permits the selection and inclusion of only intentional homicides, and the matching of homicide rates to individuals' decision-making outcomes months prior to their *MxFLS* interview. The *National Agrarian Registry (RAN)* also provides information on the number of *ejidos* per municipality and state which is added as a heterogeneous market trend in baseline regressions to control for initial municipality conditions.

As a robustness test, I draw from an alternative data set, the Mexican National Survey on the Dynamics of Household Relations (ENDIREH), to cross-check female decision-making power outcomes observed in the *MxFLS*. *ENDIREH* is a nationally representative repeated cross-sectional survey containing information on women's intra-household decision-making outcomes and self-reported measures of IPV, which is used as an additional outcome in the paper. Like the *MxFLS*, the survey overlaps with the timing of the gold mining boom, and was conducted in 2003, 2006 and 2011. Altogether, *ENDIREH* surveyed 34,184, 133,398 and 152,636 women who cohabitated with a partner or husband, and who were 15 years and above in 2003, 2006 and 2011 respectively.[18] In particular, women were asked if they experienced any form of IPV in the 12 months prior to the interview as well as their decision-making power over various sets of goods and services. It is important to use *ENDIREH* to examine the effects of the gold mining boom on intra-household female welfare outcomes related to domestic violence for instance, as the *ENDIREH* is currently the only available data set in Mexico that contains detailed information about women's IPV experiences. Different from the *MxFLS* however, location data for the *ENDIREH* is only available on the state rather than municipality level since the aim of the survey was to get a general gauge of the intensity and severity of domestic abuse across Mexico.

III.b *Empirical Strategy*

An important assumption is that the production of gold which essentially serves as the treatment variable, intensified during the onset of the global financial crisis in 2003. Since the goal is to examine how intra-household female decision-making authority was influenced by changes in employment due to the gold mining boom over time, it is necessary to ensure that there is variation in gold mining

[18] It is possible that the *ENDIREH* did not capture a particularly vulnerable age group of those below 15, since marriage as young as the age of 12 was legal in some states in Mexico during the sample period. Nonetheless, the average proportion of girls married below 15 was approximately only 3.3% out of all women who were married across the three *ENDIREH* survey rounds (INEGI, marriage statistics).

production activities stimulated by the global economic downturn. In order to test this assumption, I run a first-stage regression analysis of the relationship between world gold prices and Mexican gold production. As previously discussed in section II.1, the association between the two variables is highly significant and positive. Figure A provides further support for this assumption which shows that world gold prices and gold production in Mexico exhibited similar trends. The availability of data on the month and year of interview in the *MxFLS* additionally allows the matching of individuals to monthly values of world gold prices.

One of the limitations of this study however, is the paucity of geocoordinate data in both the *MxFLS* and *ENDIREH*. As such, calculating the exact distance of individuals to mines is not possible, unlike studies on Sub-Saharan Africa by Kotsadam and Tolonen (2016) and Kotsadam et al. (2016) for instance, that use the Demographic Health Survey (DHS) series containing geocoordinate data. Moreover, due to limited data availability on historical gold mining projects, I utilize historical gold mining concessions as an alternative, which is a continuous endowment variable indicating the land area designated for the exploitation and extraction of gold. Municipalities that have larger mining concession areas therefore signify greater gold endowment compared to those with smaller mining concession land areas. In this respect, the treatment intensity is determined by the size of gold mining concession areas in the municipalities where women reside. It is also worth noting that since concessioned land areas may be explored but not eventually exploited, the empirical strategy follows an intent-to-treat approach which relies on the assumption that rising gold prices encouraged the exploitation and production of gold. Lastly, out of the 136 municipalities represented in this study, approximately 39% have land areas designated for the mining of gold, ranging from 18 to 3362 hectares (18,000 to 33,622,813 square meters).

In order to fully exploit changes in gold mining production activities due to the global economic crisis, I interact historical gold mining concession areas with the global gold prices. Doing so should help to elicit the differences in employment and intra-household bargaining outcomes between women who live in municipalities endowed with gold during the mining boom, and those who do not. On this account, the empirical strategy follows a difference-in-differences method of estimation, and capitalizes on the temporal and geographical variation in gold mining production across Mexico. Accordingly, the baseline regression takes the following form:

$$Y_{i,m,t} = B_0 + B_1(Gendowment_m * Price_{t-5}) + B_2 X'_{i,t} + B_3 Z'_{m,t} + \emptyset_t + \pi_i + \varepsilon_{i,m,t} \quad (1)$$

Where $Y_{i,m,t}$ is the average decision-making power index of woman i in municipality m at time t, $Gendowment_m$ is the log of the land area claimed by gold mining concessions between 1973 and 1983 in municipality m, $Price_{t-5}$ is the *average* world price of gold 5 months prior to the individuals' interview month, $X'_{i,t}$ and $Z'_{m,t}$ are vectors of individual- and municipality-level covariates such as woman's age, age squared, indigenous status, education level, number of children,

the presence of her spouse during the interview, the homicide rate per 100,000 inhabitants, the introduction of domestic violence and divorce laws, and time trends interacted with municipal characteristics such as rural-urban status, transport network quality, community quality and the presence of *ejidos*, to account for heterogeneous market trends that may be correlated with initial municipal conditions.[19] $\emptyset_t$ and π_i are month and individual fixed effects respectively, and $\varepsilon_{i,m,t}$ is the usual disturbance term.

It is crucial to control for municipality homicide rates as higher homicide rates have been found to lower women's bargaining power at home (see Tsaneva et al., 2018).[20] Due to the drug war, the Mexican mining industry grew in its susceptibility to drug-related criminal activity as the rising gold prices and concurrently declining profitability of drug trafficking from Mexico to the United States stimulated drug cartels to switch from trafficking to gold mining (Global Initiative against Transnational Organized Crime (GIATOC), 2016). Additionally, from the mid-1990s to the mid 2000s, Mexico implemented various divorce laws and reforms that criminalized domestic violence. Details on the dates of these various reforms can be found in Beleche's (2017) study which examines the effect of these laws on female suicide in Mexico. Given the evidence that divorce law reforms and domestic violence laws improve a woman's outside option, and hence her intra-household decision-making power (see Chiappori et al. 2002; Rangel 2006; Stevenson and Wolfers 2006), it is important to include the timing of these reforms as controls in the benchmark regression. Lastly, while the lag of the average gold prices in the last 1, 2, 3, 4, and 6 months also generates significant estimates for female decision-making power outcomes, this paper uses the average prices of gold over the last 5 months prior to the interview month of the individual, as this mean composite measure produces the most pronounced effect of the mining boom on women's intra-household bargaining power. Because gold mining production might take some time to respond to changes in prices and hence generate lags in production and hiring adjustments, and since individuals may not immediately respond to economic stimulus, the more prominent results produced by the average of gold prices over the last 5 months is conceivable. In Figure A4 of the appendix, I present a coefficient plot of a woman's mean decision-making power index according to the average gold prices over the last 1-6 months. In summary, the figure provides evidence that the choice of using average gold prices over the last 5 months is not arbitrary (the coefficient plot is a quadratic function with a maximum point at the 5th lag).

[19] Transport network quality and community quality are indices calculated using standard principal component analysis. They include various transport network questions such as the kind of materials that the roads, streets or highways are made of, if cars were able to pass through the community in the last two years, inter alia, and community quality questions like flooding problems, air quality, the sufficiency of public light systems, among others.

[20] Because homicides are least subject to failure in reporting and are the most consistent with multiple studies using drug-related crimes, they remain the best indicator for violent living conditions despite the availability of data on other types of crimes related to the drug war (Ellsberg et al., 2011; Brown and Velásquez, 2017).

Next, the inclusion of individual fixed effects is also especially advantageous given the nature of this study as individual decision-making behaviour for instance, could vary greatly across individuals due to latent individual traits. Month of interview fixed effects additionally account for time trends that vary uniformly across municipalities. A potential threat to identification remains however, due to selective migration. For instance, women and men in the *MxFLS* could have moved to mining municipalities across the three survey waves in search of better job opportunities. It could also be that individuals migrated away from municipalities that were more dangerous as a result of the drug war, which has been reportedly associated with gold mining. Intra-household female welfare estimates could therefore be either upward or downward biased, depending on each specific scenario. Albeit an examination of the *MxFLS* shows that only 2.8% of women changed their municipalities of residence across all three survey waves, I nonetheless fix individuals to their municipality of residence in the first survey wave (2002) regardless of if they relocated to other municipalities over the years, to rule out any biases arising from selective migration. Consequently, the *MxFLS* results represent the intent-to-treat (ITT) effect as opposed to the average treatment effect (ATE) of the relationship between the gold mining boom and women's intra-household decision-making power.

IV. Results

IV.1 *The Effect of the Gold Mining Boom on Women's Decision-Making Power*

Table 1 show the results from estimating equation (1) which estimates the effect of the gold mining boom on women's mean overall decision-making power and their decision-making authority over individual goods and services. Specification (1) includes individual and month fixed effects, but no controls, (2) sequentially adds baseline controls, and (3) is the benchmark regression which includes non-parametric trends interacted with municipal characteristics aforementioned in section III.b, to account for heterogeneous market trends correlated with initial municipality conditions. Taken together, the results show that contrary to the commonly hypothesized negative relationship between mining and intra-household female decision-making power, women in gold endowed municipalities experienced an overall increase in their ability to partake in household decision-making processes. A more disaggregated analysis of the different categories of goods and services shows that the improvement in their average aggregate bargaining power was driven by three specific types of goods: food expenditures, money given to their own parents, and contraceptive use. The findings for the remaining categories of goods and services are presented in Table B3 of the appendix, and do not show a significant relationship with the gold mining boom.

The benchmark specification in column (3) reveals that women living in gold endowed municipalities experienced an improvement in their decision-making power by about 0.01 (0.006/0.541) of a standard deviation when compared to the

mean. Equivalently, this suggests that a two standard deviation increase in the price of gold results in a 0.02% increase in a woman's decision-making power index. This effect appears to stem from an observed rise in women's bargaining power over food expenditures, money given to the woman's own parents and contraceptive use, where coefficient estimates for decision-making power over these particular goods in column (3) show an increase of 0.04%, 0.06% and 0.04% respectively, with a two standard deviation increase in gold prices. Though the magnitude of these effects is considerably small, the findings nonetheless indicate that economic booms in male-dominated sectors like gold mining, do not necessarily worsen a woman's decision-making power at home and could instead lead to an increase in their intra-household bargaining power over certain goods.

Table 1
The effect of the gold mining boom on female decision-making power (*MxFLS* data).

	(1)	(2)	(3)	Mean (std. dev.)
Mean DMP (all goods)	0.001	0.003	0.006***	0.541
	(0.002)	(0.002)	(0.002)	
Observations (*N*)	10,462	10,330	9,123	
DMP (individual goods):				
Food expenditures	0.014**	0.014**	0.018***	0.829
	(0.006)	(0.006)	(0.006)	
Observations (*N*)	7,075	6,987	6,187	
Money to own parents	0.000	0.003	0.016*	0.538
	(0.007)	(0.008)	(0.009)	
Observations (*N*)	7,125	7,025	6,144	
Contraceptive use	-0.000	0.005	0.011**	0.461
	(0.006)	(0.005)	(0.005)	
Observations (*N*)	7,114	7,035	6,177	
Baseline controls	No	Yes	Yes	
Heterogeneous trends	No	No	Yes	
Individual FE	Yes	Yes	Yes	
Month FE	Yes	Yes	Yes	

Notes: Standard errors are clustered at the municipality level and reported in parentheses (.). Baseline controls include a woman's age, age squared, indigenous status, education level, number of children, the presence of her spouse during the interview, and municipality covariates like the homicide rate per 100,000 inhabitants and the introduction of domestic violence and divorce laws. Column (1) does not include any controls, and columns (2), (3) sequentially add baseline controls and time trends interacted with municipal characteristics such as rural-urban status, transport network quality, community quality and the presence of *ejidos* (heterogeneous market trends) respectively. *** $p < 0.01$ ** $p < 0.05$ * $p < 0.1$.

In order to check that these results are not spurious, I draw from a separate pooled cross-sectional data set, *ENDIREH*. As discussed in section III.a3, the *ENDIREH*, which was conducted in 2003, 2006 and 2011 also contains information on women's decision-making power, though geographic data is only available on the state-level. Subsequently, I utilize this data set as a robustness check to examine if the gold mining boom indeed generated an increase in intra-household female bargaining power as reflected in the *MxFLS*.[21] Since individuals in the *ENDIREH*

[21] The *ENDIREH* contains a total of thirteen decision-making questions in the 2003 and 2011 surveys, though the 2006 survey only contains eleven questions. For consistency, I exclude the two

however, were only interviewed over a period of one month between mid-October and mid-November for all three survey rounds, exploiting gold prices as a source of temporal variation is not feasible. Consequently, I define the post-treatment group as individuals interviewed in the 2006 and 2011 survey during which gold prices and production increased sharply, and those interviewed in 2003 as the pre-treatment group. Given that the *ENDIREH* surveyed individuals about their experiences with IPV and intra-household bargaining power 12 months (1 year) prior to the date of interview in the *ENDIREH*, responses in 2003 represent 2002 outcomes before gold prices started to rise in 2003. Table B4 of the appendix reports some descriptive statistics of the mean value of all covariates for both treatment and control groups in the *ENDIREH*. The summary statistics show that women in the control group are more likely to be rural and indigenous, have more children and have higher levels of education compared to the treated group. Given that the Mexican drug war only began in 2007, the large differences in the homicide rate between the treated and control group is expected as the control group was exposed to much less violence prior to 2007. The phase-in implementation of three domestic violence and divorce laws across states and time also explains the difference in mean values between the treated and control groups. For most of the covariates, the difference in means between both groups are statistically significant, indicating the importance of controlling for these covariates in the baseline regressions. Accordingly, I estimate the following difference-in-differences model:

$$Y_{i,s,t} = B_0 + B_1(Gendowment_s * Post_t) + B_2 X'_{i,t} + B_3 Z'_{s,t} + \emptyset_t + \pi_s + \varepsilon_{i,s,t} \qquad (2)$$

Where $Y_{i,s,t}$ is woman i's average decision-making power index in state s during survey year t, $Gendowment_s$ is the log of the land area claimed by gold mining concessions between 1973 and 1983 in state s, $Post_t$ is a binary variable equal to 1 for the survey years 2006 and 2011 during the peak of the gold price increase, and 0 otherwise. $X'_{i,t}$ and $Z'_{s,t}$ are vectors of individual- and state-level covariates such as a woman's rural and indigenous status, age, age squared, length of relationship with her partner, number of children, education level, the homicide rate per 100,000 inhabitants, the timing of domestic violence and divorce law reforms across Mexican states and time trends interacted with state characteristics such as proximity to coast, protected areas, presence of *ejidos*, population density and physio geographic classification to account for heterogeneous market trends associated with prior state conditions. $\emptyset_t$ and π_s is the survey year of interview and state fixed effects respectively, and $\varepsilon_{i,s,t}$ is the error term. The results from estimating equation (2) are shown in Table 2.

questions that were missing from the 2006 survey, and subsequently select questions that are similar to the ones asked in the *MxFLS*. This results in a remainder of six suitable decision-making questions that are then used to construct the average decision-making power index. For example, questions like '*who makes decisions about your participation in social or political activities?*' are excluded as they are not asked in the *MxFLS* data set.

Table 2
The effect of the mining boom on female decision-making outcomes (*ENDIREH* data).

	(1)	(2)	(3)	Mean (std. dev.)
DMP index (overall)	0.001	0.001	0.003**	0.640
	(0.001)	(0.001)	(0.001)	
Observations (*N*)	191,768	186,506	186,506	
DMP index (HH expenditures)	0.004	0.003	0.011***	0.832
	(0.002)	(0.002)	(0.002)	
Observations (*N*)	190,246	185,107	185,107	
DMP index (who uses the contraception)	-0.004*	-0.005*	-0.006***	0.622
	(0.002)	(0.002)	(0.002)	
Observations (*N*)	115,055	112,242	112,242	
DMP index (contraceptive use)	-0.001	-0.000	-0.001	0.594
	(0.002)	(0.002)	(0.002)	
Observations (*N*)	116,173	113,328	113,328	
Baseline controls	No	Yes	Yes	
Heterogeneous trends	No	No	Yes	
State FE	Yes	Yes	Yes	
Survey Year FE	Yes	Yes	Yes	

Notes: Standard errors are clustered at the state level and reported in parentheses (.). Baseline controls include a woman's rural and indigenous status, age, age squared, length of relationship with her partner, number of children, education level, and state-level controls like the homicide rate per 100,000 inhabitants and the introduction of domestic violence and divorce laws. Column (1) does not include any controls, and columns (2), (3) sequentially add baseline controls and time trends interacted with state characteristics like proximity to coast, protected areas, presence of *ejidos*, population density and physio geographic classification (heterogeneous market trends) respectively. *** $p < 0.01$ ** $p < 0.05$ * $p < 0.1$.

As can be seen, the same qualitative conclusion from the *MxFLS* data set can be drawn, where the estimated coefficient of a woman's overall decision-making power index is positive and statistically significant. In particular, women living in gold endowed states experienced increases in their aggregate decision-making power by 0.0005 (0.003/0.640) of a standard deviation relative to the mean. Similar to the *MxFLS*, this result appears to be driven particularly by household expenditures where women's decision-making power over this category of goods increased by about 0.013 (0.011/0.832) of a standard deviation. The findings in Table 2 also indicate that women in gold endowed states experienced lower bargaining power over the decision of which partner should use contraception, with estimated coefficients showing a decline in her decision-making authority over this matter by 0.001 (0.006/0.622) when compared to the mean. Estimates for a woman's bargaining power over contraceptive use however, which is analogous to the question asked in the *MxFLS* and not who uses contraception, is statistically insignificant and zero-bound. The effect of the gold mining boom on the remaining decision-making categories which do not show a statistically significant relationship are presented in Table B5 of the appendix. Taken together, albeit the estimated coefficients from the analysis using both the *MxFLS* and *ENDIREH* are quantitatively small, they support the basic conclusion that the gold mining boom improved intra-household female decision-making power.

IV.2 *Possible Channels*

It is important to examine the effect of the gold mining boom on labour market outcomes and other determinants of welfare, to better understand the underlying mechanisms behind the increases in female decision-making power. Accordingly, Table 3 presents results from an analysis of the effect of the gold mining boom on male and female employment probabilities in the *MxFLS*. It also shows the impact of the gold mining boom on individuals' perceptions of safety given the reported association between drug-related violence and gold mines in Mexico (GIATOC, 2016).

Table 3
The effect of mining on labor market outcomes and perceptions of safety (*MxFLS* data).

	(1)	(2)	(3)	Mean
Men:				
Employed	0.018***	0.019***	0.012*	0.803
	(0.007)	(0.007)	(0.006)	
Observations (*N*)	8,420	7,906	6,968	
Fear of assault	0.028*	0.026	0.029*	0.296
	(0.016)	(0.017)	(0.016)	
Observations (*N*)	8,747	7,924	7,042	
Women:				
Employed	0.003	0.001	0.001	0.190
	(0.005)	(0.004)	(0.004)	
Observations (*N*)	10,471	10,338	9,131	
Fear of assault	0.017	0.019	0.014	0.370
	(0.014)	(0.013)	(0.012)	
Observations (*N*)	10,471	10,338	9,131	
Baseline controls	No	Yes	Yes	
Heterogeneous trends	No	No	Yes	
Individual FE	Yes	Yes	Yes	
Month FE	Yes	Yes	Yes	

Notes: Standard errors are clustered at the municipality level and reported in parentheses (.). Baseline controls include a woman's age, age squared, indigenous status, education level, number of children, the presence of her spouse during the interview, and municipality covariates like the homicide rate per 100,000 inhabitants and the introduction of domestic violence and divorce laws. Column (1) does not include any controls, and columns (2), (3) sequentially add baseline controls and time trends interacted with municipal characteristics such as rural-urban status, transport network quality, community quality and the presence of *ejidos* (heterogeneous market trends) respectively. *** $p < 0.01$ ** $p < 0.05$ * $p < 0.1$.

Across all three specifications, the estimates reveal that men living in gold endowed municipalities experienced an increase in employment prospects during the mining boom. Female employment on the other hand, appears to have been unaffected. In particular, male employment probability estimates are statistically significant at the 10% level and positive in the baseline specification in (3), where the estimated coefficient shows an increase in male employment of 1.2 percentage points (or 1.5% when compared to the sample mean). Coefficients for female employment probabilities however, are insignificant and close to zero, indicating that while the gold mining boom had a positive impact on male employment, it did not have any effect on female labour force participation.

Altogether, these results suggest that the observed increase in female decision-making power was likely to be driven by increases in male employment

during the gold mining boom. Unitary household bargaining models lend support to this finding as women's intra-household decision-making power increased despite no observable changes in their employment probabilities. This indicates income pooling which is a central prediction of unitary models of the household, where the consumption of goods by the husband or wife depends solely on the total household income rather than on the sources of income (Samuelson, 1956). The same household income effect has also been documented in other developing countries like India (see Neff et al., 2012; Klasen and Pieters, 2015), where the elasticity of female labour supply increased in response to higher household wealth. Subsequently, since male employment in gold endowed municipalities increased, suggesting a rise in aggregate household income, women simply could have had more household wealth to allocate expenditures to household goods like food. In addition, the 2002 *MxFLS* pre-treatment survey wave shows that women had higher decision-making power over household goods and services compared to men (0.404 for women versus 0.176 for men), lending support to the idea that since women have conventionally had more control over household matters, the increase in women's bargaining power over this particular set of goods and services could have simply been driven by an improvement in their husbands' employment opportunities.

Table 3 also reveals some evidence of a decrease in men's perception of safety in gold endowed municipalities during the boom, though there were no changes in women's safety perceptions. The estimated coefficients for men's fear of assault are significant and positive at the 10% level, and show that the gold mining boom increased men's fear of getting assaulted by 2.9 percentage points (or 10% when compared to the sample mean). This result is plausible, and could possibly be explained by the increase in drug-related violence in gold endowed municipalities as some Mexican drug cartels reportedly switched into gold production, and since mining is still predominantly a male economic sector (GIATOC, 2016). Men in gold endowed municipalities are therefore likely to be exposed to more dangerous surroundings as a result. Subsequently as expected, the baseline regressions show a strong and significant positive correlation between men's fear of assault and the municipal homicide rate. A first-stage regression analysis of the relationship between the homicide rate and the interaction term of gold prices and endowment, also reveal statistically significant *t*-statistics (2.86), indicating a positive relationship between the gold mining boom and violence.[22] Lastly, these findings also provide evidence of the male-breadwinner stereotype, where despite men being more afraid of getting assaulted or attacked during the gold mining boom, male employment probabilities still increased, with no observable changes in the female labour supply.

[22] Output is not listed, but available upon request.

IV.3 *Additional Outcome: Intimate Partner Violence (IPV)*

Since the state-level *ENDIREH* data set also contains information on women's experiences of intimate partner violence (IPV), I examine the effect of the gold mining boom on several types of gender-based violence as an additional outcome in the study. Following Bobonis et al.'s (2013) approach, IPV incidences are grouped into the four main categories: physical, sexual and emotional abuse, and the threat of violence, with a total of eight questions classified under physical violence, three questions under sexual violence, thirteen questions under emotional violence, and two questions under the threat of violence.[23] For physical and sexual violence, I create dichotomous variables equal to one if a woman experienced a single incident in the past year. Considering that emotional violence is more likely to be subject to personal interpretation, I construct an emotional violence indicator equal to one if a woman answered "yes" to one incident, but stated that it happened multiple times, or if she answered "yes" to at least two emotional abuse questions. Lastly, the threat of violence indicator is equal to unity if a woman answered "yes" to at least one threat of violence question.

Accordingly, I estimate the same equation in (2), but replace the dependent variable with dichotomous indicators of the four different types of IPV. The results from the analysis are displayed in Table 4, and show that while women in gold endowed states had increased decision-making power at home, they were also more likely suffer from all four forms of IPV. Specifically, the benchmark specification in column (3) shows that women living in gold endowed states experienced approximately 0.9, 0.1, 0.3 and 0.4 percentage points more emotional abuse, threats of violence, physical abuse and sexual abuse respectively.[24] Compared to the mean values during the pre-treatment period before the gold mining boom, these figures represent an average increase in all four types of IPV by approximately 3.0% (emotional abuse), 3.4% (threats of violence), 3.8% (physical abuse) and 5.5% (sexual abuse). In a cross-country study on male-female job opportunities and IPV, Bhalotra et al. (2020) documented similar effect sizes of female unemployment on the incidence of physical violence. In their paper, a 1% increase in female unemployment was associated with a 2.75% and 2.87% increase in physical abuse respectively.

The positive relationship between the gold mining boom and women's risk of domestic violence could potentially be a result of male psychological stresses related to increased levels of fear. As shown in Table 3, the gold mining boom had a negative impact on men's perception of safety, which was likely due to increased

[23] For a detailed breakdown of the specific IPV questions and categorization, see Bobonis et al.'s (2013) online appendix: https://www.aeaweb.org/articles?id=10.1257/pol.5.1.179. In 2003, only twenty-nine questions on IPV were asked compared to the 2006 and 2011 survey rounds which had thirty IPV questions. I therefore only include the twenty-nine IPV questions from 2003 across all survey years to ensure consistency in the IPV measures.

[24] According to Cameron et al. (2008), standard errors of the main IPV estimates are likely to be underestimated due to the small number of clusters (30 states), which is below the recommended benchmark of 40. As a robustness check, I therefore present wild-cluster bootstrapped standard errors in Table B6 of the appendix, which show that standard errors increase slightly as expected, and estimates remain statistically significant.

drug-related crime in mining areas. These findings can therefore be juxtaposed against several studies by Angelucci (2008) and Heise and Kotsadam (2015) for instance, that underscore psychological stress and trauma as drivers of domestic abuse. The rise in female intra-household decision-making power along with a concurrent increase in domestic violence is a striking finding, which could also possibly be explained by theories on male-backlash. The male-backlash effect, first proposed by Macmillan and Gartner (1999) suggests that when a wife experiences an increase in her tangible or intangible independence, men may be stimulated to perpetrate more violence as a means of "reinstating dominance and authority over his wife." Therefore, in order to emotionally compensate for the increase in women's decision-making power at home despite better employment prospects, men may retaliate through various forms of IPV.

Table 4
The effect of the gold mining boom on intimate partner violence (IPV) (*ENDIREH* data).

	(1)	(2)	(3)	Mean
Emotional Abuse	0.002	0.002	0.009***	0.297
	(0.002)	(0.002)	(0.002)	
Observations (*N*)	168,787	163,902	163,902	
Threat of Violence	0.001**	0.002**	0.001**	0.029
	(0.001)	(0.001)	(0.001)	
Observations (*N*)	191,940	186,666	186,666	
Physical Abuse	0.002**	0.002**	0.003**	0.080
	(0.001)	(0.001)	(0.001)	
Observations (*N*)	192,011	186,730	186,730	
Sexual Abuse	0.003***	0.004***	0.004***	0.073
	(0.001)	(0.001)	(0.001)	
Observations (*N*)	191,665	186,413	186,413	
Baseline controls	No	Yes	Yes	
Heterogeneous trends	No	No	Yes	
State FE	Yes	Yes	Yes	
Year FE	Yes	Yes	Yes	

Notes: Standard errors are clustered at the state level and reported in parentheses (.). Baseline controls include a woman's rural and indigenous status, age, age squared, length of relationship with her partner, number of children, education level, and state-level controls like the homicide rate per 100,000 inhabitants and the introduction of domestic violence and divorce laws. Column (1) does not include any controls, and columns (2), (3) sequentially add baseline controls and time trends interacted with state characteristics like proximity to coast, protected areas, presence of *ejidos*, population density and physio geographic classification (heterogeneous market trends) respectively. *** $p < 0.01$ ** $p < 0.05$ * $p < 0.1$.

Notwithstanding, given that women's IPV outcomes are from a more spatially aggregated analysis (state-level) compared to decision-making outcomes conducted at the municipality level, one should remain cautious about attributing the rise in women's IPV risk solely to these mechanisms related to the gold mining boom. Because more spatially disaggregated data on IPV in Mexico is not available, it is not feasible to check if the mechanisms that happen at a more localized level, like at the municipality level in the *MxFLS* for example, are comparable to those that occur at a more aggregated level. Lastly, in order to provide a more detailed breakdown of the effect of the gold mining boom on IPV, I create a dummy for each individual question on physical abuse, sexual abuse, emotional abuse and the threat of violence, and

conduct an analysis analogous to equation (2). Results from the analysis are presented in Tables B7, B8, B9 and B10 of the appendix.

Next, I examine the impact of the gold mining boom on women's IPV outcomes across various socio-economic groups. Farmer and Tiefenthaler (1997), Aizer (2010) and Anderberg et al. (2016) found that higher female labour force participation and wages is associated with less domestic abuse. Wider educational gaps between women and their spouses have also been documented to increase IPV risk (Hidrobo and Fernald, 2013; Heath, 2014). Additionally, because rural areas may have weaker policing, or have greater proportions of indigenous populations where the *machismo* culture is likely to be stronger, women residing in secluded places may also be subject to more IPV. To test for the presence of such heterogeneous effects, I divide women from the *ENDIREH* into three sub-samples according to their employment status, education level and rural residential status.[25] Accordingly, I examine the effect of the gold mining boom on each of the three sub-samples of women by repeating the estimation in equation (2), with the results presented in Table 5.

Table 5

The effect of mining on the incidence of intimate partner violence (IPV) among women from low socio-economic classes (*ENDIREH* data).

	Unemployed	Rural	Low educated
Emotional Abuse	0.008*	0.010***	0.008*
	(0.006)	(0.003)	(0.004)
Mean	0.341	0.265	0.296
Observations (*N*)	24,888	33,527	105,714
Threat of Violence	0.004**	-0.002	0.002
	(0.002)	(0.001)	(0.001)
Mean	0.040	0.030	0.034
Observations (*N*)	27,758	37,430	120,203
Physical Abuse	0.009***	0.007**	0.004**
	(0.003)	(0.003)	(0.002)
Mean	0.109	0.083	0.084
Observations (*N*)	27,777	37,435	120,234
Sexual Abuse	0.008***	0.002	0.007***
	(0.002)	(0.002)	(0.002)
Mean dep. var	0.096	0.081	0.087
Observations (*N*)	27,660	37,372	120,027
Baseline controls	Yes	Yes	Yes
Heterogeneous trends	Yes	Yes	Yes
State FE	Yes	Yes	Yes
Survey year FE	Yes	Yes	Yes

Notes: Standard errors are clustered at the state level and reported in parentheses (.). Baseline controls include a woman's rural and indigenous status, age, age squared, length of relationship with her partner, number of children, education level, and state-level controls like the homicide rate per 100,000 inhabitants and the introduction of domestic violence and divorce laws. Heterogeneous trends include time trends interacted with state characteristics like proximity to coast, protected areas, presence of *ejidos*, population density and physio geographic classification. *** $p < 0.01$ ** $p < 0.05$ * $p < 0.1$.

[25] Women are considered employed if they had worked at least one hour in the past week. According to the INEGI's definition, women living in localities with less than 2,500 inhabitants are classified as rural. Lastly, educated women are defined as those who have completed at least junior high school ('secundaria'), which is Mexico's basic compulsory education requirement.

The findings show that the indicator for physical violence is positive and significant for all three sub-samples of women, where the probability of physical abuse is approximately 0.9, 0.7 and 0.4 percentage points (8.3%, 8.4% and 4.8% in comparison to the mean) higher for unemployed, rural women, and low educated women respectively. In addition, the results reveal that women from lower socio-economic classes were also more likely to experience emotional abuse with estimated coefficients significant and positive across the three difference groups of women (0.8, 1 and 0.8 percentage points for unemployed, rural and low educated women respectively). Overall, less educated and unemployed women appear to suffer more from sexual abuse, facing an increase in the probability of this type of abuse by about 0.7 and 0.8 percentage points. Since a woman's employment however, is likely to be endogenous to the explanatory mining boom variable, the estimates for unemployed (and employed) women should be interpreted with caution.

In a subsequent analysis, I estimate the impact of the mining boom on women from upper socio-economic classes: those who are employed, live in urban areas and are relatively more educated. The results in Table 6 demonstrate that compared to poorer women, the positive gold mining shock did not have any impact on the probability of physical abuse for women from upper socio-economic classes. In particular, the coefficients for the physical abuse indicator across all three sub-sampled of women are statistically insignificant and close to zero. Women who are more well-off however, appear to suffer more from emotional abuse and threats of violence than poorer women. The results show that employed, urban and high educated women experienced a 0.8, 0.7 and 1.2 percentage point (2.9%, 2.3% and 4% respectively when compared to the mean) increase in their likelihood of emotional abuse, and urban and high educated women were subject to 0.2 and 0.3 percentage points (6.9% and 12.5% respectively) more threats of violence from their partners respectively. The findings also indicate that urban women are more likely to suffer from sexual abuse than employed and high educated women, with a 0.4 percentage point (5.6%) increase in their probability of experiencing this type of IPV.

To explain why poorer women may be more susceptible to harder forms of IPV like physical abuse, I draw from a pioneering study by Gelles (1976) which showed that women who had fewer financial resources were less likely to leave an abusive relationship. Given that poorer women may be more hesitant to report domestic violence or file for divorce due to their lower income earning potential, and hence greater reliance on their husbands' incomes, men with partners from lower socio-economic classes may be less wary about exhibiting harder types of IPV like physical or sexual abuse. On the other hand, women from upper socio-economic classes may be more likely to report domestic violence or file for divorce in cases of wife abuse, given their greater economic independence and earning potential. Partners of women from higher socio-economic classes may thus commit softer forms of IPV that are less tangible in nature and harder to prosecute.

Table 6

The effect of mining on the incidence of intimate partner violence (IPV) among women from upper socio-economic classes (*ENDIREH* data).

	Employed	Urban	High educated
Emotional Abuse	0.008***	0.007***	0.012***
	(0.002)	(0.002)	(0.004)
Mean dep. var	0.275	0.306	0.298
Observations (*N*)	123,484	130,375	58,607
Threat of Violence	-0.000	0.002***	0.003**
	(0.001)	(0.001)	(0.001)
Mean dep. var	0.024	0.029	0.024
Observations (*N*)	141,539	149,236	66,918
Physical Abuse	-0.001	0.001	0.001
	(0.002)	(0.001)	(0.001)
Mean dep. var	0.065	0.078	0.074
Observations (*N*)	141,581	149,295	66,951
Sexual Abuse	0.002	0.004***	0.002
	(0.002)	(0.001)	(0.002)
Mean dep. var	0.061	0.071	0.057
Observations (*N*)	141,386	149,041	66,837
Baseline controls	Yes	Yes	Yes
Heterogeneous trends	Yes	Yes	Yes
State FE	Yes	Yes	Yes
Survey Year FE	Yes	Yes	Yes

Notes: Standard errors are clustered at the state level and reported in parentheses (.). Baseline controls include a woman's rural and indigenous status, age, age squared, length of relationship with her partner, number of children, education level, and state-level controls like the homicide rate per 100,000 inhabitants and the introduction of domestic violence and divorce laws. Heterogeneous trends include time trends interacted with state characteristics like proximity to coast, protected areas, presence of *ejidos*, population density and physio geographic classification. *** $p < 0.01$ ** $p < 0.05$ * $p < 0.1$.

IV.4a *Robustness: Sensitivity Analyses and Alternative Measures of DMP*

To further probe the robustness of the main results, I use an alternative empirical model to examine the effect of the gold mining boom on female decision-making power. Specifically, I estimate a multinomial logit fixed effects model where the decision-making power indicator is a categorical dependent variable ranging from 1 to 3, with the same covariates and fixed effects as in equation (1). For instance, if a woman responds that she was the sole decision-maker of that particular good category, it is assigned a value of 3 (woman has full power in decision-making). If the decision was jointly made with her husband, the category is assigned a value of 2, and if the decision was made solely by her husband, the category is assigned a value of 1 (indicating that the woman had no bargaining power over that good at all). Accordingly, the results from the analysis are presented in Table B11 of the appendix, which show qualitatively similar results as Table 1. Using value 3 (woman has full decision-making power) as the base comparison category, the findings indicate that with a unit increase in the decision-making power over the money given to a woman's spouse's parents ceteris paribus, the logarithm of the probability that the husband makes the full decision (decision is jointly made) in this category relative to the wife making the full decision in this category decreases by 0.246 (0.248). Equivalently, decision-making over food expenditures is only statistically significant for the joint decision-making category

and shows that the odds of the decision being made jointly in this category versus the decision being made fully by the wife decreases by 0.088. Coefficient estimates are not significant for other categories of goods and services. In essence, the results point to the same baseline conclusion that women living in gold endowed municipalities were more likely to partake in intra-household decision-making processes compared to those that did not.

As an additional robustness check, I conduct a series of sensitivity analyses on the main female decision-making power estimates presented in Table 1. First, I omit municipalities in three Northern states: Oaxaca, Chihuahua and Durango where gold mining activity is the most prominent (see Figure B) to ensure that the main results are not driven by mining intensive states in this region of Mexico's geographical landscape. Altogether, the results presented in Table 7 show that the baseline estimate in column (3) of Table 1 increases by 0.002 to 0.007 compared to the main estimate of 0.005, with coefficients remaining significant at the 5% level. Next, I exclude municipalities with high levels of violence, specifically those in the 75^{th} percentile according to the homicide rate. I do so to check if more violent municipalities downward biased the main female decision-making power estimates given the positive correlation between gold mining and drug-related violence, and subsequently, the documented negative effect of violence on women's intra-household bargaining power (see Tsaneva et al., 2018). The results from this analysis provide some indication that the main coefficient of a woman's decision-making power in Table 1 is underestimated, as excluding violent municipalities increases the estimated coefficient by 0.001 when compared to the baseline estimate of 0.005. This therefore suggests that in the absence of the confounding drug war, women residing in gold endowed municipalities would have had higher intra-household decision-making power than reported in Table 1.

In a following robustness check, I include the interaction term of homicide rates, gold endowment and world gold prices. Albeit the movement of drug cartels into gold mining reportedly only intensified from 2012 onwards according to GIATOC (2016), one cannot rule out that the spike in gold mining opportunities during the sample period prior to 2012, was also accompanied by an increase in drug-related crime. Since excluding violent municipalities increases the main decision-making power estimate, and given the evidence presented in Table 3 reflecting decreased perceptions of safety among men in the *MxFLS*, it is important to account for the possible conflicting impact that drug-related violence could have had on female intra-household bargaining outcomes during the gold mining boom. Subsequently, Table 7 shows that the inclusion of the interaction term of drug-related crime proxied by homicide rates with gold endowment and price, decreases the statistical significance of the main estimate to the 10% level. The estimated coefficient of a woman's overall mean decision-making power index also decreases, though minimally by 0.001 compared to the main coefficient of 0.005. Taken together, this indicates that the relationship between drug-related crime and the gold mining boom in Mexico was not likely to have affected female decision-making power outcomes significantly, at least during the sample period of the study. In

addition, a number of papers namely by Brown et al. (2017), Ajzenman et al. (2015) and Velásquez (2010) have reaffirmed that differences in the economic impact of the global financial crisis were uncorrelated with differences in homicide growth rates across municipalities in Mexico.

Table 7
Sensitivity analysis of effect of the gold mining boom on female decision-making power (overall) (*MxFLS* data).

Dependent Variable: Woman's decision-making power (overall)				
	(1)	(2)	(3)	Mean
Exclude northern	0.001	0.004	0.007**	0.539
municipalities	(0.004)	(0.004)	(0.003)	
Observations (*N*)	9,225	9,107	8,020	
Exclude violent municipalities	0.003*	0.004***	0.006**	0.540
	(0.002)	(0.001)	(0.002)	
Observations (*N*)	7,580	7,501	6,763	
HR*Gendowment*Price	0.000	0.001	0.004*	0.541
	(0.001)	(0.001)	(0.003)	
Observations (*N*)	10,462	10,330	9,123	
World export value of gold	0.013*	0.012*	0.016*	0.548
	(0.007)	(0.007)	(0.008)	
Observations (*N*)	7,786	5,078	4,664	
Baseline controls	No	Yes	Yes	
Heterogeneous trends	No	No	Yes	
Individual FE	Yes	Yes	Yes	
Month FE	Yes	Yes	Yes	

Notes: Standard errors are clustered at the municipality level and reported in parentheses (.). Baseline controls include a woman's age, age squared, indigenous status, education level, number of children, the presence of her spouse during the interview, and municipality covariates like the homicide rate per 100,000 inhabitants and the introduction of domestic violence and divorce laws. Column (1) does not include any controls, and columns (2), (3) sequentially add baseline controls and time trends interacted with municipal characteristics such as rural-urban status, transport network quality, community quality and the presence of *ejidos* (heterogeneous market trends) respectively. *** $p < 0.01$ ** $p < 0.05$ * $p < 0.1$.

As a final robustness test, I replace global gold prices with the world value of gold exports less Mexico, with data provided by the *International Trade Centre (ITC)*. Because the value of women's assets increases along with the rising global gold prices if they possess gold jewellery for instance, this would improve their outside option, which could subsequently increase their intra-household decision-making power as predicted by non-unitary household bargaining models. The *ITC* however, only supplies trade data containing information on each country's export value of gold from 2004 to present. As such, it is not feasible to use all three waves of the *MxFLS* for this analysis as no available data exists for the first wave conducted in 2002. Accordingly, I utilize two waves of the *MxFLS* conducted in 2005-2006 and 2009-2010, and match individuals' month and year of interview to the world value of gold exports. Results from estimating an analogous regression to equation (1), replacing world gold prices with the world value of gold exports less Mexico is shown in Table 7. The estimates support the basic conclusion that women residing in gold endowed municipalities experienced increases in their decision-making power. Coefficients are nonetheless evidently larger, reflecting an increase of 0.011, up from

the main estimate of 0.005, which could possibly be explained by the different sample and time frame analysed.

IV.4b *Robustness: Parallel Trends*

The difference-in-differences estimation method hinges on the assumption that in the absence of the gold mining boom, the decision-making outcomes for women in the treatment group (those living in gold endowed municipalities), and women in the control group (women who do not live in gold mining municipalities) follow parallel trends. Accordingly, I plot the average decision-making power index of women in both groups across all three *MxFLS* survey waves in Figure C. The graph provides some support for the common trends assumption required for a difference-in-differences analysis as it indicates that trends in women's average decision-making power index for both the treatment and control group were on similar paths during the pre-gold mining boom period (wave 1 to 2). Moreover, Figure C shows a divergence in women's decision-making power trends between the treatment and control group during the gold mining boom (wave 2 to 3), with women in the treated (control) group experiencing higher (lower) average decision-making power during this time period. This observation is consistent with the main estimates presented in Table 1, showing that women who resided in gold endowed municipalities experienced higher decision-making power at home.

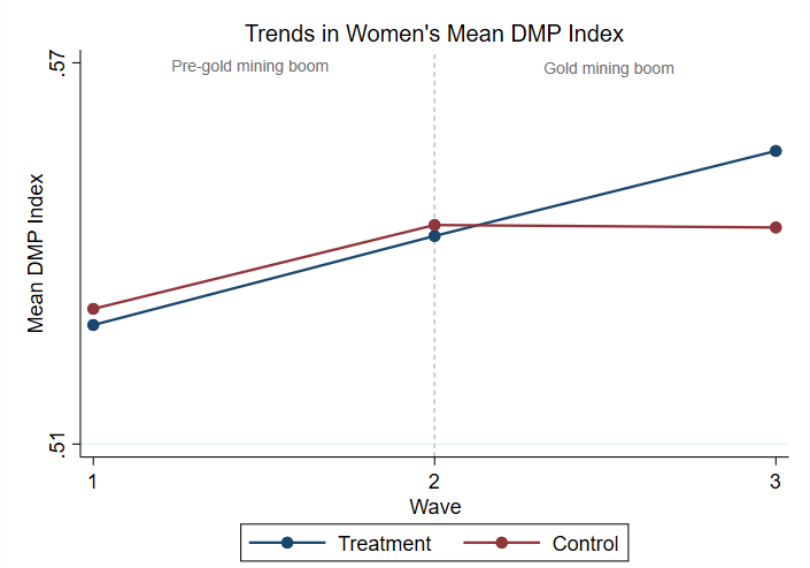

Figure C. Trends in women's mean decision-making power (DMP) index in the *MxFLS* across three survey waves (2002, 2005-2006, 2009-2010). *Notes*: This figure plots pre- (before the gold mining boom) and post- (during the gold mining boom) trends of women's average decision-making power indices across all three *MxFLS* waves. The blue (red) line denotes the treatment (control) group.

V. Discussion and Concluding Remarks

How accurate are theories that postulate a decrease in female decision-making power during booms in male-dominated sectors like gold mining? One existing study by Tolonen (2018) which focuses on Sub-Saharan Africa, has yet to discover any effects of gold mining on women's intra-household decision-making

outcomes. Using Mexico's gold mining boom which was stimulated by the 2007-2008 global financial crisis as an exogenous event, I show that women residing in gold endowed municipalities experienced small but statistically significant increases in their average decision-making power over a set of goods and services, against the theoretical predictions by non-unitary household bargaining models. The results are robust to the inclusion of heterogeneous market trends, an alternative decision-making power index, various sensitivity analyses, and are consistent with findings from a separate state-level survey (*ENDIREH*) containing similar questionnaires on spousal decision-making.

The rise in female decision-making authority is likely to have been driven by the increase in male employment during the gold mining boom, but not female employment as no changes in female employment probabilities were observed. These findings are consistent with unitary household bargaining models, which predict that regardless of how much each individual contributes to household income, the outcomes of household decisions only depend on the aggregate household wealth. The results also provide support for the income pooling assumption of the unitary household bargaining framework, as women still experienced increases in their decision-making power, particularly over household goods like food expenditures for instance, despite not working more. This indicates that financial gains from the increase in male employment was likely to have been allocated to household expenditures, which women have traditionally been more responsible for. This finding carries important implications for poverty alleviation initiatives like cash-transfer programs for instance, as it implies that the outcomes are independent of the recipient of the transfer.

Using an alternative state-level data set (*ENDIREH*) containing information on women's IPV experiences, I additionally find that although women living in gold endowed states experienced higher intra-household bargaining power, they were also more likely to suffer from four different types (physical, sexual, and emotional abuse, and threats of violence) of IPV. Particularly, poorer women were more susceptible to hard forms of IPV like physical abuse, and more well-off women suffered from softer forms of IPV like threats of violence and emotional abuse. These findings could possibly be attributed to various factors such as men's heightened fear of assault and psychological stress possibly due to drug-related crime in gold mining areas, differences in poor and rich women's responses and acceptance towards domestic violence and the male-backlash effect. A limitation of the data on IPV however, is that location information which is only available at the state-level is not as disaggregated as that of the *MxFLS* panel which contains municipality data. Therefore, since the regression for IPV outcomes is not as tightly controlled as those for decision-making power using the *MxFLS*, caution is required when attributing any effects on IPV solely to the gold mining boom. Nonetheless, since the *ENDIREH* is the only Mexican survey that has extensively surveyed women across the country about their IPV experiences, the results arguably still shed some light, more broadly, on the effects of changing economic

conditions on women's probability of IPV in the context of a Latin American country like Mexico.

From a policy perspective, this study underscores the need for more work in altering social and gender norms to accommodate increases in intra-household female decision-making power. In particular, it is important for gender mainstreaming efforts to specifically target the balancing of male psychological and emotional shifts along with increases in both tangible and intangible aspects of female empowerment. For instance, efforts should focus on providing more counselling services for men facing stressful periods, and in mitigating the male-backlash effect where men's authority may come under threat. Doing so could help to ensure that an increase in a woman's bargaining power would not be accompanied by more IPV as demonstrated in this study.

More generally, this paper highlights the importance of investing more in women shelters rather than substitute them with policies that may backfire, such as giving cash to victims of domestic violence (The Michoacan State Congress, 2019). Since economic booms in male-dominated sectors like mining women could generate more IPV, governments should focus on the provision of shelters in areas where women are more susceptible to domestic violence. Policy-makers should also encourage female employment during economic booms in male-dominated sectors. This paper shows that a gold mining boom in Mexico did not increase female employment, and that an increase in a woman's intra-household decision-making power was likely to be driven by an increase male employment probability. In order to encourage and support female labour force participation during economic booms in male-dominated industries like mining for example, governments should consider cooperating closely with mining companies that operate in local communities. Newmont Goldcorp for instance, a Canadian mining company in Mexico set up an economic development program providing local SMEs with seed money to increase revenue. Such programs reduce tensions between rural communities and mining corporations by helping to stimulate local economies and improving the livelihoods of women, who are typically the owners of local SMEs.

What is the external validity of the results presented in this study? Due to socio-cultural differences, the findings from this paper may be more generalizable to mineral-rich countries in Latin America such as Colombia, Peru, Argentina, Brazil and Ecuador, rather than Africa, where little evidence of the impact of mining on female bargaining power and IPV was found (Kotsadam et al., 2016; Tolonen, 2018). It may also be interesting for future research to examine the heterogeneous effects of different mining minerals on the various female welfare outcomes explored in this study. For example, oil extraction could have different effects on women's intra-household well-being if the underlying mechanisms are distinct from the ones presented in this paper.

Appendix A: Figures

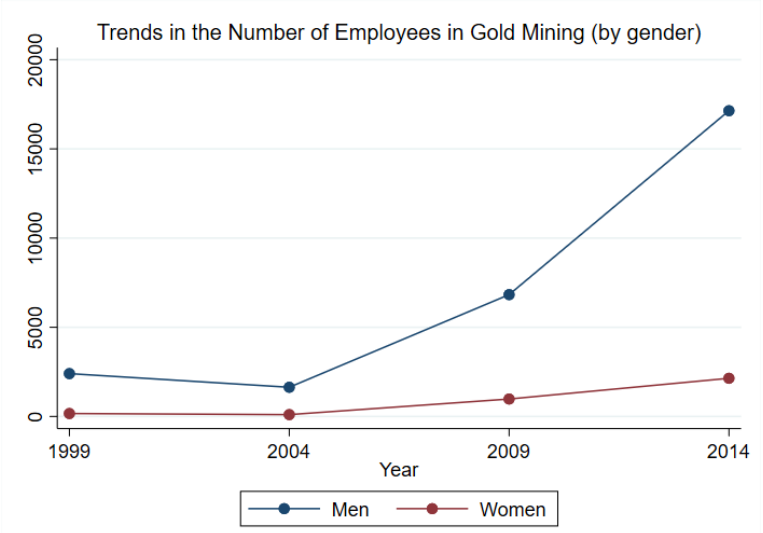

Figure A1. Trends in the number of employees in gold mining, by gender. *Notes*: This diagram shows the trends in the number of male (blue) and female (red) employees hired in gold mining between 1999 and 2014. Data is from the National Institute for Statistics and Geography (INEGI), and is only available for the years 1999, 2004, 2009 and 2014 as the economic census is only conducted once every five years.

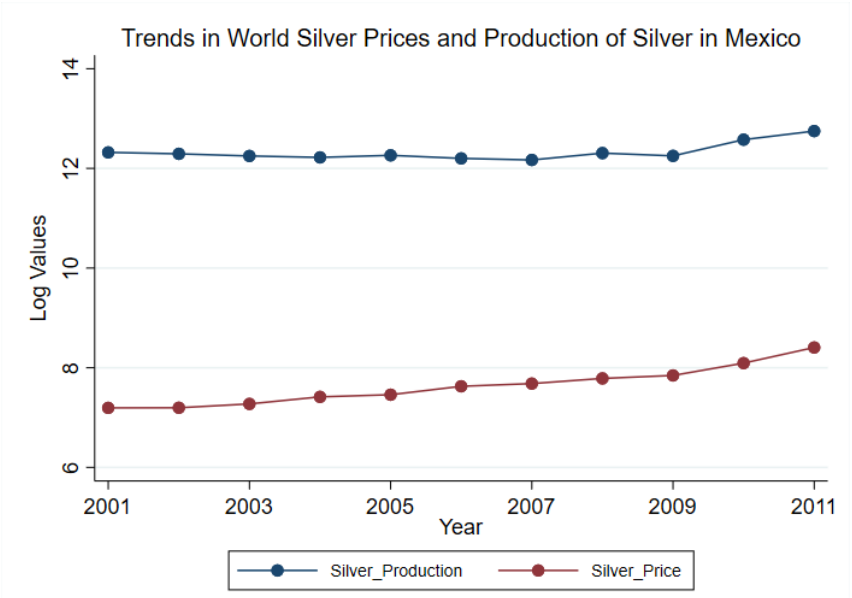

Figure A2. Trends in world silver prices and Mexican silver production. *Notes*: This diagram shows the relationship between world silver prices and the production of silver in Mexico between 2001 and 2011. Each point is the logged value of prices or production. The blue (red) line denotes production (price). Data on Mexico's silver production come from the National Institute for Statistics and Geography (INEGI), and data on world silver prices is from the London Metal Exchange's (LME) monthly historical price series.

DH01.	INTERVIEWER VERIFY: ARE YOU MARRIED/LIVE IN DOMESTIC PARTNERSHIP WITH A HOUSEHOLD MEMBER? (HM08 FIRST COLUMN)	Yes ..... 1 → CONTINUE No ..... 3 → SECTION MG

I am going to ask you how your family makes certain decisions.

(DH02 Type)	DH02. Generally speaking, in this household, who makes the decisions regarding [...]? (CIRCLE ALL THAT APPLY)																
EXPENSES AND TIME ALLOCATION	RESPONDENT	SPOUSE	SON/DAUGHTER	MOTHER	FATHER	MOTHER IN LAW	FATHER IN LAW	BROTHER	SISTER	BROTHER IN LAW	SISTER IN LAW	GRANDPARENTS	Other (specify)	W	X	Y	DOES NOT KNOW
A. The food eaten in this household	A	B	C	D	E	F	G	H	I	J	K	L	M _____				8
B. Your clothes	A	B	C	D	E	F	G	H	I	J	K	L	M _____				8
C. Your spouse's/partner's clothes	A	B	C	D	E	F	G	H	I	J	K	L	M _____				8
D. Your children's clothes	A	B	C	D	E	F	G	H	I	J	K	L	M _____	W			8
E. Your children's education	A	B	C	D	E	F	G	H	I	J	K	L	M _____	W			8
F. Your children's health services and medicines	A	B	C	D	E	F	G	H	I	J	K	L	M _____	W			8
G. Important household expenditures (refrigerator, car, furniture, etc.)	A	B	C	D	E	F	G	H	I	J	K	L	M _____				8
H. Money that is given to your parents/relatives	A	B	C	D	E	F	G	H	I	J	K	L	M _____		X		8
I. Money that is given to your parents-in-law/relatives of your spouse/partner	A	B	C	D	E	F	G	H	I	J	K	L	M _____		X		8
J. If you should work or not	A	B	C	D	E	F	G	H	I	J	K	L	M _____				8
K. If your spouse/partner should work or not	A	B	C	D	E	F	G	H	I	J	K	L	M _____				8
L. If you or your spouse/partner use birth-control (for not having children)	A	B	C	D	E	F	G	H	I	J	K	L	M _____			Y	8

Code DH02: W. Does not have sons/daughters (in or outside the household)
X. Does not have parents/parents in law/relatives, or does not give them money (in or outside the household)
Y. Does not apply

Figure A3. *MxFLS* questionnaire on decision-making. *Notes*: This diagram shows a sample of the decision-making questionnaire of the *MxFLS* survey. In total, twelve decision-making questions ('A' to 'L') are administered to both a woman and her partner. The decision-making questionnaire is the same across the two survey waves used in this study.

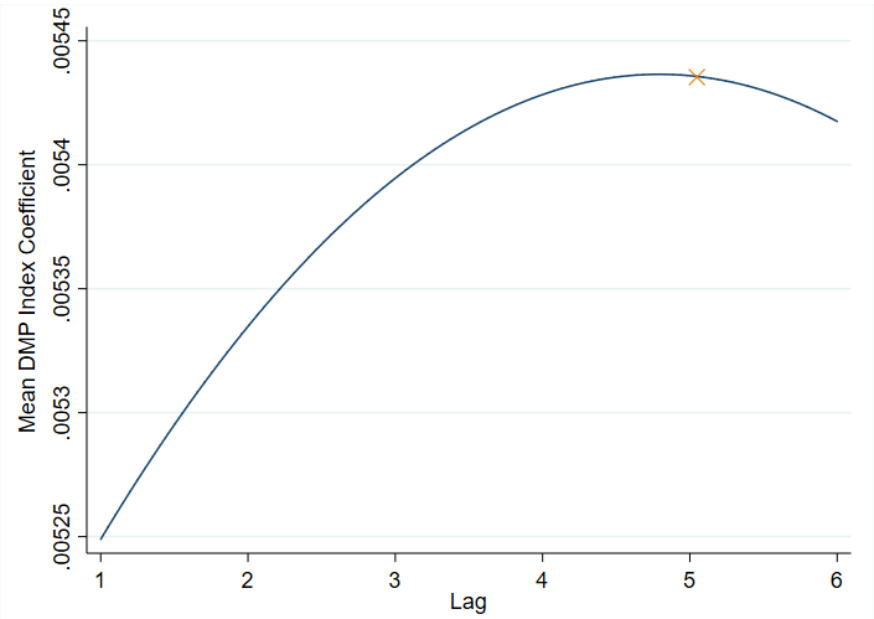

Figure A4. Coefficient plot for a woman's relative decision-making power (DMP). *Notes*: This figure plots the coefficients of the regression of a woman's decision-making power index on the lag of gold prices (t = 1, 2,..,6). The orange 'x' denotes the highest coefficient value at *t-5,* and shows a quadratic relationship between lagged price proxy values and a woman's decision-making power estimate.

Appendix B: Tables

Table B1
Summary Statistics of Dependent Variables.

	Mean	SD	Min	Max	*N*
Dependent Variable – Woman's average decision-making power (DMP) over all goods:					
Mean DMP index (*MxFLS* data)	0.5	0.13	0	1	10,470
Mean DMP index (*ENDIREH* data)	0.7	0.21	0	1	191,768
Dependent Variables – Woman's decision-making power over (individual decisions) (MxFLS data):					
Contraceptive use	0.5	0.3	0	1	7,992
Spouse's work choice	0.2	0.3	0	1	10,397
Own work choice	0.6	0.4	0	1	10,369
Money given to spouse's family	0.3	0.3	0	1	7,833
Money given to own family	0.5	0.4	0	1	7,927
Large expenditures	0.4	0.3	0	1	10,295
Child's health	0.5	0.3	0	1	8,668
Child's education	0.5	0.3	0	1	8,469
Child's clothes	0.6	0.4	0	1	7,192
Spouse's clothes	0.3	0.4	0	1	10,409
Own clothes	0.8	0.3	0	1	10,430
Food eaten in the house	0.8	0.3	0	1	10,388
Other Dependent Variables (MxFLS data):					
Male employment	0.8	0.4	0	1	8,964
Female employment	0.2	0.4	0	1	10,478
Male fear of assault	0.3	0.5	0	1	9,069
Female fear of assault	0.4	0.5	0	1	10,478
IPV outcomes (ENDIREH data):					
Emotional Abuse	0.3	0.5	0	1	168,787
Physical Abuse	0.1	0.3	0	1	192,011
Sexual Abuse	0.1	0.2	0	1	191,665
Threat of Violence	0.0	0.2	0	1	191,940

Notes: Summary statistics of dependent variables. The number of observations (*N*) for decision-making power questions vary, since not all women in the sample have children, and some decisions are neither made by the husband or the wife.

Table B2
Summary Statistics of Independent Variables.

Independent Variables (MxFLS data):					
	Mean	SD	Min	Max	*N*
Indigenous	0.1	0.3	0	1	10,478
Presence of spouse during interview	0.1	0.3	0	1	10,455
Age	43.6	12.9	15	101	7,990
Age squared	2,074	1,253	225	10,201	7,990
Years of education	9.6	4.3	0	22	10,466
Number of children	1.6	1.5	0	9	10,478
Homicide rate	0.5	0.6	0	3.4	10,478
Assist Law	0.7	0.4	0	1	10,478
Divorce law	0.7	0.5	0	1	10,478

Penal Code	0.9	0.3	0	1	10,478
Independent Variables (ENDIREH data):					
Rural status	0.2	0.4	0	1	192,055
Indigenous	0.1	0.2	0	1	191,711
Age	40.9	13.8	15	104	191,849
Age squared	1860.1	1253.3	225	108,816	191,849
Length of relationship	21.3	14.0	1	83	189,142
Number of children	3.3	2.3	0	25	190,410
Homicide rate	15.9	19.4	2.0	130.6	192,055
Assist Law	0.8	0.4	0	1	192,061
Divorce law	0.8	0.4	0	1	192,061
Penal Code	0.9	0.3	0	1	192,061

Notes: Summary statistics of independent variables.

Table B3

The effect of the gold mining boom on female decision-making power (other goods and services) (*MxFLS* data).

	(1)	(2)	(3)	Mean (std. dev.)
Normalized DMP (individual goods):				
Own clothes	-0.002	-0.001	-0.002	0.829
	(0.005)	(0.005)	(0.007)	
Observations (*N*)	10,419	10,288	9,087	
Spouse's clothes	-0.007	-0.007	-0.007	0.538
	(0.008)	(0.008)	(0.010)	
Observations (*N*)	7,125	7,025	6,144	
Child's clothes	0.000	0.005	0.003	0.461
	(0.008)	(0.010)	(0.012)	
Observations (*N*)	5,880	5,819	5,092	
Child's education	0.009	0.008	0.008	0.516
	(0.007)	(0.006)	(0.006)	
Observations (*N*)	7,779	7,692	6,774	
Child's health	0.003	0.003	0.007	0.534
	(0.010)	(0.009)	(0.009)	
Observations (*N*)	8,049	7,954	7,014	
Spouse's work choice	-0.006	-0.005	-0.001	0.208
	(0.009)	(0.008)	(0.010)	
Observations (*N*)	10,389	10,258	9,053	
Own work choice	0.004	0.007	0.008	0.594
	(0.006)	(0.006)	(0.006)	
Observations (*N*)	10,358	10,228	9,026	
Money given to spouse's parents	-0.003	0.000	0.008	0.292
	(0.010)	(0.010)	(0.008)	
Observations (*N*)	7,000	6,903	6,029	
Household expenditures	0.004	0.004	0.011	0.386
	(0.006)	(0.007)	(0.007)	
Observations (*N*)	10,266	10,135	8,953	
Baseline controls	No	Yes	Yes	
Heterogeneous trends	No	No	Yes	
Individual FE	Yes	Yes	Yes	
Month FE	Yes	Yes	Yes	

Notes: Standard errors are clustered at the municipality level and reported in parentheses (.). Baseline controls include a woman's age, age squared, indigenous status, education level, number of children, the presence of her spouse during the interview, and municipality covariates like the homicide rate per 100,000 inhabitants and the introduction of domestic violence and divorce laws. Column (1) does not include any controls, and columns (2), (3) sequentially add baseline controls and time trends interacted with municipal characteristics such as

rural-urban status, transport network quality, community quality and the presence of *ejidos* (heterogeneous market trends) respectively. *** $p < 0.01$ ** $p < 0.05$ * $p < 0.1$.

Table B4

Descriptive Statistics: *ENDIREH* survey

	$Post_t = 1$ (T)	$Post_t = 0$ (C)
Individual Covariates:		
Rural	0.196	0.229
Indigenous	0.059	0.092
Length of relationship	21.439	20.708
Age	41.072	39.875
Age squared	1877.746	1769.333
Number of kids	3.181	3.624
Education level	3.579	4.145
State Covariates:		
Homicide rate	17.366	8.728
Assist law	0.867	0.589
Divorce law	0.861	0.518
Penal Code	0.894	0.822
Observations	160,750	31,305

Notes: 'T' represents the treated group belonging to the 2006 and 2011 *ENDIREH* survey and 'C' represents the control group surveyed in 2003. The table reports mean values for each covariate and group.

Table B5

The effect of the gold mining boom on female decision-making power (other goods and services) (*ENDIREH* data).

	(1)	(2)	(3)	Mean (std. dev.)
Normalized DMP (individual goods):				
Own work choice	0.000	0.001	0.004	0.829
	(0.002)	(0.001)	(0.002)	
Observations (*N*)	171,794	169,236	167,236	
Expenditures on own goods	0.003	0.003	0.000	0.538
	(0.002)	(0.002)	(0.002)	
Observations (*N*)	187,334	182,193	182,193	
Children's goods	0.001	0.002*	0.001	0.461
	(0.001)	(0.001)	(0.001)	
Observations (*N*)	162,143	158,935	158,935	
Baseline controls	No	Yes	Yes	
Heterogeneous trends	No	No	Yes	
Individual FE	Yes	Yes	Yes	
Month FE	Yes	Yes	Yes	

Notes: Standard errors are clustered at the municipality level and reported in parentheses (.). Baseline controls include a woman's age, age squared, indigenous status, education level, number of children, the presence of her spouse during the interview, and state controls like the homicide rate per 100,000 inhabitants. Column (1) does not include any controls, and columns (2), (3) sequentially add baseline controls and heterogeneous market trends respectively. *** $p < 0.01$ ** $p < 0.05$ * $p < 0$.

Table B6

The effect of the gold mining boom on intimate partner violence (IPV) with wild-cluster bootstrapped standard errors (*ENDIREH* data).

	(1)	(2)	(3)	Mean
Emotional Abuse	0.002	0.002	0.007**	0.297
	[0.004]	[0.003]	[0.008]	
Observations (*N*)	168,787	163,902	163,902	

Threat of Violence	0.001**	0.001**	0.001*	0.029
	[0.001]	[0.001]	[0.001]	
Observations (*N*)	191,940	186,666	186,666	
Physical Abuse	0.002**	0.002**	0.003**	0.080
	[0.001]	[0.001]	[0.003]	
Observations (*N*)	192,011	186,730	186,730	
Sexual Abuse	0.003***	0.003**	0.004***	0.073
	[0.002]	[0.002]	[0.003]	
Observations (*N*)	191,665	186,413	186,413	
Baseline controls	No	Yes	Yes	
Heterogeneous trends	No	No	Yes	
State FE	Yes	Yes	Yes	
Year FE	Yes	Yes	Yes	

Notes: Standard errors are clustered at the state level and reported in parentheses (.). Baseline controls include a woman's age, age squared, indigenous status, education level, number of children, the presence of her spouse during the interview, and state-level controls like the homicide rate per 100,000 inhabitants. Column (1) does not include any controls, and columns (2), (3) sequentially add baseline controls and heterogeneous market trends respectively. *** $p < 0.01$ ** $p < 0.05$ * $p < 0.1$.

Table B7

The effect of mining on the incidence of physical intimate partner violence (IPV) (*ENDIREH* data).

Physical abuse (individual questions):				
	(1)	(2)	(3)	Mean
Pushed you/	0.001**	0.001*	0.002	0.061
Pulled your hair	(0.001)	(0.001)	(0.001)	
Observations (*N*)	191,999	186,720	186,720	
Tied you up	-0.000*	-0.000**	-0.000	0.002
	(0.001)	(0.000)	(0.000)	
Observations (*N*)	191,961	186,684	186,684	
Kicked you	0.001**	0.001**	0.001	0.019
	(0.001)	(0.001)	(0.001)	
Observations (*N*)	191,976	186,698	186,698	
Hit you with his hands	0.003***	0.003***	0.002**	0.047
	(0.001)	(0.001)	(0.001)	
Observations (*N*)	191,979	186,702	186,702	
Baseline controls	No	Yes	Yes	
Heterogeneous trends	No	No	Yes	
State FE	Yes	Yes	Yes	
Year FE	Yes	Yes	Yes	

Notes: Standard errors are clustered at the state level and reported in parentheses (.). Baseline controls include a woman's age, age squared, indigenous status, education level, number of children, the presence of her spouse during the interview, and state-level controls like the homicide rate per 100,000 inhabitants. Column (1) does not include any controls, and columns (2), (3) sequentially add baseline controls and heterogeneous market trends respectively. *** $p < 0.01$ ** $p < 0.05$ * $p < 0.1$.

Table B8

The effect of mining on the incidence of sexual intimate partner violence (IPV) (*ENDIREH* data).

Sexual abuse (individual questions):				
	(1)	(2)	(3)	Mean
Forced sexual relations	0.001**	0.002**	0.001*	0.022
	(0.001)	(0.001)	(0.000)	
Observations (*N*)	191,607	186,359	186,359	
Demand sex	0.003***	0.003**	0.004***	0.069
	(0.001)	(0.000)	(0.000)	

Observations (*N*)	191,648	186,397	186,397	
Used force to have sex	0.002***	0.002***	0.002***	0.023
	(0.001)	(0.001)	(0.000)	
Observations (*N*)	191,530	186,287	186,287	
Baseline controls	No	Yes	Yes	
Heterogeneous trends	No	No	Yes	
State FE	Yes	Yes	Yes	
Year FE	Yes	Yes	Yes	

Notes: Standard errors are clustered at the state level and reported in parentheses (.). Baseline controls include a woman's age, age squared, indigenous status, education level, number of children, the presence of her spouse during the interview, and state-level controls like the homicide rate per 100,000 inhabitants. Column (1) does not include any controls, and columns (2), (3) sequentially add baseline controls and heterogeneous market trends respectively. *** $p < 0.01$ ** $p < 0.05$ * $p < 0.1$.

Table B9

The effect of mining on the incidence of the threat of violence (IPV) (*ENDIREH* data).

Threat of violence (individual questions):				
	(1)	(2)	(3)	Mean
Threatened with	0.001**	0.001*	0.001*	0.014
weapon	(0.000)	(0.000)	(0.000)	
Observations (*N*)	191,958	186,684	186,684	
Threatened to kill you	0.001**	0.001**	0.001	0.025
	(0.001)	(0.001)	(0.001)	
Observations (*N*)	191,943	186,668	186,668	
Baseline controls	No	Yes	Yes	
Heterogeneous trends	No	No	Yes	
State FE	Yes	Yes	Yes	
Year FE	Yes	Yes	Yes	

Notes: Standard errors are clustered at the state level and reported in parentheses (.). Baseline controls include a woman's age, age squared, indigenous status, education level, number of children, the presence of her spouse during the interview, and state-level controls like the homicide rate per 100,000 inhabitants. Column (1) does not include any controls, and columns (2), (3) sequentially add baseline controls and heterogeneous market trends respectively. *** $p < 0.01$ ** $p < 0.05$ * $p < 0.1$.

Table B10

The effect of mining on the incidence of the emotional intimate partner violence (IPV) (*ENDIREH* data).

Emotional abuse (individual questions):				
	(1)	(2)	(3)	Mean
Destroyed things in	0.002**	0.002**	0.002**	0.046
house	(0.001)	(0.001)	(0.001)	
Observations (*N*)	191,965	186,692	186,692	
Threatened to leave	0.002**	0.002**	0.002**	0.087
	(0.001)	(0.001)	(0.001)	
Observations (*N*)	191,973	186,700	186,700	
Not allowed to leave	0.000	0.000	0.001*	0.036
home	(0.000)	(0.000)	(0.000)	
Observations (*N*)	191,967	186,964	186,964	
Accused you of	0.001	0.001	0.003**	0.069
cheating	(0.001)	(0.001)	(0.001)	
Observations (*N*)	191,940	186,667	186,667	
Made you feel fearful	0.003***	0.003***	0.002**	0.082
	(0.001)	(0.001)	(0.001)	
Observations (*N*)	191,954	186,681	186,681	
Ignored you	0.003**	0.003**	0.003	0.096
	(0.001)	(0.001)	(0.002)	

Observations (*N*)	191,963	186,691	186,691
Baseline controls	No	Yes	Yes
Heterogeneous trends	No	No	Yes
State FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes

Notes: Standard errors are clustered at the state level and reported in parentheses (.). Baseline controls include a woman's age, age squared, indigenous status, education level, number of children, the presence of her spouse during the interview, and state-level controls like the homicide rate per 100,000 inhabitants. Column (1) does not include any controls, and columns (2), (3) sequentially add baseline controls and heterogeneous market trends respectively. *** $p < 0.01$ ** $p < 0.05$ * $p < 0.1$.

Table B11

The effect of mining on female decision-making power (multinomial logit), with full decision-making power as the base category (*MxFLS* data).

	Husband makes full decision			Joint decision-making		
	(1)	(2)	(3)	(4)	(5)	(6)
Decision-making power over:						
Food Expenditures	-0.089	-0.068	-0.084	-0.063*	-0.064*	-0.088**
	(0.076)	(0.077)	(0.099)	(0.034)	(0.035)	(0.041)
Observations (*N*)	5,504	5,429	4,786	5,504	5,429	4,786
Money to spouse's parents	-0.232**	-0.246**	-0.246*	-0.206**	-0.216**	-0.248*
	(0.102)	(0.104)	(0.130)	(0.102)	(0.103)	(0.129)
Observations (*N*)	3,784	3,733	3,276	3,784	3,733	3,276
Baseline controls	No	Yes	Yes	No	Yes	Yes
Heterogeneous trends	No	No	Yes	No	No	Yes
Individual FE	Yes	Yes	Yes	Yes	Yes	Yes
Month FE	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Standard errors are clustered at the municipality level and reported in parentheses (.). Baseline controls include a woman's age, age squared, indigenous status, education level, number of children, the presence of her spouse during the interview, and municipality covariates like the homicide rate per 100,000 inhabitants and the introduction of domestic violence and divorce laws. Column (1) does not include any controls, and columns (2), (3) sequentially add baseline controls and time trends interacted with municipal characteristics such as rural-urban status, transport network quality, community quality and the presence of *ejidos* (heterogeneous market trends) respectively. *** $p < 0.01$ ** $p < 0.05$ * $p < 0.1$.

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Chapter III

How Violence Dis-Empowers Women: Evidence from the Mexican Drug War*

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Abstract

This paper examines the effect of violent living conditions on various forms of female empowerment in Mexico. Exploiting the exogenous rise in homicides between 2007 and 2011 as a source of variation and proxy for unsafe surroundings, the findings suggest that violence hampers women's intra-household bargaining power, employment, mobility and emotional and mental well-being. Higher homicide rates also appear to have a weaker impact on poorer women's labor supply even though these women remain fearful amidst increasingly homicidal surroundings, indicating a trade-off between income and emotional stability among those who are financially constrained. The negative effects of the drug war are also more salient among women who live in relatively more dangerous municipalities that face a higher risk of violence, and those who had previously experienced assault.

JEL-Codes: J12, J16, I31

Keywords: Female Empowerment; Mexican Drug War; Violent Crime; Outside Option

I. Introduction

The impact of violent living conditions on female welfare has not been widely explored in economic literature. Yet at present, there are approximately 45 civil wars going on across the globe, with 10 out of these 45-armed conflicts resulting in over 1,000 fatalities. Using the Mexican Drug War as a natural experiment, this paper endeavours to shed more light on the effects of a violent milieu on various forms of female empowerment such as intra-household decision-making power, employment, mobility, social capital and emotional well-being. In order to guide gender mainstreaming and gender equality efforts, understanding the consequences of violence on women's welfare is imperative.

From a theoretical perspective, non-unitary household bargaining models predict that external shift parameters such as the conditions of a woman's living environment are key determinants of her bargaining power.[1] These external environmental factors termed as 'outside options' affect the threat point in a marriage or domestic partnership, and are a function of an individual's decision-making authority (Lommerud 2003; Lundberg and Pollak 1994, McElroy and Horney 1981; Manser and Brown 1980). Non-unitary household bargaining models therefore hypothesize that changes in a wife's outside option are sufficient to alter her aggregate bargaining power within the household. Studies by Chakraborty et al. (2018) and Siddique (2018) additionally suggest a negative relationship between violence and female labor force participation, especially when the opportunity cost of being unemployed is low. For example, married women living in violent environments may be incentivized to decrease their work effort if partners are willing to increase their workload to make up for the loss in aggregate household income through their wives' lower labor force participation. The opposite may be true however, for women heading single-parent households as the economic trade-offs of being unemployed are higher.

More recent studies have also found evidence of a negative association between violence and women's mobility. In the state of Bihar in India, Muralidharan and Prakash (2017) documented an increase in girls' school enrolment due to a 'Cycle program' which provided girls with bicycles that subsequently enhanced safety. This case study indicates that in places like India where incidences of sexual assault and rape are generally higher, a dearth of safety on travel routes may hamper female labor force participation in the long run through poorer educational outcomes of girls. Sociological and economic literature has also highlighted trust as an important component of social capital, which has been shown to increase economic growth and investments in human capital through increases in employment (Beugelsdijk and van Schaik 2005; Knack and Keefer 1997;

[1] This study follows the framework of a non-unitary instead of unitary household bargaining model. A considerable number of empirical studies have not found support for unitary household models across different countries and contexts. On theoretical grounds, unitary household bargaining models have been criticized for their over-simplicity and inconsistency with real life data (Bobonis 2009; Browning and Chiappori 2006; Lundberg and Pollak 1994).

Coleman 1988). Particularly in developing and middle-income countries like Mexico with larger informal labor markets (about 60% of the population is in informal work), women may rely more on social capital for employment. Especially given the existing evidence of suppressed levels of trust during civil war and conflict, uncovering the relationship between female employment and lower trust levels (and hence lower stock of social capital) as a result of violence is important (Friebel et al. 2013; Alesina and La Ferrara 2000). Lastly, violent environments may exacerbate female welfare outcomes as women have been found to suffer disproportionately more from mental and emotional distress during warfare as compared to men, further undermining their capabilities to partake in income-generating activities (Dyregrov et al. 2000; Kuterovac et al.1994).

In December 2006, the newly elected Mexican President Felipe Calderón, initiated Mexico's war on drugs. This event entailed a massive deployment of army troops to combat drug cartels operating across the nation. Within two months of the government's crackdown on drugs, nearly 20,000 military personnel were involved in operations aimed at curbing the country's rampant drug trafficking activities. To date, one of the biggest costs of this intensive drug war has been human. According to the Institute for Economics and Peace (IEP), the number of homicides between 2007 and 2012 was about 40 percent higher than it would have been without the drug war (IEP, 2013). Specifically, the number of intentional homicides rose alarmingly from 8,800 in 2007 to approximately 27,000 in 2011.[2] Accordingly, Figure A illustrates trends in intentional homicides between 1990 and 2011, and shows a sharp increase in the total number of homicides across the country starting in 2007 right after president Felipe Calderón took office at the end of 2006. The significant increase in the number of murders could be attributed to violent attacks on civilians by drug cartels in the initial years at the beginning of the drug war, but later resulted from clashes between the Mexican military and organized crime groups involved in drug trafficking. In total, the estimated economic costs associated with violence containment in Mexico amounted to approximately 4.4 trillion *pesos* in 2012, enough to provide each Mexican citizen with 37,000 *pesos* (US$3,000), about twice the amount the government invests in health and education per individual. The IEP further calculated that the productivity loss per person during the period of intense violence was approximately 35 million *pesos* (US$2.6 million). Putting these figures into perspective, the total amount of revenue generated from illegal drug trade ranged between 154 and 548 billion *pesos* (US$14.1 billion to US$50.3 billion) in 2013, while the number of additional lives lost due to the drug war in 2012 was 11,006, amounting to a cost of about US$29 billion (IEP, 2013). Considering that this value is more than half of the average revenue gained through drug trading activities, the net welfare loss to the Mexican

[2] The distinction between intentional and unintentional homicides is important as unintentional homicides often result from accidental events that are unrelated to the drug war. Including unintentional homicides may add more noise in the data which could cloud the true effect of violent conditions on a woman's relative decision-making power.

society is likely to have outweighed the benefits due to the negative spill over effects of this national conflict that are challenging to quantify.

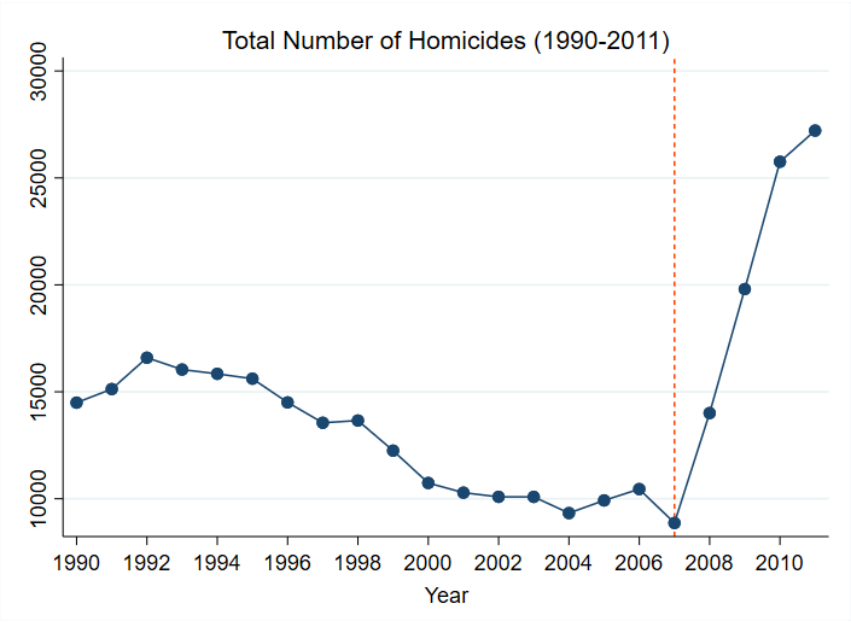

Figure A. Annual data on intentional homicides, National Institute for Statistics and Geography (INEGI).

This study exploits a conceivably exogenous rise in the homicide rate between 2007 and 2011 during the Mexican Drug War, to analyse the impact of violent and precarious living conditions on various forms of female empowerment. Prior to President Felipe Calderón who was part of the National Action Party (PAN), the Mexican government typically took a passive stance on combating drug cartels in the 1980s through to the early 2000s. Using panel data from three waves of the Mexican Family Life Survey (MxFLS), I track changes in a woman's welfare over time as a result of higher homicide rates used as a proxy for violent living conditions. The choice of homicides as an indicator for dangerous living conditions is motivated by the fact that homicide rate data is least subject to under-reporting compared to other drug-related crimes, and provides a clear source of variation as a result of President Felipe Calderón's plausibly unsystematic initiation of the drug war at the end of 2006. The MxFLS also provides a rich amount of both individual and household level information and allows for the inclusion of individual fixed effects to remove any unobserved individual heterogeneity that could be correlated with a woman's welfare outcomes. This is especially advantageous given the nature of this study as individual decision-making behaviour for instance, could vary greatly across women due to latent individual traits.

Altogether, the results from this study reveal lower female decision-making power over one specific set of goods and services which is that of their children's, as a result of higher homicide rates. The findings also show that higher levels of violence are associated with poorer female employment outcomes, lower mobility and greater community distrust. Consistent with Siddique's (2018) findings on India, I observe however, that violence had a weaker effect on economically

disadvantaged women in Mexico who may still have had to participate in the labor market despite increasingly precarious environments. The negative effects of violence on female welfare also appear to be stronger among women living in 'high-risk' municipalities that were predisposed to more violence, and those who had previously been assaulted.

The relevance of this study relates to the fact that many countries are still currently plagued with strife or are threatened by potential conflict. Understanding the way unsafe living conditions affect spousal intra-household dynamics is thus essential for streamlining protection efforts of women and children during vulnerable times. Building on previous literature that similarly adopt non-unitary household bargaining models, this paper would be one of the first to classify and examine external living conditions as an outside option or shift parameter of a woman's bargaining power. Subsequently, it also sheds light on the trickle-down effect of weaker female decision-making power on children's well-being. The lack of access to justice for women in Mexico provides another source of motivation for improving female welfare. Notwithstanding the implementation of the General Law of Access for Women to a Life Free of Violence (GLAWLFV) in 2007, Mexico has experienced a steady climb in the number of femicides since 2007 (Mexican Commission for the Defense and Promotion of Human Rights, CMPDPH, 2012).[3] According to the CMPDPH and UN Women, the country still lags behind in normalizing the GLAWLFV across states and many women remain discriminated against while attempting to access the legal judicial system. In a milieu plagued with intense violence and conflict, it is thus increasingly important to enhance women's safety considering their susceptibility to dangerous surroundings. Consequently, this paper strives to elucidate the need for greater protection of women within the Mexican society, by providing empirical evidence of the relationship between unsafe living environments and various facets of female empowerment.

In what follows, Section II provides some background detail and related literature on the topic of violence, female well-being and the Mexican Drug War. Section III describes the data used to analyse the association between homicides and the various female welfare outcomes aforementioned, and Section IV explains the empirical strategy employed. Section V provides a detailed interpretation and analysis of the results, performs a series of robustness checks and explores heterogeneous impacts. Section VI finally concludes.

II. Background and Related Literature

II.1 *The Mexican Drug War*

[3] Femicides is a term used to describe gender-based murders that occur as a result of being a woman. Homicide rate data from the National Institute of Statistics and Geography (INEGI) does not permit the segregation of femicides from non-femicides during the period of the MxFLS as information on the exact motivation behind killings is not provided.

Throughout the 1980s up till the mid-2000s, Mexico had remained relatively static in combating illegal drug trading activities. As a consequence, drug-related crimes such as homicides, car thefts, kidnappings, extortions and assaults experienced a steady declining trend up till 2007 (Rios, 2013). Almost immediately after President Felipe Calderón was inaugurated at the end of 2006 however, over 7,000 Mexican army soldiers were mobilized to put a stop to the persisting brutality and violence instituted by powerful drug cartels across the country. Within two months of the drug war, nearly 20,000 military soldiers had been deployed to partake in Mexico's intense fight against illegal drug trafficking. Since then, homicide rates spiked sharply due to violent clashes between civilians, political party members as well as organized crime groups (OCGs) largely associated with drug cartels. According to official homicide rate statistics by the National Institute for Statistics and Geography (INEGI), intentional homicides across Mexico increased by roughly 3-fold from 8,800 in 2007 to 27,000 in 2011 (see Figure A). Altogether, the number of lives claimed as a result of drug-war related crimes was estimated to be 60,000 during the same period, with a large proportion attributed to homicides.

Qualitative and quantitative analyses by Espinosa and Rubin (2015), Escalante (2011) and Merino (2011) confirmed that the military interventions to contain drug-related violence had backfired and instead caused an increase in homicides. This was by and large a result of a potpourri of issues related to corruption, the lack of resources and prison-overcrowding, which the Mexican government had struggled to rectify. The drug war also affected men and women in different ways. While men were more subject to crimes related to extortions, business thefts and kidnappings, women were victimized by crimes that were more personal in nature (United Nations, 2011). Since the onset of the drug war, a large number of women and girls were pulled into sex slavery and used as drug traffickers. This phenomenon is likely to have been more prevalent among women from poorer households who may have resorted to drug trading activities for income. Crime statistics by the National Institute for Statistics and Geography (INEGI) additionally reveal that female incarcerations resulting from drug-related crimes increased by about 400% between 2007 and 2011, during the intensification of the drug war. Concurrently, Castellanos (2013) reported that women increasingly became targets of rape and sexual assault - offenses highly associated with illicit drug trading activities initiated by drug cartels. According to Amnesty International, a fifth of undocumented migrants travelling through Mexico by freight train were women and young girls, who were also mostly victims of human trafficking (Amnesty International, 2010).

II.2 *Violence and Intra-household Bargaining Power*

This study examines the relationship between violence and female welfare using three waves of the MxFLS. In a similar paper using two waves of the MxFLS, Tsaneva et al. (2018) find a decline in women's *absolute* decision-making power on average when restricting their sample to women who are married, live with their

husbands and have at least one child. Using three waves of the MxFLS and restricting my sample to women who were married or cohabitating, and to women who did not have children, I observe a decline in a woman's *relative* decision-making power over one specific set of goods and services which is that of their children's.[4] The link between a woman's living conditions as an outside option and her intra-household bargaining position, has been scarcely studied in the past until recently (Tsaneva et al., 2018). Non-unitary household bargaining models posit that improving a woman's outside option inevitably increases her bargaining power, whether it may be through a direct and materialized improvement or a potential upgrade in her outside option (Aizer 2010; Pollak 2005).[5] Other shift parameters of a woman's outside option, such as labor market opportunities, sex ratios in the marriage market and divorce law reforms have also been explored in economic literature, although to a lesser extent than individual determinants of female decision-making power such as income, non-labor income, education, land and asset ownership. (Majlesi 2016; Brassiolo 2016; Jensen 2012; Bulte et al. 2011; Angrist 2002 and Chiappori et al. 2002).

A large body of evidence also point to a positive relationship between female bargaining power and children's health, nutritional status, educational outcomes as well as household consumption. Duflo (2003), Thomas (1994) and Thomas (1990) discovered that the larger the income or assets in the hands of women, the better the anthropometric status of offspring. Across several developing countries, a woman's control of assets such as land has also been shown to be positively correlated with investments in children's human capital accumulation (Gitter and Barham 2008; Quisumbing and Maluccio 2003; Handa 1996). Women have also been found to devote larger budget shares to children and household consumption than men, underscoring the importance of female bargaining power for children's welfare and development, especially in areas experiencing acute destitution (Duflo 2003; Phipps and Burton 1998; Lundberg, Pollak, and Wales 1997; Handa 1994; Hoddinott and Haddad 1994; Thomas (1994, 1990)). Unlike previous studies that used proxies for female decision-making power such as income or non-labor income, newer datasets have reduced the need to use such traditional proxies of bargaining power that have been argued to be sensitive to identification issues. Specifically, the MxFLS used in this study permits the

[4] Tsaneva et al. (2018) argue that cohabiting women face different constraints than married women, and have a high attrition rate. In the context of Mexico however, Amador (2016) documented declining trends in marriages for cohorts born after 1975. Cohabitation has therefore grown to become an increasingly common family formation strategy among newer generations of both lowly and highly educated Mexican women. Cohabitating is thus more likely to be a persistent state without the transition into marriage. Given this demographic transition towards informal unions, cohabiting couples are more likely to face similar constraints as married couples and are subsequently included in my sample.

[5] In non-unitary household bargaining models, a woman's income at the bargaining equilibrium may not necessarily equate to her income at the threat point of her marriage. For instance, a woman may choose to work after a divorce which is the marriage threat point, but not at a cooperative equilibrium where she earns zero income (Pollak, 2005).

mapping of changes in a woman's living environment to her explicit decision-making authority over a specific set of household and personal goods over time.

This study adopts a non-unitary household bargaining model which predicts an aggregate increase in a woman's decision-making power through an improvement in her outside option (Aizer 2010; Pollak 2005). Unitary bargaining models have been largely rejected on both empirical and theoretical grounds across economic literature. A growing number of empirical studies have failed to find support for the unitary household framework across various contexts and in real world data. In theory, unitary household bargaining models have been criticized for being over-simplistic by assuming that two family members pool income resources, are altruistic and maximize a single utility function. Therefore, while Samuelson's (1956) and Becker's (1974) unitary bargaining model provides a simple mechanism of household resource allocation, it ignores the fact that economic agents may have distinct preferences on the intra-household distribution of goods. Non-unitary bargaining models contrarily allow for greater flexibility in the range of decision-making behaviour among family members.

The conventional non-unitary decision-making model typically consists of two household members: a husband and a wife. Individually, the husband and the wife have a utility function consisting of their own consumption of private goods, where after maximizing the Nash production function, the respective utilities of the husband and wife are simplified to be:

$$U^h(q^h) = T^h(X) + a^h\Big(U^h(q^h) - v^h(p,y)\Big),$$

And

$$U^w(q^w) = T^w(X) + a^w\big(U^w(q^w) - v^w(p,y)\big),$$

The divorce 'threat point' is characterized by $T^h(X)$ and $T^w(X)$, where X is a set of shift parameters which affect the conditions outside a marriage, or in other words, the husband and wife's outside option. In the case where a marriage fails, the threat point would then represent the best a wife or husband can do if they leave the household (their utilities in the case of divorce). a^h and a^w are the bargaining weights of the husband and wife and $v^h(p,y)$ and $v^w(p,y)$ represent the indirect utilities from a marriage which are functions of the price of consumption goods, p, and labor incomes, y.

In this study, I hypothesize that unsafe surroundings worsen a woman's outside option, which in turn lowers her aggregate utility at the threat point. To date, only a handful of studies have empirically examined the association between outside options and intra-household decision-making dynamics. A well-researched external shift parameter of bargaining power relates to sex ratios in the marriage market and divorce law changes. In China, Bulte et al. (2011) discovered that the scarcer women were in the marriage market, the stronger their bargaining power within the household. Angrist (2002) also reported that higher male-female sex ratios in the United States motivated men to marry sooner, and also improved

female marriage prospects. Similarly, American women were found to receive larger income transfers from their spouses in a milieu with higher male to female population ratios, and with changes to divorce laws that favoured women (Chiappori et al., 2002). Results from Beleche's (2017) recent study additionally indicate a reduction in physical and sexual violence by partners due to the Penal Code Reform in Mexico, which involved criminalizing domestic abuse. In Spain, divorce law reforms resulted in a significant reduction in spousal conflict and extreme partner violence as it facilitated the process of dissolving a marriage (Brassiolo, 2016).

Other forms of outside options such as labor market opportunities, gender-specific police stations as well as previous exposure to familial domestic violence have also been explored. In developing countries like Mexico and Bangladesh, an improvement in the number of economic opportunities for women was found to increase a woman's relative intra-household decision-making power. Majlesi's (2016) study on Mexico revealed a positive impact of an increase in female manufacturing jobs on women's relative bargaining outcomes within the household. Likewise, in Bangladesh, women living in areas with high factory density participated more in the labor force, had higher bargaining power and were more likely to have children who were enrolled in school (Kagy, 2014). The presence of legal enforcements favouring women, such as female police stations, has also been shown to reduce female homicide rates in Brazil, indicating the effectiveness of gender-specific legal institutions in controlling intimate partner violence through an improvement in women's outside options (Perova and Reynolds, 2017). Lastly, Bowlus and Seitz's (2006) study also suggests that husbands' exposure to domestic violence during childhood, reduces wives' outside options due to the increased probability that these husbands would become abusive future spouses.

II.3 *Violence and Other Determinants of Female Welfare*

Apart from intra-household decision-making power, this paper also examines the effect of violence on other forms of female empowerment such as employment, mobility, social capital and emotional and mental well-being. The relationship between violence and the aforementioned factors have been explored in both developed and developing countries like the United States, India, Uganda and to a lesser extent, Mexico. Particularly for crimes against women, Chakraborty et el. (2018) found lower levels of female labor force participation in communities reporting higher levels of sexual harassment in India. Similarly, Siddique (2018) documented a reduction in female employment probability in areas in India with higher reports of sexual assaults. The opposite effect of violence on female labor supply was found in the United States where during the second world war, women were compelled to participate in the labor market to make up for the loss in aggregate household income when men were recruited to combat in war (Acemoglu et al., 2004). In Mexico, Tsaneva et al. (2018) also documented an increase in female employment probabilities in the midst of the drug war, suggesting that this

was due to more men staying home as a result of increasingly violent living conditions.

UN Women estimates that roughly 73.9% of journeys undertaken by Mexican women are on public transport (UN Women, 2017). Simultaneously, reports reveal striking evidence of widespread gender-based harassment on Mexico's public transport systems, with nine out of ten women experiencing violence in public transportation spaces (Zermeño et al., 2009). This situation has been exacerbated by the ongoing war on drugs across the country as drug traffickers typically prefer well-connected roads and highways that lead to points of exit or entry, such as airports and maritime shipping ports that help to lower transportation costs (NDIC, 2011). In addition, an increasing number of women have been pulled into illicit drug trade, either through sex slavery or the compulsion to become assassins, couriers or watchers. The higher levels of violence and probability of assault on Mexico's public transit systems may thus deter women from commuting altogether or compel them to switch to different modes or routes of transport that may increase travel times and the need to pay multiple fares. In the state of Bihar in India, Muralidharan and Prakash (2017) found evidence of a relationship between violence, female mobility and human capital accumulation. Under a 'Cycle program' which provided girls with bicycles, girls' school enrolment rates increased due to enhancements in safety when commuting to school.

The impact of warfare or violent conflict on fear and psychological distress has also been documented across economic literature. Blattman and Annan (2010) found that exposure to the severe civil war conflict in Uganda imposed mental stress on ex-combatants, whom subsequently experienced reductions in their lifetime earnings. Their findings are consistent with developed countries like the United States, where ex-veterans who participated in the Vietnam War experienced a 15% decline in their long-term wages due to psychological distress from the war (Angrist, 1990). Additional evidence suggests gendered differences in the impact of combat on psychological health and educational outcomes. In studies by Dyregrov et al. (2000) and Kuterovac et al. (1994), girls were more likely to exhibit symptoms of post-traumatic stress disorders (PTSD) resulting from exposure to war situations as compared to boys. Adolescent Tajikstani girls for example, were also found to have poorer educational outcomes than their male counterparts when exposed to civil war (Shemyakina, 2011). In the third wave of the MxFLS used in this study, I observe that women were also more likely to report being fearful of assault as compared to the second wave, indicating increased vulnerability during the drug war.[6]

Lastly, studies on warfare typically find an inverse relationship between trust and conflict, suggesting lower stocks of social capital in a violent milieu. In a cross-country analysis between 1981 and 2008, Rohner et al. (2013) discovered a negative and significant correlation between the frequency of civil war and average

[6] The proportion of women who reported feeling fearful was approximately 36.6% in the second wave and 40.2% in the third wave.

trust levels, suggesting that individuals are less trusting in a violent environment characterized by a drug war for instance. Trust is an important component of social capital, which is particularly beneficial for individuals living in societies with large informal labor markets. In a country like Mexico with approximately 60% of the population involved in the informal labor market, the likelihood of women gaining employment through non-formal means is high (ILO, 2014). Moreover, because females are also more likely to be involved in informal jobs than males, the role of trust is particularly important for women in accessing labor market opportunities which may in turn improve their outside option.

III. Data

This study draws from two main sources of information, the Mexican National Institute for Statistics and Geography (INEGI) and the Mexican Family Life Survey (MxFLS). It merges monthly municipal-level homicide rates from the INEGI with information on intra-household decision-making, employment, mobility, social capital and emotional well-being from the MxFLS. Public death certificates are released by the INEGI annually, and contain details on the cause of death, the gender of the deceased, the day, month and year of death as well as the municipality in which the death occurred for the years 1990-2011. The availability of this data permits the selection and inclusion of only intentional homicides, and the matching of homicide rates to a woman's bargaining power months prior to their MxFLS interview.[7] The use of homicide rates as an indicator for a violent living environment is apt for several reasons in the case of Mexico. First, the conceivably exogenous increase in the number of homicides between 2007 and 2011 provides a good source of temporal variation suitable for panel data analysis. Table 1 shows the rising trend in the average quartic root of homicide rates per 100,000 inhabitants across the three MxFLS interview waves in represented municipalities.[8] During the pre-violence period from 2002 to 2006 (MxFLS1 and MxFLS2), the mean quartic root of homicide rates per 100,000 inhabitants over the last trimester was about 0.51. By the start of the third MxFLS wave in 2009, homicide rates had risen to an average rate of 0.64 before reaching a high of 0.67 in 2010. Across the 136 municipalities included in this study, the percentage change in homicide rates ranged from -100% to 2000% between 2007 and 2011 indicating geographical variation in violence patterns across municipalities. Particularly, about 15% of the

[7] INEGI classifies deaths in accordance with the WHO international classification of deaths which can be found here: http://apps.who.int/classifications/icd10/browse/2016/en#/X85-Y09. The respective codes used to select intentional homicides range from X85 to Y09 in the 'Assault' section. The MxFLS only contains data on the month and year in which an individual was interviewed, dissimilar to the INEGI, which also provides information on the day the murder occurred. Under these data limitations, only the matching of homicide rates to a woman's bargaining power by months prior to the interview instead of days is possible.

[8] Given that some municipalities in the MxFLS have zero homicides, the quartic root of homicides is used to preclude the dropping of observations. This measure produces results similar to applying log transformations for positive numbers and has been used in analyses across various related studies (Brown and Velásquez 2017; Thomas et al. 2017; Ashraf et al., 2015; Tarozzi et al., 2014).

municipalities experienced negative homicide growth rates over the respective period, 15% saw no changes in homicides and the majority of the municipalities (over 70%) experienced positive homicide growth rates.

There is reason to believe that municipalities closer to the U.S. border and those that had at least one drug cartel present prior to 2007 experienced greater increases in violence. Considering the high volume of drug trafficking across the U.S. - Mexico border through which people and weapons on top of drugs pass, it is likely that northern Mexican municipalities experienced different patterns of drug-related violence. Municipalities with pre-existing drug cartels were also likely to be targeted by the government and thus may have experienced higher rates of violence. Using Coscia and Rios's (2012) data on the presence of drug cartels in Mexico, I subsequently exploit the geographical variation in violence to test if the effects on female empowerment were larger in 'higher-risk' municipalities that had drug cartels present before 2007, and in municipalities along the U.S. - Mexico border (see section V).

Table 1.
Homicide rates across MxFLS1(2002), MxFLS2(2005-2006) and MxFLS3(2009-2010)

	Mean Quartic root of homicide rates per 100,000 inhabitants (last trimester)				
Year	Mean	SD	Min	Max	*N* (municipalities)
2002	0.510	0.415	0	1.194	136
2005	0.450	0.414	0	1.283	136
2006	0.558	0.403	0	1.273	136
2009	0.643	0.477	0	1.846	136
2010	0.671	0.502	0	2.107	136

Notes: This table displays the mean, standard deviation and range of the quartic root of homicide rates over time for each interview year in the MxFLS. A total of 136 municipalities are represented both in the MxFLS and my sample of analysis.

Data on murders are allegedly more credible in Mexico than other types of crime as a deceased body is documented in public records regardless of the willingness to report it. Offenses related to self-reported intimate partner assaults or domestic violence which also directly affect female welfare outcomes, have on the other hand been shown to suffer from more under-reporting (Ellsberg et. al, 2001). A cross-check with several other studies using different drug-war related criminal data such as car thefts, extortions and kidnappings additionally exhibit similar patterns of increases as homicide rates (Brown and Velásquez, 2017; Rios 2013; Molzhan et al. 2012). Because homicides are least subject to failure in reporting and are the most consistent with multiple studies using drug-related crimes, they remain the best indicator for violent living conditions despite the availability of data on other types of crimes related to the drug war.

The MxFLS is a nationally representative panel survey, containing information on the decision-making power of married or cohabiting couples. Conducted over three different waves: 2002, 2005-2006, 2009-2010, the MxFLS interviewed 8400 households which included about 35,000 individuals in more than 150 municipalities across Mexico. It explicitly asked couples within the household about who made decisions in four main categories: a). Wife's private goods and services (clothing, money sent to own parents and work choice), b). Husband's private goods and services (clothing, money sent to own parents and work choice) c). Household expenditure goods (food, major expenditures, contraceptive use) and d). Children's goods (child's health, child's education and child's clothing).[9] Detailed information about an individual's indigenous status, education, age, employment and the number of kids at home are also provided, and included in the set of time-varying controls. The MxFLS additionally notes the presence of a woman's spouse during an interview, which enables the accountability of possible measurement errors resulting from reporting biases.[10] Lastly, the fortuitous overlap of the spike in the number of homicides in 2007 with the third wave of the MxFLS is especially helpful in providing insights into a woman's well-being, pre and post exposure to violent environments. The MxFLS was also able to re-interview and trace virtually 90% of households across all three waves, making a comprehensive documentation of welfare changes in the Mexican society over time possible.[11] Summary statistics of the data are shown in Tables B1 and B2 of the appendix.

IV. Identification Strategy

IV.1 *Simultaneity and Selection Bias*

This study is subject to two main identification threats characterized by selective migration and reverse causation. The high incidence of homicides in some municipalities may have increased the likelihood of migration to safer areas as individuals searched for more security. This selectively migratory behaviour however could bias estimates downwards. If women had migrated to safer municipalities with lower homicide rates for example, the effect of a violent living environment on a woman's welfare would be attenuated. Women who chose to migrate across municipalities could also have inherently different characteristics compared to women who did not move. If these unobserved individual traits are simultaneously correlated with female welfare outcomes, estimates would also be inaccurate. Moreover, while the data reveals minimal migration across municipalities among surveyed individuals, selective exposure to violence could

[9] Data and documentation are available at http://www.ennvih-mxfls.org/. An example of the household decision-making questionnaire can be found in Figure A1 of the appendix.
[10] Reporting biases may arise from the 'Hawthorne effect', a psychological term referring to the alteration of one's behavior or survey response due to the cognizance of being observed (Landsberger, 1957).
[11] See http://www.ennvih-mxfls.org/english/assets/usersguidemxfls-3.pdf for additional information about the MxFLS.

still pose as a potential threat to identification.[12] Even if the decision to migrate was not motivated by high homicide rates, it could have changed the municipality of choice of where to relocate to. To account for this possible source of endogeneity, individuals are fixed to their municipality of residence in the very first wave of the MxFLS, regardless of whether they had moved in the second or third waves of the survey. Coefficients therefore reflect intent-to-treat (ITT) estimates rather than the average overall effect of homicides on a woman's well-being. 'Selective stayers' however, could still undermine the accuracy of estimates if some women, whom for unobservable reasons deliberately chose to remain in dangerous municipalities. Subsequently, I exclude women who moved across the three MxFLS waves from my sample of analysis, and observe that the main results remain significant with coefficients changing minimally.[13]

In order to mitigate potential simultaneity bias, I use the lag of average homicide rates in the last four months prior to the interview month and year, as the main explanatory variable representing an unsafe environment. The motivation behind this methodology is that current female outcomes should not, in theory, affect previous homicides. It is argued however, that one of limitations of this method is the increased difficulty in interpreting coefficients from regressions due to the use of a proxy (lagged value) for the original variable. The use of lagged homicide rates is nonetheless particularly appropriate for this study as past exposure to violent environments are likely to affect women's welfare more so than current exposure. This could be due to lags in the dissemination of news on murders within a municipality for example, or the fact that previous violent experiences may instil fear and psychological distress among individuals. Individual level outcomes are also unlikely to affect aggregate municipal level homicide rates as killings largely due to the drug war were mostly unpredictable. Accordingly, I divide average homicide rates by trimesters and use the mean homicide rates over the last 4 months as the benchmark indicator for a violent environment.[14]

IV.2 *Individual Fixed Effects*

The main empirical strategy employed in this paper is equivalent to a generalized difference-in-differences model, with homicide rates as a continuous treatment variable. Unit-level data provided by the MxFLS also allows the inclusion of individual fixed effects, which is essential in removing any latent and fixed individual characteristics that may be correlated with a woman's welfare outcomes. Since individual heterogeneity plays a major role in influencing women's

[12] The baseline dataset reveals a proportion of approximately 2.8% of women that changed their municipality of residence across the three waves.
[13] Results are presented in Table B3 of the appendix.
[14] Average homicide rates in the last trimester (4 months) generate the most pronounced effect of homicides on a woman's decision-making power, although estimates produced from using mean homicide rates over the last quarter (3 months) or last 5 months do not differ significantly. Because feelings of fear and distrust for instance are likely to grow and accumulate in response to violence exposure over time, the use of a mean composite index of an unsafe environment rather than a disaggregated measure is justified. A plot of the average homicide rate coefficients over the last 1 to 6 months is provided in Figure A2 of the appendix.

behaviour, the addition of individual fixed effects is especially important. Accordingly, the baseline regression model is estimated below:

$$Y_{i,t} = B_o + B_1 HR_{m,t-4} + B_2 X_{i,t} + \emptyset_i + \gamma_t + \varepsilon_{i,t}, \quad (1)$$

Where $Y_{i,t}$ is the respective outcome variable of interest such as a woman's relative decision-making power index, employment probability, hours allocated to work in a week, probability of the fear of assault and of changing transportation routes and a measure of social capital: neighbourhood trust. A woman's relative bargaining power index is calculated by taking the total number of sole decisions made by a wife less the total number of sole decisions made by her spouse in each decision-making category type.[15] Consistent with household bargaining literature, I separate decision-making questions (12 in total) into four distinct types: wife's private goods and services, husband's private goods and services household expenditure goods and children's goods. The explanatory variable of interest, $HR_{m,t-4}$ is expressed as the average quartic root of homicide rate per 100,000 inhabitants in municipality *m*, over the last trimester according to an individual's respective interview month and year at time *t*. $X_{i,t}$ is a vector of time-varying and observable individual and household covariates, which includes a woman's indigenous status, age, age squared, an interview control denoting the presence of a wife's spouse during the interview, the number of children below 15 years old at home, her educational attainment and her employment status. The choice of controls draws from existing household bargaining literature documenting the influence of these variables on various forms of female empowerment (among others, see, Ashraf et al. 2015; Bulte et al. 2011; Brown 2009; Datta 2006; Panda and Agarwal 2005). $\emptyset_i$ and γ_t represent the individual and month of interview fixed effects accordingly, and $\varepsilon_{i,t}$ is the error term.

The inclusion of individual fixed effects is necessary for removing any unobservable innate characteristics that influence a woman's well-being, and month of interview fixed effects accounts for time trends that vary uniformly across municipalities. Subjects are assigned to the lag of homicide rates by months instead of years, due to the volatility and sensitivity of a woman's welfare to many factors that plausibly make them more transient. Additionally, women are fixed to their municipalities of residence in the first wave of the MxFLS conducted in 2002, to minimize the severity of endogeneity issues related to selective migration discussed in the previous section. The sharp increase in homicide rates between 2007 and 2011 and differences in patterns of violence across municipalities also provide temporal and geographical variation required for the estimation of a fixed effects model.

[15] I do not count decisions that were made together by both spouses as opinions regarding joint decision-making power are prone to great subjectivity. For instance, a woman who reports having joint decision-making authority over a specific good may have less than 50% of the decision-making power in reality.

V. Results

V.1 *Homicides and Female Welfare Outcomes*

Table 2 displays results from the individual fixed effects model in equation (1) using homicide rates as a continuous treatment variable and as a proxy for violent living conditions. Column (1) includes only individual and municipality fixed effects but no controls, column (2) adds baseline covariates and column (3) includes potentially endogenous controls like a woman's education, employment status and number of children.

Table 2
The effect of homicide rates (HR) on female welfare outcomes.

Wife's relative decision-making power over children's goods			
	(1)	(2)	(3)
HR	-0.133**	-0.146**	-0.152**
	(0.059)	(0.059)	(0.060)
Controls	No	Yes	Yes
Endogenous controls	No	No	Yes
Mean	0.477	0.477	0.477
N	11085	10912	10903
R2	0.463	0.467	0.469

	Employment			*Time allocated to work (hours)*		
	(1)	(2)	(3)	(4)	(5)	(6)
HR	-0.049*	-0.048*	-0.049*	-2.656***	-2.616**	-2.539**
	(0.029)	(0.028)	(0.027)	(1.051)	(1.044)	(1.025)
Controls	No	Yes	Yes	No	Yes	Yes
Endogenous controls	No	No	Yes	No	No	Yes
Mean	0.194	0.194	0.194	8.505	8.505	8.505
N	10997	10902	10803	10997	10902	10803
R2	0.592	0.605	0.607	0.605	0.616	0.618

	Fear of assault		*Changed transport*		*Neighborhood trust*	
	(1)	(2)	(3)	(4)	(5)	(6)
HR	0.093**	0.087**	0.038*	0.053***	-0.108***	-0.111***
	(0.036)	(0.037)	(0.022)	(0.019)	(0.038)	(0.039)
Controls	No	Yes	No	Yes	No	Yes
Mean	0.369	0.369	0.092	0.092	0.786	0.786
N	12233	12049	12138	9852	7570	7346
R2	0.456	0.471	0.427	0.470	0.589	0.595

Notes: Standard errors clustered at the MxFLS1 municipality of residence and reported in parentheses. All regressions include individual fixed effects and month of interview fixed effects. Sample contains only married or cohabiting women. *** p <0.01 ** p <0.05 *p <0.1.

Altogether, the empirical estimates reveal a negative and significant effect of homicides on a woman's relative decision-making power over only one category of goods and services: her children's goods which include investments in education,

health and clothing.[16] The model yields estimates that are robust at a 5 – 10% level and are economically meaningful across different specifications. In particular, a 1 percentage point increase in the mean homicide rate over the last trimester decreases a woman's relative decision-making power over her children's goods by about 0.13 to 0.15, or equivalently about 30% when compared to the mean. These findings can be juxtaposed against a large body of studies documenting a higher preference in the allocation of resources to children among women than men. A woman's relative bargaining power over her children's goods and services may therefore be more sensitive to negative income shocks due to increased violence for example.

Substituting the dependent variable from equation (1) with a binary variable equal to 1 if a woman is employed, and a continuous variable representing the number of hours a woman normally works in a week, I observe that higher homicide rates lowered employment outcomes.[17] Since women from more well-off families may be less incentivized to work, I include a measure of household wealth as an additional control and robustness measure.[18] Subsequently, the results reveal evidence of a significant and negative association between homicide rates and both employment outcomes, indicating that employment prospects were poorer amidst homicidal environments. In the baseline results in columns 2 and 5 of Table 2, a woman's chance of employment and number of hours worked in a week fell by approximately 4.8 percentage points and 2.6 hours respectively, in response to a percentage point increase in the homicide rate. In comparison to the mean, these figures translate to about a 25% and 30% decrease respectively. Given that the average hourly minimum wage in Mexico is roughly 18.05 *pesos* (US$0.9), this amounts to a reduction of roughly 2,445 pesos (US$127) in potential annual earnings at the least (OECD, 2018). Results for male employment outcomes are presented in Table B5 of the appendix and show no significant impact of homicides on men's probability of employment or hours allocated to work in the past week. This could be indicative of the fact that male employment may have been less sensitive to external environmental changes given husbands' traditional roles as breadwinners of the family, and the fact that that fewer males were interviewed in the MxFLS.

The final set of results in Table 2 examine the relationship between homicides and a woman's probability of the fear of assault, changing transportation

[16] Results on the effect of homicides on a woman's relative decision-making power over her husband's goods and services, her own private goods and services and household expenditures are shown in Table B6 of the appendix.

[17] I aggregate the time allocated to both primary and secondary jobs, as more than half (55.5%) of Mexican women not employed in agriculture were involved in informal work (National Institute for Statistics and Geography's (INEGI), 2017 survey on occupation and employment). The likelihood of taking on supplementary jobs, for instance, participating flexibly in family run businesses is therefore high.

[18] The composite household wealth index is calculated using standard principal component analysis. It includes various household assets such as the ownership of a vehicle, an additional house, a dryer and washing machine, electrical appliances, furniture or refrigerator, a stove, a bicycle, farm animals and other domestic appliances. The wealth index additionally considers the quality of the house by accounting for the floor material and access to water through various sources.

routes as a security measure and community trust levels. The dependent variable from equation (1) is substituted with a dichotomous variable equal to 1 or 0 if a woman was afraid of getting assaulted in the day or night, if she changed her transportation route as a security measure, and if she perceived her neighbours to be trustworthy or not.[19] In addition, I control for community level traits such as the log of community population, the proportion of households with electricity and an indicator measuring the level of development of community transport systems for the regression on transportation route changes.[20] Coefficients with the inclusion of baseline covariates in columns 2, 4 and 6 show that a percentage point increase in the homicide rate corresponded to an increase of 8.7, 5.3 and 11.1 percentage points in a woman's fear of assault, probability of changing transport routes, and neighbourhood distrust respectively. The expected rise in women's fear amidst high homicide rates is consistent with Blattman and Annan's (2010) study on Uganda, where ex-combatants experienced more psychological distress due to increased exposure to warfare. Moreover, exposure to situations like homicidal surroundings for instance, has been established as one of the triggers for post-traumatic stress disorders (PTSD) (Herman 2015; Flouri 2005). Safety on public transportation has also been shown to be an important factor in female labor force participation. According to the International Labor Organization (ILO), limited access to safe transportation lowered the probability of female labor force participation by about 16.5% in developing countries (ILO, 2017). In Mexico, 87.7% of women surveyed in Mexico City did not feel safe taking public transport, and 79.4% felt insecure and unsafe in public spaces (ENVIPE, 2016). This effect is likely to have been exacerbated in areas especially affected by the drug war, as drug traffickers would typically prefer well-connected roads and pathways that would help to reduce transportation costs. Moreover, since women undertake various activities related to child-care taking, household chores and market work, they may be required to commute to various places in a day, or travel during off-peak hours and take different modes of transport (Peters, 2002). The observed increase in the probability of transport route changes as a safety measure, together with the concurrent decrease in female employment is therefore plausible in the context of Mexico, where women have reportedly felt more unsafe during the period of the drug war.

Lastly, the observed lower levels of perceived neighbourhood trust, an indicator for social capital, is supported by existing research on civil conflict, psychological distress and aggregate community trust. In Sweden for example,

[19] The variable for neighbourhood trust is constructed from a household level questionnaire asking if people are trustworthy in the neighbourhood. Households which responded a). Disagree and b) Completely disagree to the statement were assigned a value of 1, and 0 otherwise. Because the MxFLS does not provide this question in wave 1, the analysis is limited to waves 2 and 3.

[20] The community transport development index is constructed by aggregating a total of 4 questions from the community transport questionnaire booklet in the MxFLS which specifically asked community representatives about a). if there was public transportation within the community, b). if there were enough roads for community traffic, c). the kind of materials that covered most of the roads/streets/highways in the community and d). if cars or trucks were able to travel on the principal road/highways/street that gave access to the community 2 years ago. The indicator ranges from 0 to 4 with 0 being the worst.

individuals who exhibited signs of PTSD were found to be less trusting of others (Scheffer and Renck, 2008). A cross-country study also established a negative correlation between public trust and civil conflict, where trust levels fell in response to higher civil war frequencies (Rohner et al., 2013). Drawing on the work of Putnam (2000) and other sociological studies, trust as a civic norm leads to mutually beneficial outcomes on personal, economic and governmental levels. Economists also recognize trust as an important component of social capital as it lowers transaction costs associated with finding employment, which ultimately promotes greater welfare and economic growth (Hamilton, Helliwell and Woolcock 2016; Chou 2006; Iyer, Kitson and Toh 2005). Since a large majority of the Mexican population is engaged in the informal labor market with mostly women involved in this type of work, lower levels of trust suggest poorer labor market opportunities and employment prospects for women, consistent with the results observed in this study.

V.2 *Identification*

A key identifying assumption of the individual fixed effects methodology in equation (1), is that homicide rate increases were orthogonal to trends in female bargaining power during the pre-violence period, before the onset of the drug war in 2007. In other words, the relative decision-making power of women for instance should exhibit a parallel trend in the years before 2007. If this condition fails to hold, the increase in homicides could be endogenous to a woman's relative decision-making power. To provide support for the validity of the empirical strategy employed, I follow an approach adopted by Bauernschuster, Hener and Rainer (2016) and Havnes and Mogstad (2011), where individuals are divided into treatment and control groups according to the absolute rate of increase in homicides between 2007 and 2011. Municipalities are first sorted according to how fast homicide rates increased in the area. Based on the variation in homicide growth rates, women are then segregated into treatment and control groups with individuals living in municipalities above the median rate of increase assigned to 'treatment'. Figure B illustrates the evolvement in relative decision-making power trends of women over the three MxFLS interview waves.

As can be seen, female bargaining power patterns over her children's goods in the pre-violence period differ minimally between treated and untreated women. The post-violence period as defined by the onset of the drug war shows larger deviations in relative decision-making power trends between the two groups. Throughout the post-violence period from 2007 to 2011, women in the control group experienced an overall mean increase of 0.54 in their relative bargaining power over children's goods, while treated women saw a decline of about 0.22 over the same sample period. A decrease in relative bargaining power for both treatment and control groups is nonetheless evident from the period just before the rise in homicides to after the increase in violence. Overall, the trends displayed in Figure B are consistent with the main results presented in Table 2, showing that women

exposed to higher levels of violence in terms of homicide rates experienced lower relative decision-making power over their children's goods.

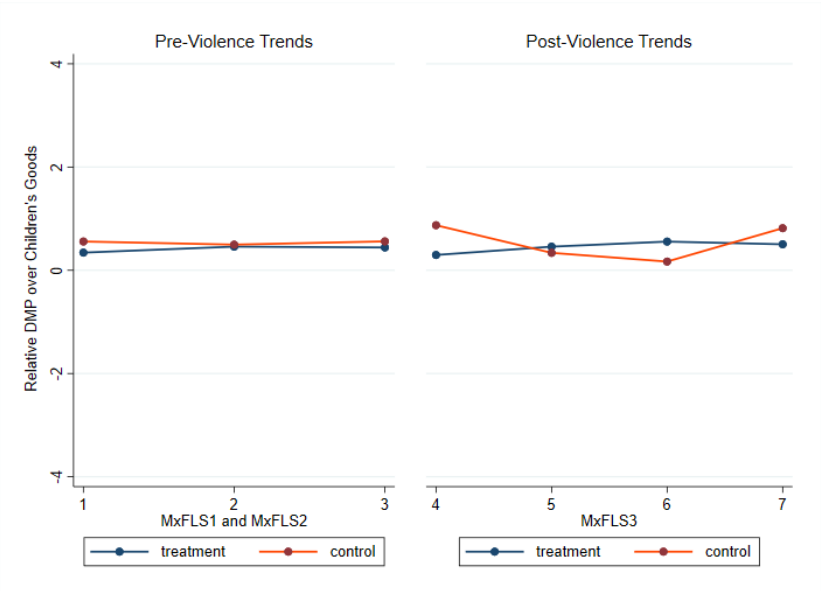

Figure B. Relative decision-making power (DMP) trends preceding the drug war (MxFLS1 & MxFLS2) and after the onset of the drug war (MxFLS3). Each data point from 1 to 7 contains averages of relative DMP indices over eight or nine months. In sum, there are 58 unique interview dates between MxFLS1(2002) and MxFLS3(2010), with 25 in the pre-violence period and 33 in the post-violence era.

To provide more support for unconfoundedness, I conduct a falsification test which performs a regression analogous to equation (1). Rather than examining the effect of past homicide rates on a woman's welfare outcomes, I look at the impact of *future* homicide rates in period *t+4*. The explanatory variable of interest, $HR_{m,t+4}$ is the average quartic root of the homicide rate per 100,000 inhabitants in municipality *m*, one trimester *after* a woman's interview date. The analysis is motivated by the fact that future homicide rates should not in theory affect current female outcomes, if the increase in homicides is truly exogenous to pre-existing trends in a woman's wellbeing. Accordingly, Table B4 of the appendix displays results from the falsification test, and shows an insignificant effect of future homicide rates on female welfare outcomes, other than on the fear of assault. The magnitude of the coefficients is additionally small (although not zero), lending support to the quick and sudden rise in homicides as an exogenous event. Lastly, the positive and significant effect of future homicide rates on the probability of fearing assault is expected, given that anticipated future attacks are likely to instil fear among individuals.

V.3 *Heterogeneous impacts*

The rise in violence following President Calderón's war against drug cartels could have had differential impacts across socio-economic groups, areas that were at a higher risk of violence and on women who had previous experiences of assault. Subsequently, the following section tests for heterogeneous impacts of the

drug war along these dimensions. First, I examine if higher homicide rates had disproportionately affected poorer women, by ranking individuals according to their household wealth. 'Poor' women are defined those that belong to households at the bottom 25th percentile of household income. Accordingly, I interact the homicide rate with a binary indicator equal to 1 if a woman is poor in equation (1). Table 3 presents the results from the analysis revealing the opposite effect of violence on employment as shown in Table 2, with positive and significant coefficients.

Table 3
The effect of homicide rates (HR) on poorer women's welfare outcomes.

Wife's relative decision-making power over children's goods			
	(1)	(2)	(3)
HR * poor	-0.117	-0.136	-0.152
	(0.095)	(0.101)	(0.102)
Controls	No	Yes	Yes
Endogenous controls	No	No	Yes
Mean	0.477	0.477	0.477
N	10739	10563	10556
R2	0.473	0.478	0.480

	Employment			*Time allocated to work (hours)*		
	(1)	(2)	(3)	(4)	(5)	(6)
HR * poor	0.081**	0.077*	0.076*	2.465	2.055	2.008
	(0.039)	(0.040)	(0.042)	(2.052)	(2.112)	(2.140)
Controls	No	Yes	Yes	No	Yes	Yes
Endogenous controls	No	No	Yes	No	No	Yes
Mean	0.194	0.194	0.194	8.505	8.505	8.505
N	10653	10556	10455	10653	10556	10455
R2	0.757	0.763	0.765	0.688	0.695	0.696

	Fear of assault		*Changed transport*		*Neighborhood trust*	
	(1)	(2)	(3)	(4)	(5)	(6)
HR * poor	0.072*	0.046	0.067	0.081**	0.097	0.088
	(0.037)	(0.037)	(0.040)	(0.040)	(0.060)	(0.064)
Controls	No	Yes	No	Yes	No	Yes
Mean	0.369	0.369	0.092	0.092	0.786	0.786
N	11865	11689	11767	9494	7152	6934
R2	0.465	0.476	0.448	0.494	0.591	0.598

Notes: Standard errors clustered at the MxFLS1 municipality of residence and reported in parentheses. All regressions include individual fixed effects and month of interview fixed effects. Sample contains only married or cohabiting women. *** p <0.01 ** p <0.05 *p <0.1.

Estimates are additionally about 1.5 times larger than the main results, indicating that the effect of violence on female labor supply is weaker among poorer women who may have been compelled to work. This could be because of low husbands' earnings for instance, which were insufficient to support children's and household expenditures. Women from poorer households also have greater economic incentives to participate in the labor force if the benefits of working outweigh the risk of assault. Altogether, the results are consistent with Siddique's (2018) finding on India, where

destitute women living in places with higher reports of sexual assault, participated more in the labor market despite their precarious surroundings.

Ethnographic studies additionally suggest that women from lower socio-economic classes may be more resilient and less vulnerable to increasing levels of violence. The estimates nonetheless show otherwise, that women from poorer households still feared assault and took precautionary measures through changing transportation routes during violent times. The coefficients for the fear of assault are additionally larger than the main results presented, indicating that these women were more afraid of rising levels of violence than those who were better off. Taken together, the findings demonstrate a trade-off between emotional well-being and labor force participation, as women from poorer households were more fearful in the midst of higher homicide rates, and yet, were still coerced to work given their limited options. Lastly, no effects of violence on poor women's relative bargaining power, the time allocated to work in a week and perceived neighborhood trust are observed, suggesting that the main results for these variables were not driven by this particular socio-economic group.

Municipalities with previous drug cartel presence could also be at higher-risk of violence, considering President Calderón's tight crackdown on drug trading activities that fuelled violent clashes between the Mexican army and drug lords. In order to examine the effect of the rise in homicides on potentially riskier municipalities, I use data recorded by Coscia and Rios (2012) on the presence of Mexican drug cartels across municipalities. The data shows geographical variation across Mexico, where half of the municipalities in the sample had at least one active drug cartel between 2000 and 2006. Accordingly, I consider these municipalities to be at a 'high-risk' of violence as they were more likely to be targets of President Calderón's anti-drug trafficking policy. To examine if women living in areas that were at higher-risk of violence were more affected by the drug war than those in lower-risk areas, I interact homicide rates with a dichotomous variable equal to one if a woman resided in a municipality that had at least one drug cartel present between 2000 and 2006, prior to the start of the drug war in 2007. The results are presented in Table 4 and show that the effect of violence on employment was stronger for women living in high-risk areas than on those who lived in relatively less risky municipalities.

Compared to the main results in Table 2, the coefficients for employment are larger and significant at a 10% level. This suggests that the main results could have been driven by women living in more violent municipalities. Specifically, a percentage point increase in the homicide rate lowered the probability of employment by 6.2 percentage points for women living in riskier municipalities, greater than the 4.8 percentage point decline observed in the main results in Table 2. The impact of homicides on the fear of assault, transportation route changes and neighbourhood trust is also evident among this group of women. Overall, the sign and significance of estimates are close to those presented in Table 2, other than for neighbourhood trust. As expected, perceived neighbourhood trust was lower among women living in municipalities at a higher-risk of violence, consistent with various

studies that have documented lower community trust levels amidst civil conflict. Lastly, the results show that women residing in riskier municipalities were not likely to experience differential impacts on their relative decision-making power over her children's goods and services or a time allocated to work in a week, compared to women residing in low-risk areas.

Table 4
The effect of homicide rates (HR) on female welfare outcomes (low vs. high-risk municipalities).

Wife's relative decision-making power over children's goods			
	(1)	(2)	(3)
HR * high-risk	0.059	0.058	0.067
	(0.104)	(0.097)	(0.096)
Controls	No	Yes	Yes
Endogenous controls	No	No	Yes
Mean	0.477	0.477	0.477
N	11085	10912	10903
R2	0.463	0.467	0.469

	Employment			*Time allocated to work (hours)*		
	(1)	(2)	(3)	(4)	(5)	(6)
HR * high-risk	-0.062	-0.062*	-0.068*	-2.196	-2.016	-2.281
	(0.038)	(0.035)	(0.035)	(1.872)	(1.831)	(1.860)
Controls	No	Yes	Yes	No	Yes	Yes
Endogenous controls	No	No	Yes	No	No	Yes
Mean	0.194	0.194	0.194	8.505	8.505	8.505
N	10997	10902	10803	10997	10902	10803
R2	0.593	0.605	0.607	0.605	0.617	0.618

	Fear of assault		*Transport change*		*Neighborhood trust*	
	(1)	(2)	(3)	(4)	(5)	(6)
HR * high-risk	0.076*	0.066	0.049*	0.011	-0.171***	-0.148***
	(0.042)	(0.042)	(0.025)	(0.031)	(0.051)	(0.051)
Controls	No	Yes	No	Yes	No	Yes
Mean	0.369	0.369	0.092	0.092	0.786	0.786
N	12233	12061	12138	9867	7570	7346
R2	0.457	0.469	0.428	0.469	0.592	0.596

Notes: Standard errors clustered at the MxFLS1 municipality of residence and reported in parentheses. All regressions include individual fixed effects and month of interview fixed effects. Sample contains only married or cohabiting women. *** p <0.01 ** p <0.05 *p <0.1.

Finally, the last set of analyses on heterogeneous impacts examines the effect of violence on women who had previously been attacked or assaulted. Research shows that individuals who had past traumatic experiences are more likely to suffer from Post-Traumatic Stress Disorders (PTSDs), which potentially affects their performance and participation in daily activities. Especially during stressful times such as the Mexican drug war, symptoms of PTSDs may be elevated. Using information on whether a woman had previously been attacked in the MxFLS, I interact the homicide rate with a dummy indicating if a woman had been assaulted before or not. Table 5 presents the results which show that women who had past

experiences of assault experienced significantly lower employment probabilities than women who had not been assaulted before. Overall, the coefficients are approximately three times larger than those presented in Table 2 and are significant at a 10% level. This suggests that higher homicide rates exacerbated female employment outcomes particularly more among women who had been harassed in the past. Additionally, the results reveal that this group of women took greater precaution amidst violent surroundings by changing transportation routes as a security measure. Similarly, the estimates are nearly three times larger than the ones in Table 2, indicating that women who had previously been assaulted were more wary during the drug war and were more likely to change their transportation routes. Lastly, no significant differences between women who were attacked before and those who were not in terms of the time allocated to work in hours, relative bargaining power over their children's goods and services, current fear of assault and perceived neighbourhood trust are observed.

Table 5
The effect of homicide rates (HR) on welfare outcomes of women who had previously been attacked.

Wife's relative decision-making power over children's goods			
	(1)	(2)	(3)
HR * been assaulted	-0.162	-0.167	-0.167
	(0.150)	(0.148)	(0.145)
Controls	No	Yes	Yes
Endogenous controls	No	No	Yes
Mean	0.477	0.477	0.477
N	10943	10855	10846
R2	0.465	0.469	0.470

	Employment			*Time allocated to work (hours)*		
	(1)	(2)	(3)	(4)	(5)	(6)
HR * been assaulted	-0.108*	-0.113*	-0.103*	-4.631	-4.725	-4.477
	(0.056)	(0.057)	(0.057)	(2.964)	(2.922)	(3.087)
Controls	No	Yes	Yes	No	Yes	Yes
Endogenous controls	No	No	Yes	No	No	Yes
Mean	0.194	0.194	0.194	8.505	8.505	8.505
N	10870	10846	10749	10870	10846	10749
R2	0.602	0.606	0.608	0.616	0.619	0.621

	Fear of assault		*Transport change*		*Neighborhood trust*	
	(1)	(2)	(3)	(4)	(5)	(6)
HR * been assaulted	-0.065	-0.046	0.128**	0.160**	-0.157	-0.160
	(0.037)	(0.074)	(0.053)	(0.068)	(0.105)	(0.105)
Controls	No	Yes	No	Yes	No	Yes
Mean	0.369	0.369	0.092	0.092	0.786	0.786
N	12094	12001	12091	9820	7344	7270
R2	0.468	0.473	0.428	0.469	0.591	0.593

Notes: Standard errors clustered at the MxFLS1 municipality of residence and reported in parentheses. All regressions include individual fixed effects and month of interview fixed effects. Sample contains only married or cohabiting women. *** p <0.01 ** p <0.05 *p <0.1.

V.4 *Robustness*

This section performs a series of robustness tests. First, there may be concerns with the explicit division of decision-making questionnaires based on the literal definition of a wife's private goods, a husband's private goods, household consumption goods and children's goods and services. If the definition of certain goods differs for individuals, this could result in measurement errors and potentially bias estimates. In some instances, women may group personal goods together with household expenditures, which would make bargaining power over these two explicit good types correlated in the data. To check if this is a potential issue, I perform a standard principal component analysis (PCA) on a woman's relative bargaining power over each of the twelve decision-making questions asked in the MxFLS, and subsequently re-estimate equation (1) using the factor components from the PCA as outcome variables. PCA is a data technique that simplifies the interpretation of coefficients by eliciting the underlying latent components from a large set of variables. It draws out the main factor components of each decision-making category type: Wife's goods, Husband's goods, Household consumption and Children's goods and services, by calculating the variance in all twelve decisions that are accounted for by each component (Jöreskog & Sörbom, 1979). The components from the resulting PCA are consistent with existing household bargaining literature in that they reflect four different aspects: Factor 1 – Children's goods, Factor 2 – Husband's goods, Factor 3 – Wife's goods, and Factor 4 – Household and income expenditures.[21] The results from the above analysis in Table 6 show that coefficients are significant at a 1% level and are negative across specifications for a woman's relative decision-making power over her children's goods. The magnitude of the coefficients is about twice as large, indicating a stronger negative impact of homicides on a woman's bargaining power. The enlargement of estimates for children's goods using PCA suggests that decision-making over goods across different category types are possibly correlated to some extent, and that the consequences of violent living conditions on female bargaining outcomes and children's welfare may be more severe after accounting for possible heterogeneity in the definition of goods and services across individuals.

Another potential concern is that municipalities that experienced sharper increases in homicides between 2007 and 2011 drove the main findings. To examine the sensitivity of the results to these municipalities, I first order municipalities according to the rate of increase in homicides from 2007 to 2011, similar to the approach used in section V. Adopting an empirical strategy analogous to equation (1), I exclude municipalities with rates of increases above the 75th percentile from my sample of analysis. The respective results displayed in Table B9 of the appendix show that estimates get larger and increase in significance when municipalities with high homicide growth rates are omitted, other than for employment probabilities. The increase in the magnitude and significance of

[21] Eigenvalues and factor loadings from the PCA are presented in Tables B7 and B8 of the appendix. Factors with eigenvalues greater than 1 are retained.

estimates, despite the omission of municipalities that experienced high rates of increases in homicides, indicates that upward biases of the main estimates are unlikely. Coefficients for employment probabilities are additionally no longer significant suggesting that women living in municipalities with more rapid increases in violence were less likely to participate in the labour force. This finding is consistent with the analysis presented in section V where women living in higher-risk areas experienced lower employment probabilities.

Table 6
The effect of homicide rates (HR) on a woman's decision-making power over children's goods (factor component derived through PCA).

Wife's relative decision-making power over children's goods			
	(1)	(2)	(3)
HR	-0.246**	-0.270***	-0.273***
	(0.095)	(0.097)	(0.095)
Controls	No	Yes	Yes
Endogenous controls	No	No	Yes
Mean	0.694	0.694	0.694
N	11039	10866	10857
R2	0.451	0.457	0.460

Notes: Standard errors clustered at the MxFLS1 municipality of residence and reported in parentheses. All regressions include individual fixed effects and month of interview fixed effects. Sample contains only married or cohabiting women. *** p <0.01 ** p <0.05 *p <0.1.

An additional concern relates to differing patterns of drug trading activities and hence violence, in municipalities situated along the U.S.- Mexican border. In an alternate analysis, I exclude municipalities in three states represented in the MxFLS that border the U.S., namely Sonora, Coahuila and Nuevo Leon.[22] Table B10 of the appendix shows that estimates are significant at levels similar to Table 2, although coefficients are smaller with the exclusion of the three border states, for decision-making, hours allocated to work in a week and the fear of assault. The magnitude of the estimates for employment probability, transport route changes and neighbourhood trust are larger than those presented in Table 2. Altogether, coefficient estimates do not differ to a large extent, indicating that women living in municipalities along the U.S. - Mexican border did not particularly influence the main results.

Lastly, one may be concerned that a coinciding event related to the 2007-2008 global financial crisis influenced levels of violence across Mexico, other than the Mexican Drug War. The main threat to identification would be that municipalities which experienced high growth rates in homicides were also the most affected by the financial crisis. If this was the case, the effect of homicides on female welfare outcomes would be upward biased as they could have been partially affected by the economic downturn during the same period. In order to attenuate concerns arising from this probable overlap of events, I control for community

[22] Six states in total border the U.S. The states of Chihuahua, Tamaulipas and Baja California North are however not represented in my sample of analysis and are therefore not included.

economic conditions provided in the community level questionnaires in the MxFLS. A number of studies namely by Brown et al. (2017), Ajzenman et al. (2015) and Velásquez (2010) have reaffirmed that differences in the economic impact of the global financial crisis were uncorrelated with differences in homicide growth rates across municipalities. Additionally, only one individual represented in the sample of analysis was interviewed between December 2007 and June 2009, which was the official recessionary period according to the U.S. Bureau of Labor Statistics (BLS, 2012). Notwithstanding, I include in equation (1), the log of the local population, three binary indicators denoting if the prices of corn, health services and education had increased in the last twelve months, and a dummy equal to 1 if job opportunities had decreased over the past year. The results presented in Table B11 of the appendix show that coefficients remain significant at a 5 - 10% level across specifications, suggesting that the global financial crisis between 2007-2008 did not confound the main results presented in Table 2 to a large extent.

VI. Conclusion

Exploiting the exogenous rise in homicides across Mexico between 2007 and 2011, this study is able to elucidate some of the negative consequences of violence on various forms of female empowerment. The empirical results suggest that violent surroundings lowered a woman's relative decision-making power over her children's goods, worsened employment outcomes, and increased the fear of assault, probability of changing transport routes and neighbourhood distrust. The findings on bargaining power can be juxtaposed against an abundance of intra-household decision-making literature documenting gender differences in preferences over the allocation of income resources to children's consumption (Gitter and Barham 2008; Quisumbing and Maluccio 2003; Duflo 2003; Handa 1996; Hoddinott and Haddad 1994). Considering that females typically prefer allocating income resources to children more than males, their bargaining power over children's goods may be more sensitive to changes in the outside option characterized by unsafe living conditions. Pre-existing social norms that impel women to devote earnings to meet collective household needs including children's rather than individual consumption needs, could additionally explain the sensitivity of female bargaining power over children's goods to external environmental changes.[23]

The results also highlight the importance of safety and community trust for various facets of female welfare related to employment, mobility and emotional and mental well-being. This study demonstrates that higher homicide rates stimulate negative behavioural and emotional changes where women are more likely to feel afraid and change transport routes as a security measure. These effects coupled with the observed decrease in social capital stock proxied by

[23] Children are typically treated as 'public goods' in economic literature since both parents are assumed to derive utility from their kids (Folbre, 1994).

neighbourhood distrust, suggests that women may decrease their work effort and hence experience poorer bargaining outcomes over their children's goods as a result of emotional and psychological distress, enhanced wariness and poorer social networks.

The effect of violence is also found to be disproportionately stronger among women from poorer households, women living in riskier areas and women who had previously been assaulted. While the labor supply of relatively poorer women is less reactive to increases in violence, they face a trade-off between emotional and mental well-being and income earnings. Given that women from lower socio-economic classes generally have more incentive to work due to poverty, they may be compelled to work despite increasingly violent surroundings to maintain household and children's expenditures, though at an emotional and psychological cost. Women experiencing larger declines in employment and neighbourhood trust, particularly in municipalities that were more predisposed to violence additionally highlights the disproportionate consequences of the drug war on areas where drug cartels were more active. Finally, in line with psychological studies that document negative impacts of past exposure to traumatic events on labor market outcomes, I find that women who had previously been assaulted had considerably lower employment probabilities compared to those that had not. This group of women were also more likely to exercise greater caution in violent surroundings by changing their routes of transport as a safety measure.

From a policy perspective, more remains to be done in increasing the safety and security of women in public spaces in order to prevent large decreases in female labour force participation during volatile times. While some states in Mexico like Mexico City have introduced women-only train carriages, this service is mostly only offered during rush-hours. The state of Puebla has also introduced 'pink taxis' that only take on female but not male passengers (Brysk, 2018). Such gender-specific transport systems however, have not been sufficiently streamlined and normalized across the country and the provision of such services remains under-supplied. The formation of virtual patrol or watch groups is another cost-effective method to maintain neighbourhood trust levels in the midst of unstable social climates. In the Netherlands for instance, several municipalities have formed WhatsApp neighbourhood crime prevention (WNCP) groups to assist police and maintain order within neighbourhoods (Pridmore et al., 2018). In an increasingly technologically dominated era with high mobile phone penetration rates, mobile driven neighbourhood crime prevention methods could greatly benefit communities that lack the resources to hire proper physical patrolling services. In this sense, such technologically driven crime prevention methods could help to maintain stocks of social capital that may help to support female employment.

Lastly, while this study is able to provide some insights into the relationship between violent living conditions and female welfare, it is unable to quantify the full causal effects of the drug war on female empowerment. Because intra-household decision-making dynamics for instance are largely associated with behavioural traits that are especially susceptible to changes amidst unstable

surroundings, it is likely that a variety of less observable factors lower a woman's bargaining power through homicides. While governments tracking drug trading organizations (DTOs) have noticed an increasing number of women participating in drug trading businesses over the years, the illicit nature of drug trade implies the paucity of data on certain facets of the drug war that potentially affect female bargaining outcomes, such as prostitution. This suggests the need for more research in conflict stricken or prone areas, where women may be more vulnerable. Especially in Latin America where drug trading activities burgeon, more research on its impacts on women ought to be conducted to help inform gender-based policies.

Appendix A: Figures

DH01. INTERVIEWER VERIFY: ARE YOU MARRIED/LIVE IN DOMESTIC PARTNERSHIP WITH A HOUSEHOLD MEMBER? (HM08 FIRST COLUMN)

Yes ..... 1 → CONTINUE
No ..... 3 → SECTION MG

I am going to ask you how your family makes certain decisions.

(DH02 Type)	DH02. Generally speaking, in this household, who makes the decisions regarding [...]? (CIRCLE ALL THAT APPLY)															
EXPENSES AND TIME ALLOCATION	RESPONDENT	SPOUSE	SON/DAUGHTER	MOTHER	FATHER	MOTHER IN LAW	FATHER IN LAW	BROTHER	SISTER	BROTHER IN LAW	SISTER IN LAW	GRANDPARENTS	Other (specify)	W	X Y	DOES NOT KNOW
A. The food eaten in this household	A	B	C	D	E	F	G	H	I	J	K	L	M _____			8
B. Your clothes	A	B	C	D	E	F	G	H	I	J	K	L	M _____			8
C. Your spouse's/partner's clothes	A	B	C	D	E	F	G	H	I	J	K	L	M _____			8
D. Your children's clothes	A	B	C	D	E	F	G	H	I	J	K	L	M _____	W		8
E. Your children's education	A	B	C	D	E	F	G	H	I	J	K	L	M _____	W		8
F. Your children's health services and medicines	A	B	C	D	E	F	G	H	I	J	K	L	M _____	W		8
G. Important household expenditures (refrigerator, car, furniture, etc.)	A	B	C	D	E	F	G	H	I	J	K	L	M _____			8
H. Money that is given to your parents/relatives	A	B	C	D	E	F	G	H	I	J	K	L	M _____	X		8
I. Money that is given to your parents-in-law/relatives of your spouse/partner	A	B	C	D	E	F	G	H	I	J	K	L	M _____	X		8
J. If you should work or not	A	B	C	D	E	F	G	H	I	J	K	L	M _____			8
K. If your spouse/partner should work or not	A	B	C	D	E	F	G	H	I	J	K	L	M _____			8
L. If you or your spouse/partner use birth-control (for not having children)	A	B	C	D	E	F	G	H	I	J	K	L	M _____		Y	8

Code DH02: W. Does not have sons/daughters (in or outside the household)
X. Does not have parents/parents in law/relatives, or does not give them money (in or outside the household)
Y. Does not apply

Figure A1. *MxFLS* questionnaire on decision-making. *Notes*: This diagram shows a sample of the decision-making questionnaire of the *MxFLS* survey. In total, twelve decision-making questions ('A' to 'L') are administered to both a woman and her partner. The decision-making questionnaire is the same across the two survey waves used in this study.

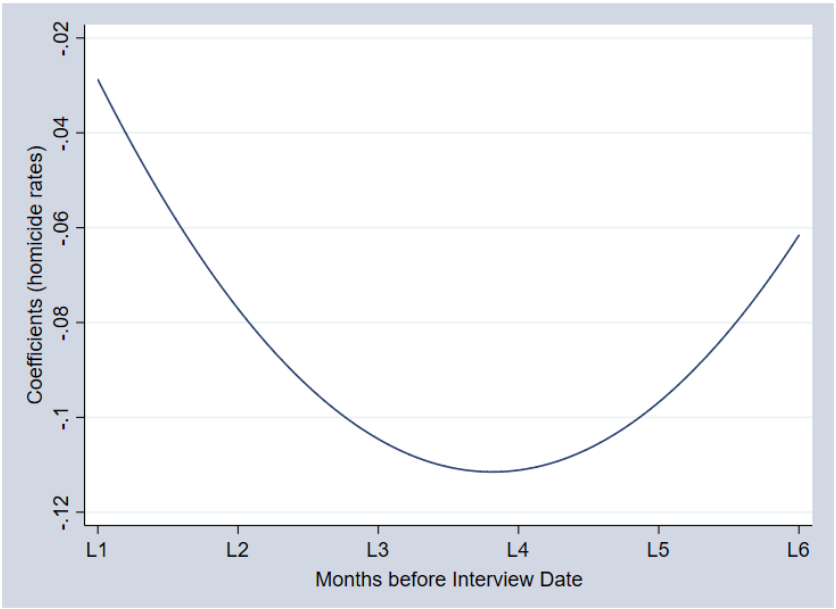

Figure A2. The figure plots the coefficients of mean homicide rates 1-6 months prior to a woman's interview date. Estimates are produced from estimating equation (1) with standard errors clustered at the MxFLS1 municipality of residence, and including baseline covariates. Coefficients reflect the effect of homicides on a woman's relative decision-making power over her children's goods and services.

Appendix B: Tables

Table B1

Summary Statistics of Dependent Variables.

Dependent Variables – Woman's relative decision-making power over (MxFLS):	Mean	SD	Min	Max	*N*
Household goods and services	0.5	0.9	-3	3	12,240
Husband's private goods and services	-1.2	1.3	-3	3	12,240
Wife's private goods and services	1.1	1.2	-3	3	12,240
Children's goods and services	0.5	1.0	-3	3	11,253
Dependent Variables – Woman's relative decision-making power over individual decisions over (MxFLS):					
Contraceptive use	0.0	0.3	-1	1	12,240
Spouse's work choice	-0.6	0.6	-1	1	12,240
Own work choice	0.2	0.8	-1	1	12,240
Money given to spouse's family	-0.2	0.5	-1	1	12,240
Money given to own family	0.2	0.5	-1	1	12,240
Large expenditures	-0.2	0.6	-1	1	12,240
Child's health	0.1	0.4	-1	1	11,239
Child's education	0.1	0.4	-1	1	11,223
Child's clothes	0.3	0.5	-1	1	11,242
Spouse's clothes	-0.4	0.8	-1	1	12,240
Own clothes	0.8	0.5	-1	1	12,240
Food eaten in the house	0.6	0.6	-1	1	12,240
Other Dependent Variables (MxFLS):					
Employment	0.2	0.4	0	1	12,240
Hours worked	8.5	18.0	0	107	12,240
Fear of assault	0.4	0.5	-1	1	12,240
Transport route change	0.1	0.2	-1	1	11,147
Neighborhood trust	0.8	0.4	-1	1	7,894

Notes: Summary statistics of dependent variables. The number of observations (*N*) for variables relating to children's goods and services is smaller, since not all women in the sample have children.

Table B2

Summary Statistics of Independent Variables.

Independent Variables (MxFLS):	Mean	SD	Min	Max	*N*
Homicide Rate (HR)	0.5	0.5	0	2.1	12,238
Controls:					
Individual:					
Indigenous	0.1	0.3	0	1	12,162
Spouse present during interview	0.1	0.3	0	1	12,137
Wife's age	44.2	13.2	15	98	12,175
Wife's age squared	2,131.7	1,276.5	225	9,604	12,175
Wife's education (in years)	9.6	4.4	0	22	12,224
Wife's employment status	0.2	0.4	0	1	12,240
Household:					
Number of kids below 15	-0.1	1.7	-8.7	1.9	12,116
Household wealth index	0.4	0.5	0	1	11,694
Community:					
Price of corn increase	0.5	0.5	0	1	11,694
Price of healthcare increase	0.3	0.5	0	1	11,694
Price of education increase	9.6	2.9	0	19	11,694
Fewer job opportunities over past year	2.9	1.0	0	4	11,694
Transport development index	0.9	0.1	0	1.4	11,428
Proportion of houses with electricity	0.1	0.3	0	1	11,196
Log of population	0.1	0.3	0	1	10,929

Notes: Summary statistics of independent variables. Differences in the number of observations for perceived neighborhood trust result from the fact that only MxFLS2 and MxFLS3 provided questionnaires on trust.

Table B3

The effect of homicide rates (HR) on a woman's relative decision-making power (excluding women who moved).

Wife's relative decision-making power over children's goods			
	(1)	(2)	(3)
HR	-0.139**	-0.153**	-0.161***
	(0.060)	(0.060)	(0.061)
Controls	No	Yes	Yes
Endogenous controls	No	No	Yes
Mean	0.477	0.477	0.477
N	10783	10614	10605
R2	0.467	0.471	0.472

Notes: Standard errors clustered at the MxFLS1 municipality of residence and reported in parentheses. All regressions include individual fixed effects and month of interview fixed effects. Sample contains only married or cohabiting women. *** p <0.01 ** p <0.05 *p <0.1.

Table B4

The effect of homicide rates (*t+4*) on a woman's relative decision-making power over children's goods.

Wife's relative decision-making power over children's goods			
	(1)	(2)	(3)
HR (*t+4*)	-0.088	-0.083	-0.083
	(0.069)	(0.067)	(0.068)
Controls	No	Yes	Yes
Endogenous controls	No	No	Yes
Mean	0.477	0.477	0.477
N	11085	10912	10903
R2	0.463	0.467	0.468

Notes: Standard errors clustered at the MxFLS1 municipality of residence and reported in parentheses. All regressions include individual fixed effects and month of interview fixed effects. Sample contains only married or cohabiting women. *** p <0.01 ** p <0.05 *p < 0.1

Table B5

The effect of homicide rates (HR) on male employment outcomes.

	Employment			*Time allocated to work (hours)*		
	(1)	(2)	(3)	(4)	(5)	(6)
HR	-0.003	-0.019	-0.020	-1.780	-2.745	-2.694
	(0.031)	(0.027)	(0.028)	(2.082)	(1.826)	(1.805)
Controls	No	Yes	Yes	No	Yes	Yes
Endogenous controls	No	No	Yes	No	No	Yes
Mean	0.791	0.791	0.791	38.17	38.17	38.17
N	9713	9487	9402	9711	9485	9400
R2	0.619	0.645	0.648	0.584	0.603	0.606

Notes: Standard errors clustered at the MxFLS1 municipality of residence and reported in parentheses. All regressions include individual fixed effects and month of interview fixed effects. Sample contains only married or cohabiting women. *** p <0.01 ** p <0.05 *p <0.1.

Table B6

The effect of homicide rates (HR) on a woman's decision-making power over various types of goods and services.

Panel A. A woman's decision-making power over household goods			
	(1)	(2)	(3)
HR	-0.139	-0.153	-0.161
	(0.060)	(0.060)	(0.061)
Controls	No	Yes	Yes
Endogenous controls	No	No	Yes
Mean	0.478	0.478	0.478
N	10783	10614	10605
R2	0.467	0.471	0.472
Panel B. A woman's decision-making power over her husband's private goods			
	(1)	(2)	(3)
HR	0.093	0.108	0.120
	(0.086)	(0.086)	(0.084)
Controls	No	Yes	Yes
Endogenous controls	No	No	Yes
Mean	-1.190	-1.190	-1.190
N	12233	12061	12049
R2	0.412	0.419	0.419
Panel C. A woman's decision-making power over her own private goods			
HR	-0.081	-0.094	-0.090
	(0.084)	(0.087)	(0.083)
Controls	No	Yes	Yes
Endogenous controls	No	No	Yes
Mean	1.119	1.119	1.119
N	12233	12061	12049
R2	0.439	0.452	0.457

Notes: Standard errors clustered at the MxFLS1 municipality of residence and reported in parentheses. All regressions include individual fixed effects and month of interview fixed effects. Sample contains only married or cohabiting women. Baseline controls include a wife's age, age squared, indigenous status and an interview dummy indicating the presence of his spouse during the interview. Endogenous controls include a woman's educational attainment, employment status and the number of kids below 15 at home. *** p <0.01 ** p <0.05 *p <0.1.

Table B7

Principal Component Analysis (PCA) of all twelve relative decision-making indices.

	Eigenvalue	Proportion of Variance	Cumulative Proportion of Variance
Factor 1	2.463	0.2052	0.2052
Factor 2	1.815	0.1513	0.3565
Factor 3	1.244	0.1037	0.4602
Factor 4	1.078	0.0899	0.5501

Notes: Factors with eigenvalues above 1 are retained.

Table B8

Factor loadings from PCA.

Relative Decision-Making Power Index for:	Factor 1 (1)	Factor 2 (2)	Factor 3 (3)	Factor 4 (4)
Child's clothes	**0.3853**	0.0710	-0.3660	-0.0828
Spouse's work choice	-0.1311	**0.4617**	-0.0006	0.0844
Money to Spouse's family	-0.0993	**0.3897**	-0.0586	**0.6295**
Spouse's clothing	0.0479	**0.4159**	-0.1991	-0.3148
Own work choice	0.2290	-0.0105	**0.5626**	0.0912
Money to own family	0.2949	-0.0481	**0.4675**	-0.3321
Own clothes	0.3710	-0.3070	-0.0515	**0.4106**
Contraceptive use	0.2175	0.1196	0.2616	-0.0259
Large household expenditures	0.0907	0.4196	0.3740	0.2419
Food	0.3433	-0.2445	-0.1433	**0.3492**
Child's health	**0.4284**	0.2301	-0.1599	-0.1046
Child's education	**0.4338**	0.2391	-0.1754	-0.1063

Notes: Bolded estimates indicate the strongest factor loadings for each category of decision-making power goods.

Table B9

Outcomes excluding municipalities with homicide rate increases above the 75th percentile.

Wife's relative decision-making power over children's goods			
	(1)	(2)	(3)
HR	-0.207***	-0.220***	-0.231***
	(0.064)	(0.064)	(0.065)
Baseline controls	No	Yes	Yes
Endogenous controls	No	No	Yes
Mean	0.477	0.477	0.477
N	7922	7808	7800
R2	0.464	0.469	0.471

	Employment			*Time allocated to work (hours)*		
	(1)	(2)	(3)	(4)	(5)	(6)
HR	-0.058	-0.054	-0.058	-3.785***	-3.638***	-3.532**
	(0.037)	(0.036)	(0.036)	(1.364)	(1.349)	(1.383)
Controls	No	Yes	Yes	No	Yes	Yes
Endogenous controls	No	No	Yes	No	No	Yes
Mean	0.194	0.194	0.194	8.505	8.505	8.505
N	7871	7804	7726	7871	7804	7726
R2	0.592	0.607	0.609	0.613	0.627	0.629

	Fear of assault		*Transport route change*		*Neighborhood trust*	
	(1)	(2)	(3)	(4)	(5)	(6)
HR	0.089**	0.081*	0.035	0.053**	-0.114**	-0.118**
	(0.040)	(0.042)	(0.026)	(0.025)	(0.045)	(0.046)
Controls	No	Yes	No	Yes	No	Yes
Mean	0.369	0.369	0.092	0.092	0.786	0.786
N	8778	8655	8708	7191	5436	5272

R2	0.472	0.486	0.432	0.474	0.595	0.602

Notes: Standard errors clustered at the MxFLS1 municipality of residence and reported in parentheses. All regressions include individual fixed effects and month of interview fixed effects. Sample contains only married or cohabiting women. *** p <0.01 ** p <0.05 *p <0.1.

Table B10

Outcomes excluding municipalities along the U.S. – Mexican border.

Wife's relative decision-making power over children's goods			
	(1)	(2)	(3)
HR	-0.116*	-0.133*	-0.140**
	(0.067)	(0.068)	(0.069)
Baseline controls	No	Yes	Yes
Endogenous controls	No	No	Yes
Mean	0.477	0.477	0.477
N	7401	7315	7307
R2	0.468	0.472	0.474

	Employment			*Time allocated to work (hours)*		
	(1)	(2)	(3)	(4)	(5)	(6)
HR	-0.058*	-0.057*	-0.063*	-2.611*	-2.555*	-2.538**
	(0.035)	(0.034)	(0.033)	(1.321)	(1.298)	(1.278)
Controls	No	Yes	Yes	No	Yes	Yes
Endogenous controls	No	No	Yes	No	No	Yes
Mean	0.194	0.194	0.194	8.505	8.505	8.505
N	7398	7347	7284	7398	7347	7284
R2	0.584	0.598	0.599	0.609	0.623	0.624

	Fear of assault		*Transport change*		*Neighborhood trust*	
	(1)	(2)	(3)	(4)	(5)	(6)
HR	0.080*	0.073*	0.047*	0.054**	-0.135***	-0.134***
	(0.042)	(0.043)	(0.025)	(0.024)	(0.046)	(0.047)
Controls	No	Yes	No	Yes	No	Yes
Mean	0.369	0.369	0.092	0.092	0.786	0.786
N	8228	8133	8170	6780	5164	5034
R2	0.469	0.480	0.438	0.483	0.591	0.598

Notes: Standard errors clustered at the MxFLS1 municipality of residence and reported in parentheses. All regressions include individual fixed effects and month of interview fixed effects. Sample contains only married or cohabiting women. *** p <0.01 ** p <0.05 *p <0.1.

Table B11
Outcomes including community economic controls.

Wife's relative decision-making power over children's goods			
	(1)	(2)	(3)
HR	-0.133**	-0.164**	-0.176***
	(0.059)	(0.064)	(0.065)
Baseline controls	No	Yes	Yes
Endogenous controls	No	No	Yes
Mean	0.477	0.477	0.477
N	11085	9532	9522
R2	0.463	0.491	0.493

	Employment			*Time allocated to work (hours)*		
	(1)	(2)	(3)	(4)	(5)	(6)
HR	-0.049*	-0.063**	-0.066**	-2.656**	-2.627**	-2.538**
	(0.029)	(0.029)	(0.028)	(1.052)	(1.134)	(1.126)
Controls	No	Yes	Yes	No	Yes	Yes
Endogenous controls	No	No	Yes	No	No	Yes
Mean	0.194	0.194	0.194	8.505	8.505	8.505
N	10997	9579	9471	10997	9579	9471
R2	0.592	0.618	0.620	0.605	0.632	0.634

	Fear of assault		*Transport change*		*Neighborhood trust*	
	(1)	(2)	(3)	(4)	(5)	(6)
HR	0.093**	0.070*	0.038*	0.044**	-0.108***	-0.099**
	(0.036)	(0.037)	(0.022)	(0.019)	(0.038)	(0.045)
Controls	No	Yes	No	Yes	No	Yes
Mean	0.369	0.369	0.092	0.092	0.786	0.786
N	12233	10628	8170	6780	7570	6126
R2	0.456	0.497	0.427	0.473	0.589	0.591

Notes: Standard errors clustered at the MxFLS1 municipality of residence and reported in parentheses. All regressions include individual fixed effects and month of interview fixed effects. Sample contains only married or cohabiting women. *** p <0.01 ** p <0.05 *p <0.1.

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