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Abstract*

Accurate demographic data are essential for effective policy design, yet private costs may deter individuals from truthfully reporting sensitive information. We examine this market failure and its implications in the context of child motherhood. Using administrative records from Brazil, Mexico, and the United States, along with census data from 59 countries, we identify systematic patterns of under-reporting, indicating that child motherhood is significantly more prevalent than previously thought. Births to mothers aged 10-14 are often missing from contemporary administrative records but appear in censuses conducted a decade later, with under-counting in birth registries reaching 20-30% in Brazil, Mexico, and the United States. We introduce a model where reporting decisions weigh instrumental benefits against age-dependent private costs, yielding predictions that align with observed patterns: truthful reporting increases markedly with the mother's age, under-reporting of child-mother births decreases with the time elapsed between data collection and childbirth, and retrospective census estimates generally provide more accurate birth counts than contemporary administrative records for this age group, but not for older mothers. Our findings suggest that social costs, rather than fear of legal repercussions, are a primary driver of under-reporting.

JEL classifications: J13, D10, J18, D82
Keywords: child motherhood, private information, social norms.

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1 Introduction

Accurate demographic and health data are a valuable public good critical for effective resource allocation, informed policy responses, and advocacy that addresses social problems. Producing this public good relies on institutional capacity and, at times, heavily on individuals truthfully reporting information. However, when reporting incurs private costs, such as legal exposure or social stigma, individuals may choose to withhold information or report it inaccurately, imposing a negative externality on society by reducing the overall availability and quality of this public good (Blank et al., 2009; Duflo et al., 2013).

We study this asymmetric information market failure in the context of an important social issue: child-mother births. Extensive research shows that childbearing at a young age harms the well-being of both mother and child (e.g., Duflo 2012; Kearney and Levine 2015; Lang and Weinstein 2015). This is especially true for younger mothers (Aizer et al., 2022), whose pregnancies are often unwanted and a result of sexual violence. Hence, accurate data on the prevalence of child motherhood is essential to understanding the magnitude of the issue at hand and keeping track of its evolution. However, this age group, for which accurate data are essential, is also likely the group for which the asymmetric information problem is the largest because social or legal repercussions tend to intensify the younger the mother is at childbirth.

To guide our analysis, we propose a simple framework for the decision to report a birth with two reporting methods: administrative records and census interviews. Mothers can report births using either or both of the methods or choose not to report. Their decision depends on whether the benefits of reporting outweigh the associated costs. Young mothers, in addition to facing instrumental costs (e.g., fees, travel, or time required to report), may also encounter "social costs" (such as stigmatization or ostracism) and "judicial costs" (if the sexual encounter leading to the pregnancy is considered a crime).[1] These social and judicial costs decrease as the mother ages and more time passes between the birth and the mother's age at reporting.

Motivated by the testable predictions of our framework, we investigate the magnitude and drivers of the under-reporting of child motherhood in administrative records and censuses from over 50 countries. We begin by estimating the extent of under-reporting of child-mother births in administrative records in three large countries: Brazil, Mexico, and the United States. These countries have significant population sizes and the availability of comprehensive administrative and census data. By comparing birth counts from administrative records with those reconstructed from census data collected up to 15 years after childbirth,

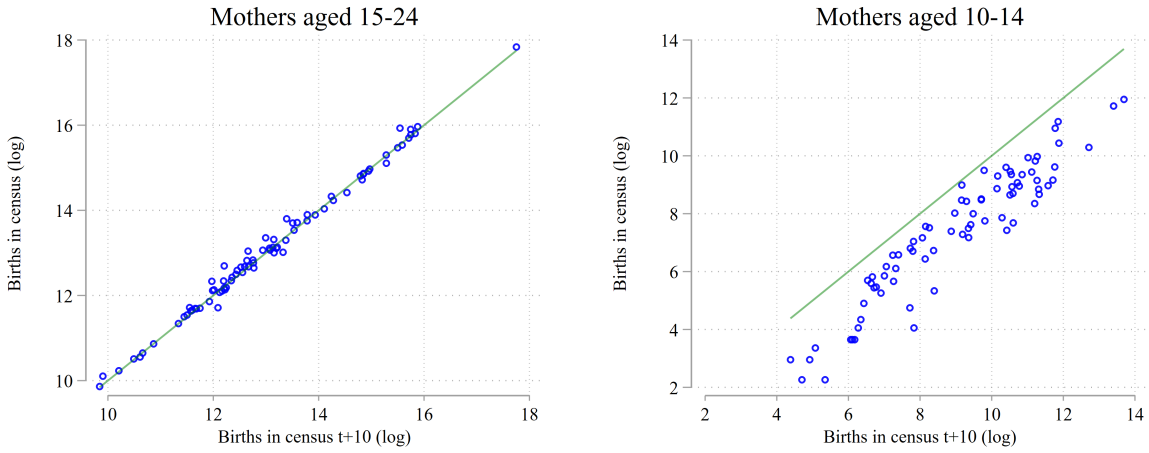
[1] Even if direct penalties affect only the father, the child-mother may experience a direct disutility from this legal exposure, either because they share an emotional, financial, or familial bond with the father, because they are vulnerable to verbal or physical retaliation from him, or because going through this legal process generates stress and suffering for the victim.

we can identify patterns of under-reporting across different age groups at the time of childbirth.

In our analysis, we expect that, in the absence of undercounting in birth registries, the number of births recorded in those registries will exceed the births inferred from subsequent censuses because census counts depend on children living with their mothers, which is not always the case and becomes less common as the children grow older. This prediction holds for mothers aged 15 or older at childbirth. However, for mothers aged 14 or younger at childbirth, we find that in all three countries, there are more births based on the estimates from the census 10 years after childbirth than in birth registries. These gaps, which represent lower bounds for under-reporting in birth registries, are substantial: 20% in Brazil (1999), 22% in Mexico (2009), and 29% in the United States (2009).

Next, we explore how child-mother birth reporting changes with the mother's age at the time of reporting. We leverage two complementary sources of variation. First, we compare birth counts for the same cohort of mothers recovered from subsequent census rounds. By comparing reporting of the same births across different census rounds, we hold the reporting method constant while varying only the mother's age at reporting. This comparison reveals that while birth counts for teen and young-adult mothers (aged 15-24 at delivery) are similar across census rounds, counts for child mothers are substantially lower in the baseline census—when mothers are still in their teens—compared to a decade later when they are in their twenties.

Figure 1: Estimated Birth Counts Based on Subsequent Censuses



Notes: The sample comprises 80 pairs of national censuses from 59 countries, with one observation per census pair, age of the mother at birth and the year of birth. We estimate the number of births by identifying the age at birth of the reported mother. Samples exclude children of foreign citizenship.

Figure 1 displays this striking pattern using 78 census pairs from 59 countries: while birth count estimates for the same cohort of teen and young-adult mothers are comparable across subsequent censuses (left side),

births to mothers aged 14 or younger (right side) show systematic under-reporting in the baseline censuses worldwide. This evidence is consistent with households not acknowledging the birth to a mother 10 to 14 years old if the mother is still in her teens at the time of the census but acknowledging it once the mother is in her twenties at the time of the census. This misreporting could take several forms, for example, omitting the presence of the child at the time of the interview or attributing the maternity of the child to another household member, for which we find evidence and later discuss.

The magnitude of under-reporting is inversely related to the mother's age at birth: baseline censuses miss approximately 65% of births to mothers aged 13 or younger, 50% of births to 14-year-old mothers, and 22% of births to 15-year-old mothers when compared to counts based on subsequent censuses. This pattern is remarkably consistent across countries and most pronounced for births occurring in the year immediately preceding the census, with the reporting gap diminishing as the time between birth and census increases. These findings suggest that previous estimates of under-registration of births—based on the possession of birth certificates among children reported in surveys and censuses occurring within a few years from childbirth—may significantly understate the true magnitude of the prevalence of child motherhood.

To investigate further how child-mother birth reporting changes with the mother's age at the time of reporting, we used Mexican administrative data from 1995 to 2020, where delayed information is available. We find that, while births to mothers aged 15-24 are typically registered within a year (80-90% of cases), births to mothers aged 10-14 show significantly longer delays, with only 50-80% registering within a year of the birth. The average registration delay decreases sharply with the mother's age, from 40 months for 12-year-old mothers to 10 months for 15-year-old mothers. Both patterns are consistent with reporting costs—whether social or judicial—declining as mothers age.

Finally, we investigate three key mechanisms underlying the observed under-reporting patterns. First, we find evidence that many births to child mothers are not entirely concealed but rather misattributed to older women in the household, particularly those beyond reproductive age. Comparing birth counts across census rounds reveals that women aged 45-55 report 80-200% more births in baseline censuses than in subsequent ones—a gap far exceeding what mortality rates alone could explain. This suggests families often report these births but attribute them to grandmothers or aunts.

Second, to assess the importance of judicial costs in the reporting decision, we exploit variation in minimum age of consent laws across countries and the timing of the pregnancy relative to the mother reaching the minimum age of consent. Using a regression discontinuity design, we find no evidence of discontinuous increases in birth reporting when mothers reach the age of legal consent, suggesting that fear of legal consequences for the abusers may not be a substantial driver of under-reporting.

Third, we examine how under-reporting varies with social norms surrounding female sexuality and reproductive rights across countries. Using data from UN Demographic and Health Surveys on women's autonomy in sexual decision-making, we find that, controlling for income levels, a one standard deviation increase in the share of women reporting autonomous sexual decisions is associated with a 20% reduction in under-reporting of child-mother births.

This paper contributes to three bodies of research. First, we make a contribution to the literature on child and teenage motherhood. Prior studies have examined the causes and consequences of fertility among teenage girls, showing that it is associated with negative outcomes for both mothers and their children (Corbacho et al., 2012; Duflo, 2012; Kearney and Levine, 2015; Klepinger et al., 1999; Lang and Weinstein, 2015). This social problem has attracted considerable policy attention, and the United Nations included reducing fertility rates among girls aged 10-19 as part of its Sustainable Development Goals (SDGs). However, both the academic literature and data used for policy primarily focus on fertility among girls aged 15-19, for whom reliable statistics are widely available. In contrast, fertility data for girls younger than 15 remain scarce and incomplete (Schoumaker and Sánchez-Páez, 2022; WHO, 2024). We contribute by producing lower-bound estimates of under-reporting for 59 countries, demonstrating that this phenomenon is more widespread and more prominent than previously thought, also affecting high- and middle-income countries. Importantly, we show that under-reporting occurs not only in census surveys but also in birth registries, which are often considered the most reliable data source for birth counts (Kearney and Levine, 2012).

Second, we extend prior research on the economics of information and public goods. Previous studies have shown that private costs can prevent individuals from truthfully disclosing socially valuable information in a variety of contexts, such as auditors reporting firms' pollution levels (Duflo et al., 2013), schools reporting student enrollment to the government (Sandefur and Glassman, 2015), and self-employed individuals declaring their income to tax authorities (Hurst and Pugsley, 2010). In the context of vital statistics, Blank et al. (2009) show that when early marriage is outlawed, individuals have incentives to misreport, leading to administrative records being an inferior data source compared to retrospective census data for studying the effects of age-of-marriage laws. Our study finds that administrative records can under-report child-mother births, even in the absence of legal repercussions, when individuals face non-pecuniary costs stemming from informal norms and social pressure.

Finally, we contribute to the literature on social norms. Prior research has shown that concerns for reputation and social image can be as influential as material incentives (Bénabou and Tirole, 2006; Butera et al., 2022; Daughety and Reinganum, 2009). Social pressure can encourage socially beneficial behavior in contexts such as voting (Ali and Lin, 2013), workplace safety (Johnson, 2020), saving (Breza and Chandrasekhar,

2019), and vaccination (Karing, 2024). However, it can also result in welfare-reducing actions, such as charitable giving beyond individual preferences (Dellavigna et al., 2012) or under-investment in education (Bursztyn and Jensen, 2015; Bursztyn et al., 2019). We show how these types of pressures can also lead individuals to under-report socially sensitive information, such as child-mother births.

This paper continues as follows. Section 2 introduces the conceptual framework, and Section 3 presents and discusses our data and measures. Section 4 presents our main empirical results, and Section 5 provides further evidence on the mechanisms. Section 6 concludes.

2 Conceptual Framework

To guide our empirical analysis, we consider a simple framework to analyze a mother's decision to report the birth of a child in a context with social and legal norms about the acceptable age for motherhood.

Environment

A child is born in period t_b to a mother of age a_b.[2] Mothers can report births using either or both of two reporting methods, $\tau \in \{C, A\}$, where C is a census interview, and A is the government's administrative records (birth registries). We denote the mother's age at the time of reporting using method τ as $a_{r,\tau}$. The mother makes an observable decision $r_\tau \in \{0, 1\}$ at period $t_r \geq t_b$, consisting of whether to report the birth under method τ truthfully ($r_\tau = 1$) or not to do so ($r_\tau = 0$). Truthfully reporting the birth encompasses accurately disclosing: i) the occurrence of the birth or the existence of the child, ii) the identity and age of the mother, and iii) the age or date of birth of the child.

Instrumental Payoffs

Reporting the child's birth generates method-specific instrumental benefits, the present value of future flows of the benefits that both the mother and the child receive as a result of the decision to report.[3] The benefits from truthfully reporting in census interviews come from improved availability and quality of public services

[2]For simplicity, we assume that each mother has only one child and that she makes the decision on whether to report the birth or not. In practice, other household members may be responsible for this decision. In such cases, we assume they are exposed to the same set of incentives and would make the same choice as the mother.

[3]Here, we assume that mothers are altruistic, such that they care about the child's payoff as much as about their own, and the instrumental payoff to registration is the sum of the mother's payoff and the child's payoff.

or additional government transfers to the community, which are frequently allocated and targeted using census data. The benefits from truthfully reporting in administrative records encompass access to childcare, healthcare, education, and other social programs, as well as any non-pecuniary welfare benefit. Reporting also generates method-specific costs, which may include pecuniary costs, like those derived from registration fees or transport costs, as well as non-pecuniary costs, like the opportunity cost of time. The instrumental payoffs are the method-specific benefits net of reporting costs. These payoffs vary across households and may also encompass the household's commitment to honesty. We denote this instrumental payoff as v_τ, and assume it is uniformly distributed between 0 and V_τ.

Social and Judicial Costs

In addition to the instrumental costs, the decision to report can generate "social" costs (S) and "judicial" costs (J). Regarding social costs, we assume that mothers are subject to social norms that disapprove of teenage pregnancies. If the mother truthfully reports, the community imposes a cost to early motherhood of $S(a_b, a_r) \geq 0$ (e.g., in the form of shaming and ostracizing); otherwise, if she does not report, the cost is not incurred. We assume that these costs decrease with the mother's age at the time of birth (a_b) and the mother's age at reporting (a_r). Additionally, we assume that the functional form of the social cost is $S(a_b, a_r) = se^{(-\alpha\, a_b\, -\beta\, a_r)}$, where the parameters $\alpha \geq 0$ and $\beta \geq 0$ regulate the rate at which the social cost, s, diminishes with the mother's age at birth and at reporting.

Regarding judicial costs, we assume a legal framework that prohibits sexual relations with individuals below a certain age, e.g., minimum age of consent laws. We assume that, even if direct penalties affect only the father, mothers experience a direct disutility from this legal exposure, either because they share an emotional, financial, or familial bond with the father, because they are vulnerable to verbal or physical retaliation from him, or because going through this legal process generates stress and suffering for the victim.[4]

While breaches of minimum age of consent laws often go undetected and without prosecution, reporting the birth increases the likelihood of judicial action because such public records are accessible to prosecutors, or the enumerator may report the suspicion of abuse to the authorities.[5] We model judicial costs with the following functional form:

[4] In practice, these laws may apply only when the father is an adult, but we abstract from this constraint here to keep the model simple.

[5] For instance, in the 1990s, Florida made the impregnation of a minor under the age of 16 by a male aged 21 or older a reportable form of child abuse, effectively using pregnancies as evidence of statutory rape (Donovan, 1997).

$$J(a_b, \overline{a}, r_\tau) = \begin{cases} (\pi + \kappa r_\tau)\ \overline{J} & \text{if } a_b < \overline{a} \\ 0 & \text{if } a_b \geq \overline{a}\ , \end{cases} \tag{1}$$

where $\overline{a}$ represents the minimum age of consent plus nine months (i.e., the lowest age in which consensual sexual relations are legally allowed plus the gestation period), $\overline{J}$ is the size of the penalty (e.g., years of mandatory prison or fines), π is the baseline probability of the offender being prosecuted and convicted, and κ is a constant representing the increase in the probability of prosecution and conviction associated with truthfully reporting the birth.

Mother's Utility and Testable Implications

Under these assumptions, the mother's utility of reporting the birth using method τ is given by:

$$U_\tau(r_\tau, a_b, a_r, \overline{a}) = r_\tau v_\tau - r_\tau\ s\ e^{(-\alpha\ a_b\ -\beta\ a_r)} -\ \mathbf{1}_{a_b<\overline{a}}\ (\pi + \kappa r_\tau)\ \overline{J} \tag{2}$$

The probability of a mother reporting under method τ is the probability that her reporting payoff is larger than the social and judicial costs:

$$p_\tau(a_b, a_r, \overline{a}) = P[v_\tau \geq s\ e^{(-\alpha\ a_b\ -\beta\ a_r)} +\ \mathbf{1}_{a_b<\overline{a}}\ (\kappa)\ \overline{J}] \tag{3}$$

Based on this framework, we can derive a set of propositions that guide our empirical analysis. The first two propositions help validate the model's assumptions by examining their consistency with observed reporting behavior.

Proposition 1 ***Reporting increasing with age at childbirth*** *For $\epsilon > 0$ and for any vector $a = [a_r, \overline{a}]$, $U_\tau(r = 1, a_b, a) < U_\tau(r = 1, a_b + \epsilon, a)$ and $p_\tau(a_b, a) < p_\tau(a_b + \epsilon, a)$*

This proposition states that all else equal, the probability of truthfully reporting should be lower for younger mothers because they face higher social and/or judicial costs. Since the proposition relies on assuming that the social and judicial costs decrease with the mother's age at the time of birth (a_b), it provides an empirical test for the assumption.

Proposition 2 ***Reporting increasing with age at reporting*** *For $\epsilon > 0$ for any vector $a = [a_b, \overline{a}]$, $U_\tau(r = 1, a_r, a) < U_\tau(r = 1, a_r + \epsilon, a)$ and $p_\tau(a_r, a) < p_\tau(a_r + \epsilon, a)$.*

This proposition states that mothers are more likely to report the birth as more time passes since the birth, as the social cost decreases over time. Similarly, the proposition relies on assuming that the social cost decreases with the mother's age at the time of reporting (a_r). Hence, it provides an empirical test for the assumption.

Under the model assumptions, the following propositions provide testable implications that allow us to learn from the data about the relative importance of the mechanisms shaping the decision to report births.

Proposition 3 ***Reporting increasing with the instrumental payoff*** *For any $a = [a_r, a_b, \overline{a}]$, $p_A(a) > p_C(a)$ if and only if $V_A > V_C$. Moreover, if $V_A > V_C$ and $a_r^A \geq a_r^C$, then for any $a = [a_b, \overline{a}]$, $p_A(a_r^A, a) > p_C(a_r^C, a)$.*

This proposition states that if the age at childbirth, age at reporting, and minimum age of consent are constant, higher reporting under one method occurs because it provides a higher instrumental payoff. The notation of the proposition relies on the uniform distribution of $v_\tau \sim U[0, V_\tau]$. However, it only requires that v_A first-order stochastically dominates v_C. This proposition allows us to test whether the net benefit of reporting in birth registries is greater than that of the census by comparing reporting behavior with the same age at childbirth, age at reporting, and minimum age of consent.

Proposition 4 ***Single crossing*** *Assume $V_A > V_C$ and $s > 0$. Let $a_r^{C^*}$ be such that for any $a = [a_b, \overline{a}]$, $p_A(a_r^A, a) = p_C(a_r^{C^*}, a)$. Then, for $a_r^C < a_r^{C^*}$, $p_C(a_r^C, a) < p_A(a_r^A, a)$; and for $a_r^C > a_r^{C^*}$, $p_C(a_r^C, a) > p_A(a_r^A, a)$. In other words, $p_C(a_r^C, a)$ will single-cross $p_A(a_r^A, a)$ from below at $a_r^{C^*}$. Moreover, $a_r^{C^*}$ exist only if $s > 0$.*

This proposition explains why, for same-aged mothers at the time of childbirth, reporting could be higher in the birth registries when the census occurred very close to childbirth and higher in the census when the census occurred a significant time after childbirth. Birth counts are lower in the census occurring close to childbirth than in the birth registries because the instrumental benefit of reporting in the registry is higher, and everything else is constant (Proposition 3). However, in the latter census, the birth count for mothers of the same age at childbirth and in the same year may be higher than in the registry because, by the time of the latter census, the social cost has shrunk more than the difference in instrumental payoff across reporting methods, leading to more reporting in the latter census than in the registry.

In summary, in the presence of social costs, reporting in the census will single-cross reporting in the administrative records as time passes between the birth and the census data collection. This proposition relies on reporting in the administrative records occurring relatively close to the childbirth, while the census may occur close to the childbirth but also a decade later.

Proposition 5 ***Reporting discontinuity at age of legal consent*** *The probability of reporting, $p_\tau(a_b, a_r, \overline{a})$, has a discontinuity at $a_b = \overline{a}$. Moreover, if and only if $\kappa\overline{J} > 0$, then $p_\tau(a_r \mid a_b > \overline{a}) > p_\tau(a_r \mid a_b < \overline{a})$*

This proposition states that if concerns about legal restrictions on underage sexual relations influence the decision to report, they will create a discontinuity in optimal reporting behavior at the legal age of consent. If judicial costs and the probability of incurring them are strictly positive, reporting is more likely when mothers are not exposed to these costs (i.e., when the mother is above the minimum age of consent).

3 Data and Measures of Child-Mother Births Under-Reporting

3.1 Challenges in Measuring Child-Mother Births

While fertility statistics for girls aged 15 to 19 are generally reliable and widely available, the same cannot be said for younger mothers (Schoumaker and Sánchez-Páez, 2022). In 2001, fertility data for girls under 15 were missing for 32% of the world's population in this age group (WHO, 2024).

In countries with reliable birth registries (i.e., with 90% or higher coverage), these registries are considered the best source of information on fertility (Kisambira and Schmid, 2022). However, the accuracy of birth registries is usually evaluated based on the total number of births. Since births to mothers under 15 account for a small proportion of this total, if under-reporting is disproportionately skewed toward younger mothers, even reliable birth registries for the overall population may significantly underestimate the true number of child-mother births.

When registry data are unavailable—especially in Sub-Saharan Africa and other low-income countries—Demographic and Health Surveys (DHS) and similar surveys are often used (Pullum and Becker, 2014; United Nations DESA, 2020b). These surveys, however, present their own challenges. Under-15 fertility is relatively rare, and survey samples are often not large enough to capture it. Additionally, surveys typically do not ask fertility questions to girls under 15, leading researchers to rely on birth history data from girls aged 15-19 instead (Pullum et al., 2018).

3.2 Data and Measures

In this study, we use data from multiple sources. First, we employ data from administrative birth registries in three large countries that make such data publicly available at a disaggregated level: Brazil, Mexico, and the

United States. Many nations incentivize birth registration—particularly those with greater state capacity—through benefits such as child tax credits, healthcare access, and social security. The birth registration process, typically initiated at birth in hospitals where most deliveries take place, is considered universal in many middle-income and advanced economies. For Brazil, the data come from the Registro de Nascimientos, in Mexico from the Estadística de Nacimientos del Registro Civil compiled by the Instituto Nacional de Estadística y Geografía (INEGI), and in the United States from the National Vital Statistics System (NVSS). Further details about these sources are discussed in Appendix C3.

Second, we use census microdata from 59 countries, primarily obtained from the University of Minnesota's Integrated Public Use Microdata Series (IPUMS).[6] For Brazil and Mexico, we sourced data directly from their national statistics institutes' websites. Additionally, we incorporate data from the UN Demographic and Health Surveys, the World Bank's World Development Indicators, and other sources. Further details are provided in Data Appendix C.

We use administrative registries and census data to estimate the number of births by calendar year and by the mother's age at childbirth, restricting our samples to birth mothers (i.e., excluding stepmothers and adoptive mothers). In population censuses, children are linked with their mothers, allowing for the counting of births by the mother's age and the child's birth year. For instance, the presence of a household in the 2010 Census with an 18-year-old mother of a four-year-old child indicates that a 14-year-old girl gave birth in 2006. Importantly, if a subsequent census is conducted, births can be recounted for the same age group of mothers and the same childbirth year. In our example, by the 2020 census, the same mother would be 28 years old, and her child would be 14. The use of census data to retrospectively reconstruct birth histories is part of a class of "reverse-survival" methods (United Nations, 1983), a long-standing but relatively under-utilized technique in demography (Spoorenberg, 2014). This approach allows us to obtain two independent, time-distant counts of the number of births by the mother's and the child's birth year for the same population.

To estimate the under-reporting of births in registries and baseline census counts, we benchmark them against census counts from a subsequent census, typically conducted a decade later. In our preferred measure, we express the gap between the baseline counts (from either registries or the census) and the subsequent census counts as a share of the subsequent census counts. In countries where data from more than two census rounds are available, we can measure this gap multiple times. In total, we analyzed 78 census pairs, which are listed in Appendix Table C1.

A relevant limitation of using census data to count births is that they only capture children residing

[6]The United States data available in IPUMS are from the American Community Survey (ACS), which replaced the long-form census questionnaire starting in 2010.

with their mothers, as questions about non-resident children are rarely included. To mitigate this concern, we estimate births only for groups where the child would be at most 15 years old at the time of the second measurement, increasing the likelihood that the child is still living with the mother. However, even with this adjustment, the second measurement of births, taken years later, is likely to be lower due to older children being less likely to reside with their mothers. Factors such as death, migration, and marriage dissolution also contribute to this decline. As a result, our estimates of births under-reporting represent a lower bound of the actual under-reporting.

4 Estimation

We turn now to the empirical analysis of child-mothers' birth reporting. Our goal is to gauge the magnitude of under-reporting and investigate, in light of our model, how the mother's age at birth and at reporting influences reporting behavior.

4.1 Under-reporting of Child-Mother Births in Administrative Records

We begin by estimating the extent of under-reporting in administrative birth records for child mothers (ages 10 to 14) in Brazil, Mexico, and the United States—three large countries where the coverage of civil registration and vital statistics (CRVS) is considered complete or nearly complete (Kisambira and Schmid, 2022). We do this by comparing administrative birth counts with birth counts obtained from census data collected 11 years later.[7] Table 1 reports the counts from administrative records (column 1) and the subsequent census estimates (column 2). It also includes our estimate of unrecorded births as a percentage of the census counts (column 3) for two groups: child mothers (ages 10 to 14) and teen and young adult mothers (ages 15 to 24).[8] A positive value in column 3 indicates under-reporting in administrative records relative to the census. In contrast, a negative value suggests that administrative records exceed the census estimates, which would be expected in the absence of social or judicial costs associated with reporting because not all children cohabit with their birth mothers.

The table displays a pattern of sizable under-reporting for child mothers in the administrative records

[7] Census counts are computed for the year prior to the most recent available census in each country: 2009 for Brazil and 2019 for Mexico and the United States. This is because census data do not capture births occurring in the same year after the census collection dates. The base year is chosen to be 11 years prior.

[8] These groupings follow the standard age-brackets classification used by the United Nations and other providers of demographic statistics (United Nations DESA, 2017)

Table 1: Under-reporting in Administrative Records Relative to Subsequent Census

	(1) Administrative Records	(2) Subsequent Census	(3) Administrative Underreporting $\frac{(2)-(1)}{(2)}$
Brazil (1999)			
Child mothers (ages 10 to 14)	27518	34372	0.20
Teen mothers (ages 15 to 24)	1737520	1244020	-0.40
Mexico (2009)			
Child mothers (ages 10 to 14)	9739	12558	0.22
Teen mothers (ages 15 to 24)	1136376	841056	-0.35
United States (2009)			
Child mothers (ages 10 to 14)	5038	7112	0.29
Teen mothers (ages 15 to 24)	1417630	839953	-0.69

Note: The table provides estimates of the number of births by age group at the time of delivery. The administrative counts reflect all births recorded within the first year after delivery, as captured in each country's administrative registry. The "subsequent census" counts are derived from the ages of children and their mothers in the microdata from the census conducted 10 years later. The percentage of unrecorded births is calculated as the difference between the administrative and census counts, expressed as a proportion of the census counts.

across the three countries. In Brazil, the number of births to child mothers recorded in administrative data is 20% lower than those captured by the subsequent census. The estimated under-reporting is 22% in Mexico and 29% in the United States. This contrasts sharply with the pattern observed for teen and young adult mothers (ages 15 to 24), where administrative records exceed census birth counts by substantial margins: 40% in Brazil, 35% in Mexico, and 69% in the United States.

These patterns are evident in Figure 2, which plots the estimated birth counts by age group and year using census and administrative records data for Brazil, Mexico, and the United States. For teenage and young adult mothers, on the left side, the birth counts from the registries are always considerably higher than in the censuses—as expected due to the census limitations discussed. However, for child mothers, on the right side of Figure 2, the birth counts estimated using a census occurring 10 or more years in the future are significantly higher than that of the birth registries.

For example, based on the 2020 Mexican census, there were 14,000 births to mothers aged 10 to 14 in 2010; however, in the administrative records, this number is less than 10,000. As we get closer to the census interview date (moving to the right on the x-axis), mothers are younger at the time of reporting, and the

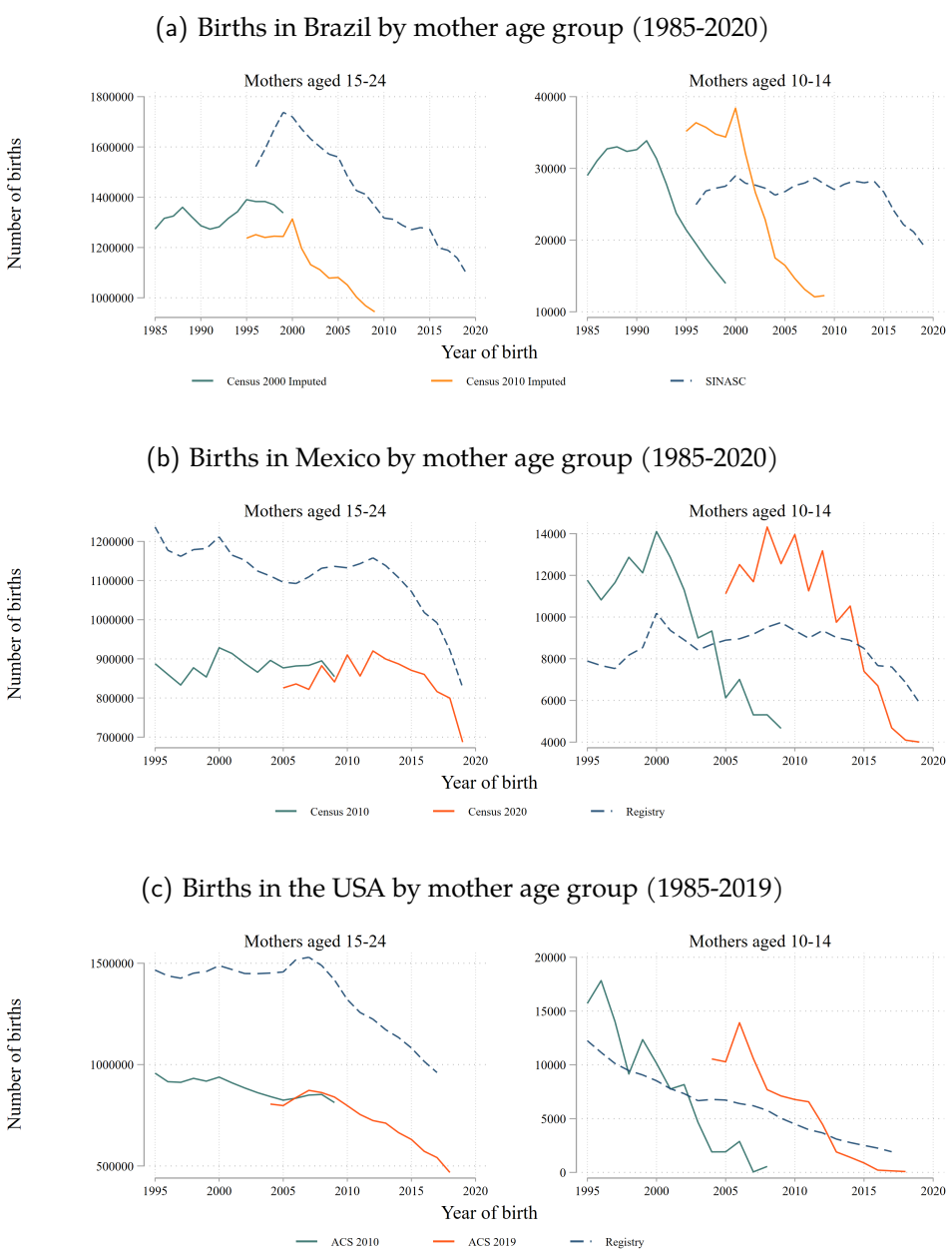


Figure 2: Total Births by Mother's Age Group According to Census and Registry Data

Note: The figure presents annual birth estimates derived from national censuses and birth registries for Brazil, Mexico, and the United States. The left panels represent mothers aged 15 to 25, while the right panels depict those aged 10 to 14. Panel (a) illustrates Brazilian birth estimates, utilizing imputed data from the 2000 and 2010 Censuses in conjunction with the Brazil Live Birth Information System (SINASC). Panel (b) portrays Mexican birth estimates, employing data from the 2010 and 2020 Censuses supplemented by the birth registry. Panel (c) exhibits U.S. birth estimates using data from the 2000 Census, the American Community Surveys (IPUMS) of 2000, 2010, 2019, and the birth registry. The 2000 survey randomly sampled 0.13% of the population, while the 2010 and 2019 surveys sampled 1%. Data from immigrant children in the United States and information from 2020, potentially affected by COVID-19 pandemic-related reporting delays, are excluded.

under-reporting problem increases to a point where the census recovers a lower estimate than that of the registries. This generates a single-crossing in the estimates between the census and the birth registries, which is the prediction of proposition 4. The main disadvantage of this methodology is that the "true" census count for a year close to a census (e.g., 2019) will only be available when the 2030 census is conducted.

These estimates and patterns demonstrate that the under-registration of births—a well-documented issue affecting many countries, especially in the developing world (United Nations DESA, 2020a)—is strikingly more pronounced among child mothers. The extent of this bias is greater than previously recognized. Using questions on registration from the Demographic and Health Survey (DHS) for five Latin American countries, Duryea et al. (2006) find that the likelihood of children under five lacking a birth certificate increases by 4.5 to 6.5 percentage points when the mother is a teenager, relative to an average of 14.5%, in Bolivia, Colombia, and Peru (but not in Brazil or Nicaragua). Similarly, Ebbers and Smits (2022), using DHS data from 40 Sub-Saharan African countries, find that children born to mothers younger than 18 have 6% lower odds of being registered.

4.2 Mothers' Age and Reporting

This section explores how the age of the mother at childbirth and at the time of reporting affects the reporting behavior. We first discuss evidence based on administrative records and then evidence based on censuses.

Administrative Records Evidence

If the social cost of reporting decreases with the mother's age at childbirth and the time between reporting and the birth, it should influence reporting behavior in administrative records in two ways. First, if the mother can somewhat control the timing of reporting, we would expect delays. These delays would happen because, at the time of birth, the social cost is so high that the optimal choice is not to report. However, as suggested in Proposition 2, as time progresses and this cost decreases, it may become beneficial to report. Second, the duration of the reporting delay is a function of the social cost, which, according to Proposition 1, declines with the mother's age at childbirth. Therefore, we would expect that, conditional on eventual reporting, this delay would be longer the younger the mother was at the time of birth.

Among the administrative registries considered in this study, only Mexico provides detailed data on delayed registration, allowing us to estimate reporting delays for different maternal age groups and birth cohorts. We summarize these data in Figure 3. Panel (a) shows the share of children of mothers aged 15-24

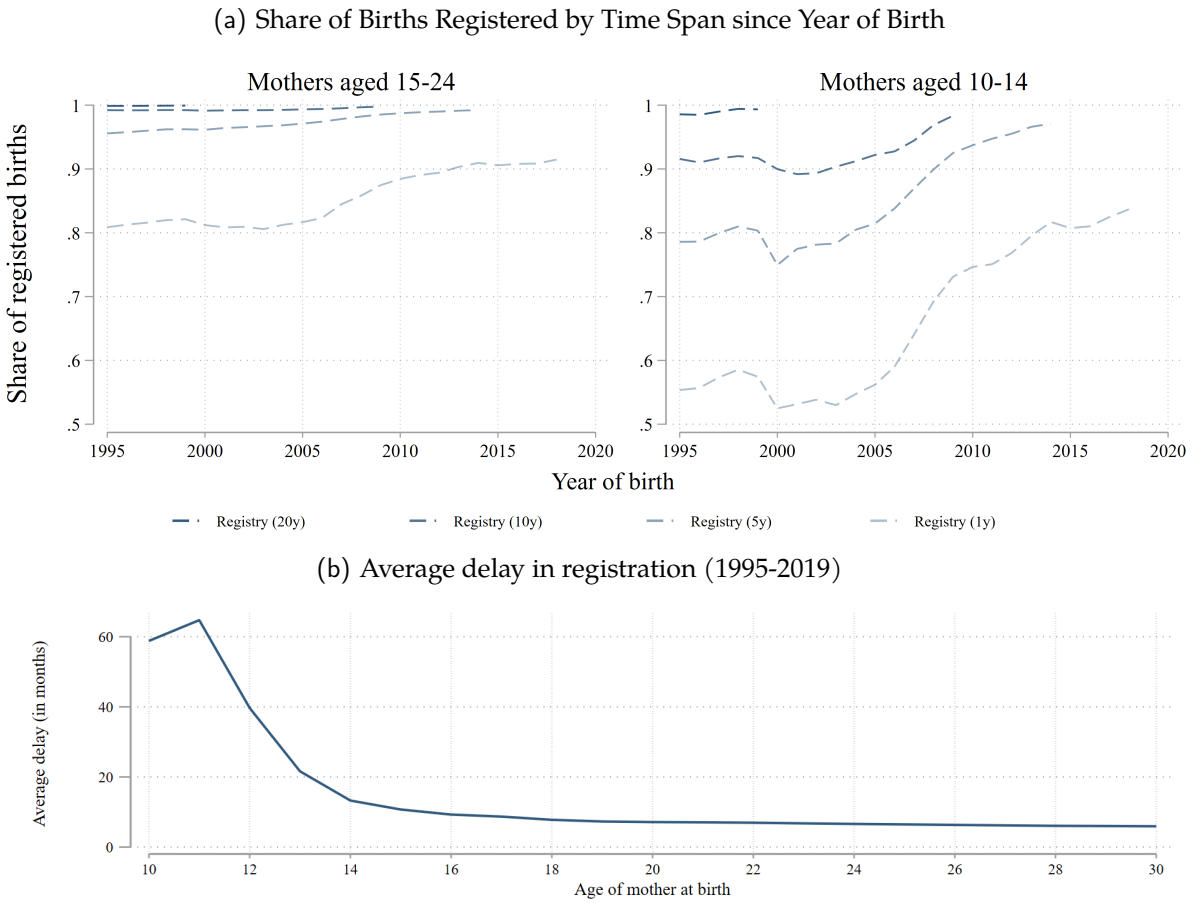


Figure 3: Birth Registration Delays in Mexico, by Mother's Age Group

Notes: This figure uses birth registry data from Mexico (INEGI). Panel A plots the share of births that took place in each year that were registered up to December 2019, by maximum delay allowed. The 1 (5, 10, 20) year(s) delay line includes births occurred from January to December of each year, registered up to 12 (60, 120, 240) months from birth. For the 1 (5, 10, 20) year(s) delay line, we only plot data up to the year 2018 (2014, 2009, 1999), which corresponds to the period that we fully observe data for the next 12 (60, 120, 240) months. Panel B plots the average delay in birth registration across the age of the mother at birth in Mexico (1995-2019), conditional on the children being registered up to 15 years after birth.

(left panel) and 10-14 (right panel) registered within one, five, ten, or twenty years of their birth date.[9] We expect some level of delay in all registrations due to costs such as fees or transportation. These delays have decreased over time as the Mexican government has expanded access to civil registry services and incentivized registration. For mothers aged 15-24, between 1995 and 2005, just over 80% of births to this age group were registered within one year, rising to 90% between 2010 and 2018).

[9]For consistency with our 2019 data cutoff, births with up to 1 year delay are shown only through 2018. This ensures all 2018 births are captured within the 1-year window without requiring 2020 data. Similarly, births with up to 5, 10, and 20 years of delay are shown through 2014, 2009, and 1999, respectively.

In contrast, for child mothers aged 10-14, registering within one year was substantially less common, ranging between 50 and 60% in the earlier period (1995-2005), improving to just above 80% by 2018. Panel (b) of Figure 3 illustrates how the average delay in birth registration decreases with the mother's age, dropping from approximately 40 months for 12-year-old mothers to around 10 months for 15-year-old mothers, after which the delay stabilizes. These findings align with the work of Keskin and Çavlin (2020) in Turkey, who found that, while 98% of births to adolescent mothers were eventually registered between 2011 and 2015, only 78% were registered within the first 30 days, compared to 95% for all births.

Census Evidence: Brazil, Mexico, and the United States

Census surveys differ from administrative records in terms of their availability as a reporting mechanism. While the option to report a birth to the registries is continuously available, the option to report it in the census is generally available only once every decade, which could occur shortly after the child's birth or several years later. Crucially, the timing of the census is exogenous to the child's birth date, the mother's age at delivery, and the mother's age at the time of reporting. Thus, we can isolate the effect of the mother's age at the time of reporting by comparing estimates from two different census rounds for the same mother's age at childbirth and year, thereby holding the reporting method and age at childbirth constant.[10] This provides an additional test for Proposition 2, which posits that under-reporting should be less severe the older the mother is at the time of reporting.

In line with this proposition, we find sharply different patterns between the teen and young-adult mothers group and child-mothers. When we consider mothers aged 15 to 24 at the time of delivery—a group for which we expect social and judicial costs of reporting to be smaller or non-existent— we observe that birth counts based on prior and later censuses are similar in Brazil, Mexico, and the United States (Figure 2, left side). In contrast, birth counts for child mothers—for whom we expect higher social and/or judicial costs—are consistently lower in the baseline census (when the mother is still in her teens at the time of reporting) than in the census conducted a decade later (when the mother is already in her twenties). The gap is large. Relative to the subsequent counts, the baseline counts are smaller by 40 to 90%.

[10] As previously discussed, this approach allows us to identify reporting differences net of attrition between the baseline and subsequent census rounds, providing a lower bound for under-reporting in the baseline census.

Census Evidence: Global Patterns of Under-reporting of Child-Mother Births

The under-reporting of child-mother births in Brazil, Mexico, and the United States, as documented above, raises the question of whether similar patterns of misreporting are prevalent in other countries. To address this, we now examine the extent of under-reporting of child-mother births in censuses across a broader set of countries, using data from 78 census pairs covering 59 countries.[11] While previous studies on child and teenage fertility have primarily focused on formal birth registration in administrative records (e.g., Duryea et al. 2006; Ebbers and Smits 2022; Wendt et al. 2022), under-registration in demographic censuses and surveys is important in its own right. These datasets play a critical role in shaping policies to address the issue and in producing research that informs policy decisions (United Nations DESA, 2020a).

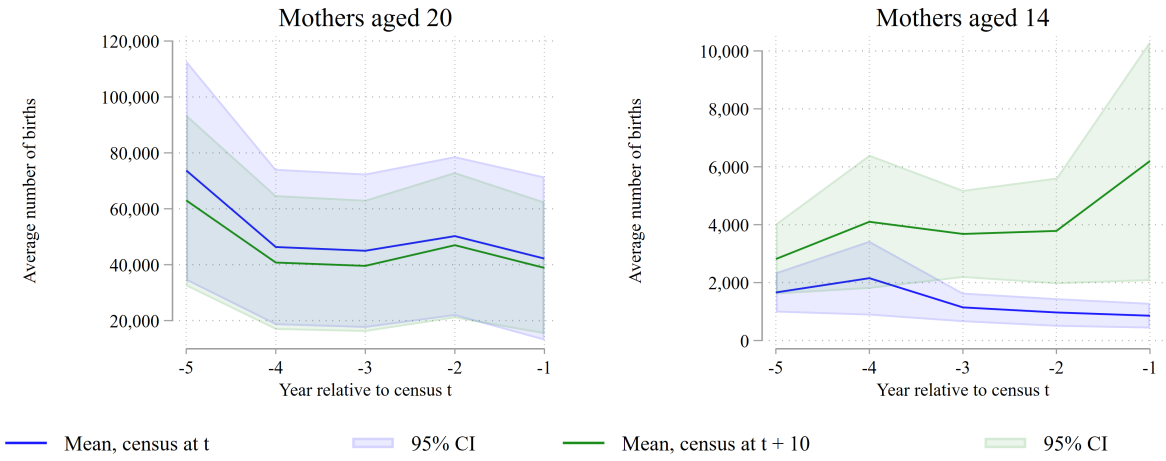


Figure 4: Birth Counts in Each of the Five Years prior to the Baseline Census

Notes: The sample comprises 80 pairs of national censuses from 59 countries, with one observation per census pair, age of the mother at birth and the year of birth. We estimate the number of births by identifying the age at birth of the reported mother. Samples exclude children of foreign citizenship.

Figure 4 presents the cross-country averages and 95% confidence intervals of birth counts (from both baseline and subsequent censuses) for each of the five years preceding the baseline census.[12] Consistent with our findings for Brazil, Mexico, and the United States, we observe systematic differences in birth counts between the baseline and subsequent censuses for child mothers (right panel), but not for older mothers (left panel). Furthermore, the undercounting of births in the baseline census is most pronounced for births

[11] Estimates are derived from census microdata integrated and standardized by IPUMS (Integrated Public Use Microdata Series, IPUMS [dataset, accessed March, 2024). To our knowledge, no comparable source exists for international birth registry data.

[12] Appendix Table A1 reports the underlying data, along with child-mother birth undercounting estimates by the mother's age at birth for each baseline census.

occurring in the year immediately preceding the census and diminishes as the time between the birth and the census increases. This provides broader empirical support for the model's prediction that the propensity to report births by young mothers increases with the mother's age at reporting, all else being equal (Proposition 2).

Finally, we explore how under-reporting in the baseline census varies by the mother's age at birth across our global sample. Figure 5 presents cross-country averages and 95% confidence intervals for the gap between baseline and subsequent census counts, expressed as a share of the subsequent census count, for each maternal age. Under-reporting of child-mother births in contemporary censuses is widespread. Across countries, birth counts are consistently higher for mothers aged 15 or younger in subsequent censuses compared to baseline censuses conducted soon after the birth. Only for mothers aged 17 or older do baseline censuses yield the higher counts that are mechanically expected. In line with Proposition 1, the likelihood of reporting increases monotonically with the mother's age at childbirth.

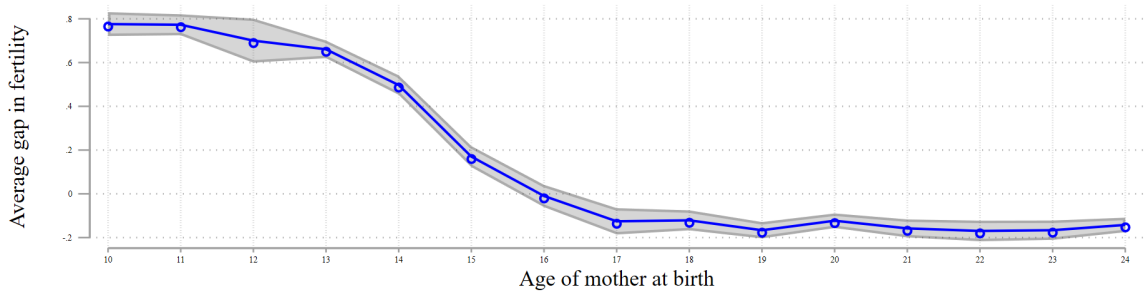


Figure 5: Gap in Reported Childbirths between Consecutive Censuses by Mother's Age

Notes: The sample comprises 80 pairs of national censuses from 59 countries, with one observation per census pair, age of the mother at birth and the year of birth. We estimate the number of births by identifying the age at birth of the reported mother. The gap measure is calculated as one minus the ratio of the number of births estimated from the first census to those estimated from the second census $\left(1 - \frac{\text{births}_t}{\text{births}_{t+10}}\right)$, over the age of the mother at birth. The interval between censuses averages 10 years, but it includes spans ranging from 8 to 12 years. Samples exclude children of foreign citizenship.

We find substantial under-reporting of child-mother births, with baseline censuses missing more than 60% births to mothers aged 13 or younger that are recorded in subsequent censuses. For mothers aged 14, this figure is around 50%, and for those aged 15, it is close to 20%.

Based on census and survey data that identify the share of young children without birth certificates, previous research has shown very low levels of birth registration in the developing world, with only about one-third of children under five registered in South Asia (Kisambira and Schmid, 2022), around 45% in Sub-Saharan Africa (United Nations DESA, 2020a), and between 8% and 25% in Latin America (Duryea et al., 2006). However, our findings indicate that census and survey samples themselves are missing many children, particularly those born to very young mothers. Therefore, the level of under-registration in birth registries is

likely significantly higher than previously estimated for this population. This is because a significant fraction of the offspring of young mothers is likely absent from these censuses and surveys, and those missing are also the most likely not to have a birth certificate.

4.3 Instrumental Payoffs and the Propensity to Report

The evidence in Figure 2 also offers insights into the differences in instrumental payoffs across reporting methods and how these payoffs compare to social and judicial costs as mothers age. According to Proposition 3, if the mother's age at the time of childbirth and reporting are held constant, reporting should be higher in the method that provides the greater net instrumental payoff. Our data can approximate these conditions when the census occurs close to the child's birth date.

In Figure 2, we observe that for births occurring in the years prior but close to the census years, and for both age groups and across all three countries, the number of births recorded in the registries exceeds the census counts. As per Proposition 3, this suggests that the net payoffs of reporting are higher for administrative records than for the census. This is unsurprising, as birth registries typically offer more direct benefits, such as access to services and public subsidies, while the benefits of reporting to the census are less immediate and direct. Thus, if a birth to a young mother occurs close to the time of the census, households that report to the census are likely to also report to the registry, but those reporting in the registry may not report in the census.

If social and judicial costs are absent or minimal, the pattern described above should persist: reporting will always be higher with the method that provides a higher net instrumental payoff. This is what we observe in the three countries for mothers aged 15 to 24 (Figure 2, left column), where the number of births in the registries consistently exceeds those estimated by the censuses.[13] However, in the presence of social and/or judicial costs that decline with the mother's age at reporting, the model predicts that for very young mothers, reporting may become higher in a later census when the mother is older, and these costs have diminished. This is what we observe in all three countries for mothers aged 10 to 14 (Figure 2, right column). For births occurring close to and prior to the time of a census, birth counts based on censuses are *lower* than in the registries when using the contemporaneous census but *higher* than the registries when using data from the subsequent census, collected 10 years later. This phenomenon leads to the single-crossing prediction described in Proposition 4.

[13] In the data, this gap also reflects the fact that census estimates only include births where the mother and child reside in the same household at the time of the census.

These results reveal that even administrative registries——the "gold standard" for fertility measurement——significantly undercount child-mother births. Current United Nations guidelines regard high-coverage birth registries as the most reliable data source for estimating adolescent birth rates, favoring them over survey and census data (Kisambira and Schmid, 2022). However, we find that retrospective census birth counts, despite their tendency to underestimate the actual number of births for older age groups, can provide a more accurate estimate of child-mother births than registries.

5 Mechanisms

In this section, we investigate the underlying mechanisms contributing to the under-reporting of child-mother births.

5.1 Attributing Children to Different Mothers

Under-reporting a child-mother's birth does not always imply that the child's existence is entirely unreported. The household could acknowledge the child but attribute their parentage to an older woman in the household, such as the child's grandmother or aunt. This strategy could help families avoid the social and legal costs associated with reporting a birth for a young mother. Moreover, it offers a plausible explanation for the child's presence when noticed by census enumerators.

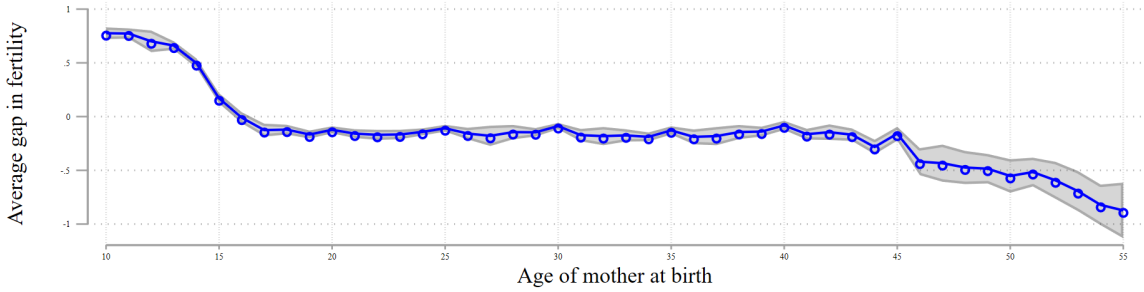


Figure 6: Gap in Reported Childbirths between Consecutive Censuses by Mother's Age, Including Women beyond Fertile Age

Notes: The sample comprises 80 pairs of national censuses from 59 countries, with one observation per census pair, age of the mother at birth and the year of birth. We estimate the number of births by identifying the age at birth of the reported mother. The bias measure is calculated as one minus the ratio of the number of births estimated from the first census to those estimated from the second census $\left(1 - \frac{\text{births}_t}{\text{births}_{t+10}}\right)$, over the age of the mother at birth. The interval between censuses averages 10 years, but it includes spans ranging from 8 to 12 years. Samples exclude children of foreign citizenship.

Figure 6 provides suggestive evidence for this mechanism by extending the analysis in Figure 5 to include mothers of older ages, including those beyond their reproductive years at the time of birth. We find that, for mothers who were 45 or older at the time of birth, the baseline census reports significantly more births than the subsequent census. Some of this gap can be attributed to mortality, as 45 to 55-year-olds may die. However, the magnitude of the difference far exceeds what would be expected based on age-specific mortality rates. Specifically, the number of births to mothers aged 46 to 55 was between 45% and 90% higher in the baseline census than in the subsequent census. This inconsistency cannot be explained by the mortality of women in this age group because the mortality rate in the next 10 years required to account for this discrepancy is between 30 and 50%.

This discrepancy strongly suggests that, in the baseline census, a substantial portion of births to child mothers were misreported as births to older women in the household, particularly those beyond reproductive age.

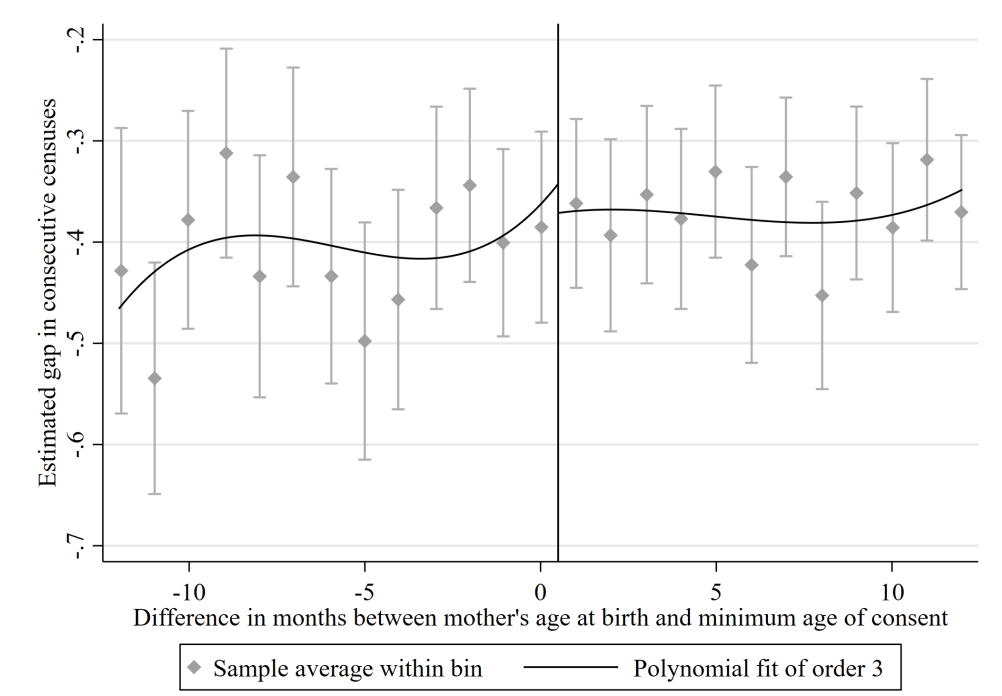
This evidence implies that the under-reporting of child-mother births does not necessarily result in an equivalent undercount of overall births. However, even when the existence of the children is acknowledged, the fact that the mother was a child remains concealed, obscuring the true scale of early motherhood. More broadly, these findings provide further evidence that the decision to report is shaped by both the instrumental payoffs of reporting and other costs—whether social or judicial—that are significant for very young mothers but not for adult mothers.

5.2 Is There a Reporting Discontinuity at the Minimum Age of Consent?

The differences in reporting as mothers age, documented in Section 4, could be driven by either social or judicial costs. Proposition 5 states that if judicial costs constitute a significant factor in the reporting decision, we should observe a discontinuous increase in the probability of truthful reporting births once the mother reaches an age where she is no longer subject to such costs. To test this hypothesis, we gathered data on statutory rape laws, which prohibit sexual encounters between adults and individuals below a specific age threshold, known as the minimum age of consent (MAoC). Therefore, if fear of judicial prosecution of a family member or retaliation from a legally liable perpetrator drives the reporting gap we observed, we should expect a noticeable increase in birth reporting for mothers just above the MAoC threshold, where the birth is no longer considered evidence of a crime.[14] We combine this legal data with our international estimates of misreporting to test this prediction using a regression discontinuity design (RDD).

[14]The birth may also not be considered a crime if the father is similarly young, depending on legal provisions.

Figure 7: Judicial Costs and Minimum Age of Consent



Note: This graph presents an RD plot of our bias measure, comparing it to the difference between a mother's age at birth and the minimum age of consent (MAoC). The sample excludes children born in the year of the first census. The MAoC ranges from 12 to 18 years. Children with foreign citizenship are excluded from the sample.

Figure 7 presents the estimates of the RDD. We do not find evidence of a discontinuity at the minimum age of consent across countries. This suggests that, at least on average, across the countries and census pairs represented in the sample, judicial costs or the likelihood of their enforcement are not substantial enough to influence the decision to report births, implying that social costs play a relatively larger role. This finding aligns with prior research indicating that transgressions of these laws are difficult to detect and prosecute. For example, in California in the late 1990s, cases filed under statutory rape laws accounted for only about 2 percent of the total number of births to underage teens fathered by adult men (Donovan, 1997).

5.3 Social Norms and Under-Reporting

The results discussed above suggest that social costs play a significant role in the decision to report child-mother births. The severity of social costs can also vary depending on prevailing social norms. In more conservative societies, for example, the risk of young women being shamed or ostracized for disclosing a pregnancy or becoming mothers at a young age may be higher.

To assess the role of social norms surrounding female sexuality and reproductive behavior, we use data from the UN Demographic and Health Surveys to measure the share of women of reproductive age, at the country level, who report making autonomous decisions about sexual relations, contraceptive use, and/or their own reproductive healthcare. We then examine the relationship between this measure of social norms and the under-reporting gap in the country's baseline censuses.

Specifically, we estimate the following equation:

$$\begin{aligned} \mathrm{G}_{a_b,i,j,t} =& \gamma_j + \beta_1 \mathbb{1}[0 \leq a_b \leq 14]_{a_b,i,j,t} \; + \; \beta_2 \mathbb{1}[0 \leq a_b \leq 14]_{a_b,i,j,t} \times ShWomenDecSex_j \\ & + \; \beta_3 \mathbb{1}[0 \leq a_b \leq 14]_{a_b,i,j,t} \times GDPpc_j + \epsilon \end{aligned} \tag{4}$$

where $\mathrm{G}_{a_b,i,j,t}$ is the difference in birth counts between the subsequent and baseline censuses, expressed as a share of the births in the subsequent census for mothers aged a_b at childbirth in census pair i from country j in calendar year t. The variable $\mathbb{1}[0 \leq a_b \leq 14]$ is an indicator that equals 1 when the mothers' age at childbirth is between 10 to 14, and 0 for ages 15-29; γ_j is a country fixed effect; $ShWomenDecSex_j$ is the share of women in the country who report making autonomous decisions about sexual relations, contraceptive use, and/or their own reproductive healthcare; and ϵ is an error term. The standard errors are clustered at the mothers' age at childbirth by country level.

Consistent with the results presented earlier, we find that the under-reporting is higher when the mother is 10 to 14 years old at childbirth (Column 1 of Table 2) and is practically the same magnitude when restricting to within-country comparisons (Column 2), where the variation comes from comparing age-at-birth categories 10-14 and 15-29. However, a one standard deviation increase in the share of women making informed sexual decisions is associated with a shrinking of this within-country gap in reporting between child mothers and older mothers by roughly 25% (Column 3). This evidence supports the notion that social costs associated with gender norms and women's reproductive freedom constitute a significant factor influencing the decision to report young mother births.

Controlling for income per capita is particularly important in this context, as poverty and lack of economic opportunity are widely recognized as risk factors that increase the likelihood of teenage fertility (Kearney and Levine, 2012) and affect birth registration rates (Ebbers and Smits, 2022). Teenage birth rates have steadily declined in recent decades, with this decline being significantly more pronounced in wealthier economies (Singh and Darroch, 2000). Additionally, societies that differ in cultural norms may also differ in their level of economic development (Jayachandran, 2015). One standard deviation increase in the income per capita is associated with a shrinking of this within-country gap in reporting between child mothers and older mothers

Table 2: Child-Mother Births Under-Reporting and Social Norms

Dependent Variable: Births Underreporting Gap in Baseline Census				
	(1)	(2)	(3)	(4)
10-14	0.772***	0.796***	0.962***	0.828***
	0.020	0.026	0.038	0.057
10-14=1 × % women making informed sexual decisions (std)			-0.239***	-0.159***
			0.039	0.047
10-14=1 × Log income per capita (std)				-0.166***
				0.047
Country FE	No	Yes	Yes	Yes
Mean dependent variable	0.02	0.02	-0.04	-0.04
Adj. R^2	0.246	0.336	0.320	0.323
N	6932	6932	2865	2865

Notes: The dependent variable is the difference in birth counts between the subsequent and baseline censuses, expressed as a share of the births in the subsequent census. Standard errors clustered at the country × age-of-the-mother level. The observations are at the country-census-pair-, age-of-the-mother-, and year-of-birth-level. Estimates use weights. The sample includes only mothers aged between 10 and 29 years old, and excludes mothers of children born in the year of the first census and of children of foreign citizenship. The sample is smaller in columns (3) and (4) because of data availability. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

by 20% (Column 4). However, even when including income per capita, one standard deviation in the share of women making informed sexual decisions continues to be associated with a 19% lower gap in reporting between child mothers and older ones.

6 Conclusion

This paper documents the systematic under-reporting of births to child mothers across multiple countries and data sources. Child motherhood is substantially more prevalent than official statistics indicate, with under-reporting reaching at least 20-30% in administrative records and up to 65% in census data for the youngest mothers.

Our analysis suggests that costs stemming from social norms (e.g., fears of stigmatization and ostracism) play a central role in the decision to under-report. Consistent with our theoretical framework, where reporting decisions weigh instrumental benefits against age-dependent private costs, the probability of reporting increases sharply with the mother's age at the time of reporting and the age at the time of childbirth. The model's predictions match observed patterns across countries, suggesting that, on average, child-mother

births are more likely to be accurately reported (rather than concealed or misreported) only once the mother is older than 16.

These findings have important implications for both research and policy. First, they suggest that current estimates of child motherhood, which inform policy responses and resource allocation, may significantly understate the scale of the issue. Second, they illustrate how private costs can lead to the systematic under-provision of socially valuable information, even in the absence of legal deterrents.

Through this channel, the informal enforcement of social norms can result in socially undesirable outcomes, such as insufficient policy and advocacy responses and the misallocation of resources to address sensitive social problems. This opens important avenues for future research, including investigating how alternative data collection mechanisms could better align private incentives with public information needs, particularly in contexts where social stigma influences reporting behavior, and exploring how shifts in social norms may impact the quality of demographic data collection over time.

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Appendix (For Online Publication)

A Additional Figures and Tables

A1 Additional Figures

(a) Births in Mexico by Mother Age Group (1985-2018)

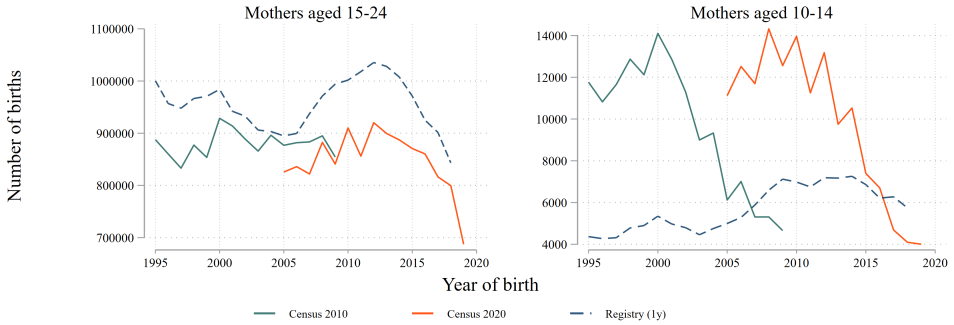


Figure A1: Total Births by Mother's Age Group According to Census and Registry Data

Note: The figure presents annual birth estimates derived from national censuses and birth registries for Mexico. The left panels represent mothers aged 15 to 25, while the right panels depict those aged 10 to 14. The graph portrays Mexican birth estimates, employing data from the 2010 and 2020 Censuses supplemented by the birth registry with only registered births within one year from birth. Information from 2020, potentially affected by COVID-19 pandemic-related reporting delays, is excluded.

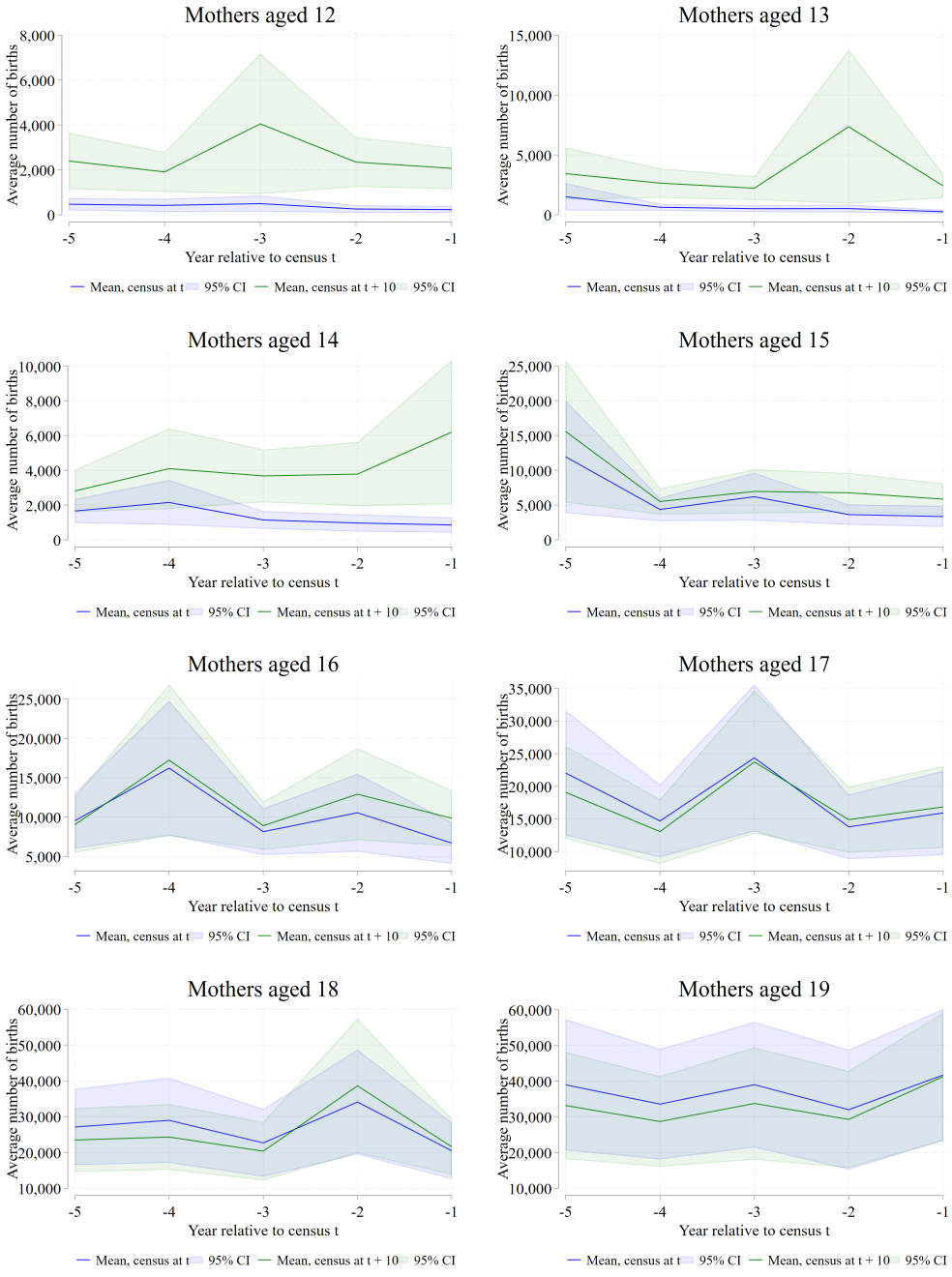


Figure A2: Average of Births Reported by Mother's Age

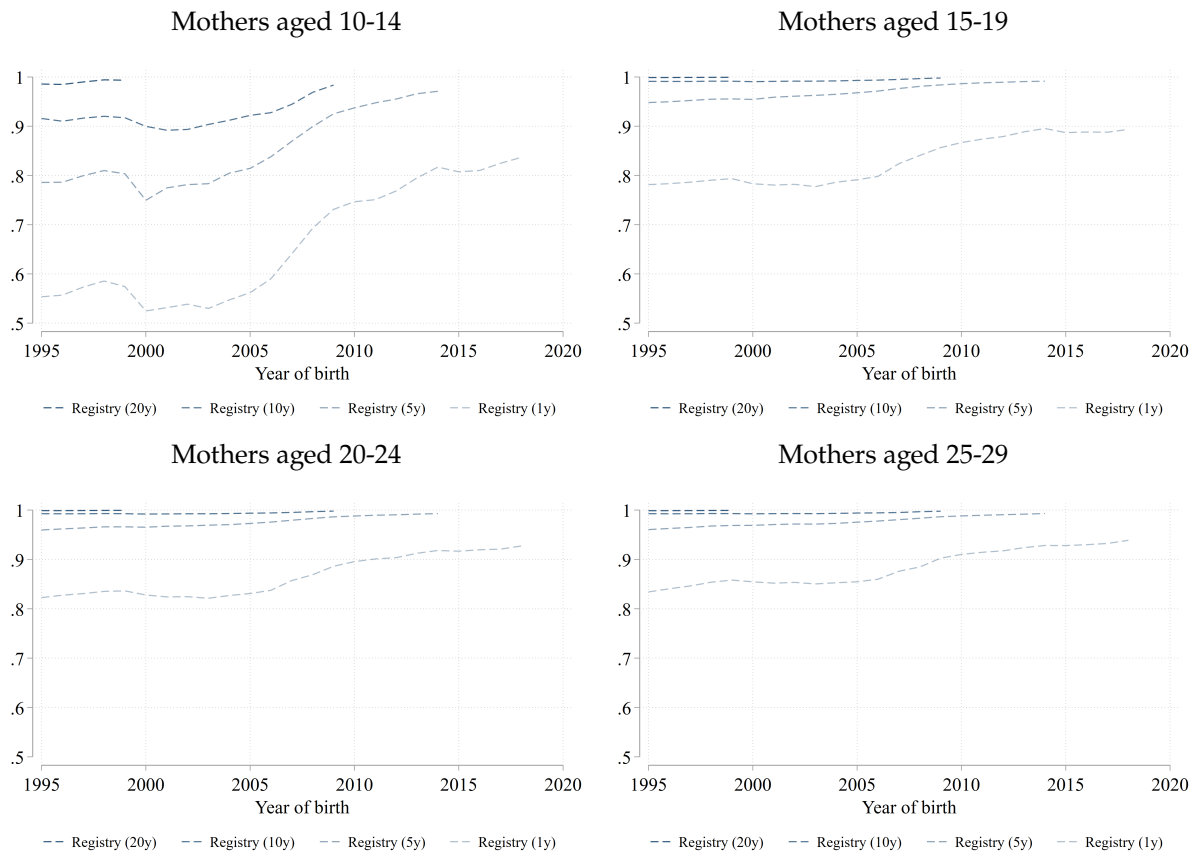
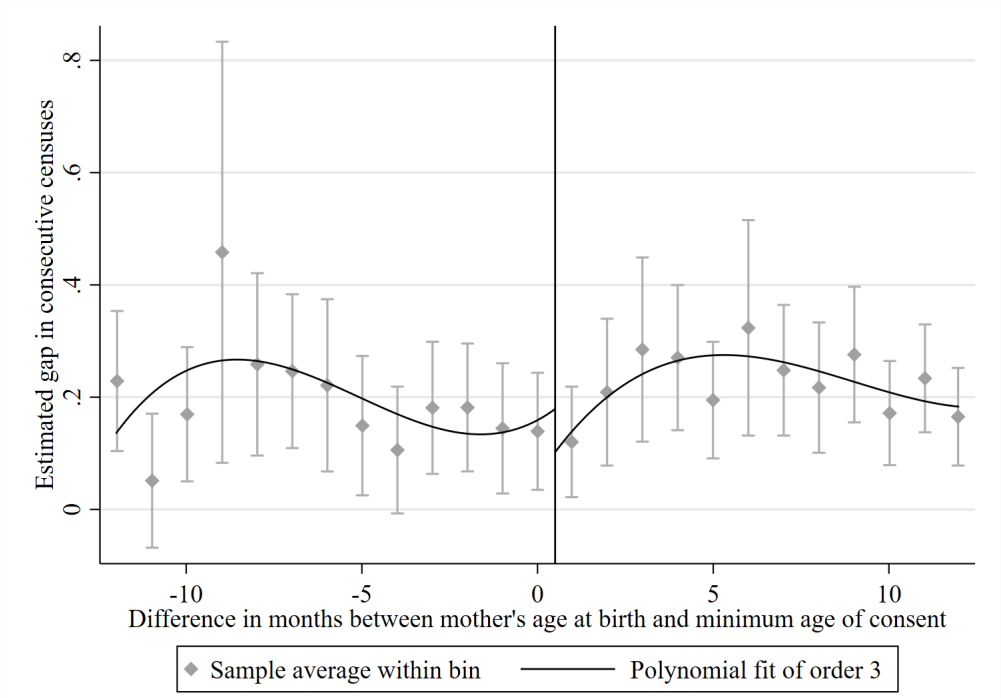


Figure A3: Exhibit 2: Mexico by Age Groups

Notes: Sample does not include registry information from 2020 onwards due to the COVID-19 emergency.

Figure A4: Judicial Costs and Minimum Age of Consent



Note: This graph depicts a RD plot of our bias measure alongside the difference between a mother's age at birth and the minimum age of consent. The sample excludes children born in the year of the first census. MAoC ranges between 12 and 18 years old.

A2 Additional Tables

Table A1: Estimated Unrecorded Births, Relative to Subsequent Census

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Mother's age at child birth					Total (ages 10 - 14)	
Baseline Census year	10	11	12	13	14	Count (in 1000s)	Share of counted
High income countries (2023)							
Austria 1991	0.050	.	0.030	0.020	0.100	0.200	95.24%
Chile 1992	0.290	0.440	0.320	0.190	0.240	1.480	42.53%
France 1990	0.360	0.636	0.800	0.924	1.484	4.204	95.11%
France 1999	0.101	0.181	0.072	0.123	0.107	0.585	70.90%
Greece 1991	.	.	0.020	0.130	0.230	0.380	55.07%
Hungary 1990	0.140	0.260	0.020	0.180	0.200	0.800	80.00%
Hungary 2001	0.140	0.160	0.080	0.060	0.040	0.480	63.16%
Panama 1990	0.270	0.350	0.210	0.320	0.430	1.580	65.02%
Panama 2000	0.150	0.210	0.340	0.380	0.250	1.330	58.59%
Portugal 1991	0.020	0.240	0.080	0.180	0.140	0.660	56.90%
Portugal 2001	0.080	0.040	0.080	0.060	0.220	0.480	77.42%
Puerto Rico 1990	0.052	0.127	0.214	0.493	0.157	1.043	69.03%
Puerto Rico 2000	.	.	0.414	.	0.216	0.630	71.92%
Romania 1992	0.190	0.140	0.070	0.120	0.770	1.290	52.02%
Romania 2002	0.040	0.030	0.240	0.210	0.130	0.650	46.76%
Russia 2002	1.380	2.200	1.420	2.220	2.980	10.200	88.24%
Spain 1991	0.200	0.140	0.120	0.240	0.037	0.737	67.03%
Spain 2001	0.717	0.396	0.345	0.347	0.317	2.122	94.65%
Switzerland 1990	.	0.020	0.020	.	0.020	0.060	75.00%
Trinidad and Tobago 2000	0.011	0.011	0.034	0.034	0.026	0.117	85.38%
United States 1990	4.935	7.949	12.000	19.397	30.122	74.403	91.15%
United States 2000	5.858	4.623	11.623	13.770	18.333	54.207	80.53%
Uruguay 1996	0.082	0.018	0.076	.	0.269	0.445	56.54%
Upper middle income countries (2023)							
Argentina 1991	1.435	1.811	2.045	2.131	3.886	11.308	68.66%
Armenia 2001	0.050	0.050	0.080	0.100	0.160	0.440	91.67%
Belarus 1999	0.030	0.030	0.080	0.070	0.180	0.390	90.70%
Botswana 1991	0.030	0.120	0.080	0.100	0.140	0.470	88.68%
Botswana 2001	0.050	0.020	0.140	0.100	0.180	0.490	85.96%
Brazil 1991	11.422	13.527	14.807	15.389	14.839	69.982	54.07%
Brazil 2000	11.931	13.012	12.578	14.396	13.935	65.853	46.82%
China 1990	6.100	11.600	10.300	14.700	25.500	68.200	87.44%
Costa Rica 2000	0.190	0.180	0.160	0.240	0.110	0.880	53.99%
Cuba 2002	0.310	0.440	0.350	0.300	0.430	1.830	57.55%
Dominican Republic 2002	0.460	0.920	1.110	1.450	2.180	6.120	56.25%
Ecuador 1990	1.250	0.970	.	1.070	.	3.290	34.41%
Ecuador 2001	0.580	0.680	0.800	1.100	1.370	4.530	47.73%
Fiji 1996	0.060	0.110	0.080	0.130	0.030	0.410	91.11%
Guatemala 1994	0.810	1.430	2.060	3.040	4.090	11.430	69.48%
Indonesia 1990	33.105	41.298	51.900	75.853	99.034	301.190	90.75%
Indonesia 2000	1.310	1.000	26.210	34.750	44.840	108.110	75.26%
Jamaica 1991	0.149	0.168	0.111	0.239	0.455	1.122	78.90%
Malaysia 1991	0.800	1.550	2.600	2.350	2.700	10.000	76.34%
Mauritius 1990	0.040	.	0.030	0.020	0.040	0.130	81.25%
Mauritius 2000	0.020	0.040	.	0.040	.	0.100	90.91%
Mexico 1990	5.553	7.694	8.866	12.756	20.231	55.100	74.18%
Mexico 2000	4.846	6.631	7.233	9.261	11.227	39.198	64.54%
Paraguay 1992	0.332	0.332	0.474	0.729	0.917	2.785	81.08%
South Africa 2001	1.650	1.863	3.400	3.544	5.304	15.760	86.67%
Thailand 1990	2.090	2.848	3.095	3.746	2.818	14.596	56.11%
Turkey 1990	4.280	5.420	7.420	9.420	12.920	39.460	76.71%
Lower middle income countries (2023)							
Bangladesh 1991	123.530	116.580	109.680	215.780	156.660	722.230	81.76%
Bangladesh 2001	33.360	50.050	86.830	167.520	195.530	533.290	80.63%
Benin 1992	2.600	2.560	4.020	5.060	3.910	18.150	71.12%
Benin 2002	4.890	4.440	7.450	11.000	5.760	33.540	84.27%
Bolivia 1992	0.590	0.650	0.930	1.280	1.970	5.420	76.23%
Bolivia 2001	1.423	1.815	1.454	1.595	1.948	8.234	84.42%
Cambodia 2004	0.315	0.019	0.185	0.019	0.199	0.737	100.00%
Egypt 1996	9.772	11.660	18.968	30.029	41.137	111.566	91.83%
Ghana 2000	5.390	5.790	6.150	9.530	11.000	37.860	94.37%
Kenya 1999	9.060	10.890	19.300	27.730	31.090	98.070	92.30%
Kyrgyzstan 1999	0.530	0.490	0.320	0.490	0.620	2.450	97.61%
Nepal 2001	3.242	4.452	5.521	11.888	14.349	39.452	83.03%
Nicaragua 1995	0.710	0.800	0.910	1.120	1.140	4.680	59.62%
Papua New Guinea 1990	0.500	0.480	1.870	3.250	3.520	9.620	83.72%
Philippines 1990	5.042	6.250	7.003	8.279	9.458	36.032	79.89%
Philippines 2000	0.475	0.996	1.056	1.217	0.174	3.917	22.01%
Senegal 2002	5.609	4.941	6.074	7.088	2.352	26.064	68.44%
Tanzania 2002	13.459	15.042	26.083	27.007	30.652	112.242	87.79%
Vietnam 1999	1.218	1.640	1.363	2.553	3.350	10.125	82.66%
Zambia 1990	3.870	5.010	4.340	6.470	6.960	26.650	90.80%
Zambia 2000	3.540	4.080	5.470	7.870	9.770	30.730	83.80%
Low income countries (2023)							
Burkina Faso 1996	4.450	5.290	4.180	5.960	3.760	23.640	63.91%
Malawi 1998	4.290	5.400	5.860	7.640	7.680	30.870	79.66%
Mali 1998	4.240	4.560	4.220	4.720	.	17.740	54.02%
Mozambique 1997	9.780	11.650	11.390	11.420	11.760	56.000	71.46%
Rwanda 1991	0.070	0.280	0.400	0.430	0.770	1.950	50.52%
Rwanda 2002	0.410	0.680	0.570	0.760	1.050	3.470	79.95%
Sierra Leone 2004	6.090	4.560	5.530	9.690	5.900	31.770	94.78%
Uganda 1991	9.286	11.325	14.480	19.492	22.164	76.747	92.68%
Uganda 2002	9.930	11.640	12.820	14.930	19.270	68.590	93.96%

Notes: Columns 1-5 present the total number of unrecorded births by mother's age at birth, calculated as the difference between the estimated total births in census t+10 and census t. Column 6 reports the aggregate number of unrecorded births, while Column 7 reports the share of unrecorded births relative to the total recorded births in census t+10.

C Data Appendix

C1 Sample

Table C1: Country-Census Pairs in Sample

Country	T_0	T_1	Country	T_0	T_1
Argentina	1991	2001	Mauritius	1990	2000
Austria	1991	2001	Mauritius	2000	2011
Bangladesh	1991	2001	Mexico	1990	2000
Bangladesh	2001	2011	Mexico	2000	2010
Armenia	2001	2011	Morocco	2004	2014
Bolivia	1992	2001	Mozambique	1997	2007
Bolivia	2001	2012	Nepal	2001	2011
Botswana	1991	2001	Nicaragua	1995	2005
Botswana	2001	2011	Panama	1990	2000
Brazil	1991	2000	Panama	2000	2010
Brazil	2000	2010	Papua New Guinea	1990	2000
Belarus	1999	2009	Paraguay	1992	2002
Cambodia	2004	2013	Philippines	1990	2000
Chile	1992	2002	Philippines	2000	2010
China	1990	2000	Portugal	1991	2001
Costa Rica	2000	2011	Portugal	2001	2011
Benin	1992	2002	Puerto Rico	1990	2000
Benin	2002	2013	Puerto Rico	2000	2010
Dominican Republic	2002	2010	Romania	1992	2002
Ecuador	1990	2001	Romania	2002	2011
Ecuador	2001	2010	Russia	2002	2010
Fiji	1996	2007	Rwanda	1991	2002
France	1990	1999	Rwanda	2002	2012
France	1999	2011	Senegal	2002	2013
Ghana	2000	2010	Sierra Leone	2004	2015
Greece	1991	2001	Vietnam	1999	2009
Guatemala	1994	2002	Spain	1991	2001
Hungary	1990	2001	Spain	2001	2011
Hungary	2001	2011	Switzerland	1990	2000
Indonesia	1990	2000	Thailand	1990	2000
Indonesia	2000	2010	Trinidad and Tobago	2000	2011
Ireland	1991	2002	Turkey	1990	2000
Ireland	2002	2011	Uganda	1991	2002
Italy	2001	2011	Uganda	2002	2014
Jamaica	1991	2001	Tanzania	2002	2012
Kenya	1999	2009	United States	1990	2000
Kyrgyz Republic	1999	2009	United States	2000	2010
Malawi	1998	2008	Burkina Faso	1996	2006
Malaysia	1991	2000	Uruguay	1996	2006
Mali	1998	2009	Zambia	1990	2000
			Zambia	2000	2010

Notes: .

C2 Definitions and Sources of Variables

Table C2: Definitions and Sources of Variables Used in the Analysis

Measure	Description	Source
Bias measure	This variable is calculated by one minus the ratio between the number of births reported in the first census over the number of births reported in the second census. To estimate the yearly number of births, we count the total number of individuals born in a specific year from the census microdata obtained from IPUMS international.	IPUMS International
% women making informed sexual decisions	This indicator measures the percentage of women aged 15-49 who are married or in a union and have autonomy in three key areas: making decisions about sexual relations, contraceptive use, and their own reproductive health care. Specifically, only women who have an active decision in the three components are considered to have autonomy in these areas.	UN Demographic and Health Surveys
Log income per capita	This metric is derived by computing the natural logarithm of the GDP at purchaser's prices, which is measured in constant 2017 international dollars.	World Bank
Difference between age and MAoC	This variable is calculated by subtracting the minimum age of consent in a given country from the age of the mother at the time of giving birth.	ageofconsent.net

C3 Further Details on Measures Used

C3.1 Census Data

The data used in this project were obtained directly through IPUMS. IPUMS International harmonizes and integrates census microdata from around the world into a consistent format over time and space, which makes it useful for cross-temporal and cross-national comparative research.

C3.2 Administrative Birth Registries

Sistema de Informações sobre Nascidos Vivos, SINASC (Brazil). This information system collects data on live births through the issuance of a Live Birth Certificate (Declaração de Nascido Vivo - DNV) at the time of birth, primarily in hospitals and healthcare facilities. When a child is born, healthcare professionals fill out the DNV, which includes comprehensive details about the birth. The hospital is responsible for entering this information into the SINASC system. In cases of home births, midwives or attending healthcare providers are responsible for issuing the DNV. The DNV is mandatory and serves as the primary document for recording a live birth. However, efficiency and effectiveness of data collection and reporting can vary across states due to differences in local healthcare infrastructure and administrative practices. Parents must take the DNV to a civil registry office (cartório) to officially register the birth. This process links the healthcare data collection with the civil registration system.

Despite its comprehensive coverage, a significant share of births still go unregistered. This can happen when births do not occur in hospitals and fail to be registered afterwards, because parents of hospital-born children report false or erroneous information, or because hospital births are not registered at a civil registry office by the parents, and the cross-validation system flags those births as requiring further checks.

Estadística de Nacimientos del Registro Civil, INEGI (Mexico). This dataset is part of Mexico's official vita statistics (Estadística Vitales), and is compiled by INEGI, the Mexican National Institute of Geography and Statistics (Instituto Nacional de Estadística y Geografía), for each year since 1985. Each year contains detailed microdata of all births registered in Mexico in that year, including date[15] and place of birth, and socio-demographic information on parents (including age at birth). In Mexico, when a birth occurs, healthcare providers are required to issue a Certificate of Birth (Certificado de Nacimiento) within the first 24 hours. This certificate is mandatory and serves both legal and statistical purposes. The parents are then required to take the Certificate of Birth to the local Civil Registry office (registro civil) to obtain the official Acta de Nacimiento (birth certificate). The Civil Registry offices spread around the country then send these Acta de Nacimiento documents directly to INEGI, whether in printed form or electronically. After receiving the data, INEGI processes, validates and diffuses the final dataset.

As in the case of Brazil, births still can go unregistered in Mexico for similar reasons: unregistered home births, non-registration of births in the civil registry, the purposeful or accidental registration of incorrect information, and lack of access to civil registry units. There is still another potential source of data on live

[15]The date of birth is different from the registration date, such that a given year's dataset can include births that took place several years before the registration date.

births in Mexico, the Subsistema de Información sobre Nacimientos (SINAC). This new system, which records data collected directly from hospitals, is run by the Health Secretary of Mexico. The accuracy of SINAC data is still unknown, however, and the literature still uses INEGI's data as the preferred source. (Arceo-Gomez and Campos-Vazquez, 2014; Meneses and Ramírez, 2018; del Carmen Hernández-Ortiz, 2016)

National Vital Statistics System, NVSS (U.S.A.). This is a system managed by the National Center for Health Statistics (NCHS) under the Centers for Disease Control and Prevention (CDC), which collects birth data through a cooperative arrangement with state vital records offices across the United States. Birth registration is primarily the responsibility of the professional attending the birth, typically a physician or midwife, who completes the birth certificate. The demographic information is usually provided by the mother. Births are registered at the local or state level, generally through state vital records offices. Parents do not need to register their children separately, as the process is typically initiated and completed at the hospital where the birth occurs. Each state has its own laws and regulations regarding birth registration, though they all follow a model U.S. Standard Certificate of Live Birth. States compile the data and transmit it electronically to the NCHS.

Delays in registration can occur due to factors such as administrative issues or complications in obtaining complete information from parents, but the system is generally believed to have a high coverage level and minimal under-registration, with 99% of natality data considered complete within four weeks. [16] Given that the CDC publishes the final birth registration count for a given year in April of the subsequent year, and it considers this count as final, preliminary counts are also published together with completeness estimates. The technical note regarding the provisional counts of the 2nd quarter of 2024 data estimated that the provisional estimates are to be within 1-2pp of the official ones. However, the same technical note recognizes that for mothers under 15 delays can cause data completeness to be 80% or lower (although small in absolute terms due to low birth rates for this group). [17] The "User Guide to the 2023 Natality Public Use File" published by the CDC (CDC, 2023) only mentions that data completeness is estimated to be 99%. Until 2014, the same report (CDC, 2014) mentioned this same figure by citing a 1964-68 birth-registration completeness test that has not been replicated more recently.

[16] urlhttps://wonder.cdc.gov/wonder/help/Natality-provisional.html

[17] urlhttps://www.cdc.gov/nchs/nvss/vsrr/natality-technical-notes.htmref2