Love in the Time of Zika*

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Abstract

We study how fertility declines shape women's labor and marriage market outcomes by exploiting exogenous variation from Brazil's Zika epidemic. Although Zika causes only mild symptoms in adults, the discovery of severe fetal risks in late 2015 led to sharp behavioral responses and a sudden reduction in fertility. Using administrative births, labor force, and marriage records linked at fine geographic scales from 2014–2018, we compare municipalities with high versus low Zika exposure based on confirmed cases, environmental suitability for the *Aedes aegypti* mosquito, and Google search intensity. Across measures, fertility fell by 10.7 percent in the most affected areas. Beginning nine months after the health emergency declaration, women's employment rose by 2–3 percentage points, and monthly earnings increased by more than 200 reais—consistent with fertility-driven effects, rather than direct viral effects. Marriage-market outcomes shifted as well: divorce rates increased and peaked a year after the epidemic, while marriage rates rose with roughly a one-year lag. These patterns are consistent with improved agency and economic opportunities for women in high-exposure regions. More broadly, our findings provide causal evidence that aggregate fertility declines can meaningfully alter women's labor force attachment and family formation, with implications for countries undergoing rapid and sustained fertility transitions.

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1 Introduction

Over the past half-century, fertility has fallen sharply across countries at all income levels. Brazil is emblematic of this transition: total fertility declined from more than six births per woman in the 1960s to well below replacement level today (World Bank, 2025). This dramatic shift coincides with rising female labor force participation and substantial social and economic change, but women's economic opportunities and family trajectories continue to be shaped by the timing and number of children women have. A large body of work documents that motherhood is associated with sizable and persistent earnings penalties, changes in occupations and sectors, and widening gender gaps in hours and wages (Adda et al., 2017; Kleven et al., 2019a; Sieppi and Pehkonen, 2019; Berniel et al., 2021; Cortés and Pan, 2023). As families become smaller in middle-income settings, there is an open question of how fertility declines feed back into women's labor market trajectories and marriage market outcomes. Do fewer births relax time and mobility constraints enough to raise women's earnings and formal employment? Do changes in fertility alter the stability and structure of marital unions, and consequently affect women's economic opportunities?

Answering these questions is empirically challenging because fertility, labor supply, and family formation are jointly determined. Women with stronger labor market preferences may choose to delay or forgo childbearing, marry later, or select different types of partners, making it difficult to isolate the causal impact of fertility from underlying preferences or unobserved heterogeneity (Adda et al., 2017). A large literature has therefore relied on quasi-experimental variation in the number or timing of children to study labor supply responses, including twin births, sibling sex composition, and infertility shocks (Aguero and Marks, 2010; Cáceres-Delpiano, 2012; Heath, 2017). These studies provide important evidence that additional children reduce women's labor supply, shift them toward more flexible or informal occupations, and widen intra-household earnings gaps (Adda et al., 2017; Goldin and Mitchell, 2017; Bertrand et al., 2010; Angelov et al., 2016). However, most of this work focuses on the impact of having an extra child, often in high-income contexts, and says less about what happens when fertility falls in the aggregate—when many women choose not to have (or to postpone) a birth that they otherwise would have had. Yet, when considering worldwide fertility declines, the relevant variation we may need should be derived from reductions, rather than increases, in births.

In this paper, we study how fertility declines affect women's labor and marriage market outcomes by exploiting exogenous variation from Brazil's Zika epidemic. The Zika virus, which spread rapidly through Brazil in the mid-2010s, causes mild or no symptoms in most adults, but poses severe risks to fetal development when contracted during pregnancy. Clinical and epidemiological evidence links maternal Zika infection to large increases in microcephaly, brain abnormalities, and other congenital Zika syndromes (Brasil et al., 2016; Mlakar et al., 2016; Haby et al., 2018). Rates of adverse fetal outcomes are dramatically higher among Zika-exposed pregnancies (Coelho et al., 2017), and case reports documenting Zika virus in fetal brain tissue established a direct causal pathway to microcephaly (Mlakar et al., 2016). Public awareness of these fetal risks rose sharply in late 2015, following the October 2015 identification of unusual clusters of microcephaly and the November 2015 declaration of a national public health emergency, and was reinforced when the World Health Organization declared a public health

emergency of international concern in February 2016.

The perceived fetal risks from Zika led to large and rapid behavioral responses in fertility. A growing literature documents that fertility fell substantially in regions with higher Zika prevalence, as women delayed or avoided pregnancies under heightened risk. Using monthly birth records and regional case counts, these studies find fertility declines on the order of seven to 10 percent in high-risk municipalities (Rangel et al., 2020; Junior and Rasul, 2020; Marteleto et al., 2020; Ryu, 2020). Survey evidence on reproductive intentions and contraceptive behavior further shows that women strategically postponed childbearing in response to perceived Zika risk, temporarily revising plans to have (additional) children (Marteleto et al., 2017; Marteleto and Dondero, 2021; Junior and Rasul, 2020; Rangel et al., 2020). Importantly, Zika's symptoms in adults are predominantly mild and short-lived, and roughly 80 percent of infections are asymptomatic (Haby et al., 2018). Unlike pandemics such as COVID-19, Zika did not trigger broad economic shutdowns. The primary policy response focused on mosquito control and public information campaigns, rather than restrictions on work or mobility. This makes Zika an unusually clean setting in which health-related fetal risk changes women's childbearing behavior without directly disturbing aggregate labor demand or broader macroeconomic conditions.

We build on this emerging literature that uses Zika as a natural experiment to study fertility (Marteleto et al., 2017, 2020; Marteleto and Dondero, 2021; Junior and Rasul, 2020; Rangel et al., 2020; Ryu, 2020), and extend it along two key dimensions. First, we strengthen identification of fertility responses by combining administrative birth records with multiple independent measures of Zika exposure: reported case counts, environmental suitability for the *Aedes aegypti* mosquito, and municipality-level Google search intensity for "Zika." Second, and more importantly, we move beyond fertility itself to study how Zika-induced fertility declines reshape women's labor supply, earnings, and marriage outcomes in a middle-income economy with a large informal sector. In contrast to the prior Zika literature, which has focused predominantly on fertility and fertility intentions, we trace the broader consequences of fertility reductions across labor and family domains.

Our paper proceeds in three stages. First, we provide new evidence on the magnitude and timing of fertility responses to Zika using rich administrative data and improved measures of exposure. We construct a monthly municipality-level panel of births using Brazil's Live Birth Information System (SINASC), linked to three complementary measures of Zika exposure. Our preferred specification exploits the staggered geographic spread of Zika in an event-study difference-in-differences framework, comparing high- and low-exposure municipalities before and after the November 2015 emergency declaration. Across exposure measures, we find that fertility in high-Zika areas falls by 10.7 percent beginning nine months after the declaration, consistent with pregnancy avoidance rather than termination, and that births do not overshoot in later periods. This pattern indicates that many "missing births" are not simply postponed but effectively foregone, corroborating and extending existing findings (Marteleto et al., 2020; Junior and Rasul, 2020; Ryu, 2020).

Second, we estimate the causal effect of this fertility decline on women's labor market outcomes. We combine the fertility panel with quarterly microdata from the nationally representative *Pesquisa Nacional por Amostra de Domicílios Contínua* (PNAD-C), which provides

detailed information on employment, formality, hours, and earnings for both formal and informal work. We link women to Zika exposure at the state–capital-region level and estimate an event-study difference-in-differences specification analogous to the fertility analysis. The timing of Zika's impact—with fertility responses beginning roughly nine months after the health emergency declaration—allows us to separate any contemporaneous, direct labor market effects of the epidemic from the lagged, fertility-mediated responses.

We find that in high-Zika areas, women's employment rises by two to three percentage points and formal-sector participation increases by up to 3.1 percentage points, beginning roughly nine months after the fertility shock. This timing closely tracks the gestational window and is consistent with the interpretation that the labor market effects operate through changes in fertility rather than direct effects of the epidemic itself. Monthly earnings increase by over 200 reais (approximately 20 percent of mean pre-epidemic earnings for women ages 20 to 34) and these gains emerge gradually over the subsequent year. Notably, these employment and earnings increases persist even after fertility rates stabilize, suggesting that the fertility shock alters women's labor market trajectories in ways that extend beyond the initial decline in births.

These results complement and extend prior work documenting that motherhood reduces women's labor supply and shifts them toward more flexible or lower-paying occupations (Adda et al., 2017; Goldin and Mitchell, 2017; Bertrand et al., 2010; Cortés and Pan, 2023). Here, we show the mirror image: a plausibly exogenous reduction in fertility in a middle-income setting leads to meaningful increases in women's earnings and attachment to the labor market. Importantly, we observe no comparable changes in the period immediately following the epidemic declaration, further reinforcing the interpretation that these labor market responses reflect the fertility decline itself rather than contemporaneous disruptions to labor demand or health-related labor supply constraints.

Third, we trace out the implications of fertility declines and improved female labor outcomes for marriage and divorce. Using annual municipality-level administrative data from the Brazilian Institute of Geography and Statistics (IBGE), we examine how marriages and divorces evolve in high- versus low-Zika areas. We document that divorces rise by about 15 percent in high-exposure municipalities, peaking roughly one to two years after the Zika shock, while marriage rates increase with a similar lag. One interpretation is that reduced fertility and stronger labor market attachment improve women's outside options and bargaining power within relationships, enabling some women to exit unsatisfactory unions and enter new ones. These patterns are consistent with broader trends of rising divorce in Brazil (Instituto Brasileiro de Geografia e Estatística, 2023; Herre et al., 2020; OECD, 2024), but our design isolates the causal role of exogenous fertility declines in accelerating these shifts. To our knowledge, this is the first paper to use the Zika epidemic to study marriage and divorce responses, and one of the few to causally link aggregate fertility shocks to changes in marriage markets in a middle-income country.

Our analysis takes place against the backdrop of long-run changes in women's economic roles and family formation in Brazil. Globally, female labor force participation has risen steadily over recent decades, but remains below male participation in virtually all countries (Goldin and Mitchell, 2017; Blau and Kahn, 2017). Brazil has followed this pattern: in the 1970s, only about 20 percent of Brazilian women were economically active, whereas in recent years female

labor force participation has plateaued around 53 percent, compared to roughly 73 percent for men (World Bank, 2025). Women have attained higher levels of education than men on average, but continue to be concentrated in sectors such as education, health, hospitality, and retail, while men remain overrepresented in construction, transport, and agriculture. Gender earnings gaps, although narrowing over time, remain large and persistent, particularly in the middle of the distribution where care and time constraints are most binding (Bertrand et al., 2010; Blau and Kahn, 2017; Khanna et al., 2025). At the same time, marriage and divorce patterns in Brazil have shifted markedly. Legal reforms have simplified the process of divorce; divorce and separation have become more common; and marriages are increasingly delayed (Instituto Brasileiro de Geografia e Estatística, 2023). These trends mirror those observed across many middle- and high-income countries, where family formation has decoupled from traditional marital institutions and household structures have diversified.

A central theme of the recent literature on gender inequality is that childbearing is the main turning point at which gender earnings gaps emerge and persist. Studies using high-quality administrative data from Denmark, the United States, Finland, and other high-income countries consistently show that earnings trajectories of men and women are similar prior to the birth of the first child, but diverge sharply thereafter (Angelov et al., 2016; Chung et al., 2017; Kleven et al., 2019b; Sieppi and Pehkonen, 2019). Women's earnings and hours fall, occupational choices shift toward more flexible or family-friendly jobs, and a sizable "child penalty" emerges that persists for years or decades (Adda et al., 2017; Bertrand et al., 2010; Cortés and Pan, 2023). Evidence from developing and middle-income countries, including Latin America, suggests similar patterns, with motherhood associated with reduced labor force participation, increased informality, and larger earnings penalties where childcare systems and labor protections are weaker (Cáceres-Delpiano, 2012; Heath, 2017; Berniel et al., 2021; Aguero et al., 2020). Cross-country comparisons indicate that the magnitude of these child penalties varies systematically with institutional context and stage of development (Kleven et al., 2019a, 2021), highlighting the importance of studying fertility–labor links in settings beyond the OECD.

Taken together, our findings speak to broader debates on the interaction between demographic transitions, gender inequality, and economic development. A growing literature shows that motherhood penalties vary systematically with institutional context and stage of development (Aguero et al., 2020; Kleven et al., 2019a, 2021), and that women often sort into flexible occupations and sectors when time demands are high (Goldin and Mitchell, 2017; Bertrand et al., 2010; Adda et al., 2017; Cortés and Pan, 2023). Our results suggest that, in a middle-income country where fertility is already low, and female labor force participation is rising, further fertility declines can amplify women's engagement in formal employment and earnings, with knock-on effects on family formation. If the mechanisms we uncover generalize, ongoing global fertility declines may reshape both labor and marriage markets in ways that narrow gender gaps, while also altering the stability and composition of households.

Unlike previous work that relies mostly on birth events for variation (and are focused on high-income countries), we study the consequences of fertility *reductions*. In many ways, reduced fertility may be the relevant variation when considering the long-term consequences of the worldwide declines in birth rates. As such, our results have important implications for how

women's roles will evolve in the labor and marriage market, and within families, as the decline in fertility continues in different parts of the world. Our focus on a populous middle-income country adds substantial evidence complementing the detailed research in high-income settings.

The remainder of the paper proceeds as follows. Section 2 provides background on the Zika epidemic in Brazil and documents key trends in fertility, women's work, and marriage and divorce prior to the epidemic. Section 3 describes our administrative and survey data sources and the construction of our Zika exposure measures. Section 4 outlines our empirical strategy. Section 5 presents our main results on fertility, women's labor market outcomes, and marriage and divorce. Section 6 concludes with implications for understanding global fertility transitions and gender inequality in labor and family outcomes.

2 Background: Zika, fertility, marriage, and work

2.1 The Zika Epidemic

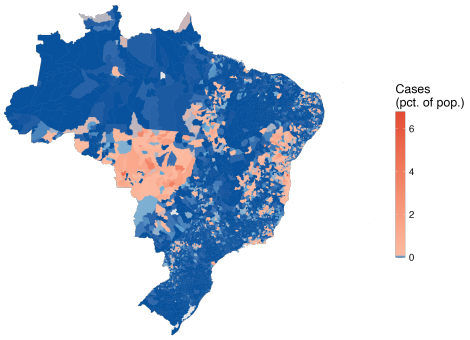
The Zika virus induces mild, short-lived symptoms in adults. Roughly 80 percent of infected people are asymptomatic; the symptomatic experience mild cold-like symptoms, and more serious complications are rare. However, when women are infected during pregnancy, the disease can be devastating to fetuses. Rates of adverse outcomes are 30 to 40 percentage points higher among fetuses, and brain abnormalities are common. In one study on Zika-affected pregnant women in Rio de Janeiro, 42 percent of live babies born to Zika-positive women had "grossly abnormal clinical and/or brain imaging," and four of those had microcephaly (Brasil et al., 2016).

The first case of Zika was confirmed via RT-PCR in May 2015, but the potential for devastating effects on fetuses was not widely known until November 2015 following the formal declaration of a public health emergency by Brazilian authorities. As symptoms were primarily observed among adults in the early stage, Zika was considered benign. In October 2015, specialists first reported a correlation between Zika and microcephaly. Brazil's Ministry of Health declared a national public health emergency in November 2015, marking the first widespread awareness of Zika's threat to the development of fetuses. As Zika spread within and beyond Brazil, the World Health Organization declared a public health emergency of international concern in February 2016.

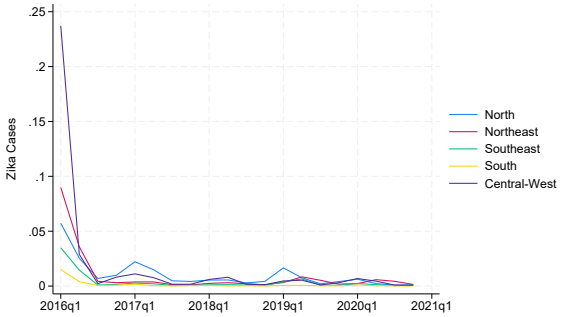
As such, a growing body of clinical and demographic evidence documents that the Zika epidemic posed severe risks to fetal health and generated large behavioral responses in fertility. Early medical studies linked maternal Zika infection to microcephaly and other serious congenital abnormalities, including evidence of Zika virus present in fetal brain tissue (Brasil et al., 2016; Mlakar et al., 2016). Subsequent research highlighted that even asymptomatic infections posed substantial threats to fetal development and contributed to fetal losses (Haby et al., 2018; Coelho et al., 2017). As information about these risks spread, fertility fell sharply in regions experiencing higher Zika transmission, with studies consistently documenting large declines in births in high-incidence municipalities (Marteleto et al., 2017, 2020; Rangel et al., 2020; Junior and Rasul, 2020; Ryu, 2020). These declines were driven not only by fetal health shocks but by households strategically delaying or avoiding pregnancy in response to perceived fetal risk

Figure 1: The Geographic and Temporal Spread of Zika Cases

(a) Map of Zika Cases



(b) Zika Cases by Region over Time



Notes: Zika case data are from the SINAN. The map in Panel 1a shows Zika case load per capita by municipality. Municipalities in blue are below the 90th percentile in case incidence, while those in red are at or above the 90th percentile. The five geographic regions shown in Panel 1b are the official regions defined by IBGE.

(Marteleto et al., 2017; Junior and Rasul, 2020; Rangel et al., 2020). For these reasons, recent research has increasingly employed Zika as a natural experiment, exploiting the geographic spread of the virus and variation in transmission risk to identify the causal impacts of fertility changes on household behavior (Marteleto et al., 2017, 2020; Marteleto and Dondero, 2021; Junior and Rasul, 2020; Rangel et al., 2020; Ryu, 2020).

Figure 1 indicates substantial variation in Zika prevalence across both time and space. The North-eastern state of Pernambuco is often considered the original epicenter of the Zika outbreak. When official case reports began in the first quarter of 2016, however, per-capita cases were the highest in the Central-West region, a landlocked agricultural area that is less densely-populated. Cases were lowest in the temperate states of the South, and in the Southeast (which includes the major population centers of Rio de Janeiro and São Paulo). Throughout the country, reported cases peaked in early 2016. With the exception of the low-population density Amazonian North that reported small outbreaks in 2017 and 2019, cases fell to near zero by early 2017, and remained there throughout the period shown.

This geographic and temporal identifying variation created by the Zika virus allows us to study the effects of fertility on labor and marriage market outcomes, as its mild symptoms in adults make it likely to affect fertility without directly affecting work behavior. Subsequent research has shown that the Zika epidemic led to a decrease in fertility in Brazil, findings that we replicate below with novel data and identification.

2.2 Fertility, Women's Work, and Family Formation

Our primary outcomes center on fertility, female employment and earnings, and marriages and divorces. We situate our analysis in a context where fertility rates worldwide have been falling steadily over the past several decades. As recently as the 1950s, the global average total fertility rate (i.e., number of children per woman over her lifetime) was roughly 4.9–5.0 children per woman, but by 2023 it had dropped to around 2.3 children per woman. This decline is also clearly visible in Brazil. In 1960, Brazil's total fertility rate was about 6.05 children per

woman. Over subsequent decades, fertility fell rapidly: by 1991 it was down to around 2.9–3.0, by 2000 roughly 2.4, and by 2010 about 1.9 children per woman. In the most recent data (2023), Brazil's fertility rate stands at around 1.6 births per woman (World Bank, 2025). Thus, Brazil's trajectory mirrors the global trend: from large families once typical to well below "replacement level" in the 21st century, suggesting a dramatic demographic shift with long-term implications.

Concurrently, across the world, female labor force participation has gradually increased over recent decades, although women continue to participate at substantially lower rates than men. According to recent estimates, around 49 percent of women globally are in the labor force, reflecting both rising educational attainment and ongoing constraints related to child care and social norms. Brazil further reflects these global patterns. In the 1970s, only about 20 percent of Brazilian women were economically active, whereas in more recent years, female labor force participation in Brazil has been around 53 percent, compared to roughly 73 percent for men (World Bank, 2025). Thus, while Brazil has experienced large gains in women's labor market involvement, persistent gender gaps remain, perhaps driven in part by unequal household responsibilities and continued barriers to formal employment (Khanna et al., 2025).

Household survey data, available in the PNAD-C, sheds light on general employment patterns for men and women in Brazil beginning in 2012. Figure A4 compares education levels of men and women both in and out of the labor force, in 2017. Women have generally attained higher levels of education, and men and women in the labor force have attained higher levels of education than those not in the labor force. This figure also compares the industry in which men and women work. Construction, transportation, and agriculture are industries primarily driven by male labor, while women tend to hold jobs in hospitality, education, and health and social services. Reflecting these education and industry trends, women are far more likely than men to work in occupations such as teaching, service, and retail.

Figure A5 shows the adjustment in the distribution of earnings for men and women between 2012 and 2019. Men's earnings remained relatively steady, but female earnings increased, primarily in the middle of the distribution. As a result, the gender pay gap reduced throughout this period, though it remains high at more than 30 percentage points in the first quarter of 2019.

Marriage patterns around the world have shifted markedly in recent decades, with most countries experiencing later marriage, lower marriage rates, and rising divorce (Herre et al., 2020). While registered marriages have declined in recent years, divorces have become more common (albeit with variation across contexts), reflecting legal reforms that simplified the process and broader social changes (Herre et al., 2020; OECD, 2024). Brazil exhibits similar trends. Over the past two decades, the number of legal divorces has risen sharply, and the average duration of marriage before divorce has fallen, perhaps indicating both greater acceptance of separation and changing gender norms (Instituto Brasileiro de Geografia e Estatística, 2023). Together, these trends point toward a gradual decoupling of family formation from traditional marital institutions and a continued diversification of household structures.

Changes in fertility, women's work, and marriage are also likely to affect patterns of time use, particularly the extent to which childcare and household responsibilities constrain labor supply. Figure A6 summarizes trends in the share of individuals reporting that they were unable to work

due to childcare or household duties, separately by age group and gender. Following the onset of the Zika epidemic, we observe notable declines among younger women in the share reporting that childcare or housework prevented them from working, while no comparable changes appear for older women, who had likely already completed fertility. By contrast, younger men exhibit a modest increase in reports of childcare-related work constraints, although the scale of this change is considerably smaller than that for women. These patterns are consistent with fertility declines reducing childcare-related barriers to women's labor supply, while only marginally altering men's time allocation.

3 Data Description

We combine a wealth of administrative and survey data. As exposure to the Zika virus varies by geography, we link several administrative and survey datasets at the municipal level.

3.1 Zika Exposure

Our preferred "treatment" measure combines temporal variation in the spread of the Zika virus with cross-sectional, location-based variation in exposure to the Zika virus. The preferred temporal variation compares before vs. after the November, 2015 announcement of a national public health emergency by Brazil's Ministry of Health. The preferred cross-sectional variation is the precise number of Zika cases reported per capita in each municipality. Plotted in Figure 1a, Zika case data come from Brazil's administrative health data, the *Sistema de Informação de Agravos de Notificação* (SINAN) (Ministério da Saúde, 2020). Previous literature using this measure found large declines in fertility in areas with higher case loads (Rangel et al., 2020; Codeço et al., 2017; Marteleto et al., 2017). For our estimation strategy (see Section 4), we create a geography-level indicator variable equal to one for geographies in which per-capita cases in the first quarter of 2016 lie above the 90th percentile of per-capita cases across the country, and equal to zero otherwise.

A potential concern with this oft-used measure of Zika exposure is that the number of diagnosed cases may be correlated with medical infrastructure and other local characteristics that could predict outcomes of interest. While our event study strategy would surface differential pre-trends between high and low exposure areas, we also show robustness of our specification to other measures of Zika exposure.

The second measure we consider captures variation in Zika exposure across municipalities due to their environmental suitability for the *Aedes aegypti* mosquito, the primary vector for the Zika virus (Faria et al., 2017; Messina et al., 2016). We refer to this measure as "Zika suitability." For our estimation strategy (see Section 4), we create a binary indicator for each municipality that assumes a value of one if suitability falls above the 90th percentile of municipality-level suitability and a value of zero otherwise. Appendix Figure A2a identifies these treated regions in red.

The third measure we consider gauges awareness and concern about the Zika epidemic. We use a municipality-level index measuring the frequency of Google searches that include the word "Zika" relative to all Google searches (Google Trends, 2018).[1] For our estimation strategy (see

[1] We thank Hal Varian for personally sharing the Google Search Data.

Section 4), we create a binary indicator for each geography that assumes a value of one if any Zika-related searches are recorded in the first quarter of 2016, and a value of zero otherwise. Appendix Figure A3a identifies these treated regions in red.

Comparing the three maps, we see that the various measures of Zika exposure indeed capture slightly different aspects of variation of the virus. For example, treated municipalities are more evenly distributed throughout the country when identified using Google searches than when identified using the two other measures. Areas with high Zika exposure show modest demographic differences in comparison with areas with high Zika exposure, such as slightly larger populations, especially according to the Google searches measure. Nonetheless, we show that these three measures are strongly correlated (results available on request).

3.2 Primary Outcomes

We measure municipal-level births using administrative births data, the *Sistema de Informações Sobre Nascidos Vivos* (SINASC), which records data on every birth in Brazil, including the municipality of maternal residence and delivery (Ministério da Saúde, 2023). We collapse this data to the municipal level by mothers' municipality of residence, and merge it with the Zika exposure measures discussed above. In this way, we create a municipal-level dataset at the monthly frequency, that includes all births within a municipality and the mothers' corresponding exposure to Zika.

The employment dataset we consider, the *Pesquisa Nacional por Amostra de Domicílios-Continua* (PNAD-C), is a rotating panel household survey conducted at a quarterly frequency, which is nationally representative of Brazilians age 15 and above (Instituto Brasileiro de Geografia e Estatística, 2024). These data measure labor force participation and earnings, as well as the respondent's state of residence and whether they live in the capital municipality. These geographic data allow us to aggregate our measures of Zika exposure to 53 distinct regions that we refer to as "state-by-capital."[2] We then link each PNAD-C respondent to the Zika exposure measure of their respective region. The result is an individual-level dataset measured at the quarterly frequency.

We obtain annual counts of marriages and divorces by municipality from *Sistema de Estatísticas Vitais* (System of Vital Statistics) maintained by the Brazilian Institute of Geography and Statistics (IBGE). These administrative records, reported at the municipality-year level, cover all civil marriages and legally registered divorces in Brazil and include the municipality in which the marriage or divorce occurred. The System of Vital Statistics provides comprehensive national coverage, allowing us to track changes in marital formation and dissolution over time. Because the data are available only at the annual frequency, our analysis of marriage and divorce is at the municipality-year level, complementing our higher frequency fertility and labor market analysis (Instituto Brasileiro de Geografia e Estatística, 2023).

[2]The PNAD-C identifies the following potential geographic locations of survey participants: (i) 26 state capitals, (ii) 26 states excluding their capitals, (iii) the federal district, i.e. national capital, and (iv) different types of municipalities within each state (e.g. capital municipality, metropolitan areas neighboring the capital, municipalities in other metropolitan areas, and other municipalities). We construct 53 "PNAD-C regions" identified by categories (i) through (iii), where every municipality is fully contained in a PNAD-C region. We also construct more disaggregated regions at the stratum level using the municipality categories in (iv) and use these for robustness checks in Appendix Figures A10 and A11.

4 Estimation Strategy

Across all outcomes, we use an extended difference-in-difference specification that compares changes in high-exposure Zika areas relative to changes in low-exposure Zika areas. However, different outcomes are available at different frequencies, for different periods, and at different levels of aggregation; we accordingly adapt some details of the analysis for each group of outcomes.

We expect Zika's direct effect to be on fertility, and we estimate that relationship as follows:

$$Births_{m,t} = \gamma_m + \delta_t + \sum_{t=Jan.2015}^{Sep.2015} \left(\alpha_t \times \text{Treated}_m\right) + \sum_{t=Nov.2015}^{Dec.2018} \left(\beta_t \times \text{Treated}_m\right) + \varepsilon_{m,t}, \quad (1)$$

where m indexes municipalities and t indexes months. $Births_{m,t}$ is the count of municipal-level births to women between the ages of 20 and 25, measured at the monthly level. Treated_m is a binary measure of low or high Zika exposure in each municipality, while δ_t represents year-by-month fixed effects and γ_m represents municipality fixed effects. These fixed effects absorb variation in births over time and across municipalities, leaving variation within municipality and time-by-treatment status to identify the β coefficients of interest.

We continue with a reduced-form regression estimating the impact of Zika on monthly, individual-level employment and wage outcomes from the PNAD-C:

$$L_{i,j,q} = \gamma_j + \delta_q + \sum_{t=2014q1}^{2015q2} \left(\alpha_q \times \text{Treated}_j\right) + \sum_{t=2015q4}^{2018q4} \left(\beta_q \times \text{Treated}_j\right) + \varepsilon_{i,j,q}, \quad (2)$$

where i indexes individuals, j indexes the 53 state-by-capital regions identifiable in the PNAD-C, and q indexes quarters. $L_{i,j,q}$ is individual-level employment or earnings measured quarterly, for women between the ages of 20 and 35. Treated_j is a binary measure of low or high Zika exposure in each of the PNAD-C regions. The fixed effects δ_q and γ_j absorb variation in employment outcomes over time and across municipalities. As a result, the β coefficients of interest estimate changes in labor-market outcomes using within geography and time-by-treatment variation.

Our main analysis concludes with another reduced-form regression estimating the impact of Zika on family formation and dissolution. Marriage and divorce data are recorded annually, leading to the following municipality-by-year specification:

$$M_{m,k} = \gamma_m + \delta_k + \sum_{k=2014}^{2015} \left(\alpha_k \times Treated_m\right) + \sum_{k=2017}^{2023} \left(\beta_k \times \text{Treated}_m\right) + \varepsilon_{m,k}, \quad (3)$$

where m indexes municipalities and k indexes years. $M_{m,k}$ measures municipal-level marriages and divorces at the annual level, across all age groups. Treated_m is our binary measure of low or high Zika exposure in each municipality, while δ_k represents year fixed effects and γ_m represents municipality fixed effects. These fixed effects absorb variation that is consistent across years and municipalities, leaving variation within municipality and time-by-treatment status to identify the β coefficients of interest.

The coefficients of interest, β, measure whether any gap between low and high Zika exposure

locations changed after Zika, specifically relative to the reference period (October 2015 for monthly specification (1), 2015 quarter 3 for quarterly specification (2), and 2016 for annual specification (3)). Three conditions must hold for these coefficients to causally estimate the impact of Zika exposure. First, in the absence of Zika, the high- and low-Zika municipalities would have had similar trends in fertility, employment, and family formation and dissolution. We estimate pre-period α coefficients that provide suggestive evidence of parallel trends before the Zika epidemic. Second, we assume SUTVA, such that there are no spillovers from high to low exposure places. This assumption would be violated if, say, the Zika epidemic led to short-term migration from high-exposure to low-exposure parts of the country. Given the immediate response in conception that we document in monthly fertility data, one may expect differential migration to be less of a concern. Third, our strategy precludes the possibility of other unrelated simultaneous changes that differentially affected high-exposure places in the corresponding months.

We require one further condition to claim that equations (2) and (3) capture the effect of fertility on employment and family formation: Zika must directly affect fertility, but only affect employment or divorces and marriages through its impact on fertility. While the effect of Zika on fertility is testable, the fact that employment and household structure are only affected via fertility responses is more challenging to test. The typical nine-month gestation period suggests that employment and marriage effects due to additional children would not appear until nine months after Brazil's declaration of a health emergency, while any impacts on employment due to pregnancy itself would likely not show up until the final trimester. This suggests that immediate direct effects on employment may be detected during the Zika pandemic, but the fertility-mediated effects would mostly appear with a six-to-nine month lag.

5 Results

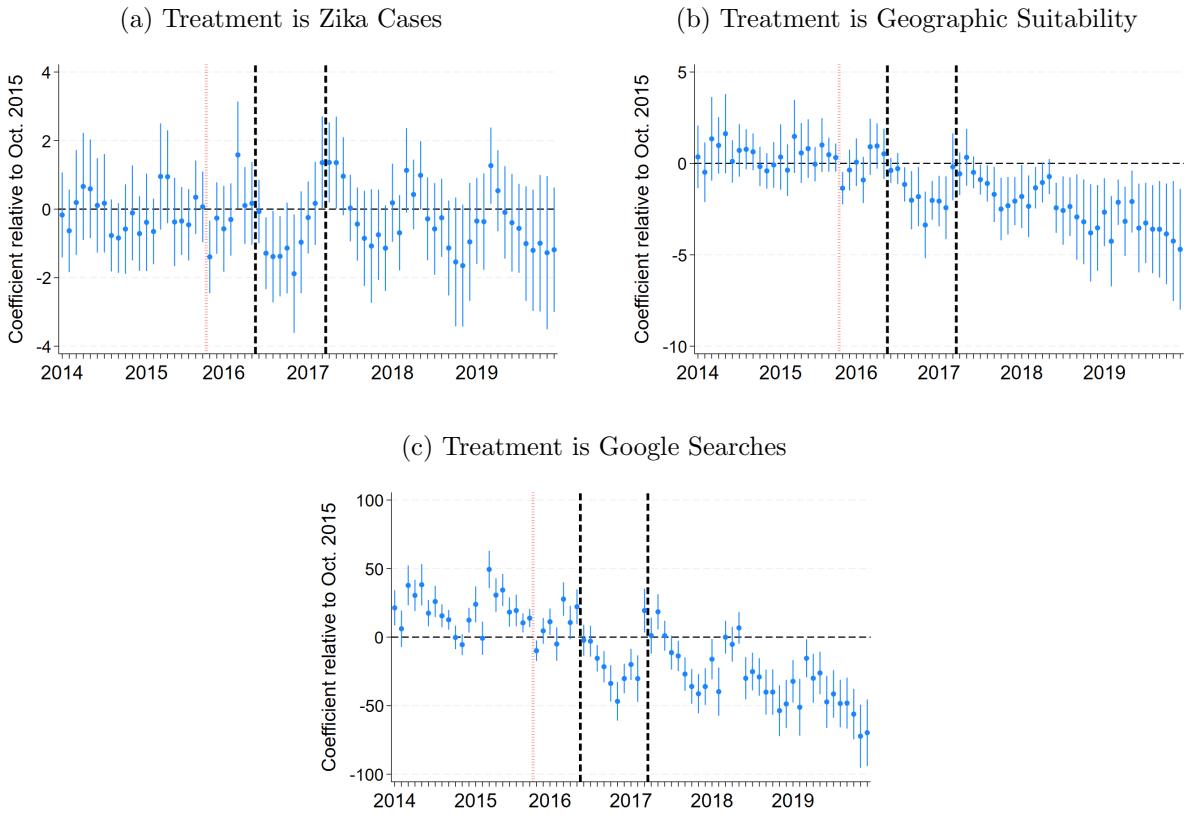
5.1 The Impact of Zika on Fertility

Figure 2 shows the impact of Zika on the total number of births within each municipality, estimated with specification (1). Each coefficient estimate measures the difference between high and low Zika exposure municipalities in the average monthly decline in births among women between the ages of 20 and 34, relative to October 2015. Thus, estimates below zero represent fewer babies in areas hardest hit by Zika.

To aid interpretation, we add three vertical reference lines to each panel. The first (red) line marks our omitted month, October 2015, immediately before the declaration of the national emergency. We then plot a line nine months after the emergency was declared, corresponding to a typical gestational period when the initial shock might begin to affect births. A second line is placed nine months after cases fall back to near-zero, indicating the effective end of the epidemic. At that point as Zika became endemic at much lower rates, births may return to prior levels—or even overshoot them—as parents resume postponed childbearing.

The estimates show relative declines in fertility in high-exposure municipalities beginning nine months after the declaration of the national emergency. Coefficients prior to the declaration of the national emergency are not statistically different from zero, providing reassurance that

Figure 2: Monthly Impact of Zika Virus on Births



Notes: All specifications include year-by-month and municipality fixed effects. Standard errors are clustered at the municipality level. The sample is restricted to women ages 20-34. The outcome is births per month measured at the municipality level. The red dotted line marks the omitted period: October 2015, the last month before the declaration of the national emergency. The first black vertical line marks nine months after the declaration of the national emergency, to allow for the lagged fertility response. The second black vertical line marks nine months after the end of the epidemic. Births data are from the SINASC, 2015-2018, while case data are from the SINAN, geographic suitability data are from Messina et al. (2016), and Google search data are from Google Trends data.

the parallel trends assumption is valid. Similarly, the coefficient estimates in the nine months following the declaration of the national emergency are small and not statistically different from zero. These patterns suggest minimal termination of pregnancies that were in utero when the health emergency was declared. There is, however, a large and statistically significant decline in births beginning nine months after the declaration of the national emergency. At the nadir of the fertility decline, women are having seven fewer children per month in areas with higher Zika cases. The average monthly fall in births over the period was 10.7% (3.44 births per month over an average of 32.11 births per month before 2016). Fertility remains at this low level for about six months before recovering in April of 2017, and declining again, albeit by a smaller margin, in subsequent months. Measuring exposure with Zika cases (Figure 2a) and Zika suitability (2b) clearly identifies these patterns, and measuring exposure with Zika awareness (Figure 2c) shows a consistent but more volatile pattern in fertility responses.

Births in high-exposure areas remain below births in low-exposure areas after the end of the

epidemic. This suggests that there is not a "rebound" or "overshooting" of births, in aggregate. If anything, aggregate births settle at a lower equilibrium following the initial epidemic-era decline. Thus, it does not appear that women are simply delaying fertility. The pregnancies that did not occur in the year following the declaration of the national health emergency still had not occurred prior to 2019, suggesting that there were fewer infants and toddlers in municipalities with high Zika exposure between April 2016 and the end of 2018.

We show robustness to our treatment thresholds in Appendix B.2 by estimating the effects with alternative definitions of treatment. Panel A7b shows the estimated effects of the Zika virus on monthly births when we define treated municipalities as those above the 75th percentile of the respective treatment variable. In Panel A7c, we estimate the effects using continuous treatment measures. In Figure A8, we show robustness to mother's age by estimating the effects of Zika on monthly births for samples of women in different age groups (15–24, 25–34, and 35–44).

Regardless of the measure used to define high Zika exposure, these panels show a large decline in births beginning nine months after the declaration of the national emergency. In the longer term, a decline in births is also evident among women younger than 35, while a slight increase in births manifests among older women, between the ages of 35 and 44. This suggests that some women may have delayed their fertility as a result of the epidemic, but many others may have chosen to have fewer children altogether. Figure A9 shows that this long-term decline is most clear among women who do not have any children, suggesting that it may not be driven by all women choosing to have fewer children, but by some women choosing not to have children at all.

5.2 Zika's Impact on Women's Work And Family Formation

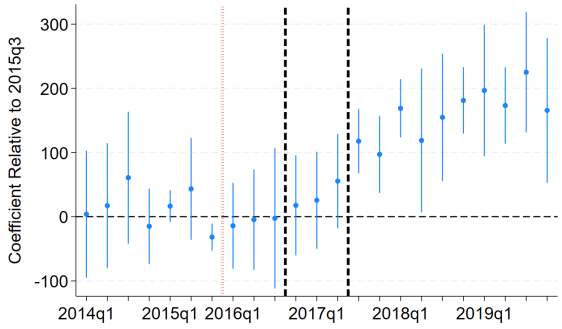
The previous section shows clear fertility declines in municipalities hardest hit by Zika. We now turn to the corresponding consequences for the labor-market. We focus on labor-market behavior of the group most exposed to the fertility declines: women aged 20-34. We use two measures of labor supply from the PNAD-C: monthly earnings (measured in reais), and a binary indicator of any employment during a reference period.

Monthly Earnings. Figure 3 shows increases in women's earnings of around 200 reais by 2019, or about 20 percent of average earnings among women between the ages of 20 and 34 in the third quarter of 2015. The figure presents the coefficient estimates resulting from Equation 2 when the outcome variable is women's reported monthly earnings. These increases in women's earnings persist through 2018 and beyond, remaining higher than before in Zika regions, perhaps because cumulative births are lower. This suggests a potential structural change in women's earnings capacity.

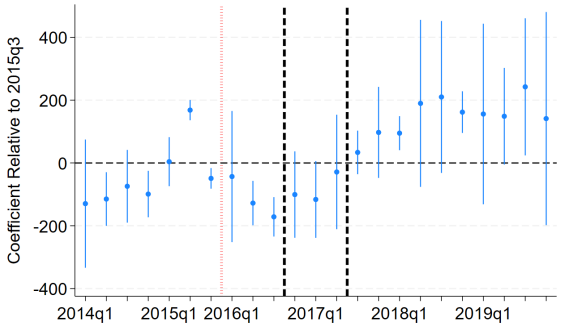
Maternity leave policies in Brazil may play a role in the timing of this increase in earnings capacity. Women working in the formal sector in Brazil are covered by a fully paid maternity leave. This leave lasts for four months for women working in the private sector, and six months for women working in the public sector. Further, employers are prohibited from firing a woman without cause within five months of her giving birth. These employment protections imply that the earnings impact of lower fertility may not be noticeable for over a year following the

Figure 3: Quarterly Impact of the Zika Virus on Monthly Earnings

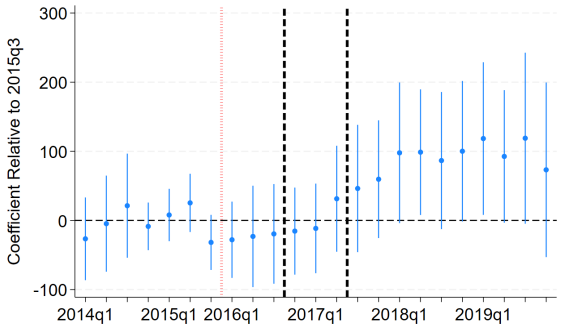
(a) At the State Capital and non-Capital Level



(b) At the State Capital Level



(c) At the Estrato Level



Notes: All specifications include year-by-month and PNAD-C region fixed effects. Standard errors are clustered at the region level. Outcomes are measured at the individual level. "Monthly Earnings" are defined as all earnings on the main, second, and other jobs in the reference month, generally the month prior. The omitted period (red dotted line) is 2015q4, the quarter of the declaration of the national health emergency. The black lines mark 2016q2 (between six and nine months following the declaration of the national health emergency) and 2017q2 (Between six and nine months following the end of the epidemic).

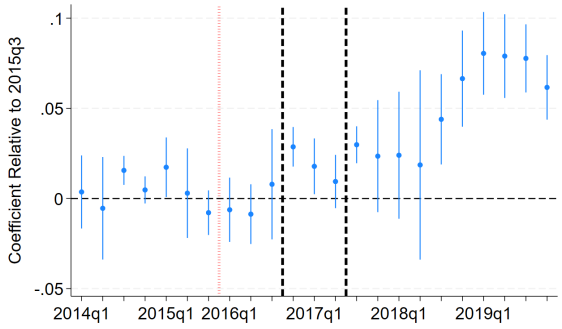
declaration of the epidemic. Figure 3 is consistent with this hypothesis: long-term earnings gains begin to manifest in the second quarter of 2017, consistent with the nine-month fertility window and five-month employment protection for mothers.

We show robustness to our results on labor earnings in Appendix B.3. Figure A10 shows robustness to alternative definitions of treatment (Panels A through C), as well as controlling for differential time trends by municipality-level demographics (Panel D).

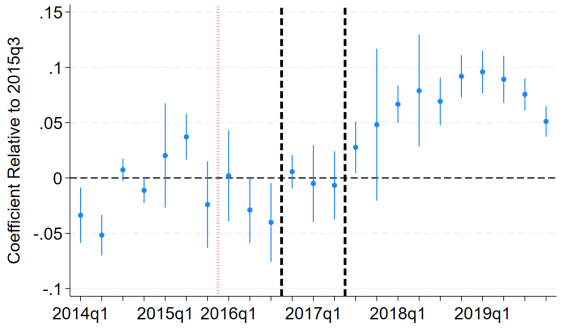
Employment. Figure 4 shows meaningful and sustained increases in female labor supply after the arrival of Zika. The figure presents the coefficient estimates resulting from Equation 2 when the outcome variable is an indicator of whether the respondent was employed in the reference period. The positive and significant coefficients beginning in the fourth quarter of 2016 suggest that women's employment is around two percentage points higher during the period of fertility declines in the areas hardest hit by Zika. These employment increases seem to maintain throughout the period, even after the end of the epidemic.

Figure 4: Quarterly Impact of the Zika Virus on Employment

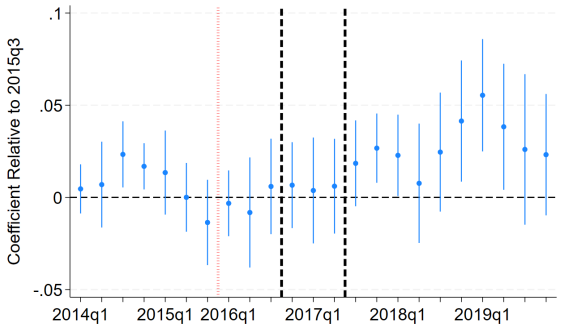
(a) At the State Capital and non-Capital Level



(b) At the State Capital Level



(c) At the Estrato Level



Notes: All specifications include year-by-month and PNAD-C region fixed effects. Standard errors are clustered at the region level. Outcomes are measured at the individual level. "Monthly Earnings" are defined as all earnings on the main, second, and other jobs in the reference month, generally the month prior. The omitted period (red dotted line) is 2015q4, the quarter of the declaration of the national health emergency. The black lines mark 2016q2 (between six and nine months following the declaration of the national health emergency) and 2017q2 (Between six and nine months following the end of the epidemic).

Like the earnings results, the timing of these increases in employment may be influenced by maternity leave policies available to women working in the formal sector. The initial uptick in employment, beginning in the third quarter of 2016, is consistent with women choosing to avoid pregnancy in the peak months of the Zika epidemic in areas that were hardest hit. The increases in employment of two to three percentage points between the fourth quarter of 2016 and the last quarter of 2017 are consistent with fewer women taking maternity leave. The longer-term increase in employment that begins in 2018 may reflect the same forces influencing earnings capacity: women may choose to leave the labor force altogether once their maternity benefits have been exhausted, and the end of employment protections after five months of giving birth may facilitate employers engaging in selective firing.

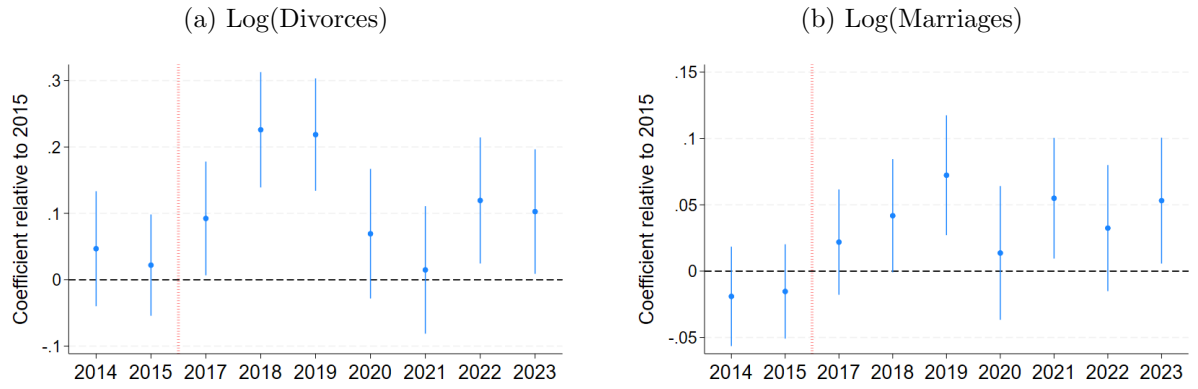
We show robustness to our results on employment in Appendix B.3. Figure A11 shows robustness to alternative definitions of treatment (Panels A through C), as well as controlling for differential time trends by municipality-level demographics (Panel D). Further, it is notable

that increases only begin nine months after the declaration of the national health emergency. This supports the hypothesis that the employment impacts of Zika are not direct, but are primarily a result of the corresponding fertility decline.

Marriages and Divorces. Figure 5 presents the estimated coefficients from Equation 3 when the outcomes are the log number of marriages and the log number of divorces. Figure 5a shows that divorce rates begin to rise in 2017, peak in 2018 and 2019, and subsequently decline, reaching levels roughly 20 percent higher in high-exposure Zika areas relative to low-exposure Zika areas at the peak. Marriage rates also increase in Figure 5b, but their rise lags that of divorces by roughly one year, potentially reflecting remarriages or delayed union formation. Appendix B.4 shows robustness to the Zika virus's effect on marriages and divorces by using alternative definitions of treatment and including a set of controls shown in Figure A12.

Our identification strategy is agnostic regarding the causal direction of these responses in employment and household formation. One interpretation of these results is that reduced fertility and improved labor market opportunities enhanced women's ability to exit or delay certain unions. Alternatively, reduced fertility could have a direct effect on marital unions. Some unions formed prior to the national health emergency may have been with the express objective of having children; when the epidemic encouraged these partners to re-evaluate having children, they may also have re-evaluated marriage and employment.

Figure 5: Annual Impact of the Zika Virus on Divorces and Marriages



Notes: All specifications include year and municipality fixed effects. Standard errors are clustered at the municipality level. Outcomes are annual log marriages and log divorces measured at the municipality level. The omitted period (red dotted line) is 2016, since the national emergency was declared at the end of 2015. Municipality level marriage and divorce data are from Instituto Brasileiro de Geografia e Estatística (2023), 2014-2023.

Theoretical literature on marital formations posits that potential matches may feel time pressure to marry in order to have children during a woman's fertile period, and partners may marry before all information is revealed about the potential marital surplus (Coles and Francesconi, 2011; Siow, 1998; Díaz-Giménez and Giolito, 2008). Unexpected events, such as a national epidemic instigating the re-evaluation of fertility choices, can reveal unknown information regarding the marital surplus, and thus increase divorces (Becker et al., 1977; Weiss and Willis, 1997; Lee and McKinnish, 2018). This could be consistent with both men and

women working more due to the Zika shock, and with the fact that the lower "steady-state" in fertility following the epidemic seems to be among women without any children to begin with.

6 Conclusion

Our findings demonstrate that the Zika epidemic led to a measurable fertility decline in Brazil, and this reduction was accompanied by increases in women's labor market earnings and employment, as well as notable changes in marriage and divorce patterns. Together, these results contribute to the broader literature on fertility, labor supply, and family formation by providing causal evidence that reductions in fertility influence women's employment opportunities and relationship dynamics. Unlike previous studies that focus on long-run fertility transitions or policy-driven fertility shifts, our paper leverages a sharp and plausibly exogenous public health shock to isolate the labor- and marriage-market effects of a sudden decline in childbearing, thereby offering a rare and credible estimate of the causal links between fertility and women's economic trajectories.

These findings have important implications for understanding ongoing and future demographic change. If temporary fertility declines driven by a health shock can meaningfully increase women's labor force participation and earnings, more persistent fertility declines—such as those observed across Europe, East Asia, and Latin America—may have even larger cumulative effects on women's lifetime labor supply, earnings potential, and economic independence. In many middle- and high-income countries, fertility rates have already fallen below replacement, and concerns about population aging, shrinking labor forces, and fiscal sustainability are increasingly central to policy debates. At the same time, falling fertility may enhance women's participation in paid work, accelerate the closing of gender gaps, and reshape intra-household bargaining power, with downstream effects on marriage, divorce, and household structure.

Our evidence also suggests that fertility reductions are not simply delayed births that eventually "catch up," but may translate into fewer births overall. This distinction matters for thinking about whether women's behavioral responses reflect timing (postponement) versus completed fertility reductions. If the latter, then long-run demographic change may not only shrink cohorts entering the labor market, but may also permanently shift women's economic roles. In contexts where childcare systems remain underdeveloped, and the motherhood penalty is large, fertility declines may further amplify women's formal employment and earnings, contributing to long-run gender convergence—although potentially widening inequalities between women with children and those without.

These results also help interpret the broader consequences of the sustained fertility declines now underway across much of the world. Much of the existing literature has focused on individual-level fertility shocks that identify how an additional child affects women's labor supply. By contrast, we study a setting in which fertility declines at the cohort and geographic level, resulting in fewer births in the aggregate rather than variation in fertility across otherwise similar individuals. Our findings show that when fertility falls at this broader scale (as seen worldwide), women's observed labor market trajectories shift upward, with sustained increases in employment, earnings, and formal-sector participation. At the same time, family formation responds measurably, with changes in both marriage and divorce rates following the

fertility decline. Taken together, these results suggest that aggregate fertility transitions may be accompanied by persistent changes in women's employment and earnings outcomes, as well as adjustments in the timing and structure of family formation, even over relatively short horizons.

Future research should explore whether the labor and marriage market effects we document persist over the longer term and whether similar patterns emerge in other settings where fertility rates are falling due to epidemiological shocks, economic downturns, or secular demographic transitions. Understanding how—and for whom—fertility declines translate into economic opportunities is crucial for anticipating how societies will adapt to ongoing global demographic change.

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Appendix

A Zika Data and Measurement

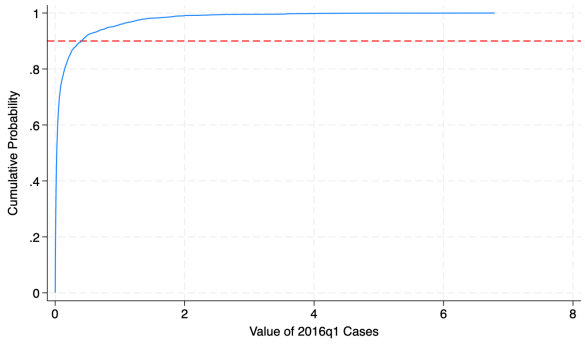
We consider three measures of the intensity of the Zika virus: Zika cases per capita, environmental suitability for the mosquito that carries the Zika virus, and an index that measures the frequency of Zika-related Google searches relative to all Google searches within a municipality. We refer to these measures as Zika cases, Zika suitability, and Zika searches. Each measure begins as a continuous variable; in this appendix, we first describe that continuous variable, and then how we select the threshold that defines "high" Zika intensity versus "low" Zika intensity for each measure.

A.1 Zika Cases

Zika case data, separately reported by municipality, are available from SINAN between 2016 and 2020. The highest measured frequency of non-zero case incidence occurred in the first quarter of 2016, when 2,353 out of 5,570 municipalities reported positive Zika cases. In the second quarter of 2016, only 1,857 municipalities reported non-zero case incidence. Figure 1b in the main text shows that this temporal pattern held across geographic regions.

As a time-invariant measure of Zika exposure, we use reported cases as a percent of population in the peak quarter of 2016q1. Figure 1a in the main text presents this measure, with the municipalities facing the lowest exposure in dark blue and those facing the highest exposure in dark red. We also consider different methods of determining a time-invariant measure of cases, such as the case incidence reached in each municipality in 2016q2, or the highest case incidence attained within each municipality throughout the period. We find a strong correlation between these various measures and choose cases as a percent of the population in 2016q1 for clarity of interpretation.

Figure A1: CDF of Municipal-level Zika Cases



Notes: Zika case data are from the SINAN. Figure A1 shows the cdf of municipalities, highlighting the 90th percentile cutoff.

Figure A1 shows the CDF of our chosen measure of Zika cases, including all municipalities that reported non-zero cases. The red line represents the 90th percentile of this measure, which is the threshold we use to distinguish whether a municipality suffered high- or low-Zika intensity. Again, we choose this threshold so that municipalities classified as high-intensity have

both high and comparable case incidence as a percent of their population. We show robustness of our results to this choice of threshold.

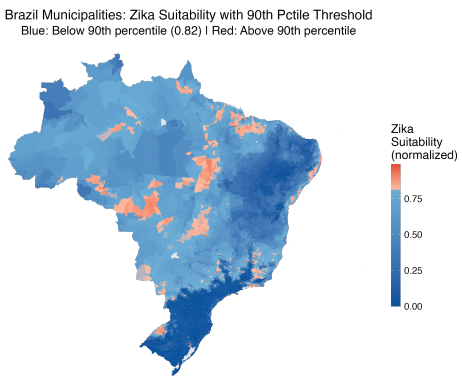
To aggregate geographically to the 53 regions available in the PNAD-C, defined by states and their capitals, we calculate a time invariant measure of case incidence within a region as a percent of the aggregate population across all municipalities within a region. We then classify regions with high-Zika intensity using the same threshold that we do for municipalities: a region is high-intensity when its case incidence is higher than the 90th percentile of all municipalities with non-zero case incidence.

A.2 Environmental Suitability for Aedes Aegypti Mosquito

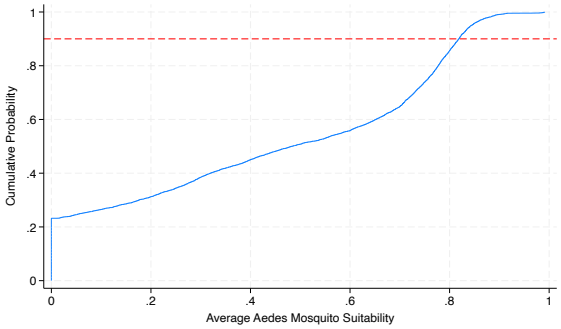
Gridded geographic data on land suitability for the Aedes aegypti mosquito is available as a raster dataset. We aggregate the raster data to the municipality level, by overlaying shape files with municipality boundaries in 2015 and calculating the mean suitability of the grid cells within each municipality, weighting cells from the raster by their relative area within each municipality. This allows us to get a municipality level average suitability measure. We use this municipality-level suitability for treatment assignment. In the map below, blue areas have the lowest geographic suitability for the Zika-carrying mosquitoes, while red areas have the highest suitability. The color changes from blue to red at the 90th percentile of Zika suitability – the threshold we use to distinguish high-Zika intensity areas from low-Zika intensity areas. Figure A2b shows the distribution of Zika suitability. The red horizontal line lies at the 90th percentile cutoff that we define to be the treatment threshold. We choose this cutoff at the point where the CDF flattens out so that high-Zika intensity areas have not only the highest, but also similar susceptibility to the virus. We show robustness of our results to this choice of threshold.

Figure A2: The Geographic Spread of Environmental Suitability

(a) Zika Suitability



(b) CDF of Municipal-level Zika Suitability



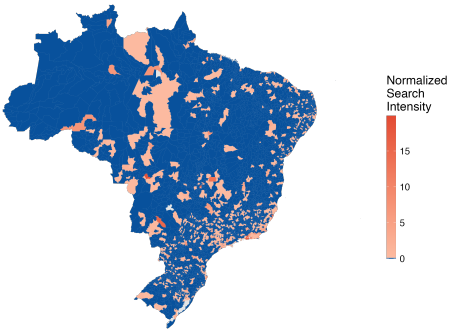
Notes: The map in Panel A2a shows normalized Zika suitability by municipality. Municipalities in blue are below the 90th percentile in case incidence, while those in red are at or above the 90th percentile. Panel A2b shows the cdf of municipalities, highlighting the 90th percentile cutoff.

A.3 Google Searches

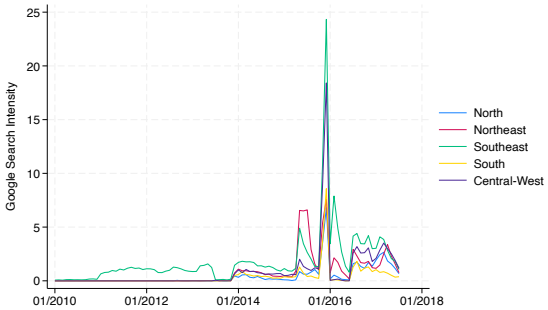
We use a municipality-level index measuring the frequency of Google searches that include the word "Zika," relative to all Google searches (Google Trends, 2018). Figure A3 shows that Zika search intensity reaches its peak in the fourth quarter of 2015, driven by searches in November of 2015–consistent with the timing of the declaration of the state of national emergency in November 2015. Accordingly, we consider municipal-level search intensity in the fourth quarter of 2015 as our time-invariant measure of Google search intensity.

Figure A3: The Geographic and Temporal Incidence of Google Searches

(a) Map of Google Searches



(b) Google Searches by Region over Time



Notes: Google Search data come from Google Trends. The map in Panel A3a shows relatively prevalence of Zika searches by municipality. Municipalities in blue are those with zero searches in 2015q4, while those in red experienced non-zero searches for Zika in that quarter. The five geographic regions shown in Panel A3b are the official regions defined by IBGE. Panel A3b plots average monthly searches for Zika by region normalized by population.

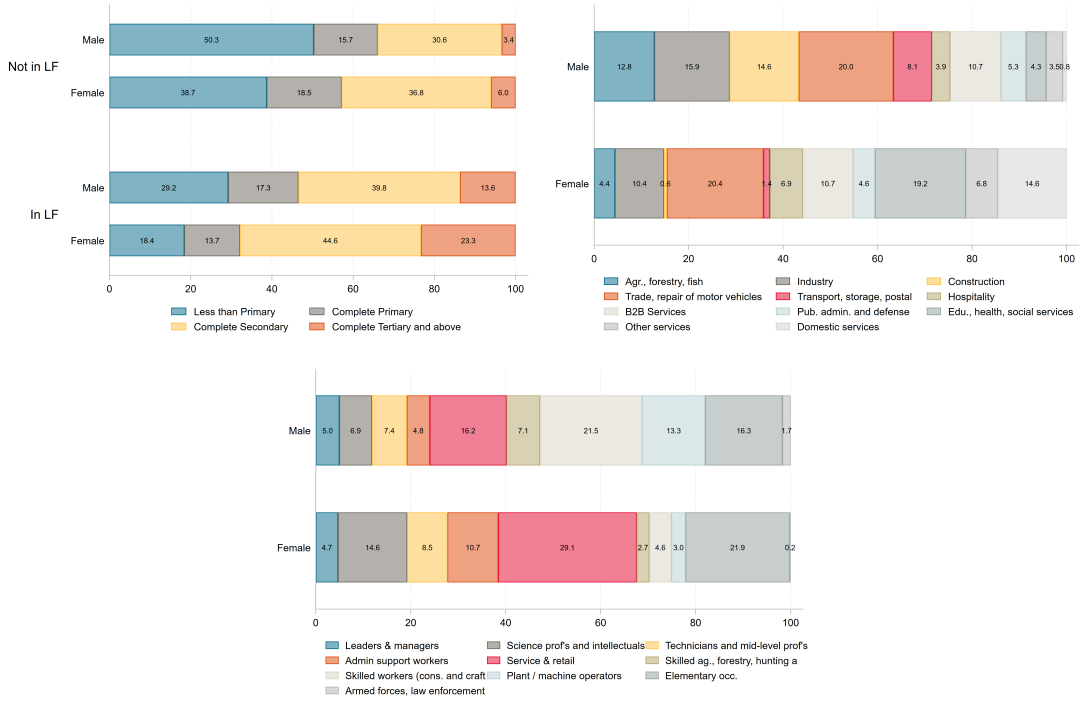
Concerns may arise that this search measure reflects access to internet more than it does concern about Zika. We therefore conduct robustness checks limited to the 1,042 municipalities that ever report any search for Zika, as we are thus sure that these municipalities have access to the internet. The results look broadly the same when we limit the sample in this way, alleviating the concern that our findings are driven purely by access to technology.

To aggregate geographically to the 53 regions available in the PNAD-C, defined by states and their capitals, we calculate a time invariant measure of google searches by averaging the search index 2015q4 across all municipalities within the region.

B Additional Figures and Robustness

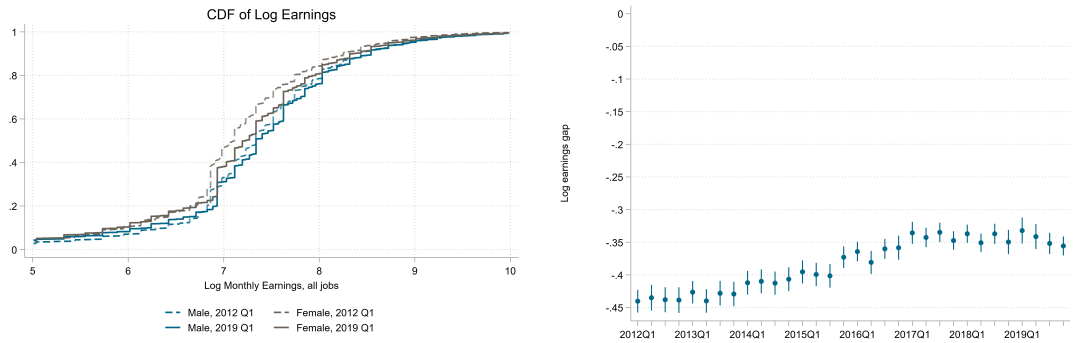
B.1 Descriptive Background

Figure A4: Women and Men in the Workforce: Education, Industry, and Occupation



Notes: Data from PNAD-C. Includes all individuals 15-49 from pooled 2016 waves.

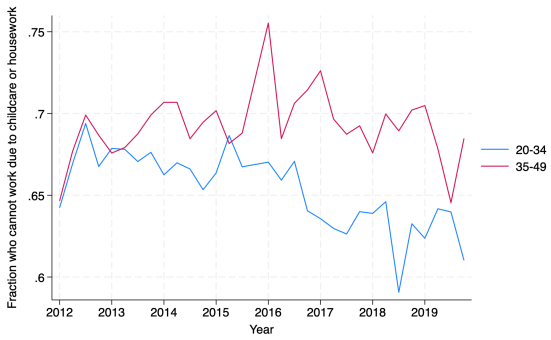
Figure A5: Women's Earnings and the Gender Pay Gap



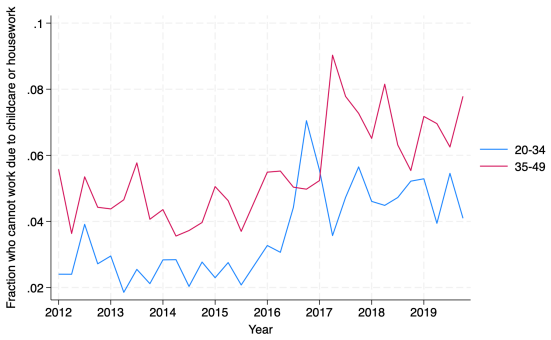
Notes: Regressed log earnings on education, age, age squared, fully interacted occupation and industry FEs, stratum FEs, and survey wave FEs. Plotted coefficients are the interaction of female and year-quarter indicators. SEs clustered by stratum and survey wave. Source: PNAD-C.

Figure A6: Fraction of People Not Working who Cannot Work due to Childcare or Housework by Age Group & Gender

(a) Women



(b) Men

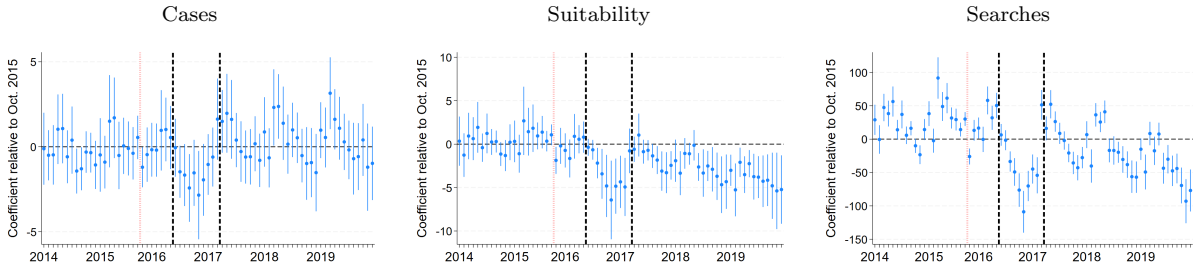


Notes: Sample is restricted to people ages 20-49 who are not working. Among the sample of people who are not working, we measure the share of this population who cannot work in the following week, if offered a job, due to childcare or housework obligations, PNAD-C, 2012-2019.

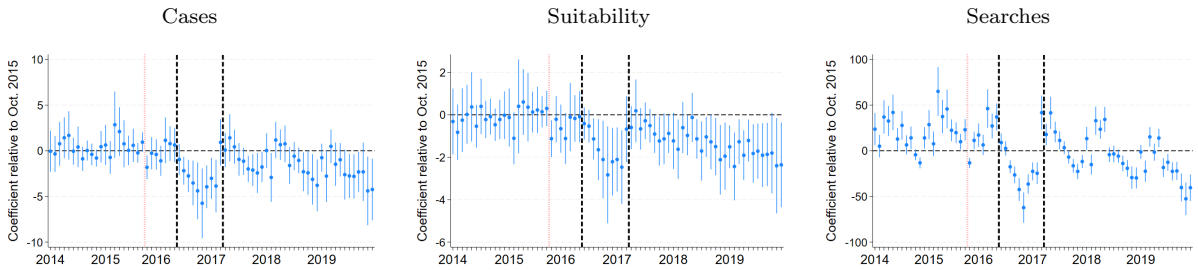
B.2 Zika's Effect on Fertility

Figure A7: Zika Impact on Monthly Births, Various Treatment Measures

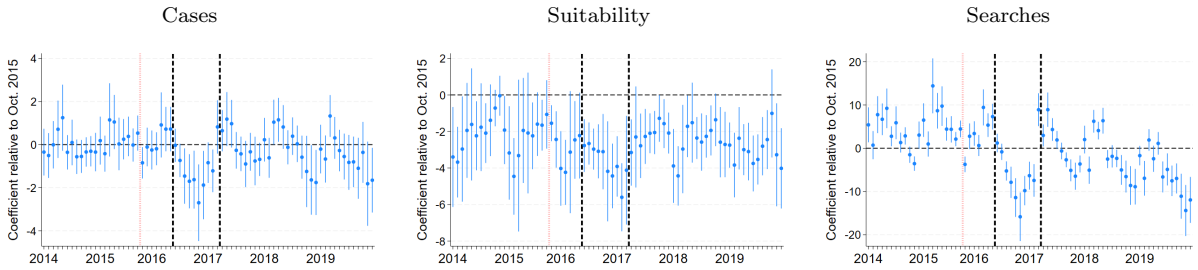
(a) Binary Indicator, Threshold 90th percentile



(b) Binary Indicator, Threshold 75th percentile



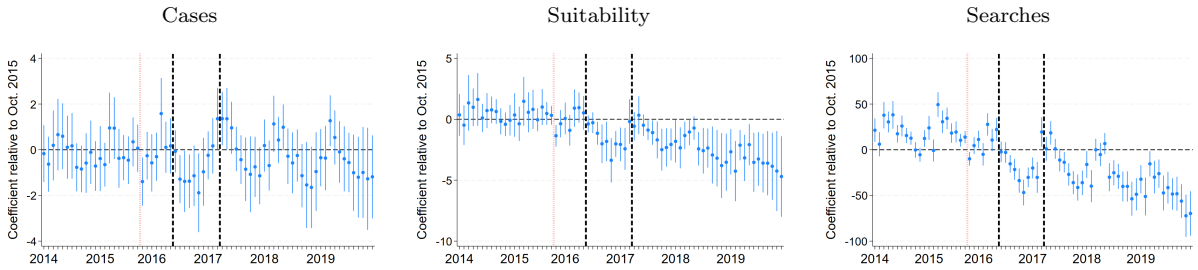
(c) Continuous Treatment Measure



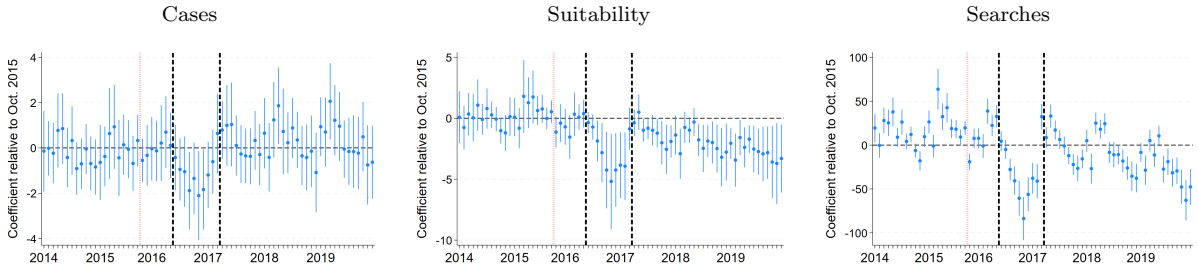
Notes: This figure compares the results from the fertility regressions using three alternative measures of high Zika intensity: a binary indicator with a threshold at the 90th percentile, a binary indicator with a threshold at the 75th percentile, and a continuous treatment measure.

Figure A8: Zika Impact on Monthly Births, By Mother's Age Group

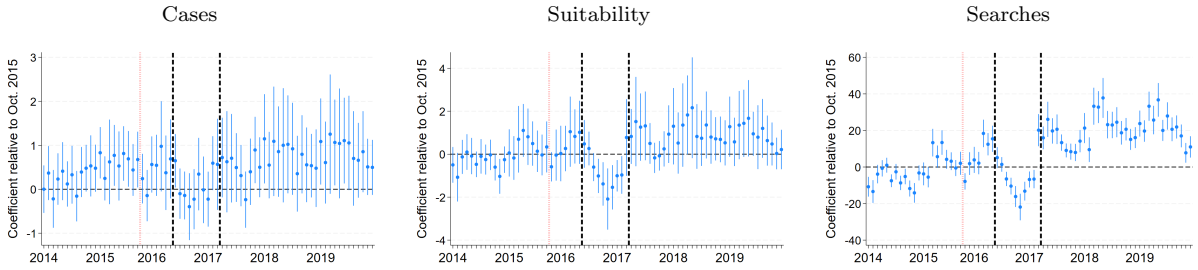
(a) Mother Aged 15–24



(b) Mother Aged 25–34

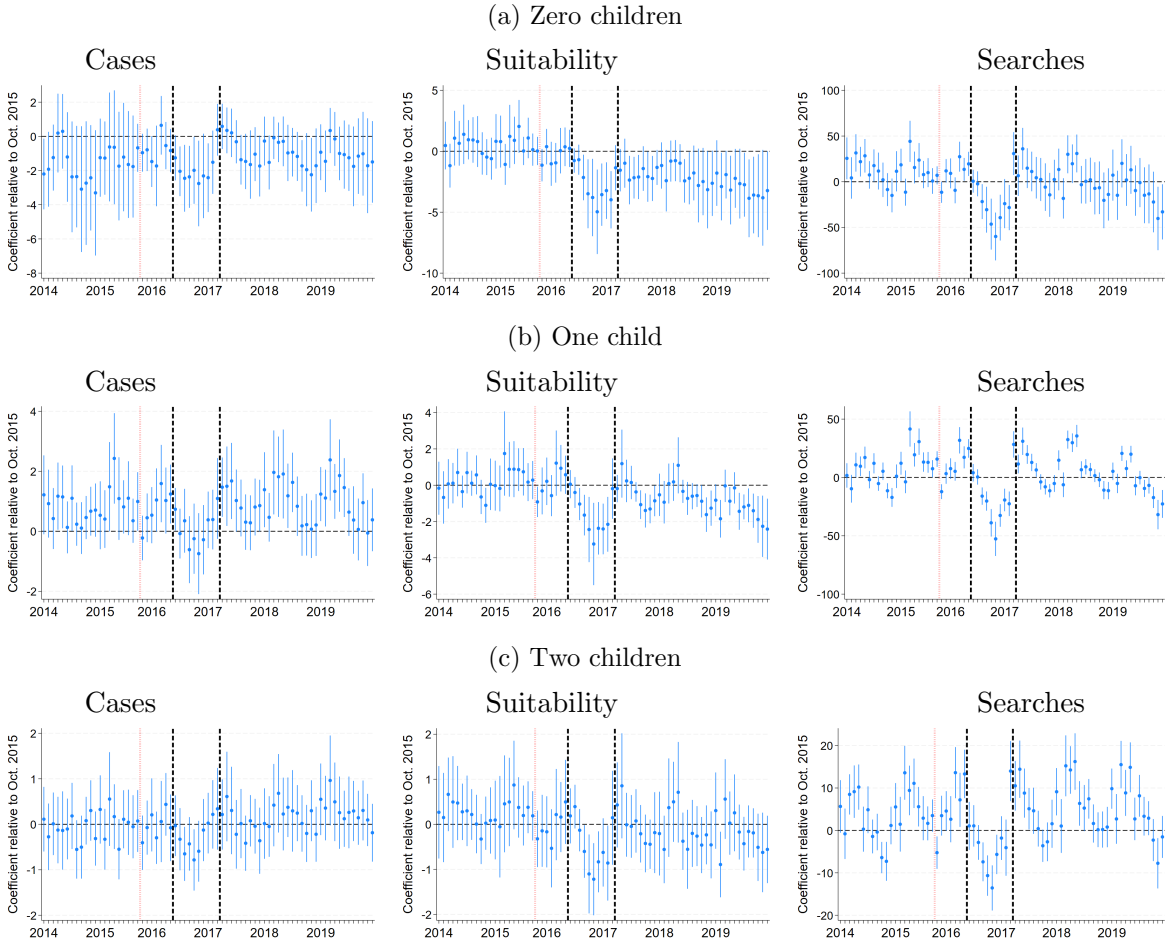


(c) Mother Aged 35–44



Notes: This figure compares the results from the fertility regressions using our preferred binary measure of Zika intensity (municipalities above the 90th percentile), estimated separately for mothers aged 15–24 (Panel A8a), 25–34 (Panel A8b), and 35–44 (Panel A8c) at the time of birth, using SINASC data.

Figure A9: Zika Impact on Monthly Births, By Birth Parity

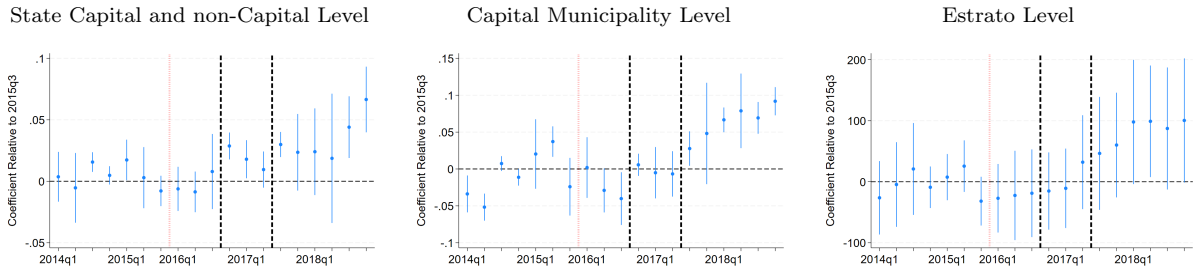


Notes: This figure compares the results from the fertility regressions using our preferred binary measure of Zika intensity (municipalities above the 90th percentile) and preferred fertility measure (monthly births), when run on various samples of mothers in the SINASC. Panel (a) shows mothers without any older children; Panel (b) shows mothers with one older child; Panel (c) shows mothers with two older children.

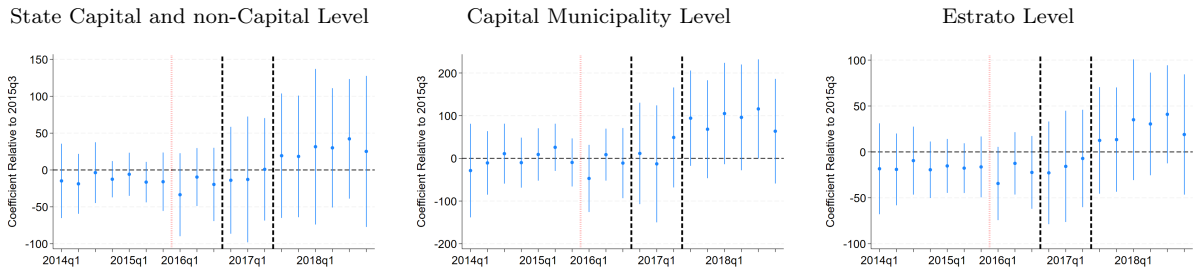
B.3 Labor-market Effects

Figure A10: Zika Impact on Monthly Income, Robustness Across Treatment & Controls

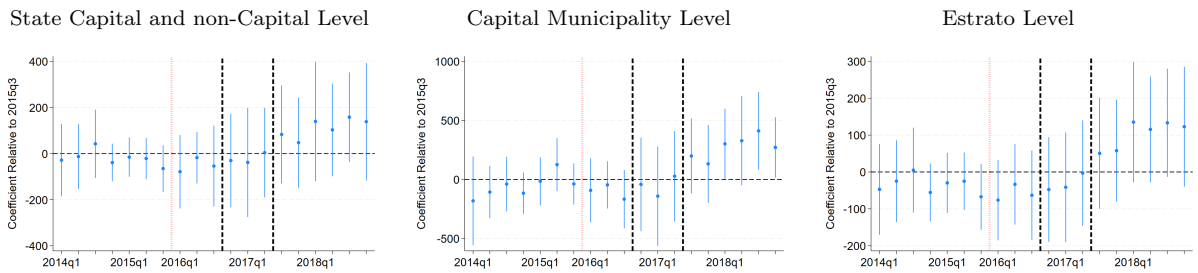
(a) Binary Indicator, Threshold 90th percentile



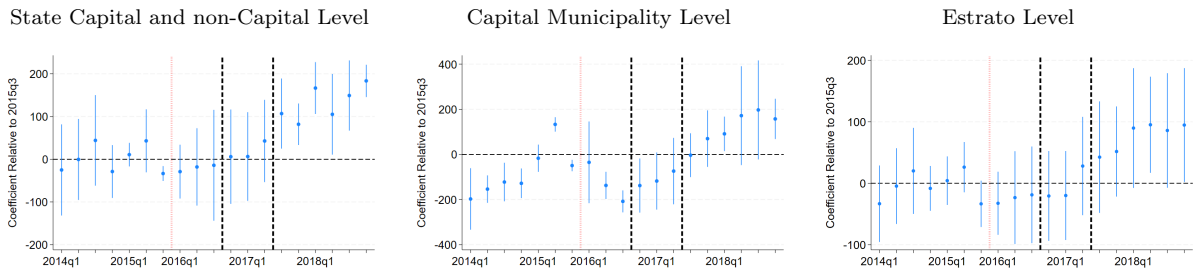
(b) Binary Indicator, Threshold 75th percentile



(c) Continuous Treatment Measure



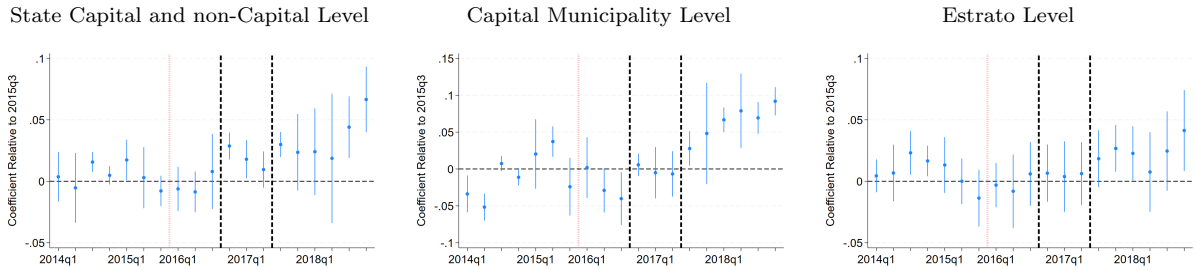
(d) Binary Indicator, Threshold 90th Percentile, With Controls



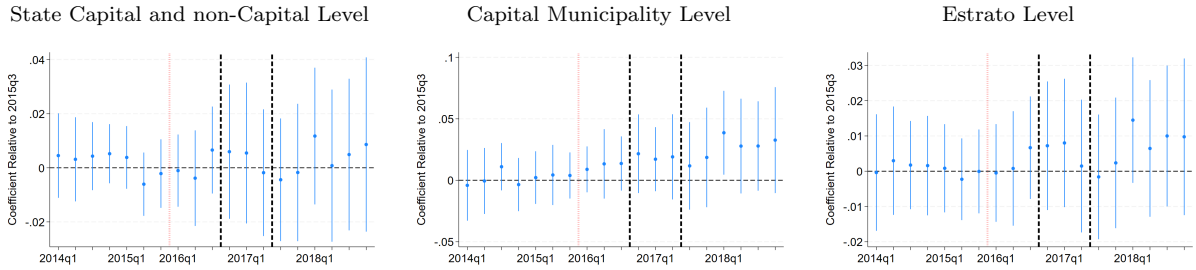
Notes: This figure shows the robustness of the results from the monthly income labor regressions to various treatment definitions and to the inclusion of demographic controls. Panels A10a through A10c use three different measurements of high-intensity Zika at each level of geographic variation available in the PNAD-C: our preferred binary measure with a threshold at the 90th percentile, a binary measure with a threshold at the 75th percentile, and the continuous measure. Panel A10d shows the robustness of the state-by-capital labor regressions to including controls. Controls consist of time-by-demographic interactions for each municipality's educational structure, age structure, rural composition, and average monthly income, as measured in the 2010 census. Educational structure is measured by the share of 20–34 year-olds who completed upper secondary schooling; age structure by the population share aged 20–34; rural composition by the share of the population living in rural areas; and average monthly income is reported directly in the 2010 census. Regressions are run at the state-by-capital, capital municipality, and state-by-stratum levels of aggregation.

Figure A11: Zika Impact on Employment Status, Robustness

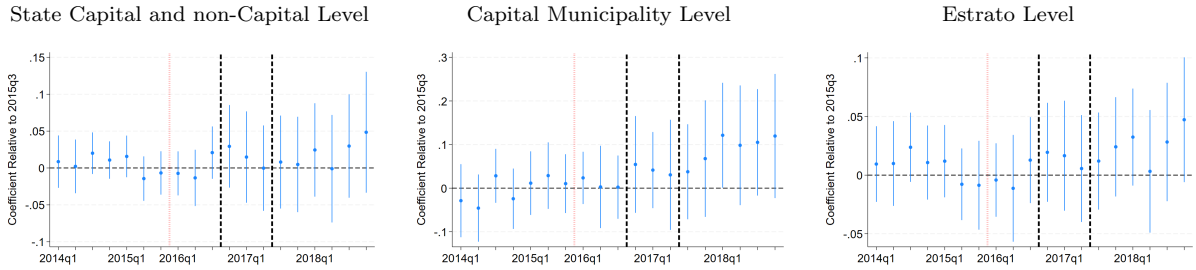
(a) Binary Indicator, Threshold 90th percentile



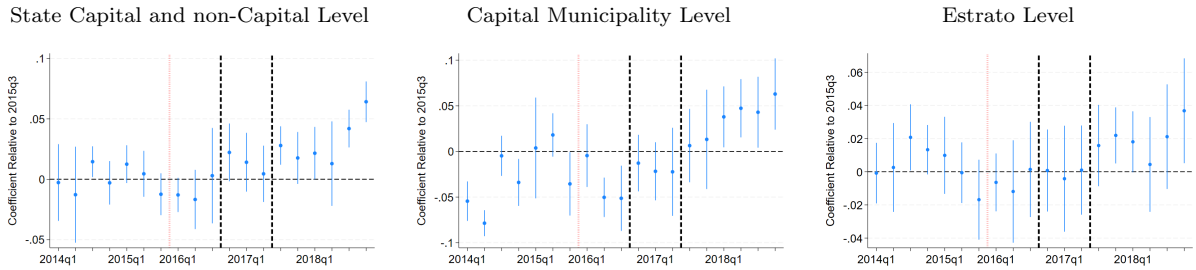
(b) Binary Indicator, Threshold 75th percentile



(c) Continuous Treatment Measure



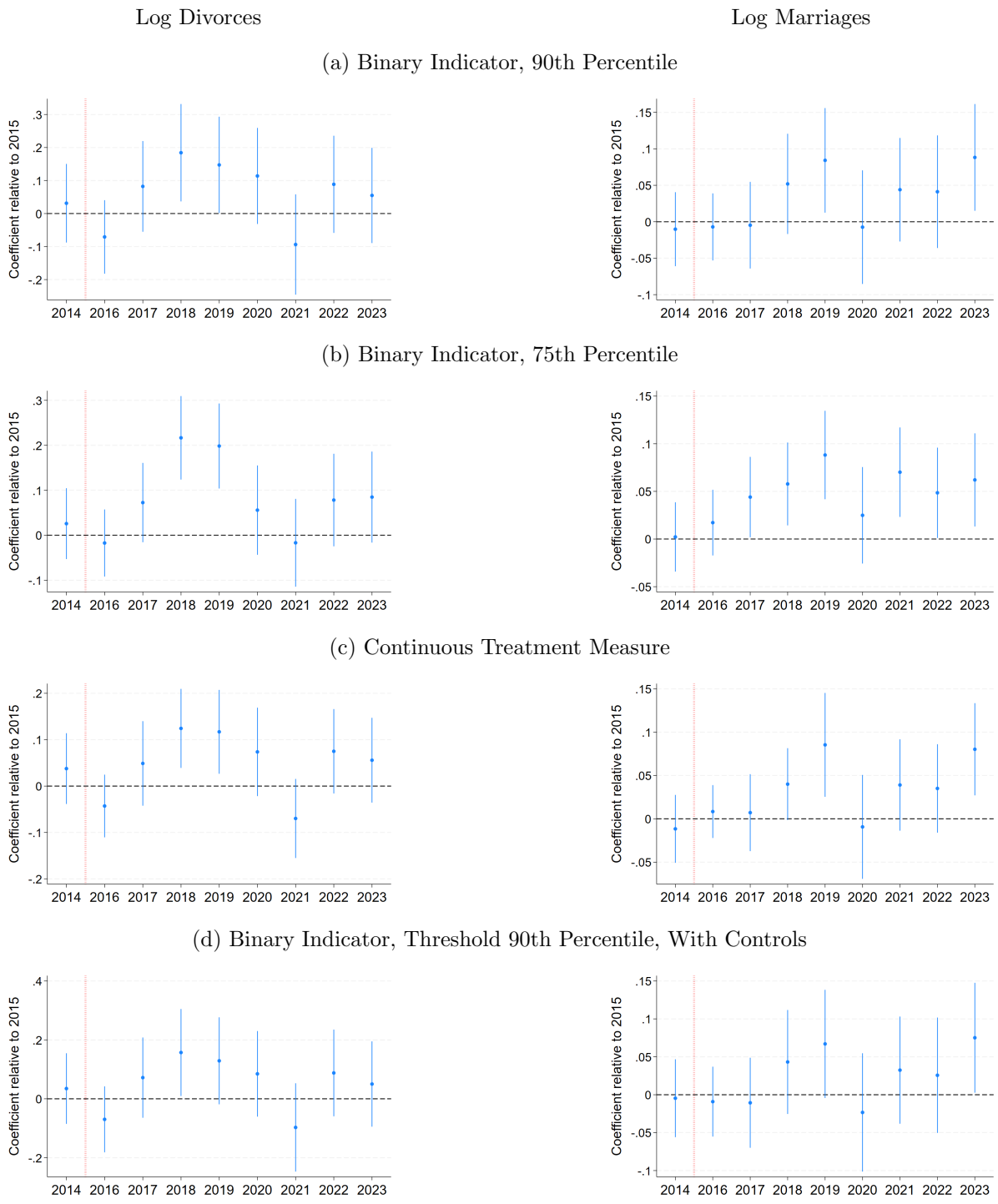
(d) Binary Indicator, Threshold 90th Percentile, With Controls



Notes: This figure shows the robustness of the results from the monthly income labor regressions to various treatment definitions and to the inclusion of demographic controls. Panels A11a through A11c use three different measurements of high-intensity Zika at each level of geographic variation available in the PNAD-C: our preferred binary measure with a threshold at the 90th percentile, a binary measure with a threshold at the 75th percentile, and the continuous measure. Panel A11d shows the robustness of the state-by-capital labor regressions to including controls. Controls consist of time-by-demographic interactions for each municipality's educational structure, age structure, rural composition, and average monthly income, as measured in the 2010 census. Educational structure is measured by the share of 20–34 year-olds who completed upper secondary schooling; age structure by the population share aged 20–34; rural composition by the share of the population living in rural areas; and average monthly income is reported directly in the 2010 census. Regressions are run at the state-by-capital, capital municipality, and state-by-stratum levels of aggregation.

B.4 Zika's Effect on Marriage and Divorces

Figure A12: Zika's Impact on Divorce & Marriage: Robustness Across Treatment Measures & Controls



Notes: Panels (a)–(c) vary the definition of high Zika intensity (binary indicator at the 90th percentile, binary indicator at the 75th percentile, and a continuous measure). Panel (d) uses the preferred binary 90th percentile definition and controls for differential time trends by municipal-level demographics by including time-by-demographic interactions for each municipality's educational structure, age structure, rural composition, and average monthly income, as measured in the 2010 census. Educational structure is measured by the share of 20–34 year-olds who completed upper secondary schooling; age structure by the population share aged 20–34; rural composition by the share of the population living in rural areas; and average monthly income is reported directly in the 2010 census.