DISCUSSION PAPER SERIES

DP18013

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DEVELOPMENT ECONOMICS AND ECONOMIC HISTORY

CEPR

ISSN 0265-8003

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Discussion Paper DP18013
Published 22 March 2023
Submitted 20 March 2023

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www.cepr.org

This Discussion Paper is issued under the auspices of the Centre's research programmes:

- Development Economics
- Economic History

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We show that large declines in maternal mortality can be achieved by raising women's political voice. Using an event study approach, we show that the arrival of first antibiotics (sulfa drugs) in the U.S. in 1937, which were effective in treating peripartum bacterial infections, led to larger reductions in maternal mortality in states that extended suffrage to women prior to the 19th Constitutional Amendment of 1920, a national mandate that extended the franchise to all women. These findings suggest important complementarities between women's voice in politics and health-improving technologies. In terms of mechanisms, we argue that earlier suffrage and the longer history of women's political participation arising from it may have laid the groundwork for greater acceptability and quicker uptake of technologies that improved women's health. We also show that earlier suffrage led to a higher likelihood of women holding Senate seats, consistent with a channel where suffrage shaped policymaking through women leaders.

JEL Classification: I14, I15, O15

Keywords: Maternal mortality

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Maternal Mortality and Women's Political Voice: Historical Evidence from the U.S.*

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Keywords codes: Maternal mortality, women's political representation, gender, suffrage, Sulfa.

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1 Introduction

Maternal mortality, defined as deaths of women due to pregnancy-related causes within 42 days of childbirth, remains a leading global health issue, accounting for 830 deaths daily and more than 216 deaths per 100,000 live births worldwide (Ceschia and Horton, 2016). The problem is not just restricted to low- and middle-income countries: the U.S. has the highest maternal mortality rate among developed countries (Tikkanen et al., 2020), and it is the only high-income country where maternal mortality rates have been increasing over the last few decades, rising from 7.2 in 1986 to 17.3 in 2016 and 32.9 in 2021 (MacDorman et al., 2016; Mann et al., 2018; Hoyert, 2022).[1]

Maternal mortality rates in the U.S. have increased despite the availability of the necessary knowledge and technology to lower them for almost a century, and the cost of implementing interventions is relatively low (Cutler et al., 2006; Loudon, 1992). Contemporary initiatives to decrease maternal mortality rates, such as those advocated by the World Health Organization, are centered on improving access to skilled birth attendants, prenatal and antenatal care, contraception, and women's education (Grépin and Klugman, 2013; Kruk et al., 2016). We propose a complementary set of strategies: ensuring women's voices in policymaking can help increase returns to technologies to reduce maternal mortality.

Using historical data from the U.S., we investigate the importance of women's political voice during a period when the U.S. (and other contemporary richer countries) experienced sharp, technology-driven declines in maternal mortality. Specifically, we examine declines in maternal mortality driven by the exogenous arrival of a new medical technology in the U.S. – sulfonamide (sulfa) antibiotics – and analyze whether the size of antibiotic led declines varied on the basis of when individual states adopted women's suffrage. Prior work has shown that the introduction of antibiotics in 1937 led to sizeable reductions in maternal mortality, ostensibly through sulfa drugs' effectiveness in treating peripartum bacterial infections (Jayachandran et al., 2010). Prior work has additional demonstrated that states which adopted women's suffrage prior to

[1]National mortality rates and rates by subgroup are publicly available here: https://www.cdc.gov/reproductivehealth/maternal-mortality/pregnancy-mortality-surveillance-system.htm

the 19th Constitutional Amendment of 1920, a federal mandate that extended the franchise to all women, experienced decreases in child mortality and increases in schooling (Miller, 2008; Kose et al., 2021) via increased investment in health and education promoting public goods (Miller, 2008; Kose et al., 2021). This work has shown that state-specific differences in the timing of suffrage was as-if random. Our empirical approach leverages these two natural experiments using an event study design, which allows us to scrutinize pre-trends and assess an extensive set of lagged effects. We further relax the parallel trends assumption and estimate bounds on the treatment effects, following Rambachan and Roth (2020).

We find that sulfa-drug led declines in maternal mortality were larger early suffrage states, defined as those implementing suffrage in advance of the federal mandate. Six years after the arrival of antibiotics, maternal mortality was 15% lower in early versus later suffrage states, with no evidence of pre-existing differential trends in the outcome between the two groups of states. These findings are robust to changes in specification, as well as to accounting for potential U.S. region-year trends that may be correlated with both adoption of suffrage and the health environment (Miller, 2008). In addition, the findings survive analysis the bounding exercise of Rambachan and Roth (2020), even allowing for significant departures of the parallel trends assumption.

We interpret these findings to suggest that the uptake of (or access to) medical innovations that improve reproductive health is greater when women are involved in policy-making. Consistent with this interpretation, we find no differences between early and late suffrage states in antibiotic-led declines in infant and child pneumonia mortality, a disease and population group that greatly benefited from the arrival of sulfa drugs as well (Jayachandran et al., 2010; Bhalotra and Venkataramani, 2014). The specificity of our findings to maternal mortality suggests that women's political voice was specifically important for women's access to medical technology. Given the historical nature of the data, it is difficult to examine mechanisms beyond this. For example, while it is plausible states in which women have voted for longer are more sensitive to interventions that favour women, we are unable to directly examine uptake of sulfa antibiotics (a limitation well-known in prior work, e.g., Jayachandran et al. (2010); Bhalotra

and Venkataramani (2014). Similarly, the lack of birth-cohort specific maternal mortality data makes it difficult to evaluate other potential mechanisms, such as improved education among cohorts exposed to suffrage early in life (Kose et al., 2021) resulting in greater access to antibiotics during childbirth. However, to draw a clearer analogue to the contemporary low-income country results (Bhalotra et al., 2023), we investigate the direct involvement of women (as policy makers rather than voters) as a potential mechanism, finding that early suffrage states had a 1.8 percentage point larger share of women in U.S. Senate in the antibiotic era, relative to a mean of 1.4%.

Our findings contribute to a nascent literature that highlights the importance of women's political power in reducing maternal mortality. Closest to our work is a recent paper by Bhalotra et al. (2023) demonstrating that raising the share of women in parliament can reduce maternal mortality. They argue that women parliamentarians implement long-available "technologies" such as birth attendance which in principle includes treating infections (Bhalotra et al., 2023). In contrast to our use of two natural experiments exploiting historical data, they use contemporary cross-country data on the staggered adoption of gender quotas in parliament across developing countries.[2] Our work is also closely related to Miller (2008), who focuses on the immediate impacts of women's suffrage on investments in health-promoting public goods and child mortality. Our findings link two domains of both intrinsic and functional interest – women's political power and maternal health – and demonstrates complementarities between the former and technologies to address the latter. The notion of complementarity is illustrated by the fact that the impacts of suffrage on maternal health materialized after life-saving technologies to address peripartum infections came into effect. These dynamic effects comport with similar dynamic relationships between women's health and women's human capital attainment, employment, and growth (Albanesi and Olivetti, 2016, 2014; Jayachandran and Lleras-Muney, 2009; Bloom et al., 2015).

The remainder of this paper is as follows. In Section 2 we provide the historical backdrop for the study, discussing both the adoption of suffrage and antibiotic-led declines in maternal

[2]See also Bhalotra and Clarke (2013), who highlight the role of maternal education in reducing maternal mortality.

mortality. Section 3 outlines the data and empirical strategy. Section 4 discusses the main findings and robustness checks. Section 5 concludes.

2 Historical Background

2.1 Adoption of Women's Suffrage

While the 19th amendment to the U.S. Constitution, ratified in 1920, established women's suffrage across the country, a number of states implemented women's suffrage prior to this mandate (Figure A1). The drivers of differential timing of women's suffrage across states are reviewed in Miller (2008) and Kose et al. (2021). We summarize the relevant points here. States in the "*wild west*" were the first to extend suffrage, all during the late 19th century. Some historians attribute this to harsh frontier conditions making it more difficult to sustain traditional gender roles (Brown, 1958; Grimes, 1967), but the quantitative literature has found no robust correlates of adoption dates (Cornwall et al., 2007). Importantly, there is no evidence that implementation of a range of other gender-progressive policies that may have had direct impacts on maternal mortality decline was correlated with suffrage adoption. This includes regulation governing alimony and divorce, mother's pension, women's maximum work hours, women's minimum wages, prohibition, worker's compensation, child labour, compulsory schooling, and state attributes such as literacy rates and prevailing wages (Miller, 2008).

Previous work has shown that state-level implementation of women's suffrage had marked effects on women's voting and led to important shifts in policymaking. State-led suffrage was associated with a sharp 40% (or 12 percentage point, 25 to 37%) rise in voter turnout in both the gubernatorial (Lott Jr. and Kenny, 1999) and presidential elections (Kose et al., 2021) and an increase in the weight of women in policy-making, leading to large increases in public health and educational spending (Miller, 2008; Kose et al., 2021). Miller (2008) provides robust evidence that this increase in women's political voice lead to substantive declines in child mortality, though no effects on mortality among women or men ages 20 and above.

2.2 Sulfa Drugs and Maternal Mortality

Sulfonamides or sulfa drugs – the first antimicrobial agents – were effective in treating peripartum infections, which accounted for about 40% of maternal deaths in the pre-antibiotic era (Albanesi and Olivetti, 2016). Prior to their arrival, MMR in the U.S. was as high as in contemporary sub-Saharan Africa, and penicillin did not arrive until 1942. There was an unprecedented and sharp drop in maternal mortality upon the introduction of sulfa drugs in 1937. The trend break in maternal mortality occurred at the same time (in 1937 or 1938) in all states and, collectively, sulfa drugs led to a 24%–36% decline in MMR by 1943 nationwide. (Jayachandran et al., 2010).

However, the size of the post-1937 decline varied considerably across the states. We investigate whether this variation in sulfa-led treatment effects can (at least in part) be explained by women's influence on policy making. Browsing specific cases suggests it might have been. For example, Colorado extended the franchise to women in 1893, 27 years before neighboring New Mexico or Alabama did in 1920. In 1936, the maternal mortality ratio in Colorado, New Mexico and Alabama was similar, at 710, 740, and 740, per 100,000 live births respectively. By 1950, in Colorado it had fallen to 80, just below the US average of 86, while in New Mexico and Alabama it was still about double the US average at 150 and 170 respectively (national-level summary statistics are in Table A1). In contemporary America, Colorado ranks 4$^{\text{th}}$ in women's political representation, while Alabama ranks 46 and these differences are persistent. While New Mexico ranks 14 now, it ranked 34 in 1975.[3]

3 Data and Research Design

3.1 Data

Data on the timing of women's suffrage was compiled by Miller (2008). We have data for 48 states and Washington D.C. (Hawaii and Alaska had not been granted statehood during the study period). We obtained state-year maternal mortality rates (hereafter, MMR) from

[3]See Rutgers: CAWP

Jayachandran et al. (2010), who collated these from US vital statistics data. These data are available for all states but Alaska, Hawaii, and Washington D.C. Full details of all study variables are provided in Appendix A. Following Jayachandran et al. (2010), the analysis sample is 1925–1943, a short window around the arrival of sulfa drugs in 1937, in which there were few large-scale public health interventions. Figure 1 plots the trends in maternal and infant pneumonia mortality rates during this period.

3.2 Empirical Strategy

Our hypothesis is that technologies that could bring about large declines in maternal mortality will be more effectively deployed in states that adopted women's suffrage earlier. To investigate this hypothesis, we estimate versions of the following event study style regression (Goodman-Bacon, 2021; Jacobson et al., 1993), in which we interact an indicator for early suffrage adoption states with a set of leads and lags surrounding the arrival of sulfa drugs in 1937:

$$\begin{aligned} ln(MMR)_{st} &= \gamma_0 + \sum_{j=2}^{12} \gamma_j^{lead} EarlySuf_s \times \mathbb{1}(\text{Year} = 1937 - j)_t \\ &\quad + \sum_{k=0}^{6} \gamma_k^{lag} EarlySuf_s \times \mathbb{1}(\text{Year} = 1937 + j)_t + \phi_t + \theta_s + \upsilon_{st} \end{aligned} \tag{1}$$

where s indexes states, t indexes years, $EarlySuf_s$ indicates states that legislated women's suffrage prior to the 19$^{\text{th}}$ amendment, and θ_s and ϕ_t represent state and year fixed effects. Standard errors are clustered at the state level.

The γ^{lag} coefficients capture dynamic effects. The γ^{lead} coefficients test the identifying assumption of no differential pre-trends. However, this serves only as partial test because, estimation of unbiased parameters requires parallel trends between treated and non-treated units in the absence of treatment. While parallel pre-trends support this assumption, they do not allow us to test what would have happened at the time of the reform had the reform not been implemented (Kahn-Lang and Lang, 2020). We address these concerns by exploiting "Honest DiD" estimator Rambachan and Roth (2020) that provides bounds on the Early suffrage post-

Sulfa coefficients under the scenario that any prevailing (even if imprecisely estimated) trends in the pre-Sulfa period between early and later suffrage states are projected forward into the post-Sulfa period (relaxing the assumption of parallel trends going forward).

We also show the corresponding DD style regression in which we interact an indicator for early adoption states with an indicator for the post-antibiotic years, allowing for trend as well as level differences by including a further interaction with year. As tracking maternal mortality is potentially a political choice, we re-estimate the model restricting the sample to a balanced panel so as to account for any correlation between data on maternal mortality and women's suffrage. We also investigate sensitivity of the results to weighting the regressions with state population.

Finally, we also estimate results for pneumonia mortality. We examined this outcome because it was treatable with sulfa drugs (Jayachandran et al., 2010) and affected both genders (among children – the age group with the highest infection rates – it affected boys more than girls (Bhalotra and Venkataramani, 2014). Examining pneumonia mortality thus allows us to differentiate between women's suffrage favouring health outcomes in general versus the pattern implied by our hypothesis, which is that women's suffrage would have particularly large impacts on uptake of/returns to technologies that reduced material mortality, in particular.

We interpret early suffrage as a proxy for the strength of women's voice in policy making as it is plausible that this increases with years of exposure to women being able to vote. An alternative interpretation may be that early adopters of suffrage had an underlying tendency to be gender progressive, and that they would have had faster declines in MMR irrespective of any influence of women in policy making. Any time-invariant level difference in progressiveness between the early adopting (Western) states and the rest will be absorbed by state fixed effects. To allow for time-varying differences between the western and other states, we test sensitivity to inclusion of census-region and year-specific fixed effects. Also, we focus not upon the coefficient on suffrage but rather on the coefficient on suffrage interacted with an indicator of access to sulfa drugs. If the general progressiveness of early adopters was such as to favour addressing MMR then, even before the introduction of antibiotics, we should expect to have seen steeper

declines in MMR in early adopting states. However, we see no differentially steeper pre-trend in MMR in early vs late suffrage states, a test of which is provided by the significance of the γ^{lead} terms. Following Miller (2008), cited above, we will, in a robustness check, control for women's labour force participation, interacting it with the post-antibiotic dummy. In an attempt to identify a mechanism that is more clearly linked to our hypothesis than to general progressiveness, we investigate whether early suffrage states had more women in government when the antibiotics arrived and made rapid MMR decline feasible.

4 Results

Our main results are displayed in Figure 2a that plots the event study for MMR. Across all states, maternal mortality fell sharply in 1937 and five years later the average decline was 50%, with state-specific declines varying between 6% and 80%. We show that some of this variation is explained by duration of exposure to women's suffrage. We find that MMR declined more rapidly in states that adopted suffrage early. The early adopters had lower levels of MMR in the pre-antibiotic era and, after 1937, the gap between early and late adopters widened. Pre-1937, the level of MMR in early adopting states was lower than in late adoption states by 11%. Six years later, this gap had widened to 26%, resulting in an estimated 15% reduction. There was no statistically significant difference in the trend in MMR in the pre-antibiotic era between the two groups of states, that is no differential pre-trends.

Our findings are robust to including interactions of baseline women's labour force participation with the post-sulfa dummy, year, and the interaction of post and year. They are also robust to restricting the sample to a balanced panel to account for endogenous tracking of maternal mortality, and to weighting by state population (see Figure A2). We also estimated a specification controlling for census division by year fixed effects to capture time-varying differences between early adopters in the west and the other states (Miller, 2008). We still see a trend break, although the coefficients are now less precisely estimated (Figure A3). The single coefficient models with the census division by year fixed effects produce largely similar

estimates.[4] We considered measures of the state-specific quality of vital statistics registers in the 1930s (discussed in in Bhalotra and Venkataramani (2014)) but as the quality of registration did not change discretely at the time of arrival of sulfa drugs, this is unlikely to bias the estimated parameters.

The DD style regression is in Table A2. We see a similar pattern of results with and without state population weights, but the estimates are larger and more precise with weights. They indicate that the level drop in MMR was 8.5% larger in early adopting states (coefficient on early adoption × post-antibiotic), and that the trend decline was 1.5% faster (coefficient on early adoption × post-antibiotic × year). The event study for pneumonia mortality (Figure 2b) shows that although there were large declines in pneumonia following the introduction of antibiotics (Jayachandran et al., 2010; Bhalotra and Venkataramani, 2014), there were no significant difference in the post-sulfa rates of decline in early vs late suffrage adopting states. Figure 3 displays the robustness of our results to loosening the parallel trends assumption following the Honest Difference-in-difference approach (Rambachan and Roth, 2020).

To assess the potential mechanism of women in positions of power increasing access to sulfa drugs (following Bhalotra et al. (2023), we collected data by state and year on the proportion of women in the House of Representatives and the National Senate (Figure 4 and Table 1). We apply a single coefficient difference in differences setup to these data, adjusting for state and year fixed effects. We find that in early adoption states relative to late adoption states (late being 1920), the share of women in Senate is a statistically significant 1 percentage point (110%) higher in 1920–1960 and 1.8 percentage points (125%) higher in 1937–1943, the latter being the period of rapid maternal mortality decline within the analysis sample. The share of women in the House of Representatives is 47% higher in 1937–43, but this estimate is not precisely determined.

[4] In the weighted specification, the coefficient on Early Suffrage × Post Sulfa is -0.075^{*}, and the coefficient on Early Suffrage × Post Sulfa × Time is -0.015^{**}. Analogous values for the specification without census division by year FEs are -0.085^{**} and -0.015^{**}.

5 Conclusion

Increased women's political participation fueled by gender quotas has resulted in steep declines in maternal mortality rates in contemporary developing countries (Bhalotra et al., 2023). However, in the past, when richer countries experienced steep declines in maternal mortality, much of the variation in women's voice in policy-making came from the timing of adoption of women's suffrage. Using historical data from the United States and an event study approach, we find that women's suffrage plays an important role in shaping the returns to new medical technologies. Early suffrage is a measure of a longer period of women having political voice, potentially raising investments in maternal health and laying the seeds of faster adoption of sulfa drugs in peripartum settings. In addition, early adoption of suffrage predicts a higher share of women in government during a period of rapid maternal mortality rate decline, suggesting that direct effects of women policymakers may be another mechanism by which early suffrage potentiated sulfa-led declines in maternal mortality. Additional mechanisms (e.g., cohort effects driven by early life exposure to suffrage, direct evidence of uptake of other medical technologies as a function of early suffrage) will be explored in future versions of this work.

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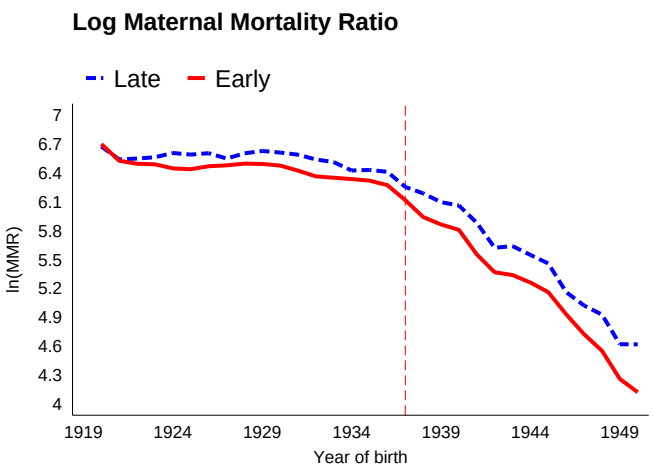
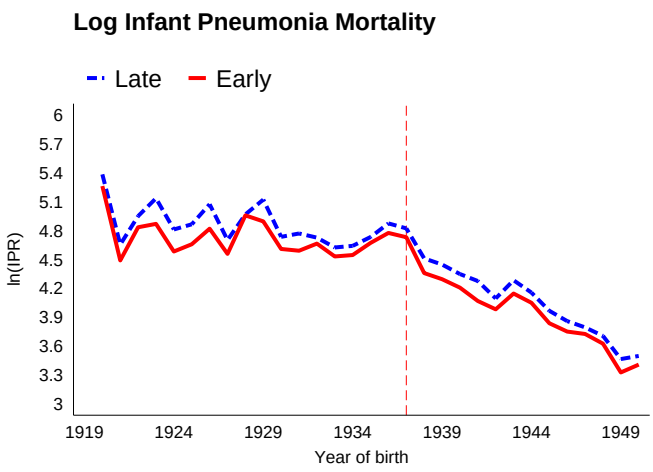
Figures and Tables

Figure 1: Maternal Mortality & Infant Pneumonia Mortality: Early vs. Late Suffrage States

(a) Log(Maternal mortality ratio)



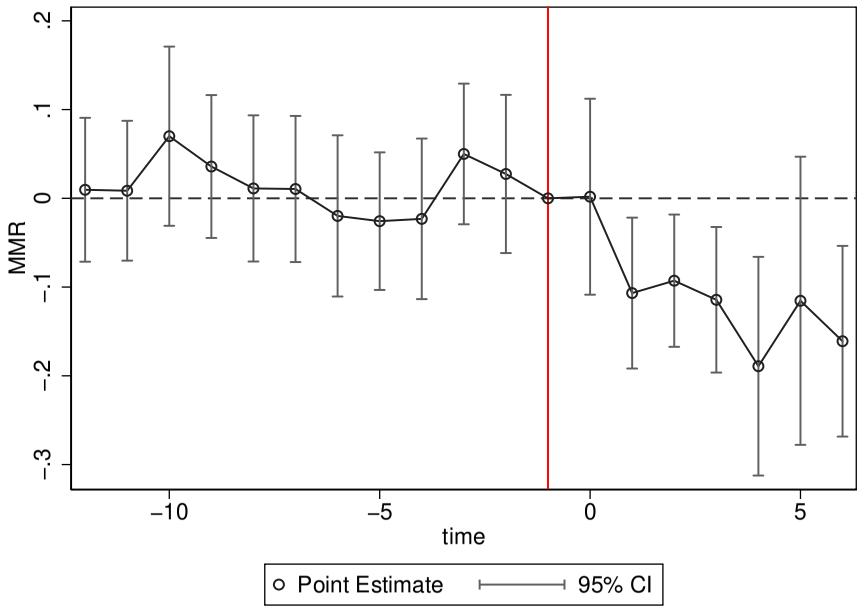
(b) Log(Rate of infant pneumonia mortality)



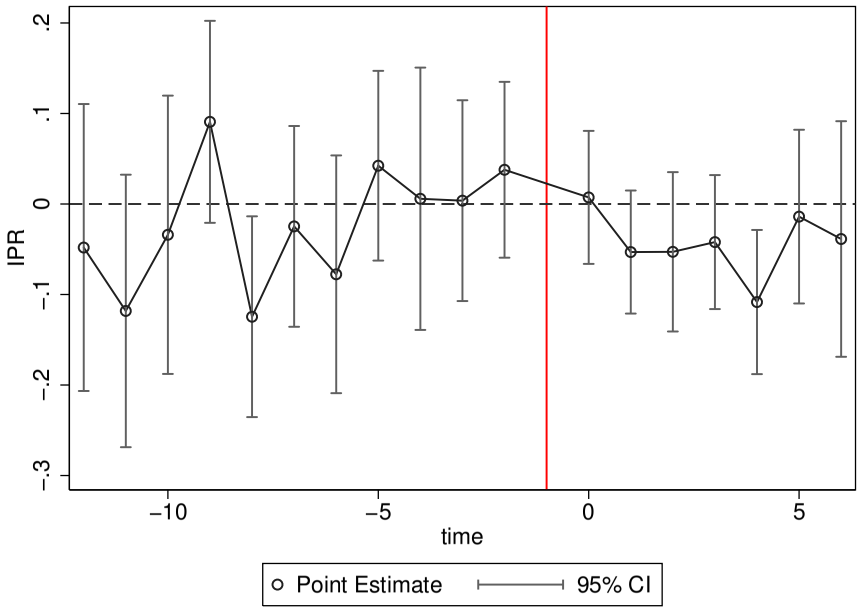
NOTES: Vertical Line indicates the arrival of Sulfa Drugs in 1937. The mean (SD) of Ln MMR in the pre-1937 period (1925–1936) is as follows (collapsing at the year level): Early states: 6.44 (0.09); Late states: 6.55 (0.07); All States: 6.49 (0.09). The mean (SD) of Ln IPR is as follows (collapsing at the year level): Early states: 4.72 (0.20); Late states: 4.87 (0.21); All States: 4.78 (0.20).

Figure 2: Women's suffrage: Event studies for maternal mortality and pneumonia mortality

(a) ln(maternal mortality ratio)

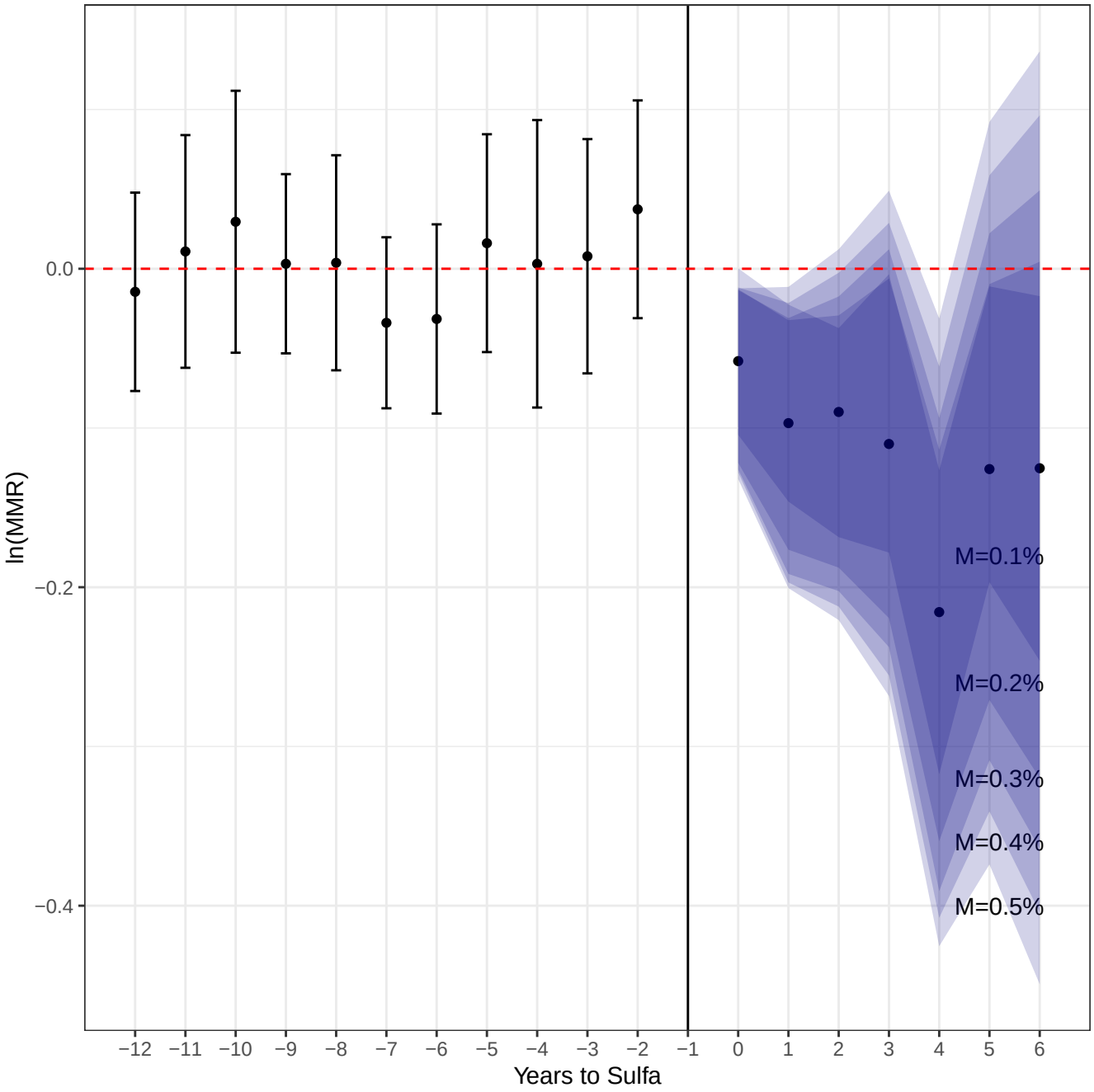


(b) ln(rate of infant pneumonia mortality)



NOTES: Event study plots differential rates of reduction of maternal mortality ratios (panel A) and infant pneumonia mortality rates (panel B) in early relative to late suffrage states, surrounding the arrival of Sulfa drugs (year 0). The omitted year is -1. All estimates are with respect to the prevailing differential one year prior to the reform. Standard errors associated with the 95% confidence intervals are clustered by state.

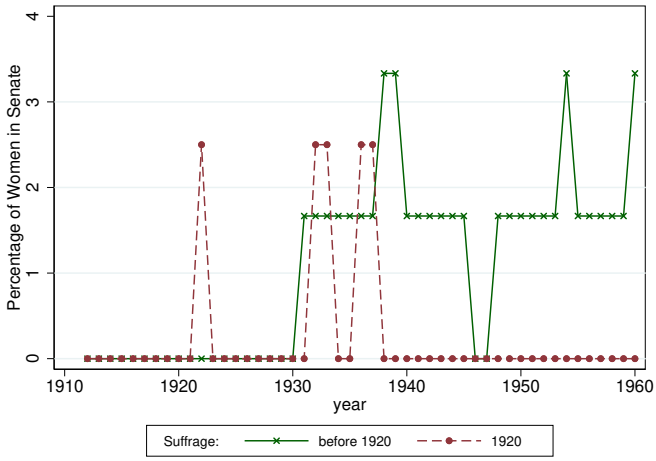
Figure 3: Loosening the Parallel Trends Assumption for Early vs Late Suffrage States



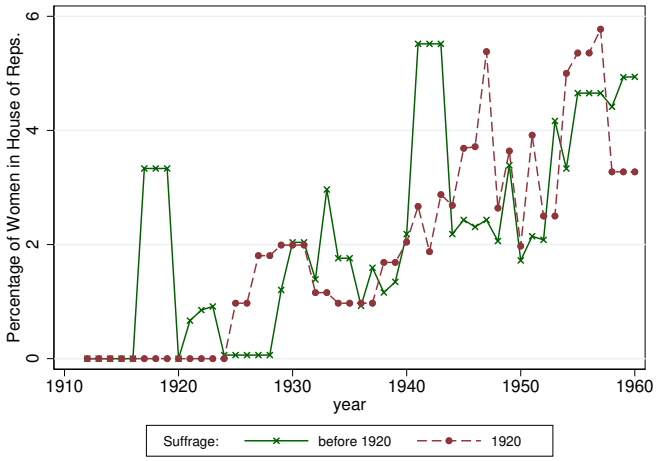
NOTES: Honest Difference-in-difference methods of Rambachan and Roth (2020) are implemented, where each shaded confidence interval allows for violations of linearity in the parallel trends assumption of up to the amount indicated in each shaded area. Plots and CI's in years prior to 0 refer to standard pre-event estimates from the event study, while shaded CIs in the post-Sulfa periods allow for violations of the parallel trend assumption (which by its nature can only be violated in post-treatment periods). The darkest CI allows for the parallel trend to be violated in a linear fashion, with up to an additional change in rates of maternal mortality of 0.1% between early and late Suffrage states, with alternative values up to 0.5% documented. Black circles refer to original estimates from event studies which impose parallel trends. Rambachan and Roth's Fixed length confidence intervals (FLCIs) are provided with 95% coverage allowing for arbitrary clustering by state. See also Figure A4

Figure 4: Suffrage and subsequent women representatives in national legislature

(a) Percentage of women in the senate



(b) Percentage of women in the house of representatives



Notes: Plots depict the percentage of female representatives in the National Senate (left-hand panel) and National House of Representatives of the USA from 1912 to 1960 for each of the early (pre-Nineteenth Amendment) and late (post-Nineteenth Amendment) states.

Table 1: Early suffrage and subsequent female representation

	1920-1960		1937-1943	
	(1) Senate	(2) House	(3) Senate	(4) House
Early Suffrage	0.996***	0.040	1.786**	1.290
	[0.265]	[0.345]	[0.786]	[1.022]
Mean of Dep. Var.	0.902	2.329	1.429	2.746
Observations	2050	2050	350	350
R-Squared	0.005	0.000	0.011	0.003

We display the coefficients of a regression of the percent of a state's representatives in the National Senate and House of Representatives on the state's suffrage status (early vs late). The percent of representation is a value from 0 to 100, and is calculated as the number of female representatives of a state in a given year divided by the total number of seats assigned to the state, multiplied by 100. For example, column 3 shows that in the 1920–1960 period, states adopting suffrage early went on to have nearly 1.8 % point more women representatives in the Senate than states which adopted in 1920. The left-hand columns are for the entire post-suffrage period up until 1960, and the right-hand columns are for the post-antibiotic period under study in this paper, of 1937-1943. * p<0.10; ** p<0.05; *** p<0.01.

ONLINE APPENDIX

Maternal Mortality and Women's Political Voice: Historical Evidence from the U.S.

Sonia Bhalotra, Damian Clarke, Joseph F. Gomes, Atheen Venkataramani

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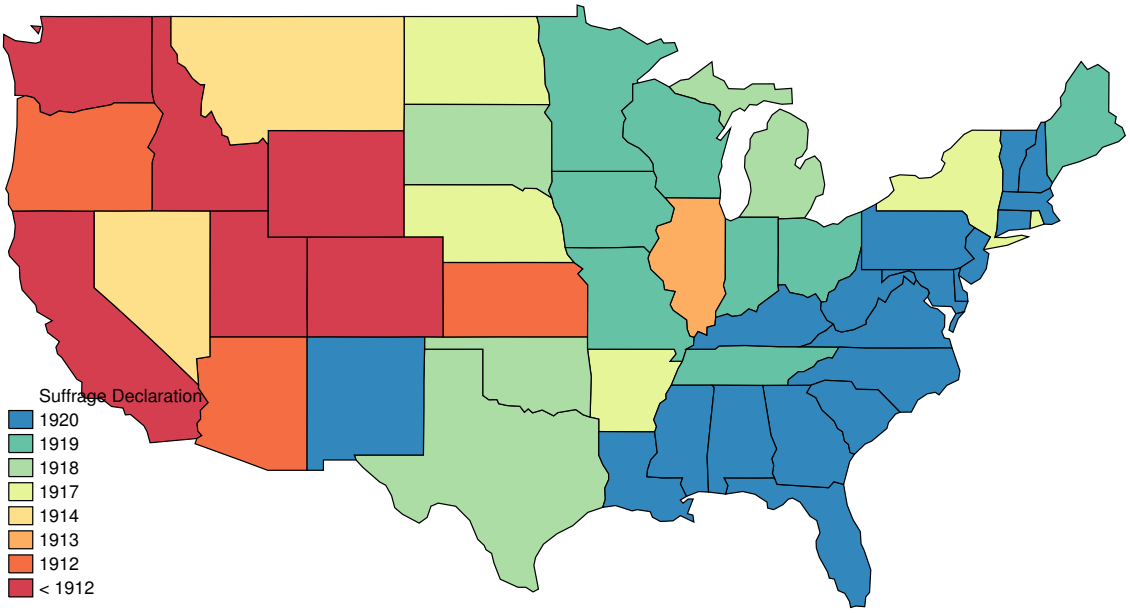
Figure A1: Suffrage timing by state



NOTES: States declaring Suffrage in 1920 with the passing of the 19th Amendment (dark blue color) are "late suffrage" states. Suffrage data are from Miller (2008).

Table A1: Summary statistics for suffrage/sulfa analysis

	N	Mean	Std. Dev.	Min	Max
Maternal Mortality Ratio	868	539.57	206.35	70.00	1210.00
Infant Pneumonia Mortality Ratio	868	102.58	34.46	36.24	236.48
Year of Birth	868	1934.37	5.34	1925.00	1943.00
Post Sulfa	868	0.39	0.49	0.00	1.00
Early Suffrage Adopter	868	0.60	0.49	0.00	1.00
Female Labour Force Participation Rate	868	0.29	0.07	0.17	0.40

NOTES: Maternal Mortality Ratio and Infant Pneumonia Mortality Ratio are measured as deaths per 100,000 live births. Sulfa drugs arrived in the US in 1937, and post-sulfa takes the value of one in all years including and following 1937. The analysis sample consists of all years in 1925-1943.

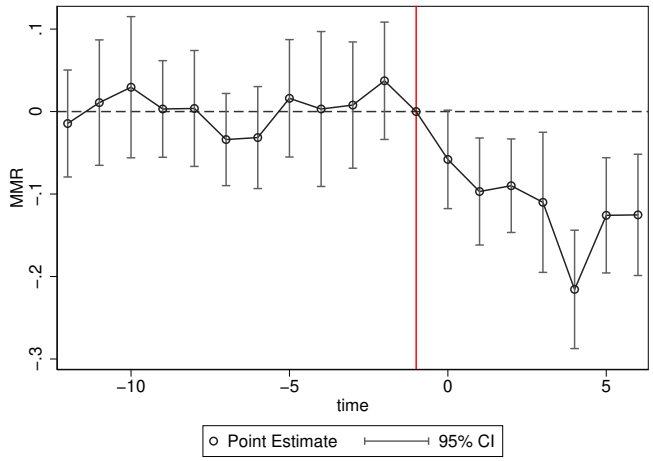
Table A2: DD estimates: Early adopters of suffrage had faster MMR decline in the post-antibiotic era

	ln(Maternal Mortality Ratio)		ln(Pneumonia Mortality)	
	(1)	(2)	(3)	(4)
Post Sulfa	-0.092***	-0.097***	0.009	0.011
	[0.030]	[0.029]	[0.022]	[0.022]
Early Suffrage × Post Sulfa	-0.085**	-0.046	-0.046	-0.060*
	[0.036]	[0.041]	[0.028]	[0.031]
Early Suffrage × Post Sulfa × Time	-0.015**	-0.019	-0.007	-0.012
	[0.006]	[0.012]	[0.013]	[0.011]
Early Suffrage × Time	0.001	-0.002	0.005	0.008
	[0.003]	[0.003]	[0.008]	[0.006]
Time	-0.023***	-0.024***	-0.029***	-0.024***
	[0.002]	[0.002]	[0.006]	[0.005]
Post Sulfa × Time	-0.089***	-0.090***	-0.061***	-0.069***
	[0.005]	[0.008]	[0.011]	[0.008]
Constant	6.294***	6.307***	4.559***	4.618***
	[0.012]	[0.011]	[0.015]	[0.015]
Mean of Dep. Var.	6.206	6.206	4.573	4.573
Observations	868	868	868	868
R-Squared	0.951	0.906	0.780	0.757
State Population Weights	Y	N	Y	N

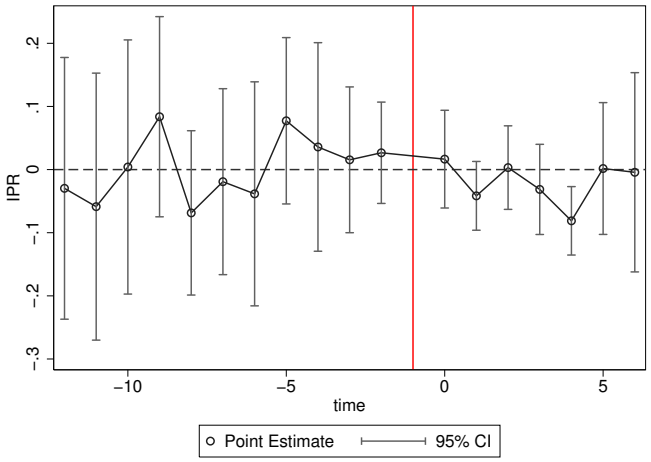
Estimation sample consists of state by year mortality data from 1925 to 1943 (inclusive) Each regression includes state and year fixed effects and clusters standard errors by state. * p<0.10; ** p<0.05; *** p<0.01.

Figure A2: Alternative specification of sulfa/suffrage event study

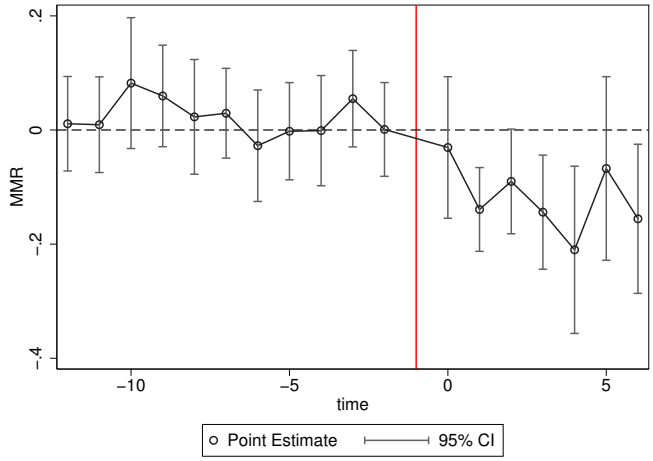
(a) ln(MMR) weighted by state population



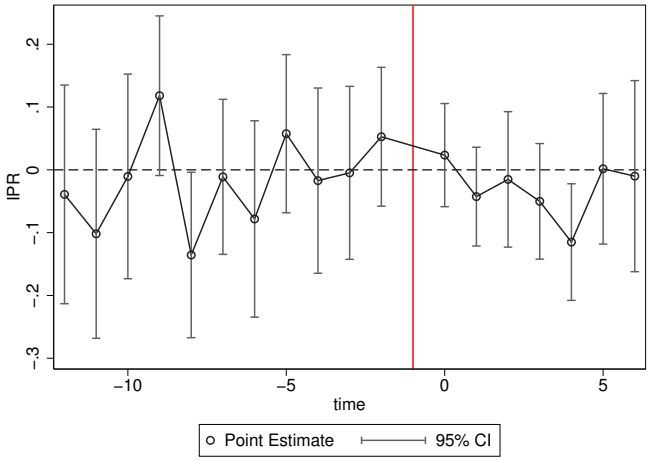
(b) ln(IPR) weighted by state population



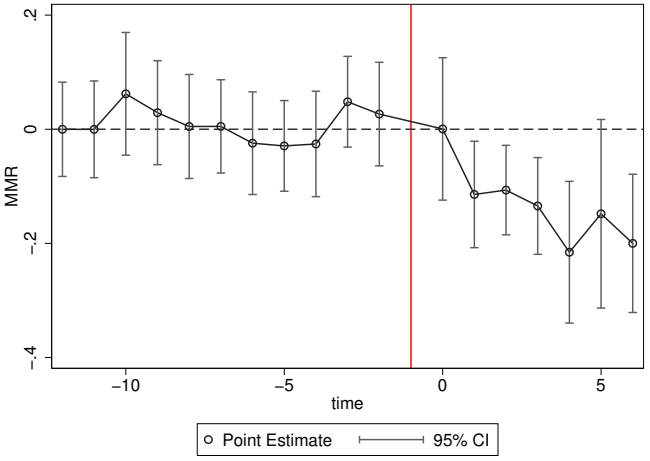
(c) ln(MMR) with balanced sample only



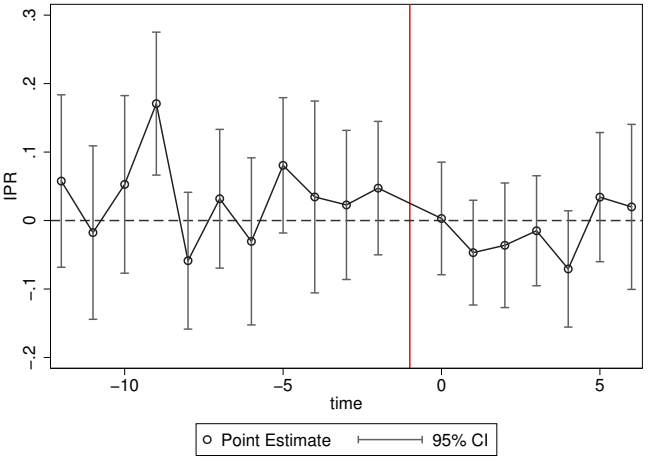
(d) ln(IPR) with balanced sample only



(e) ln(MMR) with FLFP controls and trends



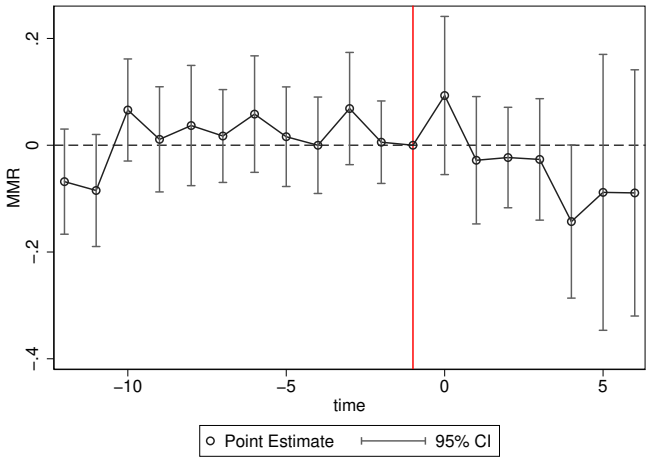
(f) ln(IPR) with FLFP controls and trends



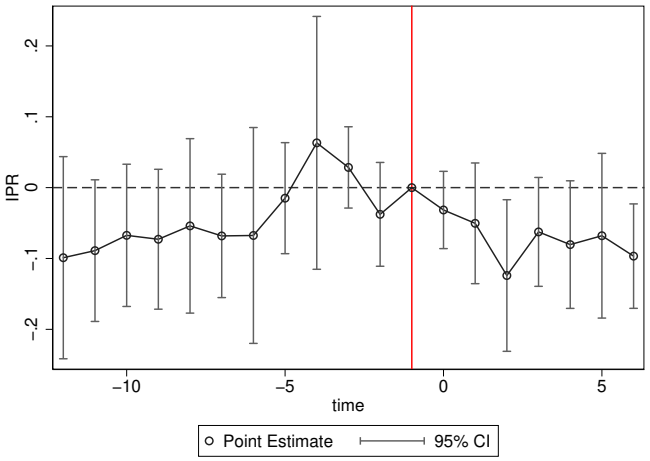
Notes: Alternative specifications of the event study shown in Figure 2. The balanced sample refers to states with mortality data in all years under study, and the final two figures augment the event study specification in equation 1 with the following controls and interactions to capture any differences in baseline women's labour force participation: a post sulfa times FLFP interaction $Post1937_t \times FLFP_s$, an interaction between FLFP and time, $year_t \times FLFP_s$ and an interaction between FLFP, time, and post sulfa $Post1937_t \times year_t \times FLFP_s$.

Figure A3: Women's suffrage: Event study for maternal mortality with Census Division by Year FE's

(a) ln(maternal mortality ratio)

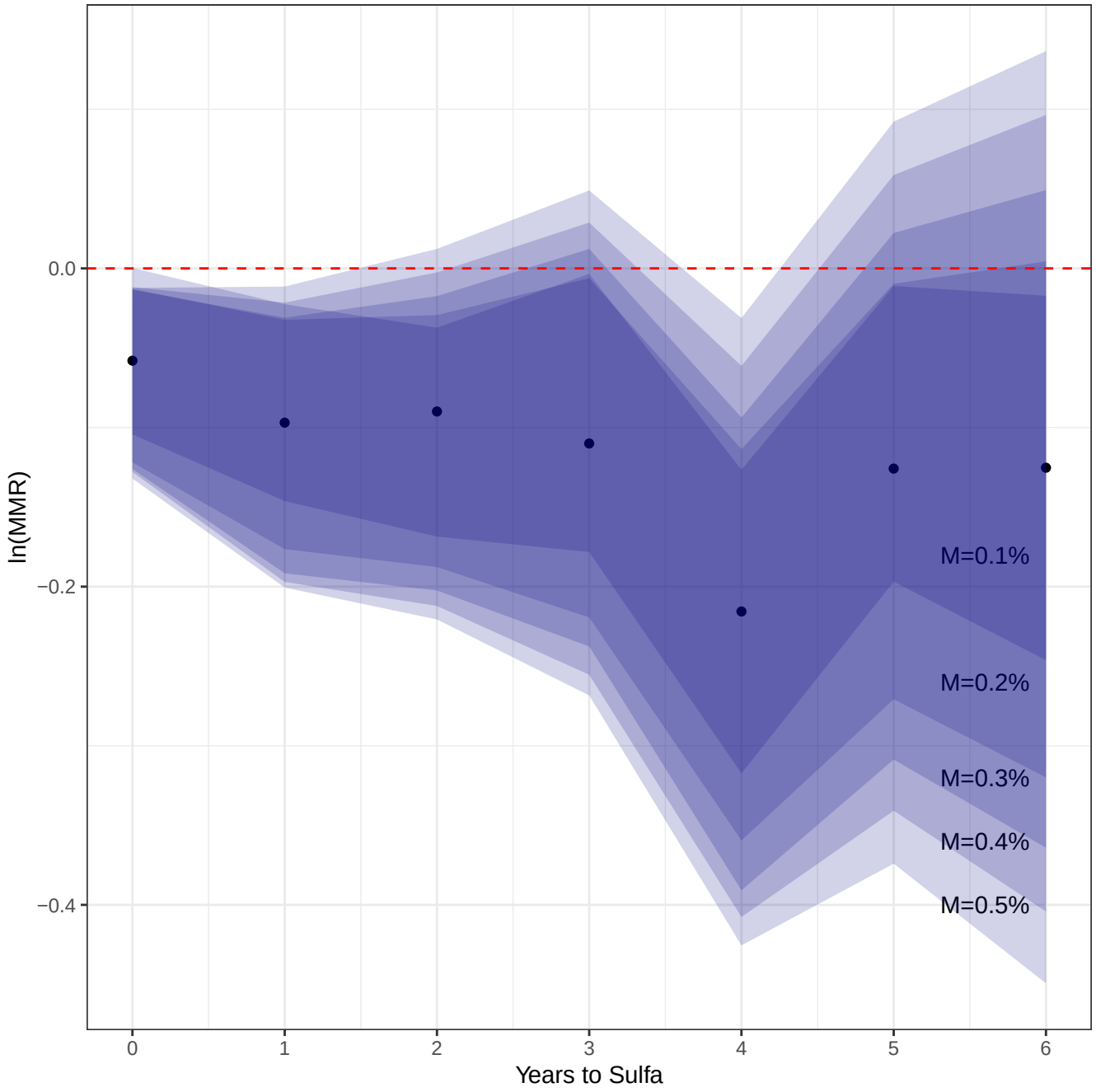


(b) ln(rate of infant pneumonia mortality)



NOTES: Refer to Figure 2, panel (a). An identical specification is estimated, howerver additionally controlling for census division by year fixed effects. When estimating a DD specification as in Table A2, Early Suffrage × Post Sulfa estimates are very similar as those not conditioning on census division by year FEs. For reference, in the weighted specification, the coefficient on Early Suffrage × Post Sulfa is -0.075* (s.e. = 0.038), and the coefficient on Early Suffrage × Post Sulfa × Time is -0.015** (0.004). Analogous values for the specification without census division by year FEs are -0.085** and -0.015**.

Figure A4: Loosening the Parallel Trends Assumption for Early vs Late Suffrage States



NOTES: Honest Difference-in-difference methods of Rambachan and Roth (2020) are implemented, where each shaded confidence interval allows for violations of linearity in the parallel trends assumption of up to the amount indicated in each shaded area. The darkest CI allows for the parallel trend to be violated in a linear fashion, with up to an additional change in rates of maternal mortality of 0.1% between early and late Suffrage states, with alternative values up to 0.5% documented. Black circles refer to original estimates from event studies which impose parallel trends. Rambachan and Roth's Fixed length confidence intervals (FLCIs) are provided with 95% coverage allowing for arbitrary clustering by state.

A Data Appendix

Women's Suffrage and Mortality Rates in the US. The state-specific adoption of women's suffrage is taken from Miller (2008), for 48 states and Washington D.C., Hawaii and Alaska had not been granted statehood during the study period. State-year maternal mortality rates were obtained from Jayachandran et al. (2010), collated from US vital statistics data. These data are available for all states but Alaska, Hawaii and Washington D.C. For 21 states these data are available for the entire period of 1920 to 1950. For the remaining states mortality data are incomplete, and available only from a later year onwards.[5] In Table A1 we provide summary statistics for each relevant variable.

Women's Representation in the Senate and US House of Representative. We created a state by year database of the proportion of women in seats representing each state of the United States for the National Senate and the House of Representatives. A complete compilation of these data is available in Manning and Brudnick (2018). We calculated the proportion of women representatives in each chamber of congress for each state for the years 1917–1960. Prior to 1917, there were no female representatives in either body.

[5]For 4 states from 1921 onwards, for 3 from 1922 onwards, for 1 from 1925, for 2 from 1926, for 5 from 1927, for 3 from 1928, for 2 from 1929, for 1 from 1932 and finally for 1 from 1933 onwards.