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THE US COVID-19 BABY BUST AND REBOUND

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ABSTRACT

We document the impact of the COVID-19 pandemic on births in the United States. First, using Vital Statistics birth data on the universe of US births, we show that the US pandemic initially was associated with a “baby bust” period, from August 2020 through February 2021. During these seven months, there were nearly 100,000 fewer births than predicted based on pre-existing birth trends and seasonality. Many of these missing births would have been conceived after the pandemic began in March of 2020, consistent with a behavioral fertility response to pandemic conditions. Other missing births would have been conceived before the onset of the pandemic. Some of these are attributable to reduced immigration of pregnant women and some to altered pregnancy outcomes for women who were pregnant during the early months of the pandemic. We further document a COVID birth rebound between March and September 2021, amounting to about 30,000 more births than predicted. Second, we document variation across US states in the size of the baby bust and rebound and investigate how that variation statistically relates to contextual factors. The bust was larger in states with larger increases in the unemployment rate, a larger reduction in household spending, and more COVID cases. The rebound was larger in states that experienced larger improvements in the labor market and household spending, consistent with a positive effect of economic conditions on birth rates, and smaller in places that had mask mandates, consistent with a dampening role of social anxiety about the ongoing pandemic.

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I. INTRODUCTION

On March 13, 2020, the outbreak of the novel coronavirus disease COVID-19 was declared a national emergency in the United States. By the end of April 2020, the U.S. had recorded nearly one million COVID-19 cases and over 65,000 related deaths.[1] In response, local government shutdowns were imposed on businesses, schools, and social gatherings around the country. The unemployment rate skyrocketed to 14.7 percent. The potential societal consequences of a nation-wide public health crisis and associated recession were widespread and far-reaching. They included the potential for a sizable reduction in fertility rates, as noted by Kearney and Levine (2020a) and Aassve, et al. (2020).

We document in this paper that the pandemic conditions that existed in the late winter and spring of 2020 led to a substantial drop in US births, followed by a partially offsetting rebound. Using Vital Statistics data on all births in the US between October 2016 and September 2021 (likely conceived between January 2016 and December 2020), we estimate that there were 97,000 fewer births during the 7-month period between August 2020 and February 2021 (likely conceived between November 2019 through May 2020) than predicted by pre-pandemic birth trends and seasonality. We refer to these as missing births as a COVID "baby bust." It represents a 4.4 percent decline in births relative to the analogous months a year earlier. During the subsequent 7-month period of March 2021 through September 2021, there was a rebound of 31,000 "excess" births (likely conceived between June 2020 through December 2020), meaning more than predicted based on pre-pandemic birth trends and seasonality.[2]

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[1] From CDC covid data tracker, https://covid.cdc.gov/covid-data-tracker/#trends_totalcases, accessed 3/8/2022.
[2] Since the rebound was ongoing at the end of our analysis period, it is possible that more of the missing births were ultimately offset in later months.

Of the COVID baby bust missing births, 41,000 (42 percent) can be attributed (in a timing sense) to a reduction in conceptions in March, April, and May of 2020. This would be consistent with a behavioral fertility response to economic and public health conditions. The remaining 56,000 missing births are attributable to conceptions prior to March of 2020 that did not result in a live birth. Some of these missing births may have resulted from a shift in birth timing due to restricted health care access, or an increase in miscarriages, still births, or abortions. Another factor driving a reduction in births soon after the COVID onset is reduced immigration among pregnant women, as pointed out by Bailey, Currie, and Schwandt (2022). We estimate that reduced immigration can account for roughly 20,000 of the missing births (about 20 percent). That leaves an additional 36,000 missing births attributable to altered pregnancy outcomes (an increase in abortion or miscarriage) for women who were pregnant when the pandemic hit or to measurement error in the assignment of conception dates.

We further document substantial variation across US states in the extent of both the COVID baby bust and subsequent rebound. Guided by existing theory and research, we empirically examine the role of potential explanatory factors in driving the extent of a state's baby bust and rebound. We use ordinary least squares regression to estimate the relationship between state monthly fertility rates (defined as births per 1,000 women of childbearing age) and a set of explanatory factors, examining the bust and rebound periods separately. The explanatory factors we consider are intended to capture both economic and non-economic effects. Our regression models include the unemployment rate, levels of household spending, and the COVID caseload rate (all at the state/month level) along with state fixed effects. For the rebound period, we additionally consider the presence of state mandates to keep schools open in the fall of 2020 and for wearing masks in public places. These are meant to proxy for widespread attitudes toward the pandemic and both enforced and practiced social restrictions.

Consistent with past research on the economics of fertility, we find that births are procyclical. Interestingly, that statistical relationship is attenuated when we also control for changes in household spending, which suggests that part of the negative effect of higher unemployment on fertility rates arises through an effect on household budgets (as captured by spending levels). The data also indicate that conditional on labor market conditions and household spending levels, during the initial baby bust period, a higher level of COVID caseloads per capita is associated with larger fertility rate declines. This is consistent with past research documenting a decline in births in response to public health outbreaks in high income countries, perhaps most relevantly from the experience of the 1918-1919 influenza outbreak in the U.S. (Chandra et al., 2018; Kearney and Levine, 2020a), though the pandemic contexts are different in important ways.[3]

During the rebound period, the observed conditional relationship between a state's COVID caseload and monthly fertility rates is much smaller, suggesting that the behavioral fertility response to COVID caseloads differed later in the year. We also find that states that mandated wearing masks in public in the summer of 2020 experienced smaller rebounds in fertility rates, holding constant the extent of COVID exposure in the state. This suggests a role for the social atmosphere surrounding pandemic worries and restrictions, beyond actual COVID caseloads. If mandated mask wearing is a suitable proxy for a greater level of social anxiety

[3] In our June 2020 Brookings report, we drew lessons from the experience of the 1918-1919 US influenza outbreak, which was a public health crisis without a corresponding economic recession. However, there are many obvious differences between that public health context and the COVID pandemic. For instance, the Spanish flu had a high mortality rate among women of childbearing age (Simonsen, et al., 1998). Furthermore, the context around fertility control is completely different now, more than 100 years later, a point also observed by Aassve et al (2021).

and/or restrictions during the ongoing pandemic, this could be interpretable as suggesting that in such places, there was a smaller rebound in fertility rates.

Our paper adds detailed descriptive evidence about the response of US fertility to the COVID pandemic to a developing body of evidence about how the COVID pandemic shaped fertility in high-income countries. Using national level vital statistics birth data through March 2021 from a set of 22 high-income countries, Assave et al. (2021) find heterogeneous effects across countries, with a statistically significant decline in the monthly crude birth rate (beyond what would have been predicted by previous trends and seasonal effects) for 7 out of the 22 countries in their analysis sample. Sobotka et al. (2021) also document a decline in births in the months following the onset of the COVID pandemic in multiple high-income countries. In more recent work, Sobotka et al. (2022) show that the initial reduction in births observed in many high-income countries was followed by a period of rebounded births, similar to the pattern we document in the current paper for the US. -

Putting the findings of this paper in broader context, we note that the COVID pandemic birth bust and rebound should be understood as a relatively minor short-term disruption of a much longer trend of declining (in the case of the US) or consistently low (in the case of many other high-income countries) fertility rates (Kearney, Levine, and Pardue, 2022). In terms of what the pandemic birth response reveals about the determinants of fertility rates, the documented patterns are broadly consistent with the predictions of the standard neoclassical model of the economic determinants of fertility rates, along with important roles for public health and social factors.

II. EXPECTED EFFECTS OF THE COVID-19 PANDEMIC ON FERTILITY RATES

When the public health crisis first took hold in the United States, some observers playfully speculated that there would be a spike in births in nine months, as people were "stuck home" with their romantic partners. Such speculation is based on persistent myths about birth spikes occurring nine months after blizzards or major electricity blackouts. As it turns out, those stories tend not to hold up to statistical examination (Udry, 1970). But the COVID-19 pandemic was much more than a temporary period of staying at home. It was a public health crisis, with associated economic loss, uncertainty, and insecurity. Economic theory and evidence lead one to expect a corresponding reduction in births. Survey evidence from the United States and Europe during the spring of 2020 confirmed that many women intended to delay or abandon their plans to get pregnant in the near future (Lindberg et al. 2020; Luppi et al. 2020).

In this section we conceptually apply lessons from the research on the economics of fertility rates to the specific context of the COVID pandemic on births. First, labor market conditions and movements in household income are important determinants of contemporary fertility rates. Standard economic reasoning posits that people are more likely to have children when they have income available to pay for the associated costs of having and raising a child. This basic prediction derives from the standard economic approach of modeling the demand for children in a constrained optimization framework, where children are desirable "goods," but are costly in terms of both money and time (Becker, 1960). If credit markets were perfect, parents could borrow and save to finance the cost of children and optimally choose when to have them without regard to business cycles (Hotz, Klerman, and Willis, 1997). But credit markets are imperfect, and many people are liquidity constrained. Couples might thus refrain from having a child at times when household income is low or the threat of earnings loss is elevated —that is, when the labor market is weak, and the unemployment rate is elevated.

There is ample evidence supporting the predictions of this decision-making framework. First, increases in household income have been found to lead to increases in births, holding other factors, like women's wages, constant. The strongest such evidence comes from contexts where researchers have been able to study the impact of exogenous changes in income (see Black, Kolesnikova, Sanders, and Taylor, 2013; Lovenheim and Mumford, 2013; Dettling and Kearney, 2014; Kearney and Wilson, 2018; and Gallego and LaFortune, 2023).[4] These studies surmount the problem of comparing fertility rates across places or over time since such comparisons are plagued by confounding factors that have independent effects on fertility rates, such as women's economic opportunities or preferences for market work. Past research also documents that employment and income losses lead to lower fertility rates (see Lindo, 2010; Autor, Dorn, and Hanson, 2019).[5]

There is also abundant empirical evidence from recent decades showing that aggregate US fertility rates follow a pro-cyclical pattern, rising and falling along with the aggregate unemployment rate (e.g., Dettling and Kearney 2014; Currie and Schwandt 2014; Schaller 2016; Schaller, Fishback, and Marquardt, 2020); Buckles, Hungerman, and Lugauer (2021) find that

[4] Black, Kolesnikova, Sanders, and Taylor (2013) show that an increase in male earnings in coal-producing areas, driven by exogenous changes in coal prices, led to an increase in births among married couples; Kearney and Wilson (2018) document an increase in birth rates in response to localized "fracking booms" that increased household income in areas where fracking was geologically feasible. In the context of Chile, Gallego and LaFortune (2023) document an increase in births in response to increase in increases in international commodity prices in Chilean localities with substantial natural resource endowments. Dettling and Kearney (2014) and Lovenheim and Mumford (2013) show that exogenous increases in house prices lead to increases in births among existing homeowners, consistent with a positive wealth or home equity effect, while Dettling and Kearney (2014) further show that increases in house prices lead to reductions in births among renters, consistent with a negative price effect.

[5] Lindo (2010) finds that women whose husbands lose their jobs at some point during their marriage ultimately have fewer children. Autor, Dorn, and Hanson (2019) show that places that experienced a reduction in employment and earnings – resulting from increased import competition from China - consequently had lower birth rates.

births are not just pro-cyclical, but are leading indicators of economic activity, suggesting that fertility behavior is forward looking and sensitive to changes in short-run expectations about the economy.

The domestic recession induced by the onset of COVID in the U.S. was extremely sharp, with the unemployment rate surging from 3.5 percent in February 2020 to over 14.7 percent in April 2020 (U.S. Bureau of Labor Statistics, 2022a). However, the massive spike in unemployment receded quickly. By October 2020, the unemployment rate had declined by more than half, falling to 6.9 percent. By the end of 2021, the unemployment rate had returned to 3.9 percent, though the employment rate remained below pre-pandemic levels through March 2022 (U.S. Bureau of Labor Statistics, 2022c). These movements in the labor market are predicted to lead to an initial reduction in fertility rates (births per 1,000 women of childbearing age), followed by a rebound.[6]

Second, the federal government responded to the economic downturn with unprecedented income support. In March 2020, Congress passed the CARES Act, which provided $2 trillion in fiscal relief (Congressional Research Service, 2020). The Act provided for $1,200 stimulus checks to US households and a $600 increase in weekly unemployment insurance (UI) benefit amounts, among other provisions, including an expanded Child Tax Credit that eligible households could begin receiving in July 2020. For lower-wage workers, the UI benefit increase provided income greater than their lost earnings (Anderson and Levine, 2020). In total, the economic assistance provided through CARES Act provisions allowed most households to

[6] In June 2020, we predicted that a year of pandemic conditions could lead to a birth rate reduction of between 8 percent to 13 percent in the US (Kearney and Levine, 2020a). That forecast was largely based on an anticipated large and lengthy recession. In recognition of the stronger than expected labor market later in 2020, we revised our estimate of the impact of COVID on births downward (Levine and Kearney, 2020b). That revision, though, was still insufficient to capture the factors dampening the size of the baby bust.

maintain consumption levels (Bhutta, Blair, Dettling, and Moore, 2020). Poverty rates did not increase by as much as previous experience would have predicted, and in fact, in the initial months after the CARES act, poverty rates actually fell (Han, Meyer, Sullivan, 2020). As described above, both theoretical and empirical evidence shows that income losses are associated with declines in fertility rates. We thus hypothesize that the provision of government income assistance to maintain household income and consumption in the face of the negative economic shock associated with the pandemic would mute the typical relationship between economic downturns and fertility rates.[7]

Third, beyond the economic conditions surrounding the COVID-19 pandemic, the public health aspects of the crisis likely affected fertility rates. The social conditions surrounding the COVID-19 public health crisis directly affected people's social activities, access to schools and childcare, and access to health services. These features of the pandemic could have had both practical effects that might either increase in decrease fertility rates, as well as psychic effects. For instance, social activities were restricted in ways that might have led to fewer romantic partnerships forming. The stress on parents from closed schools and childcare centers might have amplified any potential birth reduction, driven by a reduction in higher parity births.

Restricted access to health care facilities might have had various effects on pregnancy rates and pregnancy outcomes. For instance, restricted access to fertility clinics might have led to a reduction in pregnancy rates to women who would have been seeking assistance getting pregnant. On the other hand, restricted access to reproductive health clinics might have led to an

[7] In a different context, Cumming and Dettling (2020) show that government policy can mediate the effect of recessionary pressures on birth rates. Using administrative data from the United Kingdom on mortgages and births, they show that a policy change that resulted in lower interest rates on mortgages led to an increase in birth rates. Their calculations imply that the pass-through of accommodative monetary policy to mortgage rates was sufficiently large to outweigh the cyclical effects of the Great Recession and prevented a reduction in births as large as that experienced in the U.S. in the wake of the Great Recession. In recent work, Dettling and Kearney (2023) show that higher unemployment insurance replacement rates dampen the cyclicality of fertility rates.

increase in pregnancies or births among women who were unable to obtain contraception or abortion services (see Bailey, Bart, and Lang, 2021; and Marquez-Padilla and Saavedra, 2023).[8]

In addition, women who were pregnant during the early months of the pandemic might have experienced altered pregnancy outcomes, due to restricted access to health care facilities and/or health-related stressors. Various studies offer support for this notion. For example, there is evidence from Turkey of increased rates of miscarriage during the first trimester of pregnancy, not obviously due to the presence of the COVID virus (see Sacinti et al., 2021). A retrospective study comparing the outcomes of pregnant women receiving care at 463 US hospitals during the pandemic period (March 2020 to April 2021), as compared to January 2019 to February 2020, documented statistically significant increases in pregnancy-related complications and maternal deaths during delivery hospitalization, even after adjusting for patients' characteristics, comorbidities, and month and hospital fixed effects (Molina et al, 2022)[9]. Relatedly, Dench et al. (2022) document a decline in preterm births after March 2020, driven by deliveries that were by cesarean or were induced. The researchers speculate that less time seeing an obstetrician in person during the lockdown resulted in fewer diagnoses of indications for delivery. We present evidence below that the COVID pandemic was associated with fewer prenatal visits among pregnant women in the US, which is consistent with Martin and Osterman (2023).

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[8] The pandemic may also have had a differential effect on births by whether the mother intended to get pregnant Bailey, Guldi, and Schmidt (forthcoming) use data from the National Survey of Family Growth, which includes a measure of intendedness, to estimate the share of the fertility decline between 2007 and 2016 that likely reflects a reduction in unintended births. They estimate that 35 percent of the reduction in births over that time potentially reflect a reduction in unintended births. The data and methods we use in this study do not provide us with a way to reliably estimate changes in births separately by mother's pregnancy intentions.

[9] The authors note that though hospital-based obstetric care remained an essential service during the COVID-19 pandemic, outpatient prenatal care experienced substantial disruptions, and much routine care was done virtually. They speculate that these disruptions and limitations in monitoring with telehealth may have contributed to the slight worsening of pregnancy-related complications. They also suggest that increased rates of hypertensive disorders due to heightened stress provoked by the pandemic could have been a contributing factor.

This discussion has so far focused on the role of economic, social, and public health determinants of fertility rates, effectuated through the mechanisms of behavioral change or change in pregnancy outcomes. Bailey et al. (2022) propose a more mechanical reason for reduced births in the US during the COVID pandemic: restricted immigration that would have led to fewer pregnant women from outside the US being in the country to give birth. We provide support for this additional mechanical determinant of fertility rates below.

III. National Evidence from US Birth Records

a. An Initial Baby Bust

We calculate the number of "missing" US births attributable to the COVID-19 pandemic using data from the US CDC National Center for Health Statistics. We use five years of monthly birth data from October 2016 through September 2021 (likely conceptions between January 2016 and December 2020), the most recent month available when we conducted our analysis. All of the birth data we use are final birth counts obtained from CDC Wonder, which is based on official birth certificate data.

We calculate missing births as the gap between actual births and the number of births predicted based on pre-pandemic trends. We report the number of missing births by the month the birth occurred, as well as the presumed month of conception, which is calculated assuming a nine-month gestation period.[10] The number of predicted births is based on pre-pandemic monthly birth data from births in October 2016 through September of 2019 (conceptions that likely

[10] We repeated this analysis using recorded gestation length, which is available in Vital Statistics Natality microdata and obtained results that were very similar to those reported below. We do not currently have access to the restricted-use geocoded data with state level identifiers, so we did not repeat this sensitivity analysis at the state level.

occurred between January 2016 and December 2018). Thus, the predicted number of births takes into account the pre-pandemic downward trend in births and typical seasonality in births.

More formally, the statistical models we estimate take the form:

$$(a) \quad Predicted\ births_{my} = \beta_0 + \beta_1 \sum_{m=1}^{12} \sum_{y=2019}^{2020} \gamma_{my} + \beta_2 trend + \gamma_m + \varepsilon_{my}$$

$$(b) \quad Missing\ births_{my} = Births_{my} - Predicted\ births_{my} \qquad [1]$$

where m is the calendar month, y is calendar year, *trend* denotes a linear time trend in months from 1 to 60), and γ_m is a vector of month fixed effects to capture seasonality. Birth dating in this specification is based on likely month of conception because we link observations to the contextual factors that were in existence at the time of likely conception, including, for instance, the declaration of the US pandemic emergency in March of 2020. The intercept in the predicted births regression captures the average monthly number of births conceived between 2016 and 2018 in July (the omitted month fixed effect), which represents April births. The monthly deviations from trend for conceptions occurring in 2019 and 2020 are captured by the interaction of monthly fixed effects indicator variables for 2019 and 2020. The residuals from this regression relevant for each month in 2016 through 2018 provide estimates of deviations from trend in those months.

The top panel of Figure 1 depicts deviations between the number of actual and predicted births – which we refer to as "missing" births – by the month of birth and likely month of conception. These data show a clear dip in births over the seven-month window between November 2019 and May 2020. The largest drop in births occurred in January 2021, which corresponds to a drop in conceptions in April 2020. Collectively, these deviations total 97,000 fewer births, or 4.4 percent fewer births compared to the same months a year earlier (2.18 million births).[11] An F-test on the coefficients on the seven-month indicators indicates that they are collectively statistically different from zero ($p < 0.01$).

These missing births comprise some births that would have been conceived in the months immediately after the onset of the US COVID-19 pandemic, reflecting behavioral responses. Some of the missing births are attributable to conceptions that would have occurred before the March 13, 2020 declaration of a US emergency. While some of these might reflect a behavioral response on the part of individuals who were closely monitoring the international emergence of COVID and decided to postpone pregnancy, others likely reflect altered pregnancy outcomes, as well as a decline in the number of foreign-born pregnant women who entered the US. We investigate these various explanations below.

b. Missing births to foreign-born women

In this section, we estimate the number of missing births to native-born and foreign-born women separately, with an eye toward estimating how much of the overall baby bust was driven by a reduction in the number of women of childbearing age in the US. The bottom panel of Figure 1 plots the two trends. The data show a baby bust of 60,000 missing births among native-born women and 37,000 missing births among foreign-born women for the 7-month period August 2020 to February 2021 (corresponding to conceptions between November 2019 and May 2020).[12] These declines represent 3.6 percent of the 1.69 million births to native-born women and 7.4 percent of the 495,000 births to foreign-born women in the same calendar months in the

[11] This result is directionally consistent with, though smaller in magnitude, than the prediction made Wilde, Chen, and Lohmann (2020). They used data on Google searches for fertility related terms during the COVID-19 pandemic to predict changes in aggregate fertility rates in the United States at the state level through February 2021. They predicted that US birth rates would drop by about 15 percent between November 2020 and February 2021. In Kearney and Levine (2020b), we predicted a drop of 8 percent (300,000 births over a longer period of time).

[12] These estimates are comparable to those in Bailey, et al. (2022), who emphasize that the initial drop in births was proportionately larger for foreign-born than native-born women.

prior year. F-tests indicate the collective drop in births over this period is statistically significant at least at the 5 percent level for each group. The reduction in births among foreign-born women could be attributable to either reduced immigration or a reduction in births among foreign-born women who had already been living in the US.

To gauge how much of the reduction in births likely reflects a reduction in births to recent immigrants, we use data from the US Census American Community Survey (ACS). We estimate the number of children of age 0 or 1 whose mothers were born outside the US and entered the US the preceding year. We conduct this exercise using data from 2016 through 2019 and 2021, reflecting the number of infants born to women who report entering the US in 2015 through 2018 and then in 2020.[13]

Figure 2 reports the tabulations. There were around 21,400 infants born to mothers who entered the country in 2020 compared to an annual average of about 42,700 infants born to women who entered country between 2015 and 2018. The difference between these numbers suggests that there were 21,300 missing births attributable to the COVID-related reduction in immigration. We reported above that the COVID pandemic period was associated with a reduction of 37,000 births to foreign-born women. Combining these estimates suggests that there were 15,700 missing births among foreign born women who were already living in the US. They would have experienced the same economic and public health conditions as native born women (though perhaps to different degrees, given that the pandemic affected different population groups differently).

c. ***Fewer prenatal care visits during the Baby Bust period***

[13] We omit data from the 2020 ACS because of concerns regarding data quality for the surveys conducted during the pandemic (Shin, 2021).

For women who were pregnant when the COVID pandemic hit, the public health crisis affected their subsequent pregnancy care and experience. Researchers have found evidence of an increase in miscarriages or still births (Sacinti, et al., 2021; and Molina, et al., 2022) and a delay in birth timing (Dench, Joyce, and Minkoff, 2022) associated with the US COVID pandemic. In this section, we provide evidence that women who were already pregnant when the COVID pandemic hit had fewer prenatal care visits during their pregnancy. This constitutes indirect evidence in support of the hypothesis that restricted health care access during the pandemic might have led to altered pregnancy outcomes resulting in fewer live births. This could have happened if, for instance, women with high-risk pregnancies were not seen by their doctors and health-affirming precautions or provisions were therefore not taken.

Figure 3 plots the average number of total prenatal care visits associated with a live birth, by month of conception (and month of birth). This information is obtained from Vital Statistics birth records for all live births. There is a noticeable drop in the average number of total prenatal visits for births that occurred between April 2020 and December 2020. This is consistent with the notion that women who experienced pregnancy during the pandemic received less pre-natal care in person. We speculate that this might have contributed to excess pregnancy loss and could thus be a partial explanation for the observed reduction in live births.

d. A Rebound in Births

After the initial baby bust period, the next 7 months exhibit a clear rebound in births. Our estimates imply that there were 31,000 "excess" births in the months of March 2021 through September 2021, corresponding to conceptions from June 2020 through December 2020. This rebound is ongoing at the time of our analysis. So far, these additional births offset around one-third of the earlier baby bust.

One important reason why fertility rates might have recovered so quickly is that the unemployment rate fell from a high of 14.7 percent in April 2020 to 6.9 percent by October. To examine whether the exceptionally short duration of the COVID induced recession potentially explains the quick rebound of fertility rates, we consider whether the estimated relationship between fertility rates and the unemployment rate was of a similar magnitude during the COVID recession as during previous recessions. We estimate the relationship between births and the unemployment rate, separately for the COVID recession and each of the three preceding recessions: 1991, 2001, and 2008/09.[14] We find that the responsiveness of births to the unemployment rate was similar in each of these recessions, including the COVID recession. Appendix Figure 1 tabulates the results. The finding of a sizable, robust negative link between the unemployment rate and the fertility rate during the rebound period of June 2020-December 2020 suggests that the shortened recession period contributed to the quick rebound in fertility rates. The data indicate that fertility rates were similarly responsive to the unemployment shock in the pandemic recession as during other recessionary periods.

In the next section we continue to probe on state variation in the magnitude of the baby bust and rebound and contextual factors to explore how additional economic and social factors affected fertility rates during the US COVID pandemic.

IV. State Variation in the Magnitude of the COVID Baby Bust and Rebound

In this section, we analyze monthly birth patterns at the state level. For each state, we calculate the predicted number of births in each month of 2019 and 2020, using the same

[14] For the 1991, 2001, and 2008/09 recessions, we estimate annual, state-level fertility rates (dated by likely month of conception) for the three years before and after each recession: 1988-1994, 1998-2004, and 2005-2012. We then estimate regression models relating these birth rates to annual, state-level unemployment rates, along with state and year fixed effects. The coefficient on the unemployment rate provides an estimate of the cyclical sensitivity of births to labor market conditions in each of these recessions. For the COVID period, we do not have post-recession data, so we instead use data from 2017-2020.

methodology in our analysis of national level data above. The calculation of the predicted number of births statistically accounts for pre-existing state-level linear trends and seasonal (monthly) variation in births using the following:

$$(a) \quad Predicted\ births_{smy} = \beta_{0s} + \beta_{1s}\sum_{m=1}^{12}\sum_{y=2019}^{2020}\gamma_{smy} + \beta_{2s}trend + \gamma_{sm} + \varepsilon_{smy}$$

$$(b) \quad Missing\ births_{smy} = Births_{smy} - Predicted\ births_{smy} \qquad [2]$$

The notation is as it was in Equation 1, with the addition of a subscript *s* for states. Equation 2a is estimated with 51 separate state level regressions (for the 50 US states plus the District of Columbia). For each state, the size of the baby bust is calculated as the difference in actual and predicted births, aggregated across the months of August 2020 and February 2021 (corresponding to conceptions from November 2019 through May 2020). We calculate the magnitude of the rebound in each state by totaling up the difference in actual and predicted births between June and December of 2020. In this state-level analysis we take an additional step to scale the size of both the COVID baby bust and rebound by the number of births in the state in November 2018 through May of 2019. This scaling facilitates a comparison across states, adjusting for differences in baseline birth counts, which differ greatly across states with different population counts.

Table 1 provides baby bust and rebound estimates for the 10 most populous states, which are more statistically reliable than those for smaller states. We report the absolute value of the size of the bust for expositional expediency; for example, a bust of 1,000 means that births fell by 1,000. The largest baby bust in percentage terms was in New York, where the birth deficit was 8.3 percent relative to the January through May 2019 birth count. This corresponds to a bust of 10,800 births that would have been conceived between November of 2019 and May of 2020 in

New York, which was the epicenter of the pandemic at its outset. The largest absolute baby bust occurred in California – 13,00 births – which is 5.0 percent of the state's birth count in the baseline period. California also had significant, early COVID exposure and is the state with the most births overall.

Map A in Figure 4 displays the relative magnitude of the changes in births during the bust period (Map A). Many of the states that experienced larger relative baby busts were those where the pandemic struck severely and quickly at the outset of the pandemic. The 10 states with the greatest COVID infection rates included New York, New Jersey, Connecticut, Massachusetts, the District of Columbia, Rhode Island, Louisiana, Michigan, Maryland, and Illinois. The baby bust in all those states and D.C. was at or above average except for Louisiana.[15] Figure 5 presents a scatter plot relating the size of the baby bust to the cumulative COVID caseload rates per 1,000 population, calculated based on data available from USAFACTS (2022) through the end of May 2020. There is a clear positive association between a state's cumulative COVID caseload and the extent of the COVID baby bust.

Map (b) in Figure 4 shades states by the size of their rebound, in percentage terms scaled by state birth counts in the baseline period. States in which the baby bust was larger tended to experience a larger rebound in births. The population-weighted correlation between the size of the bust and the rebound is 0.62. This reasonably high correlation suggests that at least part of the rebound in births is attributable to delayed births that were conceived later in the year. We examine the role of other factors below.

[15]Although DC is not displayed on the map, its bust was 6.2 percent of its baseline number of births.

V. HOW STATE SPECIFIC CONDITIONS RELATE TO THE SIZE OF THE BABY BUST AND REBOUND

a. Methods, Data, and Hypotheses

In this section we statistically explore determinants of the size of a state's baby bust and rebound. We begin by estimating ordinary least squares (OLS) regression models relating the natural log of the fertility rate during the baby "bust" period (August 2020 through February 2021, corresponding to conceptions from November 2019 through May 2020) to three explanatory factors, motivated by the conceptual framework described above: the state unemployment rate, state-level COVID cases per capita, and a measure of household spending. These explanatory variables are assigned to the month and year of birth based on the date of likely conception. Appendix Table 1 reports the national averages of the fertility rate by month of conception along with monthly values of each explanatory variable used here and in the subsequent analysis of the rebound period.[16] These regression models also control for state fixed effects.

We estimate analogous models during the baby "rebound" period (June 2020 through December 2020) relating fertility rates to the same three explanatory factors, plus two COVID policy variables – a state-level public mask mandate in place as of July 2020 and a state requirement that schools open in-person for the 2020-21 school year (measured in July 2020). Estimating the model separately for the two periods flexibly allows the estimated relationship

[16] These national averages are constructed by weighting state level data by the population of women between the ages of 15 to 44 in each state, not by the total population. These constructed averages might therefore not match population weighted averages reported elsewhere.

between the explanatory factors and fertility rates to be different during the earlier and later parts of the year. More formally, the models we estimate take the form:

Bust Period: January 2020 to May 2020

$$ln(fertility\ rate)_{smy} = \beta_0 + \beta_1 \cdot URate_{smy} + \beta_2 \cdot Caseload_{smy} + \beta_3 \cdot Spending_{smy} + \gamma_s + \varepsilon_{smy}$$

[3]

Rebound Period: June 2020 to December 2020

$$ln(fertility\ rate)_{smy} = \beta_0 + \beta_1 \cdot URate_{smy} + \beta_2 \cdot Caseload_{smy} + \beta_3 \cdot Spending_{smy} + \beta_4 \cdot Masks_{smy} + \beta_5 \cdot Schools\ Open_{smy} + \gamma_s + \varepsilon_{smy}$$

In the estimated regressions, each observation is a state-by-month observation (7 months and 51 states, including DC, resulting in 357 observations in each of the two periods). The regressions are weighted by the 2020 population of women between the ages of 15 and 44 in each state. This enhances the statistical precision of the model and yields a population-level estimate of the relationship between explanatory factors and the change in fertility rates.

Data on state unemployment rates come from the U.S. Bureau of Labor Statistics (2022b). Our measure of state-level COVID exposure is cases per thousand population, aggregated between March and May of 2020, obtained from USAFACTS (2022). We use a state-level measure of household spending tracked since the pandemic began by Opportunity Insights (described in Chetty, et al., 2020) in its "Economic Tracker" tool (https://trackthe recovery.org/). These spending data are based on credit- and debit-card spending and reflect changes in spending levels relative to January of 2020 (i.e. the January 2020 value is zero and a value of -0.265 in

April indicates that spending was 26.5 percent lower in April than in January).[17] Mask mandate policies effective as of July 2020 are obtained from Harring (2021). We obtained data indicating which states had a statewide mandate for K-12 schools to be open in the 2020-2021 academic year, recorded as of July 2020, from EducationWeek (2020).

We hypothesize that births should fall with a higher unemployment rate, a higher count of COVID cases, and larger declines in household spending. The link between fertility rates and labor market conditions was discussed above. A larger COVID caseload is expected to lead to a greater reduction in births to the extent that the public health crisis (as captured by the caseload) affected things like access to health care or general life anxiety (although reduced access to family planning services, particularly for women from lower-income households, might lead to increases in births). A larger decline in household spending might be associated with a larger reduction in births because it would reflect greater financial strain, less confidence in the economic recovery, and/or more restricted activities. The presence of a mask mandate may be linked to fewer births if it reflects greater social anxiety associated with the pandemic. Mandated school opening policies might do the opposite. It is an empirical question as to how much of these relationships are mediated by the others.

b. The Bust Period

The top panel of Table 2 reports the results of these state-by-month level regressions for the baby bust period. Model 1 yields a statistically significant negative estimate of the relationship between the unemployment rate and fertility rate. This is consistent with the well-documented pro-cyclicality of fertility rates. The estimated coefficient on the unemployment rate

[17] These data show that national spending plunged in March and April before recovering completely by the end of 2020. Note that these statistics are based on credit and debit-card receipts, which may not accurately reflect all forms of spending.

suggests that a one percentage point increase in the unemployment rate is associated with a 0.86 percent reduction in the fertility rate. This relationship is comparable in magnitude to what we reported earlier regarding the cyclicality of births.

Model 2 includes the measure of cumulative reported COVID caseloads per capita. As expected, states with greater COVID exposure during the bust period experienced a greater decline in their fertility rates.[18] The coefficient on the unemployment rate is attenuated somewhat in this specification. This suggests that some of the estimated relationship between the unemployment rate and fertility rates in model 1 is capturing the public health effect of the pandemic recession, independent of labor market conditions.

Model 3 additionally includes the measure of household spending. The estimated coefficient on this spending measure indicates a statistically significant, economically important positive relationship between household spending and fertility rates. Furthermore, the estimated effect of the unemployment rate is attenuated in this model. We interpret this pattern as suggestive evidence that the link between aggregate economic conditions and fertility rates is driven by reduced household income or expected income and the larger the reduction in household spending/income in a state, the larger their baby bust.[19]

c. The Rebound Period

Table 2 panel (b) reports the estimated coefficients from analogous OLS models estimated during the rebound period. The estimated relationship between the unemployment rate

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[18] We also tested the sensitivity of our results to using COVID hospitalization rates rather than COVID caseload rates. The correlation between the two measures in the bust period is low (under 0.2) and the hospitalization rate is not significantly related to births. This disparity may occur because public perceptions are more likely to be affected by the number of cases reported. In the rebound period, the correlation across measures is reasonably high (around 0.5) and using either measure yields similar results.

[19] A working paper by Dettling and Kearney (2023) tests this relationship directly by examining the mitigating effect of unemployment insurance replacement rates on the link between unemployment rates and birth rates during the period 2000-2019. They similarly find that the negative effect of aggregate unemployment rates on fertility is driven by individual income loss, not temporal substitution of birth timing (as some life-time models of fertility posit.)

and fertility rates is considerably larger during the rebound period than during the bust period. This suggests that the recovery of the unemployment rate during the second part of 2020 was a meaningful contributor to the rapid turnaround of the COVID baby bust.

The estimated relationship between COVID caseloads and fertility rates was very different in the rebound period than it was during the bust period. The coefficient estimates turn positive during the rebound period. This suggests that COVID caseloads did not lead to the same types of behavioral changes in the later half of the year as during the first half of the year, at least not in all states. One plausible interpretation of this pattern is that in states where individuals more quickly returned to "normal life," both COVID caseloads and birth rates increased.

Model 3 adds our measure of household spending to the regression equation. The estimates indicate that household spending is positively and statistically significantly related to fertility rates, as it was during the bust period. As was the case for Model 3 in the bust period, including spending in this model somewhat attenuates the estimated relationship with the unemployment rate. Model 4 yields a negative point estimate on the state mask mandate policy. This is consistent with the conjecture that places with a state-wide mask mandate tended to have more public anxiety and social restrictions around COVID which we hypothesized would be associated with a smaller birth rebound. The estimated effect of the school opening mandate is not statistically significant.

VI. Conclusion

The US Covid pandemic of 2020 brought about an initial baby bust, followed by a birth rebound. The onset of the pandemic in March 2020 led to a statistically significant reduction in births between August 2020 and February 2021, driven by reduced conceptions and a reduction in live births that were conceived in the months before the pandemic. The reduction in pregnancies and births reflect the impact of economic, social, and public health factors. Consistent with past theory and evidence, a rise in the unemployment rate and a drop in household spending is associated with a sizable drop in conceptions. Uncertainty and fear around the initial rise in COVID caseloads amplified these economic effects. In addition, restricted access to in-person health care during the pandemic resulted in fewer pre-natal visits for pregnant women, which might have led to an increase in late-term miscarriages. Restricted immigration during the pandemic contributed to less entry of foreign-born women and an associated drop in births to foreign-born women.

Our empirical analysis further suggests that the rapid recovery of the labor market, along with a resumption of household spending (driven in part by an unprecedented multitrillion-dollar government policy response that bolstered household balance sheets) are related to the rapid rebound in fertility rates.[20] Early in the pandemic, states with relatively large COVID caseloads experienced the largest relative declines in births. Our empirical analysis finds that by the summer of 2020 and the remainder of that year, that relationship reversed. One possible explanation is that the psychology of the pandemic shifted over time. It seems that in some states, people were less anxious after COVID had been circulating for many months and more open to getting pregnant, despite caseload counts. The fact that states which instituted mask mandates had a smaller rebound in births suggests that those locations where COVID anxiety was still greatest continued to experience lower fertility rates.

Looking beyond the analyses of this paper, we note that the size of the COVID baby bust and rebound pales in comparison to the longer-term decline in US births (Kearney, Levine, and

[20] Our analysis is based on 2021 birth data (conceptions through the end of 2020) and it is not clear that the rebound period was over at that point. Future analysis should explore whether any additional lessons can be gleaned as the pandemic wound down.

Pardue, 2022). Births have fallen by 20 percent over the last 15 years and show no signs of reversing. Births in the U.S. have now fallen well below replacement levels, a situation that has existed in other developed countries for the past few decades. Such low levels of fertility have the potential to affect economic growth, the solvency of social insurance programs, and other economic and social outcomes going forward. That demographic trend is much more consequential to society than the temporary baby bust and rebound associated with the COVID pandemic.

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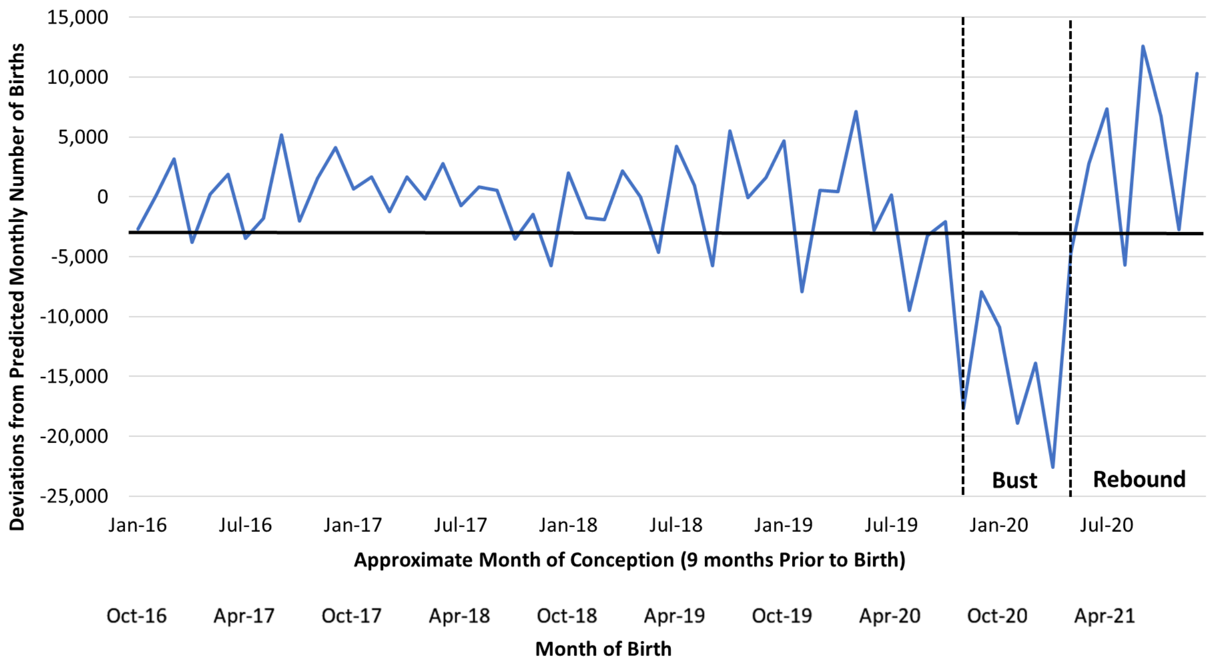
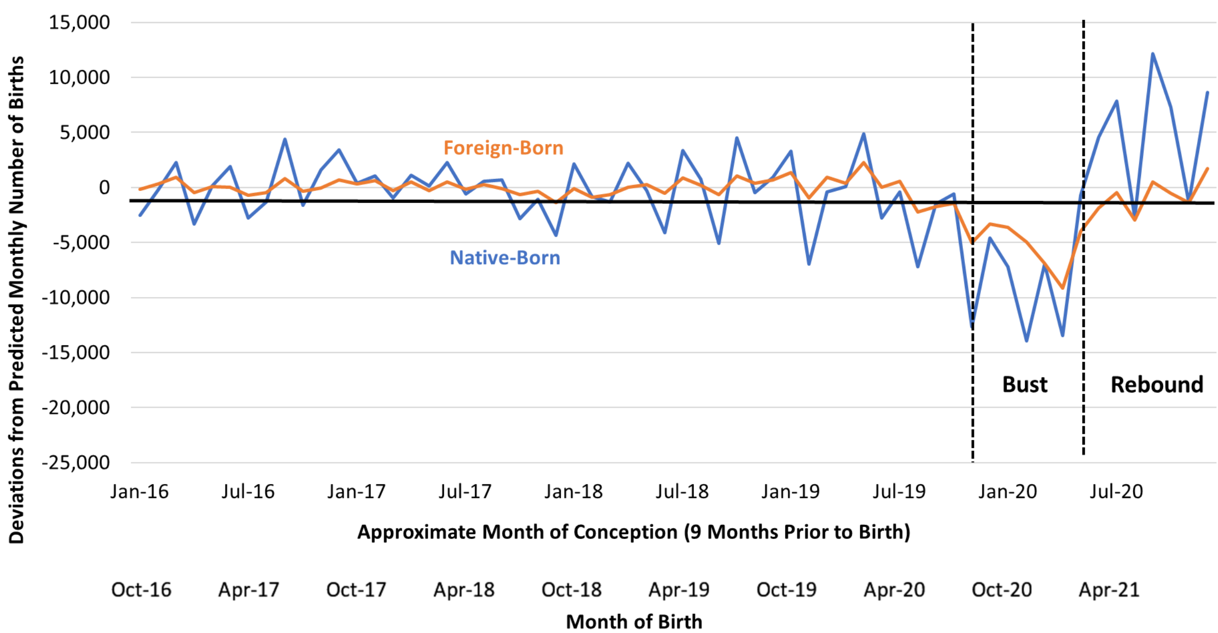
Figure 1: Deviation from Predicted Monthly Births, by Month of Conception

All Births

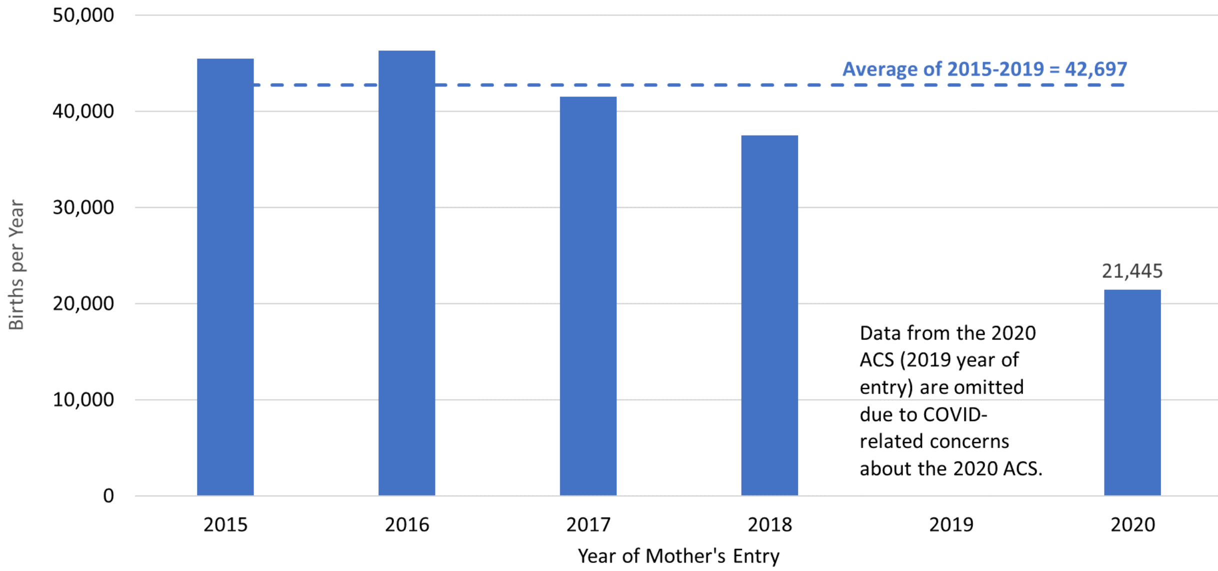


Births by Mother's Nativity



Notes: Predicted monthly birth rates are based on detrended and de-seasoned monthly birth rates using data on births by months of conception from January 2016 through December 2020 (births between October 2016 and September 2021).

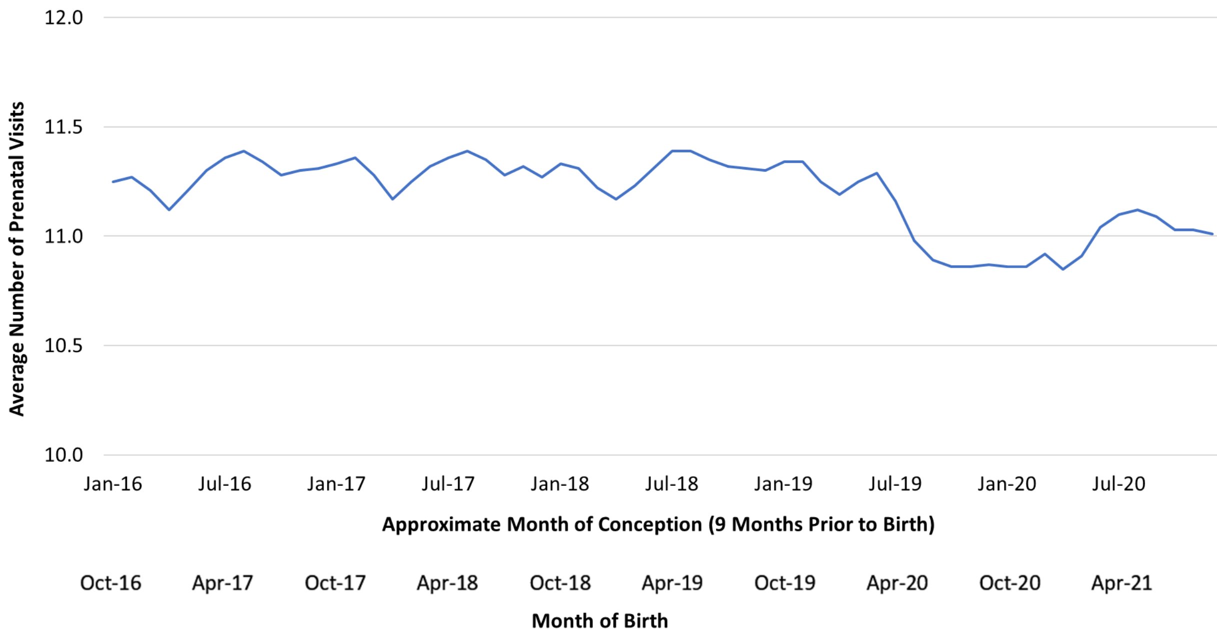
Figure 2: Births to Recent Immigrants



Source: Authors' calculations from American Community Surveys.

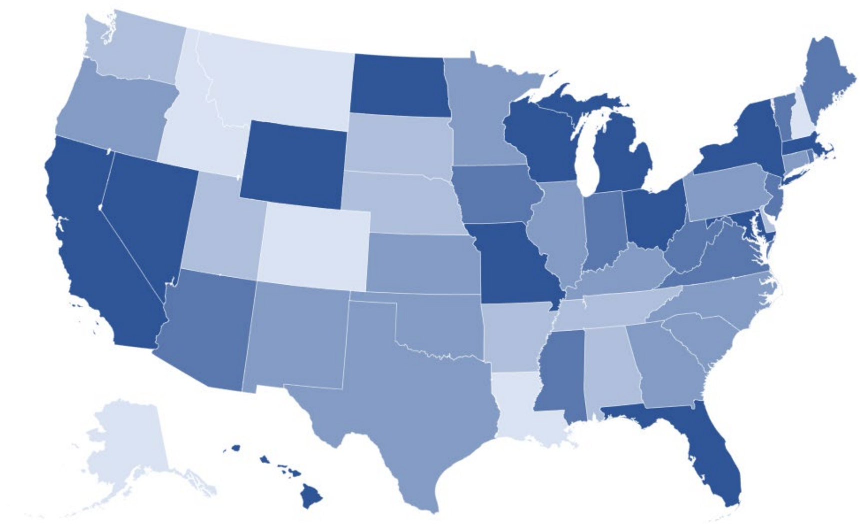
Notes: Births are recorded based on a child's age of 0 or 1 in an ACS survey year in which the mother reported entering the country the preceding year.

Figure 3: Average Number of Total Prenatal Care Visits during Pregnancy, among Women with a Live Birth, by Month of Conception



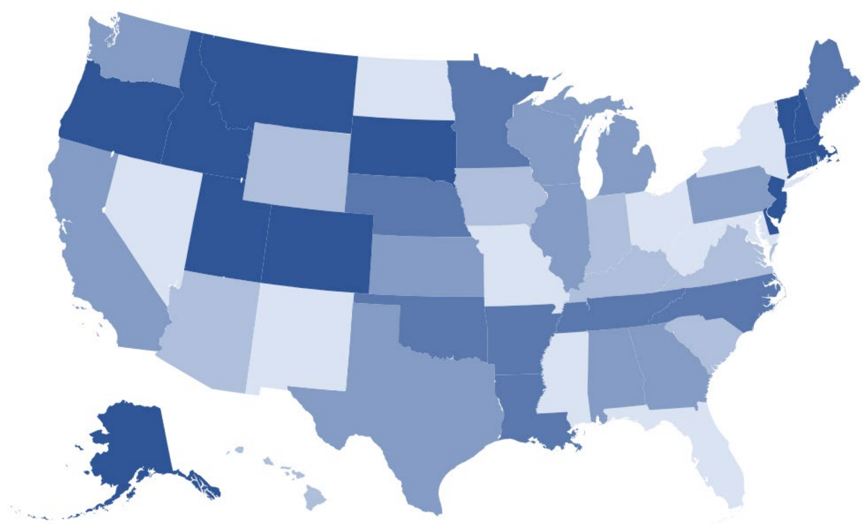
Source: CDC Wonder

Figure 4: Size of COVID-19 Baby Bust and Rebound, by State



Map A: Bust (in absolute value)

> 5% > 4% > 3% > 2% < 2%

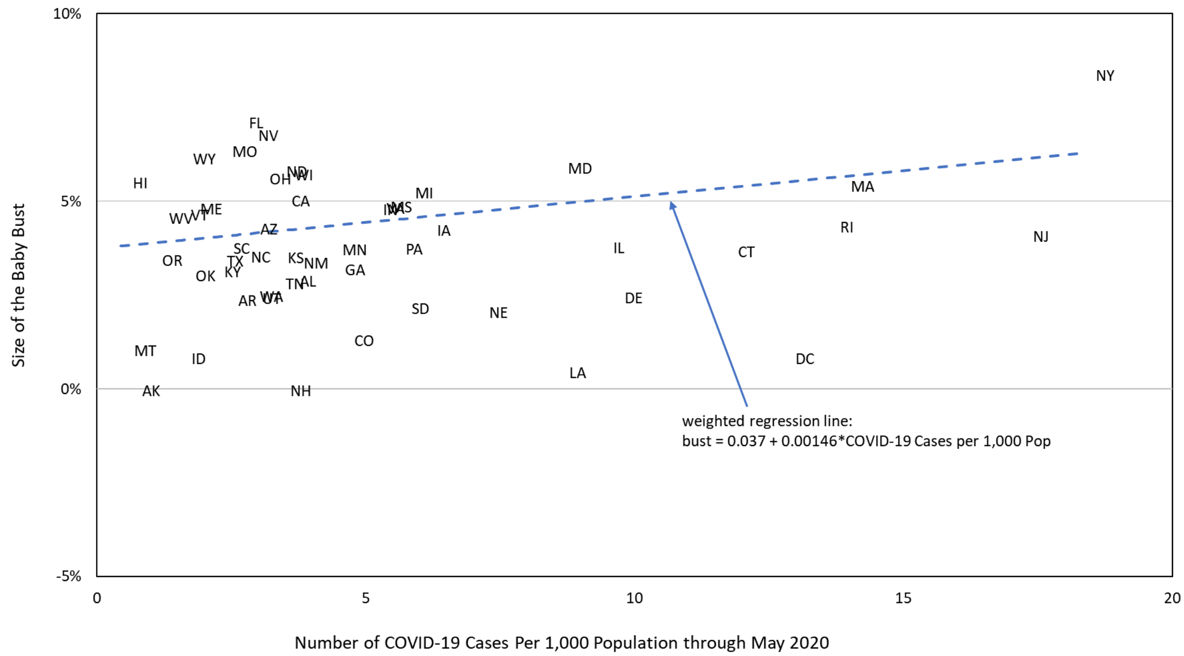


Map B: Rebound

> 4% > 2% > 1% > 0% < 0%

Notes: The relative size of the COVID-19 baby bust (rebound) is measured as the reduction (increase) in births between November 2019 and May 2020 (June and December, 2020) relative to a baseline number of births taken from November 2018 through May 2019. Each measure is estimated using the state-level analog of the methodology used in the construction of Figure 1.

Figure 5: COVID-19 Caseload through May 2020 and the Size of the Baby Bust



Note: The size of the baby bust is the absolute value of the birth rate decline (in percentage terms) attributable to COVID-19.
Sources: COVID-19 caseload statistics are from USAFACTS (2022).

Table 1: Size of COVID-19 Baby Bust and Rebound in the 10 Highest Birth States and in the United States

State	Baseline Births	Baby Bust	Baby Bust Rebound	Bust as % of Baseline Births	Rebound as % of Baseline Births
New York	128,511	10,752	-753	8.4%	-0.6%
Florida	130,643	9,278	-181	7.1%	-0.1%
Ohio	77,689	4,353	-1,388	5.6%	-1.8%
Michigan	61,901	3,240	800	5.2%	1.3%
California	259,425	13,005	3,618	5.0%	1.4%
Illinois	80,306	3,035	1,088	3.8%	1.4%
Pennsylvania	77,538	2,903	968	3.7%	1.2%
North Carolina	69,587	2,446	1,671	3.5%	2.4%
Texas	223,742	7,636	4,263	3.4%	1.9%
Georgia	74,622	2,373	1,492	3.2%	2.0%
United States	2,182,344	96,603	31,391	4.4%	1.4%

Notes: Column definitions are as follows: Baseline = births conceived between November of 2018 and May of 2019; Bust = the estimated missing number of births conceived between November of 2019 and May of 2020 (note: positive values reflect declines in births); Rebound = the estimated number of surplus births conceived between June and December of 2020. Source: Authors' calculations based on CDC birth data for births conceived between January 2016 and December 2020 (births between October 2016 and September 2021).

Table 2: OLS Relationship between State-level Factors and Birth Rates in the COVID-19 Baby Bust and Rebound Periods

(a) Bust Period (Conceived between November 2019 and May 2020)

	Model 1	Model 2	Model 3
Unemployment Rate	-0.857	-0.628	-0.309
	(0.061)	(0.070)	(0.094)
Covid Cases per 1,000 population		-1.321	-0.781
		(0.222)	(0.241)
Spending Relative to Jan 2020			24.723
			(5.072)

(b) Rebound Period (June 2020-December 2020)

	Model 1	Model 2	Model 3	Model 4
Unemployment Rate	-1.976	-1.666	-1.023	-1.483
	(0.160)	(0.174)	(0.203)	(0.212)
Covid Cases per 1,000 population		0.148	0.174	0.171
		(0.037)	(0.036)	(0.034)
Spending Relative to Jan 2020			44.139	58.658
			(7.976)	(8.046)
Mask in Public Mandate				-4.514
				(0.958)
Schools Open Mandate				-1.671
				(1.163)

Sources: Author's calculations based on various data sources:
Births: Vital Statistics birth data from US Center for Disease Control
Unemployment Rate: US Bureau of Labor Statistics
COVID Cases per 1,000 population: USAFACTS (2022)
Spending Relative to January 2020: Opportunity Insights, Economic Tracker
Mask Mandates: Harring (2020)
Schools Open Mandate: EducationWeek (2020).

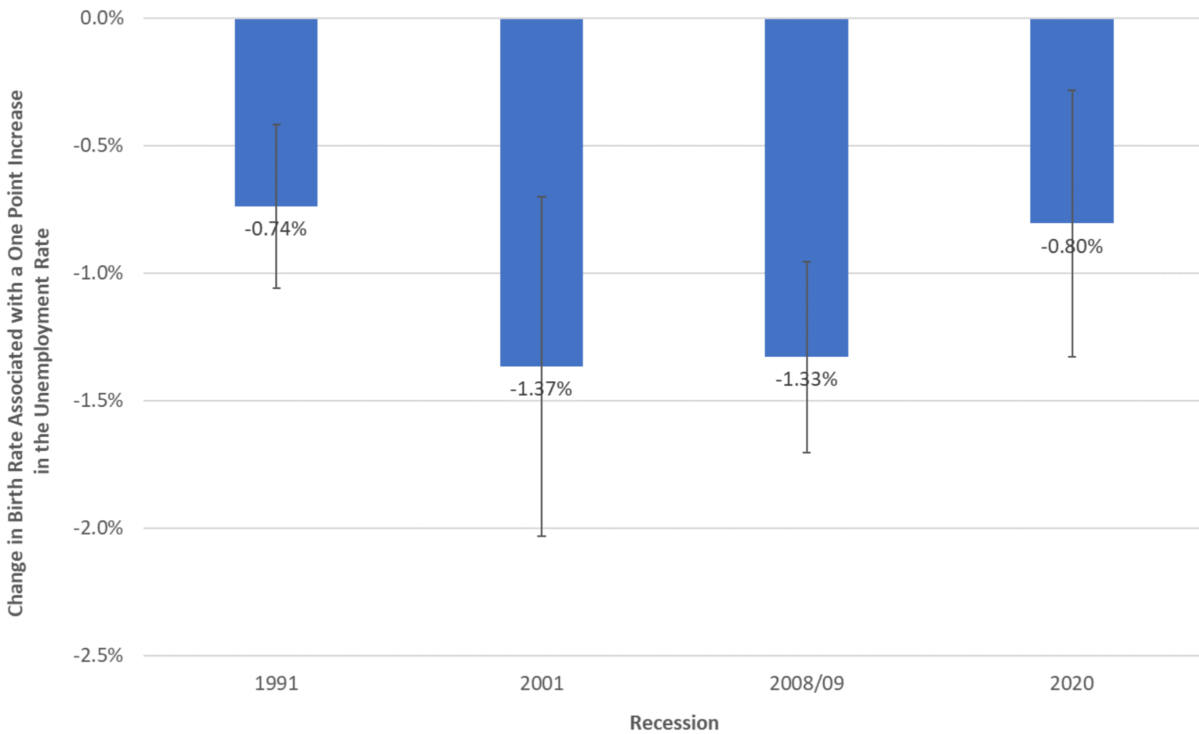
Notes: The dependent variable is measured in natural logs. All regression models include state fixed effects and are weighted by the 2020 population of women between the ages of 15 and 44. All coefficients are multiplied by 100.

Appendix Table 1: National Trends in Births and Other Factors, by Month of Conception in 2020

2020 Month of Conception	Birth Rate	Unemploy-ment Rate	COVID Cases per 1,000 Pop.	Spending Relative to January	Percent with Mask Mandate (7/2020)	Percent with School-Open Mandate (7/2020)
1	5.22	3.8	0.0	0.5%		
2	4.83	4.1	0.0	-0.6%		
3	4.96	14.6	0.6	-10.8%		
4	4.73	13.0	2.6	-26.5%		
5	4.55	11.2	2.2	-15.3%		
6	5.17	10.2	2.7	-9.4%		
7	5.01	8.7	5.9	-7.0%	67.9%	38.3%
8	5.14	7.9	4.2	-4.9%	67.9%	38.3%
9	5.36	7.2	3.6	-3.4%	67.9%	38.3%
10	5.57	6.9	5.6	-2.4%	67.9%	38.3%
11	5.63	6.8	13.5	-3.6%	67.9%	38.3%
12	5.54	6.5	19.4	-3.2%	67.9%	38.3%
Total	5.14	8.4	5.0	-7.2%	67.9%	38.3%

Notes: all estimates reflect national means from state-level data weighted by the size of the female population between the ages of 15 and 44 (the appropriate weight for the birth rate). They may not exactly match national means weighted by the size of the full population.

Appendix Figure 1: Cyclical Responsiveness of Births to Recessions



Source and Notes: Authors' calculations based on annual, state-level birth rates (dated by month of conception) in the three years before and after the recession. No post-recession data is available for the 2020 recession.