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FERTILITY IN THE HEART OF THE COVID-19 STORM

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ABSTRACT

We describe how the COVID-19 pandemic affected reproductive choices in New York City, the most acutely impacted area of the United States. We contrast changes in New York City with reproductive outcomes in the rest of the US. We find that births to New York City residents fell 8.4% more between March, 2020 and February 2021 than that would have been expected given trends leading up to the pandemic. Births to US-born residents of New York City fell 5.5% over the same year, triple the observed decline in the rest of the US. Births to foreign-born New York City residents fell 11.4%, twice the decline observed in the rest of the US. Reported induced abortions to New York City residents fell precipitously whereas induced abortions nation-wide rose slightly. The acute downturn and robust recovery in births in New York City maps closely with the spike in mortality and its equally rapid decline three months later. We conclude that the fear and uncertainty in the early months of the pandemic is the best explanation for the sudden, but brief drop in births in New York City.

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Introduction

The COVID-19 pandemic caused an unprecedented increase in deaths to New York City residents in the spring of 2020 relative to both national rates of death, and New York City rates in prior years (Samuel, Zhenqiu Lin, and Carlos del Rio 2020). In April of 2020, the all-cause mortality rate was over three times greater in New York City than in the rest of the US while the COVID-19 death rate was 18 times greater (Figure 1a and 1b). The pandemic had a similarly dramatic effect on economic activity. In May of 2020, the unemployment rate in New York City peaked at 21.0 as compared to 14.7 percent nationally. [1] In this study we examine the change in birth and abortion rates to New York City residents in the wake of the COVID-19 pandemic.

The pandemic may have affected reproductive choices in several ways. First, there is an extensive literature that documents the association between economic downturns and decreased birth rates (Sobotka, Skirbekk and Philipov 2011; Macunovich 1996; Cherlin et al. 2013; Currie and Schwandt 2014; Schneider 2015; Schneider and Hastings 2015; Gemmill and Hartnett 2022). Whether the short-term decline in birth rates affect total fertility rate remains an open question (Cherlin et al. 2013; Currie and Schwandt 2014; Aassve et al. 2020; Gemmill and Hartnett 2022). Second, studies have demonstrated that health shocks such as the Ebola epidemic in Liberia in 2014, the Zika virus in Brazil in 2016, and the 1918-19 flu pandemic can depress conception rates almost immediately followed by a rebound when the perceived risk has abated (McBain et al. 2016; Castro et al., 2018; Marteleto et al., 2020; Rangel et al., 2020; Boberg-Fazlic et al., 2021). In the US, initial forecast of the size of the likely "baby-bust" due to COVID-19 was as high as half a million fewer births (Kearney and Levine, 2020). The anticipated bust in fertility was based on the association between fertility and unemployment as well as the severity of the health shock. But the "baby-bust" never materialized. As more data become available the initial decline of 62,000 births nationally gave way to almost an equivalent rise of 51,000 births. Researchers estimated a net decrease of only 11,000 births 18 months after the pandemic (Kearney and Levine (KL), 2022). The authors attributed the rapid

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rebound in births to the rapid decrease in unemployment, government transfer payments and declining cases of COVID-19.

In New York City, the epicenter of the pandemic in the US in Spring 2020, the fall in births was substantial. A recent report found that births fell 18.9% among ten New York City hospitals from December 2020 to February 2021, and 13.4% among four hospitals on Long Island, NY (McLaren, 2021) compared to the same months in the previous four years. In a study of all 50 states, researchers estimated that births to New York State residents fell 7.7% in between January-May of 2020, as compared to a 4% decline nationally (Kearney and Levine 2022).

Other researchers have cast doubts on a "baby-bust." They point to the decline in births to foreign-born women relative to US-born women prior to the onset of the pandemic. They conclude that the observed decline in births resulted primarily from decreased immigration that began before the pandemic and which intensified in its wake. The decline was followed by a large increase in fertility in 2021, suggestive of a baby-bump rather than a baby-bust (Bailey, Currie and Schwandt (BCS), 2022).

In this analysis, we explore how the COVID-19 pandemic affected reproductive choices in New York City, the most acutely impacted area of the United States. Specifically, we analyze whether the combined effect of economic contractions, fear of illness and public health measures to contain the pandemic affected decisions to conceive, to terminate or to leave the City to give birth. New York City provides a unique setting from which to sort out whether the observed changes in fertility represented a behavioral response to the economic and public health conditions brought on by the pandemic or whether the decline in births was due to changing patterns of immigration to, or emigration from, NYC. First, the economic and health shocks to the City were much larger and more precipitous than those in the rest of the US. Second, New York City historically has been a major entry point to the US for foreign nationals. Forty-nine percent of all births in New York City in 2019 were to foreign-born women. If decreased immigration and not the pandemic were driving the decrease in birth rates, then we should observe little deviation from trend in birth rates among US-born women. Third, we have data on induced terminations of pregnancies and can examine whether the decline in births may be related to changes in induced abortions (Bailey, Bart and Lang 2022). Fourth, we

use the difference between the date of birth and the length of gestation to describe births by month of conception. Conceptions resulting in live births are an additional way to map the timing of the pandemic to reproductive choices. Finally, we stratify both births and induced terminations by whether they were publicly or privately financed to assess whether reproductive responses to the pandemic varied by a broad measure of socioeconomic status.

We find that births to New York City residents fell 8.4% more between March, 2020 and February 2021 than that would have been expected given trends leading up the pandemic. Births to US-born residents of New York City fell 5.5% over the same year, triple the observed decline in the rest of the US. Births to foreign-born New York City residents fell 11.4%, twice the decline observed in the rest of the US. But births quickly bounced back in 2021 consistent with trends in previous health crises. Despite the "baby-bump," births to US-born New York City residents remained 3.0 % below trend in the second year of the pandemic (March 2021-December 2021) while births to foreign-born New York City residents remained 4.9% below trend over the same period. These patterns contrast with the rest of the US in which the 3.3% rise in births among US-born women from March to December, 2021 exceeded the decline (-1.8%) from the previous 12 months. We agree with BCS (2022) that the decline in births beginning in April of 2020 reflects events related to conceptions that clearly preceded the pandemic (i.e., either fewer pregnant people in NYC for reasons such as inability to immigrate, or decisions not to carry to term [abortion]). Nevertheless, the sharp deviations from trend after October of 2020 point to changes in reproductive choices associated with the pandemic. For instance, births to New York City residents that were privately financed did not deviate from trend until November of 2020. When we plot these same births by month of conception, the abrupt drop in conceptions occurs in March of 2020. Other changes point to sudden responses to the pandemic. The percent of births to New City residents delivered outside the City jumped from 6 to 12 percent of births in April and May of 2020 and was concentrated among more affluent, US-born women.

Finally, we report a steep drop in induced terminations of pregnancy at the onset of the pandemic. This would tend to increase births if the pandemic limited access to reproductive services. However, the decline is also consistent with fewer conceptions (Lindberg et al. 2021). All totaled, the precipitous drop in births in New York City in the early phase of the pandemic

and its rapid rebound is consistent with the parallel spike in deaths and economic shutdown due to COVID-19. The large drop in births among foreign-born residents of New York City most likely reflects decreases in immigration that preceded the pandemic as well as travel bans along with response to the health and economic shocks that rocked New York City in the early phase of the pandemic.

II. Methods

Data

We use data on births, deaths and induced terminations of pregnancies (ITOPs) from the Centers for Disease Control and Prevention (CDC) and the New York City Department of Health and Mental Hygiene (DOHMH). We use the population of women 15 to 49 to compute birth rates and we use the number of births to US and foreign-born women as outcomes given the lack of appropriate denominators.

1.   Births

Births are from two sources. We use births data compiled by the CDC as they record births by place of mother's residence regardless of where they occurred. We stratify the analyses by nativity and method of finance (publicly or privately funded). We use births from New York City's DOHMH along with data on births from the CDC to distinguish resident births delivered in the City from those delivered outside the City. We stratify the percent of births to New York City residents delivered outside the City by publicly and privately financed births.   For births delivered in New York City we code them as publicly financed if paid for by Medicaid or New York State's health insurance programs such Family and Child Health Plus. All other births are treated as privately financed. With birth data from the CDC, we categorize births financed by Medicaid as publicly financed and those financed by private insurance as privately financed. Other categories used by the CDC include self-pay, other state and local programs, and unknown method of finance. These latter categories are small in comparison to Medicaid and privately financed and are consistent across time.

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2.   *Induced termination of pregnancies (ITOPs).*

We describe changes in ITOPs to New York City residents that took place in the City. Unlike births, there is no national registry of ITOPs with which to track residents of New York City who left the city or state to terminate a pregnancy. Another limitation with the ITOPs data from New York City is underreporting. Abortion counts from New York State's abortion surveillance, which includes New York City's separate surveillance, reported 21 percent fewer abortions in 2017, 33 percent fewer in 2019 and 43 percent fewer in 2020 than the counts from the Guttmacher Institute's periodic survey of abortion providers.[2] Importantly, the Guttmacher Institute reported a decline of 6,780 abortions (5.7%) in New York State between 2019 and 2021 (Jones, Kirstein and Philbin 2022) but a 9.1 percent decline in New York City.[3] Despite these limitations, a decline in ITOPs that deviated from trend during the pandemic would suggest that changes in births may have been affected, in part, by decreased access to abortion services. We cannot rule out, however, that the decline in induced abortions reflected increased underreporting during the pandemic. Nevertheless, the Guttmacher Institute reported a one percent increase in abortions nationally between 2019 and 2020 and a five percent increase since 2017 (Jones Kirstein and Philbin 2022). Those trends are in contrast to the 9.1 percent decline reported for New City, and thus, may represent fewer abortions and not fewer reported abortions. Moreover, we can stratify ITOPs by nativity and method of finance which may offer additional insights as to whether access to reproductive services varied by socio-economic status.

3.   *Population*

        For US population data we use US Census Bureau, population estimates of the July 1, 2021 vintage using 2020 census for the years 2020 and 2021 and July 1, 2020 vintage for the years 2016-2019. For the earlier years, we use a closure of error formula to adjust for the incongruence in estimates between intercensal periods. The formula smooths the difference in

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[2] Comparisons are from the CDC's Abortion Surveillance reports (Kortsmit et al. 2021; Kortsmit et al. 2022).
[3] In personal communications, Rachel Jones of the Guttmacher Institute reported that abortions fell 9.1 percent in New York City between 2019 and 2020.

estimates that occur by adjusting the earlier periods more the closer in time they are to the 2020 census. The formula is

$$P_t = Q_t(\frac{P_{3653}}{Q_{3653}})^{\frac{t}{3653}}$$

where t is the number of days since July 1, 2010, P_t is the adjusted population estimate at time t, Q_t is the estimate at time t derived from the 2010 census, P_{3653} is the estimate for July 1, 2020 derived from the 2020 estimate and Q_{3653} is the estimate for July 1, 2020 derived from the 2010 census.

The New York City estimates come from the "2021 County and Economic Development Regions Population Estimates" by the Cornell Jeb E. Brooks School of Public Policy (Program on Applied Demographics, 2022). Data are compiled by New York City DOHMH. We use population to create birth rates to women 15 to 49 years of age. However, we lack population denominators analyses on financial coverage.

Forecasting models

We regress births, and birth rates where possible, by month of event on indicators for each month of the year and linear term from January 2016-February 2020. We use the estimated parameters to predict the outcomes over the same period. We use the same model to forecast the likely path of the outcomes through December 2021. We do the same by month of conception, but the data are from the New York City DOHMH. We estimate the fitted model through April 2019 and forecast forward beginning in May of 2019 because women who conceived in May may have left the City to deliver in March of 2020. We estimate 95% confidence intervals (CIs) around the forecasted births as two times the standard deviation of the prediction error. Actual values outside of the CIs indicate a change that is unlikely to have occurred by chance. To facilitate interpretation all estimates are adjusted for seasonality by subtracting each month's estimated coefficient and adding back the average coefficient for all months. This preserves the average of the series without having an effect on the difference between actual, fitted or forecasted values.

III. Results

1.   Changes in births and birth rates

       The decline in birth rates was much greater among New York City residents than among women in the rest of the country (Figure 2a). Birth rates of New York City residents were 22 percent below the projected trend at their trough in December of 2020, a decline roughly four times greater than the deviation observed in the rest of the US (Figure 2b). Over the twelve months from March 2020-February 2021 the sum of births to New York City residents was 8.4 percent below trend while the sum of births in the rest of the US was 2.6 percent below its expected level (Table 1). In the 10 months after February 2021, the sum of births to New York City residents remained 4.0 percent below its projected trend while the sum of births in the rest of the US was 2.5 percent above trend (Table 1).

       The decline in total births and birth rates masked large differences by nativity (BCS 2022).   Among New York City residents, the sum of births to foreign-born women fell 11.4 percent below trend in the first year of the pandemic but only 5.5 percent among US-born women (Table 1). The number of births to foreign-born residents of New York City fell below the 95% confidence interval in May of 2020 and declined more precipitously after October of 2020 (Figure 3a and 3b). The decline among US-born residents of New York was more gradual with a steep drop after October 2020 as well (Figures 3a and 3b). The one-month decline in December, 2020, where the bulk of March conceptions would have occurred, is the largest one-month decline for both the foreign-born and US-born series.

       The time-series pattern of births in the rest of the country was similar to that of New York City but less stark (Figures 4a and 4b). The decline in births among US-born women dipped below the 95% confidence interval between August 2020 and January 2021 but rebounded strongly thereafter (Figures 4a and 4b). The decline in births to foreign-born women who resided outside of New York City was evident early in the pandemic reflecting a fall in conceptions that began in the summer of 2019. This pattern suggests a fall in immigration combined with a possible decline in conceptions related to the anti-immigration sentiment in the

country.[4] Nevertheless, birth to US foreign-born women who did not reside in New York City dropped sharply after November of 2020, but also rebounded after January of 2021 (Figure 4b).

The time-series pattern of births in New York was consistent with both a decline in immigration prior to the pandemic (BCS 2022) as well as a behavioral response to the acute economic downturn, the spike in mortality and the sequelae of COVID-19 control measures that hit New York City (Kearney and Levine 2022). We were unable, however, to separately identify the health effect from the economic crisis. The unemployment rate in New York City peaked at 21 percent in May of 2020 and did not drop below 10 percent—the peak level reached during the Great Recession (2007-2009)—until July of 2021.[5] Despite 17 months of historical rates of post-World War II unemployment, conceptions resulting in births began to rebound in July of 2020. BCS conclude that the "…standard model linking unemployment to reductions in fertility failed" (p. 16). KL found the standard model still useful. "Consistent with past theory and evidence, changes in economic conditions played an important role in these fluctuations" (p.23). BCS analyzed national changes in birth rates whereas KL took advantage of state-month variation to link changes in birth rates to changes in unemployment. Importantly, KL found that the spike in unemployment could not explain the baby bust whereas the fall in unemployment from its peak was associated with the rapid rebound in birth rates.

The sharp drop and rapid recovery in birth rates in New York City appears more closely linked to the perceived health risk than the unemployment rate. As shown in Figures 1a and 1b, the spike in both the all-cause mortality rate and the COVID-19 mortality rate lasted less than three months. If we plot birth rates by month of conception instead of month of delivery, the link between the drop in births with the spike in deaths becomes apparent. Figure 5a shows birth rates by month of conception and Figure 5b displays their deviations from the expected trend.[6] The drop in conceptions resulting in births between February and March 2020 was as abrupt as its equally sharp reversal in June of 2020.

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[4] See https://www.census.gov/library/stories/2022/12/net-international-migration-returns-to-pre-pandemic-levels.html

[5] See https://beta.bls.gov/dataViewer/view/timeseries/LASCT365100000000003;jsessionid=04C7AED15CA3997820E00C16EC7CFAF9 (last accessed on December 29, 2022)

[6] To compute the month of conception we subtracted gestational age from the exact date of birth. Such detailed information was only available from the New York City DOHMH. Thus,

As noted, the New York City unemployment rate peaked in May of 2020 and its decline was more gradual than the change in conceptions which had returned to trend by June of 2020. We also find it noteworthy that KL (2022) found that only the COVID-19 caseload was associated with both the fall and rebound in births.

One possibility is that KL picked up travel to areas less impacted by the virus, which likely had both lower unemployment rates and more births than would have occurred otherwise. In figures, 2a and 5a, we used birth rates that adjusted for population changes in New York City. In these Figures, the rebound was above trend as it was for the rest of the country whereas the actual number of births did not return to trend (Figure 3a).

Similar fertility responses occurred with the Ebola and Zika outbreaks once the risks became apparent. Births to women in Liberia fell roughly 50 percent in the first six months of Ebola outbreak in which the case fatality rate may have been as high as 70 percent (The WHO Ebola Response Team 2014; McBain et al. 2016). Conception rates in the Pernambuco region of Brazil fell dramatically after the Brazilian Ministry of Health declared Zika a public health emergency even though peak infection rates occurred months earlier (Castro et al. 2018; Rangel, Nobles and Hamoudi 2020).

2.   *Changes in births by SES and location*

In this section we stratify births to New York City residents by how the birth was financed and whether the birth was delivered within or outside New York City. Responses to the pandemic varied by this broad measure of socioeconomic status. For instance, Figures 6a and 6b show births to New York City residents that were paid for by Medicaid versus privately financed births. The decline in births to women on Medicaid began around March 2020. These

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births in Figure 5 were limited to New York City residents who delivered in the City. One concern was that we overestimated the fall in births because numerous New York City residents delivered their births outside the City in the early months of the pandemic. However, as we show below, the exodus occurred in April-June of 2020 for births conceived July-August 2019. By December of 2020, the proportion of births to New York City residents who delivered outside the City but conceived in March and April had returned to its pre-pandemic level. Thus, the abrupt drop in conceptions resulting in live births was not overestimated by an increase in pregnant women leaving the City to deliver.

were births conceived in the early summer of 2019. However, the fall in births among women with private health insurance did not fall significantly below trend until November of 2020. These births bottomed out in December and January before rising quickly in the early months of 2021. The differential pattern by method of finance suggested that the abrupt decline in births that were privately financed after October of 2020 was in response to the pandemic and not part of a pre-existing trend. As further evidence we stratified theses series by US and foreign-born women.

Figure 7a and 7b shows monthly births to US and foreign-born New York City residents that were paid for by Medicaid. The first point of note is that most births to women on Medicaid in New York City were to foreign-born women. Second, the decline in births to foreign-born women began after March of 2020 but with a further dip after November 2020. This pattern contrasts distinctly with birth to US-born women on Medicaid who resided in New York City. The trend was relatively flat throughout with a modest decline associated with the pandemic.

Figure 8a shows US and foreign-born births to New York City residents that were privately financed. The distribution by nativity is the opposite of Medicaid- financed births as the vast majority of births to US-born women in New York City were privately financed. More importantly, the time-series pattern by nativity was largely the same. Trends were flat up until November of 2020 after which there was a substantial decline over the next two months before returning to the pre-pandemic trend by roughly March of 2021 (Figure 8b).

The last piece of evidence that highlights the differential response to the pandemic by SES is the percentage of births to New York City residents delivered outside the City. The CDC was the first to report the sharp increase in births to New York City residents delivered outside the City in April and May of 2020 (Gregory et al. 2021). The number of births to New York City residents delivered outside the City increased 140 percent among white non-Hispanic women, more than triple the increase among Hispanic or black non-Hispanic women. By December of 2020, the percent of births to New York City residents delivered outside New York City had returned essentially to its pre-pandemic level (Gregory et al. 2021).

In Figure 9 we show the percent of births to New York City residents delivered outside the City by nativity. The increase in the early months of the pandemic was almost exclusively

limited to US-born residents. The exodus was also concentrated among US-born women whose births were privately as compared to publicly financed (Figure 10).

3.   Changes in births by Race and Ethnicity

The changes in birth rates by race and ethnicity mirrored those by SES. Births began to fall below the projected trend too soon to be caused by the pandemic (See Appendix Figures A1-A4). Once we further stratified births by nativity a more familiar pattern emerged. Births to foreign-born non-Hispanic white, black and Asian women tended to fall below their projected trend between April and August of 2020 (Figures 11, 12, 14). The decline represented a fall in conceptions prior to the onset of the pandemic and pointed to a decline in immigration. Whether the nadir of births in December of 2020 indicated a fall in conceptions associated with the pandemic or a travel ban to the US remained unclear. The pattern among US-born non-Hispanic white, black and Asian women suggested a less-steep deviation from trend in absolute terms and more in line with a decline in conceptions associated with the pandemic (Figures 11, 12 and 14). The pattern among Hispanic women was more distinct. There was a precipitous decline among births to foreign-born Hispanic women after October of 2020 that bottomed out in January of 2021 before rebounding quickly (Figure 13). Among US-born Hispanic women the deviation from trend was relatively minor but with a noticeable trough in December-January of 2020-21 (Figures 13).

4.   Changes in Induced Terminations of Pregnancy (ITOPs)

Induced terminations fell precipitously after March 2020. By June of 2020 there were approximately 2,000 fewer reported ITOPs than in February of the same year (Figure 15). The June trough mostly likely reflected fewer terminations of March-May conceptions.

The drop in ITOPs was similar in relative terms among US-born residents of New York as compared to non-US-born residents (Figure 16). New York is one of 16 states that pays for induced abortions through its Medicaid program and most induced abortions in the New York City are publicly financed. The decline in induced abortions was larger for non-publicly financed abortions and there was little evidence of a rebound (Figure 17).

The decline in abortions in New York City was contrary to national trends based on the Guttmacher Institute's periodic survey of abortion providers. Induced abortions in the US rose slightly between 2019 and 2020 but fell 6 percent in New York State and 9 percent in New York City (Jones, Kirstein, Philbin 2022).[7] As noted previously, data on ITOPs from the New York City Department of Health and Mental Hygiene consistently reported fewer abortions than were recorded by the Guttmacher Institute. Thus, the level of abortions in Figures 15-17 was an undercount. Nevertheless, the decline in abortions to New York City residents in Figures 15-17 was consistent with the fall in abortions reported by Guttmacher Institute for New York State and City. If induced abortions fell due to fear of exposure to COVID-19 or from the limited availability of services, we would have expected births to rise, all else equal (Bailey, Bart and Lang 2022). Alternatively, the fall in abortions among pregnancies conceived in March-May of 2020 could represent more conscious attempts to prevent unplanned pregnancies in response to the pandemic as well as less unintended conceptions due to the lockdown (Lindberg et al. 2021). The truth was probably some combination of both.

IV. Conclusion

In this study we focused on changes in birth rates to New York City residents associated with the pandemic. The spike in deaths due to COVID-19, the extreme economic contraction and the intense public health response in New York City were more sudden and more extreme than in the rest of the US. The severity of the shock made possible the disentanglement of pre-existing trends in fertility from changes in response to the pandemic. We agree with BCS that the decline in foreign-born births preceded the pandemic but the steep drop in births in December 2020 and January 2021 to foreign-born residents of New York City represented a deviation from trend associated with the pandemic. The decline in births and its timing among US-born residents of New York City reflected a short but distinct response to the pandemic. The jump in births to New York City residents delivered outside the City and the sharp drop in conceptions beginning in March of 2020 were additional evidence of deliberate responses to the pandemic.

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[7] Abortion data for New York City are based on personal communications with Rachel Jones of the Guttmacher Institute.

We could not definitively identify whether the abrupt drop in births was due to the fear of COVID-19 or the uncertain consequences from the economic shutdown and its indeterminate length. Yet the simultaneous spike in deaths and drop in conceptions along with their brief duration suggested that people responded more to the unknown health risks than the economic contraction. This response was consistent with the fall in births following the outbreaks of Ebola and Zika. The impact of Zika on fertility was more protracted than with Ebola because the risk of exposure persisted longer and because the most vulnerable groups were infants and young children (Marteleto et al. 2020; Paixao et al. 2022).

Also unclear was whether the dramatic fall in induced terminations prevented an even greater fall in births than was observed. Evidence from the Guttmacher Institute supported a decline in recorded abortions, but the extent of the decline was unclear. Women, for example, may have used medication abortion to avoid a surgical procedure or couples may have practiced more effective contraception to prevent unintended pregnancies (Luppi, Arpino and Rosina 2020; Lindberg, VandeVusse, Mueller and Kirstein 2021).

The rapid rebound in births was more difficult to attribute predominantly to the reversal of the negative health shocks (KL 2022; BCS 2022). The spike in all-cause mortality rates in New York City dropped below national rates by July of 2020. Conceptions resulting in live births were above their pre-pandemic trends by June of 2020. Although the New York City unemployment rate did not fall below its peak rate during the Great Recession until July, 2021, the unprecedented federal response protected many households from the decline in income associated with extensive job loss (Gwyn 2022).

The changes in fertility that occurred in New York City were sudden, large but brief. Changes in fertility in the rest of the US were qualitatively similar but of smaller magnitude because the health and economic impact of COVID-19 were less acute. The trends in the US were also more difficult to identify from confounding changes to immigration and declining fertility among foreign-born women.

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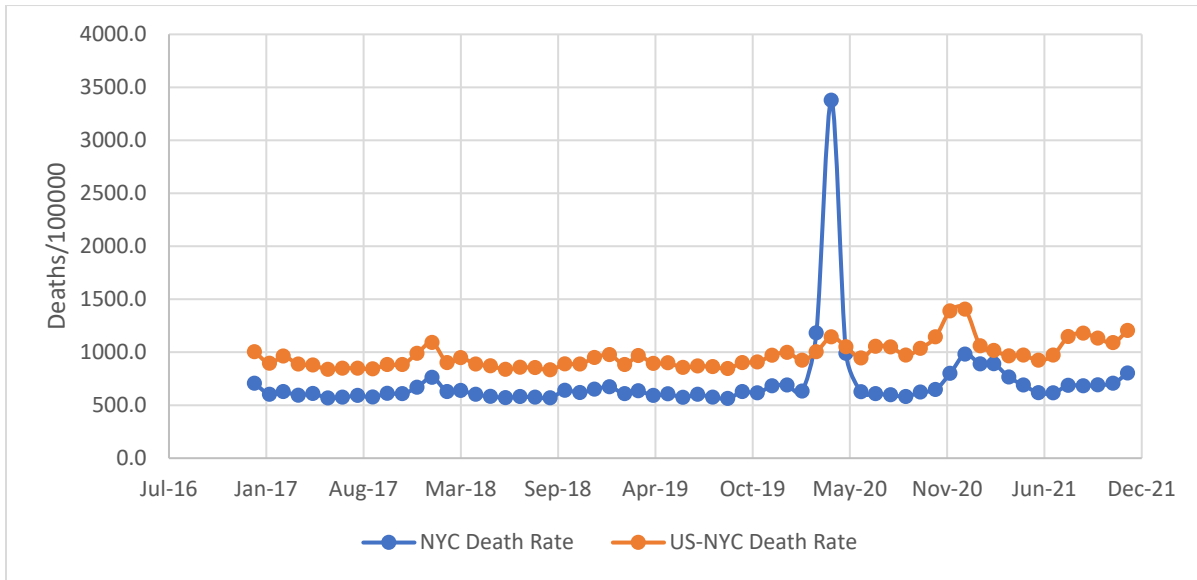
Figure 1a: Annualized Monthly All-cause Mortality Rate for New York City and the rest of the US
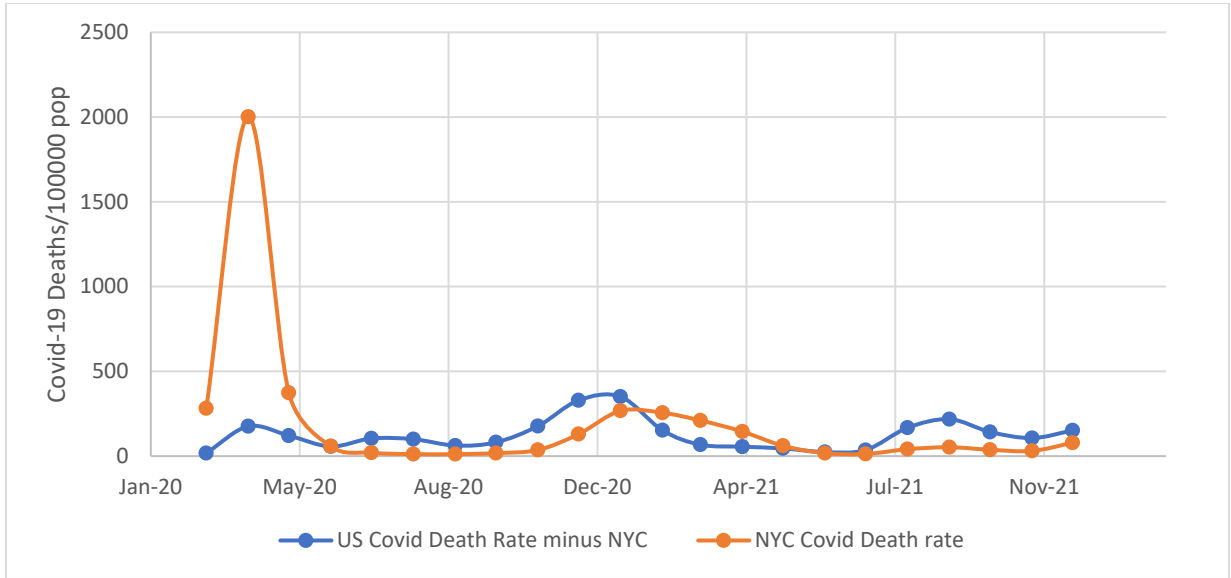
Figure 1b: Annualized Monthly COVID-19 Mortality Rate in New York City and the Rest of the US

Source: Deaths: CDC WONDER, Multiple Cause of Death (2021 data are provisional). Population: US Census Bureau, population estimates, 2021 vintage. New York City population for 2016-2019 are from "2021 County and Economic Development Regions Population Estimates" by the Cornell Jeb E. Brooks School of Public Policy
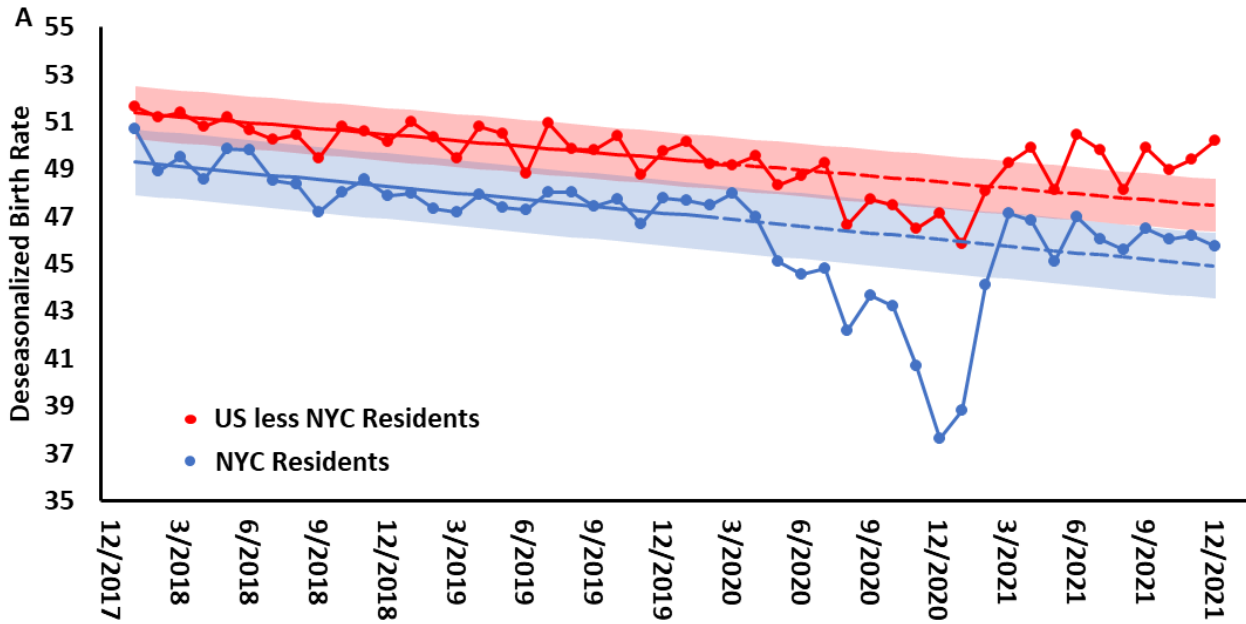
Figure 2a: Births per 1000 women Ages 15-49 to New York City Residents and US residents less New York City residents, January, 2018 – December, 2021.
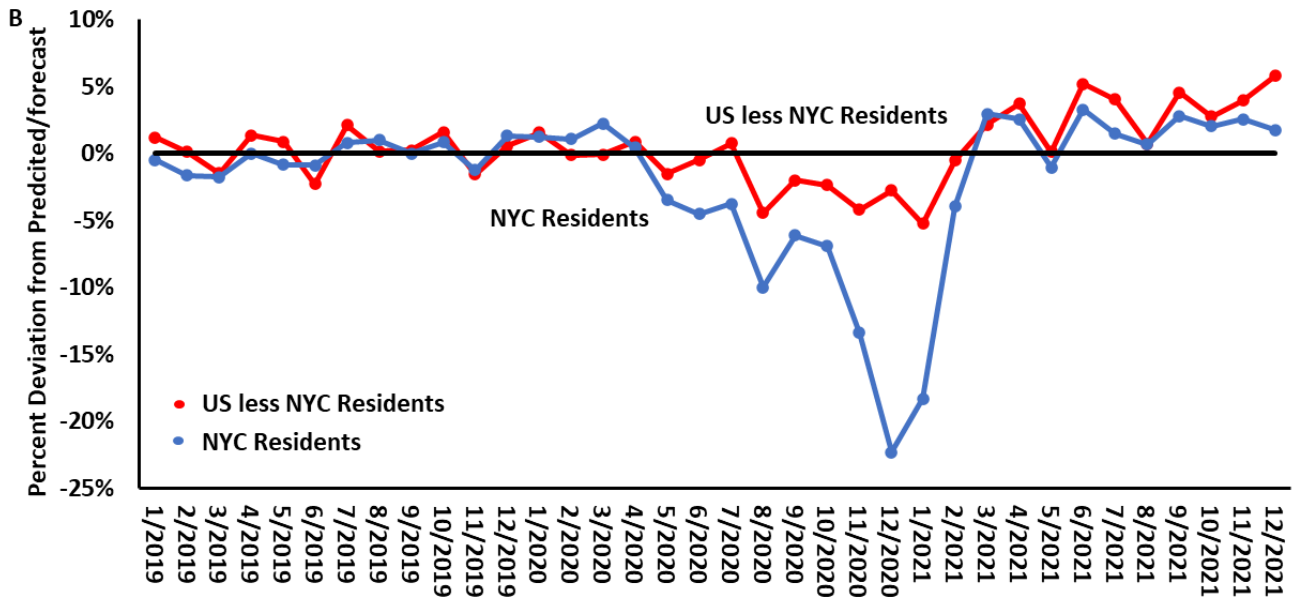
Figure 2b: Percent deviation from projected trend in birth rates among New York City residents and US residents less New York City residents, January, 2019 – December, 2021.

Source: CDC Wonder

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Notes: The solid line in panel A is the fitted trend based on monthly data from January 2016 to February 2020. The broken line is the projected path of the series based on the equation of the fitted trend. Actual, fitted and forecasted births are adjusted for seasonality by adding monthly indicators to the trend regression, subtracting the coefficient for each corresponding monthly indicator and adding back in the average monthly indicator, based on a weighted average of monthly indicators where the weights are the average number of births that take place in each of these months in 2019. The shaded area represents the 95% confidence interval equal to two times the standard deviation of the prediction error from January 2016 to February 2020. The deviations in panel B are simply the error divided by the projected values.
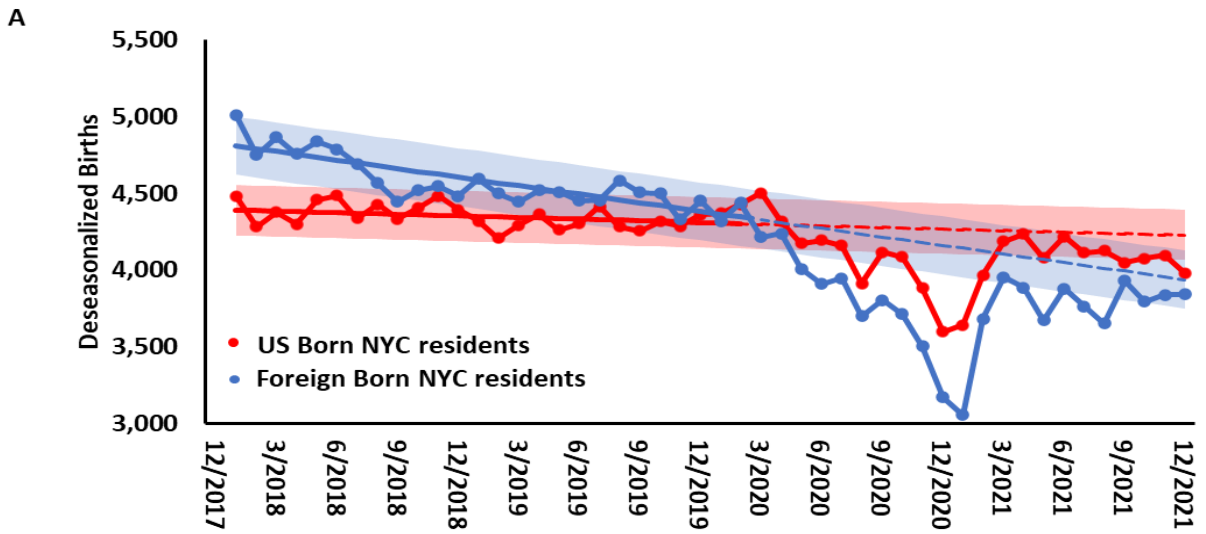
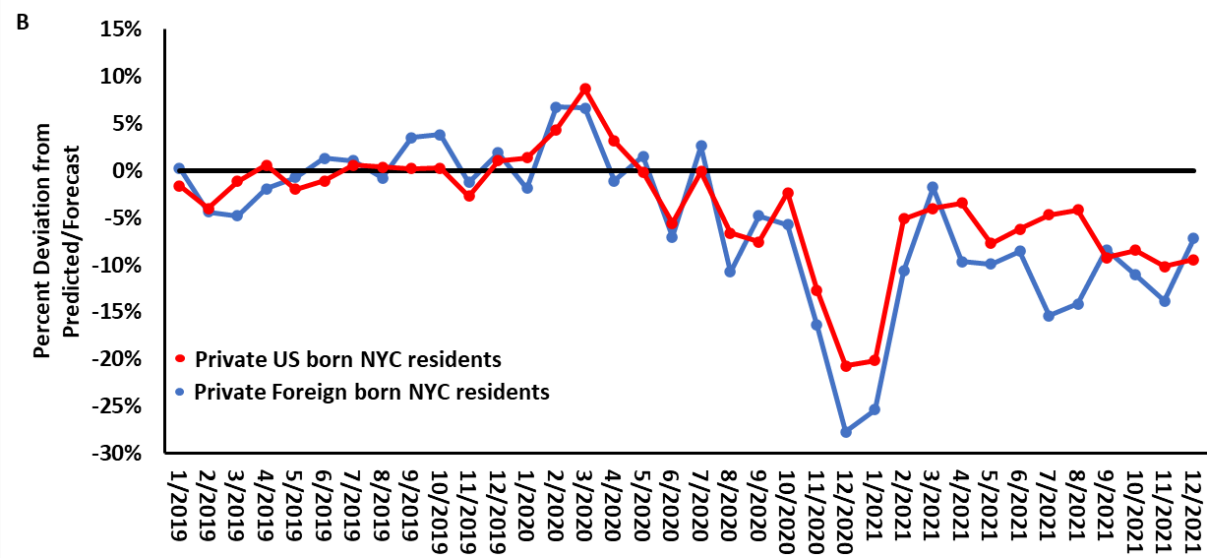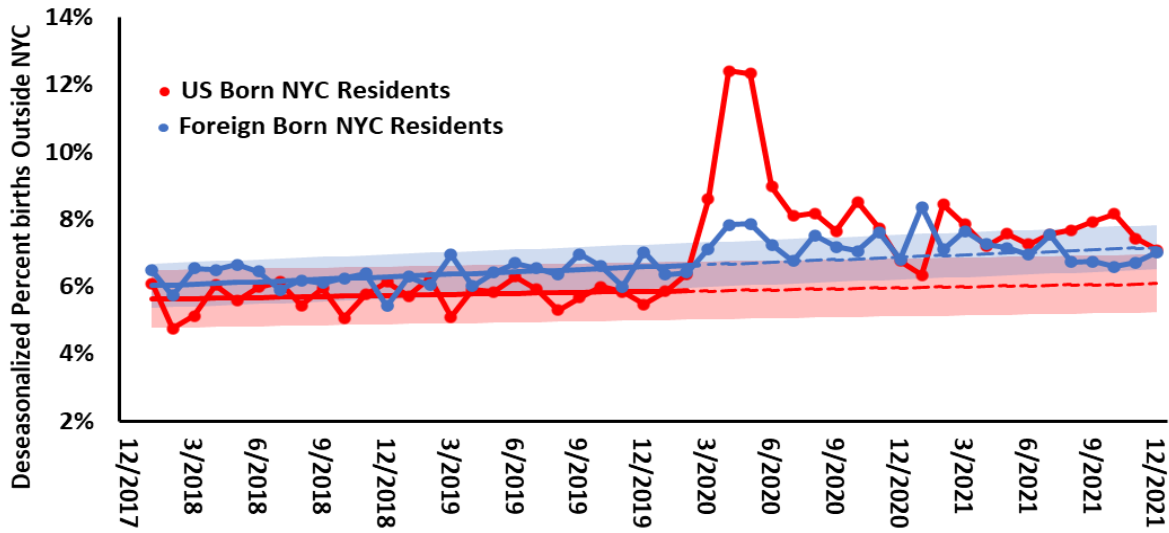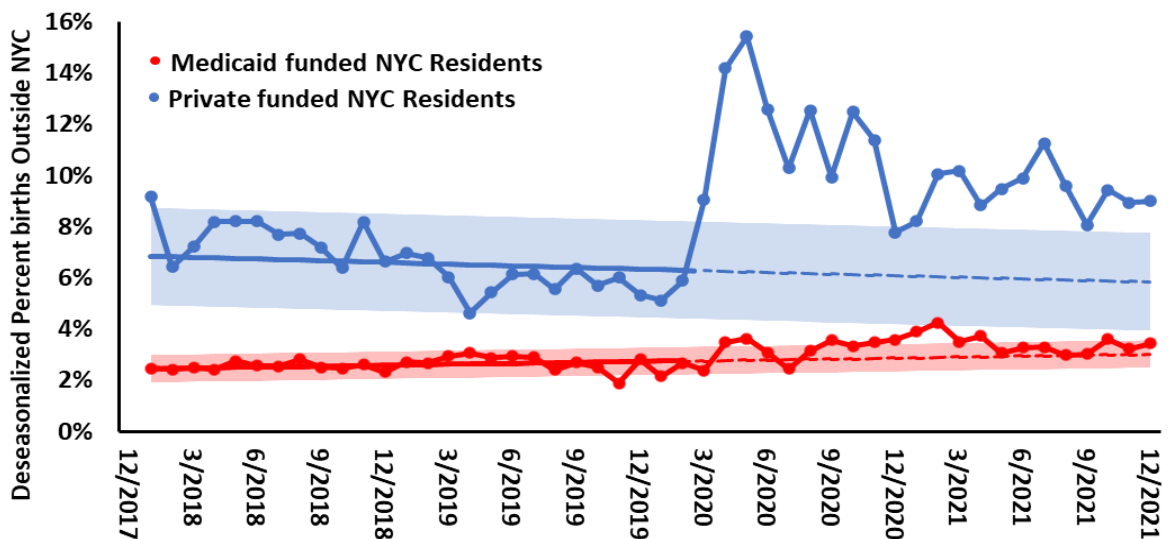**Figure 3a: Births to US and Foreign-born New York City residents, January, 2018 – December, 2021.**
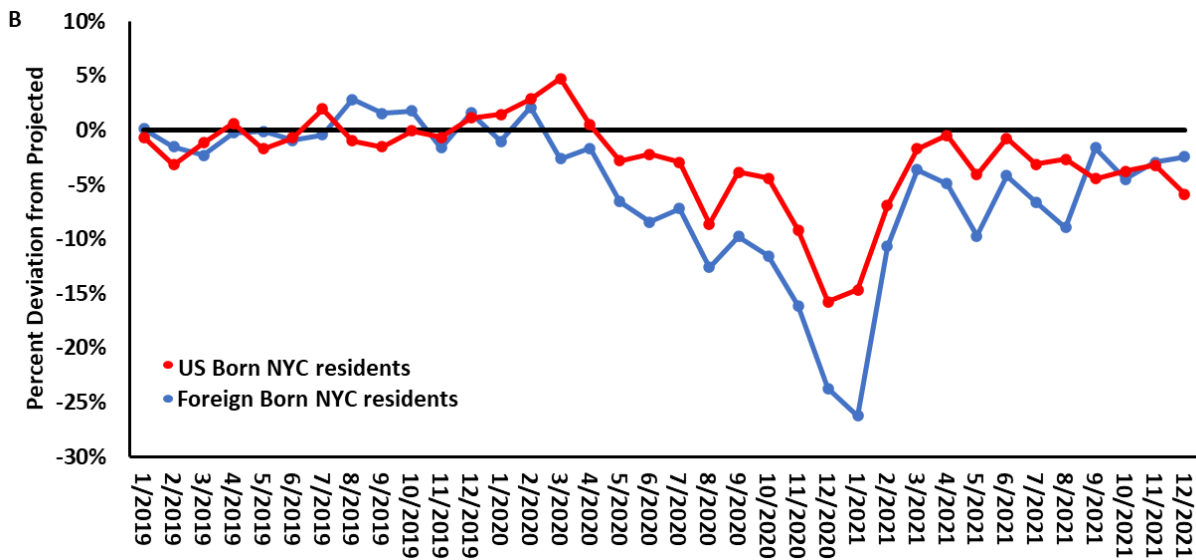
Figure 3b: Percent deviation from projected trends of births to US and Foreign-born New York City residents, January, 2019 – December, 2021.

Source: CDC Wonder. **See notes to Figure 2**
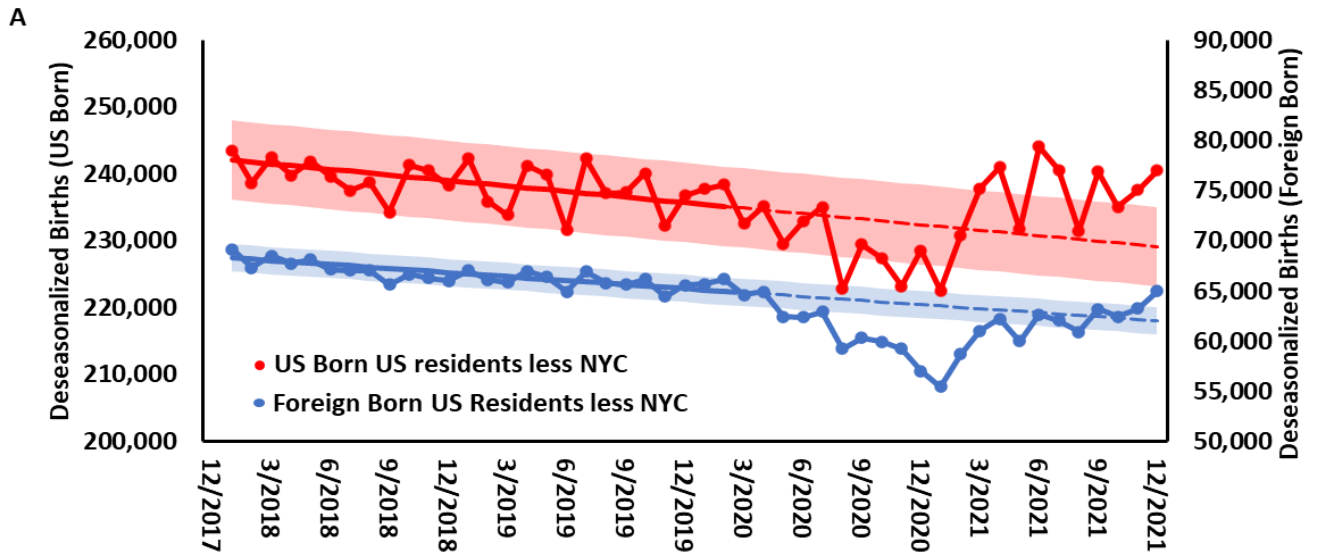
Figure 4a: Births to US and Foreign-born residents of the US less New York City, January, 2018 – December, 2021.
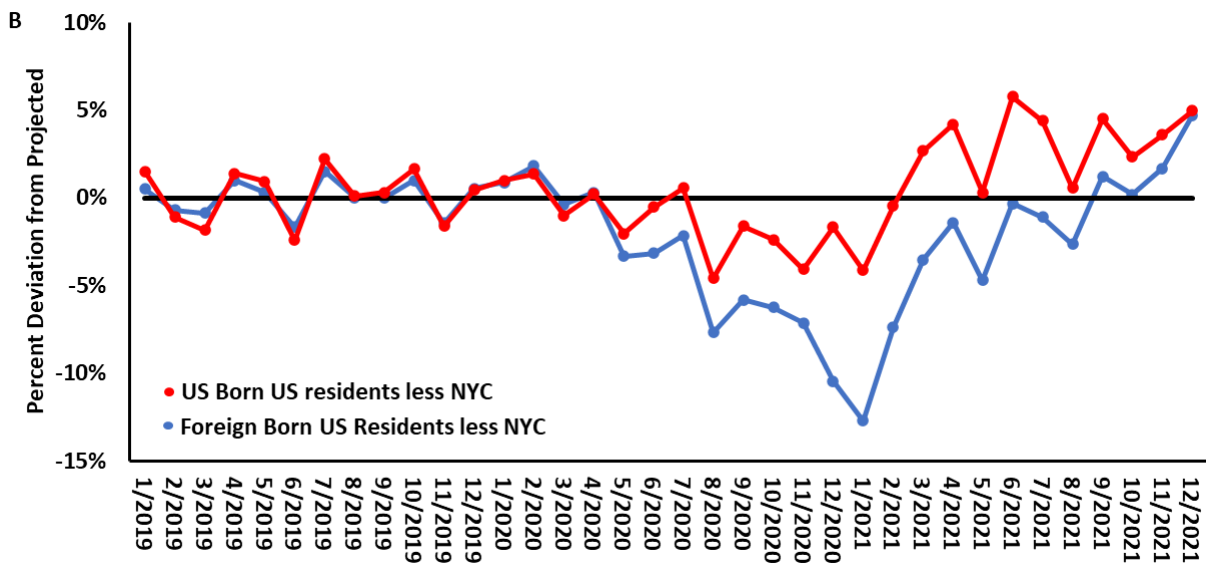
Figure 4b: Percent deviation from projected trends of births to US and Foreign-born residents of the US less New York City, January, 2019 – December, 2021.

Source: CDC Wonder. **See notes to Figure 2**
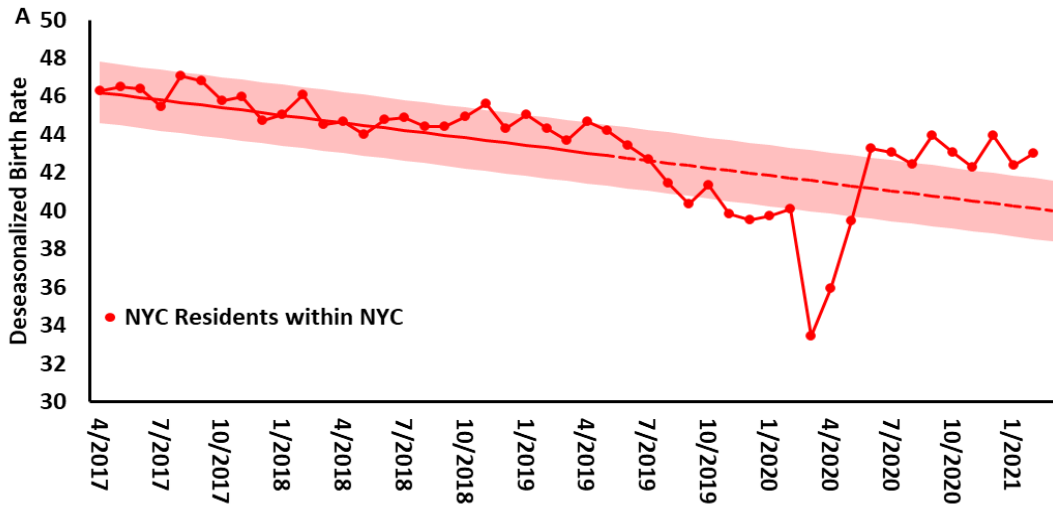
Figure 5a: Birth rates to New York City residents by month of conception. Births include only those that were delivered in New York City (see footnote 4 in the text), January, 2018 – December, 2021.
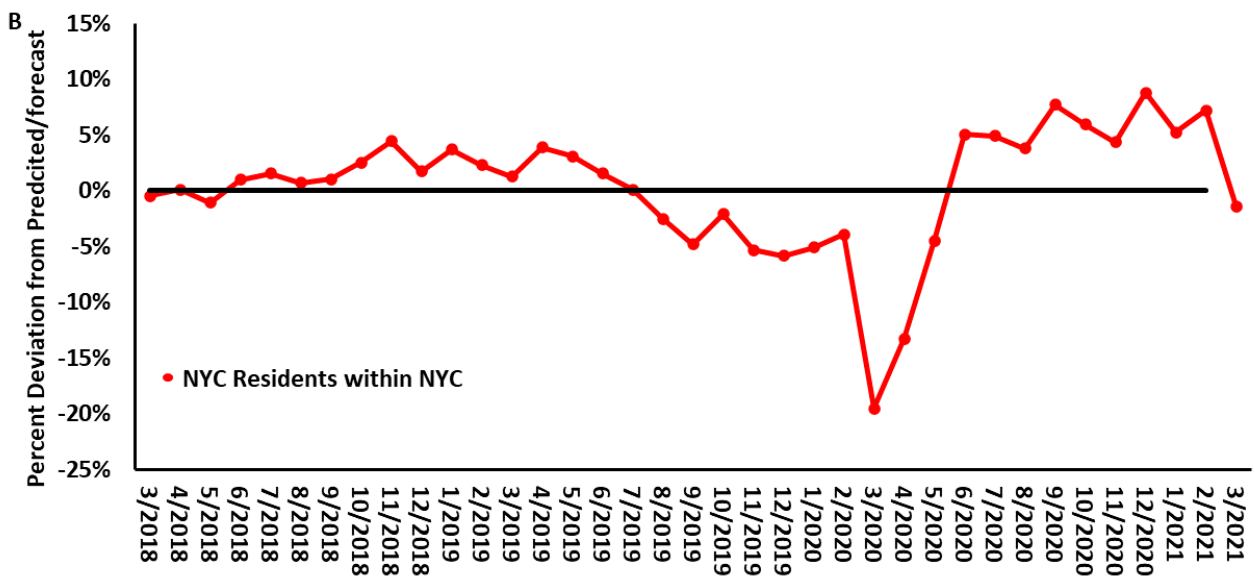
Figure 5b: Percent deviation from projected trends of births rates by month of conception to New York City residents of birth delivered in New York City (see footnote 4 in the text), January, 2019 – December, 2021.

Source: Special tabulations by the New York City, Department of Health and Mental Hygiene, Office of Vital Statistics.
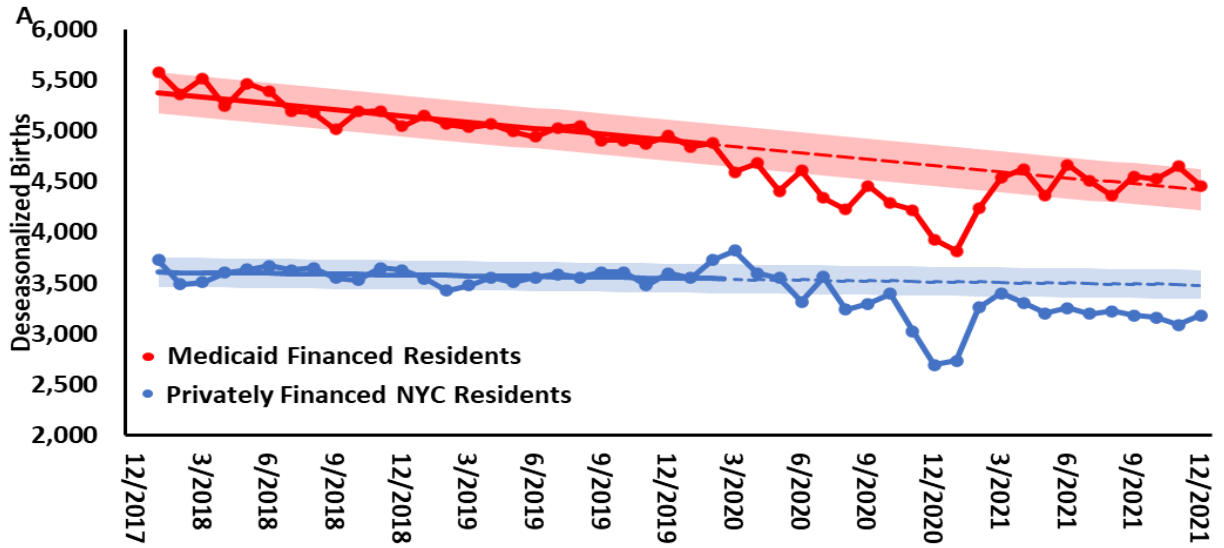
Figure 6a: Birth to New York City residents financed by Medicaid and by private insurance, January, 2018 – December, 2021.
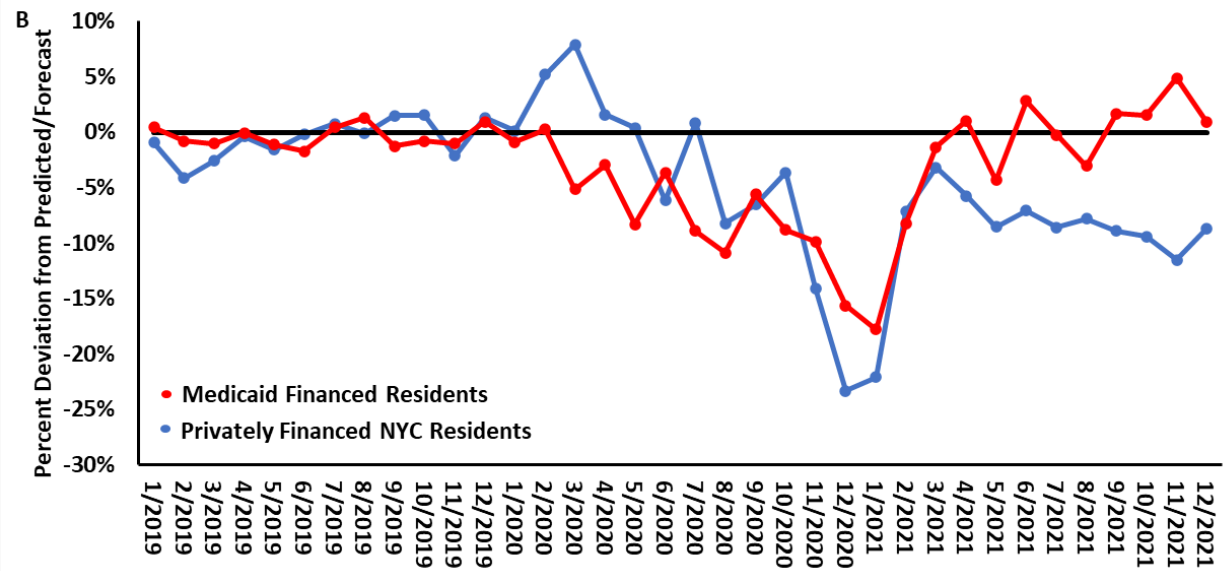
Figure 6b: Percent deviation from projected trends of births to New York City residents financed by Medicaid and by private insurance, January, 2019 – December, 2021.

Source: CDC Wonder. **See notes to Figure 2**
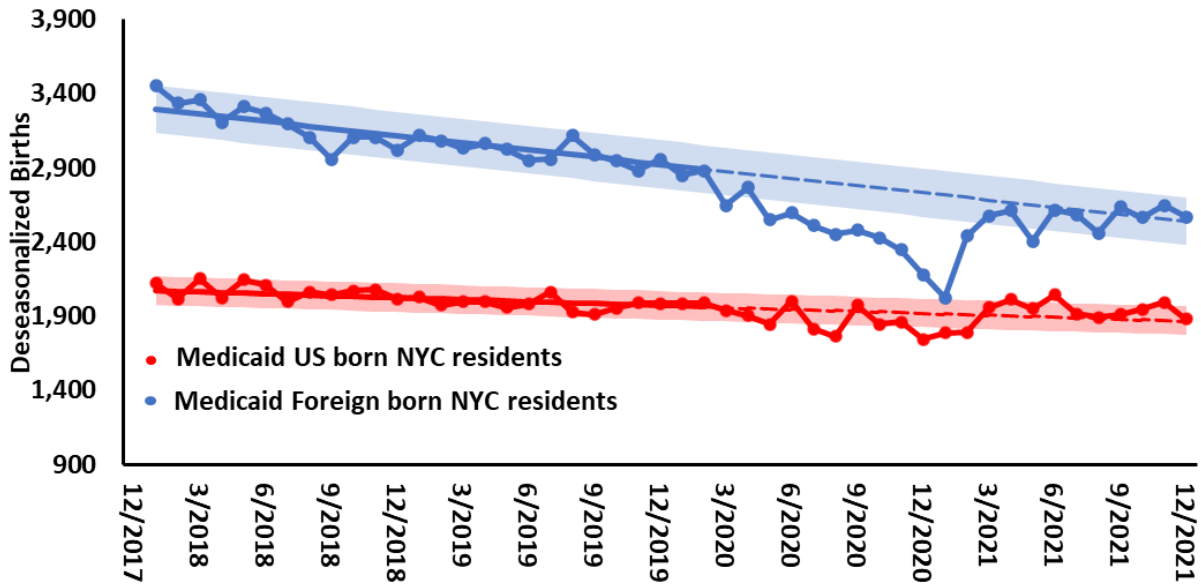
Figure 7a: Birth to US and foreign-born New York City residents financed by Medicaid, January, 2018 – December, 2021.
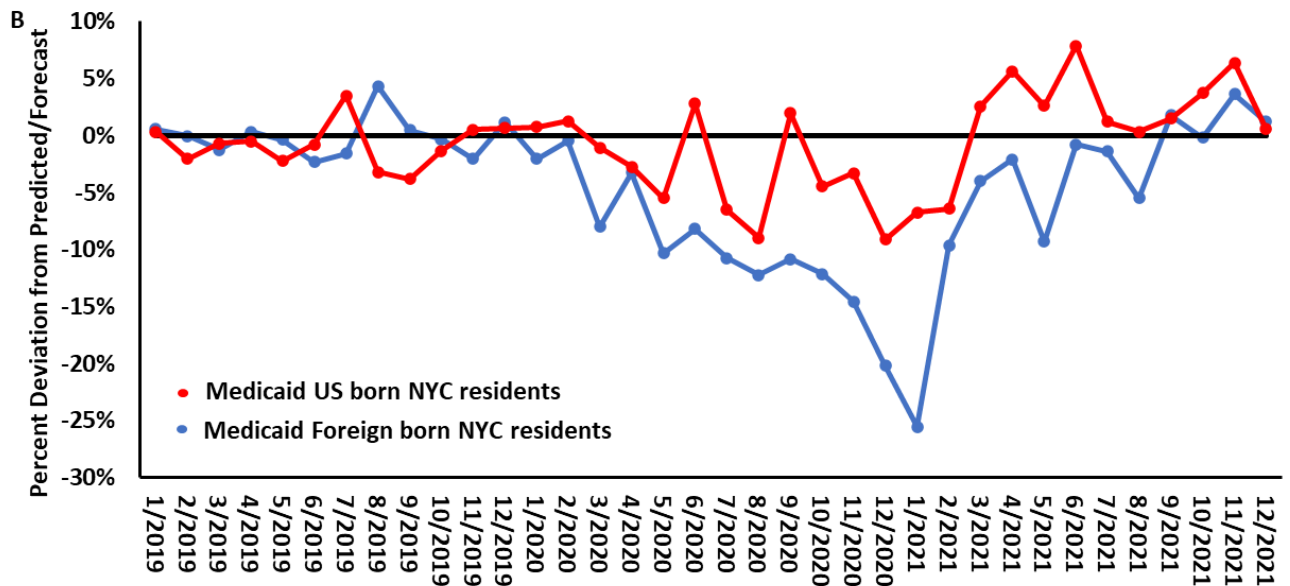
Figure 7b: Percent deviation from projected trends of births to US and foreign-born New York City residents financed by Medicaid, January, 2019 – December, 2021.

Source: CDC Wonder. **See notes to Figure 2**
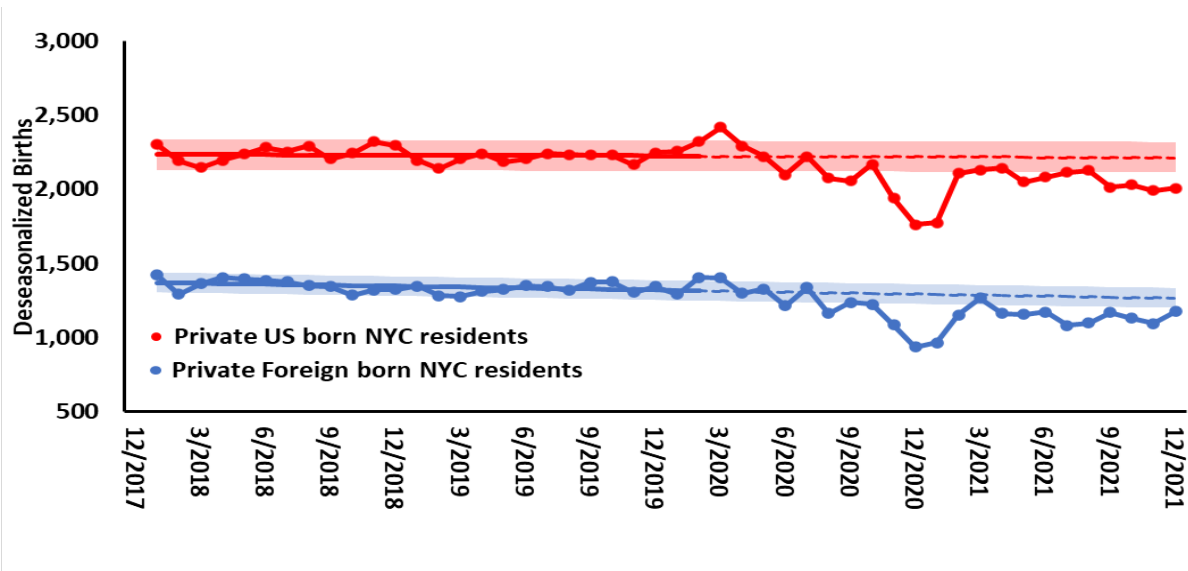
Figure 8a: Births to US and foreign-born New York City residents financed by Private Insurance, January, 2018 – December, 2021.

Figure 8b: Percent deviation from projected trends of births to US and foreign-born New York City residents financed by Private Insurance, January, 2019 – December, 2021.

Source: CDC Wonder. **See notes to Figure 2**

Figure 9: Percent of births to US and foreign-born New York City residents that occurred outside New York City, January, 2018 – December, 2021.

Figure 10: Percent of births to New York City residents financed by Medicaid and Private insurance that occurred outside New York City, January, 2018 – December, 2021.

Source: CDC Wonder Special tabulations by the New York City, Department of Health and Mental Hygiene, Office of Vital Statistics. See notes to Figure 2.
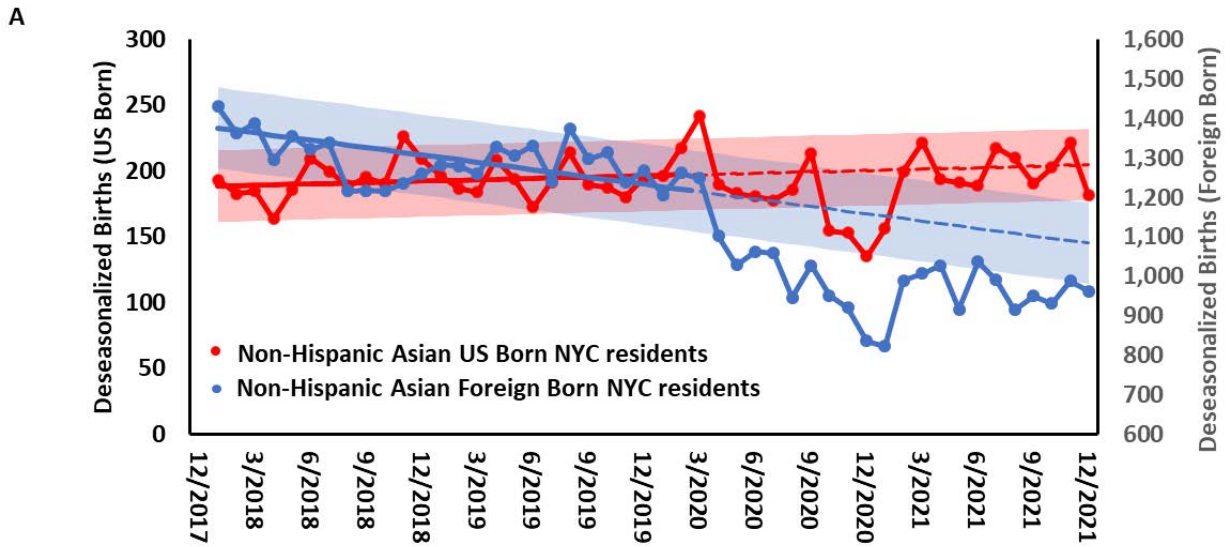
**Figure 11a: Births to Non-Hispanic Asian NYC residents, January, 2018 – December, 2021.**
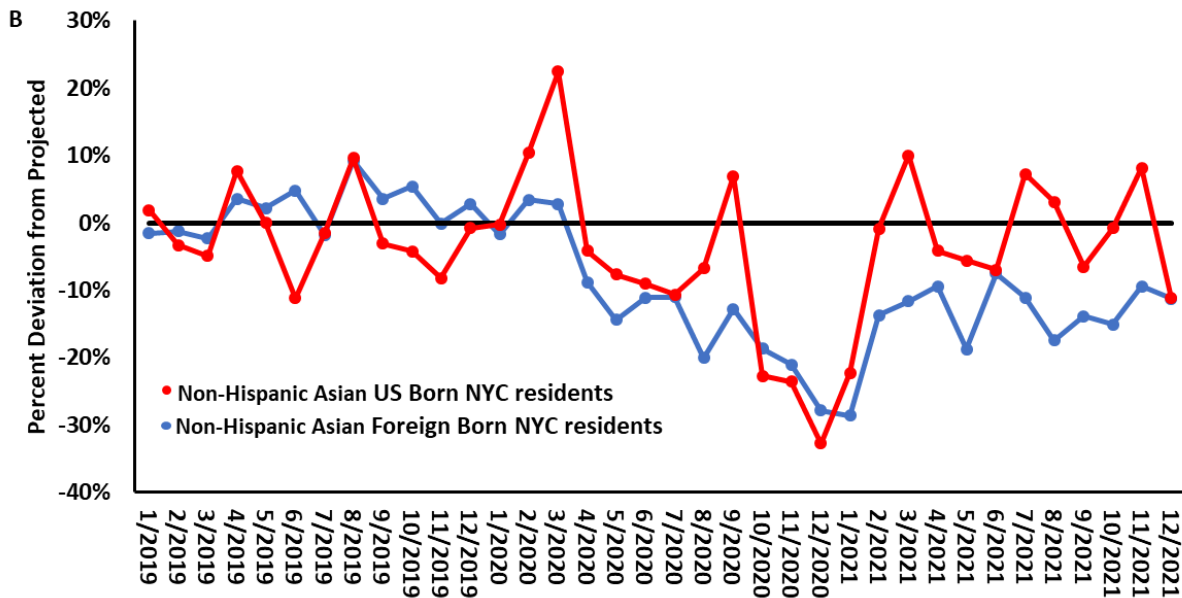
Figure 11b: Percent deviation from projected trends births to Non-Hispanic Asian NYC Residents, January, 2019 – December, 2021.
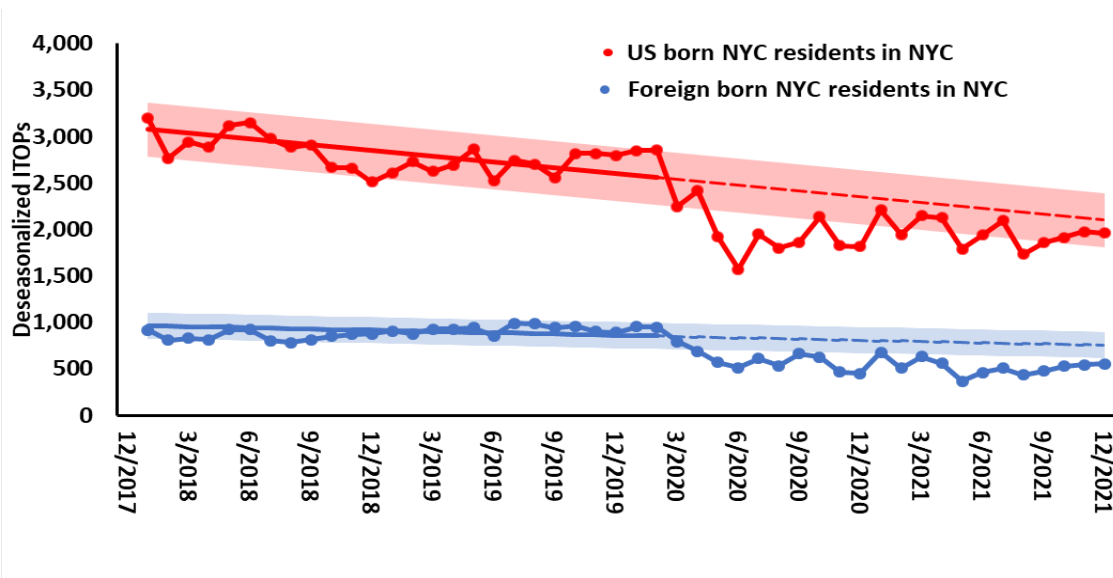
Source: CDC Wonder. **See notes to Figure 2**
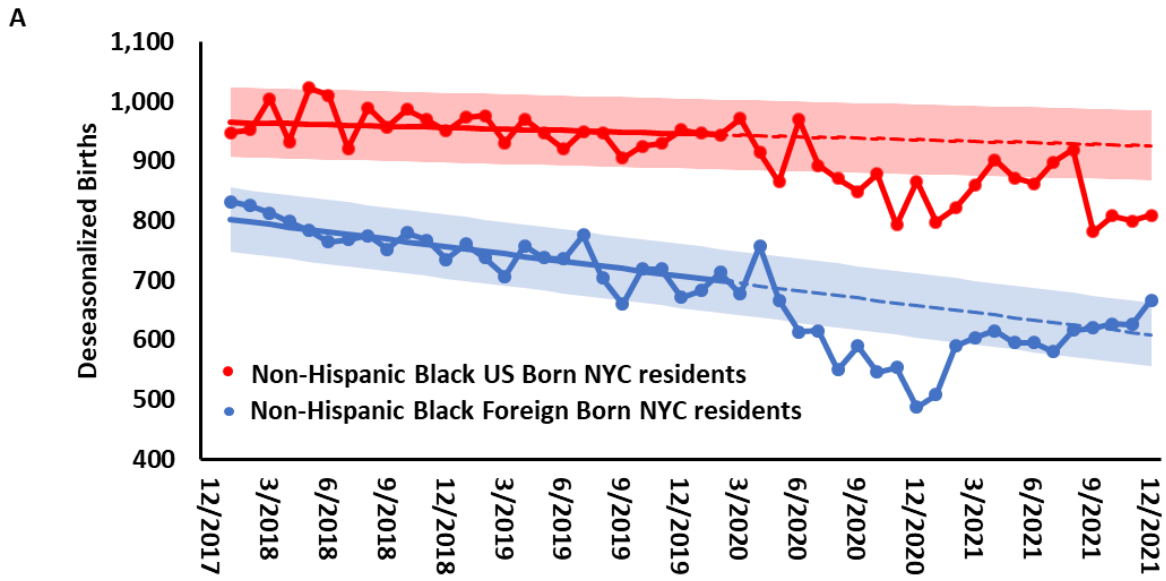
Figure 12a: Births to Non-Hispanic Black NYC residents, January, 2018 – December, 2021.
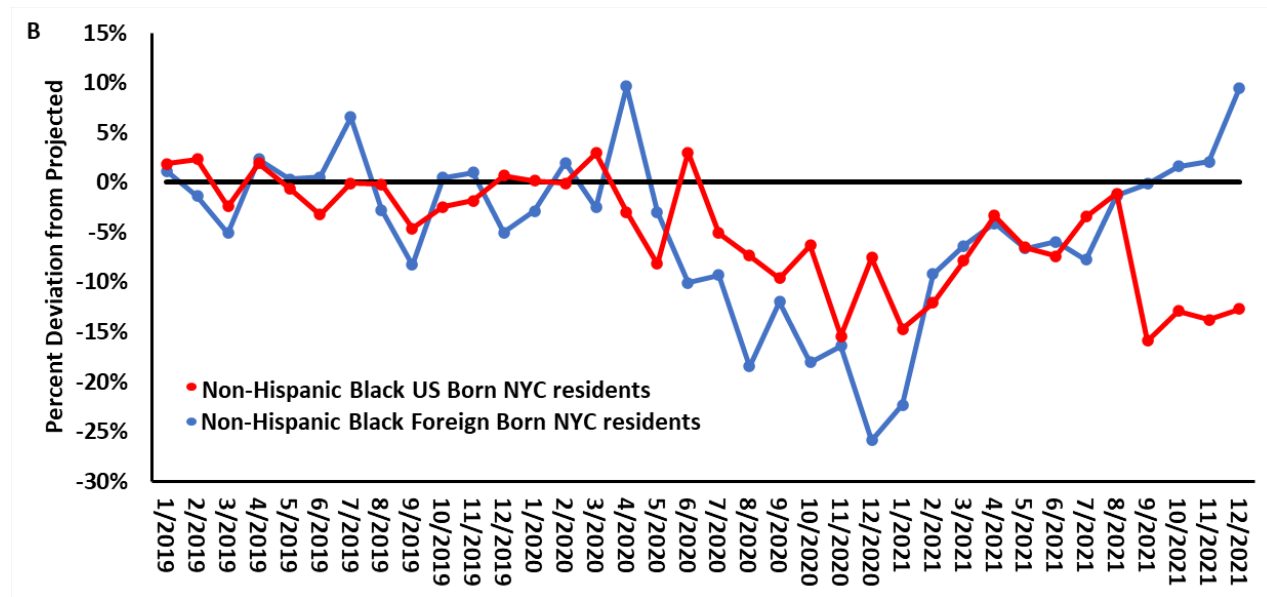
Figure 12b: Percent deviation from projected trends of birth rate to Non-Hispanic Black NYC Residents, January, 2019 – December, 2021.

Source: CDC Wonder. **See notes to Figure 2.**

A
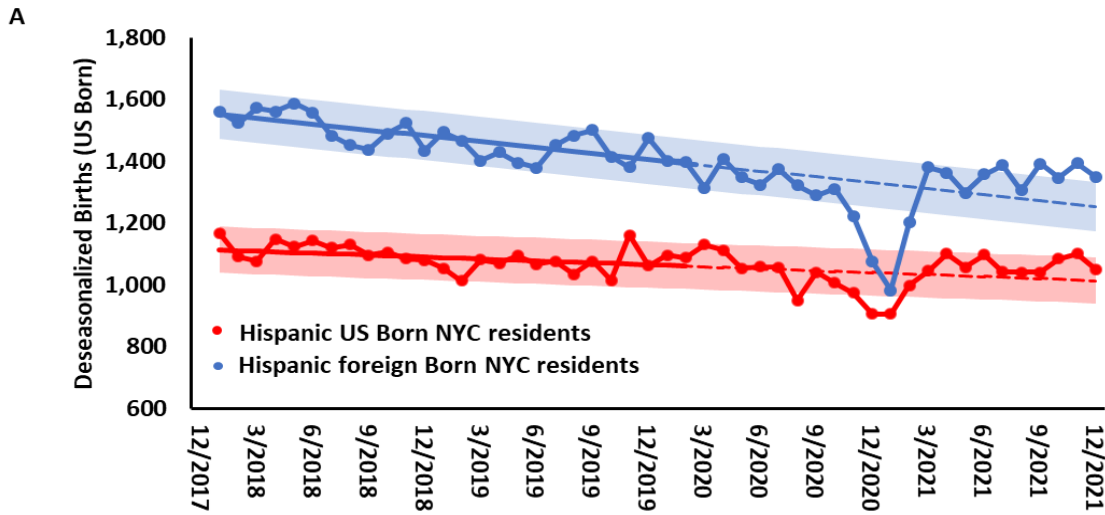
Figure 13a: Births to Hispanic New York City residents, January, 2018 – December, 2021.

B
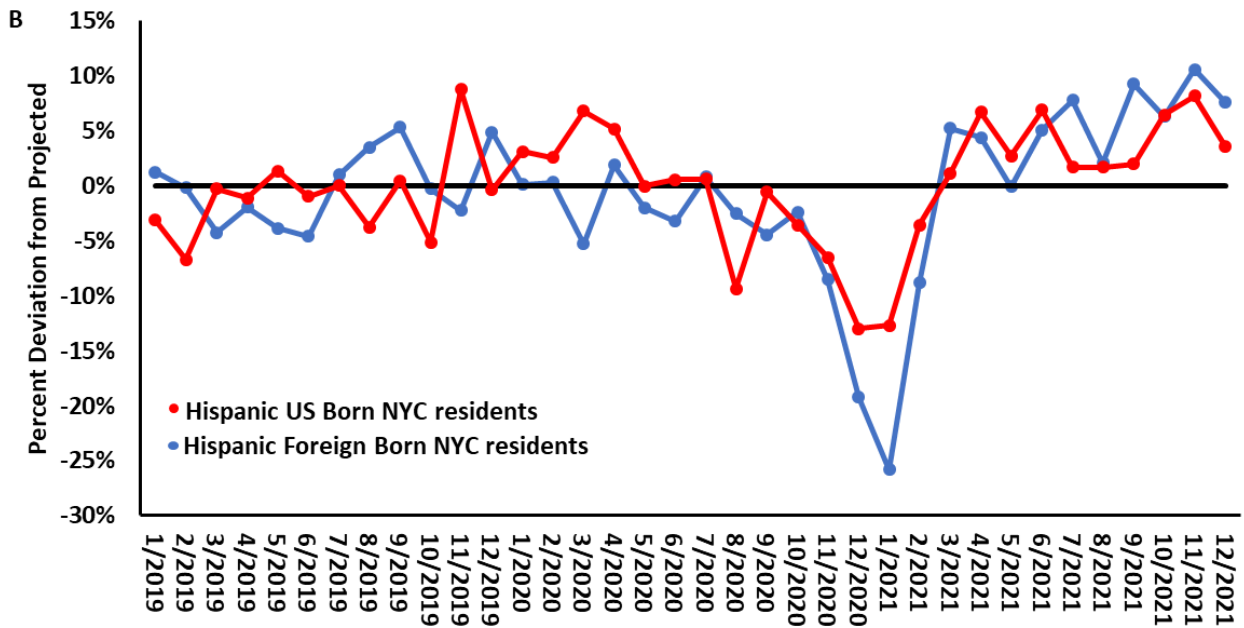
Figure 13b: Percent deviation from projected trends of birth rate to Hispanic NYC Residents, January, 2019 – December, 2021.

Source: CDC Wonder. **See notes to Figure 2.**

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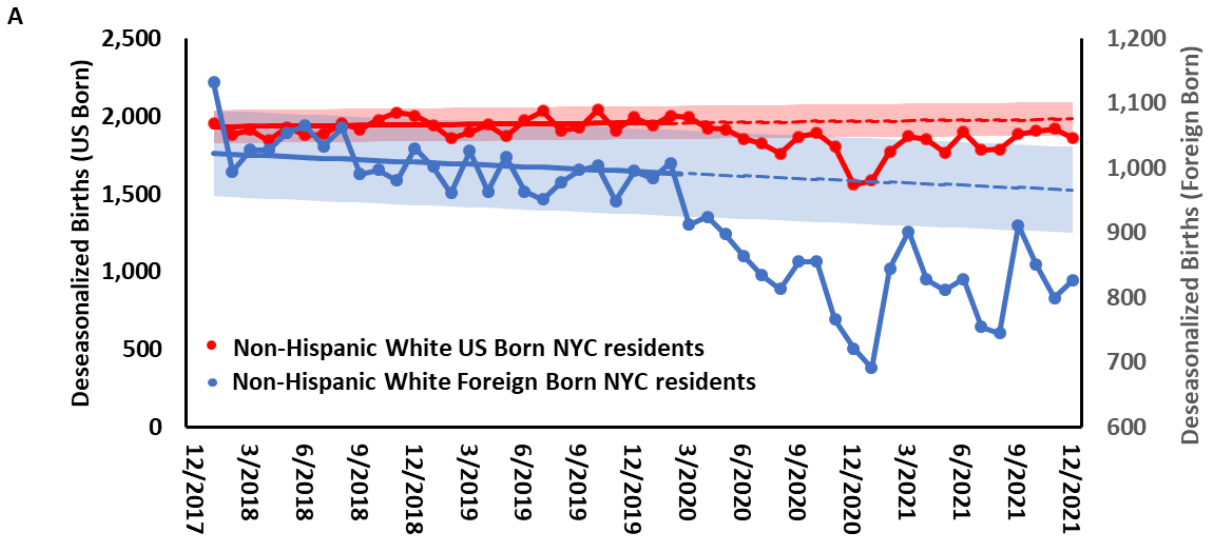
Figure 14a: Births to Non-Hispanic White NYC residents, January, 2018 – December, 2021.
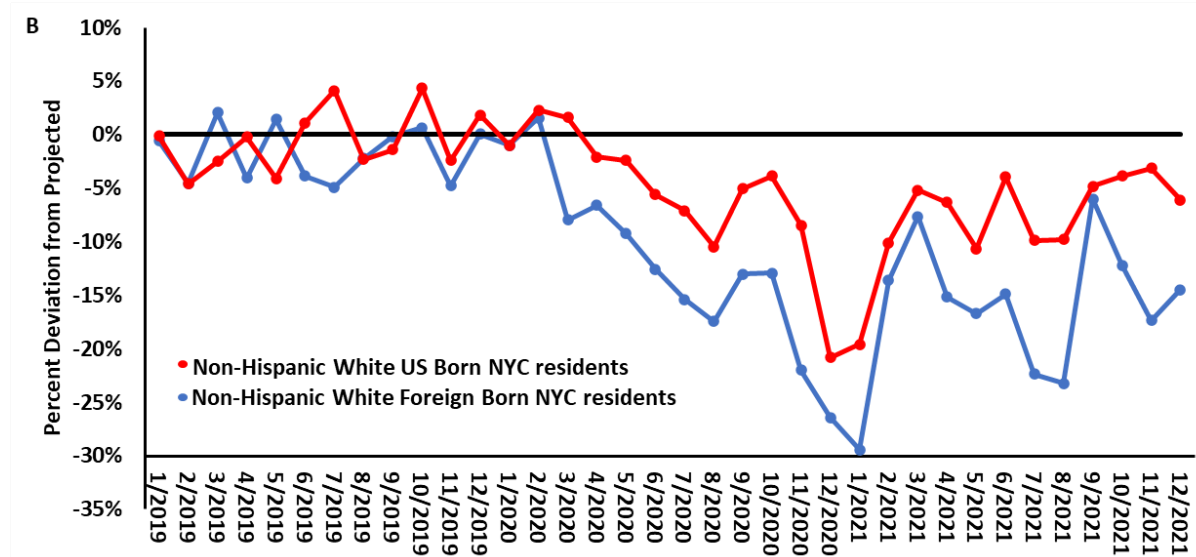
Figure 14b: Percent deviation from projected trends of birth rates to Non-Hispanic White NYC Residents, January, 2019 – December, 2021.
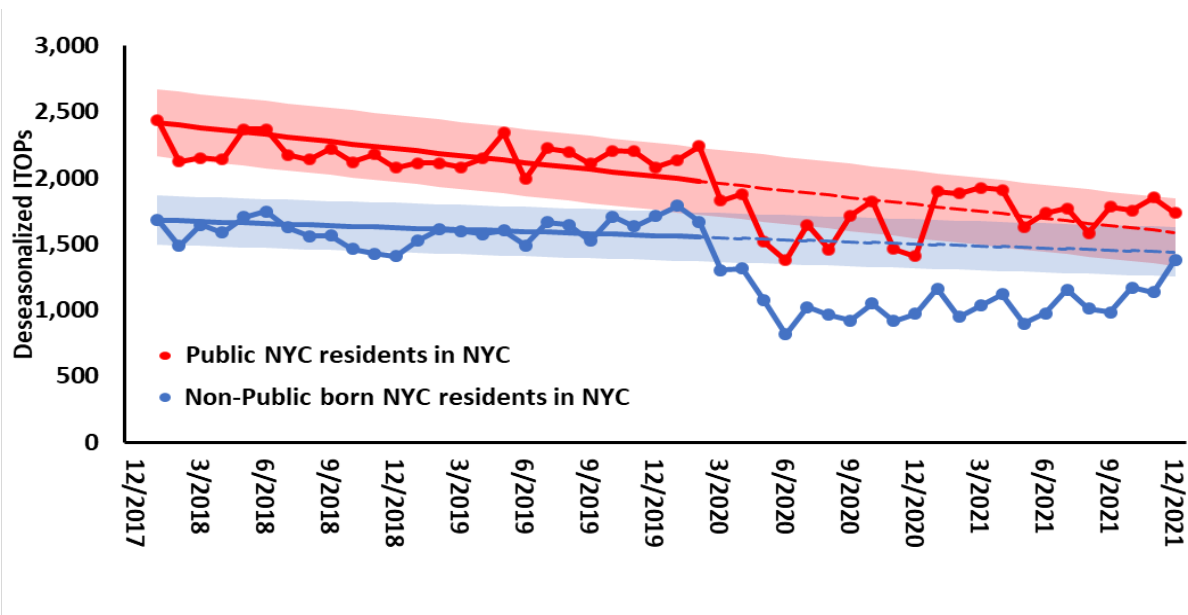
Source: CDC Wonder. See notes to Figure 2.
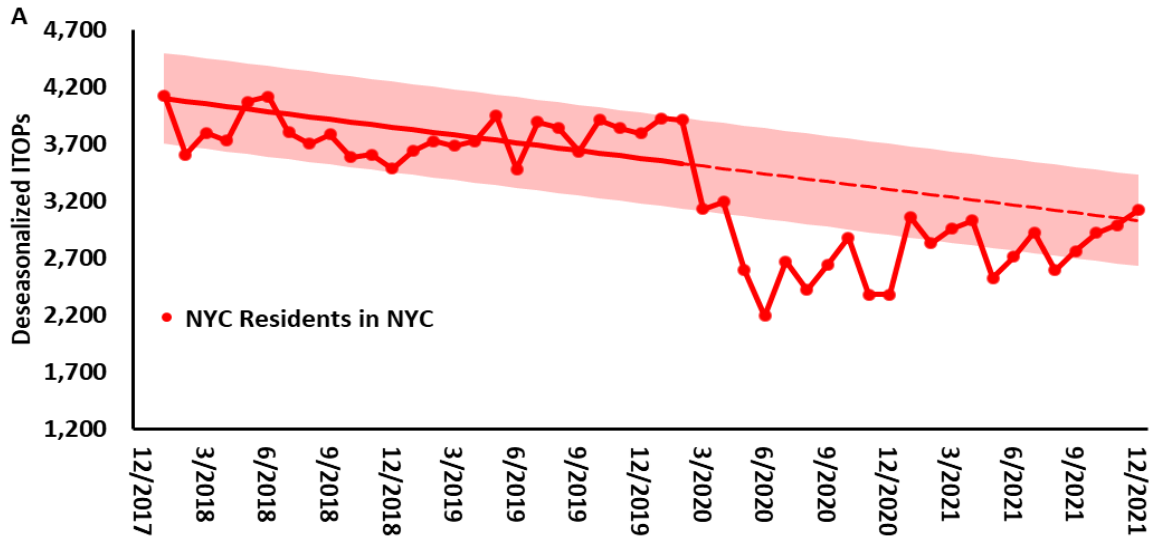
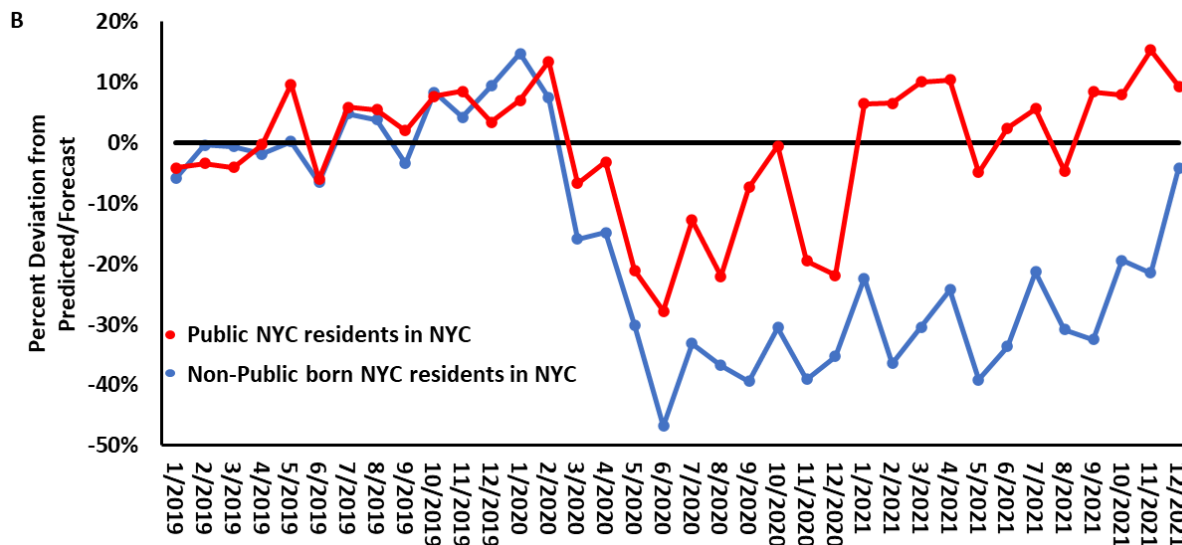**Figure 15a: Induced terminations of pregnancies to NYC residents taking place within New York City, January, 2018 – December, 2021.**
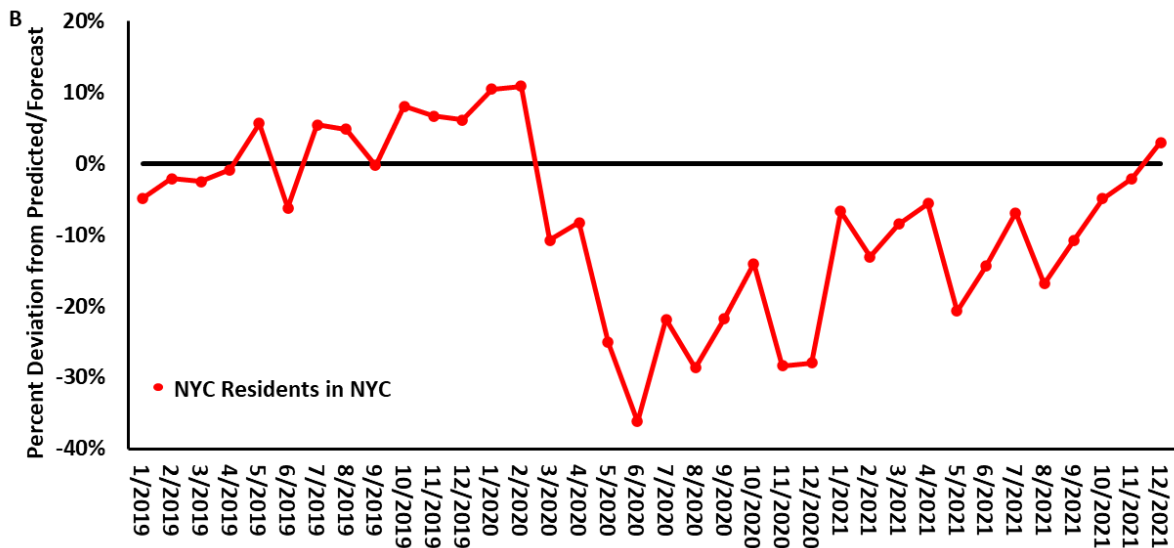
Figure 15b: Percent deviation from projected trends of induced terminations of pregnancies to NYC residents taking place within New York City, January, 2019 – December, 2021. Source: Special tabulations by the New York City, Department of Health and Mental Hygiene, Office of Vital Statistics. See notes to Figure 2.

Figure 16a: Induced terminations of pregnancies to US and Foreign born NYC residents taking place within New York City, January, 2018 – December, 2021.
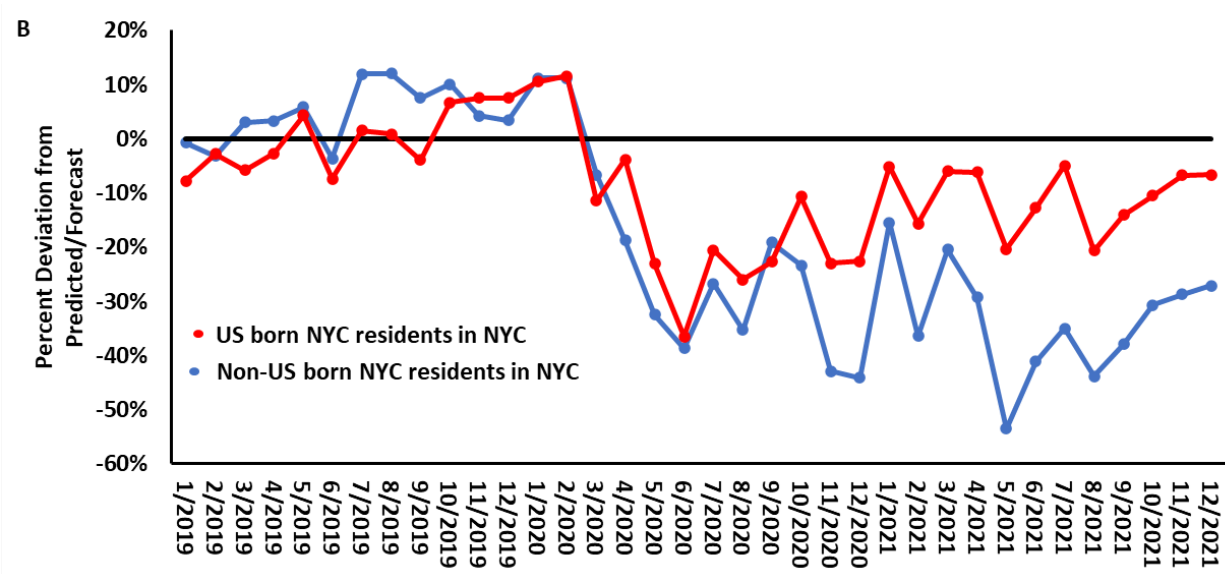
Figure 16b: Percent deviation from projected trends of induced terminations of pregnancies to US and Non-US born NYC residents taking place within New York City, January, 2019 – December, 2021.

Source: Special tabulations by the New York City, Department of Health and Mental Hygiene, Office of Vital Statistics. See notes to Figure 2.

Figure 17a: Induced terminations of pregnancies financed publicly and non-publicly to NYC residents taking place within New York City, January, 2018 – December, 2021.

Figure 17b: Percent deviation from projected trends of induced terminations of pregnancies financed publicly and non-publicly to taking place within New York City, January, 2019 – December, 2021.

Source: Special tabulations by the New York City, Department of Health and Mental Hygiene, Office of Vital Statistics. See notes to Figure 2.

Table 1: Births to New York City Residents and US Births less New York City Residents by Year of Birth, 2019-2021

	3/2019-2/2020	3/2020-2/2021			3/2021-12/2021			2020-2021
	All births or rate	All births or rate	Total Deviation	% deviation	All births or rate	Total deviation	% deviation	Net Births Relative to Trend
A. Births to NYC Residents								
Number	105,341	93,245	-8,579	-8.41%	80,158	-3,296	-3.95%	-11,875
Rate	47.5	42.8			46.7			
Number US-Born Mothers	51,841	48,466	-2,827	-5.51%	41,477	-1,282	-3.00%	-4,109
Number Foreign-Born Mothers	53,406	44,489	-5,753	-11.37%	38,601	-1,997	-4.92%	-7,749
B. Births US Residents Less NYC								
Number	3,638,740	3,476,373	-93,003	-2.61%	3,040,607	73,954	2.49%	-19,050
Rate	50.0	47.7			50.0			
Number US-Born Mothers	2,842,464	2,744,003	-50,663	-1.81%	2,404,382	76,623	3.29%	25,959
Number Foreign-Born Mothers	788,855	725,458	-42,242	-5.5%	629,292	-3,809	-0.60%	-46,051

Source: Births are from CDC Wonder. Population: US Census Bureau, population estimates, 2021 vintage.

Appendix
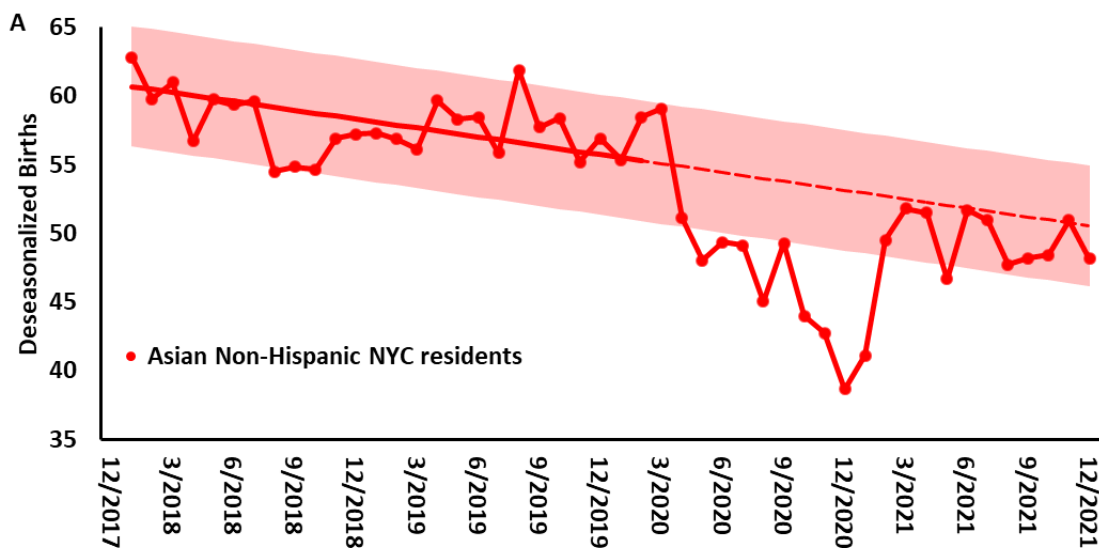
Figure A1a: Births to Non-Hispanic Asian New York City residents, January, 2018 – December, 2021.
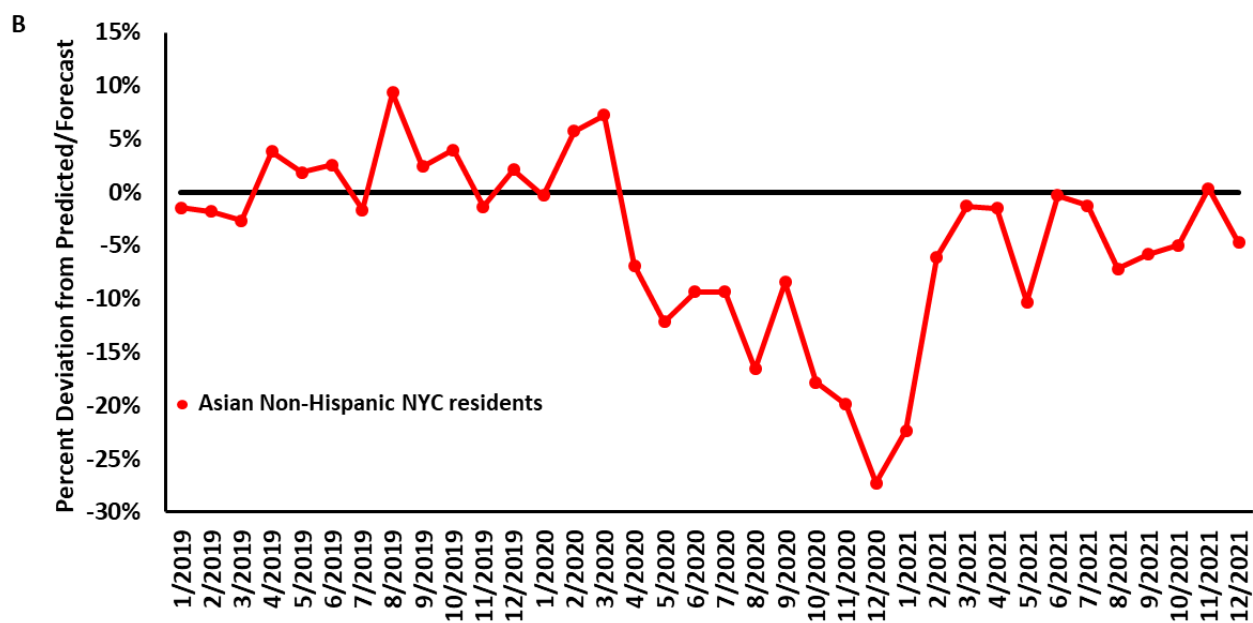
Figure A1b: Percent deviation from projected trends births to Non-Hispanic Asian NYC Residents,   January, 2019 – December, 2021.

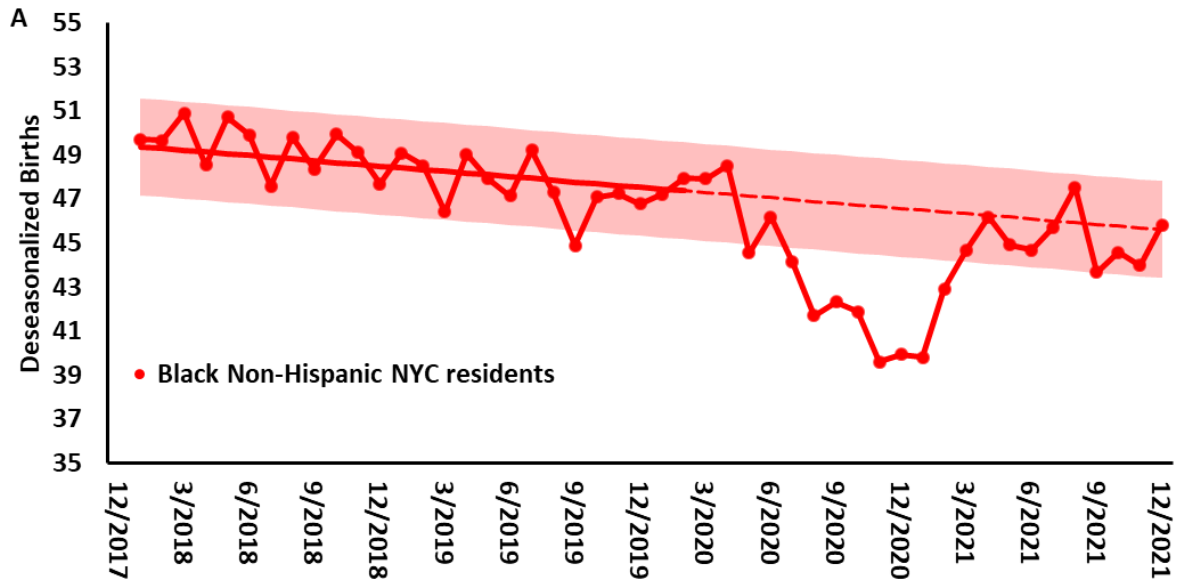**Source: CDC Wonde**r**, See notes to Figure 2.**

Figure A2a: Birth rates to Non-Hispanic Black New York City residents, January, 2018 – December, 2021.
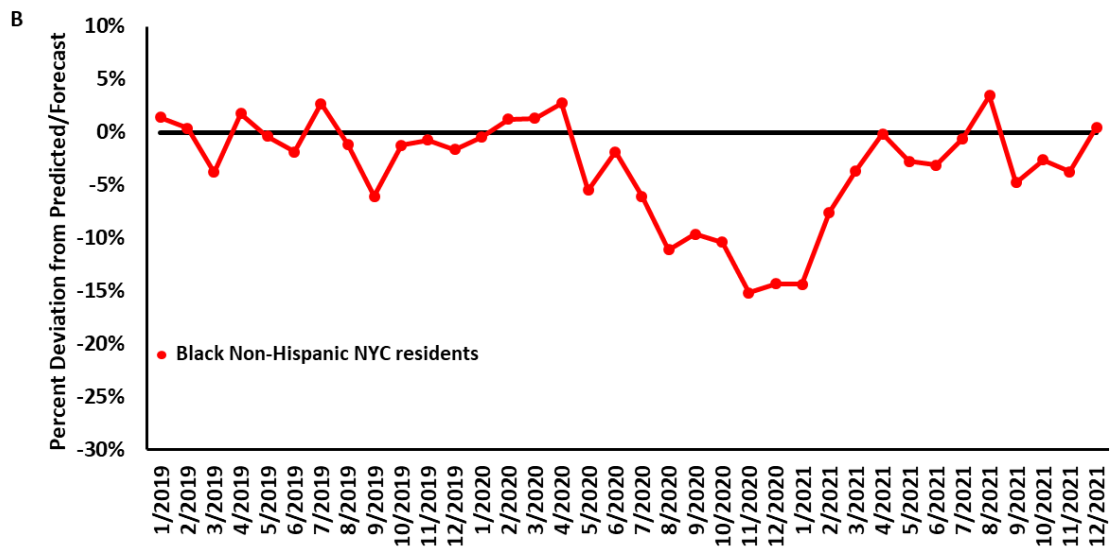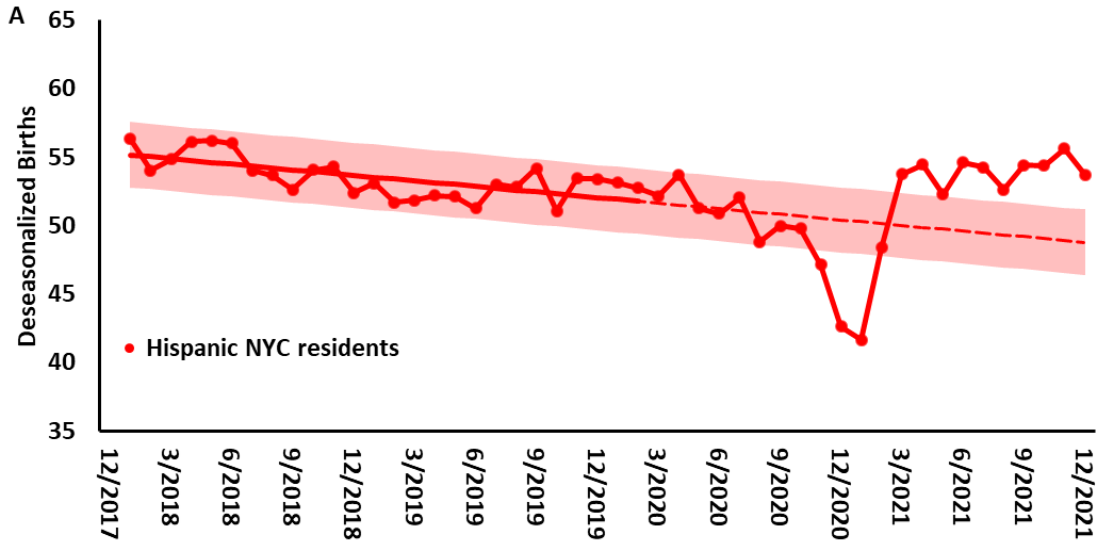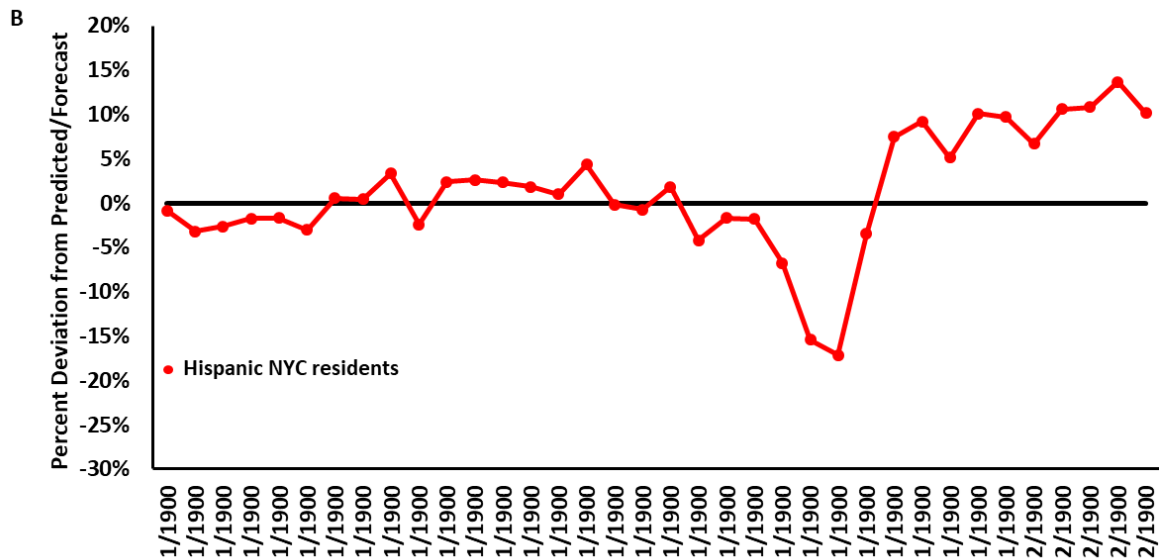

Figure A2b: Percent deviation from projected trends of birth rate to Non-Hispanic Black NYC Residents, January, 2019 – December, 2021.

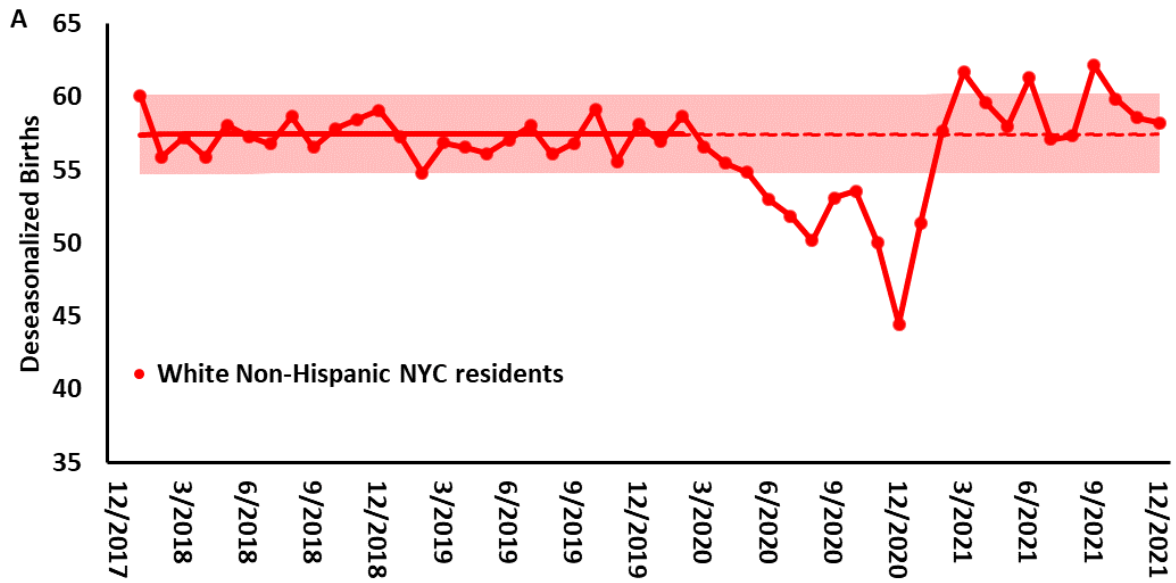**Source: CDC Wonde**r, **See notes to Figure 2.**

Figure A3a: Birth rate to Hispanic New York City residents, January, 2018 – December, 2021.
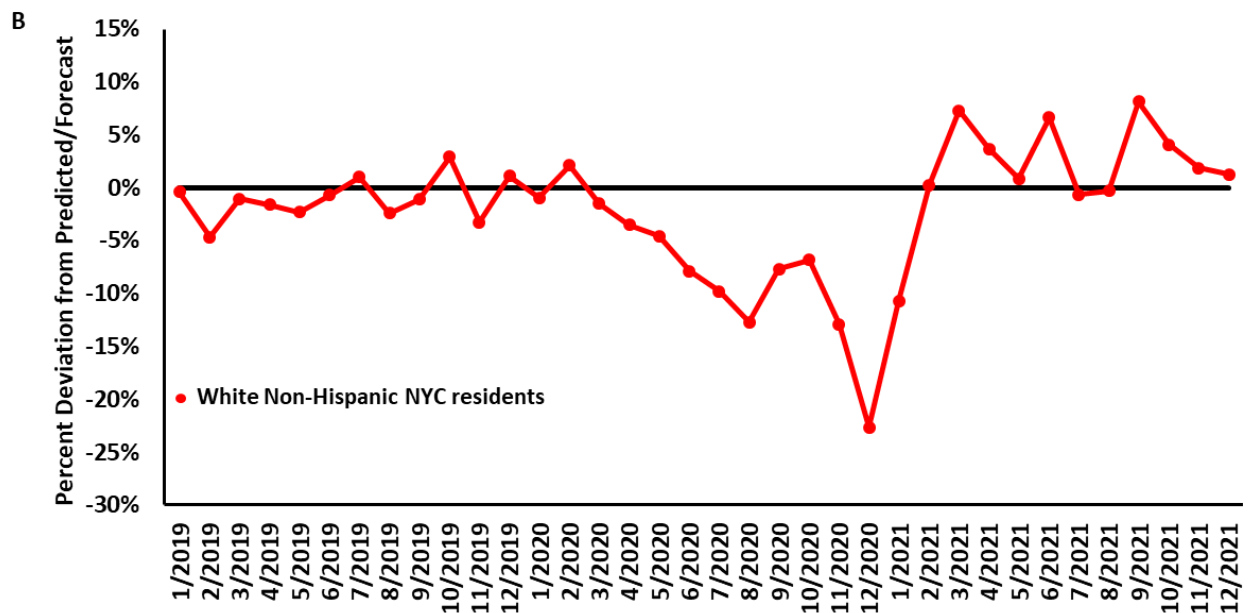

Figure A3b: Percent deviation from projected trends of birth rate to Hispanic NYC Residents, January, 2019 – December, 2021.

Source: CDC Wonder, See notes to Figure 2.

Figure A4a: Birth rate to White New York City residents, January, 2018 – December, 2021.

Figure A4b: Percent deviation from projected trends of birth rates to White NYC Residents, January, 2019 – December, 2021.

Source: CDC Wonder, See notes to Figure 2.