THE PANDEMIC CRISIS AND THE DECLINE OF BIRTHS IN ITALY: A CAUSAL-EFFECT ANALYSIS OF THE PANDEMIC SHOCK [1]

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1. Introduction

The Covid-19 pandemic crisis has affected demographic dynamics, accelerating the depression of births already underway in Italy since 2008 (Mencarini *et al.*, 2022). From the provisional data published by ISTAT, the year 2021 certifies yet another negative milestone of a lower birth rate ever recorded in the history of Italy (Istat, 2022). If in the first ten months of 2020, compared to the same period of the previous year, there was a relatively small drop (-2.7%) and entirely in line with the order of magnitude of the regressive trends that have followed one after the other since 2009 (Blangiardo, 2021), starting in November 2020 there was a sign of a sudden sharp drop in the birth rate, which then continued, with some positive fluctuations, in 2021. In the following study, we show empirical evidence of the pandemic crisis's negative impact on our country's birth rate.

In an already articulated and complex decision-making process, the pandemic and its media narrative have added further layers of uncertainty, causing yet another postponement of life plans (Mencarini *et al.*, 2022). While the pandemic has hit our country particularly hard in terms of deaths, especially among the older generations, the health emergency has also intervened forcefully in demographic behaviour (i.e., having fewer births).

Our study tests the relationship between pandemic shocks and births in Italy. Using monthly data between 2019-2021, we link months of pandemic waves with pregnancy months. Then, through a regional time series analysis, the causal impact of the Covid-19 shock on births is measured. Further, exploiting the pandemic shock, we estimate the difference in the number of borns between high and low-welfare system regions (*Mezzogiorno*) through the difference-in-differences (dif-in-dif) econometric strategies. The results show that the Mezzogiorno regions suffered a greater negative impact than the other regions of about 1.4 percent fewer births.

[1] The introduction, the paragraphs 1.1 and 1.2 were written by Liguori M.A.. The paragraphs 1.3 is written by Feoli F.. The the paragraphs 2.1, 2.2 and the conclusion were written by Fosco G.

The article is organised as follows: Section 1 provides an institutional and historical overview of birth trends and the pandemic. Section 2 shows the impact measurement strategy and results. Section 3 concludes.

2. Institutional and historical framework

2.1. The timing of the pandemic

On 31 December 2019, Chinese health authorities notified an outbreak of pneumonia cases of unknown etiology in the city of Wuhan (Hubei Province, China). On 9 January 2020, the China Centre for Disease Control and Prevention (the China CDC) identified a new coronavirus (provisionally named 2019-nCoV) as the etiological cause of these diseases. On 11 February, the World Health Organization (WHO) called the respiratory disease COVID-19 (Corona Virus Disease). One month later, on 11 March, the WHO, after assessing the severity levels and global spread of the SARS-CoV-2 infection, declared the status of a pandemic for COVID-19.

The World Health Organization counts almost 517 million diagnosed cases worldwide, leading to more than 6 million deaths from the beginning of the pandemic to 15 May 2022. The first two cases of Covid-19 in Italy were confirmed on 30 January 2020 by the Spallanzani Institute. The second case of infection occurred in Codogno, a Lombardy municipality in the province of Lodi, on 18 February 2020. The discovery of new coronavirus cases within national borders and their growth led to a decree on 22 February to quarantine delimited areas in northern Italy. The first weeks of March saw a succession of decree-laws that gradually brought the whole country into a strict lockdown, with the suspension of activities and mobility never seen in the history of the Italian Republic. The national lockdown period ran from 9 March 2020 to 2 May 2020. Later there was a progressive reduction of the restrictions to limit movement and the laws to regulate commercial and private activities.

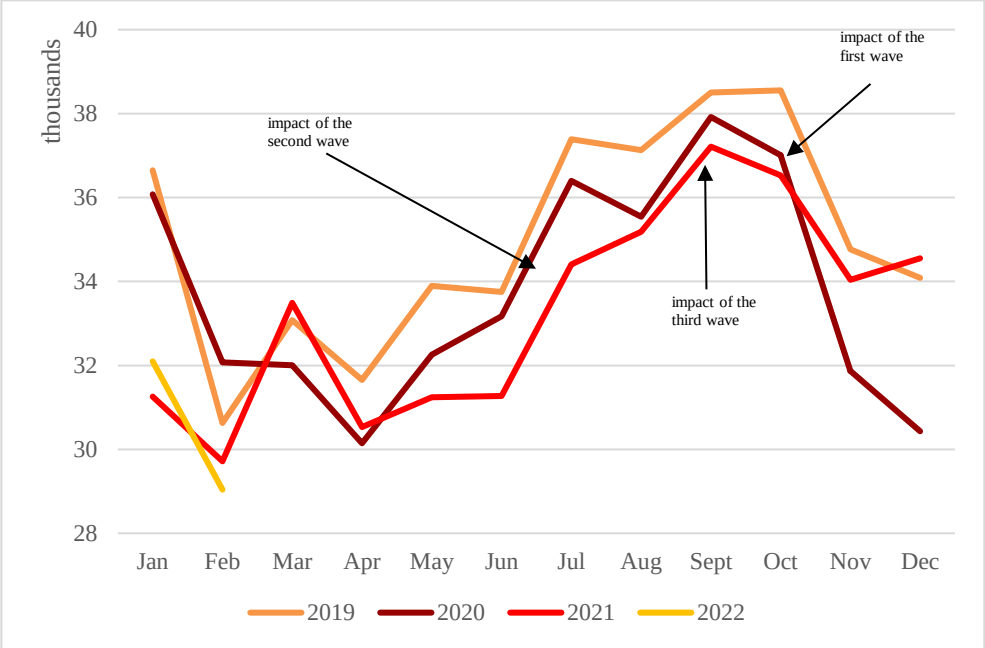
Since the increase in the infection curve, on 8 October 2020, the Italian prime minister reintroduced the previous containment measures, extending the state of emergency up to 31 January 2021. But given the tightening of the crisis, the 6 November 2020, the Italian government introduced additional social distancing measures, which provide a national curfew and containment for differentiated scenarios of infection risk to apply at the regional level, establishing more stringent actions for regions with a high level of infection (i.e., orange and red zones). During the Easter festivities we have witnessed a further reinforcement of the

emergency containment measures that has remained in force until 26 April. Starting from the end of April 2021, a new phase of emergency management began with a gradual reopening of the yellow zones and the introduction of the Covid-19 green certification.

2.2. Births and pandemic waves

The spread of Covid-19 across territories explains the timing and geography of missed pregnancies. The first impact was in November 2020, with an 8.3% reduction in births compared to one year before. In December, the decline was even higher, equal to 10.7%. Then, the trend continued with a slight increase in March 2021. The second wave led to a new drop-in birth in July 2021. Figure 1 highlights the birth decline nine months after the pandemic waves (in the second wave there is only a slowdown in the increase in birth).

Figure 1 – *Births per month - Years 2019, 2020, 2021, 2022 - Values in thousands.*



Source: Istat, Balance of the resident population (provisional data 2021)

Several measures taken at the national and local level to contain the Covid-19 pandemic have had significant consequences on the well-being of citizens in terms

of their economic situation, social, family, and couple relationships, and life plans. Covid-19, along with restrictions on residential mobility and wedding celebrations, has had consequential effects on reproductive choices made in late 2020 and 2021.

According to the study of Boberg-Fazlic *et al.* (2017), the effects of the demographic structure can be classified into biological and behavioural effects. The first includes increased mortality and reduced fertility linked to the physical impossibility of conception due to the mortality or disease status of the fertile population. The latter include voluntary variations in conception choices. For instance, potential parents may postpone births or decide to have fewer or more children due to changing socioeconomic conditions. Hence, Covid-19 has mainly affected the behaviour of young families, aggravating an already difficult situation since it had a scarce biological effect on the fertile population.

In the decision-making of creating a family or choosing to have a child, the relevant factors are employment, the prospects of stability of professional paths, and the possibilities of reconciliation between life and work (Caracciolo *et al.*, 2021).

Aassve *et al.* (2020) claim that Covid-19 could negatively affect fertility in advanced economies due to worsening economic conditions and increase in future uncertainty about them. Authors also hypothesise other adverse effects related to the increased burden of child care due to the closure of educational facilities and worsening access to assisted fertilisation techniques.

Microeconomic evidence confirms that the perception of uncertainty about future conditions is crucial in explaining the pro-cyclical dimension of fertility. For instance, the US's post-World War II baby boom seems to be attributed mainly to a reduction in economic uncertainty linked to the Great Depression and World War II (Chabé-Ferret and Gobbi, 2018). Del Bono *et al.* (2015) point out that job loss induces women to reduce fertility, regardless of how quickly they find a new job.

In sum, the worse economic conditions, the reduction of hospital facilities, and the increased burden of childcare due to Covid-19 increased the uncertainty related to the future (Vignoli *et al.*, 2020). Thus, we hypothesize that these factors, in a decision-making framework, increase the cost of having children and disincentivize the choice, particularly during the pandemic waves, when the economy and health system has suffered more.

2.3. Covid-19, births, and regional-level heterogeneities

During the pandemic, the average number of children per woman decreases in the North (1.16 to 1.14) and equally in the South (1.23 to 1.21). It remains stable at the Centre (1.11). In the North, the Autonomous Province of Bolzano (1.62), followed by the province of Trento (1.27), holds the primacy of Italian fertility. Among regions of the Centre, the highest level is observed in Lazio (1.13) while in Mezzogiorno, the peak is recorded in Sicily (1.30) and Campania (1.28). In comparison, Sardegna reaches a minimum value of 0.94 (Istat, 2021).

In 2018 (pre-covid), the Northern regions once again held the highest fertility record. Above all the autonomous provinces of Bolzano and Trento (respectively 1.72 and 1.45), Valle d'Aosta (1.38) and Lombardy (1.35). While in the Center and in the South the fertility levels were very close (1.23 and 1.26). In Southern Italy, the value was equal at 1.26 (1.29 in 2017), while the Centre felled from 1.27 and 1.23. At the regional level, Sardegna has the lowest fertility level (1.02), still decreasing compared to 2017 (Istat, 2019).

The regional heterogeneity in fertility, and thus, in pregnancy decision-making, is most related to imbalances in the supply of childcare support services of local and regional governments.

The results of a sample survey on educational services for children in Italy - conducted by the Presidency of the Council of Ministers-Department for Family Policies, Istat and Ca' Foscari University of Venice - show that private structures and especially the structures of the South have encountered greater difficulties. Unfortunately, the pandemic has adversely affected the behaviour of parents especially in the South of Italy, where there is a lower propensity to use structured educational services.

Analysing the per capita expenditure of municipalities for kindergarten per 100 children from 0 to 2 years of age (i.e., socio-educational services - Survey on social actions and services of single and associated municipalites), we can observe territorial disparities: on average, Italian municipalities sustained per capita expenditure of 876 euros in 2019 against 299 euros in the South and the 420 in the islands; whereas, the regions that invest more are those in the Centre, with an average expenditure of 1511 euros. The state does not change if we analyse the per-capita amounts of the kindergarten bonus for 100 children from 0 to 2 years old: in Italy, there is a per-capita amount of 179 euros while in the South, 106 euros, in the islands, 120 euros and the Centre 247 euros.

Analysing the educational offer, we see that the Italian coverage of posts authorized for children from 0 to 2 years in 2019 stands at 26.9%, still below the European parameter set at 33%.

At the regional level, we can see that the regions of the North are the ones with the highest coverage, Valle D'Aosta is the region with the highest value (43.9%), also exceeding the European parameter, while there are the regions of the South with the lowest values, Campania and Calabria have values below 11%.

Hence, regional heterogeneity can help us better understand factors affecting pregnancy path variations. In an economic decision-making process, the demand for children may be related to the burden of caring for them. Therefore, we expect that individuals that live in areas supplied by more childcare support facilities are more incentivized to have a child because they bear lower costs of having children, which are offset by the public sector.

3. Methodologies and results

3.1. The pandemic shock on births in each Italian region

The ISTAT database provides updated Italian birth information up to January 2022. In particular, it delivers monthly and annual detail by each Italian region. These data allow us to identify months affected by the main pandemic waves and directly link them with children's conception months.

To address the causal impact of the pandemic, we develop an OLS regression in a time series framework using monthly data for every region from January 2019 to December 2021 to match the timing of the pandemic waves months with the child's conception month (nine months before birth). From a comparative perspective, we consider this time span, in which the emergency takes place in such a way as to compare critical months of the health crises with those less stressed.

Therefore, to quantify the extent of pandemic shock on births in each Italian region, we regress specific-region OLSs for the number of births per thousand inhabitants in each month on an indicator variable $covid_t$ equal 1 in nine months before if a (conception) month was affected by a pandemic wave[2] and 0 otherwise,

$$birth_{r,t} = \alpha_r + \beta_r covid_t + X_{r,t} + \varepsilon_{r,t} \quad (1)$$

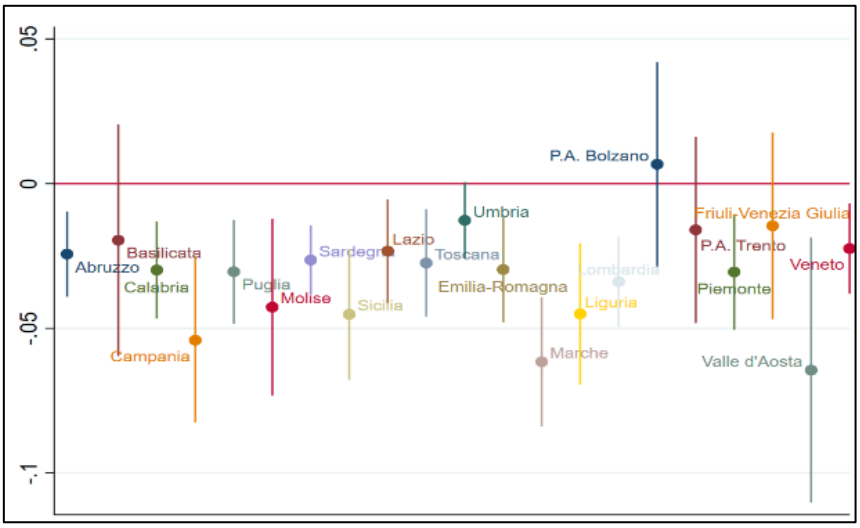
Where $X_{r,t}$ is a vector of control variables that includes a cubic polynomial in the number of months by January 2019 to control long-run trends and a month-

[2] The months affected by pandemic waves are those with the exponential growth of infections, typically, related to a R_t greater than 1. The pandemic waves that occurred in Italy are three. The first goes from February to May 2020, concomitance with the WHO pandemic status declaration. The second one occurred between October and January 2021, and new covid variants characterized it. The third wave was between February and May 2021.

specific fixed effect of controlling for seasonality. These allow us to disentangle from pandemic shock possible confounding factors related to technological changes affecting demographics (Greenwood *et al.*, 2005) and the seasonal cycle of births. The Newey-West standard allows for autocorrelation of order twelve (i.e., one year) is also provided. Therefore, β_r is the region-specific estimate. Consistent estimates of β require that the timing of pandemic waves be uncorrelated with other (omitted) determinants of births in $\varepsilon_{r,t}$.

The β_r is the time series coefficient specific to each region; it represents the mean difference between birth months in which nine months before the child's conception were exposed to the pandemic wave and those who were not exposed to the wave. In quantitative terms, the coefficients point out how many children are born per month for every thousand inhabitants.

Figure 2 – *Pandemic shocks on births in Italian regions- Years 2019, 2020, 2021*



Source: Authors' elaboration on Istat data

Results. Figure 2 shows the differential effect of the covid pandemic waves on births in the Italian areas, based on separate regressions of the birth rate per thousand inhabitants in each region on a measure of the pandemic waves. The plots show the point estimate and confidence intervals of the coefficient of this variable. Newey-West standard errors are used for constructing confidence intervals. The figure shows the region-specific estimated β_r's and the associated confidence intervals. The coefficient is not significantly different from zero for Basilicata, Provincia Autonoma Bolzano, Provincia Autonoma Trento, and Friuli-Venezia

Giulia and is close to statistically significant for Umbria. Further, the Valle d'Aosta point estimate is not precise due to the large confidence intervals.

The results point out that most regions belonging to *Mezzogiorno* are those worst affected by the pandemic shock, exhibiting spikes in the birth rate during the pandemic waves between -0.06 and -0.02 fewer born on average per thousand inhabitants. Therefore, since the statistical significance of the impact also after controlling for other relevant factors, we can conclude that pandemic waves due to Covid-19 represent random shocks.

3.2. Childcare support facilities and regional differences in births

In this next paragraph exploiting pandemic wave shocks, we try to measure the difference in births between *Mezzogiorno* and Centro-Nord regions. Since *Mezzogiorno* regions are historically those with structural weakness in the welfare system, we indirectly investigate the relationship between births during the pandemic period and the lack of the welfare system for childcare services support.

To estimate the impact of the pandemic shock on births in regions with deprived welfare systems in childcare support, we pool data from all regions and use the annual birth rate per thousand inhabitants.

We define the *Mezzogiorno* regions as the treatment group, corresponding to areas with deprived welfare systems in childcare services support, which have the public spending for socio-educational services by municipalities and posts authorized in the socio-educational sector (for children aged between 0-2) lower than their respective median values. Hence, we exploit the control group Center-North regions (above the median) to compare the difference in the number of births. We can thus compare the decrease in births during pandemic periods in regions with and without deprived welfare systems in childcare support, respectively, by estimating the following diff-in-diff specification:

$$birth_{r,t} = \beta \cdot (covid_t \cdot Mezzogiorno_r) + \gamma' X_{r,t} + f_r + f_t + \varepsilon_{r,t} \qquad (2)$$

The dependent variable is the birth rate per thousand inhabitants in region r and year t. The $covid_t$ is the fraction of months in each calendar year related to pandemic waves nine months before (which have contributed to the annual birth rate). The $Mezzogiorno_r$ is our treatment dummy equal to 1 for regions of Italian *Mezzogiorno*, $X_{r,t}$ is a vector of additional determinants of the birth rate, which may be correlated with the treatment group and the timing of pandemic waves (log population, fertility rate, covid positive rate, and covid deaths rate). The estimated coefficient β captures the differential change in births during the pandemic period in regions with deprived socio-educational services in childcare support (i.e., *Mezzogiorno*).

Results. Table 1 shows the differential effect of pandemic waves on births in the *Mezzogiorno* regions. In all columns, except for (4), the dependent variable is the birth rate per thousand inhabitants in each region and year; in column (4), the dependent variable is the logarithm of 1 plus the total number of births in each region and year. The explanatory variable is the interaction between covid, the fraction of months in each calendar year related to pandemic waves nine months before, and an indicator variable *Mezzogiorno*. Region-fixed effects are included in all regressions. In columns (2)-(4), we also have year-fixed effects, the logarithms of GDP per capita and population, and the fertility in each region and year. In columns (3) and (4), the contagion and covid death rates are also included. Robust standard errors to heteroskedasticity are reported in square brackets.

Table 1 – *Pandemic shocks on births across Italian regions.*

	(1)	(2)	(3)	(4)
$covid_t \cdot Mezzogiorno_r$	-0.095	-0.241***	-0.208***	-0.014*
	[0.154]	[0.046]	[0.047]	[0.007]
Control and Year FE	NO	YES	YES	YES
Covid control	NO	NO	YES	YES
N	84	84	84	84

(p < 0.05, ** p < 0.01, *** p < 0.001) - Source: Authors' elaboration on Istat data*

According to the diff-in-diff specification in column (1), which only includes region-fixed effects, the difference in the birth rate between *Mezzogiorno* regions and all others is not statistically significant. This result is affected by including the fertility rate and the log of the population (column (2)), the birth rate in *Mezzogiorno* regions decreases by 0,24 less per 1000 inhabitants (statistically significant at 1%). We also drop $covid_t$ in front of year fixed effect. In column (3), we also include the covid positive rate and covid deaths rate to control pressure on the hospital system. The result is relatively unchanged, as in column (2). In column (5), we re-estimate the same specification for the log of births. The result points out that the birth rate decreased by 1,4% in Mezzogiorno regions during the pandemic waves.

4. Conclusion

A persistently low birth rate accelerates the population's aging process, producing demographic imbalances with substantial negative consequences on economic growth and the welfare system.

The pandemic shock has further reduced births in Italy: our analyses estimate 30 fewer births per month in Italy during a covid wave nine months earlier. The

possible transmission mechanisms are attributable to the uncertainty due to worse economic conditions, the reduction of hospital facilities, and the increased burden of childcare.

Whereas, in the dif-in-dif model that measures the relationship between births and deprived socio-educational services in childcare support, we highlight that the most significant falls were felt in the regions with the lower childcare assistance services: -1.4% in the *Mezzogiorno* regions.

Since the desire to have children remains high (2 additional children per woman as the European average), to reverse the birth rate trend, it is needed for the development strategies of modern societies to focus on an integrated and systemic way on aspects such as reconciling work and family. In particular, by investing in childcare services to reduce the gap between the desire to have a children and actual births.

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SUMMARY

The Covid-19 pandemic crisis has produced effects on demographic dynamics, accelerating the depression of births already underway in Italy since 2008. From the provisional data published by Istat, the year 2021 certifies yet another negative milestone of lower birth rate ever recorded in the history of Italy. In the following study we show new empirical evidence of the negative impact of the pandemic crisis on the birth rate in our country.

In recent years, Italy's birth rate has been among the worst in Europe. The collapse in birth rates is also linked to a widely documented structural phenomenon: the baby-boom generations of women have left childbearing age, replaced by smaller and smaller cohorts born in the baby bust years. In fact, the number of births depends not only on the average propensity to have children, but also on the number of parents of childbearing age.

In an already articulated and complex decision-making process, the pandemic and its media narrative have added further layers of uncertainty causing yet another postponement of life plans. While the pandemic has hit our country particularly hard in terms of deaths, especially among the older generations, the health emergency has also intervened forcefully in demographic behaviour.

Our aim was to check whether there is a link between the pandemic and the decision to have children.

Using updated birth data and pre-pandemic data, we developed a causal effect analysis on regional time series that allowed us to identify the impact of the Covid-19 shock on births, net of structural trends in the phenomenon. Subsequently, we exploited the pandemic shock to estimate its impact on the lower-performing regional family welfare systems (*Mezzogiorno*), through the difference-in-differences (dif-in-dif) treatment effect estimation model.

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