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RESEARCH PAPER

Nonnationals' Fertility and the Great Recession in Italy: A Panel Analysis of Quantum and Tempo Responses

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Abstract
Fertility responses to economic downturns differ among subpopulations. Whether the relationship between employment and fertility varies according to ethnic origin, and if so, how, are issues that have yet to be sufficiently acknowledged in empirical studies. It is well known that economic conditions affect childbearing, but little is known about how macro-level nonnationals' fertility was affected by the economic crisis. This study accounts for the effects by comparing the fertility responses of nonnationals with nationals (in terms of 'quantum' and 'tempo'), while assessing the role of compositional changes on the decline of nonnationals' fertility before, during and after the recession in Italy. It also determines whether and how responses to economic conditions differentially affected the fertility of nonnationals and nationals based on the stage of the recession. We built a regional-level panel dataset for the period 2006–2018 and estimated several ordinary least squares regression models with regional and calendar year fixed effects to control for unobserved regional and period characteristics. Results show that nonnationals' fertility responses were procyclical and more responsive to male than female unemployment. Fertility behaviours also responded to compositional effects, such as the increase in the stock of nonnational women coming from Eastern Europe and mixed marriages. The procyclical effect was stronger after 2009, primarily for nonnationals. Another important finding is that the greatest reduction in fertility was linked to age-specific unemployment among nonnational women aged 20–24 and 25–29. Finally, fertility responses of nationals were weaker independently of the observed unemployment measures.

Keywords Nonnationals · Nationals · Fertility · Unemployment · Great Recession · Regional models

JEL Classification J110 · J130 · J610

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1 Introduction

The Great Recession, which started in the United States (U.S.) in 2007, led to a severe economic downturn in Europe beginning in 2008. While some countries experienced a recovery after 2010, the improvement of economic conditions in Southern Europe was slow and experienced a 3-year delay (Matysiak et al. 2021).

Two trends characterised the first years of the economic recession in Italy: the systematic increase in unemployment rates (URs, which continued to increase even after the recession) and the widespread use of flexible contracts, which further deteriorated job opportunities and conditions. The consistent growth in URs led to one of the strongest (per-capita) income reductions in Europe (De Rose and Strozza 2015), while the growing flexibility in working conditions negatively affected both adult and youth employment levels (Liotti 2020; Mariani et al. 2022). Austerity measures were implemented in 2010, but URs continued to increase, followed by decreasing investment in the public provision of services (Addabbo et al. 2015).

The great economic recession also had a strong impact on immigrants in Italy (Bonifazi and Marini 2014; Fullin and Reyneri 2011; Fullin 2011). Compared to natives, immigrants were more likely to experience limited access to high-skilled jobs and high occupational segregation, which were not dependent on their individual characteristics (Paterno et al. 2016; Fellini 2018).

In addition, during the years of the economic recession, total fertility rates (TFRs) in most European countries declined (Matysiak et al. 2021), particularly among young women (Goldstein et al. 2013; Comolli 2017; Bellido and Marcén 2019) and in Southern European countries where the crisis hit especially strongly (Lanzieri 2013; Garofalo et al. 2018; Ponzo 2021; Benassi and Carella 2022).

Italy was one of the countries in which fertility was already at exceptionally low levels. In fact, it exhibited its '*lowest-low*'[1] fertility around 1992 (Kohler et al. 2002) and had slightly recovered thereafter. However, it maintained what Caltabiano et al. (2009) called '*persistent low fertility*', with TFRs below 1.5 children per woman. The recovery of fertility stopped when the economic recession struck (Cazzola et al. 2016; Vitali and Billari 2017; Zambon et al. 2020), and in the following years, TFRs further declined to the lowest-low levels (1.29 in 2018), which illustrates the important effect economic uncertainty can have on micro-level fertility in Italy (Vignoli et al. 2012; Barbieri et al. 2015; Kim et al. 2015).

Italy is an interesting case to study for several reasons. First, during the crisis, unemployment and fertility were not strongly related—contrary to what was observed in other European countries (Cazzola et al. 2016)—while regional differences were still profoundly marked (Vitali and Billari 2017; Zambon et al. 2020; Egidi and Salvati 2021). Second, in contrast with main European trends, immigration only slowed during the crisis, leaving immigrant population stocks almost invariant (Bonifazi and Marini 2014; Pernagallo and Torrisi 2023). Finally, even though nonnationals' fertility rates had always been systematically higher than those of natives, the reduction of TFRs was sharper among nonnational women (Graham et al. 2016), reaching the lowest value ever registered in 2018 (1.94 children per woman).

[1] A situation in the TFR is lower than 1.3 children per woman (Kohler et al. 2002).

Fertility responses to economic downturns tend to vary among population groups [i.e., based on socioeconomic status, gender and ethnicity; Vignoli et al. (2012, 2019); Kreyenfeld (2016); Bellido and Marcén (2019); Seltzer (2019); Matysiak et al. (2021)]. However, whether the relationship between employment and fertility varies according to ethnic origin, and if so, how, are issues that have yet to be sufficiently acknowledged in empirical studies (Wood and Neels 2017). It is well known that economic conditions affect childbearing, but little is known about how immigrants' aggregated fertility behaviours were affected by the recent economic crisis. Few studies have stressed the role played by international migration and/or ethnicity on fertility during the Great Recession (Seltzer 2019; Sabater and Graham 2019), and most studies on the macro-level relationship have not specifically considered differences between migrants and natives either in Italy (Cazzola et al. 2016; Zambon et al. 2020) or in Europe (Bellido and Marcén 2019; Matysiak et al. 2021; Comolli 2017; Hiilamo 2017; Kotzamanis et al. 2017). Moreover, previous research has somehow neglected the importance of both the 'tempo' and 'quantum' of immigrants' fertility on overall levels of fertility.

The purpose of this study is twofold. We first compare fertility responses to unemployment measures of nonnationals and nationals from 2006 to 2018 at the macro level, with Italian regions as the unit of analysis. This first aim also looks for the possible contribution of compositional effects to fertility responses among nonnationals. Second, we explore whether and how the relationship between fertility and unemployment changed across three different phases of the observation period. These two purposes are connected by two key transversal aims. First, we focus on fertility responses that involve both tempo and quantum measures to examine whether the crisis had differentially impacts on the level or the timing of fertility of nonnationals and nationals. Second, we included several measures of unemployment (overall, male and female) of these groups to search for gender-specific responses to fertility.

This research contributes to recent literature on the subject in several ways. First, it accounts for the fertility responses of nonnationals (individuals without Italian citizenship) to the economic crisis (considering that most of the previous studies were only focused on overall fertility) and compares them to national fertility responses, including a temporal window long enough to evaluate trends and relations during the period under examination. Second, it assesses the role played by compositional changes (share of women according to geographic origin and mixed unions) on nonnationals' fertility during and after the recession. Third, it examines if nonnationals' fertility responses vary according to women's age and if these responses diverge from those of nationals. To this end, we analysed the effect of economic context (Overall, Male and Female Unemployment Rates—OUR, MUR and FUR), compositional changes and the trend of the economic downturn (pre-recession, short-term and long-term post-recession changes) on the 'quantum' (Total Fertility Rates—TFRs) and the 'tempo' of fertility (Age-Group-Specific Fertility Rates—ASFRs).

The remainder of the paper is organised as follows. Section 2 presents the theoretical background and research hypotheses; it explains the main theories and the international state of the art followed by a description of the Italian case and research hypotheses. In Sect. 3 on methodology, we describe the data and variables that were used and then the methods and analytical strategy that was applied. Section 4 presents the results of panel analyses divided according to differences in quantum and tempo fertility responses

for both nonnational and nationals, while Sect. 5 is dedicated to the observed changes over time. Section 6 contains our conclusions.

2 Theoretical Background and Research Hypotheses

2.1 Main Theories and International Review of Literature

A rich body of research based on aggregate-level data has studied the effects of the recent economic recession on fertility responses.[2] As stated by Goldstein et al. (2013), there are wide changes in fertility responses to periods of economic uncertainty depending on the territory (country, state) and the historical period. These changes are either procyclical or countercyclical. There is a procyclical pattern when fertility is reduced in times of economic hardship and births are postponed or forgone. This response was explained by Morgan and Bachrach (2011) by the difficulty of affording the elevated costs of having a child during an economic crisis. Dixit and Pindyck (1994) and Ranjan (1999) have referred to this childbearing standby—in which individuals wait for better times in economic terms—as the income effect. If the relationship is instead countercyclical, fertility increases despite the economic downturn because the rearing cost of children decreases when women are out of the labour market (substitution effect). Given the gendered division of household chores, women may have more time to spend in care and may choose to become mothers (Butz and Ward 1979; Friedman et al. 1994; Alderotti et al. 2021).

Initially, most studies were focused on the United States. Among them, Cherlin et al. (2013) linked increases in unemployment at the state level to declining fertility levels between 2007 and 2009 but not to the pre-recession period. Studies on the European case have recently been expanded. Goldstein et al. (2013) showed that unemployment had a negative effect on fertility rates, which was stronger at younger ages. Authors have also stressed that the impacts of deeper recession and weaker institutional arrangements converged to stimulate a stronger fertility decline in Southern Europe. This result is in line with a study by Bellido and Marcén (2019), which stated that the negative effects of economic downturns can be reduced if welfare systems are generous. Comolli (2017) confirmed that a decrease on TFRs is associated with increasing URs, and this effect was also observed in an analysis of female unemployment. Focused on Finland, Hiilamo (2017) reported that increases in unemployment led to decreasing fertility independently of the measure of unemployment and that the effect was stronger during the Great Recession (2008–2014).

Studies on the relationship between the timing of fertility and economic conditions have shown that fertility responses vary according to women's age (Bellido and

[2] Few studies have investigated the fertility response of immigrants and/or foreigners to the economic crisis. Most of these [see, among others, Andersson and Scott (2007); Wood and Neels (2017); González-Ferrer et al. (2017); Alderotti et al. (2019)]. Philipov et al. (2009) and Balbo et al. (2013) focused their attention on employment and fertility links across ethnic groups using micro-level information. Considering data availability, the huge variability of fertility, migration and unemployment among regions in Italy (Cazzola et. al 2016; Vitali and Billari 2017; Impicciatore and Dalla Zuanna 2017; Zambon et al. 2020) and differences in the impact of the economic recession (De Rose and Strozza 2015; Liotti 2020), we opted for a regional panel empirical research supported by a macro-level theoretical background.

Marcén 2019; Matysiak et al. 2021). Schneider (2015) and Seltzer (2019) similarly reported that the effect of macro-economic conditions on fertility differs by age, with a greater impact at younger ages (20–24, 30–34), which points to birth postponement rather than forgoing. Authors have identified a positive fertility response to increasing unemployment in age groups when childbearing decisions cannot be further postponed (biological clock) even in times of crisis. The most recent study on European regions was conducted by Matysiak et al. (2021), and it estimated a 0.04 decrease on the TFR given a 10 percentage points increase in URs. This fertility decline was stronger among women under 30 and after 2008 due to the accumulation of negative economic developments and the rise in uncertainty about the future.

Bellido and Marcén (2019) included the annual percentage of immigrants (over the total population) to control for diversity of fertility behaviours and differences in fertility responses to unemployment. They showed that the stock of immigrants positively influences fertility rates, while confirming the negative relationship between unemployment and fertility: the higher the unemployment rate, the lower the fertility rate.

Sabater and Graham's (2019) observed a negative relation between fertility and unemployment during the economic recession in Spain. Authors found that, even if immigration decreased, it still had a positive impact on overall fertility.

One of the most important contributions is the study conducted by Seltzer (2019) on the differential influence of macroeconomic conditions on fertility across race and ethnicity in the United States during the Great Recession. The author found that labour market polarisation influenced the fertility levels of all racial/ethnic groups, but the pro-cyclical response of Hispanic women to unemployment was stronger. Age-specific fertility rate models have suggested that economic conditions caused delayed births for women in their 20 s and a negative response for teenage fertility (women aged 15–19) for white and Hispanic women.

2.2 A Focus on the Italian Case

Long after political unification, Italian territories are still characterised by major, persistent and even increasing structural differences in several domains (socioeconomic, demographic, cultural and institutional) that have followed a north–south pattern of divergence over a very long period of time (Ciccarelli and Fenoaltea 2013; Colombo and Regini 2016; Salvati et al. 2017; Del Monte and Pennacchio 2020).

At the regional level, patterns of lowest-low fertility were still part of demographic trends in southern Italy in 2010, while they had been over in central and northern regions since 2008. In 2010, the relationship between the TFR and Gross Domestic Product (GDP) was negative in the provinces of the central area, positive in northern provinces and not statistically significant in southern provinces (Vitali and Billari 2017). The highest TFR was observed in northern Italy in 2010 and was mostly due to the contribution of the fertility of foreign women in these regions. Subsequently, when fertility started declining again between 2011 and 2018, it was more intense in the north than in any other Italian macro region, with high and stable heterogeneity among regional fertility rates during the 1994–2018 period (Zambon et al. 2020).

By plotting changes in TFRs and URs in Europe during the crisis (2007–2012), Cazzola et al. (2016) found one of the most pronounced decreases in fertility in Italy, mixed with a middle reduction in unemployment. Innocenti et al. (2021) confirmed this negative association among Italian provinces, even when controlling for the positive effect of economic complexity on fertility.

Recent analyses have found that the recession's impact followed gender-specific responses, as fertility levels were more dependent on male economic conditions even if sensitive to female unemployment. Women's employment was positively related to fertility levels in some northern provinces, given the higher concentration of immigrants, and negatively related to it in the south (Vitali and Billari 2017).

There has been great variation in the contribution of nonnational population composition to subnational fertility in Italy (Graham et al. 2016). Nonnationals' TFRs have followed a decreasing trend since 2006, which became deeper after the beginning of the crisis. Meanwhile, nonnational URs began to increase after 2009, which might be pointing to a very sensible response of nonnationals' fertility to the worsening of economic conditions.

Several studies have stated the importance of considering that fertility responses to economic downturns might differ among population subgroups and reflect compositional effects (Vignoli et al. 2012, 2019; Kreyenfeld 2016; Bellido and Marcén 2019; Seltzer 2019; Matysiak et al. 2021). This is important to an analysis of the Italian case for several reasons. First, almost half of the recovery of the overall period fertility was attributed to immigrants' fertility (Strozza 2019; Ferrara et al. 2009; Goldstein et al. 2009; ISTAT 2010). Second, period-fertility indicators followed divergent trends between nationals and nonnationals. Third, the timing of reproduction also differs, with nonnational women having children at younger ages. Finally, nonnationals' contribution to fertility varies according to the national origin and gender of who is heading the migratory project (Mussino and Strozza 2012; Giannantoni et al. 2018; Impicciatore et al. 2020).

Regarding differences in reproductive behaviours between nonnationals and nationals as well as compositional effects, Mussino and Strozza (2012) and Fellini (2018) highlighted that despite the stable general trend, the number of nonnationals coming from Eastern Europe increased after the start of the economic crisis. This might be important for at least three well-known reasons. The first regards childbearing because nonnationals' fertility levels vary greatly according to their citizenship (Sobotka 2008; Mussino and Strozza 2012; Giannantoni et al. 2018), and this particular group show very-low fertility levels, as do Italians (Impicciatore et al. 2020; Mussino and Cantalini 2021). The second deals with differential effects that the crisis might have had on unemployment rates of women and men coming from Eastern European countries. In general, nonnational men were hit harder by the crisis (due to overrepresentation in more cyclical positions in the construction and manufacturing sectors) as compared to nonnational women (mainly employed in care-related sectors; Bonifazi and Marini 2014; Del Boca and Venturini 2016; Paterno et al. 2016; Fellini 2018).

Fertility behaviours of nonnationals in Italy have also been linked to the type of union (the second compositional effect). Endogamous and mixed couples have significantly grown in the last decades and show well-differentiated reproductive patterns.

In particular, mixed couples display lower and later fertility and lesser conjugality (Maffioli and Paterno 2008; Maffioli et al. 2012; Guetto and Azzolini 2015).

3 Research Hypotheses

Bearing in mind the existing literature, we observed and compared nonnational with national fertility responses to economic conditions during the 2006–2018 period. We examined fertility responses (TFRs—quantum; ASFRs—tempo) based on the unemployment rate as its main determinant, which we considered overall (men + women—OUR) and disaggregated by gender (men—MUR; women—FUR). The second determinant regarded nonnationals only, and corresponded to compositional effects that we considered through the share of nonnational women coming from Eastern European countries and the proportion of mixed unions among total unions. We then interacted unemployment to the trend of the economic downturn, which was divided in three phases, to search for changes in this relationship over time and across population subgroups (nonnationals and nationals).

We built three main groups of research hypotheses, the first two linked to the first objective of this study and to the first step of its analytical strategy, while the third was related to the second of both. Our first group of research Hypotheses (H1) is referred to as the 'quantum' of fertility (TFRs). In a comparison between nationals and nonnationals, we expected to find different fertility responses between groups; more specifically, nonnational responses might be stronger than those of nationals as they are more vulnerable on a socioeconomic basis and have more precarious job conditions (H1a). With nonnationals, we assumed that the relationship between nonnationals' TFR and OUR would be negative, especially when examining MUR, since men were more penalised by the recession (H1b). We also expected that the sharp decline in nonnational TFRs would reflect compositional effects, especially the increasing shares of nonnational women coming from Eastern European countries and of mixed unions (H1c).

Our second group of Hypotheses (H2) considers the 'tempo' of fertility (ASFRs). In comparing age-specific responses of nonnationals and nationals,[3] we expected to find a pro-cyclical response among nonnational women in contrast with a countercyclical response from national women at the end of their reproductive ages, considering that the process of delaying childbirth has been more pronounced among Italian women—reaching older ages at childbirth—and given that they cannot delay fertility decisions much longer (H2a). Regarding nonnationals age-specific fertility, based on the review of literature and given that foreign women tend to have children at a relatively young age compared to native women, we assumed we would observe a clear postponement of childbearing before age 30 as a response to rising unemployment rates within this group of women (H2b).

Our third Hypothesis (H3) is aimed at searching for differential effects exerted by unemployment measures (OUR, MUR and FUR) and the trend of the recession

[3] We observed nonnational and national ASFRs for Italian regions that were clustered in 5-year age groups (15–19 to 45–49) in relation to all unemployment measures and controlling for compositional effects for nonnationals only.

(considering the three established time periods) on fertility responses of nonnationals and nationals. We supposed that nonnationals' fertility responses to economic shocks might be more dependent on recession trends than those of nationals. Considering that nonnational unemployment rates sharply increased, especially after 2013, and remained high, not yet reaching pre-recession levels in 2018, we expected to observe a stronger negative fertility response to the worsening of economic conditions after 2013 among nonnationals.

4 Methodology

4.1 Data and Variables

We exploited data collected by the Italian National Institute of Statistics (ISTAT) to build a panel dataset for each year included in the observation period (2006–2018) and for each one of the twenty Italian regions.

Data on fertility were drawn from vital statistics. The main variable to measure the quantum effect of recession on fertility was the TFR, disaggregated by mothers' citizenship (nationals and nonnationals[4]) since the available data did not allow for further distinguishing nonnationals by country of citizenship (and/or origin) at the regional level. Aggregated information regarding neither the age at arrival of women nor their length of stay in Italy was available. As stated by Sobotka (2008), in spite of these limitations, TFR remains—in the absence of alternative estimates—an accurate indicator accounting for regional differences in fertility levels.

We also calculated age-group-specific fertility rates for Italian regions (ASFRs: 15–19, 20–24, 25–29, 30–34, 35–39, 40–44, 45–49) by dividing the number of births that occurred in a year to women of the given age at the time of the birth by mean number of females of that age in the reference year. We are aware that in computing ASFR for nonnationals from vital statistics, there could be difficulty resulting from the reliability of the available basic data due to incomplete accounting in the estimations of live births (numerator) and the number of women (denominator), especially in the past. However, the stock of nonnationals in Italy has gained stability over time (Giannantoni et al. 2018), thus reducing the probability of result bias. The stock of registered nonnationals has also been the most stable and numerous during the last years (around 90% of total presences) and the irregularity rate has reached its minimum, steady at around 6–7% (Blangiardo 2017). Therefore, our results can be considered sufficiently realistic.

In a further step of the empirical analyses, substitute TFRs were considered for the ASFRs of each of the 5-year age groups and for each population subgroup as dependent variables on model specifications to account for the tempo effect of recession on fertility and to test for delayed or forgone childbearing (Schneider 2015; Seltzer 2019).

We used unemployment rates to measure changing working and economic conditions of nationals and nonnationals during the observed period. Indicators were

[4] The fertility levels of foreign-born women might be even lower than those of women without Italian nationality (nonnationals in this article) given that in the available data, they are classified as Italian women even if born abroad. According to ISTAT data on the Survey Social Conditions and Integration of Foreign Citizens (SCIF 2011/12), around 4% of foreign-born individuals declared having Italian nationality.

calculated from labour force survey microdata and computed annually as the number of persons without a job but available for and seeking employment divided by the number of persons in the labour force. Later in our analyses, overall unemployment rates (OUR) were separately replaced by male (MUR) and female (FUR) unemployment rates to examine gender-specific responses in the impact of the recession (Comolli 2017; Hiilamo 2017; Bellido and Marcén 2019).

With reference to the relationship between aggregated measures of economic downturns and fertility, previous studies usually lagged economic measures on their analyses.[5] Following the most widespread empirical approach, we included lags of 1 year when examining the impact of URs on TFRs and ASFRs. Therefore, our regional-level dataset merges unemployment measures (OURs, MURs and FURs) for the years 2005–2017 with fertility indicators for the period 2006–2018 and other controls. To compare fertility responses during different phases of the observation period, we empirically built dummy variables to identify three phases (pre-recession: 2006–2008; short-term recession: 2009–2013; and long-term post-recession: 2014–2018).

4.2 Methods and Analytical Strategy

After performing descriptive analyses (see Online Appendix), we estimated several multivariate models. As in previous studies on the influence of worsening economic conditions on fertility at the macro level (Goldstein et al. 2013; Schneider 2015; Comolli 2017; Hiilamo 2017; Bellido and Marcén 2019; Seltzer 2019), we separately estimated for nationals and nonnationals ordinary least squares regression models with entity and time fixed effects on two outcomes: fertility quantum (TFR) and tempo (ASFR). Modelling cross-sectional times-series as panel data allowed us to account for unobserved heterogeneity; that is, to account for the effects of factors not included in the analyses that might influence fertility. Thus, the estimated regression models included calendar year fixed effects (including $t - 1$ years as time dummies) to control for any unobserved influence that varied over time and differently affected Italian regions and region fixed effects (with $n - 1$ regions added as dummies in the model) to control for those unobserved factors that are constant over time but vary among regions[6] (Kohler and Kreuter 2005; Bartels 2008; Bartolucci et al. 2015).

By applying this approach, we can assess the net effect of economic conditions and compositional factors that vary over the period under observation on the fertility-dependent variables (TFRs and ASFRs) within Italian regions, removing the effect of both time-varying omitted variables that are stable across regions and time invariant characteristics that change across regions. As we include time-varying regional level variables, robust standard errors of model specifications were clustered by regions to control for possible result bias from correlation both within and across regions (Bartels

[5] Some authors use 1-year lags (Goldstein et al. 2013; Schneider 2015; Comolli 2017; Hiilamo 2017; Seltzer 2019; Matysiak et al. 2021), while others apply lags of two years (Cherlin et al. 2013; Bellido and Marcén 2019). In line with these authors, we also assume that the error term is uncorrelated with unemployment rates, but we are aware that some endogeneity could remain even after applying this lag.

[6] However, there might still be some unobserved heterogeneity that is not accounted for by these models.

2008). The variables were included once at the time to better capture changes in the influence of unemployment measures[7] on fertility.

The analytical strategy of this research followed two steps that are in line with our research aims and groups of research hypotheses. The first step was comprised of two sets of models aimed at accounting for the effects of economic conditions on nonnationals' fertility during the observation period, thereby testing our first research hypothesis. The first set of models within this step used quantum fertility (TFR) as the dependent variable and overall unemployment and male and female unemployment rates (OUR, MUR and FUR) in turn as the main independent variables, separately for nonnationals (M1–M4) and nationals (M5–M6; Table 2). Only the set of models for nonnationals also included variables intended to control for compositional effects (M3–M4). The inclusion of the annual shares of Eastern European women among the nonnationals' population (PFWEastern) and of mixed marriages (MM)[8] allowed for the testing of the impact of changes in union formation patterns among nonnationals on period fertility reduction and delay (Mussino and Strozza 2012; Giannantoni et al. 2018; Impicciatore et al. 2020; Maffioli and Paterno 2008; Maffioli et al. 2012; Cherlin et al. 2013; Guetto and Azzolini 2015; González-Ferrer et al. 2017; Seltzer 2019). These compositional factors were built as time-varying measures to control for changes in the regional composition of nonnationals that might have affected fertility patterns and were included once at the time to better capture changes in the influence of unemployment measures on fertility.

The second set of models in this first step was intended to approximate tempo effects of economic conditions on nonnationals' and nationals' fertility and test our second research hypothesis. Here, the first group of models were estimated including ASFRs (where each 5-year age group is treated as the dependent variable) and the employment measures under consideration (OUR, MUR, FUR, each one treated in turn as the independent variable), while controlling for composition effects (PFWEastern and MM) only for nonnationals. For the sake of interpretation, coefficients for each group (nonnationals without and with compositional effects and nationals) are separately plotted on Fig. 1 for all unemployment measures considered (OUR, MUR and FUR).

The second step of the analytical strategy focused on examining whether and how the relationship between fertility and unemployment changed over time and to the same extent between nonnationals and nationals, thereby testing our third and last research hypothesis. Therefore, models also included interaction terms between recession stages and unemployment measures to search for period-differential effects on this relationship and to control for region-specific period developments in unobserved variables that might bias results. The first part was dedicated to analysing quantum responses by plotting statistically significant results of the interactions as average marginal effects of unemployment measures (OUR, MUR, FUR) on TFR by recession

[7] Robustness checks, including per capita gross domestic product at current prices to control for economic growth at the regional level, were performed, and they showed similar results with respect to those that were obtained considering only unemployment measures. They are available upon request.

[8] Mixed marriages are those in which one of the spouses is national and the other is not (i.e., national man married to a nonnational woman; national woman married to a nonnational man). This category does not include marriages in which both spouses are nonnationals with different citizenships. In Italy, there are minimal marriages between foreigners of different citizenships (ISTAT 2013).

Table 1 Descriptive statistics for fertility, unemployment, compositional and economic variables by recession periods for nonnationals and nationals

Variable	2006–2008				2009–2013				2014–2018			
	Mean	SD	Min	Max	Mean	SD	Min	Max	Mean	SD	Min	Max
Nonnationals												
TFR	2.667	0.287	1.9	3.3	2.240	0.222	1.7	3.010	1.911	0.192	1.540	2.410
MM	10.038	3.737	3.599	15.390	9.685	3.652	3.333	16.244	10.490	3.938	3.878	17.213
PFWE	16.081	5.689	5.532	28.051	21.532	5.654	9.930	32.245	22.708	5.039	12.244	34.179
OUR	10.522	3.122	5.920	24.138	11.756	3.164	5.556	19.977	17.218	4.070	5.926	27.297
MUR	8.191	4.175	6.615	20	9.954	3.636	1.351	20.471	16.476	4.521	5.147	29.834
FUR	13.011	7.443	5.736	33.333	14.058	3.977	5.195	25.325	18.204	4.984	4.237	29.114
Nationals												
TFR	1.264	0.107	1.060	1.520	1.281	0.101	1.080	1.520	1.229	0.103	1	1.540
OUR	7.135	4.216	2.339	16.489	8.247	4.220	2.420	19.063	11.678	5.709	3.632	23.750
MUR	6.168	4.159	1.535	17.550	7.203	4.006	1.771	17.846	10.919	5.555	3.421	22.244
FUR	8.287	4.785	2.460	18.818	9.766	4.845	3.183	22.116	12.726	6.171	3.874	26.089
GDP_log	10.774	1.087	8.378	12.728	10.809	1.087	8.418	12.789	10.822	1.107	8.439	12.861

Source: Own elaboration, panel data

stages,[9] separately as independent variables of interest for nonnationals and nationals (Fig. 2). The second instead dealt with age-specific responses ('tempo', with each 5-year age group treated as the dependent variable) and graphically compared average marginal effects of unemployment measures (OUR, MUR, FUR) on ASFR by recession stages resulting from model interactions (Fig. 3).

Table 1 summarises average values for dependent and independent variables during the three recession phases considered in our analyses. The figures confirm the high temporal variation in regional fertility of nonnationals (TFRs), which has been accompanied by a pretty stable fertility of nationals between 2006 and 2018. Another interesting aspect arises from comparing nationals and nonnationals' fertility: TFRs of nonnationals are converging over time across regions—given the reduction of the standard deviation (SD) between periods—while TFRs of nationals have become more heterogeneous. There is also an important temporal variation in unemployment measures of nonnationals and nationals: rising after the start of the Great Recession, increasing the most between 2014 and 2018 and particularly sharp for nonnationals (OUR). Again, interesting differences between groups arise. First, the magnitude of the rise in unemployment is more gender balanced among nationals, while among nonnationals, it is significantly higher for men than for women.

5 Fertility Responses of Nonnationals and Nationals to Unemployment

5.1 Differences in Quantum Effects

The results of our main models on the relationship between 1-year lagged unemployment measures (OUR, MUR, FUR) and TFRs in Italy during the period 2006–2018 are presented in Table 2. There are six model specifications for each unemployment measure, four for nonnationals and two for nationals, as follows: M1 and M5 are baseline models without controls; M2 and M6 include region and calendar-year fixed effects and robust standard errors clustered by regions; and M3 and M4 (for nonnationals only) add compositional effects once at the time.

Results for OURs of nonnationals show that in the baseline (M1), as unemployment increases by one percentage point, the respective TFR decreases by 0.038. This negative association is also found when including fixed effects and clustered robust standard (M2), but the strength of the relationship grows to approximately 0.045.

As stated by previous studies (Sobotka 2008; Mussino and Strozza 2012; Giannantoni et al. 2018), given the highly dependent nature of the intensity of nonnationals' fertility on their citizenship, the sharp decline in TFRs might be reflecting changes that occurred in its composition by national origin. This is particularly important when considering that the composition of women coming from Eastern Europe has recently increased, and their fertility levels are basically equal to or even lower than those of Italians (Impicciatore et al. 2020; Mussino and Cantalini 2021). To test for

[9] Average marginal effects plotted in Figs. 2 and 3 should be interpreted as the different estimated levels of fertility associated with a unit change in the corresponding unemployment measure for each one of the recession stages.

Table 2 Fixed-effects regression models of nonnationals' and nationals' total fertility rates (TFRs) by overall, male and female unemployment rates (OUR, MUR, FUR) between 2006 and 2018 for Italian regions

Variables	Nonnationals				Nationals	
	M1	M2	M3	M4	M5	M6
OUR	− 0.038***	− 0.045***	− 0.029***	− 0.027***	− 0.003**	− 0.009***
	(0.005)	(0.007)	(0.005)	(0.004)	(0.001)	(0.002)
PFWEastern	–	–	− 0.0689***	− 0.0686***	–	–
	–	–	(0.00521)	(0.00463)	–	–
MM	–	–	-	− 0.0303**	–	–
	–	–	-	(0.0109)	–	–
Constant	2.728***	2.819***	4.038***	4.314***	1.279***	1.335***
	(0.064)	(0.092)	(0.106)	(0.148)	(0.013)	(0.018)
Region FE	NO	YES	YES	YES	NO	YES
Year FE	NO	YES	YES	YES	NO	YES
Observations	256	256	256	256	256	256
R-squared	0.22	0.305	0.723	0.737	0.019	0.239
N		20	20	20		20
MUR	− 0.033***	− 0.037***	− 0.024***	− 0.023***	− 0.003**	− 0.008***
	(0.004)	(0.005)	(0.003)	(0.003)	(0.001)	(0.002)
PFWEastern	–	–	− 0.0689***	− 0.0685***	–	–
	–	–	(0.00529)	(0.00465)	–	–
MM	–	–	–	− 0.0333***	–	–
	–	–	–	(0.0110)	–	–
Constant	2.607***	2.662***	3.935***	4.314***	1.279***	1.324***
	(0.05)	(0.06)	(0.109)	(0.148)	(0.0123)	(0.0140)
Region FE	NO	YES	YES	YES	NO	YES
Year FE	NO	YES	YES	YES	NO	YES
Observations	256	256	256	256	256	256
R-squared	0.232	0.301	0.736	0.737	0.021	0.261
N		20	20	20		20
FUR	− 0.020***	− 0.027***	− 0.017***	− 0.016***	− 0.002*	− 0.006***
	(0.004)	(0.007)	(0.004)	(0.004)	(0.001)	(0.001)
PFWEastern	–	–	− 0.0740***	− 0.0732***	–	–
	–	–	(0.0056)	(0.00468)	–	–

Table 2 (continued)

Variables	Nonnationals				Nationals	
	M1	M2	M3	M4	M5	M6
MM	–	–	–	− 0.0382**	–	–
	–	–	–	(0.0148)	–	–
Constant	2.520***	2.630***	4.011***	4.363***	1.277**	1.322***
	(0.063)	(0.102)	(0.116)	(0.163)	(0.014)	(0.016)
Region FE	NO	YES	YES	YES	NO	YES
Year FE	NO	YES	YES	YES	NO	YES
Observations	256	256	256	256	256	256
R-squared	0.0970	0.164	0.7721	0.689	0.0141	0.142
N		20	20	20		20

Robust Standard Errors in parentheses; ***p < 0.01, **p < 0.05, *p < 0.1

this, M3 included the annual share of Eastern European women over nonnationals. As shown, a one percentage point increase in this share entails a decrease of TFR of almost 0.069, and its inclusion significantly reduces the magnitude of the association between unemployment and fertility (to − 0.029).

The addition to the empirical analyses in M4 of the share of mixed marriages (as a percentage of total marriages) is relevant because differences in fertility behaviours by couple type may also be reflecting differences in fertility responses to unemployment. Previous studies (Maffioli and Paterno 2008; Maffioli et al. 2012) have shown that marriages in which husband and wife have different citizenships (one Italian and one foreign or both foreigners) tend to have lower fertility than those sharing the same citizenship (both Italian or both foreigners). Estimated coefficients are presented in M4, and as expected, the higher the share of mixed marriages, the lower the TFR (b = − 0.0303).

Nationals' quantum fertility responses to OURs are displayed in M5 and M6. The baseline model (M5) also confirms the negative association between TFR and unemployment among nationals during the observed period, but coefficients are significantly smaller. M6 (with fixed effects) shows that in the whole period 2006–2018, a one percent increase in nationals' OUR was associated with a reduction of 0.009 in TFRs the following year.

To disentangle gender-differentiated responses, we also investigated the role played by male and female unemployment rates (Table 2: MUR and FUR). For nonnationals, we found that there was a significant negative relationship between both male and female unemployment and fertility between 2006 and 2018, after adjusting for calendar year and region fixed effects (Table 2, MUR M2: b = − 0.037; FUR M2: b = − 0.027). The influence of both the shares of Eastern European women and mixed marriages on nonnationals' TFR remains negative and significant, regardless of the employment measure adopted (Table 2: MUR and FUR, M3 and M4, respectively). These coefficients show a much more sensitive response of nonnationals' fertility to

MUR than to FUR. In fact, as MUR increases by one percentage point, nonnationals' TFR decreases by 0.023; instead, a percentage-point rise in FUR is associated with a smaller decrease in TFR (b = − 0.016). Nationals' fertility was also more sensitive to male (MUR: M5 b = − 0.003) than to female unemployment (MUR: M5 b = − 0.002), but again, the effects were smaller than for nonnationals. This gender-specific response of nationals' fertility gets stronger when adding fixed effects (MUR: M6 b = − 0.008 vs FUR: M6 b = − 0.006).

5.2 Differences in Tempo Effects

We verified if fertility responses to unemployment varied according to women's age, estimating the influence of unemployment on age-group-specific fertility rates. Each one of the coefficients displayed in Fig. 1 examines the relationship between the respective ASFR and OUR, MUR and FUR, separately for each of the following model estimations: nonnationals without controls (NN) and while controlling for composition effects (NN_c); and nationals.

Among nonnationals, OURs' effects were highly significant for fertility of women between 15 and 29 years old. However, there are important differences regarding its magnitude that deserve to be highlighted. After controlling for composition effects (NN_c), the largest negative influence of unemployment on fertility was still observed among women aged 20–24 (b = − 1.568), followed by those aged 25–29 (b = − 0.455). A still significant but much smaller association was found among the youngest women (ages 15–19, b = − 0.102). It is interesting that the relationship between unemployment and fertility for women aged 35–39 is positive (b = 0.176), indicating a countercyclical response of this age group, even in times of crisis.

Unemployment levels positively influenced fertility responses of national women aged 40–44 (b = 1.238) and 45–49 (b = 0.139), as they did not show signs of deferral in any age group.

When comparing gender-specific responses, the positive impact of FURs on fertility was stronger than the impact of MURs for nonnational women aged 35–39 (b = 0.178 vs b = 0.105, respectively), while the fertility levels of nonnational women aged 15–19, 20–24 and 25–29 were negatively related and much more sensitive to male than to female unemployment.

Among nationals, the positive impact was also stronger for older age groups (40–44 and 45–49) when considering FUR (b = 1.163 and b = 0.130, respectively) rather than MUR (b = 1.031 and b = 0.117, respectively). This illustrates a different picture if compared to age-specific fertility responses of nonnationals to unemployment, in which the postponement of childbearing linked to unemployment is clearcut. In fact, countercyclical age-specific fertility responses were observed among national women after their 40 s and among nonnational women between 35–39, while procyclical responses were observed only for nonnational women (not for nationals) between 15 and 29 years old.

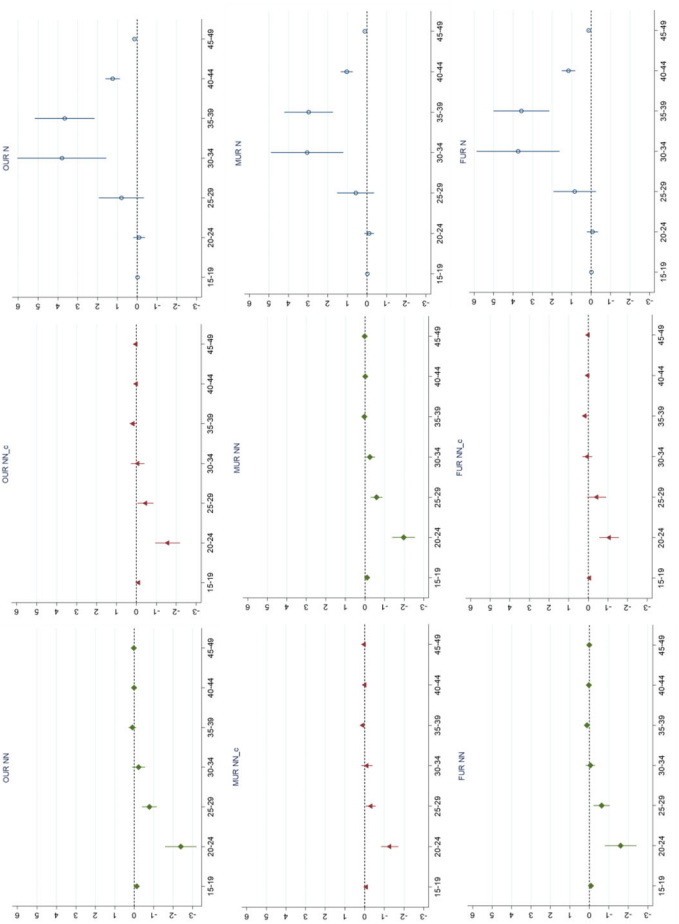

Fig. 1 Coefficients from fixed-effects regression models of nonnationals' (NN, NN_c) and nationals' (N) age-specific fertility rates (ASFR) by overall, male and female unemployment rates (OUR, MUR, FUR) between 2006–2018 for Italian regions (80% CI). Not all results are statistically significant. Models for nonnationals control for compositional effects in NN_c. Full models in Appendix (Tables 3, 4, 5)

6 Changes Over Time in Nonnationals' and Nationals' Fertility Responses

This section is aimed at examining whether the observed relationship between fertility responses to unemployment of nonnationals and nationals changed over time, and if so, how, by adding interaction terms between unemployment measures and recession phases.

As regards quantum responses of nonnationals over time (Fig. 2), interaction terms between recession periods and unemployment are negative and highly significant, suggesting that OURs between 2009–2013 and 2014–2018 were negatively associated to fertility and were not positive because it was during the pre-recession period (2006–2008; Fig. 2: OUR-NNs). The link between male unemployment (Fig. 2: MUR-NNs) and fertility is pretty similar (in terms of the magnitude of the coefficients of the interactions) to that found when using OUR, but coefficients are slightly higher. Fertility responses of nonnationals to female unemployment (Fig. 2: FUR-NNs) are also negative, but coefficients are smaller and less variable than those observed when using OUR and MUR as independent variables. These findings are again suggesting

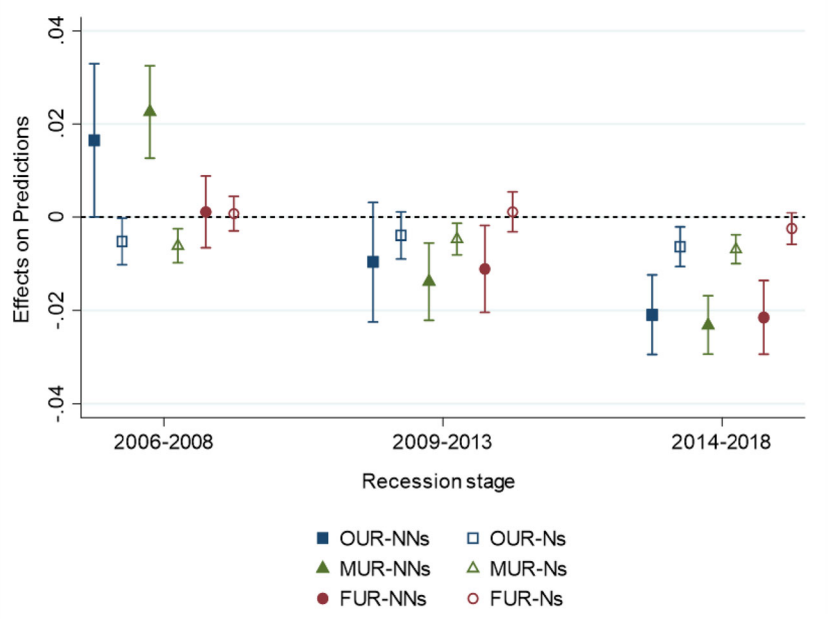

Fig. 2 Average marginal effects of selected unemployment measures (OUR; MUR, FUR) on TFR of nonnationals (NNs) and nationals (Ns) by recession stage resulting from model interactions (95% CI). Statistically significant interactions are those of OUR-NNs, MUR-NNs, FUR NNs and FUR Ns. Models for nonnationals control for compositional effects. Full models in Appendix (Table 6)

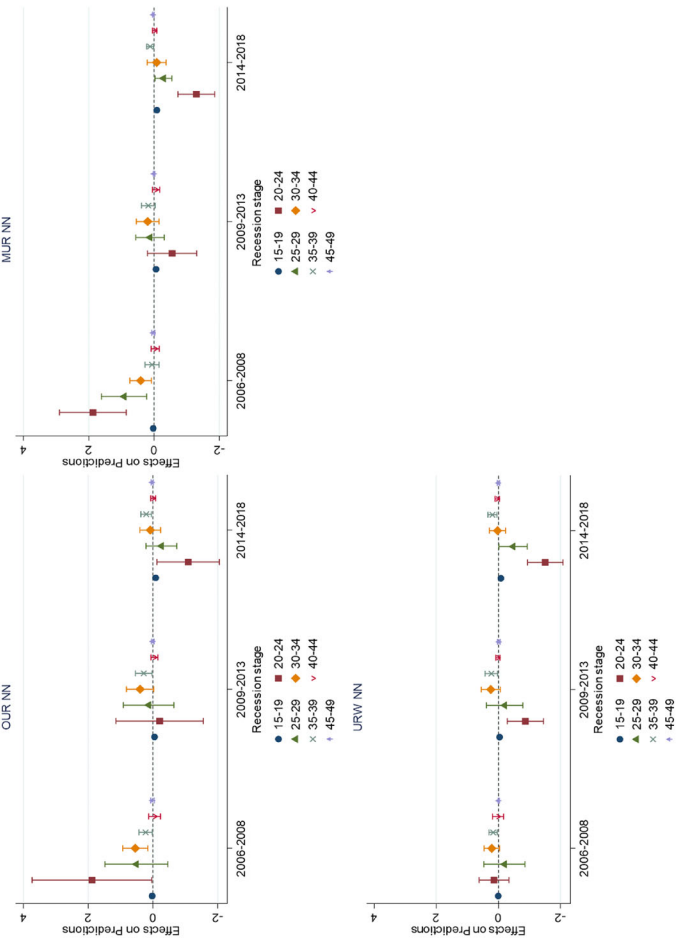

Fig. 3 Average marginal effects of selected unemployment measures (OUR; MUR, FUR) on ASFR of nonnationals by recession stage resulting from model interactions (95% CI). Statistically significant interactions are those of OUR-NN (20–24, 25–29, 30–34), MUR-NN (15–19, 20–24, 25–29, 30–34), FUR NN (15–19, 20–24, 30–34). Models for nonnationals control for compositional effects. Full models in Appendix (Tables 7, 8, 9)

a procyclical behaviour of nonnationals' fertility after 2009,[10] and particularly after 2013, but a much more sensitive fertility response to MUR than to FUR.

In contrast, period interactions for nationals are only statistically significant when considering FUR, which is negative after 2013 (Fig. 2: FUR-Ns). This indicates a stronger negative response of nationals' fertility rates to female unemployment during 2014–2018 if compared to the previous stages under examination (2006–2008 and 2009–2013). Again, national fertility over time has also been less responsive to economic downturns than nonnational fertility independently of the unemployment measure examined. This is also illustrated by the smaller coefficients obtained when examining OUR and MUR (even if coming from not statistically significant interaction terms).

About tempo responses, in general, after age 35, coefficients are not significant and closer to zero for nonnational women. Only interactions of nonnationals at certain age groups were statistically significant. Again, the largest influence of unemployment on fertility was observed among women aged 20–24 (Fig. 3, OUR). The relationship between OUR and age-specific fertility of this group was negative after 2009, getting stronger between 2014 and 2018. These time effects were also present but smaller for women aged 25–29 and 30–34. There has been a clear postponement of fertility for these women in response to the worsening economic conditions, but results are not yet showing signs of a recovery on its tempo.

We also tested the deferral of nonnational fertility using gender-specific URs. Results are displayed in Fig. 3 (MUR and FUR).[11] Again, as found in the analysis of TFRs, the associations between MURs and ASFRs are almost identical to those observed for OURs. Differences in the magnitude of coefficients between OURs and MURs are higher for specific fertility of women aged 20–24 and 25–29, especially after 2009. Nonnationals' age-specific responses to female unemployment were also negative between 2009 and 2018, with women aged 20–24 once more showing the strongest fertility response. Less important but still significant associations over time were found among the youngest age group (15–19) for both measures (MUR and FUR).

7 Discussion and Conclusions

This paper examines and compares the relationship between nonnationals' and nationals' fertility behaviour (in terms of quantum and tempo) and unemployment at the macro level in Italy between 2006 and 2018. Confirming our expectations, we found significant differences when comparing fertility responses of nonnationals and nationals with their respective unemployment rates.[12] Regarding quantum, and in line with the first hypothesis of this group (H1a), the influence of all measures of

[10] Robustness checks performed (Online Appendix, Table I) that geographically disaggregate the analysis of the quantum show similar results for nonnationals despite the macro area of residence (North, Center, South).

[11] As shown in Table II of the Online Appendix, as part of a series of robustness checks that were performed (which control for compositional effects of population and marriages as well as per capita GDP), the pattern seems very robust when considering the whole period 2006–2018.

[12] The empirical analysis of macro data allowed us to examine gross effects of aggregate unemployment measures on fertility responses. Further developments on this subject should consider both individual and

unemployment is procyclical between nonnationals and smaller for nationals than for nonnationals (as shown by differences in the magnitude of coefficients and R2 values of model specifications). This finding is in line with Seltzer (2019), one of the few studies that has directly examined this link for ethnic groups.

It is interesting that the procyclical relationship between nonnationals' fertility and unemployment is also maintained when female and male unemployment rates are separately investigated. However, nonnationals' fertility responses to male unemployment were stronger that to female unemployment, thus confirming our H1b research hypothesis. This broadly supports previous research on the important role played by gender-specific unemployment measures on the reduction of overall fertility in Europe between 2000 and 2013 (Comolli 2017; Hiilamo 2017).

Our results report that nonnationals' fertility behaviours also respond to compositional effects (confirming H1c). First, the increase in the stock of nonnational women coming from Eastern European countries has been negatively affecting their TFRs. This result is in line with previous research highlighting that compositional changes might affect nonnationals' fertility (Cherlin et al. 2013), as the overall level of fertility of Eastern European women is lower if compared to other nonnational women and is much like that of Italian women (Impicciatore et al. 2020; Mussino and Cantalini 2021). Second, our findings confirm those of Maffioli and Paterno (2008) and Maffioli et al. (2012) that mixed marriages have lower fertility than endogamous marriages, as higher shares of this type of union correspond to reduced TFRs.

Another important finding is the varying nature of nonnationals' and nationals' fertility responses according to women's age. Comparing these tempo effects, and confirming our H2a research hypothesis, we found a procyclical response of younger nonnational women and a countercyclical response of national women in their 40 s and no effects for younger ages. This result is in line with previous studies (Schneider 2015; Bellido and Marcén 2019) that observed a reversal on the relationship between fertility and economic conditions (from procyclical to countercyclical) with the ticking of women's biological clock.

As suggested by our hypothesis of postponement of births among nonnational women (H2b), the greatest reduction of fertility linked to unemployment was observed among women aged 20–24, followed by those aged 25–29. There are similarities between the age-specific fertility pattern found in this study and the one described by Seltzer (2019), who reported the largest effect sizes for all racial/ethnic groups among women in their 20 s.

Dissimilarities observed in quantum and tempo of fertility between nonnationals and nationals might suggest, as highlighted by Goldstein et al. (2013) and Bellido and Marcén (2019) in pondering the role of welfare systems on fertility trends during economic hardship, that contextual issues influencing institutional settings and regional labour markets might differently affect reproductive behaviours of individuals according to their origins. We showed that even if contemporaneously living the different phases of the Great Recession, nationals' and nonnationals' childbearing decisions in times of economic austerity are diverse. Unfortunately, due to data limitations, we are

Footnote 12 continued
regional unemployment in a multilevel setting to properly identify income or substitution effects while comparing nonnationals' and nationals' responses.

not able to disentangle either the mediator effect that public policies might have on the decision to have a child in times of economic crisis or the differential impact that such measures might have on different population groups (such as nonnationals or among them) at the regional level.

Regarding changes over time on the relationship between fertility responses and unemployment between nonnationals and nationals, the current study corroborates a procyclical response for the period as a whole but, as hypothesised (H3), with important differences across groups for both quantum and tempo fertility measures. For nonnationals, we observed a stronger negative effect in the second phase (2009–2013) and an even stronger effect in the third (2014–2018) as compared to the first phase (2006–2008) prior to the kick off of the recession. This outcome is in accordance with the results of Matysiak et al. (2021), demonstrating that the reduction of fertility in Europe due to the worsening of economic conditions was much stronger during the economic recession than during the pre-recession period. It is interesting that the relationship between fertility (in terms of TFR) and OUR or MUR was positive before the economic crisis struck, becoming negative in the following stages. This change might have something to do with the 'significance' of unemployment among nonnationals and with the possibility that unemployment might have had different influences on fertility before entering a period in which the economic conditions were worse for all, but especially so for nonnational men—given that they were more likely to work in the economic sectors that were harder hit by the crisis (Bonifazi and Marini 2014; Del Boca and Venturini 2016; Paterno et al. 2016; Fellini 2018).

The relationship between unemployment and fertility among nationals remained basically unchanged between 2006 and 2018, except for female unemployment, which had a stronger effect in the last period (2014–2018). Results confirm that nonnationals' fertility responses gained strength over time independently of the unemployment measure applied.

Moreover, as reported for the quantum effect, this negative tempo response for nonnational women aged 20–24, 25–29 and 30–34 was stronger after 2009, particularly between 2014 and 2018. Thus, such an intense postponement of childbearing as a response to unemployment was not limited to the short term; instead, it continued well after the hardest years of the economic recession and still does not show any signs of recovery. It is highly likely that such a strong and sustained delay will negatively influence nonnationals' completed fertility, but to be able to evaluate the hypothesis of forgone births, it would be necessary to observe their entire reproductive biographies after women have closed their reproductive lives.[13]

There are several possible explanations for the strong reduction and the intense delay of nonnationals' fertility in Italy. The first could be related to the accumulation of disadvantages and the increasing uncertainty about the future in this country that followed the start of the Great Recession. The second might be reflecting, as stated by González-Ferrer et al. (2017), the combination of work-related migratory trajectories and the lack of policies aimed at conciliating family and working life. Finally, fertility of migrant women tends to assimilate—over time—to natives' fertility (Mussino and

[13] Changes in the tempo of fertility can at least partially be read throughout age-specific fertility rates. However, since these rates belong to different individuals, they might not accurately capture delay or catch-up effects (Bratti and Tatsiramos 2012). This caveat is common to most research using macro data.

Strozza 2012; Gabrielli et al. 2017; Giannantoni et al. 2018; Impicciatore et al. 2020) and, therefore, further reductions and delays in fertility might persist as migration arrives to a more mature phase.

Our study highlights the importance of considering differential responses of nationals and nonnationals to economic shocks in current debates and policies on fertility (Guzi et al. 2021; Solano and De Coninck 2022), especially in high-immigration, low-fertility countries—such as Italy—given that important structural changes might not be visible by observing overall fertility and unemployment alone. Unfortunately, there is little evidence on how nonnationals react to family policies and on whether there are differential fertility responses to such policies between nonnationals and nationals. Some studies on Sweden (Andersson et al. 2017: Mussino 2022)—a country with a considerably larger degree of universalism in benefits as compared to Italy—have called attention to the necessity to consider that the reactions (in terms of fertility) of immigrant families when exposed to different policies (such as parental leaves and earnings-based benefits) tend to be highly heterogeneous.

Despite its contribution, our research is not free from limitations, which are mostly due to data shortcomings. The lack of availability of estimated births of nonnational women by citizenship and birth order at the regional level did not allow us to calculate either stratified TFRs or stratified ASFRs. Access to this information is crucial for understanding how the differential impacts of economic shocks according to origin affect nonnationals' fertility behaviours, not only for understanding variations in the effect of economic conditions by parity but also for identifying parity-specific underlying mechanisms. We are also fully aware that the use of population register data to compute nonnationals TFRs and ASFRs could result in some over coverage because it could affect the rates' denominators given that individuals may have left the country without deregistering (Monti et al. 2020).[14] Available data do not let us to control for any of the following aspects: age at migration, length of the stay, birth order, number of children had on arrival and the migratory model (linked to family reunification or work reasons) which are well known determinants of fertility behaviours on destination countries (Toulemon 2004; Toulemon and Mazuy 2004; Impicciatore et al. 2020; Mussino and Strozza 2012).

Unfortunately, we were not able to verify if nonnational women who arrive after their thirties have the lowest likelihood of having a child in Italy given that they generally become mothers before leaving their countries of origin, as demonstrated by recent studies based on individual data, and whether women whose migratory project is signed by working reasons rather than familiar reasons tend to postpone or even forgo their reproductive choices (Giannantoni and Gabrielli 2015; Gabrielli et al. 2017). However, in our opinion, there are no reasons to doubt that observed age-specific fertility responses (stronger at young ages) seem to be further stressing the postponement rather than the forgoing of childbirth among nonnational women.

[14] The over-coverage might be affecting the denominators of fertility rates, independently of the origin. Despite the former, the estimation of such rates is still done by competent institutions (i.e., national statistics institutes, international institutions) using population register data. Some efforts have been made to identify alternative ways to compute fertility rates (i.e., Bordone et al. 2009) but even these are not free from limitations.

Our results might also be affected by migrants' self-selection, particularly if we consider that their responses to unemployment might relate not only to fertility but also to remigration (internal or to another host country) or a return to the country of origin, which remain understudied subjects in the literature. One of the main reasons behind this gap is the lack of data because survey panel data (including a specific migrant sampling) and/or linked data (survey and register data) is needed to shed some light on these issues but is unlikely to be available. The few studies focused on these subjects tend to confirm our findings, but we still maintain it is necessary to include a brief debate in this regard. In general, spells of unemployment tend to increase the return probabilities among immigrants, while spells of reemployment delay their return intentions (Bijwaard et al. 2014). Regarding economic downturns, Papademetriou and Terrazas (2009) showed that the economic recession increased migrants' likelihood of returning to their countries of origin after experiencing unemployment and decreasing wages. It has been demonstrated that immigrant men are most vulnerable to the adverse effects of unemployment as compared to both natives and immigrant women (Leopold et al. 2017) and that migrants face larger costs of job loss as compared to natives in terms of both earnings losses and reemployment probabilities (Illing and Koch 2021).

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Declarations

Conflict if interest The authors have no relevant financial or non-financial interests to disclose.

Research involving human participants and/or animals Not applicable.

Informed consent Not applicable.

Appendix

See Tables 3, 4, 5, 6, 7, 8, and 9.

Table 3 Fixed-effects regression models (without composition controls) of nonnationals' age-specific fertility rates (ASFR) by overall, male and female unemployment rates (OUR, MUR, FUR) between 2006 and 2018 for Italian regions

Variables	M1 15–19	M2 20–24	M3 25–29	M4 30–34	M5 35–39	M6 40–44	M7 45–49
UR	− 0.130***	− 2.396***	− 0.780***	− 0.225	0.0955	0.00915	0.0217
	(0.0205)	(0.388)	(0.184)	(0.158)	(0.0914)	(0.0363)	(0.0145)
Constant	4.827***	152.1***	129.9***	90.80***	47.35***	13.06***	0.627***
	(0.279)	(5.281)	(2.501)	(2.146)	(1.244)	(0.494)	(0.197)
Observations	256	256	256	256	256	256	256
R-squared	0.261	0.250	0.096	0.021	0.007	0.000	0.017
Number of id	20	20	20	20	20	20	20
MUR	− 0.106***	− 1.969***	− 0.590***	− 0.246*	0.0371	− 0.0102	0.0219
	(0.0160)	(0.276)	(0.146)	(0.129)	(0.0682)	(0.0260)	(0.0136)
Constant	4.337***	143.3***	126.4***	90.73***	48.20***	13.31***	0.657***
	(0.194)	(3.342)	(1.770)	(1.559)	(0.826)	(0.315)	(0.165)
Observations	256	256	256	256	256	256	256
R-squared	0.246	0.241	0.078	0.035	0.002	0.000	0.025
Number of id	20	20	20	20	20	20	20
FUR	− 0.0784***	− 1.604***	− 0.628***	− 0.0518	0.127*	0.0281	0.00650
	(0.0205)	(0.389)	(0.200)	(0.117)	(0.0733)	(0.0522)	(0.00897)

Table 3 (continued)

Variables	M1 15–19	M2 20–24	M3 25–29	M4 30–34	M5 35–39	M6 40–44	M7 45–49
Constant	4.269***	144.2***	128.9***	88.54***	46.69***	12.75***	0.822***
	(0.317)	(6.014)	(3.085)	(1.809)	(1.132)	(0.807)	(0.138)
Observations	256	256	256	256	256	256	256
R-squared	0.138	0.163	0.091	0.002	0.019	0.003	0.002
Number of id	20	20	20	20	20	20	20

Robust Standard Errors in parentheses; ***p < 0.01, **p < 0.05, *p < 0.1

Table 4 Fixed-effects regression models (with composition controls) of nonnationals' age-specific fertility rates (ASFR) by overall, male and female unemployment rates (OUR, MUR, FUR) between 2006 and 2018 for Italian regions

Variables	M1 15–19	M2 20–24	M3 25–29	M4 30–34	M5 35–39	M6 40–44	M7 45–49
UR	− 0.102***	− 1.568***	− 0.455**	− 0.0652	0.176**	0.0111	0.0298
	(0.0185)	(0.299)	(0.191)	(0.162)	(0.0798)	(0.0373)	(0.0183)
PFWE	− 0.108***	− 3.175***	− 1.262***	− 0.691***	− 0.460***	− 0.0930*	− 0.00575
	(0.0350)	(0.464)	(0.235)	(0.110)	(0.114)	(0.0527)	(0.0192)
MM	− 0.0428	− 1.603*	− 0.553	0.0155	0.456***	0.346***	− 0.119
	(0.0434)	(0.811)	(0.443)	(0.331)	(0.142)	(0.0773)	(0.100)
Constant	7.134***	223.1***	157.3***	102.9***	51.26***	11.50***	1.830**
	(0.692)	(11.76)	(4.681)	(4.173)	(3.087)	(1.751)	(0.733)
Observations	256	256	256	256	256	256	256
R-squared	0.369	0.517	0.247	0.133	0.119	0.048	0.069
Number of id	20	20	20	20	20	20	20
MUR	− 0.0820***	− 1.275***	− 0.312**	− 0.117	0.105*	− 0.00705	0.0278*
	(0.0173)	(0.206)	(0.121)	(0.136)	(0.0573)	(0.0302)	(0.0151)
PFWE	− 0.109***	− 3.181***	− 1.289***	− 0.663***	− 0.443***	− 0.0861	− 0.00719
	(0.0356)	(0.487)	(0.229)	(0.117)	(0.115)	(0.0585)	(0.0175)
MM	− 0.0554	− 1.788**	− 0.635	0.0380	0.495***	0.355***	− 0.117
	(0.0424)	(0.807)	(0.471)	(0.310)	(0.148)	(0.0777)	(0.0980)
Constant	6.880***	219.2***	156.3***	102.6***	51.64***	11.50***	1.911**
	(0.690)	(11.01)	(4.574)	(3.930)	(3.022)	(1.705)	(0.753)
Observations	256	256	256	256	256	256	256
R-squared	0.358	0.513	0.237	0.139	0.108	0.048	0.077
Number of id	20	20	20	20	20	20	20
FUR	− 0.0584***	− 1.064***	− 0.427*	0.0530	0.178**	0.0324	0.00936
	(0.0166)	(0.237)	(0.230)	(0.119)	(0.0664)	(0.0486)	(0.0102)
PFWE	− 0.126***	− 3.392***	− 1.288***	− 0.730***	− 0.454***	− 0.0994**	0.00182
	(0.0327)	(0.508)	(0.235)	(0.0937)	(0.127)	(0.0443)	(0.0182)
MM	− 0.0729	− 2.002*	− 0.627	− 0.0362	0.480***	0.340***	− 0.107
	(0.0566)	(1.019)	(0.436)	(0.379)	(0.154)	(0.0896)	(0.101)
Constant	7.314***	226.8***	159.0***	102.5***	50.55***	11.34***	1.818**
	(0.837)	(13.44)	(4.847)	(4.454)	(3.207)	(1.845)	(0.751)
Observations	256	256	256	256	256	256	256

Table 4 (continued)

Variables	M1 15–19	M2 20–24	M3 25–29	M4 30–34	M5 35–39	M6 40–44	M7 45–49
R-squared	0.297	0.490	0.257	0.133	0.131	0.052	0.045
Number of id	20	20	20	20	20	20	20

Robust Standard Errors in parentheses; ***p < 0.01, **p < 0.05, *p < 0.1

Table 5 Fixed-effects regression models of nationals' age-specific fertility rates (ASFR) by overall, male and female unemployment rates (OUR, MUR, FUR) between 2006–2018 for Italian regions

Variables	M1 15–19	M2 20–24	M3 25–29	M4 30–34	M5 35–39	M6 40–44	M7 45–49
OUR	− 0.0184	− 0.0982	0.795	3.797	3.661	1.238*	0.139**
	(0.0153)	(0.559)	(2.142)	(4.200)	(2.834)	(0.687)	(0.0522)
Constant	0.820***	23.37***	62.78***	78.75*	41.04	6.289	− 0.0773
	(0.143)	(5.221)	(20.01)	(39.23)	(26.47)	(6.418)	(0.487)
R-squared	0.024	0.000	0.002	0.013	0.027	0.053	0.112
MUR	− 0.0173	− 0.109	0.574	3.050	2.971	1.031*	0.117**
	(0.0127)	(0.460)	(1.764)	(3.468)	(2.338)	(0.566)	(0.0429)
Constant	0.793***	23.37***	65.38***	88.53***	50.20**	9.164*	0.235
	(0.107)	(3.878)	(14.86)	(29.21)	(19.69)	(4.764)	(0.361)
R-squared	0.025	0.001	0.001	0.010	0.021	0.045	0.095
FUR	− 0.0152	− 0.0707	0.844	3.747	3.580	1.163*	0.130**
	(0.0143)	(0.536)	(2.048)	(3.992)	(2.688)	(0.653)	(0.0498)
Constant	0.809***	23.20***	61.27**	74.52*	37.31	5.532	− 0.157
	(0.151)	(5.680)	(21.69)	(42.29)	(28.47)	(6.915)	(0.527)
R-squared	0.018	0.000	0.003	0.014	0.028	0.051	0.106
Region FE	YES	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES
Observations	256	256	256	256	256	256	256
N	20	20	20	20	20	20	20

Robust Standard Errors in parentheses; ***p < 0.01, **p < 0.05, *p < 0.1. Not significant interaction effects were found between unemployment measures and recession stages, independently of the age-specific fertility rate considered

Table 6 Fixed-effects regression models of nonnationals'(NNs) and nationals' (Ns) total fertility rate (TFR) with unemployment rates (OUR, MUR, FUR) with interaction effects by recession stage for Italian regions

Variables	OUR—NNs	MUR—NNs	FUR—NNs	OUR—Ns	MUR—Ns	FUR—Ns
OUR/MUR/FUR	0.0165*	0.0226***	0.00114	− 0.00521	− 0.00614	0.000775
	(0.00840)	(0.00507)	(0.00394)	(0.00254)	(0.00186)	(0.00191)
PFWEastern	− 0.0347***	− 0.0296***	− 0.0480***	–	–	–
	(0.00660)	(0.00645)	(0.00741)	–	–	–
MM	− 0.0250***	− 0.0288***	− 0.0228***	–	–	–
	(0.00573)	(0.00599)	(0.00698)	–	–	–
2009–2013 * OUR/MUR/FUR	− 0.0261***	− 0.0364***	− 0.0122***	0.0013	0.00143	0.000381
	(0.00475)	(0.00505)	(0.00416)	(0.00102)	(0.00130)	(0.000648)
2014–2018 * OUR/MUR/FUR	− 0.0374***	− 0.0457***	− 0.0226***	− 0.0011	− 0.00073	− 0.00321***
	(0.00602)	(0.00545)	(0.00344)	(0.00071)	(0.00099)	(0.000534)
Constant	3.332***	3.279***	3.650***	1.304***	1.305***	1.261***
	(0.154)	(0.140)	(0.153)	(0.022)	(0.0134)	(0.0201)
Region FE	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES
Observations	256	256	256	256	256	256
R-squared	0.824	0.841	0.790	0.270	0.290	0.268
N	20	20	20	20	20	20

Robust Standard Errors in parentheses; ***p < 0.01, **p < 0.05, *p < 0.1

Table 7 Fixed-effects regression models of nonnational's age-specific fertility rates (ASFR) with overall unemployment rates (OUR) and interaction effects for Italian regions

Variables	M1 15–19	M2 20–24	M3 25–29	M4 30–34	M5 35–39	M6 40–44	M7 45–49
OUR	0.0259	1.887*	0.512*	0.548**	0.227**	− 0.0522	0.0144
	(0.0288)	(0.944)	(0.497)	(0.198)	(0.105)	(0.0926)	(0.0289)
PFWEastern	− 0.0107	− 0.470	− 0.637	− 0.351*	− 0.476***	− 0.123	− 0.00590
	(0.0384)	(0.556)	(0.408)	(0.198)	(0.165)	(0.129)	(0.0239)
MM	− 0.0258	− 1.192***	− 0.361	0.171	0.495**	0.327***	− 0.128
	(0.0353)	(0.400)	(0.476)	(0.280)	(0.179)	(0.0862)	(0.0975)
2009–2013 * OUR	− 0.0729***	− 2.095***	− 0.380*	− 0.151	0.0568	0.00720	− 0.00937
	(0.0155)	(0.378)	(0.217)	(0.126)	(0.113)	(0.0794)	(0.0170)
2014–2018 * OUR	− 0.109***	− 2.976***	− 0.774**	− 0.465***	− 0.0188	0.0456	0.00795
	(0.0175)	(0.546)	(0.338)	(0.150)	(0.0704)	(0.0826)	(0.0161)
Constant	4.253***	145.1***	136.1***	89.70***	50.38***	12.83***	2.122**
	(0.715)	(14.00)	(11.64)	(4.491)	(2.985)	(3.247)	(0.745)
Region FE	YES	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES
Observations	256	256	256	256	256	256	256
R-squared	0.446	0.674	0.298	0.200	0.126	0.055	0.086
N	20	20	20	20	20	20	20

Robust Standard Errors in parentheses; ***p < 0.01, **p < 0.05, *p < 0.1

Table 8 Fixed-effects regression models of nonnationals' age-specific fertility rates (ASFR) by male unemployment rates (MUR) and interaction effects for Italian regions

Variables	M1 15–19	M2 20–24	M3 25–29	M4 30–34	M5 35–39	M6 40–44	M7 45–49
MUR	0.0278	1.875***	0.922**	0.412**	0.0628	− 0.0342	0.0278
	(0.0261)	(0.521)	(0.353)	(0.169)	(0.109)	(0.0642)	(0.0227)
PFWEastern	− 0.0161	− 0.524	− 0.328	− 0.316	− 0.521**	− 0.0848	0.00499
	(0.0446)	(0.686)	(0.445)	(0.229)	(0.189)	(0.0946)	(0.0234)
MM	− 0.0433	− 1.438**	− 0.445	0.163	0.518**	0.336***	− 0.125
	(0.0403)	(0.521)	(0.440)	(0.246)	(0.186)	(0.0844)	(0.0943)
2009–2013*MUR	− 0.0849***	− 2.427***	− 0.796**	− 0.214	0.114	− 0.0260	− 0.0236
	(0.0204)	(0.445)	(0.319)	(0.208)	(0.160)	(0.0615)	(0.0214)
2014–2018*MUR	− 0.111***	− 3.168***	− 1.207***	− 0.490**	0.0603	0.0171	− 0.00517
	(0.0209)	(0.477)	(0.374)	(0.213)	(0.107)	(0.0615)	(0.0179)
Constant	4.530***	151.9***	130.2***	91.69***	52.71***	11.98***	1.862**
	(0.803)	(11.42)	(10.24)	(3.959)	(3.606)	(2.352)	(0.770)
Region FE	YES	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES
Observations	256	256	256	256	256	256	256
R-squared	0.421	0.659	0.324	0.195	0.114	0.055	0.097
N	20	20	20	20	20	20	20

Robust Standard Errors in parentheses; ***p < 0.01, **p < 0.05, *p < 0.1

Table 9 Fixed-effects regression models of nonnationals' age-specific fertility rates (ASFR) by female unemployment rates (FUR) and interaction effects for Italian regions

Variables	M1 15–19	M2 20–24	M3 25–29	M4 30–34	M5 35–39	M6 40–44	M7 45–49
FUR	0.00503	0.140	− 0.194	0.213	0.169**	0.0126	− 0.00591
	(0.0164)	(0.245)	(0.337)	(0.126)	(0.0678)	(0.0905)	(0.00852)
PFWEastern	− 0.0319	− 1.505**	− 1.037***	− 0.580***	− 0.498***	− 0.122	− 0.0140
	(0.0415)	(0.565)	(0.306)	(0.148)	(0.160)	(0.123)	(0.0223)
MM	− 0.0132	− 0.986**	− 0.308	0.207	0.505**	0.314***	− 0.129
	(0.0326)	(0.457)	(0.508)	(0.323)	(0.186)	(0.0883)	(0.0992)
2009–2013*FUR	− 0.0438***	− 1.009***	− 0.00806	0.0304	0.0565	0.00213	− 0.000438
	(0.0112)	(0.273)	(0.178)	(0.0842)	(0.0821)	(0.0710)	(0.0103)
2014–2018*FUR	− 0.0849***	− 1.649***	− 0.279	− 0.185**	0.0226	0.0240	0.0181***
	(0.0156)	(0.266)	(0.197)	(0.0784)	(0.0587)	(0.0757)	(0.00616)
Constant	4.621***	175.8***	149.0***	95.61***	50.89***	12.19***	2.475***
	(0.817)	(9.255)	(9.080)	(4.921)	(3.007)	(3.203)	(0.854)
Region FE	YES	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES
Observations	256	256	256	256	256	256	256
R-squared	0.445	0.633	0.291	0.184	0.135	0.056	0.080
N	20	20	20	20	20	20	20

Robust Standard Errors in parentheses; ***p < 0.01, **p < 0.05, *p < 0.1

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