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Economic complexity and fertility: insights from a low fertility country

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ABSTRACT

This paper analyzes the relationship between a new indicator of economic context, economic complexity (EC), and fertility change in Italian provinces between 2006 and 2015. We hypothesize that the level of EC is associated with fertility as it reflects a territory's capacity to innovate, grow and create job opportunities. The results illustrate a clear positive association between EC and fertility change across Italian provinces for the period considered, net of traditional fertility predictors. Those areas that stand at the frontiers of EC are also more likely to dominate and adapt to the negative consequences of globalization.

KEYWORDS

fertility; globalization; economic complexity; Italy

JEL F60, J11, R11

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INTRODUCTION

Over the second half of the 20th century, one of the relatively most straightforward associations identified regarding fertility was the negative effect of economic development. Since the middle of the last century, much academic effort has been devoted to the study of this effect, as well as to searching for the reasons behind this negative association (Anderson & Kohler, 2015; Caldwell, 1976; Gaddy, 2021; Galor & Weil, 2000; Lesthaeghe, 1995). Recently, however, this accepted regularity is straining, and renewed attention has been paid to the link between economic development and total fertility (Herzer et al., 2012; Hofmann & Hohmeyer, 2013). To date, there is evidence of both a positive and a negative relationship between economic circumstances and fertility, depending on the level of a country's human development and its positive or negative trend (Myrskyla et al., 2009; Wang & Sun, 2016). The cross-country correlation between human development and fertility seems to become positive for countries with higher levels of human development (Myrskyla et al., 2009). Similar findings have also been detected across subnational regions of a growing number of middle-high-income countries (Fox et al., 2019; Wood et al., 2017). The increasing speed, dynamics and volatility of globalization has contributed to altering previously established relationships (Mills & Blossfeld, 2013). These changes have been occurring in industrialized economies in recent decades, although the advent of the Great Recession and the new era of uncertainty contributed to a more stagnant fertility development over the last years (Lesthaeghe, 2020; Vignoli et al., 2020a).

The concept of globalization is multifaceted, encompassing economic and technological spheres, as well as financial, political and social processes – all of which have wide-ranging effects on society and the global economy (Gangopadhyay, 2017). The search for different measures of increasing globalization has been studied (primarily) in the economic and (partly) in the sociological literature. Regarding the studies in economics, these typically refer to common macroeconomic measures, such as foreign direct investment, financial flows, and international trade in goods and services (Sutcliffe & Glyn, 2019). Although these measurements provide a

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degree of insight into the increasing international integration of economic activity, they are too narrow to employ from a socio-demographic perspective. Giddens's (1990, p. 64) definition, 'world-wide social relations which link distant localities', or even Held et al.'s (2000, p. 16), 'generating transcontinental or interregional flows and networks of activity', refer to complex political, cultural and social exchanges aside from economic activities. While the consequences of globalization and technological change on the labour market have received substantial scholarly interest (Gaston & Nelson, 2004; Potrafke, 2013), few studies have addressed the role of globalization and technological change on fertility in post-industrial societies (Bernardi & Nazio, 2005; Mills & Blossfeld, 2013). At best, these studies have operationalized the negative forces of globalization through unemployment or the diffusion of jobs with uncertain conditions (Kreyenfeld et al., 2012; Matysiak et al., 2021; Vignoli et al., 2020b), disregarding the ongoing industrial change occurring across various countries and regions. Consequently, we argue here for the need to consider new, more aptly suited markers of the continuous economic- and labour market-related transformations in the realm of fertility research.

This study relies on a new indicator of economic context and its prospects for future development: economic complexity (EC). The notion of EC stems from a recent strand of research, pioneered by Hidalgo and Hausmann (2009), that promotes a view of economic growth and development emphasizing the complexity of a country or region. The level of EC indicates the sophistication of a country's (or a region's) productive structure by combining information on the area's diversity in terms of the products exported and their ubiquity (i.e., how many countries/regions export that product). The idea is that an area with higher EC will outperform areas with lower EC in terms of future economic growth (i.e., gross value added, employment). Many studies have demonstrated the strong relationship between EC and several economic and social conditions. For example, EC increases gross domestic product (GDP) (Chávez et al., 2017; Poncet & de Waldemar, 2013), and knowledge and innovation (Balland & Rigby, 2017; Petralia et al., 2017). Furthermore, EC has been shown to reduce economic and social inequality (Hartmann et al., 2017). These studies suggest that the level of EC represents a marker of several characteristics of an area, including the inclusiveness of institutions, human capital and social welfare (Hidalgo, 2015).

We posit – to the best of our knowledge, for the first time – that different levels of EC might also affect fertility. We hypothesize that the EC level is associated with fertility not only because it embodies several dimensions customarily considered key drivers of fertility change, such as educational qualifications and the accumulation of human capital, but also because it helps to withstand, or resist, the negative adjustments of contemporary economic- and labour market-related transformations, fuelled by globalization and technological change. Specifically, we ask: Does an area's level of EC affect fertility? We address this question for Italy, covering the period 2006–15. Italy typifies a depressed fertility setting which has been stagnating in recent decades to 1.3–1.4 children per woman, alongside extraordinary regional differentials in socioeconomic circumstances and fertility (Vitali & Billari, 2017). The Great Recession (Grusky et al., 2011) strongly hit the country and sharpened the decrease in fertility levels, particularly in the regions where unemployment and persistent poverty were already high (Coppola & Di Laurea, 2016).

The links between economic context and fertility operate across multiple social and geographical levels (e.g., countries, regions and provinces). These links are often simultaneously relevant, with neighbouring units displaying similar patterns (Klüsener et al., 2013b). The geographical focus of our analysis is at the smallest geographical level of investigation offered by the European Union (EU) classification system for units with comparable population size: NUTS-3 (i.e., Italian provinces). In this study, EC is measured following the methodology developed by Hidalgo and Hausmann (2009), then refined by Balland and Rigby (2017), using information on the diversification of the specializations of Italian provinces, as well as these specializations' ubiquity. We measured the EC index (ECI) using employment data (Chávez et al., 2017; Mealy et al., 2019), rather than either export (Hidalgo & Hausmann, 2009) or patents data (Balland & Rigby, 2017; Petralia et al., 2017). We did so in order to construct a measure of complexity that better acknowledges the productive structure of the provinces (Gao & Zhou, 2018).

THEORETICAL BACKGROUND

Globalization and complexity

Since the 1980s, an array of global transformation has occurred, characterized by the declining centrality of national borders for economic transactions; the intensification of worldwide social relations; tougher tax competition between countries; and deregulations, privatization and liberalization of domestic industries and markets (Barbieri & Bozzon, 2016; Guillén, 2001; Held et al., 1999; Raab et al., 2008). The gains of globalization, such as more competitive prices, a wider array of choices and higher living standards have, however, been accompanied by negative consequences. These include, but are not limited to, salary cuts, lost jobs, layoffs, bankruptcies and failing companies (Mills & Blossfeld, 2013).

The original concept of globalization refers to the diffusion of international trade, and has traditionally meant greater openness in trade as a means to higher, and more rapid, rates of economic growth. This has impacted the industrial diversification and specialization of countries and regions. Furthermore, this implies changes in the labour market and education policies as a means to deal with the increased economic complexity of a globalized world. There have been many attempts to measure globalization, including such composite indices as the GlobalIndex (Raab et al., 2008) or the KOF index (Dreher, 2006), composed of quantitative and qualitative measures. However, as they were designed at the country level, they cannot be easily transposed to a fine-grained geographical level. In any event, there is no consensus on the reliability of these, and other, measures of globalization (Sutcliffe & Glyn, 2019).

As a result of globalization, advances in information and communication technologies, significant decreases in transportation costs, increased purchasing power, and the adaptation of the labour market competition in prosperous nations has increasingly shifted from price to innovation and design competition, thereby requiring an increasing amount of specialization (Hartmann, 2014). This has led to increasingly complex and specialized organization of production. Moreover, in the last decade, studies have introduced new and more sophisticated methods to determine a country's or a region's optimal productive structure for growth or competitiveness. This debate is often integrated with the notions of diversification and variety (Boschma & Frenken, 2009). The idea that variety and an area's industrial composition may be among the most important characteristics in explaining why some territories grow, while others stagnate or decline, has been the topic of much academic discussion (Frenken et al., 2007). While the debate on the role of diversity, variety and industrial specialization has increased in recent years (e.g., Boschma & Frenken, 2009; Mameli et al., 2014), it is not yet clear whether diversification or specialization is more important in favouring economic growth (Beaudry & Schiffauerova, 2009; Van Oort, 2015). In this context, increasing attention has been paid to the interactions among sectors and, thus, to a more comprehensive understanding of the elements of variety and specialization that most effectively influence growth.

Hidalgo and Hausmann's (2009) seminal work, which used the concepts of diversification and ubiquity, argued that a country's capacity to grow and reach a higher level of development is based on its EC – itself defined by the diversity and ubiquity of products that a country produces and exports. Each country develops specializations in different products based on its historical development and previous specializations. Countries tend to specialize in as many products as possible, as this facilitates the development of skills with which to produce new and additional products that need more specialized competences. These new products are less ubiquitous and harder to copy because few other countries hold the necessary competencies required to produce these types of 'composite products'. This is the very notion of complexity – rarer products produced by areas that hold many specializations are the most complex products. Similarly, the areas that produce the rarest (least ubiquitous) products and, in general, hold a wealth of specializations are classified as more complex areas. For example, the United States, China and South Korea are characterized not only by a large variety of specializations, but also by many rare products. For this reason, they are classified among the most complex countries. The same holds true for some European countries (irrespective of their dimension or centrality in global competition), such as Switzerland, Sweden or Germany (Simoes & Hidalgo, 2017). In contrast, several countries from the African continent, such as Chad, Guinea or Nigeria (to name but a few), are less specialized and economically complex. Furthermore, certain countries, such as Libya and Iraq, which can be characterized by relatively higher levels of GDP, have not been able to translate their higher income into technological advancements by diversifying in innovative and rarer specializations.

In this framework, areas that produce the least ubiquitous products face less competition. Countries that practice a wide array of specializations are able to create new complex products by combining the specializations they already possess. Consequently, each new specialization can be easily combined with a large number of other specializations. In recent years, the notion of EC has gathered increasing attention within the literature because it has proved to be highly predictive of future economic growth. Since Hidalgo and Hausmann (2009), many other scholars have followed the framework in different areas (Balland et al., 2020), applying the concept to products – as in the original work (Hartmann et al., 2017; Zhu & Li, 2017) – to patents (Balland et al., 2019; Balland & Rigby, 2017; Petralia et al., 2017) and to industries (Chávez et al., 2017; Mealy et al., 2019). While the first studies using the concepts and methodology of EC were developed at the national level (Felipe et al., 2012; Hidalgo & Hausmann, 2009), EC research has more recently addressed smaller geographical units, such as regions (Chávez et al., 2017; Gao & Zhou, 2018), provinces (Reynolds et al., 2018) or cities (Balland et al., 2020; Balland & Rigby, 2017). These studies suggest that regions or provinces may specialize into different activities following the industrial and technological trajectories driven not only from their countries' policies, but also by territorial specificities (e.g., the availability of raw materials or geographical characteristics).

Globalization, complexity, and fertility

It is tempting to conclude that global fertility decline is one of the outcomes of globalization, as the opening of borders and ever-increasing communication across societies likely encourage convergence in ideas and behaviour. Much has been written about globalization and its possible effect on our lives and the future of our societies, but this literature is often imprecise about what globalization actually entails. European citizens have begun to perceive globalization as a force that erodes the welfare state, causes job insecurity, and fosters job mobility and job-hopping, in clear opposition to the labour market dynamics of the past (e.g., Blossfeld et al., 2005). Volatile global markets and the recent Great Recession have fuelled the view that globalization is a multiplier of uncertainty (Mills & Blossfeld, 2013; Vignoli et al., 2020a). Deteriorating economic conditions are usually manifested by declining economic activity, as captured by a decline in GDP, falling consumer confidence and adverse labour market trends. The worsening of labour market conditions is reflected in stagnating or declining wages, higher incidences and persistence of unemployment, and a spread of more uncertain employment forms, such as time-limited contracts and involuntary self-employment. The majority of contemporary studies into such economic forces have customarily operationalized the diffusion of unemployment or uncertain jobs as the main driver of fertility decline (Comolli, 2017; Matysiak et al., 2021; Vignoli et al., 2020b).

The decline in fertility has been shown to be associated with changes in individual socioeconomic conditions, leading to the avoidance of large family sizes (Lesthaeghe, 2010; 2020). Such a decline, however, has not occurred either uniformly or simultaneously across regions and countries (Coale, 2017). Certain studies have investigated the effect of the diffusion of new habits, ideas or social norms, explaining how these can modify individuals' routines and preferences (Inglehart, 1977; Van de Kaa, 1987). Others have focused on the connections between fertility and globalization. Caldwell (2001) suggested that globalization might influence fertility by changing a country's economic structure, thus altering its social and demographic habits. Linkages between economic conditions in a country, or region, and community characteristics have been discussed across demographic (Arpino & Tavares, 2013; Bleha & Ďurček, 2017), sociological (Hank, 2002) and economic (Sato, 2007) studies, but past research has found different effects – mainly depending on the area's level of development and the period analyzed. For medium- or high-income countries, there has been a discussion over a reversal in the fertility trend (Gaddy, 2021; Myrskyla et al., 2009) based on the idea that an area's socioeconomic development is associated with a decline in fertility only up to a certain point, after which the association becomes positive (Day, 2012; Myrskyla et al., 2009). Yet the question remains: What leads to such a reversal in the relationship?

Recent empirical analysis – spearheaded by Autor et al. (2013, 2014, 2016), Dauth et al. (2014) and Bloom et al. (2016) – has shown how globalization has affected such individual labour market outcomes as unemployment, labour-force participation and job vacancies. These changes occurred rapidly (e.g., due to the spread of automation and the consequent disappearance of entire job sectors), meaning that people must be prepared for an economic environment that increasingly requires flexibility and lifelong learning. This huge wave of change cannot be downplayed or ignored when addressing fertility drivers. We posit that, in post-industrial economies, an area's EC level might help people withstand the negative consequences of the dramatic economic- and labour market-related changes fuelled by globalization and technological innovation. This, in turn, also favours fertility. The level of EC may represent a crucial driver of fertility because the diversification and rarity of products in a certain area embodies the capacity of a territory to innovate, grow and create job opportunities. This serves to foster a fertility-friendly environment.

EC and fertility may also be linked because of two additional sets of reasons. First, while the notion of EC was initially used to identify differences and variations in GDP, employment and innovative capacity (Balland & Rigby, 2017; Hidalgo & Hausmann, 2009; Poncet & de Waldemar, 2013), EC has more recently been used to show connections to a country's inequality (Hartmann et al., 2017), its level of human development (Hartmann, 2014), and its absolute level of poverty and social welfare (Ravallion, 2004). Most particularly at subregional levels, the industrial structure and levels of diversification and specialization – all factors reflected by an area's EC (Hartmann, 2014) – are connected not only to a territory's productive structure, but also to other important socioeconomic characteristics (Becattini, 1990), such as the level of human capital and ability to ameliorate social inequality. These socioeconomic characteristics are also well-known determinants of fertility (cf. Wood et al., 2017). Second, the linkages between EC and fertility may also be related to migration patterns (Bahar et al., 2019). Migration is more likely to occur from less to more complex regions as these flows are often driven by employment reasons. After all, migrants are usually relatively young and characterized by higher fertility proneness (e.g., Kulu, 2005; Sato, 2007).

RESEARCH DESIGN

Dependent variable: total fertility rate (TFR)

This study provides a longitudinal analysis of the association between EC and fertility across all 103 Italian provinces between 2006 and 2015. The TFR was taken from the Italian National Institute of Statistics. These data were computed by combining national statistics on births by the age of the mother and complete data on female population by age. TFR is customarily defined as the number of children who would be born to a woman if she were to live to the end of her childbearing years and bear children in accordance with the age-specific fertility rates of the specified year. Figure 1 depicts the TFR trends in the Italian macro-regions during the research period (2006–15).

We note clear differences between the north and south, particularly before the advent of the Great Recession. In fact, the fertility levels for the north and, to a lesser extent, the centre were increasing, while the south's fertility level stagnated.

Economic complexity

We followed the methods proposed by Hidalgo and Hausmann (2009), and refined by Balland and Rigby (2017), to build our EC index (ECI). We used employment data (Chávez et al., 2017; Mealy et al., 2019) drawn from a firm-level database (AMADEUS, Bureau Van Dijk) with industries disaggregated according to the NACE[1] industrial classification at the four-digit level of all the analyzed provinces during the study period.

Using employment data, we first defined the industrial specializations of the Italian provinces. Following the

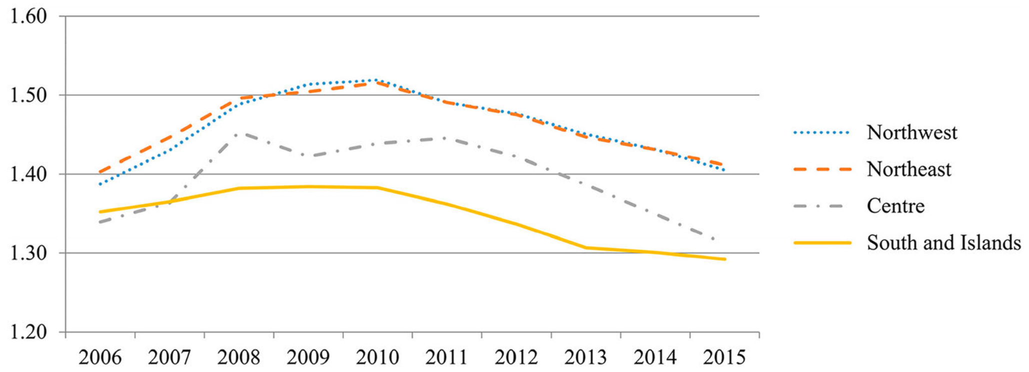

Figure 1. Total fertility rate trends in Italian macro-regions, 2006–15.

formula of the revealed comparative advantage (RCA), the province (*p*) is considered to be specialized in the considered industry (*i*) if the *i* share in the industrial basket of the *p*, divided by the share of *i* in Italian industrial composition, is higher than a threshold (*tv*). Mathematically, this is rendered as:

$$RCApi = (Epi/Ep)/(Ei/E) > tv$$

where *E* represents the number of employees; *i* is the four-digit industry; and *p* is the province.

Once done, we operationalized the RCA as an adjacency matrix (*Mpi*), where $Mpi = 1$ if *p* has a relative specialization in *i*, and 0 otherwise.

Conscious of the algebraic problems raised by the use of Hidalgo and Hausmann's (2009) original method, the so-called method of reflections (Caldarelli et al., 2012), we followed the method refined by Balland and Rigby (2017) – which is based on the reformulation proposed by Tacchella et al. (2012) – namely, the second eigenvector method.

We calculated the complexity of provinces based on employment data using the product matrix *W* equal to the product of matrix *Mpi* (row standardized) and its transpose M^T (row standardized), a squared matrix of dimensions 103. The elements along the principal diagonal of *W* represent the average ubiquity of the industrial classes, in which the row and column province has RCA. The off-diagonal elements represent the product of the industrial classes in which province (*j*; row) has RCA and the ubiquity of the industrial classes in which province (*k*; column) has RCA. These elements thus capture the similarity in the industrial structure of province pairs. The complexity for each province is provided by the second eigenvector of matrix *W*.

Figure 2 shows that more diversified provinces are specialized in less ubiquitous industries. Note that the provinces characterized by high diversification and low ubiquity (lower right on the graph) are predominantly located in the north of the country, with a handful of provinces in the centre and south. For instance, Milan has the highest number of specializations and the lowest value in terms of average ubiquity of the specialized industries. Accordingly, this province has, on average, the country's rarest industries, and offers the opportunity to hold this advantage because there are so few other provinces to compete with. In addition, the higher RCA allows the province of Milan to combine them with many other related industries – or possibly even with new entrants – allowing the province to remain at the frontier.

By contrast, Enna (Sicily) shows the lowest number of RCAs and the highest level of average ubiquity of these specializations. Specialization in more 'common' industries forces the province into competition with other regions, thereby hindering its capacity to grow. At the same time, the few RCAs owned obstruct the province from expanding its areas of expertise and reaching rarer specializations that require several different competences to be obtained.

These extreme examples suggest that levels of diversification and ubiquity are intuitively able to express not only a province's complexity, but also its capacity for future growth, ability to attract highly specialized and educated workers (required by the most complex industries), contribution to job creation, economic affluence, and human capital accumulation (Hartmann, 2014). These factors allow a province to face globalization and technological change, and favour the enhancement of a proactive social and economic context.

Model specification

To test the impact of EC on fertility change in Italian provinces, we used panel regression techniques with year and province as fixed effects. TFR was the dependent variable, while the key explanatory variable was represented by the ECI standardized to favour the year-to-year comparison.

To better understand the association between TFR and ECI, we included additional control variables in the model equation following a stepwise procedure. The selection of such control variables relied on past findings, as well as on data availability and reliability.

A first control variable was the province's population density (measured as the population/km^2). This variable is often added to studies analyzing the determinants of change in fertility as a proxy of the level of urbanization of an area – fertility has been found to decline with urbanization (Sato & Yamamoto, 2005).

Among the 'standard' fertility predictors, we considered a range of labour market measures that indicate

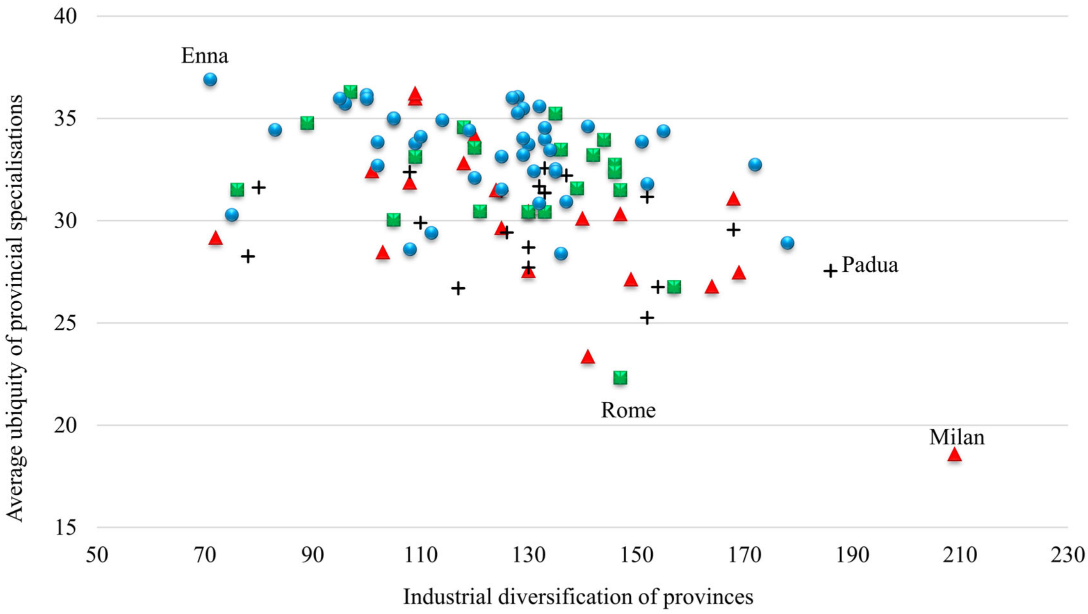

Figure 2. Diversification of provinces and average ubiquity of industries, 2011.
Note: Different symbols refer to Italian macro-regions: triangles the north-west, crosses the north-east, squares the centre and circles the south.

employment instability and the persistence of joblessness. First, we included the area's unemployment rate, namely the variation of the unemployment rate of each province (e.g., Matysiak et al., 2021). Second, we included the percentage of workers with a temporary job over the total number of workers in each province (e.g., Barbieri et al., 2015; Vignoli et al., 2012). We also controlled our estimates for the accumulation of human capital per province, proxied by the percentage of residents with at least a tertiary education qualification (e.g., Caltabiano et al., 2019). These last two indicators were computed from the European Labour Force Survey, which is a comparative large-sample survey designed for collecting high-quality labour market data. Moreover, we included GDP per capita at constant prices in euros (thousands) in the model equation – a measure available in Eurostat – so as to capture the economic development of each province. The annual rate of GDP growth can be considered as a proxy of general economic prosperity and economic trends (e.g., Lacalle-Calderon et al., 2017).

One other possible provincial characteristic that may influence fertility rates is migration between provinces (e.g., Kulu, 2005; Sato, 2007). Migration typically occurs from less to more economically advantaged areas. Higher flows have been observed for employment reasons, and migrants are usually relatively young. Therefore, we added the province-specific net migration rate, taken from Eurostat data, to the model specification.

Finally, we added two variables (typically neglected within fertility studies) to control for the typical specialization of the province, measured as a location quotient (LQ) (Lazzeretti et al., 2008; Von Hofe & Chen, 2006). The LQ is built at the one-digit level (dividing the sectors in industries and services). In the economic literature, it is well established that industry and service sectors strongly differ in terms of workers' social class, as well as their behaviour and expectations (Johnson, 2015; Paci, 1991). Several factors associated with fertility are also key features of industrial districts, such as social norms, the labour market and welfare specificities (Becattini, 1979). These characteristics – particularly relevant for Italy given the widespread presence of industrial districts across territories – have been largely discussed in both the sociological and economic literatures (Cruickshank, 1981; Mingione, 2009; Wrigley, 2006). Hence, it is reasonable to anticipate that a province's different industrial specialization might also affect an area's fertility.

Additionally, the diffusion of tertiary education and (women's) labour force participation, and the increased concentration of employment in the industrial sector, is most prevalent in the north of Italy (Caltabiano et al., 2019). Given this well-known regional divide between the centre–north and south of Italy, we segmented these areas to test whether there is a different effect of ECI level on TFR variations between the north and south.

Table 1 presents the descriptive statistics of the variables added to the regressions and their correlations.

Mathematically, the estimated model takes the following form:

$$\begin{aligned} y_{i\,t+1} = {} & \alpha_i + \lambda_i + \beta_1 + \beta_2 ECI_{i\,t} + \beta_3 \text{Unemp}_{i\,t} \\ & + \beta_4 \text{Pop.Density}_{i\,t} + \beta_5 \text{GDP}_{i\,t} \\ & + \beta_6 \text{Hum Cap}_{i\,t} + \beta_7 \text{Temporary Job}_{i\,t} \\ & + \beta_8 \text{Migrat}_{i\,t} + \beta_9 \text{LQ\_Ind}_{i\,t} + \beta_{10} \text{LQ\_Ser}_{i\,t} \\ & + \epsilon_{i\,t} \end{aligned}$$

where $y_{i\,t+1}$ is the TFR level; α_i represents the province dummies; and λ_i represents the time dummies included in the model. Additionally, every model includes the

Table 1. Descriptive statistics and correlation analysis.

	Variables	1	2	3	4	5	6	7	8	9	Observations	Mean	Minimum	Maximum
1	TFR	1									927	1.369	0.93	1.74
2	ECI	0.248	1								927	0.172	−1.716	2.043
3	Population density	0.260	0.027	1							927	256.87	19.23	2691.38
4	Unemployment	−0.362	−0.428	0.016	1						927	9.040	1.87	27.81
5	Net migration	0.257	0.301	0.006	−0.686	1					927	0.006	−0.72	0.6
6	LQ industries	0.165	0.252	−0.105	−0.433	0.230	1				927	1.033	0.291	1.392
7	LQ services	−0.083	−0.222	0.172	0.378	−0.189	−0.970	1			927	0.913	0.374	2.249
8	GDP	0.495	0.407	0.258	−0.770	0.732	0.236	−0.153	1		927	32.36	17.92	67.11
9	Tertiary education	0.011	0.115	0.159	−0.025	0.241	−0.011	0.061	0.255	1	927	0.114	0.039	0.218
10	Unstable job	−0.284	−0.431	−0.201	0.529	−0.443	−0.454	0.354	−0.559	−0.218	927	0.162	0.066	0.380

Note: ECI, economic complexity index; GDP, gross domestic product; LQ, location quotient; TFR, total fertility rate.
Source: Authors' elaboration.

variable of interest, ECI, and the control variables were added following a stepwise procedure.

RESULTS

Figures 3 and 4 are maps of the provincial level of EC in 2006 and 2014, respectively, as well as the TFR level for the same years. Higher levels of EC are concentrated in the north of the Italian peninsula. During the studied period, the EC levels grew in the north and slightly decreased in the south. A similar pattern can be observed by viewing the period change in TFR, where we see a concentration of higher values in the north (with the exception of certain Sicilian provinces). This divide seems to have grown during the considered period. These descriptive results are in line with the literature that shows different connotations between the north and south with respect to several socioeconomic forces (Kertzer et al., 2009; Vitali & Billari, 2017; Zambon et al., 2020).

As the next step, we estimated the relationship between the ECI and TFR in a multivariate panel regression setting. From Table 2, we note a positive association between ECI and fertility during the studied period. The effect of the ECI remains elevated after we controlled our estimates for the control variables considered.

The first two models aim to address, separately, the relationship between TFR and ECI (model 1) and unemployment (model 2). They both show significant effects but, as expected, in opposite directions. While unemployment and TFR showed a negative association, corroborating much of the previous research on the topic (e.g., Matysiak et al., 2021), the association between ECI and TFR was found to be positive. Crucially, ECI variation retains a positive and significant effect after including unemployment in the same specification (model 3).

In models 4–8, we added controls for population density in the model equations. The results show a negative correlation between population density and TFR, despite the estimates being statistically imprecise.

In model 5, we then added a variable controlling for the province's GDP per capita. This variable did not show significant effects in any model specification. This result is unsurprising, as the effects of adverse labour market trends and deteriorating economic conditions on fertility are known to not be significantly captured by a fall in GDP (Sobotka et al., 2011).

In model 6, we added two further controls: the proportion of a province's more highly educated residents and the share of precariat. Neither of these variables was proved to have a significant effect. In models 7 and 8, we additionally controlled for the province-specific net migrations rate, which also showed no significant association with TFR.

Interestingly, in models 7 and 8, we included the two variables connected to the provinces' level of industry and service specialization. We added these in separate models as they are highly collinear (Table 1). The results suggest a positive relationship between the level of

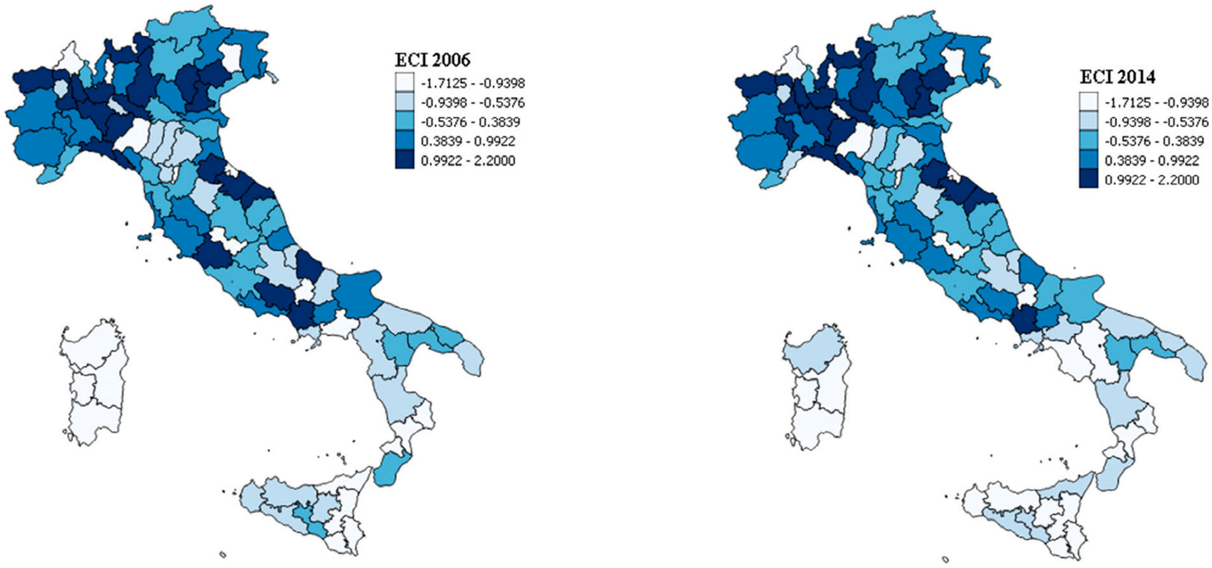

Figure 3. Economic complexity (EC) level in Italy, 2006 and 2014.

specialization of provinces in industrial sectors and TFR (model 7). Fertility seems to be related to the typical industrial specialization of the area. This emphasizes the idea that, given globalization and remarkable technological change, accounting for 'standard' variables of economic uncertainty (e.g., unemployment and share of temporary jobs) is no longer sufficient for studying fertility variation.

Models 9–11 show the results for the northern and central provinces, while models 12–14 present the results only for those located in the south. The results show interesting differences: the effects of complexity on fertility are positive for the northern provinces, yet we found no significance in any of the three models regarding the south of Italy. The effect of unemployment is significant and negative in each of the six models presented. The results also present clear differences regarding the control variables. Model 11 (north) shows significant and negative effects of the presence of highly educated people and the share of precariat in the province on fertility, while model 14 (south) shows a significant and negative effect of population density, and a positive and significant effect of GDP. These results support recent studies suggesting a differentiated effect on fertility of various indicators across Italian provinces, particularly between north and south (Vitali & Billari, 2017; Zambon et al., 2020). This heterogeneity regards – in our case – the sign, significance and magnitude of the coefficients.

Three final issues deserve attention. First, one may ask for a test of the ECI's two components, namely diversity

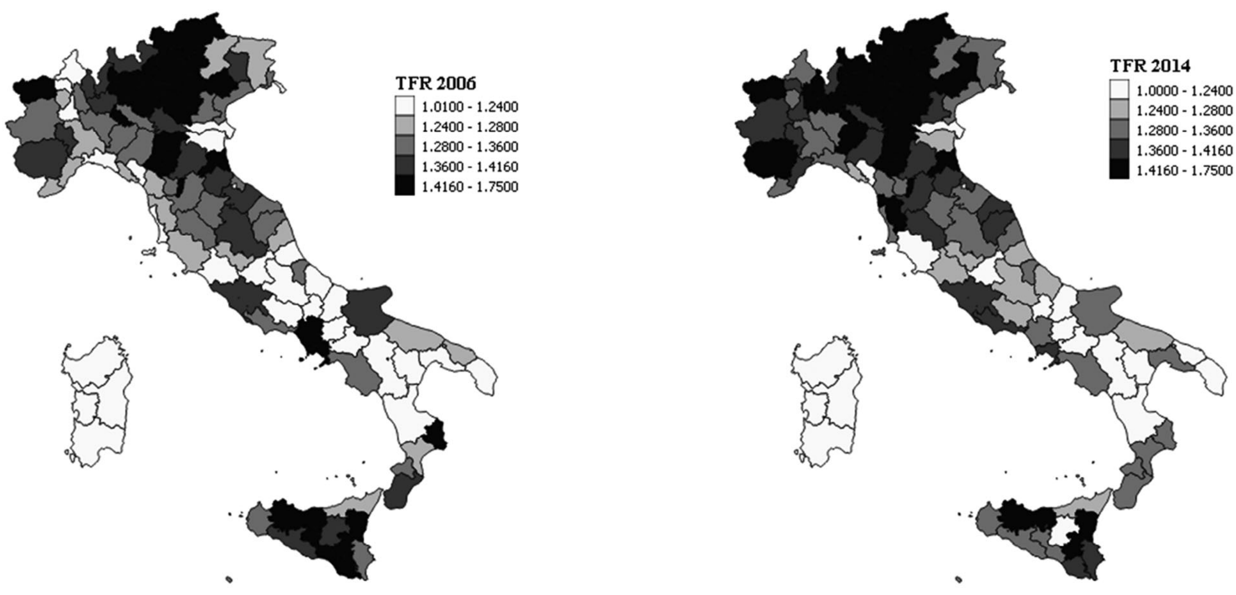

Figure 4. Total fertility rate in Italy, 2006 and 2014.

Table 2. Estimation results.

Variables	Model 1 TFR 2006–15	Model 2 TFR 2006–15	Model 3 TFR 2006–15	Model 4 TFR 2006–15	Model 5 TFR 2006–15	Model 6 TFR 2006–15	Model 7 TFR 2006–15	Model 8 TFR 2006–15
Economic complexity index	0.0240**		0.0218**	0.0218**	0.0218**	0.0205**	0.0202**	0.0204**
	(0.0100)		(0.0101)	(0.0101)	(0.0101)	(0.0102)	(0.0102)	(0.0102)
Unemployment rate		−0.00205**	−0.00176*	−0.00180*	−0.00181*	−0.00174*	−0.00147	−0.00167
		(0.00102)	(0.00103)	(0.00103)	(0.00104)	(0.00104)	(0.00105)	(0.00105)
Population density				−0.000128	−0.000131	−0.000154	−0.000160	−0.000158
				(0.000241)	(0.000247)	(0.000248)	(0.000248)	(0.000249)
GDP					−0.0000719	−0.000232	0.0000322	−0.000107
					(0.00137)	(0.00138)	(0.00140)	(0.00140)
Tertiary education						0.149	0.156*	0.151
						(0.125)	(0.098)	(0.129)
Unstable job						−0.00943	−0.00138	−0.00342
						(0.0916)	(0.0920)	(0.0922)
Net migration							−0.00872	−0.0124
							(0.0205)	(0.0205)
Specialization industry							0.0628**	
							(0.0304)	
Specialization service								−0.0194
								(0.0183)
Constant	1.528***	1.541***	1.539***	1.573***	1.576***	1.570***	1.497***	1.585***
	(0.00437)	(0.00816)	(0.00818)	(0.0637)	(0.0893)	(0.0901)	(0.0960)	(0.0927)
R^2	0.4153	0.4140	0.4174	0.4176	0.4176	0.4186	0.4220	0.4197
No. of cases	927	927	927	927	927	927	927	927
Province FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

(*Continued*)

Table 2. Continued.

Variables	Model 9: North TFR 2006–15	Model 10: North TFR 2006–15	Model 11: North TFR 2006–15	Model 12: South TFR 2006–15	Model 13: South TFR 2006–15	Model 14: South TFR 2006–15
Economic complexity index	0.0433***		0.0510***	−0.0114		−0.0113
	(0.0161)		(0.0135)	(0.0164)		(0.0165)
Unemployment rate		−0.0130***	−0.0117***		−0.00641***	−0.00519***
		(0.00215)	(0.00213)		(0.00122)	(0.00129)
Population density			−0.00053			−0.00128*
			(0.00034)			(0.000707)
GDP			0.00412			0.0721***
			(0.0171)			(0.0273)
Tertiary education			−0.447***			−0.126
			(0.155)			(0.146)
Unstable job			−0.550***			−0.225
			(0.113)			(0.139)
Net migration			−0.0127			−0.0436
			(0.0302)			(0.0461)
Constant	1.421***	1.415***	1.525***	1.352***	1.384***	1.401***
	(0.0081)	(0.0091)	(0.0682)	(0.0124)	(0.0167)	(0.0792)
R^2	0.0879	0.0781	0.1422	0.096	0.135	0.2494
No. of cases	603	603	603	324	324	324
Province FE	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes

Notes: FE, fixed effects; GDP, gross domestic product; TFR, total fertility rate.
Significant at: *$p < 0.1$, **$p < 0.05$, ***$p < 0.01$. Standard errors are shown in parentheses.
Source: Authors' elaboration.

and ubiquity, separately. This point has been widely debated in the literature (Caldarelli et al., 2012; Hidalgo & Hausmann, 2009; Tacchella et al., 2012). The vast majority of researchers suggest that the ECI's two components cannot be used separately to infer the complexity of a country or region. In fact, the mere ubiquity of specializations may be exclusively due to the availability of an area's natural resources. Second, to investigate a possible non-linear relationship between ECI and TFR, we added the squared term of ECI to the full models for all provinces first together, and then for those located in the north and in the south. The results (see Table A1 in Appendix A in the supplemental data online) do not suggest a non-linear relation between ECI and fertility. Finally, we performed a robustness check evaluating the relation between the year changes in the ECI and the TFR. Indeed, using the change in TFR may identify the trend of TFR rather than the co-variation of ECI and TFR; we expected higher levels of ECI to be associated with an increase of the change of TFR. Nonetheless, the results did not show relevant differences compared to those presented in Table 2 (see also Table A2 online).

CONCLUSIONS

This paper relies on a new economic indicator: economic complexity (EC). The level of EC indicates the sophistication of a context's productive structure by combining information on the diversity of the area (in terms of products exported) and their ubiquity (how many countries/regions export that product). We expected the EC level to be associated with fertility not only because it embodies several dimensions customarily considered key drivers of fertility change (e.g., educational qualifications and the accumulation of human capital), but also because it captures a territory's capacity to innovate, grow and create job opportunities. The results illustrate a clear association between EC and total fertility across Italian provinces between 2006 and 2015. Provinces characterized by higher levels of EC also had higher levels of TFR. The results stratified by north and south further support these considerations. In those areas with pre-existing high levels of complexity (the centre–north of Italy), an additional increase in EC is associated with a rise in TFR. The provinces at the forefront of EC seem able to effectively adapt to, and dominate, increasing globalization, and favour fertility. In regions characterized by relatively low levels of complexity (the south), even an increasing trend of EC does not suffice to promote fertility. Overall, these results suggest that an increase in EC is a potent driver of fertility development, which has not been captured by the standard economic forces traditionally used in socio-demographic research.

There are two main sets of reasons that could explain these results. The first is connected to the meaning of the EC of an area, which accounts for economic conditions and future opportunities, as well as for an additional variety of factors, such as decreases in inequality, higher levels of education, more effective and generous social welfare, and the inclusiveness of institutions. The second set of reasons – in our opinion the most relevant – relate to the growth in globalization of recent decades, through which increased technological complexity has changed the dynamics of the labour market and communications, and has altered the cultural behaviour of individuals and their perceptions of uncertainty, and the precariat (Autor et al., 2014; Gangopadhyay, 2017). This points to the need for a different, more contemporary, approach for evaluating the determinants of fertility. We have shown that provinces with higher EC levels are also more likely to dominate and adapt to globalization. This is primarily due to their increased capacity with which to face labour market or technological changes.

Another interesting factor that emerges from the analysis is the relevance of the province's typical, specialization in favouring fertility. This theme has been strongly downplayed in the existing literature on the regional determinants of fertility (Schleutker, 2014; Vitali & Billari, 2017). While a strong emphasis has been placed on urban/rural differentials (Kulu, 2013; Sato & Yamamoto, 2005), less attention has been directed to understanding whether these differentials are related to the level of urbanization per se, or more associated with an area's typical specialization (agriculture, industry or services). Our results show that an area's level of industrial specialization is positively associated with fertility, while the level of specialization in service sectors is not.

This study is not free of limitations. First, it was difficult to evaluate whether the observed fertility change was mostly driven by the temporary postponement of childbearing or by changes in the underlying level (quantum) of fertility. Second, it is necessary to avoid drawing conclusions and interpretations about individual-level behaviour based on an extrapolation of our findings. Although the theoretical section of this article puts forward potential pathways of association between EC and fertility, the understanding of the mechanisms operating between family behaviour and regional characteristics requires a different research setup, such as micro-level (quasi-) natural experiments (Klüsener et al., 2013a; Neyer & Andersson, 2008). Third, the range of available economic and labour market indicators is more restricted at a subnational level, which consequently prevented us from delving deeper into different possible links between economic development and fertility. Finally, it would be both interesting and beneficial to study a longer time series. However, due to data constraints, our analysis had to focus on the period between 2006 and 2015.

Despite its weaknesses, this article opens up a new outlook in fertility research. In the aftermath of the Great Recession, fertility in Italy (as well as elsewhere in Europe; Vignoli et al., 2020a) registered a new contraction, providing the literature with an added stimulus to focus on the role of unemployment and the diffusion of jobs with uncertain conditions as drivers of fertility change. Nonetheless, this study suggests that limiting the analysis to traditional measures of the economic and labour context only provides a partial view: one that highlights only the negative side of huge technological changes and globalization. We suggest that, in industrialized economies such as Italy, climbing the ladder of industrial complexity can foster fertility. Indeed, in high-income countries, a more complex economy is associated with economic opportunity, personal and societal well-being, and lower levels of economic uncertainty (Hartmann et al., 2017; Hidalgo, 2015). All these factors allow a territory to suitably face globalization and technological change, and favour the enhancement of a proactive social and economic context, thereby leading to an increase in total fertility. In line with recent findings regarding the Belgian vanguard case (Wood et al., 2017), we conclude that a positive link between human development and fertility seems attainable. Future research should explore the relationship between EC and fertility in other countries, characterized by dissimilar institutional settings and different starting levels of TFR, as well as varying levels of economic development. In addition, achieving a more comprehensive understanding of the effects of specific industrial specializations on fertility dynamics appears to be an interesting avenue for future research.

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NOTE

1. NACE, or the Nomenclature statistique des activités économiques dans la Communauté européenne, represents the statistical classification of economic activities in the European Community.

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REFERENCES

Anderson, T., & Kohler, H. (2015). Low fertility, socioeconomic development, and gender equity. *Population and Development Review*, *41*(3), 381–407. https://doi.org/10.1111/j.1728-4457.2015.00065.x

Arpino, B., & Tavares, L. (2013). Fertility and values in Italy and Spain: A look at regional differences within the European context. *Population Review*, *52*(1), 62–86. https//doi.org/10.1353/prv.2013.0004

Autor, D., Dorn, D., & Hanson, G. (2013). The China syndrome: Local labor market effects of import competition in the United States. *American Economic Review*, *103*(6), 2121–2168. https://doi.org/10.1257/aer.103.6.2121

Autor, D., Dorn, D., & Hanson, G. (2016). The China shock: Learning from labor market adjustment to large changes in trade. *Annual Review of Economics*, *8*(1), 205–240. https://doi.org/10.1146/annurev-economics-080315-015041

Autor, D., Dorn, D., Hanson, G., & Song, J. (2014). Trade adjustment: Worker-level evidence. *The Quarterly Journal of Economics*, *129*(4), 1799–1860. https://doi.org/10.1093/qje/qju026

Bahar, D., Rapoport, H., & Turati, R. (2019). *Does birthplace diversity affect economic complexity? Cross-country evidence* (Discussion Papers No. 2019020). Université catholique de Louvain, Institut de Recherches Economiques et Sociales (IRES).

Balland, P., Boschma, R., Crespo, J., & Rigby, D. (2019). Smart specialization policy in the European Union: Relatedness, knowledge complexity and regional diversification. *Regional Studies*, *53*(9), 1252–1268. https://doi.org/10.1080/00343404.2018.1437900

Balland, P., Figueroa, C., Petralia, S., Steijn, M., Rigby, D., & Hidalgo, C. (2020). Complex economic activities concentrate in large cities. *Nature Human Behaviour*, 1–7. https://doi.org/10.1038/s41562-019-0803-3

Balland, P., & Rigby, D. (2017). The geography of complex knowledge. *Economic Geography*, *93*(1), 1–23. https://doi.org/10.1080/00130095.2016.1205947

Barbieri, P., & Bozzon, R. (2016). Welfare, labour market deregulation and households' poverty risks: An analysis of the risk of entering poverty at childbirth in different European welfare clusters. *Journal of European Social Policy*, *26*(2), 99–123. https://doi.org/10.1177/0958928716633044

Barbieri, P., Bozzon, R., Scherer, S., Grotti, R., & Lugo, M. (2015). The rise of a Latin model? Family and fertility consequences of employment instability in Italy and Spain. *European Societies*, *17*(4), 423–446. https://doi.org/10.1080/14616696.2015.1064147

Beaudry, C., & Schiffauerova, A. (2009). Who's right, Marshall or Jacobs? The localization versus urbanization debate. *Research*

Policy, *38*(2), 318–337. https://doi.org/10.1016/j.respol.2008.11.010

Becattini, G. (1979). *Dal settore industriale al distretto industriale. Alcune considerazioni sull'unità di indagine dell'economia industriale*. Il Mulino.

Becattini, G. (1990). The Marshallian industrial district as a socio-economic concept. In F. Pyke, G. Becattini, & W. Sengenberger (Eds.), *Industrial districts and inter-firm cooperation in Italy* (pp. 37–51). IILS.

Bernardi, F., & Nazio, T. (2005). Globalization and the transition to adulthood in Italy. In H. P. Blossfeld, E. Klijzing, M. Mills, & K. Kurz (Eds.), *Globalization, uncertainty and youth in society: The losers in a globalizing world* (pp. 359–385). Routledge.

Bleha, B., & Ďurček, P. (2017). An interpretation of the changes in demographic behaviour at a sub-national level using spatial measures in post-socialist countries: A case study of the Czech Republic and Slovakia. *Papers in Regional Science*, *98*(1), 331–351. https://doi.org/10.1111/pirs.12318

Bloom, N., Draca, M., & Van Reenen, J. (2016). Trade induced technical change? The impact of Chinese imports on innovation, IT and productivity. *The Review of Economic Studies*, *83*(1), 87–117. https://doi.org/10.1093/restud/rdv039

Blossfeld, H.-P., Klijzing, E., Mills, M., & Kurz, K. (2005). *Globalization, uncertainty and youth in society*. Routledge.

Boschma, R., & Frenken, K. (2009). Technological relatedness and regional branching. In H. Bathelt, M. Feldman, & D. Kogler (Eds.), *Beyond territory: Dynamic geographies of knowledge creation and innovation* (pp. 64–68). Routledge.

Caldarelli, G., Cristelli, M., Gabrielli, A., Pietronero, L., Scala, A., & Tacchella, A. (2012). A network analysis of countries' export flows: Firm grounds for the building blocks of the economy. *PLOS One*, *7*(10), e47278. https://doi.org/10.1371/journal.pone.0047278

Caldwell, J. (1976). Toward a restatement of demographic transition theory. *Population and Development Review*, *2*, 321–366. https://doi.org/10.2307/1971615

Caldwell, J. (2001). The globalization of fertility behavior. *Population and Development Review*, *27*, 93–115.

Caltabiano, M., Dreassi, E., Rocco, E., & Vignoli, D. (2019). A sub-regional analysis of family change: The spatial diffusion of one-parent families across Italian municipalities, 1991–2011. *Population, Space and Place*, *25*(4), e2237. https://doi.org/10.1002/psp.2237

Chávez, J. C., Mosqueda, M. T., & Gómez-Zaldívar, M. (2017). Economic complexity and regional growth performance: Evidence from the Mexican economy. *Review of Regional Studies*, *47*(2), 201–219.

Coale, A. (2017). *The decline of fertility in Europe*. Princeton University Press.

Comolli, C. (2017). The fertility response to the Great Recession in Europe and the United States: Structural economic conditions and perceived economic uncertainty. *Demographic Research*, *36*, 1549–1600. https://doi.org/10.4054/DemRes.2017.36.51

Coppola, L., & Di Laurea, D. (2016). Dynamics of persistent poverty in Italy at the beginning of the crisis. *Genus*, *72*(1), 1–17. https://doi.org/10.1186/s41118-016-0007-x

Cruickshank, M. (1981). *Children and industry: Child health and welfare in north-west textile towns during the nineteenth century*. Manchester University Press.

Dauth, W., Findeisen, S., & Suedekum, J. (2014). The rise of the East and the Far East: German labor markets and trade integration. *Journal of the European Economic Association*, *12*(6), 1643–1675. https://doi.org/10.1111/jeea.12092

Day, C. (2012). Economic growth, gender wage gap and fertility rebound. *Economic Record*, *88*, 88–99. https://doi.org/10.1111/j.1475-4932.2012.00799.x

Dreher, A. (2006). Does globalisation affect growth? Evidence from a new index of globalisation. *Applied Economics*, *38*(10), 1091–1110. https://doi.org/10.1080/00036840500392078

Felipe, J., Kumar, U., Abdon, A., & Bacate, M. (2012). Product complexity and economic development. *Structural Change and Economic Dynamics*, *23*(1), 36–68. https://doi.org/10.1016/j.strueco.2011.08.003

Fox, J., Klüsener, S., & Myrskylä, M. (2019). Is a positive relationship between fertility and economic development emerging at the sub-national regional level? Theoretical considerations and evidence from Europe. *European Journal of Population*, *35*(3), 487–518. https://doi.org/10.1007/s10680-018-9485-1

Frenken, K., Van Oort, F., & Verburg, T. (2007). Related variety, unrelated variety and regional economic growth. *Regional Studies*, *41*(5), 685–697. https://doi.org/10.1080/00343400601120296

Gaddy, H. (2021). A decade of TFR declines suggests no relationship between development and sub-replacement fertility rebounds. *Demographic Research*, *44*, 125–142. https://doi.org/10.4054/DemRes.2021.44.5

Galor, O., & Weil, D. (2000). Population, technology, and growth: From Malthusian stagnation to the demographic transition and beyond. *American Economic Review*, *90*(4), 806–828. https://doi.org/10.1257/aer.90.4.806

Gangopadhyay, P. (2017). *Economics of globalisation*. Routledge.

Gao, J., & Zhou, T. (2018). Quantifying China's regional economic complexity. *Physica A: Statistical Mechanics and its Applications*, *492*, 1591–1603. https://doi.org/10.1016/j.physa.2017.11.084

Gaston, N., & Nelson, D. (2004). Structural change and the labor-market effects of globalization. *Review of International Economics*, *12*(5), 769–792. https://doi.org/10.1111/j.1467-9396.2004.00481.x

Giddens, A. (1990). *The consequences of modernity*. Polity.

Grusky, D. B., Western, B., & Wimer, C. (2011). *The great recession*. Russell Sage Foundation.

Guillén, M. (2001). Is globalization civilizing, destructive or feeble? A critique of five key debates in the social science literature. *Annual Review of Sociology*, *27*(1), 235–260. https://doi.org/10.1146/annurev.soc.27.1.235

Hank, K. (2002). Regional social contexts and individual fertility decisions: A multilevel analysis of first and second births in Western Germany. *European Journal of Population/Revue européenne de Démographie*, *18*(3), 281–299. https://doi.org/10.1023/A:1019765026537

Hartmann, D. (2014). *Economic complexity and human development*. Routledge.

Hartmann, D., Guevara, M., Jara-Figueroa, C., Aristarán, M., & Hidalgo, C. (2017). Linking economic complexity, institutions, and income inequality. *World Development*, *93*, 75–93. https://doi.org/10.1016/j.worlddev.2016.12.020

Held, D., McGrew, A., Goldblatt, D., & Perraton, J. (1999). *Global transformations*. Polity Press.

Held, D., McGrew, A., Goldblatt, D., & Perraton, J. (2000). Rethinking globalization. In D. Held, & A. McGrew (Eds.), *The global transformations reader: An introduction to the globalization debate* (pp. 54–60). Polity.

Herzer, D., Strulik, H., & Vollmer, S. (2012). The long-run determinants of fertility: One century of demographic change 1900–1999. *Journal of Economic Growth*, *17*(4), 357–385. https://doi.org/10.1007/s10887-012-9085-6

Hidalgo, C. (2015). *Why information grows: The evolution of order, from atoms to economies*. Basic Books.

Hidalgo, C., & Hausmann, R. (2009). The building blocks of economic complexity. *Proceedings of the National Academy of Sciences*, *106*(26), 10570–10575. https://doi.org/10.1073/pnas.0900943106

Hofmann, B., & Hohmeyer, K. (2013). Perceived economic uncertainty and fertility: Evidence from a labor market reform. *Journal*

of Marriage and Family, *75*(2), 503–521. https://doi.org/10.1111/jomf.12011
Inglehart, R. (1977). *The silent revolution: Changing values and political styles in advanced industrial society*. Princeton University Press.
Johnson, T. (2015). The professions in the class structure. In R. Scase (Ed.), *Industrial society* (pp. 93–110). Routledge.
Kertzer, D., White, M., Bernardi, L., & Gabrielli, G. (2009). Italy's path to very Low fertility. The adequacy of economic and second demographic transition theories. *European Journal of Population*, *25*(1), 89–115. https://doi.org/10.1007/s10680-008-9159-5
Klüsener, S., Neels, K., & Kreyenfeld, M. (2013a). Family policies and the Western European fertility divide: Insights from a natural experiment in Belgium. *Population and Development Review*, *39* (4), 587–610. https://doi.org/10.1111/j.1728-4457.2013.00629.x
Klüsener, S., Perelli-Harris, B., & Sánchez Gassen, N. (2013b). Spatial aspects of the rise of nonmarital fertility across Europe since 1960: The role of states and regions in shaping patterns of change. *European Journal of Population/Revue européenne de Démographie*, *29*(2), 137–165. https://doi.org/10.1007/s10680-012-9278-x
Kreyenfeld, M., Andersson, G., & Pailhe, A. (2012). Economic uncertainty and family dynamics in Europe: Introduction. *Demographic Research*, *27*(28), 835–852. https://doi.org/10.4054/DemRes.2012.27.28
Kulu, H. (2005). Migration and fertility: Competing hypotheses re-examined. *European Journal of Population/Revue européenne de Démographie*, *21*(1), 51–87. https://doi.org/10.1007/s10680-005-3581-8
Kulu, H. (2013). Why do fertility levels vary between urban and rural areas? *Regional Studies*, *47*(6), 895–912. https://doi.org/10.1080/00343404.2011.581276
Lacalle-Calderon, M., Perez-Trujillo, M., & Neira, I. (2017). Fertility and economic development: Quantile regression evidence on the inverse J-shaped pattern. *European Journal of Population*, *33*(1), 1–31. https://doi.org/10.1007/s10680-016-9382-4
Lazzeretti, L., Boix, R., & Capone, F. (2008). Do creative industries cluster? Mapping creative local production systems in Italy and Spain. *Industry and Innovation*, *15*(5), 549–567. https://doi.org/10.1080/13662710802374161
Lesthaeghe, R. (1995). The second demographic transition in Western countries: An interpretation. In K. O. Mason & A. M. Jensen (Eds.), *Gender and family change in industrialized countries* (pp. 17–62). Clarendon.
Lesthaeghe, R. (2010). The unfolding story of the second demographic transition. *Population and Development Review*, *36*(2), 211–251. https://doi.org/10.1111/j.1728-4457.2010.00328.x
Lesthaeghe, R. (2020). The second demographic transition, 1986–2020: Sub-replacement fertility and rising cohabitation – A global update. *Genus*, *76*(10), 1–38. https://doi.org/10.1186/s41118-020-00077-4
Mameli, F., Faggian, A., & McCann, P. (2014). Estimation of local employment growth: Do sectoral aggregation and industry definition matter? *Regional Studies*, *48*(11), 1813–1828. https://doi.org/10.1080/00343404.2012.756578
Matysiak, A., Sobotka, T., & Vignoli, D. (2021). The Great Recession and fertility in Europe: A sub-national analysis. *European Journal of Population*, 37(1), 29–64. https://doi.org/10.1007/s10680-020-09556-y
Mealy, P., Farmer, J., & Teytelboym, A. (2019). Interpreting economic complexity. *Science Advances*, *5*(1), eaau1705. https://doi.org/10.1126/sciadv.aau1705
Mills, M., & Blossfeld, H. (2013). The second demographic transition meets globalization: A comprehensive theory to understand changes in family formation in an era of rising uncertainty. In A. Evans & J. Baxter (Eds.), *Negotiating the life course* (pp. 9–33). Springer.
Mingione, E. (2009). Family, welfare and districts: The local impact of new migrants in Italy. *European Urban and Regional Studies*, *16*(3), 225–236. https://doi.org/10.1177/0969776409104690
Myrskyla, M., Kohler, H., & Billari, F. (2009). Advances in development reverse fertility declines. *Nature*, *460*(7256), 741–743. https://doi.org/10.1038/nature08230
Neyer, G., & Andersson, G. (2008). Consequences of family policies on childbearing behavior: Effects or artifacts? *Population and Development Review*, *34*(4), 699–724. https://doi.org/10.1111/j.1728-4457.2008.00246.x
Paci, M. (1991). Classi sociali e società post-industriale in Italia. *Stato e mercato*, *32*(2), 199–217.
Petralia, S., Balland, P., & Morrison, A. (2017). Climbing the ladder of technological development. *Research Policy*, *46*(5), 956–969. https://doi.org/10.1016/j.respol.2017.03.012
Poncet, S., & de Waldemar, F. S. (2013). Export upgrading and growth: The prerequisite of domestic embeddedness. *World Development*, *51*, 104–118. https://doi.org/10.1016/j.worlddev.2013.05.010
Potrafke, N. (2013). Globalization and labor market institutions: International empirical evidence. *Journal of Comparative Economics*, *41*(3), 829–842. https://doi.org/10.1016/j.jce.2013.02.002
Raab, M., Ruland, M., Schönberger, B., Blossfeld, H., Hofäcker, D., Buchholz, S., & Schmelzer, P. (2008). Globalindex: A sociological approach to globalization measurement. *International Sociology*, *23*(4), 596–631. https://doi.org/10.1177/0268580908090729
Ravallion, M. (2004). *Pro-poor growth: A primer*. World Bank.
Reynolds, C., Agrawal, M., Lee, I., Zhan, C., Li, J., Taylor, P., Mares, T., Morison, J., Angelakis, N., & Roos, G. (2018). A sub-national economic complexity analysis of Australia's states and territories. *Regional Studies*, *52*(5), 715–726. https://doi.org/10.1080/00343404.2017.1283012
Sato, Y. (2007). Economic geography, fertility and migration. *Journal of Urban Economics*, *61*(2), 372–387. https://doi.org/10.1016/j.jue.2006.08.002
Sato, Y., & Yamamoto, K. (2005). Population concentration, urbanization, and demographic transition. *Journal of Urban Economics*, *58*(1), 45–61. https://doi.org/10.1016/j.jue.2005.01.004
Schleutker, E. (2014). Determinants of childbearing: A review of the literature. *Zeitschrift für Soziologie*, *43*(3), 192–211. https://doi.org/10.1515/zfsoz-2014-0303
Simoes, A., & Hidalgo, C. (2017). *The observatory of economic complexity*. In The economic complexity observatory: An analytical tool for understanding the dynamics of economic development. Workshops at the 25th AAAI Conference on Artificial Intelligence.
Sobotka, T., Skirbekk, V., & Philipov, D. (2011). Economic recession and fertility in the developed world. *Population and Development Review*, *37*(2), 267–306. https://doi.org/10.1111/j.1728-4457.2011.00411.x
Sutcliffe, B., & Glyn, A. (2019). Measures of globalisation and their misinterpretation. In J. Michie (Ed.), *The handbook of globalisation*. Edward Elgar.
Tacchella, A., Cristelli, M., Caldarelli, G., Gabrielli, A., & Pietronero, L. (2012). A new metrics for countries' fitness and products' complexity. *Nature Scientific Reports*, *2*, 1–7. https://doi.org/10.1038/srep00723
Van de Kaa, D. (1987). Europe's second demographic transition. *Population Bulletin*, *42*(1), 1–59.
Van Oort, F. (2015). Unity in variety? Agglomeration economics beyond the specialization-diversity controversy. In C. Karlsson, M. Andersson, & T. Norman (Eds.), *Handbook of research methods and applications in economic geography* (pp. 259–271). Edward Elgar.

Vignoli, D., Drefahl, S., & De Santis, G. (2012). Whose job instability affects the likelihood of becoming a parent in Italy? A tale of two partners. *Demographic Research*, *26*, 41–62. https://doi.org/10.4054/DemRes.2012.26.2

Vignoli, D., Guetto, R., Bazzani, G., Pirani, E., & Minello, A. (2020a). A reflection on economic uncertainty and fertility in Europe: The Narrative framework. *Genus*, *76*(28), 1–27. https://doi.org/10.1186/s41118-020-00094-3

Vignoli, D., Tocchioni, V., & Mattei, A. (2020b). Job uncertainty on first-birth postponement. *Advances in Life Course Research*, 45, 100308. https://doi.org/10.1016/j.alcr.2019.100308

Vitali, A., & Billari, F. (2017). Changing determinants of low fertility and diffusion: A spatial analysis for Italy. *Population, Space and Place*, *23*(2), 1–18. https://doi.org/10.1002/psp.1998

Von Hofe, R., & Chen, K. (2006). Whither or not industrial cluster: Conclusions or confusions? *The Industrial Geographer*, *4*(1), 2–28.

Wang, Q., & Sun, X. (2016). The role of socio-political and economic factors in fertility decline: A cross-country analysis. *World Development*, *87*, 360–370. https://doi.org/10.1016/j.worlddev.2016.07.004

Wood, J., Klüsener, S., Neels, K., & Myrskylä, M. (2017). *Is a positive link between human development and fertility attainable? Insights from the Belgian vanguard case* (No. WP-2017-014). Max Planck Institute for Demographic Research.

Wrigley, E. (2006). *Industrial growth and population change*. Cambridge University Press.

Zambon, I., Rontos, K., Reynaud, C., & Salvati, L. (2020). Toward an unwanted dividend? Fertility decline and the North–South divide in Italy, 1952–2018. *Quality & Quantity*, *54*(1), 169–187. https://doi.org/10.1007/s11135-019-00950-1

Zhu, S., & Li, R. (2017). Economic complexity, human capital and economic growth: Empirical research based on cross-country panel data. *Applied Economics*, *49*(38), 3815–3828. https://doi.org/10.1080/00036846.2016.1270413