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Economic Complexity and Fertility. Insights from a Low Fertility Country

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Economic Complexity and Fertility

Insights from a Low Fertility Country

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ABSTRACT

This paper analyses the relationship between a new indicator of economic context, economic complexity (EC), and fertility change in Italian provinces for the period 2006–2015. We hypothesise that the level of EC is associated with fertility because it captures the capacity of a territory to innovate, grow, and create job options. 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 globalisation.

KEYWORD

Fertility; Globalisation; Economic Complexity; Italy

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INTRODUCTION

Over the second half of the twentieth 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, effort has been devoted to the study of this effect, searching for the determinants of this negative association (Caldwell, 1976; Lesthaeghe, 1995; Galor and Weil, 2000; Anderson and Kohler, 2015). Recently, this accepted regularity is creaking, and renewed attention has been paid to the link between economic development and total fertility (Herzer et al., 2012; Hofmann and Hohmeyer, 2013). The increasing speed, dynamics and volatility of globalisation has contributed to altering previously established relationships (Mills and Blossfeld, 2013). These changes have been taking place in industrialised economies in recent decades and have substantially intensified with the advent of the Great Recession. To date, there is evidence of both a positive and a negative relationship between economic circumstances and fertility, depending on the level of economic development of the country and the positive or negative trend of this development (Myrskyla et al., 2009; Wang and Sun, 2016).

The concept of globalisation is multifaceted, encompassing the economic and technological sphere as well as financial, political and social processes, which have wide-ranging effects on the global economy and society (Gangopadhyay, 2017). The search for different measures of the increasing globalisation is an issue that has been studied mainly in the economic and partly in the sociological literature. Regarding the studies in economics, usually these refer to common macroeconomic measures as foreign direct investment, financial flows and international trade in goods and services (Sutcliffe and Glyn, 1999). Although these measurements provide some insight into the increasing international integration of economic activity, they are too narrow to use 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 also to complex political, cultural and social exchanges aside from economic activities. While substantial attention has been devoted to the consequences of globalisation and technological change on the labour market (Gaston and Nelson, 2004; Potrafke, 2013), few studies have addressed the role of globalisation and technological change on fertility in post-industrial societies (Bernardi and Nazio, 2005; Mills and Blossfeld, 2013). At best, these studies have operationalised the negative forces of globalisation through unemployment or the diffusion of jobs with uncertain conditions (Kreyenfeld et al., 2012; Vignoli et al., 2019; Matysiak et al., 2020), disregarding or downplaying the ongoing industrial change occurring across various countries and regions. In this paper, we argue for the need to consider new, better-suited markers of the continuous economic- and labour market-related transformations in the realm of fertility research.

This work 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, first developed by Hidalgo and Hausmann (2009), which sustains a view of economic growth and development that emphasises 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 diversity of the area in terms of products exported and their ubiquity (how many countries/regions export that product). The idea is that an area with higher EC will perform better 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 (Poncet and De Waldemar, 2013; Chavez et al., 2017) and knowledge and innovation (Petralia et al., 2017; Balland and Rigby, 2017). Furthermore, EC reduces 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).

In this paper, we posit—for the first time—that different levels of EC might also affect fertility. We hypothesise that the level of EC 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 fight against the negative adjustments of contemporary economic- and labour market-related transformations, driven by globalisation and technological change. Specifically, we ask: *Does the level of EC of an area matter for fertility?* We address this question using a macro perspective for Italy by analysing Italian provinces over the period 2006–2015. The country typifies a very low fertility setting where fertility has been stagnating in recent decades to 1.3–1.4 children per woman, alongside extraordinary regional differentials in socio-economic circumstances and fertility (Vitali and Billari, 2017). The Great Recession, the term used to describe the global financial, economic and labour market decline of 2007 to 2009 (Gruskyet al., 2011), which strongly hit the country, sharpened the decrease in fertility levels, particularly in the regions in which levels of unemployment and persistent poverty were already high (Coppola and Di Laurea, 2016). The links between economic context and fertility operate across multiple social and geographic levels (e.g. countries, regions and provinces). These links are often simultaneously relevant, with neighbouring units displaying similar patterns (Klüsener et al., 2013). The geographic focus of the analysis presented here is at the smallest geographic level of investigation offered by the European Union classification system for units with comparable population size, the NUTS-3 level (i.e. Italian provinces).

THEORETICAL BACKGROUND

Globalisation and Complexity

Since the 1980s, an array of global transformation has occurred, characterised by the declining importance of national borders for economic transactions; intensification of worldwide social relations through the information and technology revolution; tougher tax competition between countries accompanied by the deregulation, privatisation, and liberalisation of domestic industries and markets; and the rising importance of exposure to a volatile work market (Held et al., 1999; Guillen, 2001; Raab et al., 2008; Barbieri and Bozzon, 2016). The promises of globalisation, such as more competitive prices, more choice, greater freedom, higher living standards, and prosperity have been accompanied by negative consequences, however, including, but not limited to: salary cuts, lost jobs, layoffs, bankruptcies, and failing companies (Mills and Blossfeld, 2013).

The original concept of globalisation refers to the diffusion of international trade and has traditionally meant greater openness in trade as a means to higher rates of economic growth. This has had an impact on the industrial diversification and specialisation 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 globalised world. There have been many attempts to measure globalisation, including composite indices like as the GlobalIndex (Raab et al., 2008) or the KOF index (Dreher, 2006) composed of quantitative and qualitative measures. However, as they are designed at the country level, there are difficulties in transposing them to a fine-grained geographical level. In any event, there is no consensus on the reliability of these and other measures of globalisation (Sutcliffe and Glyn, 2019).

As a result of globalisation, advances in information and communication technologies, further significant decreases in transportation costs, increased purchasing power, and the adaptation of the labour market, competition in the rich world has increasingly shifted from price to innovation and design competition, requiring an increasing amount of specialisation (Hartmann, 2014). This state of affairs has led to increasingly complex and specialised organisation of production. In addition, in the last decade, studies have introduced new and more sophisticated methods to determine a country or region's optimal productive structure for growth or competitiveness. This debate is often integrated with the notions of diversification and variety (Boschma and Frenken, 2009). The idea that variety and the industrial composition of an area may be among the most important characteristics in explaining why some territories grow, while others stagnate or decline, has been debated in the literature (Frenken et al., 2007). While the debate on the role of diversity, variety and industrial specialisation has increased in recent years (see, for example, Boschma and Frenken, 2009; Mameli et al., 2014), is not yet clear whether diversification or specialisation is more important in favouring economic growth (Beaudry and Schiffauerova, 2009; Van Oort, 2015). In this context, growing attention has been paid to the interactions among sectors and, thus, to a better understanding of the elements of variety and specialisation that may best influence the growth of territories.

The seminal work by Hidalgo and Hausmann (2009), using 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. EC is defined by the diversity and ubiquity of products that each country produces and exports. Each country develops specialisations in different products based on its historical development and on previous specialisations. Countries specialise in as many products as possible because this allows to build up the skills to produce new, additional products that need more specialised competences. These new products are less ubiquitous and less easy to copy because few other countries hold all the competencies required to produce this type of 'composite products'. This is the idea of complexity—rarer products, those produced by areas that hold many specialisations, are the most complex products; in a similar vein, the areas that produce the rarest (least ubiquitous) products and, in general, hold many different specialisations, are classified as more complex areas. In this framework, areas that produce the less ubiquitous products face less competition. A large number of different specialisations allows them to create new complex products, combining the specialisations that they already possess. Then, each new specialisation can be easily combined with a large number of other specialisations. The notion of EC received wide attention because it proved to be highly predictive of future economic growth. Since the work of Hidalgo and Hausmann (2009), many other scholars followed the framework in different areas (Balland et al., 2020), applying the concept to products as in the original work (Zhu and Li, 2017; Hartmann et al., 2017), to patents (Petralia et al., 2017; Balland and Rigby, 2017; Balland et al., 2019) and to industries (Chavez et al., 2017).

Globalisation, Complexity, and Fertility

From the globalisation perspective, it is tempting to conclude that global fertility decline is one of its outcomes, as the opening of borders and ever-increasing communication across societies should encourage convergence in ideas and behaviour. Much has been written about globalisation and how it may affect our lives and the future of our societies, but this literature is often imprecise about what globalisation actually entails. European citizens have begun to perceive globalisation as a force eroding the welfare state, causing job insecurity and fostering job mobility and job-hopping, marking a clear divide from the labour market dynamics of the past (see, for example, Blossfeld et al., 2005). Volatile global markets and the recent Great Recession have fuelled the view that globalisation is a multiplier of uncertainty (Mills and Blossfeld, 2013). 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 that have concentrated their attention on such economic forces customarily operationalised the diffusion of unemployment or jobs with uncertain conditions as the main driver of fertility decline (Comolli 2017; Vignoli et al., 2019; Matysiak et al., 2020).

The decline in fertility is known to be associated with changes in individual socio-economic conditions, which lead families to avoid large family sizes (Lesthaeghe, 2010). Such a decline, however, has not occurred uniformly and simultaneously across regions and countries (Coale, 2017). There are works investigating 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). Other works have studied the connections between fertility and globalisation, looking at the connections between the two. Caldwell (2001) suggested that globalisation might influence fertility by changing the economic structure of a country and hence its social and demographic habits. Linkages between economic conditions in a country or region and community characteristics are discussed across demographic (Arpino and Tavares, 2013; Bleha and Durcek, 2017), sociological (Hank, 2002) and economic (Sato, 2007) studies, but prior studies have found different effects, mainly depending on the level of development of the area and the period analysed. When talking about medium- or high-income countries, there has been a discussion over a reversal in the fertility trend (Myrskyla et al., 2009) based on the idea that the socio-economic development of an area is associated with a decline in fertility only up to a certain point, after which the association becomes positive (Myrskyla et al., 2009; Day, 2012). The question remains, however, what leads to such a reversal in the relationship?

Recently, empirical analysis spearheaded by Autor et al. (2013; 2014; 2016), Dauth, Findeisen & Suedekum (2014) and Bloom, Draca & Van Reenen (2016), has shown how globalisation has affected individual labour market outcomes such as unemployment, labour-force participation and job vacancies in recent decades. These changes occurred rapidly (e.g. due to the spread of automation and the consequent disappearance of entire jobs), and people need to 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. In this article, we posit that in post-industrial economies, the level of EC of an area might help to face the negative consequences of the dramatic economic- and labour market-related changes occurring due to globalisation and technological change. This, in turn, also favors fertility. In this regard, the notion of EC and related methodologies have been employed to infer the capacity to innovate (Balland et al., 2019) or to grow (Poncet et al., 2013), using smaller geographical units such as regions or provinces. More recently, the notion of EC has been used to show connections between the level of complexity and income inequality within countries (Hartmann et al., 2017), the level of human development (Hartmann, 2014) and a country's absolute level of poverty and social welfare (Ravallion, 2004).

The EC of a region or country may impact many different factors, not only strictly economic factors. As explained by Hartmann (2014), many socio-economic characteristics of the territories, such as their labour market, inequality and levels of human capital, may be influenced by EC. These socio-economic characteristics are also well-known determinants of fertility. Here, we add that the level of EC might represent a crucial driver of fertility because the diversification of products in a certain area (i.e. its level of EC) embodies the capacity of a territory to innovate, grow, create job options, and fight against socio-economic inequalities.

RESEARCH DESIGN

Dependent variable, Total Fertility Rate

The paper presents a longitudinal analysis of the association between EC and fertility across all 103 Italian provinces from 2006 to 2015. The total fertility rate (TFR) is taken from the Italian National Institute of Statistics. These data are 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 that would be born to a woman if she were to live to the end of her childbearing years and bear children in accordance with age-specific fertility rates of the specified year. Figure 1 depicts the TFR trends in the Italian macro-regions during the period under consideration (2006–2015).

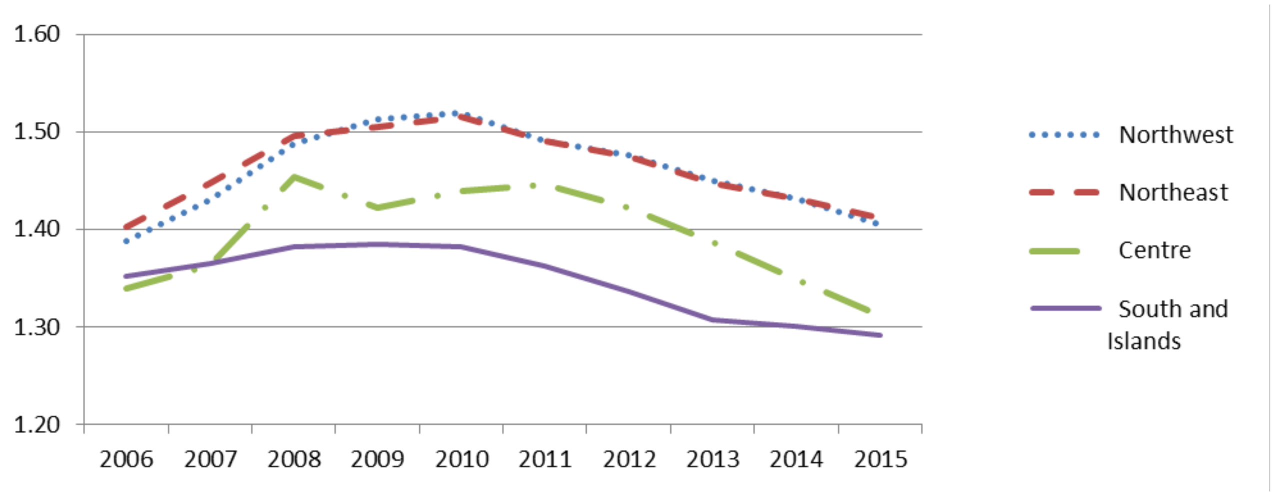

Figure 1. Total Fertility Rate trends in Italian macro-regions, 2006–2015

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

Economic complexity

To build our EC index (ECI), we followed the methods proposed by Hidalgo and Hausmann (2009), refined by Balland and Rigby (2017). We used employment data (Chavez et al., 2017) with industries disaggregated according to the Nace industrial classification at the 4-digit level of all the analysed provinces during the period 2006–2015.

We operationalised employment data as an adjacency matrix M_{pi}, where M_{pi} is equal to 1 if the province p has a relative specialisation in industry i and equal to 0 if this is not the case. Province p is considered to be specialised in the considered industry i and, thus, has a revealed comparative advantage (RCA) if the share of industry *i* in the industrial basket of the province *p*, divided by the share of industry *i* in Italian industrial composition, is higher than a threshold value *tv*. Mathematically, RCA*pi* = (E*pi*/E*p*)/(E*i*/E) > *tv*.

Hidalgo and Hausmann's seminal work suggested applying the method of reflection, using RCA to compute the two components that construct ECI, namely the diversity between each province (in term of industries) and the ubiquity (of the industries located in that provinces). After a series of *n* iterations of these measures at both the industry and province levels, the process ends with a stable measure of ECI. The iterations stop when the correlation with the previous is near 1, meaning that there is no relevant additional information to be captured by another use of the method of reflection. In our work, ECI is computed for each year and province. Conscious of the algebraic problems raised by the use of the method of reflection (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).

The complexity of provinces based on employment data was calculated using the product matrix W equal to the product of matrix M (row standardised) and its transpose M^T (row standardised), a squared matrix as large as the number of our provinces (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 (row) *p* has RCA and the ubiquity of the industrial classes in which province (column) *i* has RCA. These elements thus capture the similarity in the industrial structure of pairs of provinces. The complexity for each province is provided by the second eigenvector of matrix W.

In Figure 2, we note that more diversified provinces are specialised in less ubiquitous industries. For instance, Milan is the province with the highest number of specialisations as well as the lowest value in terms of average ubiquity of the specialised industries. This means that in this province there are, on average, the rarest industries of the country, offering the opportunity to hold this advantage because there are few other provinces to compete with. In addition, the higher RCA allows the province of Milan to combine them with many other related industries and possibly even with new entrants, allowing the province to remain at the frontier.

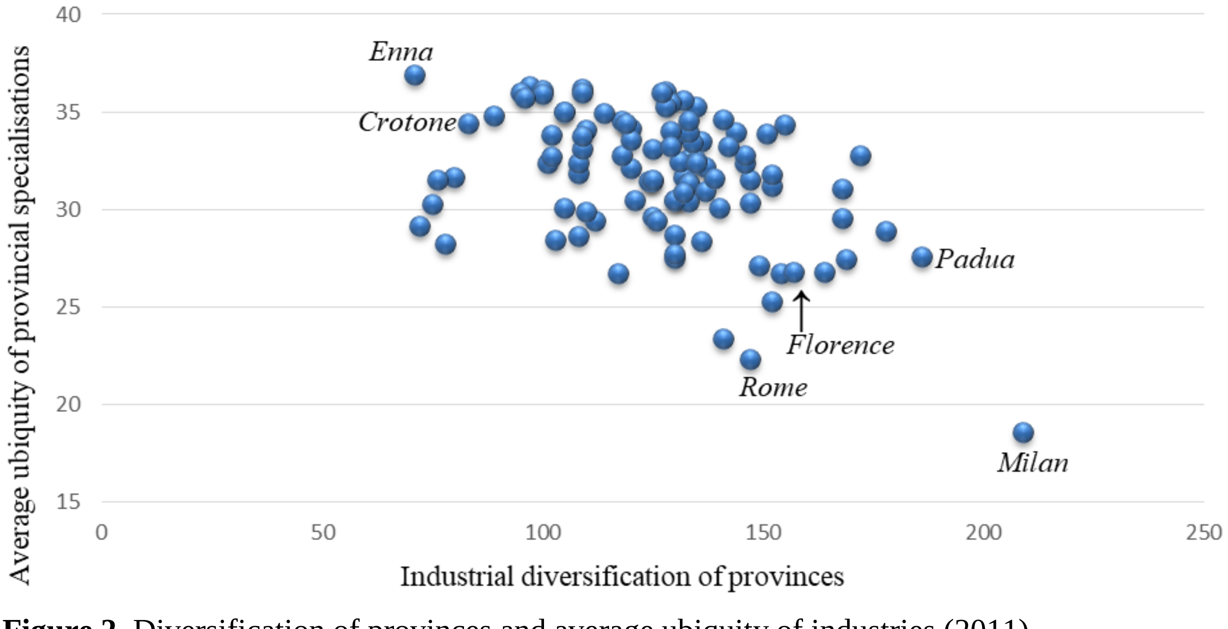

Figure 2. Diversification of provinces and average ubiquity of industries (2011).

By contrast, the province of Enna shows the lowest number of RCAs and the highest level of average ubiquity of these specialisations. Specialisation in more ‘common’ industries forces the province to compete with many other provinces, hindering its capacity to grow. At the same time, the few RCAs owned obstruct the province in climbing the specialisation tree, preventing it from reaching rarer specialisations that require several different competences to be obtained.

These extreme examples suggest that level of diversification and ubiquity are intuitively able to express the complexity of the provinces and their capacity to grow in the future, attracting highly specialised and highly educated workers (required by the most complex industries), contributing to job creation, economic affluence and human capital accumulation (see Hartmann, 2014). All these factors allow a province to face globalisation and technological change and favour the enhancement of a pro-active social and economic context.

Model specification

To test the impact of EC variation on fertility growth in Italian provinces, we utilised panel regression techniques with year and province as fixed effects. Our dependent variable is represented by TFR change, while the key explanatory variable is represented by the ECI. To better understand this association, additional control variables were included in the model equation following a stepwise procedure. The selection of such control variables relied on past findings and also on data availability and reliability.

A first control variable is the population density of the province, used to control for the level of urbanisation, measured as the population per squared kilometre of the province. This variable is often added to studies analysing the determinants of fertility growth as a proxy of the level of urbanisation of an area—fertility has been found to decline with urbanisation (Sato & Yamamoto, 2005).

Among the ‘standard’ fertility predictors, we considered a range of labour market measures that indicate instability of employment and persistence of joblessness. First, we included the unemployment rate of the area, namely the variation of the unemployment rate of each province (e.g. Matysiak et al., 2020). Second, we included the percentage of workers with a temporary job over the total number of workers in each province (e.g. Vignoli et al. 2012; Barbieri et al., 2015). 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 by authors from the European Labour Force Survey, which is a comparative large-sample survey designed for collecting high-quality labour market data. In addition, we included GDP per capita at constant prices in EUR in the model equation, a measure available in Eurostat, used 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 characteristic of the province that may influence fertility rates is migration between provinces (e.g. Kulu, 2005; Sato, 2007). Migrations are usually from less economically advantaged areas to more economically advantaged ones. Higher flows are observed for employment reasons, and migrants are usually relatively young. The province-specific net migration rate, taken from Eurostat data, was therefore added to the model specification.

Finally, we added two variables not usually considered in fertility studies to control for the typical specialisation of the province, measured as a location quotient[4] (LQ) (Von Hofe and Chen, 2006; Lazzeretti et al., 2008). The two specialisations that we controlled for are industry and services. In the economic literature, it is well-established that industry and service sectors strongly differ in terms of worker behaviour, social classes and expectations (Paci, 1991; Johnson, 2015). Hence, it is reasonable to anticipate that the different industrial specialisations of the province might also affect the fertility of the area.

In addition, given the well-known regional divide between the centre-north and south of Italy (Caltabiano et al., 2019), 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.

Table 1. Descriptive statistics and correlation analysis

	Variables	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**Obs**	**Mean**	**Std. Dev**	**Min**	**Max**
1	TFR	1									927	1.369	0.124	0.93	1.74
2	ECI	.248	1								927	45.648	26.604	0	100
3	Population density	.260	.027	1							927	256.87	337.778	19.237	2691.385
4	Unemployment	-.362	-.428	.016	1						927	9.040	5.020	1.873	27.807
5	Net migration	.257	.301	.006	-.686	1					927	0.006	0.215	-0.72	0.6
6	LQ Ind	.165	.252	-.105	-.433	.230	1				927	1.033	0.182	0.291	1.392
7	LQ Serv	-.083	-.222	.172	.378	-.189	-.970	1			927	0.913	0.281	0.374	2.249
8	GDP	.495	.407	.258	-.770	.732	.236	-.153	1		927	32365	8489.2	17924	67108
9	Tertiary education	.011	.115	.159	-.025	.241	-.011	.061	.255	1	927	0.114	0.033	0.039	0.218
10	Unstable job	-.284	-.431	-.201	.529	-.443	-.454	.354	-.559	-.218	927	0.162	0.044	0.066	0.380

Source: Authors' elaboration on different data sources.

Mathematically, the estimated model takes the following form:

$$\begin{aligned}
&\Delta y_{i\,t} \\
&= \alpha_i + \lambda_i + \beta_1 + \beta_2 ECI_{i\,t} \\
&+ \beta_3 Unemp_{i\,t} + \beta_4 Pop.\,Density_{i\,t} + \beta_5 GDP_{i\,t} + \beta_6 Hum\ Cap_{i\,t} + \beta_7 Temporary\ Job_{i\,t} \\
&+ \beta_8 Migrat_{i\,t} + \beta_9 LQ\ Ind_{i\,t} + \beta_{10} LQ\ Ser_{i\,t} + \epsilon_{i\,t}
\end{aligned}$$

where $\Delta y_{i\,t}$ is the variation in fertility rate between t and $t+1$, α_i represents the province dummies, and λ_i represents the time dummies included in the model. Additionally, every model includes the variable of interest, ECI, and the control variables are added following a stepwise procedure.

RESULTS

Figures 3 and 4 display, respectively, the maps of the provincial level of EC in 2006 and 2014 as well as the level of the TFR for the same years. Higher levels of EC are concentrated in the north of the Italian peninsula. During the period under consideration, the EC levels grew in the north and slightly

[4] The location quotient is a measure of the relative specialisation of a given province in a specific sector, compared to the specialisation of the country in that sector. A value higher than 1 implies that the province is more specialised in that sector compared to the average of the country.

decreased in the south. A similar pattern can be observed by looking at the period-change in TFR, where we see a concentration of higher values in the north, with the exception of some Sicilian provinces. This divide seems to have grown during the considered period.

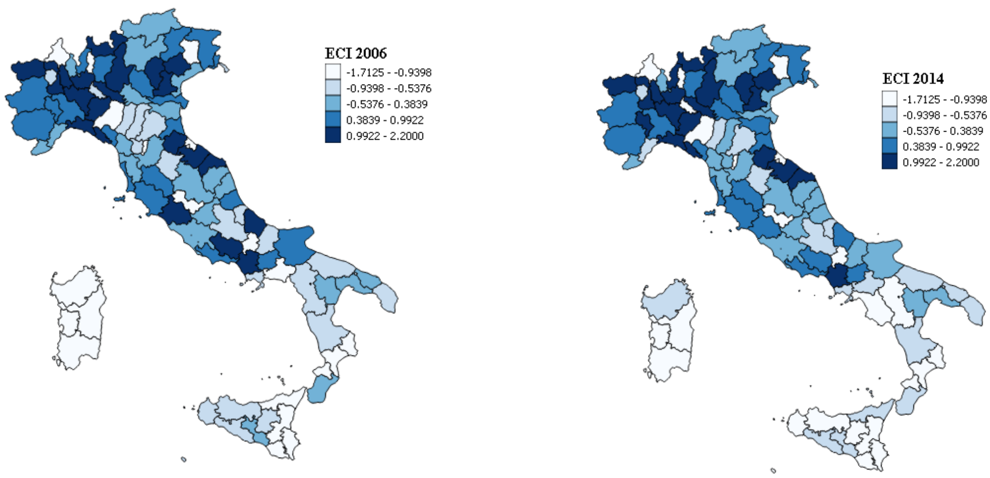

Figure 3. Economic complexity level in Italy, 2006 and 2014

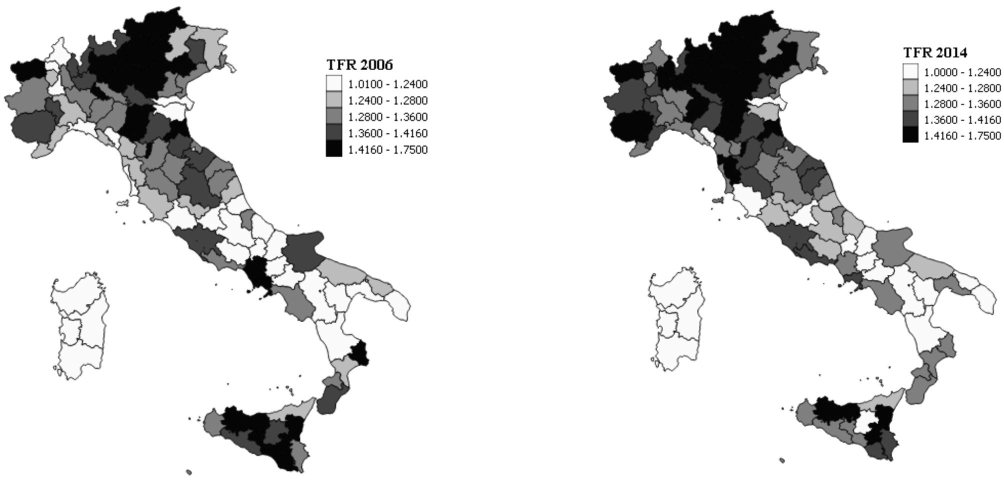

Figure 4. Total fertility rate in Italy, 2006 and 2014

As the next step, we estimated the relationship between the ECI and TFR in a multivariate panel regression setting. Looking at Table 2, we note a positive association between ECI and fertility variation during the period 2006–2015. 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 the association between unemployment and TFR is negative, corroborating much of the previous research on the topic (e.g., Matysiak et al., 2020), the association between ECI and TFR is positive. Importantly, ECI variation retains a positive and significant effect after including unemployment in the same specification (Model 3).

In Models 4 to 8, we added controls for population density in the model equations. The results in two cases (Models 5 and 6) show a negative correlation between the population density and TFR—

in more urbanised provinces we located a decreasing fertility trend during the considered period. This finding is in line with the results of several other studies (e.g., Kulu, 2013).

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

In Model 6, two additional controls were added—the proportion of higher educated people living in the province and the share of precariat. The effects of both variables did not prove to be significant. In Models 7 and 8, we additionally controlled for the province-specific net migrations rate, which also did not show a significant association with TFR.

Interestingly, in Models 7 and 8, we included the two variables connected to the level of industry and service specialisation of the provinces. These were added in separate models as they are highly collinear (see Table 1). The results suggest a positive relationship between the level of specialisation of provinces in industrial sectors and TFR (Model 7). Fertility variations seem to be related to the typical industrial specialisation of the area. This emphasises the idea that, in light of huge technological changes and globalisation, it is no longer enough to account for 'standard' variables of economic uncertainty (e.g., unemployment and share of temporary jobs) to study fertility variation.

Models 9–11 show the results for the provinces located in the north and centre of Italy, while Models 12–14 present the results only for the provinces located in the south. The results show interesting differences: the effects of complexity on fertility are positive for the provinces located in the north, while no significance was found 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 on fertility for the presence of highly educated people and also for the share of precariat in the province, while Model 14 (South) shows a significant and negative effect of population density and a positive and significant effect of GDP.

Finally, to investigate a possible non-linear relationship between ECI and TFR, the squared term of ECI was added to the full models for all Italian provinces together and then for those located in the north and in the south of Italy. The results do not show any significance regarding the squared values of ECI, suggesting that there might not be a non-linear relation between ECI and fertility (results available upon request from authors).

Table 2. Estimation results

	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**	**Model 7**	**Model 8**
Variables	*TFR 2006-15*	*TFR 2006-15*	*TFR 2006-15*	*TFR 2006-15*	*TFR 2006-15*	*TFR 2006-15*	*TFR 2006-15*	*TFR 2006-15*
Economic Complexity Index	**0.0209*** **		**0.0189** **	**0.0190** **	**0.0189** **	**0.0178** **	**0.0175** **	**0.0177** **
	(0.00671)		(0.00877)	(0.00878)	(0.00880)	(0.00886)	(0.00886)	(0.00888)
Unemployment rate		**-0.00176** **	**-0.00151* **	**-0.00155* **	-0.00156	**-0.001499* **	-0.00127	-0.00143
		(0.000878)	(0.000883)	(0.000887)	(0.001361)	(0.000898)	(0.00903)	(0.00091)
Population density				-0.000115	**-0.000117* **	**-0.001371** **	-0.0001436	-0.000141
				(0.000216)	(0.000121)	(0.000521)	(0.000222)	(0.000223)
GDP					0.0121	-0.0132	0.0108	0.0101
					(0.01237)	(0.0121)	(0.0103)	(0.0103)
Tertiary education						0.135	**0.196* **	0.1365
						(0.113)	(0.119)	(0.1131)
Unstable job						0.00820	-0.0120	-0.0029
						(0.0797)	(0.0800)	(0.0801)
Net migration							-0.0075	-0.0107
							(0.0178)	(0.0177)
Specialisation Industry							**0.0546* **	
							(0.0264)	
Specialisation Service								-0.0168
								(0.0158)
Constant	1.328***	1.340***	1.339***	1.368***	1.371***	1.365***	1.302***	1.378***
	(0.00380)	(0.00709)	(0.09712)	(0.0554)	(0.0777)	(0.0783)	(0.0834)	(0.0805)
R-Squared	0.336	0.334	0.337	0.337	0.336	0.335	0.337	0.335
N. 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

Significant at: * p < .1, ** p < .05, *** p < .01. Standard errors in parentheses.

Source: Authors' elaboration.

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	**0.0377*** **		**0.0445*** **	-0.00992		-0.00957
	(0.0140)		(0.0135)	(0.0142)		(0.0143)
Unemployment rate		**-0.0112*** **	**-0.0100*** **		**-0.00552*** **	**-0.00446*** **
		(0.00185)	(0.00182)		(0.00105)	(0.00111)
Population density			-0.0007			**-0.00114* **
			(0.0003)			(0.00063)
GDP			0.0028			**0.0625** **
			(0.0147)			(0.0297)
Tertiary education			**-0.494* **			-0.115
			(0.242)			(0.132)
Unstable job			**-0.386*** **			-0.187
			(0.134)			(0.120)
Net Migration			-0.0110			-0.0379
			(0.0262)			(0.0401)
Constant	1.341***	1.345***	1.451***	1.285***	1.306***	1.365***
	(0.0071)	(0.0079)	(0.0649)	(0.0115)	(0.0147)	(0.0783)
R-Squared	0.096	0.039	0.056	0.021	0.103	0.134
N. of Cases	603	603	603	324	324	324
Province FE	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes

Significant at: * p < .1, ** p < .05, *** p < .01. Standard errors in parentheses.

Source: Authors' elaboration.

CONCLUDING DISCUSSION

This paper relies on a new indicator of the economic context, economic complexity. 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 hypothesise that the level of EC is associated with fertility not only because it embodies several dimensions customarily considered key drivers of fertility change, such as different job options, educational qualifications and the accumulation of human capital, but also because it captures because it captures the capacity of a territory to innovate, grow, and create job options. The results illustrate a clear association between EC and total fertility across Italian provinces for the period 2006–2015. Provinces characterised by higher levels of EC also had higher levels of TFR growth. The results stratified by distinguishing between north and south of Italy further support these findings. In those areas where the levels of complexity are already quite high (the centre-north of Italy), an additional increase in EC is associated with an increase of the TFR, while in those regions where the general level of EC is relatively low (the south of Italy) this effect is less likely to occur. Overall, these results suggest that an increase in EC is a potent driver of fertility development, that has not been captured by the standard markers of the economic context traditionally used in socio-demographic research. Unemployment, GDP and diffusion of precariat proved to be less relevant than EC for explaining the variation in TFR in recent years.

There are two main sets of reasons that could explain these results. The first one is connected to the meaning of the EC of the area, which accounts not only for economic conditions and future opportunities but also for many other factors like decreases in inequality, higher levels of education, better social welfare and the inclusiveness of institutions. The second set of reasons, in our opinion the most relevant ones, connect to the increased globalisation that has occurred in recent decades, through which increased technological complexity has changed the dynamics of the labour market, of communications and has changed the cultural behaviour of individuals and their perceptions of uncertainty and precariat (Autor et al., 2014; Gangopadhyay, 2017). This points to the need for a different, more up to date, way to look at the determinants of fertility. We have shown that those provinces that stand at the frontiers of EC are also the provinces that are more likely to dominate and adapt to globalisation, as they are better able to deal with socio-economic inequalities, labour market changes and technological changes.

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

This study is not free of limitations. First, it is difficult to evaluate whether the observed fertility change was mostly driven by the temporary postponement of childbearing or rather by changes in the underlying level (quantum) of fertility that will also depress the completed family size of women who are in prime reproductive ages. Second, it is necessary to avoid drawing conclusions and interpretations about individual-level behaviour based on an extrapolation of our findings at the aggregate level. Third, the range of available economic and labour market indicators is more restricted at a sub-national level, preventing us from delving deeper into different possible links between economic development and fertility. Finally, it would be interesting to study a longer time series, but the analysis, due to data constraints, had to concentrate in the period 2006–2015.

Despite these weaknesses, this paper opens up a new outlook in fertility research. In the aftermath of the Great Recession, fertility registered a new decline in Italy, giving further impulse to the literature focusing 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 us with a partial view, highliting only the negative side of huge technological changes and globalisation. We suggest that in industrialised economies like Italy, climbing the ladder of the industrial complexity can favour fertility development. Indeed, in high-income countries, a more complex economy is associated with economic opportunity, well-being and lower levels of economic uncertainty (Hidalgo, 2015; Hartmann et al., 2017). All these factors allow a territory to face globalisation and technological change and favour the enhancement of a pro-active social and economic context, leading—we add here—to an increase in total fertility. Future research should explore the relationship between EC and total fertility in other countries, characterised by different institutional settings and different starting level of TFR, as well as higher and lower levels of economic development. In addition, more deeply understanding the effects of specific industrial specialisations on fertility dynamics appears as an interesting path for future research.

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APPENDIX

Table 3. Estimation results

Variables	**Model 15** *TFR 2006-15*	**Model 16 North** *TFR 2006-15*	**Model 17 South** *TFR 2006-15*
Economic Complexity Index	**0.0176****	**0.0461*****	-0.0123
	(0.00895)	(0.0138)	(0.0196)
Economic Complexity Index^2	-0.0023	-0.00452	-0.00181
	(0.00442)	(0.0071)	(0.0098)
Unemployment rate	-0.0013	**-0.0101*****	**-0.00444*****
	(0.00071)	(0.00183)	(0.00112)
Population density	-0.0001	-0.0005	**-0.00115***
	(0.00022)	(0.0003)	(0.00064)
GDP	0.0088	0.0021	**0.0624****
	(0.0102)	(0.015)	(0.0238)
Tertiary education	0.118	**-0.503*****	-0.114
	(0.113)	(0.103)	(0.133)
Unstable job	-0.0022	**-0.383*****	-0.196
	(0.0798)	(0.135)	(0.121)
Net migration	-0.0143	0.0108	-0.0379
	(0.0177)	(0.026)	(0.0401)
Constant	1.352***	1.323***	1.395***
	(0.0589)	(0.00709)	(0.0786)
R-Squared	0.335	0.056	0.131
N. of Cases	927	603	324
Province FE	Yes	Yes	Yes
Time FE	Yes	Yes	Yes

Significant at: * p < .1, ** p < .05, *** p < .01. Standard errors in parentheses.

Source: Authors' elaboration.