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Item 5 – Constructing assumptions for fertility: data, methods and analysis

Is there a fertility convergence across the Member States of the European Union?[1]

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1. INTRODUCTION

Population projections are one of the major outcomes in demography and mostly produced on regular basis by national statistical offices, research institutes and international organisations. When the projections exercise is carried out over a set of geographical entities (regions, countries, areas of the world, etc.[3]), an additional requirement is the consistency of the results across those entities. In fact, producing multi-country projections adds a cross-sectional dimension to the usual time series framework. For instance, if countries are (demographically) moving in the same way, then this supplementary information should be taken into account in the assumptions setting process.

Typical examples of potential constraints are the First and Second Demographic Transitions theories. The former theory explains the fall of mortality first and fertility after to lower levels; the latter focus on fertility and family changes on a wider social and cultural context. Thus, whilst the engine of the First Demographic Transition is mortality, the engine of the Second Demographic Transition is fertility (van de Kaa, 2004). The former theory is commonly accepted in the scientific literature, while the contribution of the latter to the understanding of the demographic changes is still questioned (e.g., Coleman, 2004). Embedded in the theory of demographic transition is the idea of convergence.

Whilst largely debated in the economics literature, where it stems from the neoclassical model of growth of Solow and it has a number of relevant policy implications, convergence as such has received relatively little attention in demography in terms of empirical evidences. Yet, if demographic convergence holds across countries, then assumptions can profitably be developed which fit with such theoretical framework. By doing so, the "international" consistency of the results is ensured with regard to that specific hypothesis. In this paper, I therefore address the issue of fertility convergence in a specific set of 27 European countries, currently belonging to the European Union (EU).

In wide social terms, there are several evidences of convergence in Europe. According to some scholars, during the past century Western European societies have showed a clear process of social integration (Kleibke, 1990). Although still unobserved in the countries which only recently joined the EU, the convergence to the European social model can well take place in the future (Draxler and Van Vliet, 2010). Focussing on the demographic point of view, Watkins (1990) showed that, during the 19th and 20th centuries, there has been a tendency of the regions to greater demographic homogeneity within nations.

Focussing on the European Union Member States (MS), it is plausible to assume that common policies and sharing of best practices may strengthen the convergence in several areas. In fact, convergence is a concept which is central to many EU policies. For instance, the Structural Funds, among the most important EU funding, have as first purpose to narrow the gap between the development levels of the various EU regions (so-called "Convergence" objective), improving their social cohesion and economic well-being. Convergence is therefore a natural conceptual framework for assumptions setting in the context of the European Union.

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[3] For sake of simplicity, I refer from here onwards to the case of countries.

The first hypothesis to be assessed is then if demographic convergence has taken place in Europe, regardless of the membership of a country to the EU. The attention is here limited to fertility, as childbearing is basically the result of individual decisions and fertility is essential to the Second Demographic Transition theory, which is supposed to occur nowadays in Europe. Going one step further, another hypothesis to be tested is if the policies efforts, mainstreamed at EU level and targeting the socio-economic convergence across Member States, may have brought an additional impulse to – or even caused – convergence in fertility.

The article is structured as follows: in Section 2, I present the various concepts of convergence proposed in the literature together with the related indicators; in Section 3, I define my method of analysis and I propose a new simple indicator of convergence; in Section 4, using ordinary methods, I assess the presence of convergence in the whole set of 27 countries currently belonging to the European Union; in Section 5, applying the indicator presented in Section 3, I analyse the possible impact of the accession to the European Union on the convergence in fertility for some of the enlargements occurred in the past; in Section 6, I conclude discussing the implications for the assumptions making in the projections exercises.

2. DEFINITIONS AND MEASURES OF CONVERGENCE

In the economics literature it is possible to find several definitions of convergence (see, for instance, Sala-i-Martin, 1995). The first, most widely used concept describes the convergence of a group of geographical units (countries, regions, counties, etc.) as the reduction over time of their dispersion of a given indicator (e.g., the GDP per capita), usually measured by means of the standard deviation or related measures[4]. This is called σ-convergence, and it thus relates to the shrinking of the cross-countries distribution over time. Therefore, it is said to be σ-convergence if:

$$\sigma_t > \sigma_{t+T} \tag{1}$$

where σ_t is the standard deviation (or assimilated measure) of the indicator at the time *t*. Another common concept is the so-called β-convergence. This definition originated from the work of Barro and Sala-i-Martin, who used regressions of the mean growth rate of the GDP per capita over a given period on the log of the initial level:

$$\gamma_{i,t,t+T} = a + \beta \cdot \ln\left(y_{i,t}\right) + \varepsilon_{i,t} \tag{2}$$

where $\gamma_{i,t,t+T} = \ln\left(y_{i,t+T} / y_{i,t}\right) / T$ is the mean annualized growth rate of the variable *y* in the country *i* in the period (*t*, *t*+*T*) under examination, $y_{i,t}$ is its value in the initial time t and $\varepsilon_{i,t}$ are the corresponding residuals. Model (2) is often referred to as Barro regression, in which a negative slope coefficient would imply that entities on lower levels of *y* have grown more, in the period under examination, than those on higher initial levels. Thus β-convergence is based on the catching up of the countries on lower initial level towards those on higher, due to different mean growth rates. Young *et al.* (2008) prove that β-convergence is a necessary but not sufficient condition for σ-convergence; on the contrary, σ-convergence is sufficient but not necessary for β-convergence (Sala-i-Martin, 1995).

Despite this approach being much criticised starting from Friedman (1992) and Quah (1993), it has recorded a large number of applications in the economic literature, as well as further developments. In order to remove the dependency of the slope coefficient in the model (2) from the length of the period of analysis, Sala-i-Martin (1995) proposes also a non-linear model[5] to test the presence of β-convergence:

$$\gamma_{i,t,t+T} = a - \left(\frac{1 - e^{-\lambda \cdot T}}{T}\right) \cdot \ln\left(y_{i,t}\right) + \varepsilon_{i,t} \tag{3}$$

where λ can be interpreted as the *speed of convergence*. Sala-i-Martin (1994) claims that, for the economies he had analysed, these speeds are surprisingly all about 2% per year, thus supporting the idea of a kind of "natural rate of convergence". This statement has been assessed by Abreu *et al.* (2005) using a meta-analysis on a large body of literature, and they found the convergence rate to be rather sensitive to the model specification bias. Whether the

[4] Commonly found in the literature are the standard deviation of the log of the indicator, as well as the coefficient of variation of the variable itself, both invariant with the mean. The pure standard deviation of the indicator is also sometimes used.

[5] The equation should be solved using non-linear methods. It is also possible to solve it by using ordinary least squares and deriving the beta parameter afterwards through the conversion formula $\lambda = -1/T\left[\ln\left(1 + \beta \cdot T\right)\right]$; however, when the time window is large and/or the negative value of the estimated slope is high in absolute terms, this approach would give a negative value for the logarithm of the conversion formula and therefore it can not be used.

unobserved heterogeneity (e.g., in technological levels) is taken into account, then the convergence rate is usually higher.

When the analysis is carried at national level, it may be difficult to accept the assumption that all countries share the same technology and preferences; however, each country can still converge towards a different steady state, but at a rate common for all. This concept is referred to as *conditional* β-convergence, and it may be detected with the inclusion in the specification of the Barro regression of an additional set of explicative variables, meant to account for varying technologies and preferences. Whether convergence is instead taking place between sub-groups of countries, then they are referred as *convergence clubs*. These are usually identified by means of dummy variables included in the conditional convergence model. In addition, Azzoni *et al.* (2003) stress the importance of testing for convergence using micro-data instead than macro-data, as these latter may be affected by compositional bias. Cole and Neumayer (2003) highlight the need of weighting by population size in income distribution studies.

Following the criticisms on the capacity of the model (2) to test for β-convergence, Boyle and McCarthy (1997) propose a simple measure aiming to capture the extent of intra-distributional mobility over time. To do so, it is there used an indicator based on the Kendall index of ranks concordance RC:

$$RC_t = \frac{Var\sum_{t=0}^{T} R_{it}}{Var\left[(T+1)\cdot R_{i0}\right]} \tag{4}$$

where R_{it} is the rank of the country i at the time t. These authors propose also a biannual version of the multi-annual index RC reported in (4):

$$RCa_t = \frac{Var\left(R_{i0} + R_{it}\right)}{Var\left(2\cdot R_{i0}\right)} \tag{5}$$

These indexes range between zero and one: the lower the value, the greater the extent of mobility within the distribution.

Several other concepts of convergence and related methods of detection have been proposed in literature. For instance, Maeso-Fernandez (2003) applies time series analysis to study the gap between a number of countries and the USA. Laurini *et al.* (2005) use non-parametric methodologies to identify income convergence clubs in Brazilian municipalities. Tomljanovich and Vogelsang (2002) apply a different econometric approach to assess the GDP convergence across US regions. Phillips and Sul (2007) develop a new method which allows testing for convergence and club convergence using a log regression model.

The Barro regression, relating the mean annualized growth rate to an initial level, masks in fact any variation within the period under examination. Therefore, in some studies, the period is broken down in sub-periods to assess breaks for the examined variable. This applies as well on analysis based on the econometric approach, where the presence of structural breaks may affect the performance of unit roots tests.

2.1. Some studies on fertility convergence

The studies on convergence in fertility are relatively few in comparison to the applications in the economic domain. Wilson (2001), using indicators based on the distribution of the world population by total fertility at given moments in time, highlights the presence of convergence at world scale in the second half of the past century. He noted how the common economic distinction between poor and rich countries is becoming of less importance for demography, and that the demographic convergence can be seen as one element of the socio-demographic change which seems to have taken place more rapidly than the economic development. However, Dorius (2008) argued that evidences are for divergence rather than convergence. He focused on relative, rather than absolute, inter-country differences in fertility intensities to measure the variation in inequality; in particular, Dorius used three index of inequality (Gini coefficient, Mean Log Deviation and Theil index) to locate the source of change in fertility inequality in the distribution of the countries by fertility. The findings of his analysis based on population-weighted σ- and β-convergence and inequality measures show that convergence begun only in the last part of the period 1955-2005, and therefore he concluded that the second half of the twentieth century can not be considered a period of fertility convergence on global scale. In order to disentangle economic and demographic effects, Herbertsson et al. (2000) focus on the conditional model and found evidence for convergence, both absolute and conditional, of fertility rates between 1978 and 1998 for about 190 countries.

Tomka (2002) takes a different perspective, analysing the demographic convergence between a specific country (Hungary) and a group of countries (Western Europe). To do so, he proposes indexes based on standardised differences from the Western European averages, on the basis of which he concludes that Hungary has converged from the beginning to the middle of the past century and then it has diverged starting from mid-60s.

Other studies refer instead to the regional dimension within a country. For instance, Franklin (2002, 2003), using σ-convergence, found that regional fertility actually diverged in Italy from the unification until the first years post WWII, followed by a period of convergence until the 70s and then again a marginal divergence. However, analysing the β-convergence, the same author concluded that after the WWII there was indeed convergence in fertility across Italian regions at a rate greater than 2%, and that the inclusion of the spatial dependence did not significantly improved the model at regional level (while it did so for the further disaggregation at provincial level). For another Mediterranean country, Kotzamanis and Duquenne (2006) found evidences of convergence of the demographic structures of the Greek regions; in particular for fertility, both period and cohort fertility indicators showed overall a clear tendency to homogeneity.

Another area of research in demography concerns the convergence between groups of population within a defined geographical unit, like for instance trends analysis of the differences in demographic behaviour between ethnic groups or between native- and foreign-born (e.g., Haines, 2002). There is no attempt in this paper to cover also this domain.

3. DATA AND METHOD OF ANALYSIS

The data used for the analysis are mainly national data as provided to Eurostat (freely available in the database of Eurostat), complemented by personal estimates. The countries[6] are the 27 Member States (MS) of the European Union: Belgium (BE), Bulgaria (BG), Czech Republic (CZ), Denmark (DK), Germany (DE), Estonia (EE), Ireland (IE), Greece (EL), Spain (ES), France (FX), Italy (IT), Cyprus (CY), Latvia (LV), Lithuania (LT), Luxembourg (LU), Hungary (HU), Malta (MT), the Netherlands (NL), Austria (AT), Poland (PL), Portugal (PT), Romania (RO), Slovenia (SI), Slovakia (SK), Finland (FI), Sweden (SE) and the United Kingdom (UK). In particular, data for France refer to Metropolitan France, thus excluding the French Overseas Departments (DOM) and Overseas Territories (TOM), data for Cyprus refer to the government-controlled area from 1974 and data for Germany always includes East Germany.

As shown above, convergence is a multi-dimensional concept. For the first hypothesis under examination, as presented in Section 1, the aim of this study is to assess the presence of convergence in fertility regardless of the form in which this occurs, for instance in terms of shrinking of the cross-countries distribution or as intra-distributional mobility.

I will therefore analyse the presence of σ-convergence, unconditional β-convergence and γ-convergence[7] using the simplest measures, i.e. by means of the indicators reported in (1), (2), (4) and (5). Because fertility, unlike mortality, is not fatal and it is renewable, I consider two indicators of fertility: the total fertility rate (TFR) and the mean age at childbearing (MAC). The former is the sum of the age-specific fertility rates in a given year, while the second is the average age weighted with the same distribution. Therefore, the TFR gives the *intensity* of fertility, while the MAC gives its *tempo* (Vallin and Caselli, 2006). By doing so, the scope of the convergence analysis is enlarged to cover not only the level, but also the timing of fertility.

Detecting unconditional β-convergence implies that all the countries would reach the same long-term equilibrium (steady state, in economics terminology) at the same time. Adopting the TFR for the β-convergence analysis has an interesting interpretation from the demographic point of view. It is known (see Preston *et al.*, 2001) that, in stable populations, the intrinsic growth rate r can be expressed as:

$$r = \frac{\ln TFR + \ln S + p(A_M)}{G} \tag{6}$$

where S is the proportion of female births constant across ages of mothers, $p(A_M)$ is the probability of surviving from birth to the mean age of childbearing and G is the mean length of generation. Keeping constant the values of these components from the time t_1 to the time t_2, the change in the intrinsic growth rate in the period (t_1, t_2) can be expressed as:

$$\Delta r = \frac{\ln\left(\frac{TFR_2}{TFR_1}\right)}{G} \tag{7}$$

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[6] The countries are listed following the official EU protocol order (based on the alphabetical order of the country name in the country-specific language) and with the official abbreviations. It is by this order that data on these countries are published in the EU publications.

[7] In order to distinguish the coefficient of the Barro regression from the rank concordance indexes, I follow the proposal of Boyle and McCarthy (1999) to refer to these latter as γ-convergence.

Under the simplifying conditions listed just above, the dependent variable in the Barro regression used for the TFR β-convergence is therefore in fact proportional[8] to the change of the intrinsic growth rate of the stable equivalent population.

For the assessment of the second hypothesis, concerning the influence of the accession in the EU on the demographic behaviour of the newcomer Member States, the indexes here used for the overall analysis of convergence do not seem to be "fit for purpose". In this case, the interest is not in the convergence *across* countries but in the convergence of a set of countries (the newcomers) *towards* the Member States already in the EU. In this theoretical framework, it is implicitly assumed that the "old" Member States share common values, towards which the "new" Member States are assumed to converge. Apart some econometric methods not considered in this work, an index appropriate for this context could be the one proposed by Tomka (2002):

$$z = \frac{x - \mu}{\sigma} \tag{8}$$

where x is the value for the country under examination, and μ and σ are respectively the mean and the standard deviation of the set of countries towards which convergence is assessed. A natural extension for this index to cover the situation when more than one country is analysed could be the simple average of the country-specific indexes:

$$Z = \sum_{i=1}^{k} z_i = \sum_{i=1}^{k} \frac{x_i - \mu}{\sigma} \tag{9}$$

However, such indicator is sensitive to changes in the dispersion within the set of reference. The focus of my analysis is instead on the convergence process of the "new" Member States, regardless if the "old" Member States are diverging or converging among them. I call this form of convergence towards a value – either observed or theoretical - "external" to the set of countries under examination as *relative convergence*.

A first easy solution for this problem could be the usual coefficient of variation, but calculated over the values for the newcomer countries and an EU aggregated value, composed by the "old" (meaning before the accession under examination) Member States. I indicate this measure by CV*, to mark the difference from the coefficient of variation CV calculated over the full set of countries. From this point of view, the variability within the EU before the new memberships could be seen as the variability of regions within a country, which is usually neglected when convergence is assessed across countries. However, although removing the variability within the group of "old" Member States, this measure does not give an idea of the convergence *towards*.

To build a simple measure of relative convergence, I then start considering the squared deviation of each newcomer country from the EU value, calculated aggregating the input data[9] of the "old" Member States, and I average on the number of cases. This is nothing else than the variance around a given value and therefore this index could be assimilated to the measures used in the σ-convergence analysis. For each time t of the period of analysis, I thus define the *index of relative convergence* (IRC) as:

$$IRC_t = \sqrt{IRC_t^2} = \sqrt{\sum_{i=1}^{n} \frac{\left(x_{i,t} - \mu_t\right)^2}{n}} \tag{10}$$

and the *coefficient of relative convergence* (CRC) as:

$$CRC_t = \frac{IRC_t}{\mu} \tag{11}$$

where μ is the EU average value referring only to the "old" Member States. Looking at the time series of these measures, shrinking values indicate convergence towards the given value, and vice versa. In case the convergence of only one country towards the EU is examined, then the IRC reduces to the simple difference between the country and the EU values, and the CRC to the relative difference.

The IRC has a useful property. It can be easily shown that the square of IRC can be decomposed as follows:

$$IRC_t^2 = \sum_{i=1}^{n} \frac{\left(x_{i,t} - \mu_t\right)^2}{n} = \sum_{i=1}^{n} \frac{\left(x_{i,t} - \overline{x}_t\right)^2}{n} + \left(\overline{x}_t - \mu_t\right)^2 = \sigma_N^2 + \Delta^2 \tag{12}$$

[8] By a factor equal to G/T, which may also be equal to the unity if the period of analysis is chosen equal to the mean length of generation.
[9] In case the input data are not available, the EU value could be obtained by averaging the national values, weighted by the population sizes.

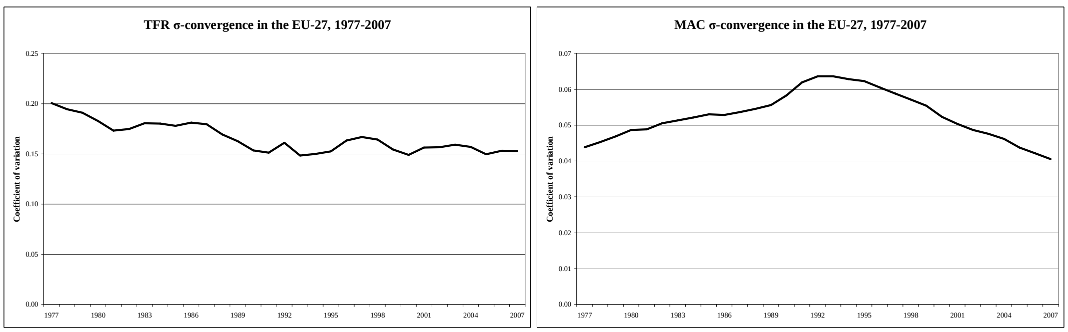
where $\overline{x}$ is the average over the newcomer countries N, σ_N^2 is their variance and Δ is the difference between the average of the new Member States and the EU value of the "old" Member States. This decomposition helps to understand whether the convergence/divergence is due to the convergence within the newcomer countries under analysis and/or to the convergence between their average and the EU value.

IRC and CRC can obviously be used also in analysis of convergence towards predefined values (for instance, theoretically defined), or in studies of convergences between subgroups of population, like for instance the convergence of the demographic behaviour of foreign-born groups to the demographic behaviour of the native-born population.

4. CONVERGENCE IN 27 EUROPEAN COUNTRIES

Due to data restrictions, the analysis on the whole set of EU-27 Member States is limited to the period 1977-2007. During these 30 years, the dispersion of the TFR has reduced of a quarter until the beginning of the 90s, when it turned to remain more stable around a value of 0.155. Over the same period, the MAC has before diverged and then, starting from 1993, converged to the initial level of dispersion (Figure 1).

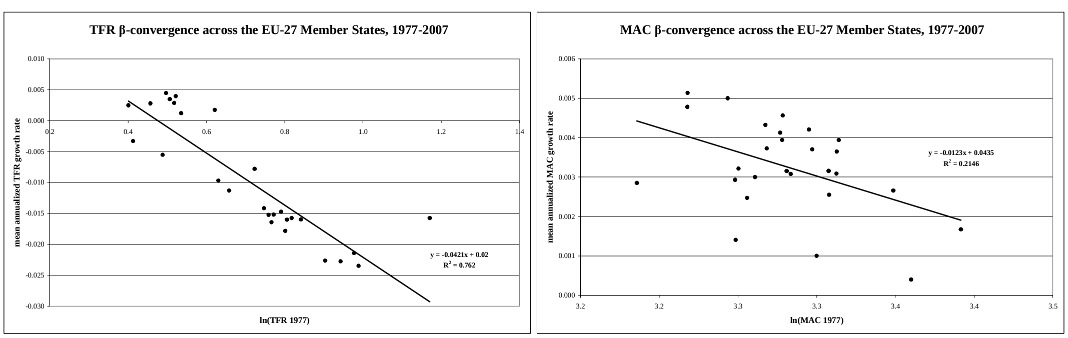
Figure 1 - Fertility σ-convergence in the EU



From the point of view of the σ-convergence, it thus seems that convergence in fertility took place until the beginning of the Nineties on the intensities and after on the timing of childbearing.

Looking at the Barro regressions (Figure 2), the slope of the unconditional β-convergence model is negative for both TFR and MAC, respectively equal to -0.042 and to -0.012, meaning that the countries on higher initial level of fertility had a decrease rate bigger than those on lower level (thus "catching down"), while this process took place to a lower extent in the tempo of fertility, and on the opposite direction (thus "catching up").

Figure 2 - Fertility β-convergence in the EU

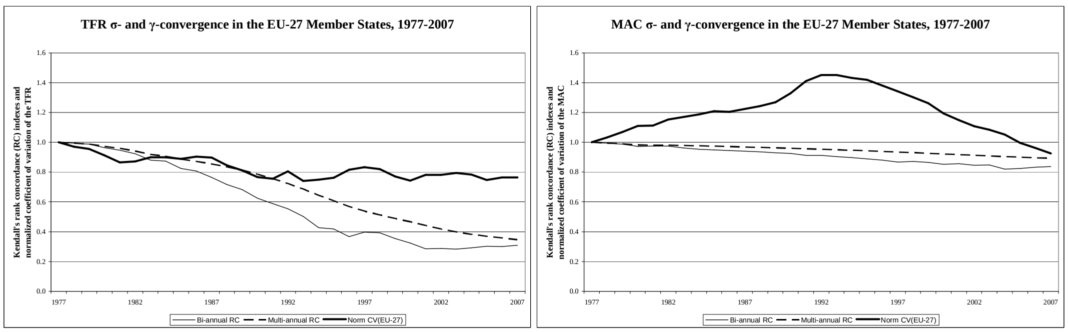


However, it must be noted that in the period 1977-2007 both indicators changed direction: on average, the TFR has been mostly decreasing and it has recently started again to grow, while the MAC has had the opposite behaviour, with a slight decline at the beginning of the period followed by a constant increase. The use of a linear model over the whole period may thus be inappropriate. The estimated speed of convergence of MAC is about 1.5%, meaning that the time necessary to half the distances would be 45 years. No similar calculation was possible for TFR with the conversion formula. For sake of brevity, no attempt is made in this paper to consider sub-periods, nor to deepen the analysis about the rate of convergence. It can be noted that β-convergence occurred regardless the presence of σ-convergence, as indeed the former is condition necessary but not sufficient for the latter; at the same way, it can be said that whenever there was σ-convergence, there was β-convergence as well, as the former is condition sufficient but not necessary for the latter.

Overall, the application of β-convergence concept and model to this fertility convergence analysis has still grounds for being perplexing, and it is not further exploited here.

The analysis of γ-convergence confirms that intra-distributional mobility for both TFR and MAC occurred between 1977 and 2007. In order to highlight the relation with the σ-convergence, the values of the two RC indexes (biannual and multiannual) are shown together with the corresponding coefficient of variation, normalised to the initial value; further, to facilitate the comparison between fertility indicators, the left and right panel of Figure 3 have the same scale. The MAC shows less mobility in its distribution than the TFR, thus national mean ages at childbearing seems to be more "moving together" than crossing each other in comparison to the TFR.

Figure 3 - Fertility γ-convergence in the EU



5. RELATIVE CONVERGENCE AND EU ENLARGEMENTS

As above described, the assumption here under test is that the membership to the EU would contribute to the spread of the demographic drivers characterising the "old" Member States into the new adherent country(ies), implying a convergence of fertility towards EU values. To verify if this hypothesis occurred in the past, the attention has been focussed on the various enlargements of the EU, looking for empirical evidences supporting the assumption of convergence between Member States especially after the accession to the EU. In the following, EU-6 refers to the European Union composed by six Member States, EU-9 to the EU with 9 Member States, and so on. In total, three out of six enlargements are taken into account, as the latest two took place too recently to see any impact on the demographic trends of the newcomers, and two enlargements have in fact been aggregated for sake of simplicity (Greece in 1981 together with Spain and Portugal in 1986).

It is useful to begin from the analysis of fertility convergence in the six founding countries of the EU-6 (Belgium, Germany, France, Italy, Luxembourg and the Netherlands). Figure 4 and Figure 5 show respectively the trends of the fertility indicators and their coefficients of variation. The trends of both TFR and MAC seem to be "moving together", rather than "moving apart" or converging to the same level.

Figure 4 - Fertility indicators in the EU-6

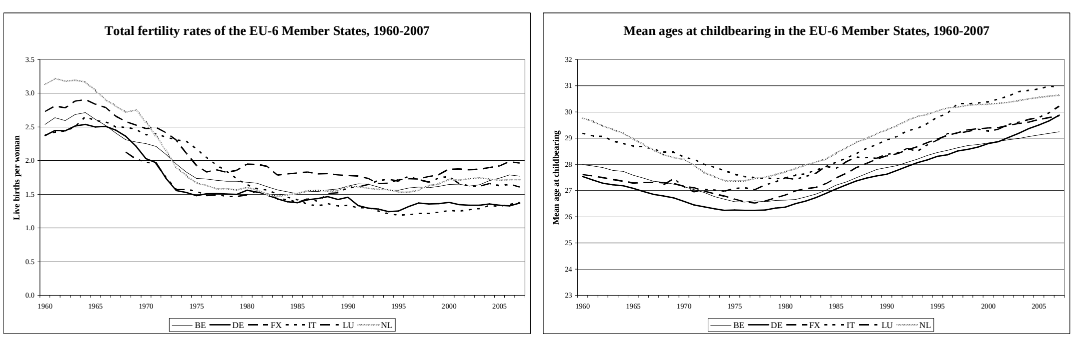
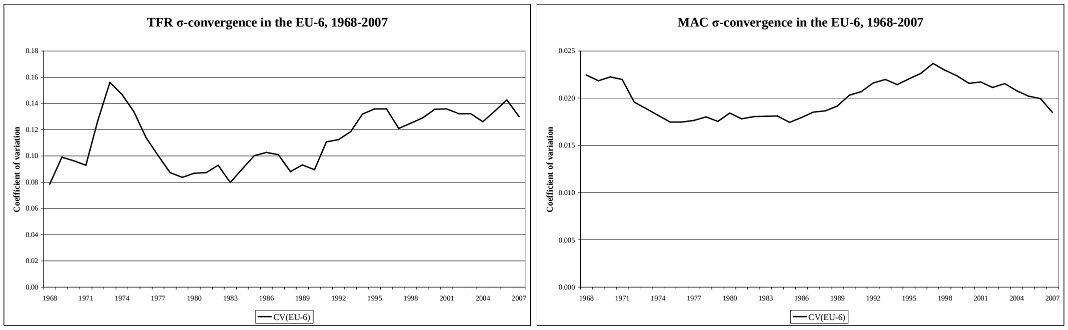


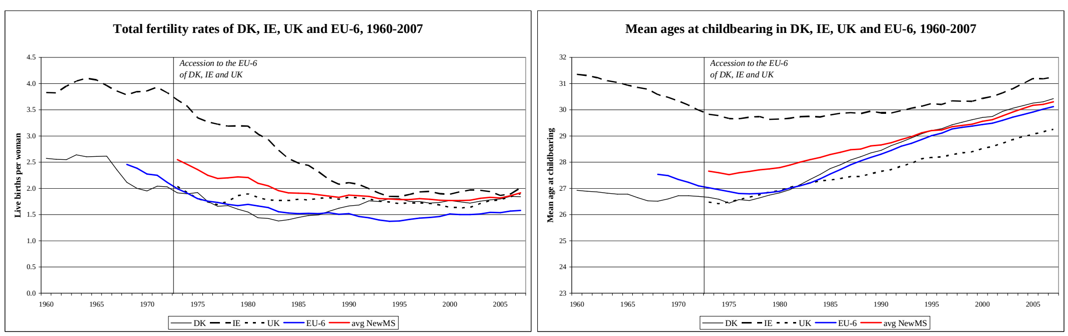
Figure 5 - Fertility σ-convergence in the EU-6



Accordingly, Figure 5 reveals a kind of cycles rather than a constant convergence/divergence along the time. The CV for the TFR goes down to 0.08 in 1983 from a peak of 0.16 reached ten years earlier (see left panel of Figure 5); afterwards, there is a slow recovery to values around 0.14. If convergence/divergence is indicated by the decrease/increase of the coefficient of variation, then strictly speaking there seems not to be conclusive evidence over a time span of our decades for these six countries. Data could be interpreted either as a period of convergence followed by a slight divergence, or as long-term fluctuations around an average CV of 0.11. The same applies for the MAC: there is convergence until 1975, then stationarity for ten years, followed by divergence until 1997 and then again convergence for the remaining ten years. Again, this could be interpreted as cycles around an average CV value of 0.02.

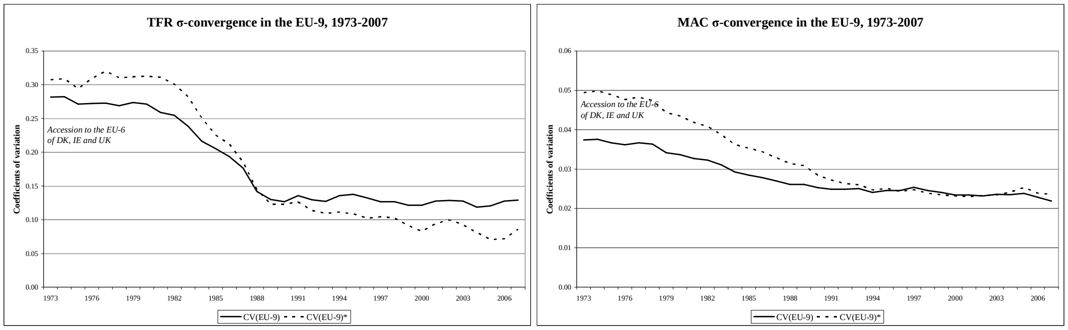
In 1973, Denmark, Ireland and the United Kingdom joined the EU. It is the first case of relative convergence that can be tested; unfortunately, data availability does not allow going back more than 1973, thus making impossible a comparison pre- and post-membership. To facilitate the interpretation of the measures of σ-convergence and relative convergence, the trends of TFR and MAC are also displayed (Figure 6). It can there be noted how Ireland has clearly converged towards the other EU countries both in levels and timing of fertility: this path will have evident consequences in the assessment of the convergence.

Figure 6 - Fertility indicators in the EU-9



Two measures of σ-convergence have been calculated (Figure 7): the first is the usual coefficient of variation CV among the nine Member States (the six founding Members plus the three newcomers of the first enlargement); the second measure CV* considers the EU-6 Member States as one single entity (EU-6, indeed) and thus the convergence is calculated over four units: the three new Members and the "common" EU-6 fertility values. These latter measures should help to assess the convergence to EU values following the membership, disentangling it from the effects of the variability among the "older" (in terms of membership to the EU) Member States. For the TFR, looking at the coefficient of variation between the EU-9 Member States, there is a clear σ-convergence until 1990, and then a stability; however, if the variability within the EU-6 Member States is excluded using the measure CV*, then the TFR continues to converge after 1990 even if on a more moderate speed. Also the MAC converges until 1994, and then remains stationary with both coefficients of variation just above 0.02, in fact several times lower than the corresponding values in the TFR.

Figure 7 - Fertility σ-convergence in the EU-9



So far, convergence in the EU-9 has been analysed without reference to the path of the "newcomers" towards "old" Member States. Figure 8 shows the coefficients of relative convergence, which display a strong decrease for the TFR from 0.40 in 1979 to 0.15 in 2005, and the halving of the coefficient for the MAC in about ten years, during the Eighties. It can therefore be concluded that the three newcomer countries have converged in fertility towards the other Member States.

Figure 8 - Fertility relative convergence in the EU-9

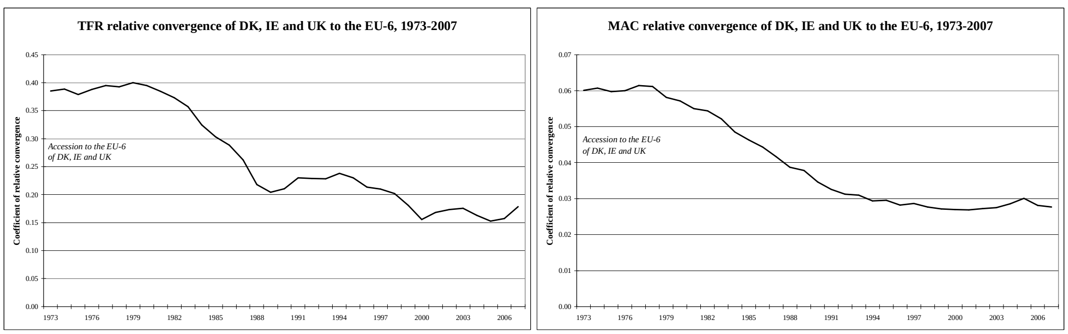
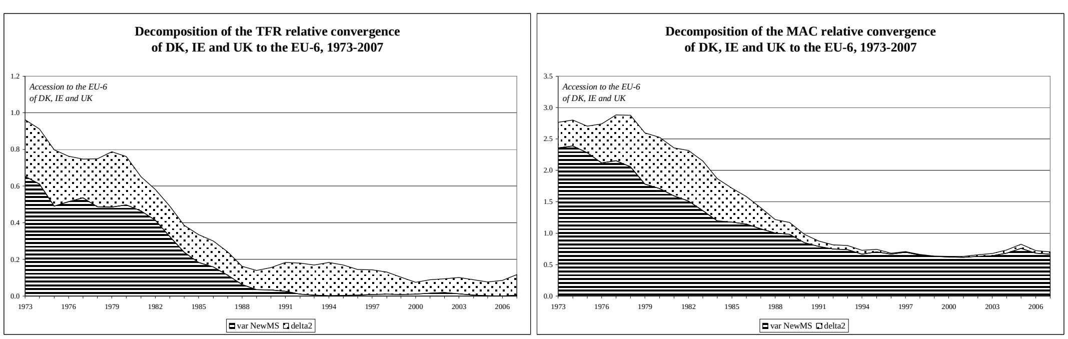


Figure 9 helps to understand the reason behind the shrinking of the coefficient of relative convergence CRC: in the TFR, the reduction until the beginning of the 90s is mostly due to the vanishing of the variability between the newcomers, and afterwards by a more moderate contraction of the difference between the averages of the two sets of Member States (old and new); for the MAC, there is a reduction of both the variability of the newcomers and the distance between averages until the mid-90s, after which the stability of the CRC is due to the persisting of the former component.

Figure 9 - Decomposition of the relative convergence in the EU-9



For sake of brevity, the analysis is not reported in detail for the other EU enlargements: in the Eighties to Greece, Spain and Portugal (from Figure 10 to Figure 13), in 1995 to Austria, Finland and Sweden (from Figure 14 to Figure 17) and in the mid-2000 to the remaining of the Member States (from Figure 18 to Figure 21). I simply report here the main elements focussing on the demographic behaviour after the EU membership: for the enlargement from EU-9 to EU-12, there is relative divergence in TFR and a recent relative convergence for the MAC; for the enlargement to EU-15, there is a recent relative divergence for TFR and a moderate relative convergence for the MAC; for the latest enlargement, no conclusion can be drawn considering the very few year passed from the accession to the EU of these countries, but referring to the past 30 years, it can be observed an alternation of relative convergence/divergence for both indicators.

Therefore, there is not conclusive full evidence that the membership to the EU would bring (additional) impulse to the convergence of fertility towards common EU values. The intensity of fertility, as measured by the TFR, looks overall less converging (in fact, mostly diverging), in relative terms, than the tempo of fertility. Even when convergence seems to take place, past experiences show that this may well be just the continuation of trends appearing already before the accession. However, although the results on past values are not convincingly supporting the assumption on convergence to EU standards, there are some arguments in favour of the adoption of this hypothesis.

First of all, there is now a larger awareness of the implications of the demographic trends and therefore a greater attention by the policy-makers. In particular, the EU heads of state and government decided in 2007 the establishment of a European Alliance for Families that will serve as a platform for the exchange of views and experience on family-friendly policies and good practices between Member States. The spreading of best practices in the policies trying to influence the demography of the Member States could thus become more effective than in the past.

Moreover, longer time windows may be necessary to identify relevant long-term relative convergence trends following the EU accession. For the first enlargements, 34 years of observations are available, but they become not more than 26 for the second and only 12 years for the last enlargement taken into consideration. Longer time series may be necessary especially in the cases of crossing to make a clear distinction between short-term fluctuations around average and long-term diverging/converging tendencies.

Last but not least, the variability may be already so low that further reductions may be difficult to achieve. Once below certain thresholds, the countries could be considered to have achieved – at least partially – the convergence. This point, which applies to the absolute as well as relative convergence, requires deeper analysis and it could be further investigated by means of an analysis of conditional convergence.

Figure 10 - Fertility indicators in the EU-12

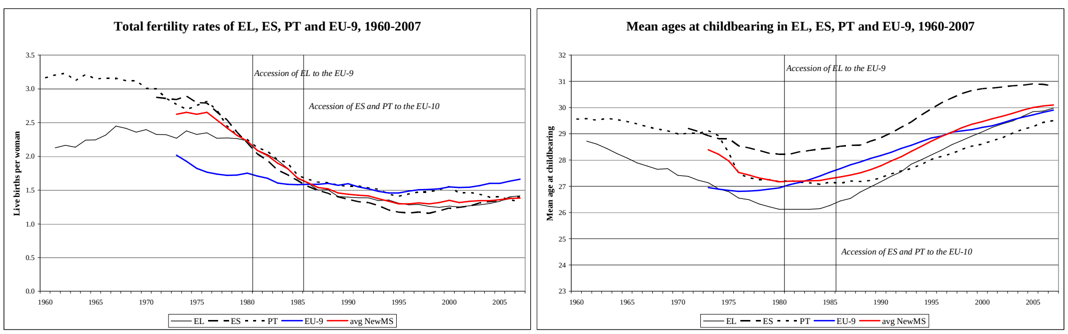


Figure 11 - Fertility σ-convergence in the EU-12

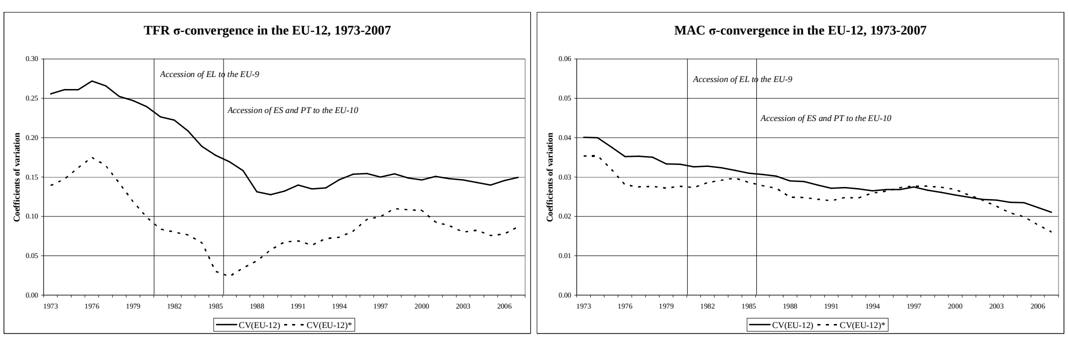


Figure 12: fertility relative convergence in the EU-12

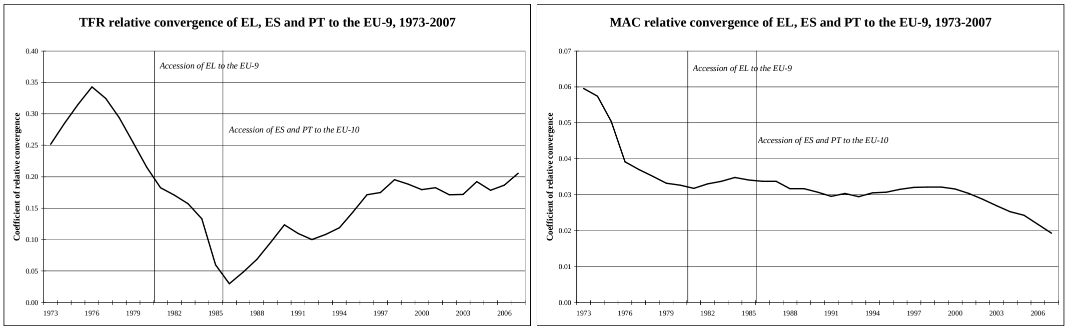


Figure 13: decomposition of the relative convergence in the EU-12

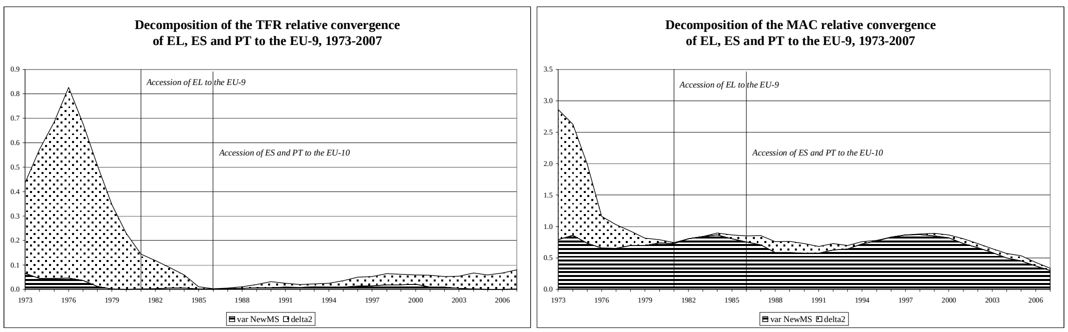


Figure 14: fertility indicators in the EU-15

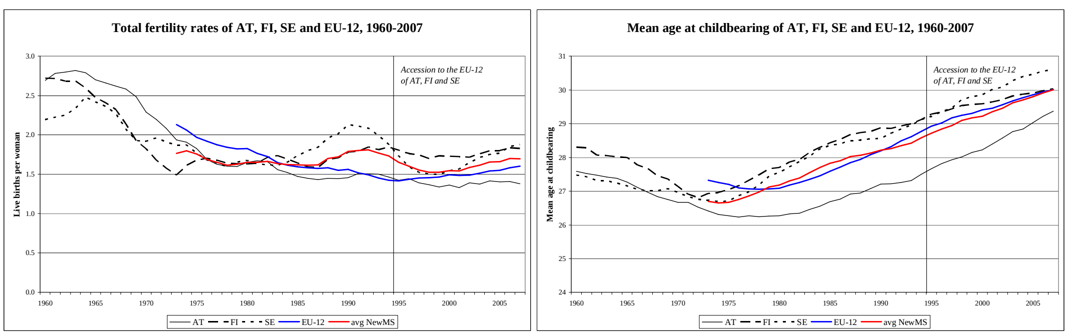


Figure 15: fertility σ-convergence in the EU-15

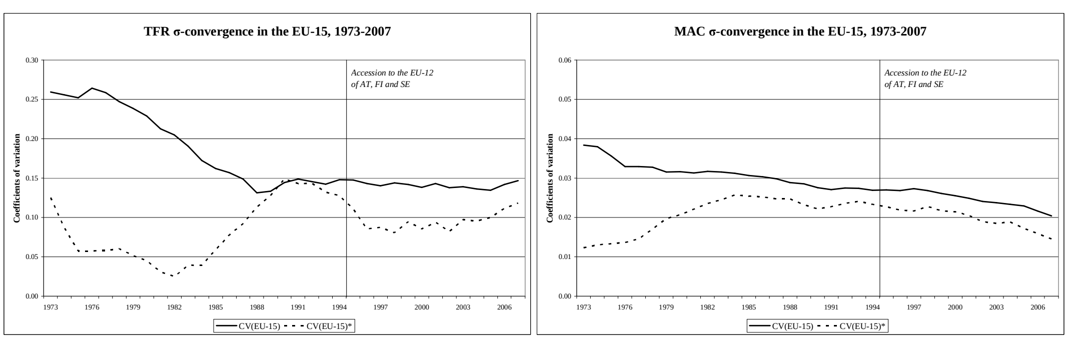


Figure 16: fertility relative convergence in the EU-15

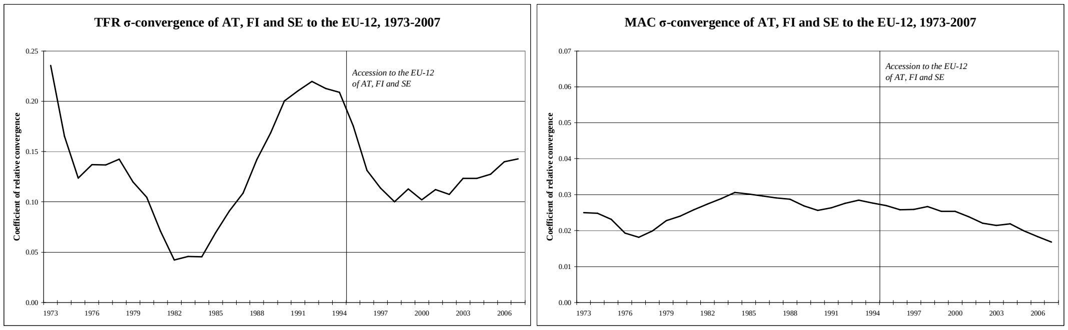


Figure 17: decomposition of the relative convergence in the EU-15

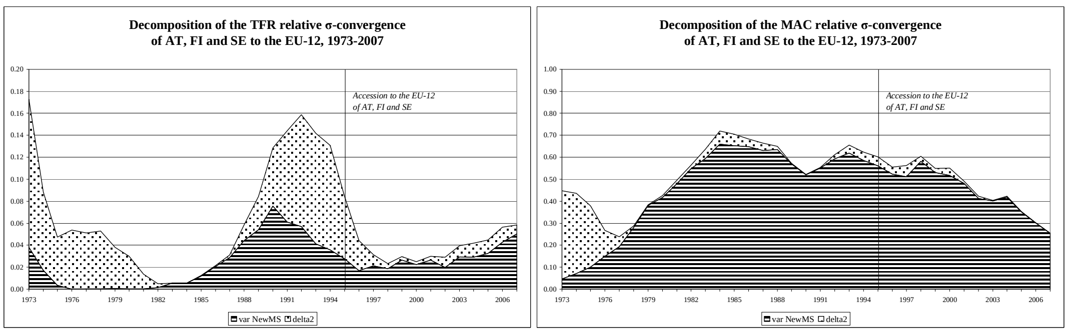


Figure 18: fertility indicators in the EU-27

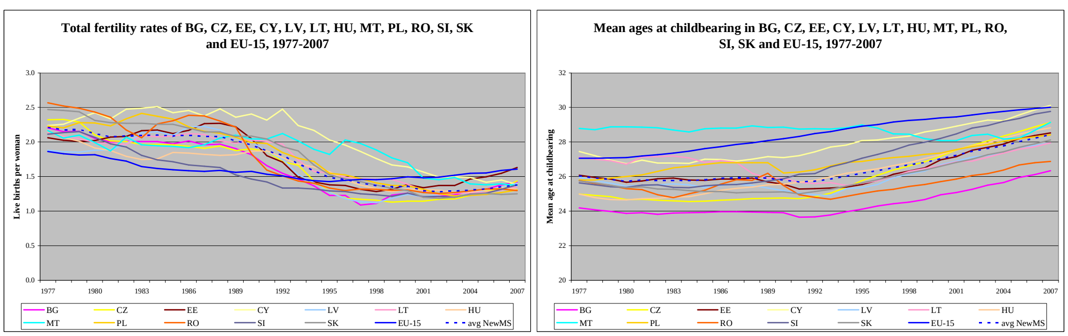


Figure 19: fertility σ-convergence in the EU-27

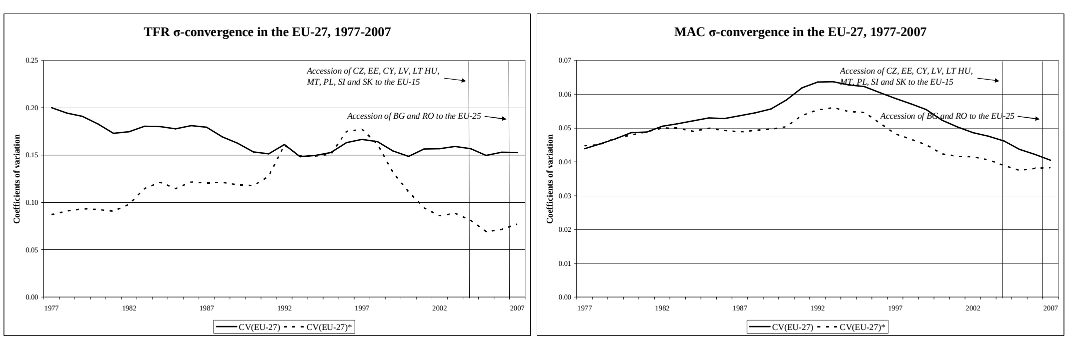


Figure 20: fertility relative convergence in the EU-27

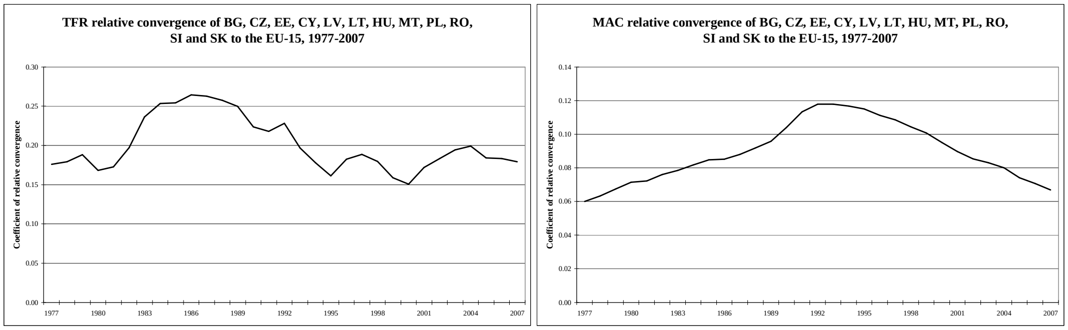
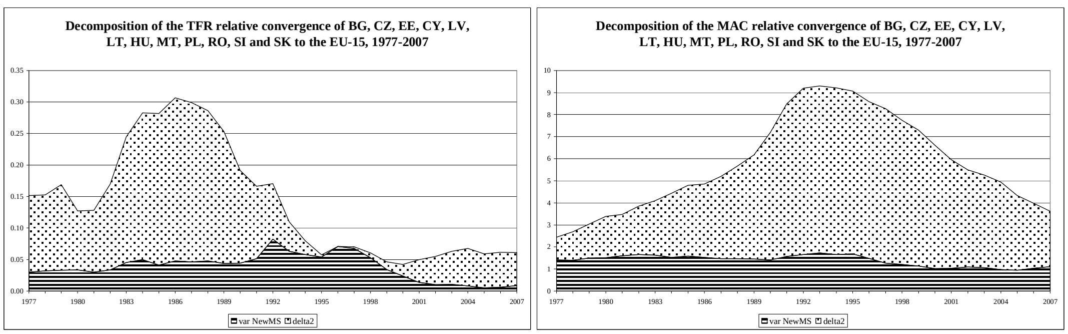


Figure 21: decomposition of the relative convergence in the EU-27



6. CONCLUSIONS

In this article, I claim the importance of taking into account additional constraints of consistency when preparing the projections assumptions for a set of countries. In the case of fertility, this may be expressed in the form of convergence between countries, to which the future national demographic behaviour could be requested – in the assumptions setting – to comply. This "international" constraint may have both theoretical and empirical grounds. From the theoretical point of view, this may be linked to the demographic transition theories; for the empirical evidence, it is necessary to define in operative terms the concept of convergence. Taking advantage from the large literature on the topic of economies convergence, I first speculate on the occurrence of absolute convergence in fertility, according to three commonly used concepts: σ-, β- and γ-convergence. With the purpose to cover not only the intensity, but also the tempo of fertility, I use two indicators appropriate for international comparisons purposes: the total fertility rate and the mean age at childbearing. The analysis over three decades for 27 European countries shows that fertility convergence, in whatever form, occurred, although periods of divergence had also taken place. However, there is no clear empirical evidence about the future developments, as the dispersion of the TFR is mostly stationary in the most recent period, and MAC does indeed converge, but after a period of divergence similar in intensity and time length to the one observed for convergence. This confirms that absolute convergence is a constraint that may be used in the assumptions setting, but need to be supported on theoretical grounds. I therefore investigate an additional hypothesis: does the membership to the European Union play any role on the national demographic behaviour? In fact, this may imply to assume that there are common, shared EU values, towards which the newcomer countries may converge. I consider the tools available in literature (at least, the most simple measures) not sufficient for the purpose of exploring this assumption, and I therefore develop and apply an indicator of *relative convergence*, concept by which I want to stress the idea of convergence *towards* a defined value (either theoretical or expression of a set of countries of reference), different from the convergence *across* countries. If such a relative convergence had occurred in the past, then the assumption of fertility convergence across Member States could have a further supporting argument. To test that hypothesis, I analyse the enlargements of the European Union that took place in 1973, in 1981-86 and in 1995, using what I call the coefficient of relative convergence. The overall outcome is somehow fuzzy, as I do not obtain conclusive evidence of a fertility convergence of the new Member States towards the common EU value expressed by the countries already member of the European Union. Nevertheless, considerations like limited time series used for the analysis, as well as specific policy efforts and exchange of best practices and experiences in the area of fertility in the EU, would support the conclusion that fertility convergence across Member States is a plausible assumption for projections at EU level.

No attempt has been made in this paper to test for conditional convergence, or for the presence of convergence clubs within the European Union. Further, nothing is said about the timing of the convergence, nor on the value toward which convergence would take place. On the former issue, the tool proposed in this paper may however provide a help. Supposing that a convergence value has been identified on theoretical grounds, the observed time series of the coefficient of relative convergence can be used to assess the speed of convergence. For instance, such time series could be properly extrapolated to calculate when the forecasted value becomes zero. Further, the decomposition property of the coefficient of relative convergence could allow assessing whether this convergence would occur on both variability of the distribution and difference between average and convergence value, or only in one of these components. Indeed, countries may well keep a certain difference among them, while their average value converges to the theoretical one. In case this assumptions-setting exercise is carried out over both TFR and MAC, then with few additional assumptions a whole fertility pattern of reference could be developed for the year of convergence (e.g., Schmertmann, 2003, 2005) and the entire fertility evolution from the base year to the end of the projections period derived accordingly (see, for instance, Lanzieri, 2009).

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