Effects of Internal and International Migration on Birth Replacement. A Regional Analysis in Spain, 1975-2005.

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1. APPROACH: THE POPULATION REPRODUCTION THROUGH THE BIRTH REPLACEMENT.

The analysis of the population reproductions as a process of renewal of their generations entails considering the interaction of the different demographic phenomena, mortality, fertility and migration. The variation of one or several of these components does not in itself define whether a population is being replaced or not.

In Spain, the drop in fertility has meant a fall in the replacement levels since the seventies. Within this context given by fertility, the reproductive situation is highly diverse owing to the effect of internal and international migration in each region: processes of concentration versus processes of depopulation. Migration appears as the most decisive factor in the replacement and reproduction of Spanish generations.

The usual indicator of replacement in the case of populations with low mortality is the Total Fertility Rate, with a level of 2.1 being used as replacement indicator. When a more advanced analysis is required, mortality is taken into account explicitly by calculating the Net Reproduction Rate, where values higher than unity represent long term growth.

However, neither the TFR nor the NRR is a useful measurement for explaining the replacement patterns in the different Spanish regions. This is because they only take into account the components of natural growth, and in regional dynamics migration tends to be a key element in replacement, both in one sense and the other[1]. In this respect the two basic processes in the last half century are emigration to cities (and to a lesser extent to Europe), which speeded up in the1960s (Logan, 1978; Fassmann and Munz, 1992; Blanco, 1993), and foreign immigration received over the last ten years (Blanco, 1993; Bodega, Cebrián et al., 1995; Huntoon, 1998; Arango and Martin, 2005). The former process has a twofold reading: from the point of view of the receiving regions, it is a major factor in growth, from that of the sending regions; it is linked to depopulation processes. Recent foreign immigration makes possible the continuation of

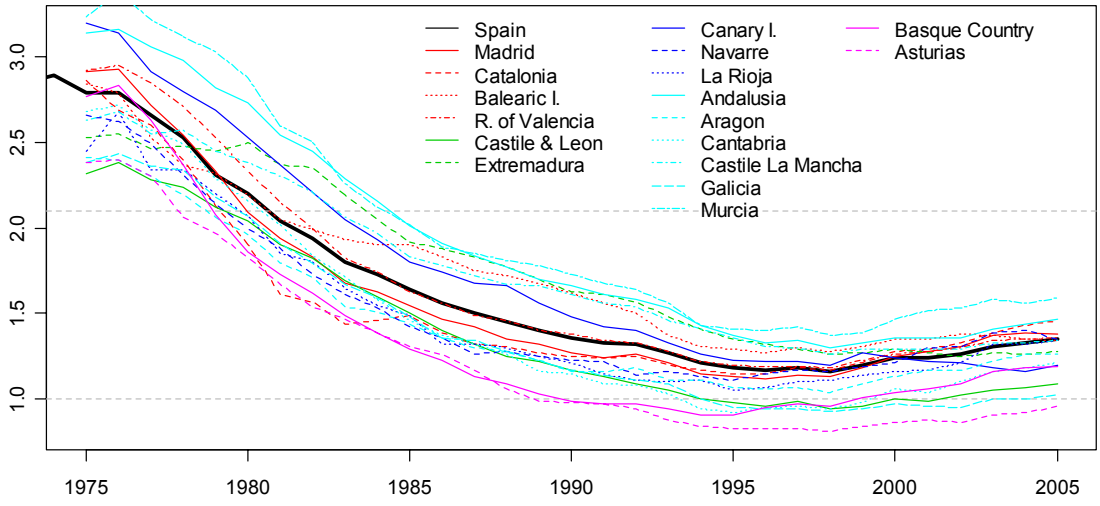
1 There are several proposals for incorporating all the factors of demographic dynamics: Ryder (1997), Calot and Sardon (2001) and Smallwood and Chamberlain (2005). However, they are based on posing migratory scenarios and use synthetic measurements of fertility and mortality. For historical populations De Santis and Livi Bacci (1997; 1998) put forward a method for estimating the Net Reproduction Rate (R_0) which allows mortality, fertility and migration to be broken down. The problem is that they take migration as a constant.

the growth process in the most dynamic poles, and may partly mitigate the consequences of depopulation in the former sending regions (Arango and Martin, 2005).

As we have said, neither the TFR nor the NRR captures the effects of these transformations: it is perfectly possible that these indicators are not modified even when a region becomes depopulated (Kohler, Billari and Ortega, 2002), since they only refer to the mortality and fertility *of those who remain*. In the case of the receivers, they also tell us of the mortality and fertility *of those who are there*, regardless of whether they were born there or immigrated. Some studies just show the effect of migration on the fertility levels and the different trends among natives and non-natives, in both international migrations (Abbassi-Shavazi and McDonald, 2000; Anderson, 2004) and internal migrations (Goldstein and Goldstein, 1981; Bach, 1981).

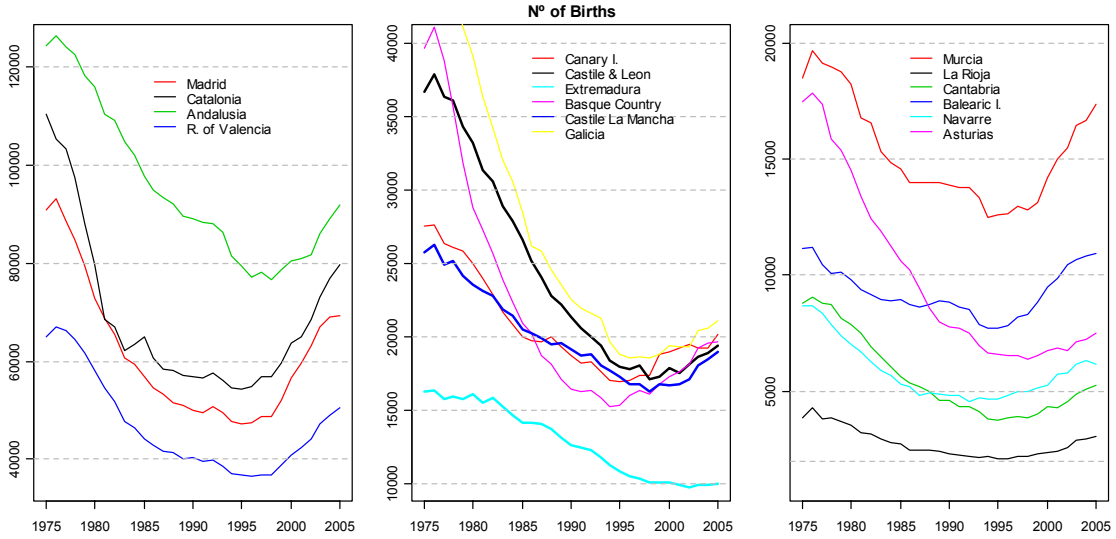
Assuming that the mortality levels in the different regions are similar[2], and observing, with small differences, one same trend in the TFR (Figure 1), we would expect homogeneous behaviour in the evolution of births from 1975 to 2005. However, what we see is a strong disparity in behaviour (Figure 2): regions with a large decrease, such as the Basque Country (-50%), Castile & Leon (-47%) or Extremadura (-38.6%), and others with very slight losses, the Balearic Islands (below -2%) and Murcia (-6%); taking as a basis international flow, in certain regions recovery is strong (from 1996 to 2005 births increased 46% in Madrid, 40% in the Balearic Islands and 37% in Murcia), whereas in others the increase has been much lower (below 10% in Castile & Leon) and has even continued to fall, as is the case in Extremadura (-5%). These data indicate the need to incorporate the migratory factor in the analysis of births and in the process of replacement and renewal of generations.

Figure 1: Total Fertility Rate by Region, 1975-2005



[2] Although some studies point out the existence of differences in the mortality levels among regions, since 1960 these are scarce and within low levels (Gómez Redondo, 1985; Ramiro-Fariñas and Sanz, 2000b).

Figure 2: Number of Births by Region, 1975-2005



The Birth Replacement Ratio includes the effect of all the demographic phenomena and determines to what extent births at the time imply replacement of the previous generation (Ortega, 2006). Furthermore, the effect of each of the demographic processes on birth replacement can be broken down: mortality and emigration of the population lead to a fall in the number of births; internal or international immigration, and differential fertility lead to an increase in the number of births. Thus, in the current migratory context the BRR is a very good indicator for analyzing the process of reproduction and replacement of generations in the different Spanish regions.

2. METHOD AND DATA

The Birth Replacement Ratio is an indicator easier to calculate; it only requires the series of births in the past and the necessary information for calculating the Total Fertility Rate (births by age of mother and number of women by age). It can be seen as a refinement of the Total Fertility Rate, which measures replacement of the population instead of fertility. Actually, the TFR is defined as:

[1]

$$TFR(t) = \Sigma F_x(t)$$

Where $F_x(t)$ is the age-specific fertility rate for age x in year t. The index thus refers to the mean number of children that a woman who has children would end up having throughout her reproductive life, according to current rates. This index is often used to account for the level of reproduction and replacement of a given population. It is, however, an indicator that expresses the fertility level of the population existing at a given time (number of children born to a number of women of a certain age), but which does not take into account the mortality, emigration or immigration that would affect the cohort of women. Hence, this index is not an indicator that accounts for the real reproduction of a population.

Calot (1984) proposed interpreting the TFR as an *index of replacement of generations* by breaking it down as follows:

[2]

$$TFR_t = B_t/G_t;\ \ G_t = \Sigma[F_x(t)/TFR_t] \,.\, E_x(t)$$

Where G_t is the weighted average of mother exposures, with the weights proportional to the fertility rate; B_t is the total number of births in year t and $E_x(t)$ the years-woman, by age, of exposure to the risk of having children. This formula serves to define the size of the generation of mothers as a weighted mean of the numbers of the female population in the period t, and in this sense Calot speaks of a period indicator of replacement (Calot, 2001).

However, strictly speaking it is not a measurement of replacement since the population concepts it compares are heterogeneous: current generation of mothers with number of births (which determines the new generation). The Birth Replacement Ratio has come into being precisely as an actual measurement of replacement in this context since it measures the size of the generation of mothers also when they were born (BG). It is therefore defined as follows:

[3]

$$BG_t = \Sigma[F_x(t)/ISF_t] \,.\, B^f(t\text{-}x)$$

That is, an average weighted of the births of women in the past where the weightings correspond to fertility rates in the present. The BRR comes from the comparison of this with the number of births:

[4]

$$BRR_t = B_t \,/\, BG_t$$

Hence, it is a matter of comparing the number of births in a given year with a weighted mean of the births of the generations of mothers (births that occurred between 15 and 50 years before). If we only consider female births we would obtain the Net Birth Reproduction Ratio ($NBRR_t$) equivalent to the BRR_t multiplied by the *sex ratio* at birth.

The decomposition of the Birth Replacement Ratio into its components of mortality, fertility, emigration and immigration is based on consideration of the ratio between G and BG. In particular, in a closed population, the only component that makes G differ from BG is mortality. In absence of migration, we would have the following relation:

[5]

$$G^{NoMig}{}_t = \sum 0.5[\, L_x(t-x) + L_{x+1}(t-x)] \cdot [F_x(t)/TFR_t] \cdot B^f(t-x)$$

Where $L_x(t)$ refers to the number of years lived at age x in the corresponding female cohort life table of generation born in year t-x. The difference between G^{NoMig} and BG can be summarized in a multiplicative factor that represents average survival of the cohorts of mothers:

[6]

$$\bar{\ell}_t = G^{NoMig}{}_t \ / BG_t$$

An interesting indicator is the following counterfactual: *what would the replacement ratio have been without migrations?* If fertility had remained the same, the number of births observed would have been TFR · G^{NoMig}. Hence, the BRR in the absence of migrations, BRR^{NoMig}, will be[3]:

[7]

$$BRR^{NoMig} = TFR_t \cdot G^{NoMig}{}_t / BG_t = TFR_t \cdot \bar{\ell}_t$$

A comparison of the replacement ratio observed and the one there would have been without migration allows us to define a proportion, k^{NetMig}, which reflects the effect of migration on birth replacement:

[8]

$$k^{NetMig} = \ [BRR_t / BRR^{NoMig}{}_t] - 1$$

That is, the difference between the BRR and the BRR^{NoMig} is due to variations in the mean size of the generation of mothers given the mortality conditions, and this is, the result of the net migratory balance.

This is the analysis that can be made when we know only the mortality, fertility rates and number of births in the past. If we have information regarding the distribution of the population of mothers by place of birth, we can be more precise and separate the effects that emigration from the region, immigration from the rest of the country and international immigration have on BRR. This information can be obtained from the population census. In this case, we can divide the generation of mothers by place of birth as follows:

[9]

$$G_t = G^{Nat}{}_t + G^{Spa}{}_t + G^{For}{}_t$$

Where *Nat* refers to those born in the region (natives), *Spa* to those born in the rest of Spain and *For* to those born abroad. These components are obtained by applying the fertility weightings to the female population in period t. In turn, we can determine the proportion of native women who emigrated by comparing G^{Nat} with G^{NoMig}, the women we would expect to find in the absence of migration. We call this proportion k^{Emig}. Finally, it is possible to define the proportions of the women of different origins to G. We call these proportions *P*. Thus equation [9] is as follows:

[10]

[3] Note that there is a similar relationship between reproduction gross rate and reproduction net rate. The difference lies in the fact that here mean mortality refers to the mortality undergone by the generations of mothers to reach the present time, and in the case of the TNR it corresponds to the mean mortality using period mortality.

$$G_t = G^{NoMig}{}_t \cdot (1-k^{Emig}{}_t) + G_t \cdot (P^{Spa}{}_t + P^{For}{}_t)$$

By finding G in the above equation, and inserting [7] and [8] in equations the following relation is obtained:

[11]

$$BRR_t = TFR_t \frac{\overline{\ell}_t \cdot (1 - k_t^{Emig})}{1 - P_t^{Spa} - P_t^{For}}$$

Thus the BRR is broken down into the four demographic components: fertility, mortality, emigration of natives and immigration (either from the rest of Spain or from abroad). By identifying terms we can also see the relationship between the net migration proportion and the terms of emigration and immigration:

[12]

$$k_t^{NetMig} = \frac{1 - k_t^{Emig}}{1 - P_t^{Esp} - P_t^{Ext}} - 1$$

Finally, we defined the *Equivalent Total Fertility Rate (ETFR)*, which can be considered at the conceptual level as an intermediate indicator between the TFR and the BRR. It corresponds to the following counterfactual: *What would the TFR have had to be so that, in the absence of migration, the number of births would have been equal to that observed?* It is an intermediate indicator since it can be obtained either from the TFR, by increasing it by the proportion of the net migrants, or else from the BRR, by dividing it by the proportion of cohort survivors:

[13]

$$ETFR_t = BRR_t / l^{Coh}{}_t = TFR_t \, (1 + k^{NetMig}{}_t)$$

The *data* for constructing the replacement indicators and breaking them down are as follows:

The annual series of births from 1925-2005, the TFR between 1975 and 2005, and the specific fertility rates from 1975-2005 per region were taken from the Spanish National Statistics Institute (INE).

The mortality tables per period were taken from the Human Mortality Database (HMD). These tables have served to estimate female cohort mortality, using a triangular distribution (year-age) of mortality in the Lexis diagram, taking into account the available disaggregation of mortality between 0 and 1 years, and between 1 and 5. For the triangles corresponding to more than five years of age, the mean of the two age-period rectangles in the five-year tables was used. The same mortality was assumed in the different regions.

Finally, information from the 1981, 1991 and 2001 censuses (INE) was used to break down the numbers of women in reproductive age (G_t) according to place of birth in each region.

3. REPLACEMENT IN SPAIN, 1970-2005.

Figure 3 shows the evolution of the main reproduction indicators in Spain between 1970 and 2005.

First, replacement in Spain has been greatly affected by the evolution of fertility. From approximately three children per woman there has been a decrease to little over one (Munoz-Pérez, 1989; Castro, 1992; Kohler and Ortega, 2002; Ortega and Kohler, 2002). This is clearly reflected in the fall in the Birth Replacement Ratios. Since 1980 fertility has dropped to below the theoretical replacement level (2.1), falling to 1.2 in 1995, and since then there has been an improvement which reached 1.35 in 2005. This increase in the TFR is due to both the contingent of immigrant women with higher fertility rates and the increase in fertility in Spanish women (Ortega, 2006). The BRR has followed the same rising trend as the TFR since the mid-nineties, although with much greater recovery as it is affected by both fertility and the increase in the number of women (Figure 4).

The second aspect to be pointed out is the inversion of the relationship between the replacement indicators with respect to the Total Fertility Rate and the Net Reproduction Rate. The BRR and the NBRR have gone from being clearly below the TFR and the NNR, respectively, to surpassing them amply from 2000 on. This situation is the result of changes in mortality and then in migration (Figure 4).

On the one hand, at the beginning of the seventies, *mortality*, especially child mortality, showed moderate values, although it was going down at a sustained rate (Reher and Sanz, 2000; Ramiro and Sanz, 2000a, 2000b; Gómez-Redondo and Boe, 2005): survival to motherhood, according to the cohort mortality, was below 0.85, that is, just over 15 women of every 100 born did not reach the mean age of maternity, which clearly affected the number of births generated in that cohort. This is the first factor that explains the major difference observed in the seventies between the TFR and the BRR on the one hand and between the NRR and the NBRR on the other hand: the TFR is not affected by mortality, whereas the NRR incorporates period mortality and not cohort mortality, which appears clearly underestimated in processes of a fall in mortality (in 1970 the L^{per} was 0.96 and the L^{coh} was 0.84). As mortality has continued to fall and become established at very low levels, the effect of mortality is diluted, cohort and period survival become equal and the indicators for fertility and replacement come closer together.

On the other hand, there is an important effect of *migration*. At the beginning of the seventies there were still high stocks of Spaniards abroad (Blanco, 1993; Arango and Martin, 2005). Until the eighties a negative net balance is recorded in the number of women (K^{NetMig}), although this has decreased as the emigrants return and a greater number of foreign immigrants arrive. As in the case of mortality, the deficit of women affects the number of births generated by these cohorts and helps to explain the differences between the BRR and TFR indicators. In the nineties the balance became positive, due to the women emigrating were few in relation to those coming in from outside. This situation gave rise to a considerable increase in the number of births, far above that expected according to the fertility levels; hence, from 2000 on the replacement indicators were higher than the TFR and the NRR. In 2001, according to

census data, the women born abroad (P^{For}) represented 8% of the women of reproductive age in Spain (Table 1), a percentage which has increased considerably up until now. For 2005, the net constant for migration in the contingent of women in reproductive age was 17%, hence the strong recovery in birth replacement, much higher than that indicated by the evolution of fertility.

Figure 3: Spanish Reproduction Index, 1970-2005

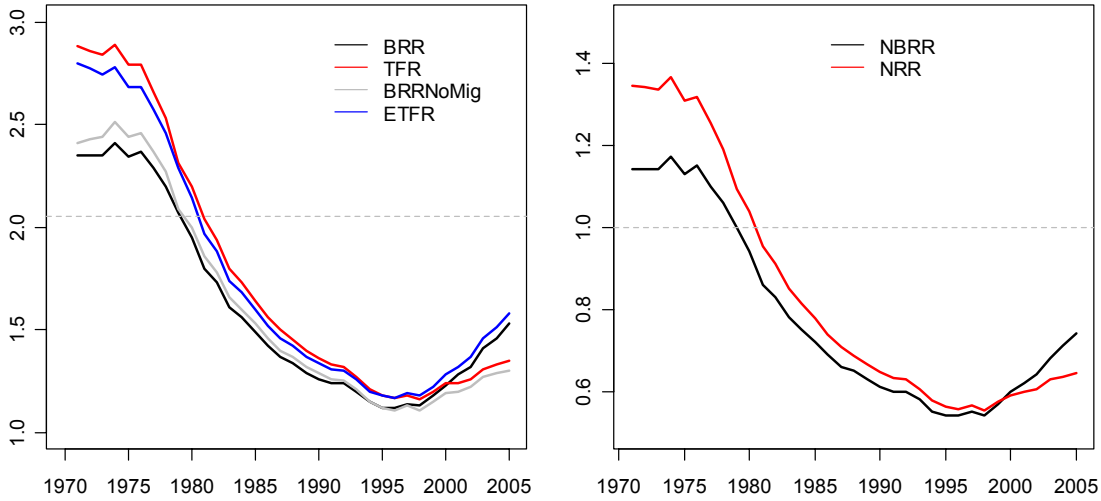
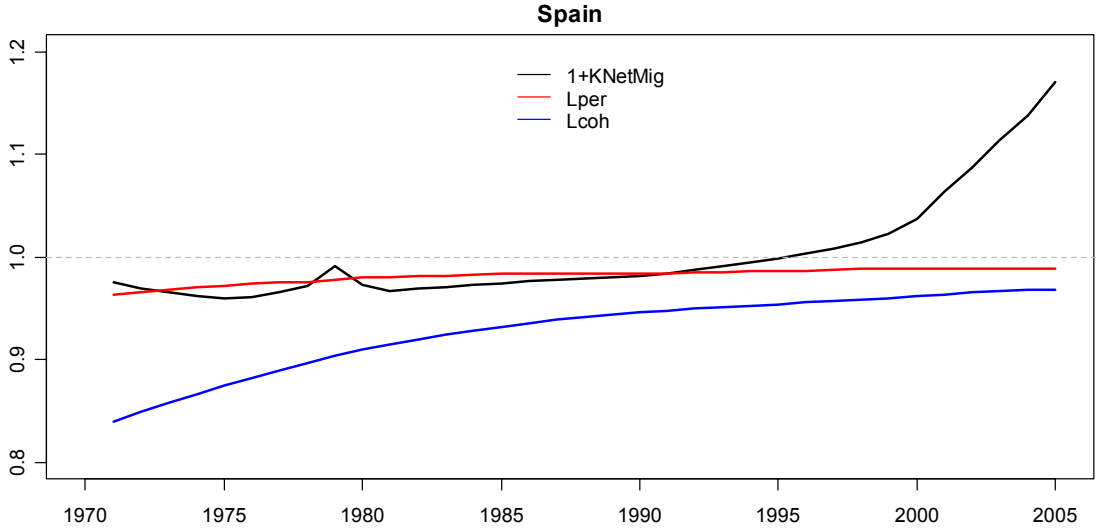


Figure 4: Net migration constant of mothers (K^{NetMig}) and average survival to motherhood by period (L^{Per}) and cohort (L^{Coh}), 1970-2005



This trend in replacement on a national scale becomes highly complex when an analysis is made of what occurred in the different Spanish regions, given the unequal behaviour of migration in each of them.

4. REPLACEMENT IN SPANISH REGIONS, 1975-2005.

Below we give the different replacement patterns observed in the regions during a period of maximum interest: on the one hand the effects of *internal migration* in past

decades can be seen, and to a lesser extent, *international emigration*; and on the other hand, at the end of the period the effect of *international immigration* is noted. All this has an impact on the depopulation and concentration processes the regions have undergone over recent decades. This behavior takes place within a context of an intense fall in fertility and mortality in the whole of Spain.

According to the results of the combination of the demographic components in this period, and mainly for migration, we have identified four replacement paths.

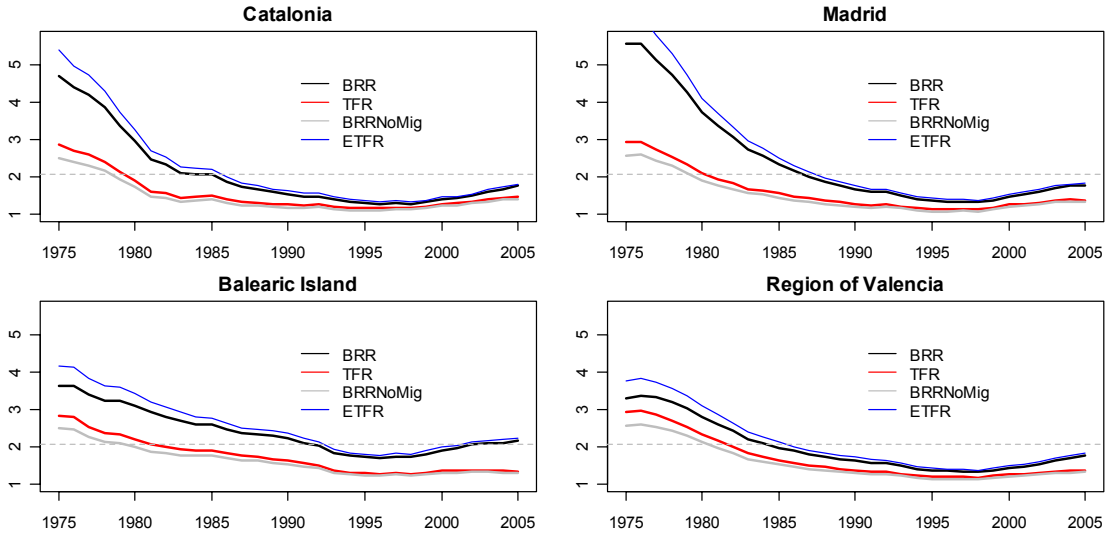
Path I: traditionally immigrants regions

Madrid, Catalonia, the Balearic Islands and the Region of Valencia show an important reproductive surplus over the period: the BRR is far above what it would be in the absence of migration (BRR^{NoMig}) (see Figure 5). As from the fifties these regions have been economically dynamic (Logan, 1978; Harrison, 1990), which entailed a major migratory flow from other parts of Spain and a highly positive net migratory balance. Since the end of the seventies a strong decrease has been observed in the replacement ratio as a consequence of the drop in fertility and less immigration. Nevertheless, the surplus has been maintained until now and in recent years has increased due to the arrival of foreigners. Madrid and Catalonia are the most illustrative cases of this replacement path.

In Madrid in the mid-seventies, the BRR was above 5.5 and in Catalonia close to 5. That is, the number of births during those years in these regions was 5 times higher than the average weighted of mothers at birth (BG_t). The existence of even higher fertility (TFR around 3 children per woman) and especially the effect of immigration, mainly internal, explain the high number of births. The replacement ratio in the absence of migration (BRR^{NoMig}) is around 2.5, this means, in Catalonia mothers not born in the region contributed almost 50% of the births and in Madrid even more (3 children were of immigrant mothers and only 2.5 of mothers native to Madrid).

In the case of Madrid, by breaking down the number of women based on data from the 1981 Census (Table 1), we find that 40% was formed by women native to Madrid (P^{Nat}), 53% by women born in other parts of Spain (P^{Spa}) and 3% by foreign mothers (P^{For}). Therefore, despite the fact that the fertility of women residing in Madrid was lower than the national average (1.9 versus 2.0) the birth replacement ratio was almost double (3.4 versus 1.8) (Table 2). Thus, although the TFR was below the theoretical replacement level, the important presence of immigrant mothers meant that births of the preceding generation (of mothers and fathers) were more than satisfactorily replaced in that year. For that year in Madrid a positive net constant migration of 0.89 was recorded, which means that there was almost twice the number of women in reproductive ages (G_{1981}^{15-49}) with respect to what was expected in the absence of migration (women born in the region between 1931 and 1966, and alive in 1981, and therefore aged between 15 and 49). Under these conditions, the TFR lacks meaning as an indicator of reproduction: although the TFR recorded was below 2, given the number of births registered in the region, in the absence of migration this indicator should have been 3.7, which corresponds to the EFTR.

Figure 5. Path I: Immigrant Regions



The situation in Catalonia in 1981 was very similar to Madrid. Catalan women only represented 55% of the mothers (Table 1). This important presence of non-Catalan women is expressed in a net migration constant of 0.7. The same as in Madrid, despite having a total fertility rate below the national average (1.6), the ETRF was 2.7 and the BRR, 2.5; hence, the births of preceding generations were more than satisfactorily replaced (Table 2).

As from the mid-eighties, the BRR fell below the replacement level (2.05). The strong fall in fertility and less immigration explain the drop in the replacement ratio.

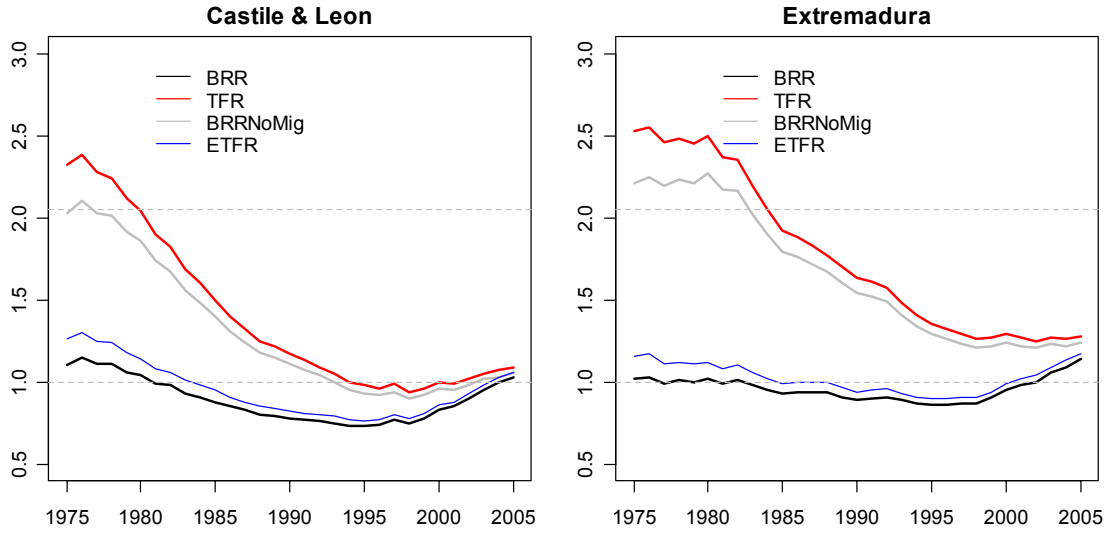
In the second half of the nineties there was a slight recovery of replacement in these regions, mainly due to international immigration and to a lesser extent to the slight improvement of the TFR. By 2001 foreign mothers (P^{For}) represented 14% of the generational of mothers in Madrid and 9% of those in Catalonia and compensated the lower number of mothers born in other parts of Spain (see Table 1). In both regions the contribution of these foreign mothers meant that the BRR and the ETFR remained clearly above the fertility level. Nevertheless, the BRR did not reach the theoretical replacement level, since current births must replace the generations born in the seventies and eighties, during which fertility was very high and the migratory balance far above the present one.

In the Balearic Islands and in the Region of Valencia the fertility level was very similar to that of Catalonia and Madrid, but the replacement ratio was lower owing to less immigration to these regions. In both communities the replacement ratio dropped progressively until the mid-nineties as internal immigration and fertility levels decreased, and then recovered because of the arrival of international migrants. At present the only autonomous region with a BRR above theoretical replacement (2.1) is the Balearic Islands, although the TFR remains very low. Currently it is the region with the highest positive net balance, largely because of the arrival of foreign women (Table 2).

Path II: traditionally emigrant regions

Castile & Leon and Extremadura are the only two regions that show a major loss of births throughout the period, as can be seen in the relationship between the BRR and the BRR in the absence of migration (see Figure 6). They are the only regions in which the TFR is higher than the BRR and are the two clearest exponents of the depopulation process which has been affecting some Spanish regions since the middle of the 20th century. At all times they are far removed from the theoretical birth replacement level.

Figure 6: Path II: Emigrant Regions



Until 1975, in Castile & Leon, despite the fact that the Total Fertility Rate was above the level considered as replacement, the constant loss of population led to an EFTR of only 1.26. This loss of population is clearly seen when comparing the BRR, which is around 1.1, with the BRR^{NoMig}, over 2, this means, for each child born in the region almost one is lost through emigration. In 1981, 50% of the generational of women in reproductive age born in the region were living in other Spanish regions (K^{Emig}). This is an underestimation, since one would have to add the women born in the region and living in other countries in Europe or America (Blanco, 1993). The net migratory balance of women aged between 15 and 49 (immigrants minus emigrants) was -0.43.

In Extremadura the reproductive situation is more acute than that observed in Castile & Leon. Despite the fact that the TFR in the seventies showed a value of 2.5, the EFTR was 1.1 and the BRR scarcely 1. The difference between the BRR and the BRR^{NoMig} was 1.2, which meant that for each birth in the region in the seventies 1.2 was lost by emigration. The emigration constant was 0.58, taking into account only women in reproductive age born in Extremadura and living in Spain, that is, over half were outside the region. During these years hardly any entries of immigrants were recorded, hence the net balance is -0.55. In the eighties and especially in the nineties the difference lessened owing to lower emigration (Table 2).

In the last part of the nineties, both in Castile & Leon and in Extremadura the BRR and the BRR^{NoMig} tended to converge as the loss of women decreased and international immigrants arrived (Tables 1 and 2). In 2001 foreign women represented 5% of the generational of women in reproductive age in Castile & Leon and 3% in

Extremadura, although this was far below the national average, 8.3%. Nevertheless, there was still a net loss of women and these regions are far from the theoretical birth replacement levels.

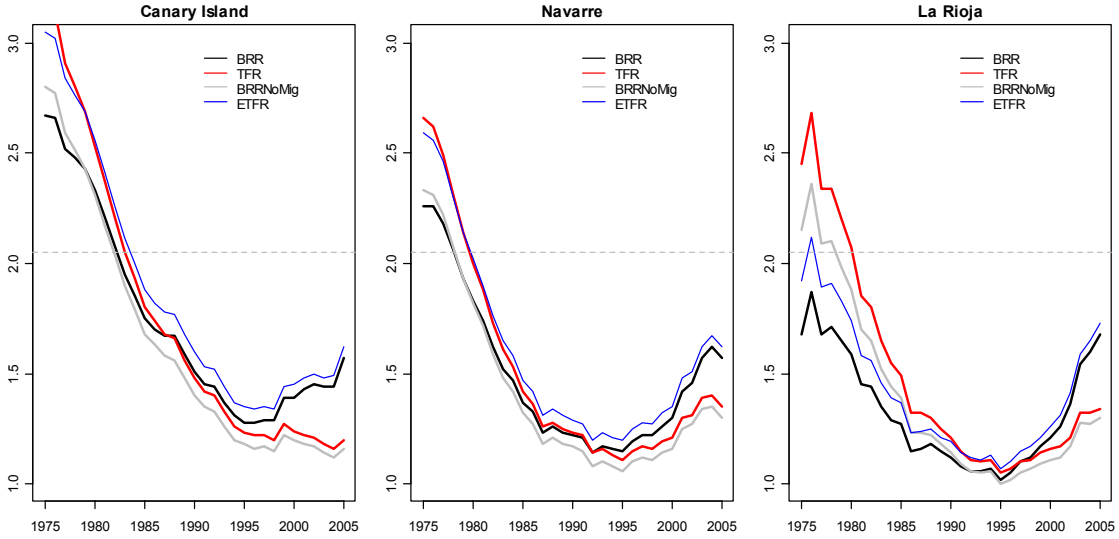
A BRR around unity, as is recorded for most of the period, means that the births for each year only replaced half of the births of the parents' generations. This intensified the depopulation process that had been affecting these regions for decades and which not even international migration has changed up until now.

Path III: from emigrant to immigrant regions

In this third path we group the regions that have gone from showing a loss of reproductive capacity due to the leaving of women and loss of births, in some cases very pronounced, to now being regions with immigration and thus having a "surplus" of births. According to the causes of this change two groups can be established: those regions where this change occurred before the development of the international flow and can thus be attributed to internal immigration; and others where the change is more recent and mainly owing to international immigration.

A) In the first group we have the Canary Islands, Navarre and La Rioja, regions which in the mid seventies showed a slightly negative migratory balance, with a BRR below BRR^{NoMig} (see Figure 7). Nevertheless, in the seventies the Canary Islands and Navarre showed BRR values above the theoretical replacement level. At the beginning of the eighties, with internal immigration, the BRR became higher than the BRR^{NoMig}. In these regions the K^{NetMig} for 1981 showed a positive balance which could mainly be attributed to national immigration (P^{Spa} of 24% in Navarre and 8% in the Canary Islands). In La Rioja this correction occurred more slowly, but before the international flow was fully developed. In all three regions, from the nineties on there was an important increase of the BRR owing to the contribution of foreign mothers (Table 1). The replacement indicator is, however, well below the level that allows renewal of the generations, because of the very low fertility. In 2001, the Canary Islands showed the peculiarity of the number of foreign women being higher than that composed of women born in other parts of Spain, which emphasizes the fact that the region is an archipelago far from the peninsula.

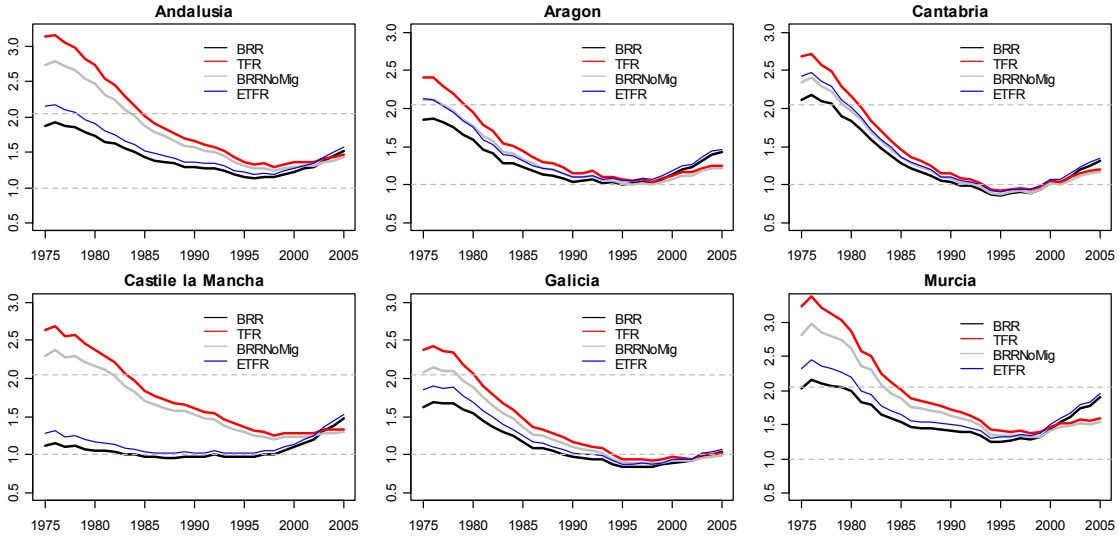
Figure 7: Path III: From emigrant regions to immigrant regions. *Type 1*



B) In the second group we find traditionally emigrant regions -Andalusia, Aragon, Cantabria, Castile La Mancha, Galicia, and Murcia- which in the second half of the nineties, due to the massive arrival of foreigners (with the exception of Castile La Mancha) became regions of immigration (Figure 8).

In the mid-seventies, some of these regions, such as Castile La Mancha, Andalusia, and to a lesser extent Murcia, showed replacement indicators similar to those observed in Castile & Leon and Extremadura. They were undergoing a clear process of depopulation and loss of reproductive capacity.

Figure 8: Path III: From emigrant regions to immigrant regions. *Type 2*.



Andalusia serves as an example for showing the path of these regions. At the end of the seventies, the fertility level was above 3; however, owing to a high rate of emigration (negative balance over 30%) the EFTR was at around 2. This loss of births is clearly reflected in the difference between the BRR and the BRR^{NoMig} (Figure 8). The loss of reproductive capacity decreased in the first place because of the decrease in the number of those leaving (K^{Emig} went from 30% in 1981 to 21% in 1991 and to 15% in 2001), and secondly because the arrival of immigrant women, mainly foreigners,

inverted the migratory balance (K^{NetMig}). In 2001, of the number of mothers in Andalusia, 8% were women born in other regions of Spain and 5% were foreign mothers; the latter figure has increased considerably over the last 4 years[4]. The arrival of these immigrant women since 1996 has contributed to a slight increase of fertility (11% increase), but above all to an important recovery of the Replacement Ratio (35% increase), as can be seen in Figure 8).

In the regions of Aragon, Cantabria, Murcia and Galicia the levels and trends are very similar. These regions have a tradition of emigration and, because of the growth of international immigration, they have recently managed to compensate the loss of births resulting from past decades of emigration. Galicia showed the peculiarity of the number of foreigners for 2001 being already greater than that of women coming from other Spanish regions, a characteristic it shared with the Canary Islands. In this case it is due to the return of the large contingent of Galicians living abroad (descendants of Galicians).

The situation of Castile La Mancha is different, since, although the change in reproductive development is also very recent, it is mainly due to internal migration. In the mid-seventies, the BRR was around 1, when in the absence of migration it would have been over 2.5, which indicates that for each birth in the region there was a loss of 1.5 through emigration. In 1981 its K^{NetMig} was –0.50, the second lowest after Extremadura, and this means that half of the women in reproductive age had left the region. The BRR remained at very low levels until quite recently and the change in the migratory balance took place after 1995. Although the international immigration that affects the whole country has contributed to this change, it is especially due to internal immigration from Madrid to neighboring provinces in Castile La Mancha, specifically to Guadalajara and Toledo[5]. In 2001 it was the region with most emigration (K^{Emig} 0.38); this loss was, however, compensated by an important presence of woman from other parts of Spain and, to a lesser extent, from abroad (Tables 1 and 2).

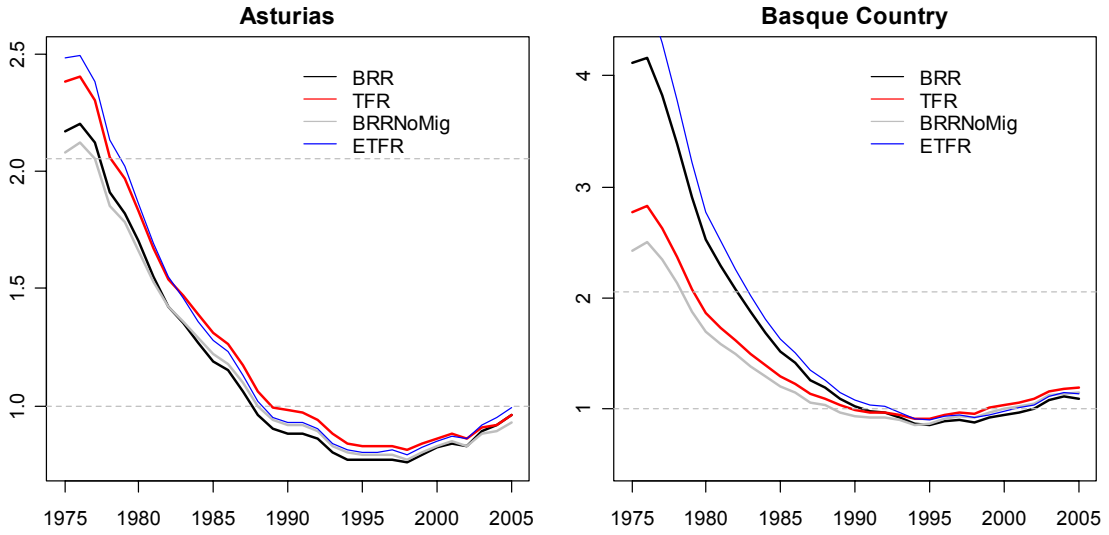
Path IV: from immigrant to emigrant regions (immigrants)

Asturias and the Basque Country show a replacement path contrary to the one seen in most of the Spanish regions. In the middle of the1970s, both regions formed part of the group of regions with positive migratory balances, especially the Basque Country, and they have evolved towards a negative balance (Figure 9).

[4] The number of foreigners in Spain in 2001 was 1,370,657 and in 2006 it was 4,144,166, whereas in Andalusia it went from a little over 164,000 to almost half a million, .in both cases it has tripled (Municipal Register, INE).

[5] In 2005 Guadalajara showed a net migration constant of 0.88, the highest on the provincial level, and the highest BRR in 2005 (2.6), whereas at the beginning of 1980 the net constant was -0.50 with a BRR below 1. In 2001 the number of women from other Spanish provinces, mainly from Madrid, represented 44% of the total of mothers. Toledo showed a similar change, although of less intensity.

Figure 9: Path IV: From Immigrant to Emigrant Regions (Immigrant)



From 1960 to 1970 the Basque Country showed levels of industrialization and development similar to those of the most dynamic regions, such as Catalonia and Madrid (Nadal, 1987; Harrison, 1990). This situation allowed it to attract population from other regions and show, in the seventies, a high Birth Replacement Ratio (over 4), with half of the births from non-native mothers. Since then this region has undergone a process contrary to that observed in other regions: the arrival of women decreased and the departure of native women increased, thus leading to a reversal of the relationship between the BRR and the BRR^{NoMig}. From the mid-nineties on it has shown a negative migratory balance of mothers (-5%) and consequently a loss of births and a very low replacement level. The Basque Country has gone from being a region traditionally receiving population to being a sending region, which so far has not been compensated by international migration.

Likewise, Asturias in the mid-seventies showed a positive migratory balance and a reproductive surplus thanks to migration, although much lower than that of the Basque Country. In the eighties and nineties it underwent the same inversion in the BRR and BRR^{NoMig} indicators. However, the appearance of international migration has made the migratory balance slightly positive again. Nevertheless it is the region with the lowest levels of fertility and replacement.

5. CONCLUSIONS

First we would like to point out the weakness of the traditional demographic indicators, TFR and NRR, for accounting for the reproductive situation of a population in contexts of high migratory impact. Whereas the TFR in Spain has gone from 2.8 in 1975 to 1.3 in 2005, a decrease of over 50%, births have only decreased 30% (from 670,000 to 466,000), owing to changes in mortality and above all in migration. The TFR is an indicator that is not sensitive to the effects of mortality and migration, and the NRR considers period mortality not cohort mortality and does not include migration either.

In the case of Spain, we found that if we look only at fertility there is hardly any heterogeneity in the behavior. However, the replacement patterns in the sending regions

and in the receiving regions are completely different. At the beginning of the eighties, Madrid and Galicia showed similar levels of fertility (1.9), but the birth replacement ratios were quite different (3.4 for the former and 1.4 for the latter) owing to the unequal effect of migration on the birth rate. What is more, the drop in fertility in Madrid, Castile & Leon and the Balearic Islands between 1975 and 2005 was identical, 53%. However, the evolution of births was quite different: in Madrid the drop was 24%; in Castile & Leon it was almost double (47%), and in the Balearic Islands only 1.7%. With similar levels of mortality, the explanation of this different evolution can be found in the migratory factor (Figure 10), specifically in the evolution of the number of women in reproductive age. Migration appears as the determining factor in demographic dynamics in the different Spanish regions.

The Birth Replacement Ratio provides a tool of maximum interest for studying the replacement of populations. It incorporates the impact of migration on replacement in a natural way, besides fertility and mortality, and allows us to study the reproductive implications of the migrations. Furthermore, the BRR tells us whether the births in each year replace the births corresponding to the mothers' generation.

The analysis performed reveals that two phenomena have determined the main variations among regions. First, from the 1950s to the 1980s, the internal migration linked to the rural exodus entailed the transfer of young population from some provinces and regions to others. The outcome was a depopulation process, with levels of around 1 in the BRR (this implied that births were divided by two in each generation) which characterized the two Castiles and Extremadura, and also certain provinces in Andalusia, Aragon and Galicia. On the other hand we have the processes of concentration of population in Madrid, Catalonia, the Basque Country, the Balearic Islands and the Region of Valencia.

The second phenomenon is the new international immigration which, since the mid-nineties, has changed the former replacement patterns: some of the previous poles of attraction have obtained new flows of young population (Madrid, Navarre and the whole of the Mediterranean coast, see maps 1-3); in some of the depopulated areas the process has been interrupted and they are becoming revitalized (the case of some provinces in Andalusia, Asturias, Murcia, Aragon and Galicia); and, moreover, there are new processes of internal migration towards the neighboring provinces of the large cities (the particular case of Guadalajara and Toledo in the region of Castile La Mancha).

In short, in a general context of a drop of fertility in Spain, quite different reproductive situations are noted in the regions owing to the difference in migratory behaviour. International migration is the factor that is leading to a certain recovery of the replacement levels in the country as a whole, although internal migration is still of core importance in the evolution of the birth rate and in replacement on a regional level.

Figure 10: Net migration constants of mothers (K^{NetMig}) by region, 1975-2005

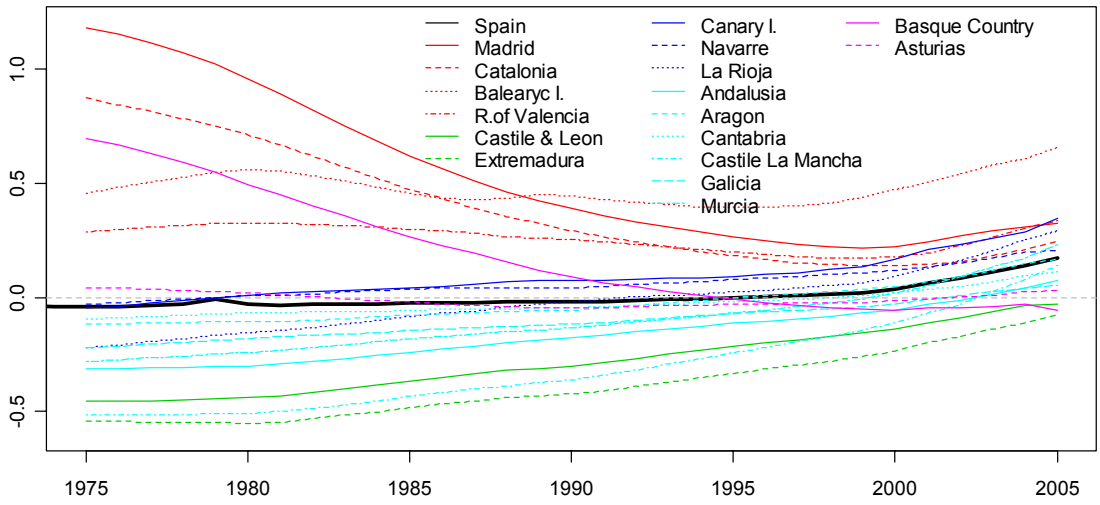


Table 1. Decomposition of the cohort of mothers (G_t) by place of birth (native to the region, born in other parts of Spain and abroad) in the census years 1981, 1991 and 2001

	1981					1991					2001				
	G_t	P^{Nat}	P^{Spa}	P^{For}	Tot	G_t	P^{Nat}	P^{Spa}	P^{For}	Tot	G_t	P^{Nat}	P^{Spa}	P^{For}	Tot
Andalusia	42577	0.92	0.06	0.02	1.0	53418	0.91	0.06	0.03	1.0	60005	0.88	0.08	0.05	1.0
Aragon	7738	0.80	0.19	0.01	1.0	8391	0.81	0.17	0.02	1.0	8779	0.78	0.15	0.07	1.0
Asturias	7844	0.80	0.18	0.01	1.0	7950	0.84	0.13	0.03	1.0	7809	0.85	0.09	0.06	1.0
Balearic I.	4532	0.59	0.36	0.05	1.0	5446	0.60	0.34	0.06	1.0	7075	0.60	0.27	0.13	1.0
Canary I.	9787	0.89	0.08	0.04	1.0	12416	0.86	0.08	0.06	1.0	15243	0.79	0.10	0.11	1.0
Cantabria	3630	0.82	0.17	0.01	1.0	3958	0.83	0.15	0.02	1.0	4120	0.80	0.15	0.05	1.0
Castile & Leon	16337	0.89	0.10	0.01	1.0	18107	0.87	0.11	0.02	1.0	17656	0.82	0.13	0.05	1.0
Castile La Mancha	10041	0.88	0.12	0.00	1.0	11783	0.85	0.14	0.01	1.0	13106	0.75	0.20	0.05	1.0
Catalonia	42110	0.55	0.43	0.02	1.0	45394	0.69	0.28	0.03	1.0	50554	0.78	0.12	0.09	1.0
R. of Valencia	25150	0.67	0.31	0.02	1.0	29208	0.72	0.24	0.04	1.0	33411	0.75	0.15	0.09	1.0
Extremadura	6480	0.92	0.08	0.01	1.0	7634	0.90	0.09	0.01	1.0	7821	0.84	0.13	0.03	1.0
Galicia	18610	0.94	0.05	0.02	1.0	18914	0.90	0.05	0.05	1.0	20258	0.86	0.06	0.08	1.0
Madrid	35155	0.44	0.53	0.03	1.0	39649	0.60	0.36	0.04	1.0	47474	0.66	0.20	0.14	1.0
Murcia	6301	0.85	0.14	0.01	1.0	7995	0.84	0.13	0.02	1.0	9991	0.78	0.12	0.10	1.0
Navarre	3571	0.75	0.24	0.01	1.0	3933	0.76	0.21	0.03	1.0	4349	0.74	0.17	0.09	1.0
Basque Country	15665	0.60	0.38	0.01	1.0	16690	0.76	0.22	0.02	1.0	16430	0.86	0.10	0.04	1.0
La Rioja	1702	0.77	0.22	0.01	1.0	1920	0.75	0.24	0.02	1.0	2095	0.68	0.23	0.09	1.0
Spain	*258043*	*0.73*	*0.25*	*0.02*	*1.0*	*293850*	*0.78*	*0.19*	*0.03*	*1.0*	*327320*	*0.79*	*0.13*	*0.08*	*1.0*

Source. Calculated from census data. P^{Nat}, P^{Esp} and P^{Ext} direct calculations.

Table 2. Fertility and replacement indicators by region, 1981, 1991 and 2001

	1981						1991						2001					
	TFR	BRR	BRR^*	K^*	K^{**}	ETFR	TFR	BRR	BRR^*	K^*	K^{**}	ETFR	TFR	BRR	BRR^*	K^*	K^{**}	ETFR
Andalusia	2.5	1.6	2.3	-0.3	0.4	1.8	1.6	1.3	1.5	-0.2	0.2	1.4	1.4	1.3	1.3	0.0	0.2	1.3
Aragon	1.8	1.5	1.6	-0.1	0.3	1.6	1.2	1.1	1.1	-0.1	0.2	1.1	1.2	1.2	1.1	0.1	0.2	1.3
Asturias	1.7	1.6	1.5	0.0	0.2	1.7	1.0	0.9	0.9	-0.1	0.2	0.9	0.9	0.8	0.9	0.0	0.2	0.9
Balearic I.	2.1	2.9	1.9	0.6	0.1	3.2	1.6	2.1	1.5	0.4	0.1	2.2	1.4	2.0	1.3	0.5	0.1	2.0
Canary I.	2.4	2.2	2.2	0.0	0.1	2.4	1.4	1.5	1.4	0.1	0.1	1.5	1.2	1.4	1.2	0.2	0.0	1.5
Cantabria	2.0	1.7	1.9	-0.1	0.2	1.9	1.1	1.0	1.0	0.0	0.2	1.1	1.0	1.0	1.0	0.0	0.2	1.1
Castile & Leon	1.9	1.0	1.7	-0.4	0.5	1.1	1.1	0.8	1.1	-0.3	0.4	0.8	1.0	0.9	1.0	-0.1	0.3	0.9
Castile La Mancha	2.3	1.1	2.1	-0.5	0.6	1.2	1.6	1.0	1.5	-0.3	0.4	1.0	1.3	1.2	1.2	-0.1	0.3	1.2
Catalonia	1.6	2.5	1.5	0.7	0.1	2.7	1.2	1.5	1.2	0.3	0.1	1.6	1.3	1.4	1.2	0.1	0.1	1.5
R. of Valencia	2.2	2.6	2.0	0.3	0.1	2.9	1.3	1.6	1.3	0.2	0.1	1.7	1.3	1.5	1.2	0.2	0.1	1.5
Extremadura	2.4	1.0	2.2	-0.6	0.6	1.1	1.6	0.9	1.5	-0.4	0.5	1.0	1.3	1.0	1.2	-0.2	0.3	1.0
Galicia	1.9	1.4	1.8	-0.2	0.2	1.6	1.1	1.0	1.1	-0.1	0.2	1.0	1.0	0.9	0.9	0.0	0.2	1.0
Madrid	1.9	3.4	1.8	0.9	0.2	3.7	1.2	1.6	1.2	0.4	0.2	1.7	1.3	1.5	1.2	0.2	0.2	1.6
Murcia	2.6	1.8	2.4	-0.2	0.3	2.0	1.7	1.4	1.6	-0.1	0.3	1.5	1.5	1.5	1.5	0.1	0.2	1.6
Navarre	1.9	1.7	1.7	0.0	0.2	1.9	1.2	1.2	1.2	0.1	0.2	1.3	1.3	1.4	1.3	0.1	0.2	1.5
Basque Country	1.7	2.3	1.6	0.5	0.1	2.5	1.0	1.0	0.9	0.1	0.2	1.0	1.1	1.0	1.0	-0.1	0.1	1.0
La Rioja	1.9	1.5	1.7	-0.2	0.3	1.6	1.2	1.1	1.1	0.0	0.3	1.1	1.2	1.3	1.1	0.1	0.2	1.3
Spain	2.0	1.8	1.9	0.0	0.3	2.0	1.3	1.2	1.3	0.0	0.2	1.3	1.3	1.3	1.2	0.1	0.2	1.3

Source: own calculations from census data and vital statistics. Several years

$BRR^* = BRR^{NoMig}$; $K^* = K^{NetMig}$; $K^{**} = K^{Emig}$

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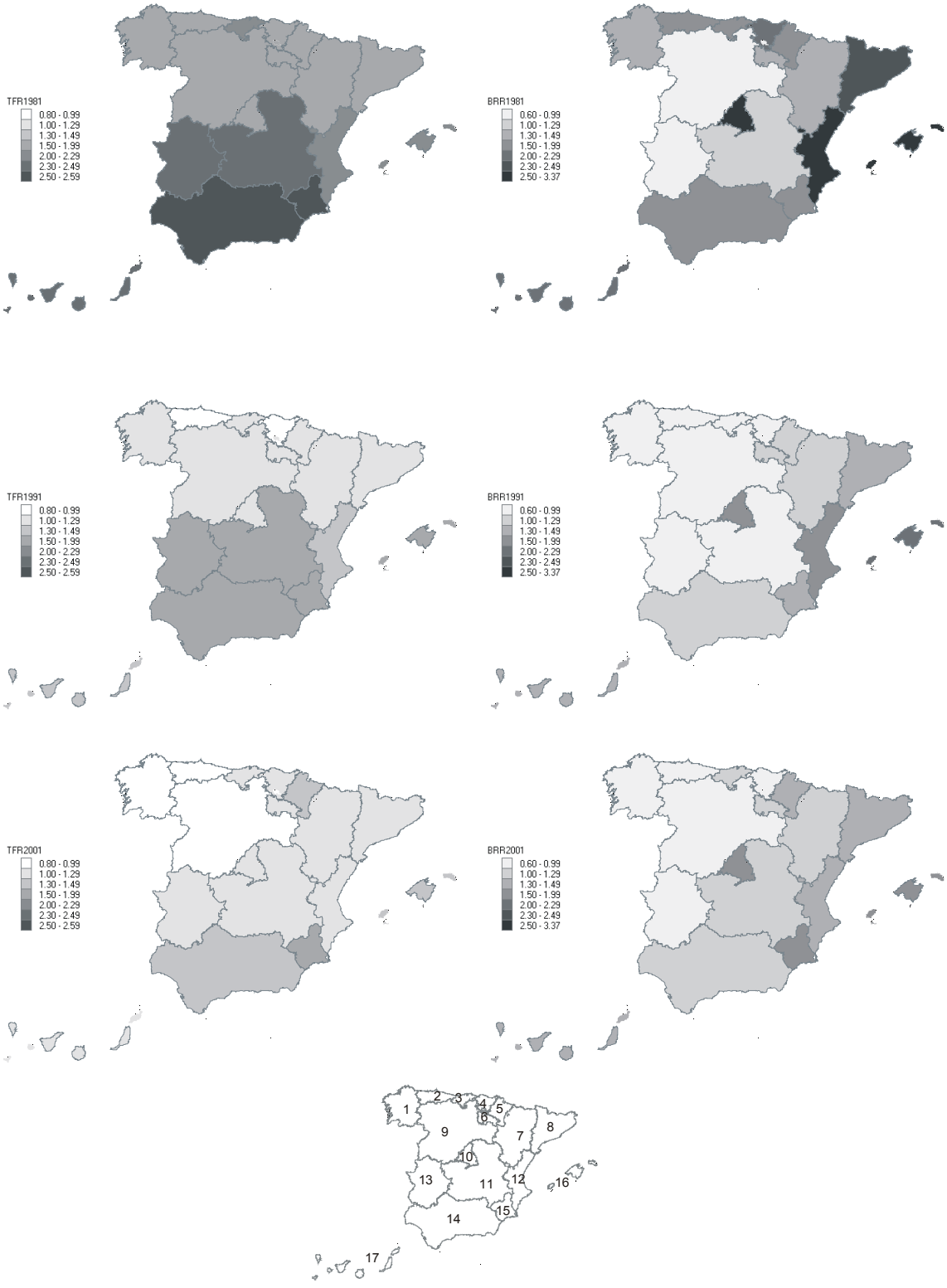
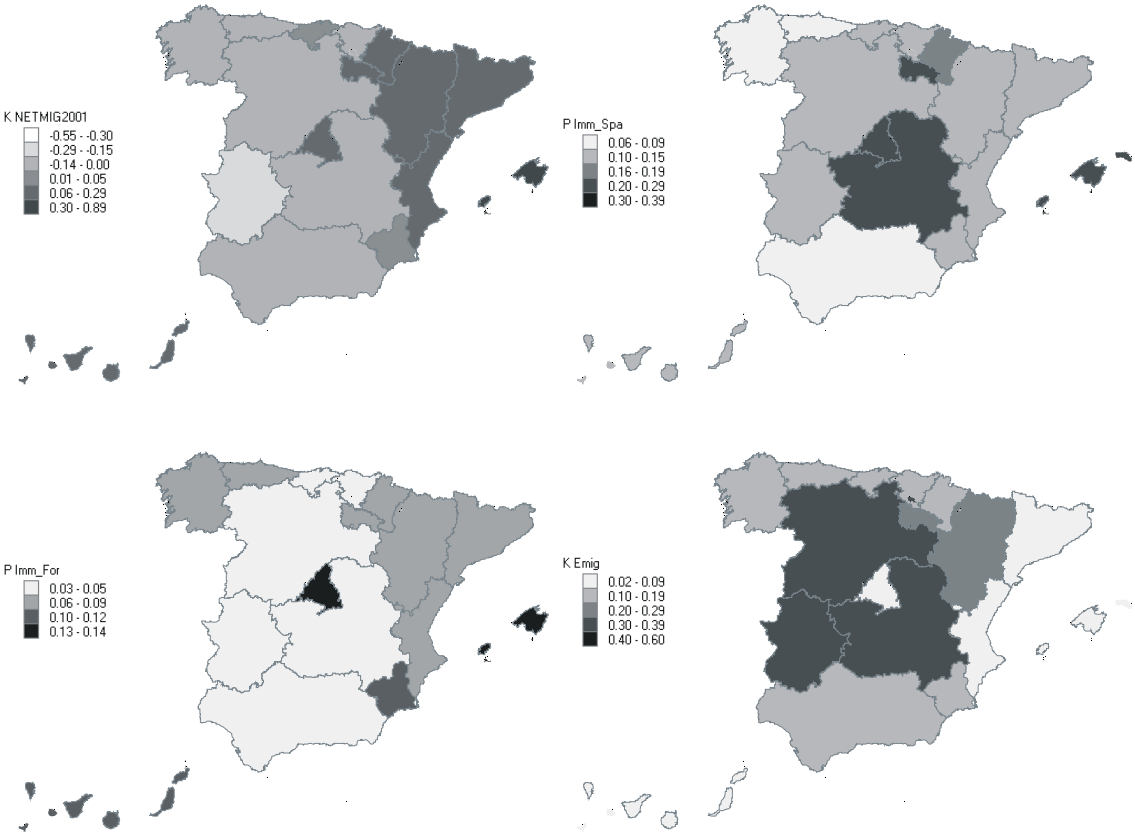
Map 1: Total Fertility Rate (TFR) and Birth Replacement Ratio (BRR) by region, 1981, 1991 y 2001



Codes of the region: 1 (Galicia), 2 (Asturias), 3 (Cantabria), 4 (Basque Country), 5 (Navarre), 6 (La Rioja), 7 (Aragon), 8 (Catalonia), 9 (Castile & Leon), 10 (Madrid), 11 (Castile la Mancha), 12 (Region of Valencia), 13 (Extremadura), 14 (Andalusia), 15 (Murcia), 16 (Balearic Island), 17 (Canary Island).

Map 2: Migration Index by region 2001:
Net migration constant (KNETMIG), Proportion of Spanish Immigrant in Gt (P Imm_Spa), Proportion of Foreigner Immigrant in Gt (P Imm_For) and, Emigration constant (KEmig)



Map 3: Net Migration Constant (KNETMIG) and Equivalent Total Fertility Rate (ETFR) by region, 1981, 1991 y 2001