The use of Population Censuses to correct the distribution of births by order of the vital registration system. Application to Spanish data in the 1975-2005 period

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Short Abstract

The availability of accurate birth statistics by order and duration is a requisite for the application of new fertility measures proposed in the last fifty years, which provide better estimates of the mean number of children women have than the Total Fertility Rate. These alternate measures also allow the calculation of fertility indices by order, which is useful in the light of the recent evolution in most European countries characterized by an increase in childlessness levels. For example the proportion of women childless reaches 18% for younger generations in Spain, and more than 20% in several Central European Countries and other Mediterranean countries like Italy. Working extensively with this kind of data for different countries, we were able to observe that the classification of birth by order is not always accurate, due to the relative complexity of the form or methodological problems at the National Statistical Institutes when applying correction or imputation algorithms.

In this work we use population censuses in order to check the series of births and to estimate new national and regional yearly series of births classified by order for Spain, applying a method similar to the so-called 'own-children method'. Using the three most recent Spanish population censuses, we are able to show that there are severe problems in these data, and that around 8% of the births classified at the first order are indeed of higher order. This leads us to obtain new estimates of the childlessness levels in Spain, which are significantly higher than those calculated with the official national statistics.

Introduction

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In most European countries, total fertility is below replacement levels since various decades, and in a considerable number of countries the Total Fertility Rate levels have been under 1.5 children per women for more than 20 years. These very low levels are accompanied by an increase in the level of childlessness and in the age at first childbearing. This dramatic evolution has been an impetus for the development of new ways to estimate the period fertility levels, in order to correct the shortcomings of the Total Fertility Rate (TFR for short). These new and more sophisticated fertility indexes allow the calculation of better estimates of its total level and also for each birth order. The new methods make a more demanding use of birth statistics than what is needed for the calculation of the TFR, and more specifically, they need accurate classification of birth by order, age of mother and duration since the last birth.

We have used this kind of data in previous works, specifically to compare the childlessness levels between European countries. We were able to observe that these levels were not always coherent. Childlessness levels were too low in certain countries and in specific periods, taking into account what we know about the biological determinants of fertility. This was especially the case for Spain, where, in spite of the relatively high level of childlessness for younger birth cohorts, we concluded that this level is too low, taking into account the distribution of the age at childbearing and of the proportion of women living in partnerships. An extensive study of childlessness levels for cohorts and for Spanish regions allowed us to observe that the problems with the statistics on birth order are permanent ones, as in some regions the proportion of women with at least one child exceeds one for some cohorts, a practical impossibility.

Working under contract with the Spanish National Statistical Institute, we developed and applied a variant of the 'own-children' method to population censuses, which allows us to correct the distribution of birth by order. This method is based on the use of census microdata, in order to reconstruct the birth order for each children living with their mother. This birth order is then corrected for the effects of children leaving parental home, using the results of the census questions on fertility (how many live births did you have?).

Using the last three Spanish population censuses, we are able to correct the classification of birth by order. We observe that between 8 and 10 % of the birth classified as first order are indeed of higher order. This allows us to calculate new estimates of childlessness levels by birth cohort. Our results show that childlessness is indeed much higher for younger women, over 20 %, with values now compatibles with our estimates of the minimum levels of childlessness based on a model that takes into account the biological determinants of fertility and the observed proportion of women living in partnership.

The birth order in birth statistics from national civil registration system

There are two main sources of information on births classified by order at the national level, the censuses and the vital statistics registration system. For censuses, the question on the fertility level of families or women has been a fruitful source of information since long time ago, especially thanks to the elaboration of a new kind of

fertility indicator, the parity progression ratio (Henry 1953). The first Census that incorporated a specific question on the number of live births was the 1911 Census for the United Kingdom. Since then this kind of question has been added to the census questionnaire by numerous countries, but sadly is progressively disappearing nowadays. This information has been completed by the publication of statistics on the distribution of birth by order, obtained from the civil registration system, which is published in some countries since the 1950s and progressively in most European countries. This kind of information is of fundamental importance in order to understand the evolution of fertility levels by birth order, using the methodology pioneered by Henry, as well as for the elaboration of better indicators of period total fertility (Rallu and Toulemon 1994; Bongaarts and Feeney 1998). This alone justifies the efforts made to ascertain the quality of this information. But another important impetus for doing so is the observation of the rise in childlessness levels in all Western Europe since the 1970s, and in Eastern Europe since the 1990s. This evolution is well known thanks to the growing availability of these statistics of births by order from the national vital registration systems, which allows us to give estimates of the proportion of women who still have no children. In the course of a study on childlessness in European countries, we observed that there is a great disparity of the quality of this kind of data across countries, and in some cases the proportion of childless women by birth cohort is as low as 1 or 2 %, when the minimum at the population level is around 5% (Devolder 2005). But apart from these obvious cases, we also observed for a substantial number of countries that the level of childlessness was too low, after taking into account the level of some of its determinants like age at first childbearing or celibacy. This is specifically the case of Spain, for which we estimated that, even if the cohort level is exceeding 15% for women born in the 1950s, the true level should be higher by as much as 5% in order to be compatible with age at childbearing and celibacy levels. In this work we use census data in order to test this hypothesis and correct the information on birth order provided by the Spanish vital registration system. The end result is a new series of births by corrected order from 1975 to 2006.

Generally speaking, there are some good reasons why the data on birth orders collected by the vital registration system should present problems, and more specifically why childlessness should be underestimated. First the experience with census data shows that childless woman very often are not correctly tabulated, and are included in the 'Not stated' group, due to ambiguities in the questionnaire. This is so usual, that a method has been devised to detect and correct this problem (Feeney 1998). The vital registration does not have the same kind of problem, as by definition childless women are excluded from the count of events. But it is easy to explain why we can observe an excess of birth of order one in some countries: when fields in the childbirth form are left unanswered, the statistical office usually assumes the birth is the first one for the mother if there is no mention of a previous birth. But if births of order one are overestimated, childlessness will be underestimated. So the final effect of the defects in the registration is the same than for the census but for a different reason.

The quality of birth statistics in Spain, and specifically of the distribution by birth order

After a thorough analysis of the quality of birth statistics in Spain, focusing on its internal consistency as well as comparing it with census data, the list of problems we observed and corrected is the following:

a. There is a temporary sub registry of total events in certain regions, most notably in the 1980s. As shown on Figure 1, there is a difference in some provinces between the registered number and the number of expected births derived from the census data. This last series is obtained using an extension of the 'own children method', as explained in the next section. This sub registry of the total of births affects around 10 provinces, mainly during the 1975-1985 period. The correction we applied consists in the replacement of the number of registered vital events by a number derived from the census, when the two series were at odd.

b. We also observed a temporary problem in some regions in the classification of birth by order, due to changes in the registration system (change in the form or administrative changes) most notably during the years 1986 and 1996. As shown in Figure 2, for Spain as a whole, there is a transfer of a significant number of births of order 1 to order 2. This problem is especially acute in the 3 Basque Provinces in 1986. The correction to this temporary problem is the same than the general one applied for the permanent problem described later, in point *d*.

c. There is a permanent problem with the determination of the birth order for multiple births: the order assigned is the same for all the children born in the same childbirth. During the 1975-79 period, the birth order was the lowest possible value, and from 1980 until now, it is the highest value. So for example, for twins born in their mother's first childbirth, the two births were assigned to order 1 during the 1975-79 period, and to order 2 from 1980 onwards. The correction applied consists in going back to the official childbirth microdata and create a new series of birth by order, assigning a different order to each birth of the same childbirth. The results of this correction are shown in Figure 3. As it was expected, the end result is to increase the number of births at order 1 after 1979 and to decrease the value for birth of higher orders (and the revere for the 1975-79 period). The difference between corrected and official values increases in time, due to the impact of assisted reproductive technologies (the proportion of multiple births that result from ART exceeds 20% for most of these techniques).

d. There is a permanent excess of births at order one, due to the incorrect assignation of births of orders two or more to the first order. This problem is created in much case by omissions when the parents fill up the form. If they omit the fields related to previous births, then the Statistical Institute assigns the birth to order one (unfortunately there is no 'not stated' category for birth order). It is quite easy to detect the effect of this problem computing cohort cumulated or total fertility rates for first births. For example Table 1 gives the first birth cohort TFR for Spanish regions, for cohort born from 1952 to 1970. Although there is some estimation involved in the computing of these results, it is quite obvious that the values obtained is too high, as it exceeds a mean number of one first child for women for numerous years, in various regions. The time trend is clearly downward, and the values we observe for the younger birth cohorts seem more reasonable. But this is a false impression, as we can see from the first birth period TFR computed for women, classified by nationality (Table 2). Again the level of this indicator is too high for several groups, even taking

into account the possibility of tempo effects. We observe for example that the first birth TFR of women from North Africa, which is the most numerous group of foreign people in Spain, has values around 2 during all the period. This again gives us a clue that the problem of the assignation of a wrong order for births still exists in the last years, although it is not clear from this table whether it is nowadays only restricted to foreign people. Another proof of the magnitude of the problem corresponds to the distance between the curves of cumulated first birth fertility rates up to different ages, computed from vital registration and from 1991 and 2001 Census data (Figure 4). This comparison shows that the cumulated fertility levels obtained from vital registration systematically deviate from the census one beginning at around age 30. The most useful comparison is for the two curves obtained at time of the 2001 Census: there is almost no difference before the 1972 birth cohort (women aged 28 years at the time of the census). But it progressively increases for older birth cohorts, reaching a difference in the proportion childless of about 9% of all the women born at the end of the 1950s (who were aged 40 years and more at the time of the census). The comparison between these curves is also very useful, because it confirms that the problem is of a wrongly classification of births of order two and more, which occurs when the women are aged 30 years and more, to order one. It also gives us an insight on the way we should correct this classification: choosing the 'false' first births on the basis of the age of the mothers for the births of higher orders.

Using Spanish population censuses to correct the births series of the vital registration system

The use of population censuses in order to derive information on the number of births and the level of fertility is not new. One of the most popular methodology used to do so is the so called 'own-children method' pioneered by (Grabill and Cho 1965). We use this method here, and specifically its extension that allows to reconstruct the birth history of women (Luther and Cho 1988). As explained before, there are three results we looked for in order to correct the Spanish vital registration data. First we calculated an estimate of the proportion of women childless by birth cohort; second, we reconstructed the evolution of the time series of total births for the Spanish regions; third, we computed an estimate of its distribution by birth order, for each year. These estimated series are then used to correct the equivalent series obtained from the vital registration system.

The three Spanish censuses we used are the 1981, 1991 and 2001 Population Censuses. As we worked under contract with the Spanish National Statistical Institute, we have access to the complete microdata files for the 1991 and 2001 Census, as well as a 10% sample of the 1981 Census. Using this information, we computed:

a. Estimates of the proportion of childless women by birth cohort which are useful for assessing the quality of the vital registration data. We use it for example for the comparison in Figure 4. In order to derive this proportion, we used mainly the data from the 1991 and 2001 Census. As we worked at the regional level, first we devised an algorithm for the classification of women by region of residence, at the time of the birth of their children. We used information like their place of birth and their region of residence ten, five or one years ago. The region of residence at the time of birth of children was then determined using that information and, if needed, a random selection. In second place we used the 'own-children' method to compute the proportion of women with 'no-owned' child for each census. Fortunately the 1991

Census also had a question asked to each woman on their number of live births, which allowed us to check the quality of the results of the own-children method (Figure 5). As we can observe the quality is quite good. The difference between the two curves in the 1991 Census is mainly explained by the propensity of children to leave parental home. We used the ratio by age of these two curves to extend the proportion obtained from the 2001 Census up to the 1950 birth cohort, as shown in Figure 4.

b. Time series of births by region for 15 years period ending in each census year. We obtained these series from the population aged less than 15 years at the time of each census, by place of birth, and applying a survival rate derived from the comparison between yearly birth numbers from the vital registration system and the number of persons by age. In the cases the relation between the two numbers was obviously wrong, we corrected the births number using the corresponding population numbers from censuses multiplied by a survival rate deduced from the years when the information provided by vital statistics were correct.

c. A distribution of births by order for each Spanish region, in the 15 years time period ending in each census year. We reconstructed the birth history of women for each census from her 'owned children'. We assigned an order of birth to each child, and corrected it for the 1991 Censuses using the results of the question asked to all women on the number of live births. If the number of children who co-reside with the mother was smaller than the number of live births, we corrected the birth order supposing that the difference was explained totally by the fact that oldest children had left the parental home. So we supposed that mortality has no effect on the assigned birth order. The result of this correction for the 1991 Census is shown in Figure 6. We used that 'bias' factor to correct the corresponding distribution of children by birth order for the 1981 and 2001 Census. The end result is a yearly series of the distribution of births by order reconstructed from census data that we use to correct the distribution obtained from the vital registration system. For example we compare in Figure 7 the yearly proportion of first births obtained from the 3 censuses and from the vital registration system. The values of that proportion obtained from the censuses are quite similar, and in all cases much lower than the corresponding values from the vital registration system. We derive a 'correct' proportion of first births from the census values, taking as a basis the proportion obtained from the 1991 Census, which we consider to be the one with the best information for our purpose. The 'correct' proportion derived from the 1991 Census is extended in the past and in the future taking as a basis the evolution in time of this proportion obtained from the 1981 and the 2001 censuses. We then extrapolate up to year 2006 supposing that the relative difference between the 'correct' proportion of first births and the proportion observed from vital statistics for the year 2000 remains constant afterwards. This last supposition is clearly problematic, but unfortunately we have at the moment no other way to correct the vital registration system data for the more recent time period. The next step after the estimation of the yearly level of the 'correct' proportion of first births in the total is to apply it to vital registration system data in order to obtain a new series of birth by order and age of mother, by regions. We apply the following conversion rules:

- If we need to transfer births of order two or more to order one (as was the case for example in years 1986 and 1996), first we inflate all the births of order 1 by the same factor; then we subtract the total number we added at order 1 from

the numbers at order 2 and more in proportion of their distribution by age at order 1: if we need for example to transfer 1.000 births from order 2 and more to order 1, and 1% of the births of order 1 corresponds to mothers aged 20 years, we subtract these 10 births at order 2 and more, for mothers also aged 20 years, in proportion of the total at order 2, at order 3, etc.

- If the problem is an excess of birth at order 1 (the most common situation), first we compute the total number we need to transfer at order 2 or more; next we distribute them in proportion of the distribution by age of births at order 2 and more; we subtract those births from the number at order 1, using the distribution by age determined at the previous step; finally we add those births to order 2 and more, distributing them at each age in proportion of the distribution by order at that age.

Results of the correction of the distribution of births by order in Spain

The first check of the quality of the results of our corrections corresponds to the comparison between cohort cumulated fertility rates calculated from vital registration data and from Censuses (Figure 8). If we take a look at the curves obtained before or after the corrections outlined in the previous section, we observe the fit between the curves improves, although the final level of childlessness estimated from (corrected) vital statistics is still slightly above the level obtained from census data. So we can say that the correction goes in the right direction but don't overshoot the mark. But in spite of this, the effect of the correction is relatively high, as the excess of births at order 1 fluctuates around 7 or 8% of the uncorrected numbers. The difference was higher during the 1980-1995 time period, with an excess of around 10% of births of order 1 (Figure 9). The main result of the correction is a new estimate for the level of childlessness by birth cohorts (Figure 10). Its uncorrected or official level for cohorts born at the end of the 1960s was reaching an interval of values between 15 and 20% of women. After the correction, the interval from the same cohorts varies from 20 and 25% of final childlessness. Another interesting result is in the level of the period mean age at first childbearing (Figure 11). We observe that the correction is to lower by about one-third to one-half of a year the level of this age. Its level was the higher in all Europe in recent years (jointly with The Netherlands), and the correction does not change that, nor the magnitude of the increase during the last 25 years: from 24.2 to 29.3, that is a gain of 5 years or, which is the same a gain of 1 year of age each 5 years of time, what is a fast increase indeed.

Discussion of the results

The main result of our paper is to reveal that the childlessness level in Spain is substantially higher than what the vital statistics say. It would be interesting to know whether this is the case also in other Europeans countries, as the quality of the data on births by order has not been checked extensively, as far as we know. We don't think that Spanish data are worse than those for other countries. For example we have serious doubts on the quality of the tabulations of birth by order for countries like France or Denmark whose statistical systems are generally considered to be good.

This work represents a check of the quality of the Spanish data on birth order, as well as an attempt to correct them. Another conclusion of this work it that it would be worthwhile to use more intensively the information provided by the censuses. Indeed what we have done is essentially to correct the proportion of first births in the total. We could have gone much farther and also used the reconstructed birth histories to correct the whole of the distribution of births by age, birth order, and duration since last birth. In fact using census data in that way, we can substitute entirely the information provided by the vital registration system, as some recent works have shown (Silva and others 2005, McDonald and Kippen 2007).

Figure 1. Total of registered births and total of expected births according to the 1981, 1991 and 2001 Census for the province of Barcelona

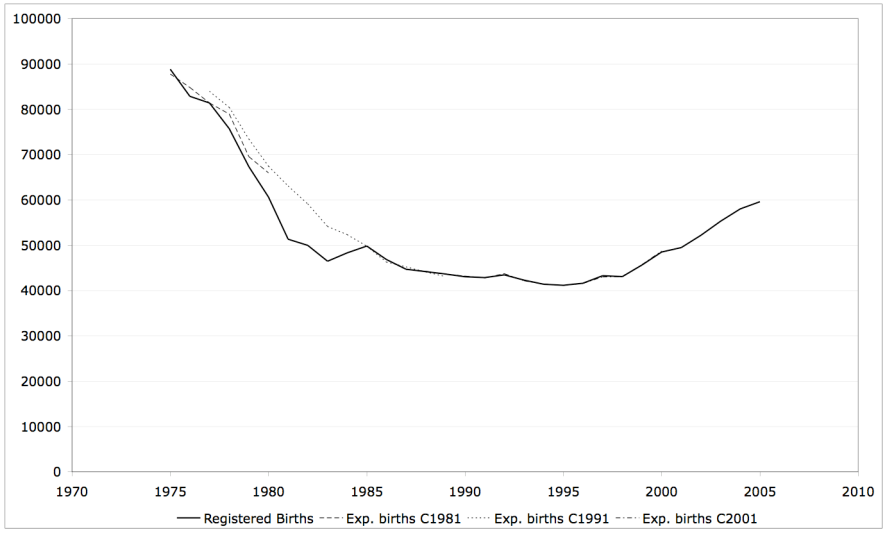
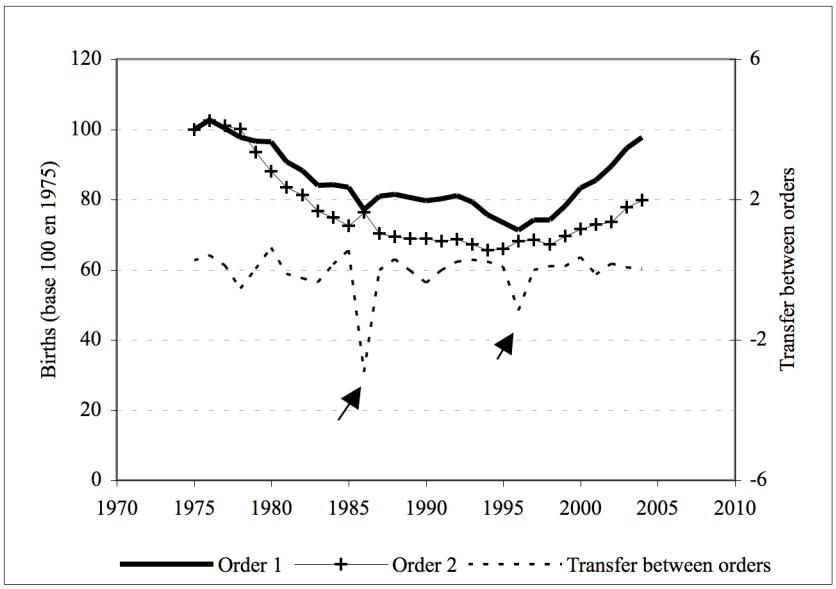


Figure 2. Births of order one and order two (index base 100 in year 1975) and evolution of an index of transfer between these two orders, Spain, 1975-2004



Note: the index of transfer between orders is calculated in the following way: first we smooth the series of number of births for each order (using the 4253H.Twice algorithm of Exploratory Data Analysis, as explained by (Velleman and Hoaglin 1981). Next we compute the absolute difference between the observed and the smoothed value for each year. The index is then computed as:

$$I = \frac{b_1 - b_2}{2\left(B_1 + B_2\right)}$$

Where b_i is the absolute difference between the observed and smoothed value for births of order i, and B_i is the observed number of births of order i.

Figure 3. Effect of the correct assignation of birth order for multiple childbirths

Note: Difference in the number of births by correct birth order and the official one, in % of the later.

Table 1. First birth Cohort Total Fertility Rate by Region ("Comunidad Autónoma"), by birth cohorts

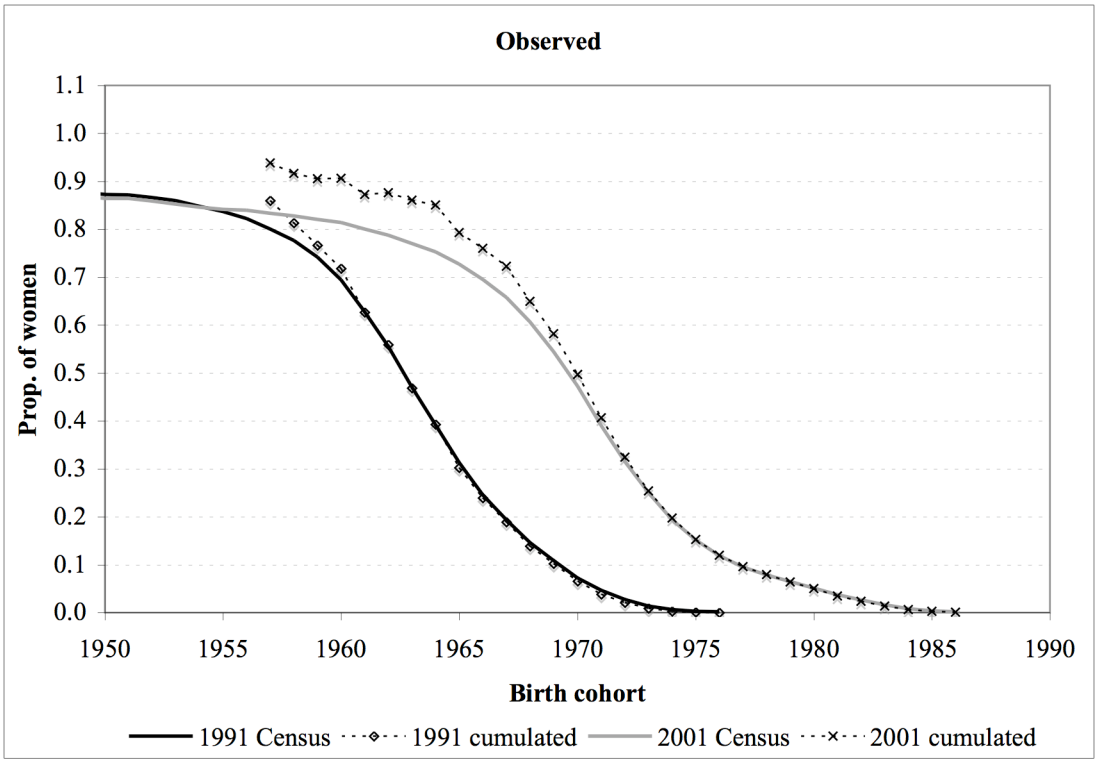
CCAA/Generación	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970
Andalucía	-	0,94	0,92	0,92	0,91	0,92	0,95	0,93	0,93	0,91	0,89	0,90	0,93	0,91	0,87	0,88	0,89	0,84	0,82
Aragón	0,89	0,89	0,86	0,85	0,88	0,84	0,86	0,85	0,87	0,87	0,81	0,84	0,84	0,82	0,81	0,81	0,78	0,75	0,74
Asturias	-	-	0,94	0,92	0,92	0,91	0,89	0,86	0,88	0,85	0,82	0,81	0,82	0,80	0,78	0,76	0,76	0,72	0,70
Baleares	-	**1,15**	**1,11**	**1,14**	**1,09**	**1,10**	**1,09**	**1,07**	**1,07**	**1,06**	**1,03**	**1,01**	**1,01**	**1,00**	0,97	0,95	0,91	0,86	0,86
Canarias	-	-	0,96	0,95	0,95	0,94	0,93	0,95	0,98	0,99	0,95	0,97	0,93	0,96	0,92	0,90	0,89	0,85	0,83
Cantabría	-	0,96	0,96	0,90	0,89	0,89	0,92	0,89	0,89	0,86	0,84	0,86	0,81	0,84	0,80	0,81	0,76	0,75	0,77
Castilla- La Mancha	0,76	0,75	0,75	0,75	0,76	0,78	0,79	0,78	0,81	0,77	0,77	0,75	0,78	0,76	0,74	0,74	0,72	0,71	0,68
Castilla- León	0,80	0,83	0,80	0,78	0,80	0,83	0,87	0,86	0,88	0,87	0,86	0,87	0,91	0,88	0,85	0,85	0,85	0,84	0,81
Cataluña	-	**1,07**	**1,04**	**1,01**	0,98	0,96	0,98	0,96	0,95	0,93	0,92	0,91	0,94	0,92	0,89	0,89	0,89	0,85	0,84
Ceuta y Melilla	-	-	0,88	0,85	0,85	0,94	0,94	0,87	**1,02**	**1,00**	0,97	0,88	**1,02**	**1,01**	0,98	**1,04**	**1,05**	0,98	**1,02**
Extremadura	0,74	0,76	0,75	0,76	0,76	0,78	0,82	0,84	0,86	0,84	0,83	0,86	0,86	0,88	0,83	0,85	0,86	0,82	0,81
Galicia	-	-	0,88	0,87	0,88	0,89	0,88	0,88	0,90	0,88	0,87	0,85	0,87	0,85	0,84	0,83	0,85	0,79	0,77
La Rioja	0,89	0,84	0,84	0,88	0,88	0,87	0,89	0,85	0,88	0,85	0,85	0,83	0,80	0,84	0,78	0,80	0,81	0,76	0,70
C. Madrid	-	**1,02**	0,98	0,96	0,93	0,93	0,94	0,90	0,89	0,87	0,85	0,85	0,86	0,85	0,83	0,82	0,81	0,77	0,76
R. Murcia	-	**1,01**	0,96	0,96	0,94	0,98	**1,01**	**1,01**	**1,00**	0,96	0,92	0,93	0,97	0,94	0,92	0,91	0,88	0,85	0,84
Navarra	0,88	0,91	0,84	0,83	0,85	0,88	0,86	0,85	0,83	0,84	0,83	0,80	0,83	0,77	0,79	0,77	0,77	0,74	0,74
P. Vasco	0,98	0,97	0,93	0,91	0,89	0,85	0,82	0,81	0,80	0,77	0,74	0,75	0,76	0,74	0,72	0,73	0,71	0,69	0,69
España	-	0,96	0,93	0,92	0,91	0,91	0,92	0,90	0,91	0,89	0,87	0,87	0,89	0,87	0,85	0,85	0,84	0,81	0,79

Note: The rates at less than 20 or more than 35 years are estimated for some birth cohorts. We have completed the fertility of these cohorts taking the rate at the same age for the closest birth cohort with an observed value. We retain only birth cohorts for which the completed fertility estimated that way does not exceed 20% of their observed fertility. The data used correspond to the 1975-2005 time period.

Table 2. First birth Total Fertility Rate by nationality of mothers, Spain, 1996 to 2004

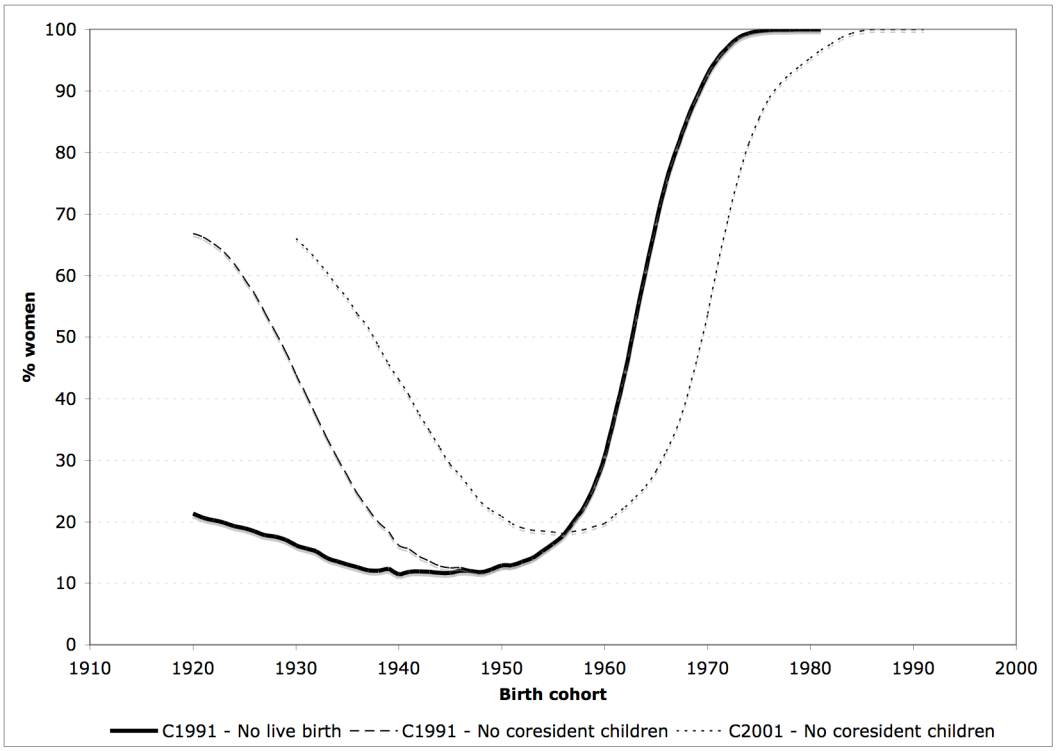
Regíón de nacionalidad /Año	1996	1997	1998	1999	2000	2001	2002	2003	2004
Africa del norte	1,9	2,2	2,3	2,1	2,0	1,8	1,8	1,8	1,9
América central	1,2	1,2	1,3	1,2	1,0	0,9	0,8	0,8	0,8
América del norte	1,5	1,5	1,4	1,3	1,2	0,9	0,9	0,8	0,7
América del sur	1,1	1,2	1,3	1,4	1,1	1,0	0,9	0,9	0,8
Asia	1,7	1,7	1,8	1,8	1,7	1,6	1,4	1,4	1,5
Española	0,6	0,6	0,6	0,6	0,6	0,6	0,6	0,7	0,7
Europa Mediterránea	0,9	1,0	0,9	0,8	0,9	0,8	0,7	0,7	0,7
Europa Occidental	0,8	0,8	0,8	0,8	0,8	0,7	0,7	0,7	0,7
Sólo nacionalidad extranjera	1,2	1,3	1,4	1,4	1,3	1,1	1,1	1,0	1,0
Oceanía	1,0	0,3	0,3	1,2	1,0	1,2	0,7	1,1	0,5
Resto África	1,5	1,6	1,8	1,8	1,6	1,4	1,3	1,3	1,3
Resto Europa	1,9	2,1	2,3	2,0	1,5	1,2	1,1	1,1	1,0
Todas	0,6	0,6	0,6	0,6	0,6	0,7	0,7	0,7	0,7

Figure 4 Comparison of the proportion of women with at least one live birth from the 1991 and the 2001 censuses and the cumulated fertility rate calculated from data of Vital Registration System, by birth cohorts, for Spain



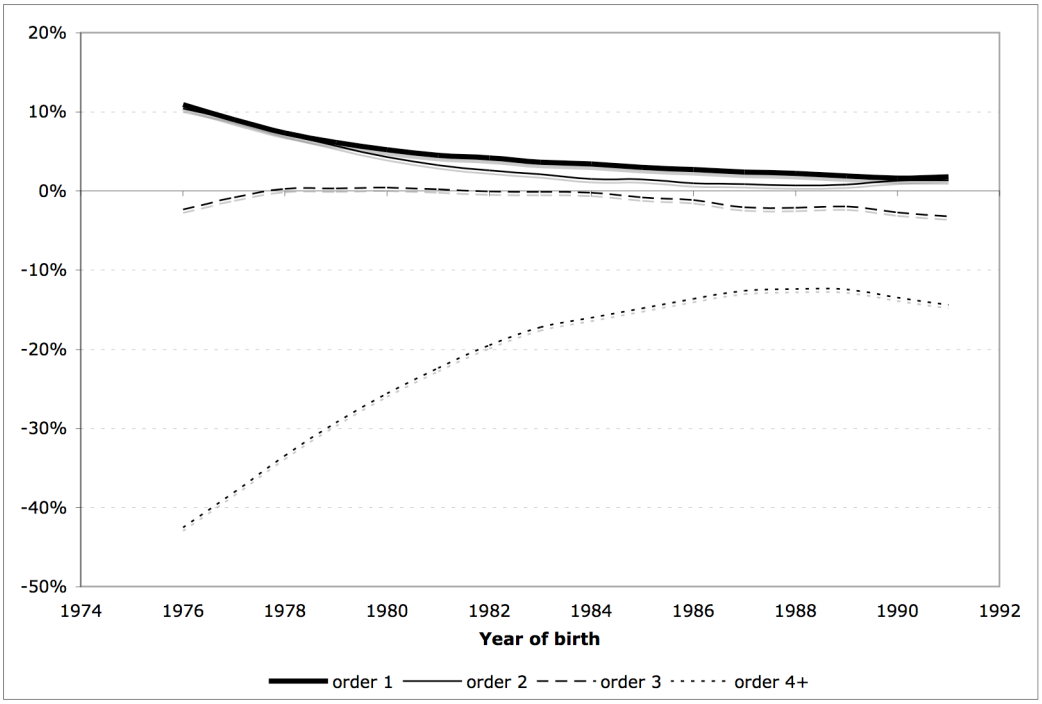
Note: the 1991 Census was taken on March 1st and the 2001 Census on November 1st.

Figure 5. Proportion of women with no live birth or with no co resident children, from 1991 and 2001 Census data, Spain



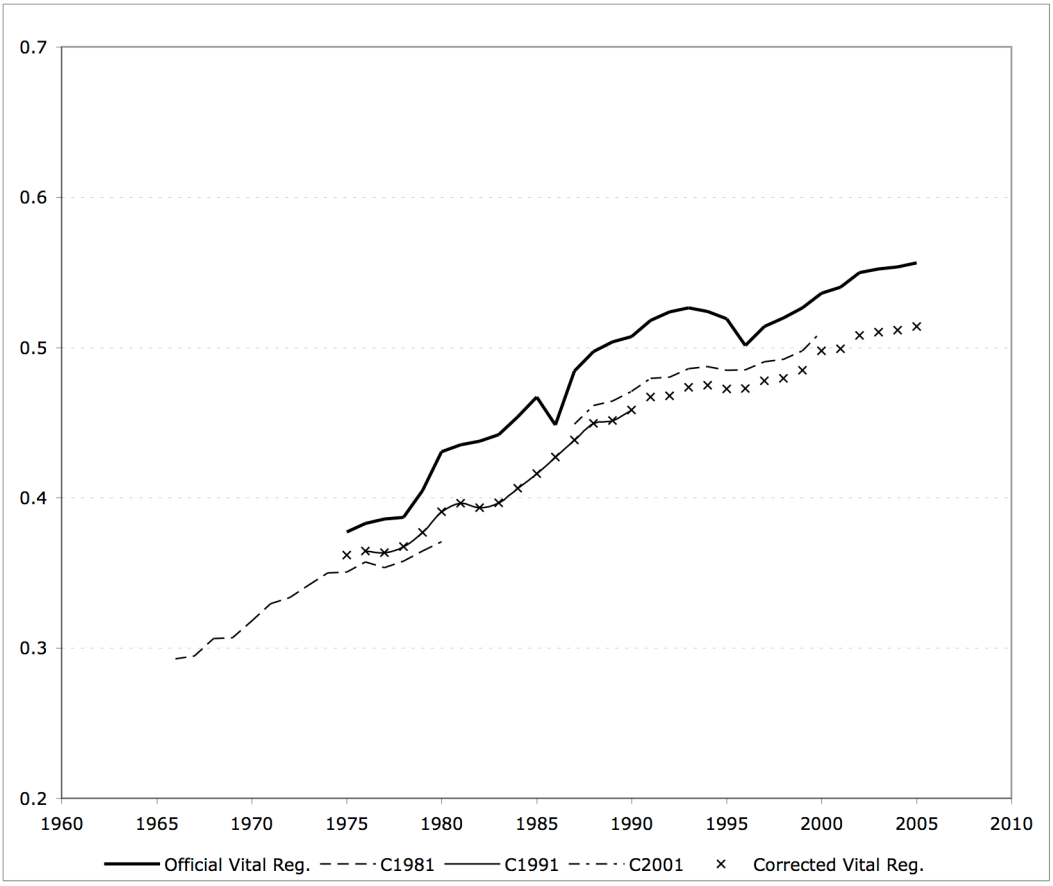
Note: 'C1991 - No live birth' is the proportion of women with no live birth, as answered in the 1991 Census questionnaire. The two other curves are obtained applying the own-children method to census microdata, as explained in the text.

Figure 6. Bias in the birth order estimated by the own-children method due to leaving the parental home (estimated from 1991 Census)



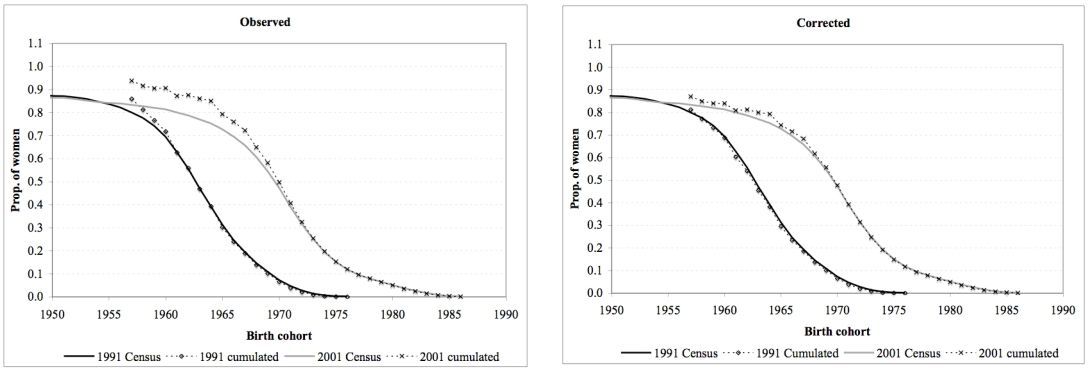
Note: proportion of births of each order as reconstructed by the own-children method, compared with proportion of births by (estimated) correct birth order. The difference between the proportion at each order is divided by the proportion obtained from the own-children method.

Figure 7. Proportion of first births in the total number: official and corrected values from the Vital Registration System and proportion calculated from 1981, 1991 and 2001 Census data, by birth cohorts, for Spain



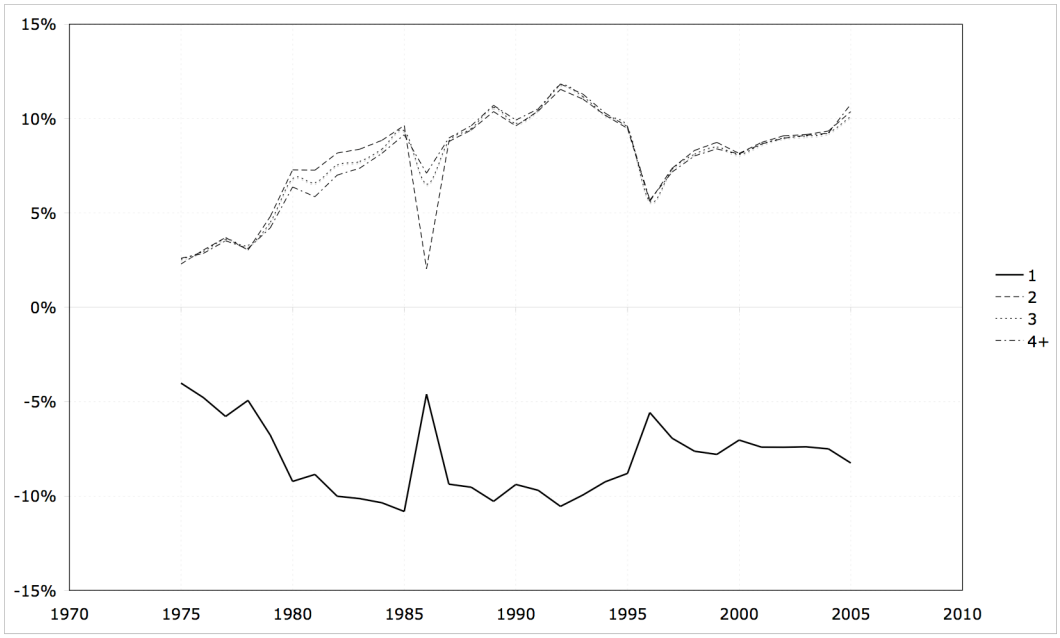
Note: the proportion of first births from the vital registration system statistics is previously corrected to take account of multiple births.

Figure 8. Comparison of the proportion of women with at least one live birth from the 1991 and the 2001 censuses and the cumulated fertility rate calculated from data of Vital Registration System: Official versus Corrected rates. By birth cohorts, for Spain



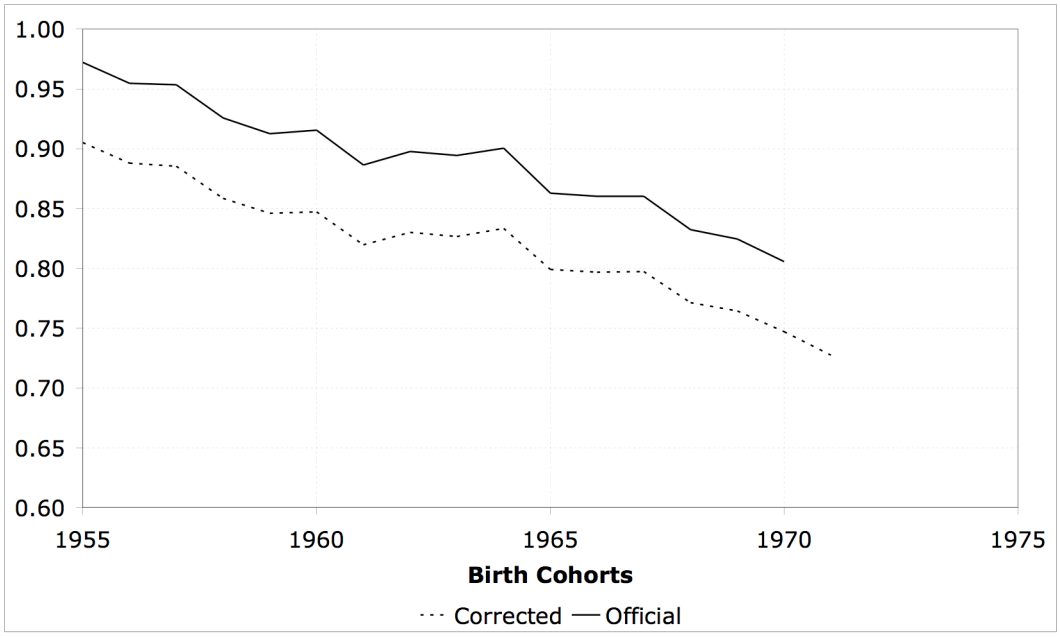
Note: The dashed curves are cumulated cohort fertility rates for each birth cohort up to their age at the moment of the two censuses. The curves on the left chart are based on observed values from the vital registration system and the curves on the right chart are corrected one. The curve for the 1991 Census is the proportion of women of each birth cohort who declared they had at least one live birth. The curve for the 2001 Census is a similar proportion based on the application of the own-children method as described in the text.

Figure 9. Relative difference between official and corrected number of births by order (in % of the official numbers)



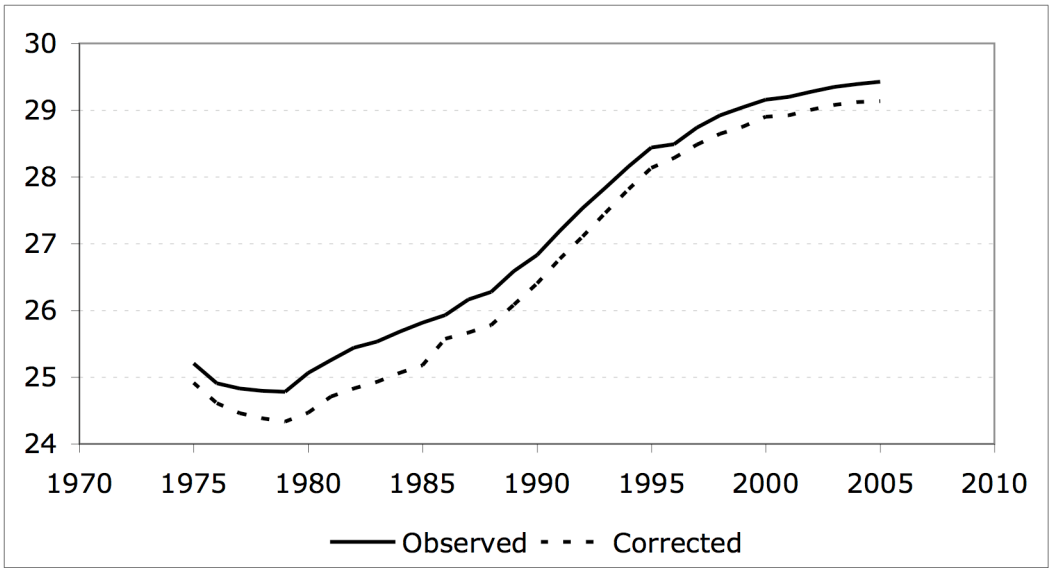
Note: the 'official' numbers of births by order correspond to the series with a different birth order assigned to multiple births of the same childbirth.

Figure 10. First birth cohort total fertility rate: official and corrected values for Spain



Not: In order to calculate the First birth Cohort Total Fertility Rate for all the birth cohorts, it is necessary to estimate the rate at less than 20 or more than 35 years for some cohorts. We have done so maintaining the rate constant at each age. We show results only for birth cohorts whose observed fertility level is 80% or more of the final CTFR.

Figure 11. Period mean age at first childbearing: comparison between official and corrected value, during the 1975-2005 period, in Spain



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