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Analysis of fertility using cohort-specific socio-economic data

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Abstract
In this paper we propose a novel approach that relates age-specific cohort fertility rates with socioeconomic conditions faced by each cohort in each single age to understand the behaviour of fertility. We implement this approach to study the evolution of fertility over the last 40 years in Spain, where both fertility and socioeconomic situations have undergone substantial changes during the period under scrutiny. We find female education and labour market conditions to be highly correlated with the evolution of cohort age-specific fertility rates in Spain.

Keywords Cohort fertility rate · Age specific fertility rate · Socioeconomic conditions

1 Introduction

The evolution of the fertility rate in Spain during the last 50 years has been one of the most striking amongst European countries (see among others Esping-Andersen 2013). Until the mid-1970s Spain was one of highest fertility countries in Europe, with TFR close to 3. Since then the fertility rate has plummeted to the lowest levels in the EU/OECD (see Fig. 1). This change has been dramatic as the fertility rate dropped by more than 60% in less than 20 years, from 2.8 in 1978 to 1.1 in 1998.[1] After hitting the bottom, the fertility rate has fluctuated between 1.1–1.4 during the last 2 decades, which could be related to the business cycle experience in Spain. However, the sudden influx of immigrants during the first decade of this century accounts for an important part of this pro-cyclical behaviour (see Fig. 8 in the Appendix). If we limit to the Spanish Nationals, the fertility rate has been quite stable

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[1] A book edited by Esping-Andersen (2013) offers a detailed description of the fertility evolution in Spain over several decades and discusses the role of socioeconomic conditions, public policies and gender differences in society.

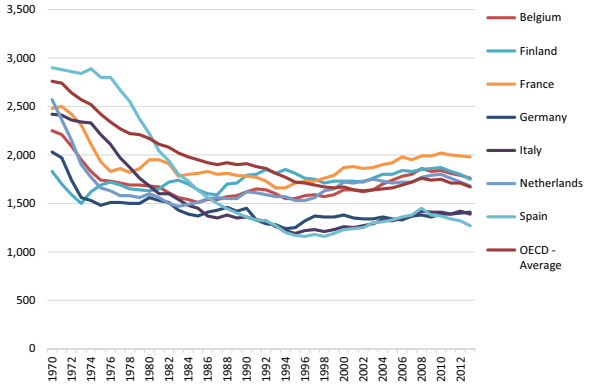

Fig. 1 Total fertility rate

around 1.2 during the last 20 years, clearly below the average rate amongst European countries and one of the *lowest-low* fertility countries (together with Italy and Germany), a label coined by Kohler et al. (2002, 2006) and Billari and Kohler (2004).

In this paper we adopt a novel approach to study fertility behaviour in Spain. We focus on fertility patterns of different cohorts of women during the last four decades and we examine the potential socio-economic forces underlying such behaviour. We adopt a cohort approach because we think it has several advantages. The most widely used fertility measure, TFR, is a short-term, period-based contemporaneous measure of fertility and therefore sensitive to the changes in tempo (age) of childbearing (Bongaarts and Feeney 1998). It is lower than the underlying rate when the childbearing age is delayed and vice versa. It is also possible that some cohorts delay while others accelerate the childbearing pace resulting in an ambiguous result on the TFR. In contrast, cohort fertility (completed or cumulative up to certain ages) can be considered as a longer-term and life-cycle measure of fertility as it considers childbearing behaviour of all (or up to observed) fertile ages of women. These issues are discussed in Myrskylä et al. (2013) and Goldstein and Cassidy (2014) who advocate for a cohort perspective in the analysis of fertility. Their focus, however, is on improving period fertility measures by implementing cohort perspectives in tempo-quantum adjustment. On the other hand, Frejka (2017) analyzes cohort fertility to establish four distinct transition patterns across developed world while Zeman et al. (2018) study the decline in cohort fertility using parity progression rates. Their main finding indicates that the decline in cohort fertility for women born between 1955 and 1970 in Central and Eastern Europe is mainly due to the drop in the progression rate to the second parity while for women of the same cohorts in Europe and East Asia it is due to a reduction in the first-birth rate. What we propose here is to take this cohort perspective to better understand the relationship between childbearing decisions and socio-economic circumstances faced by each cohort along their fertile ages. As most covariates included are not genuinely exogenous, the results should be interpreted more as correlations rather than causal effects.

An important advantage of our approach is that we can directly relate the socioeconomic conditions faced by each cohort in each single age (and cumulative conditions up to each age) to their age-specific fertility rates. Furthermore, we can

control for the cumulative fertility experience up to a particular age in the estimation of age-specific fertility rate. Another advantage of our approach is that we can document how the changes in childbearing patterns (number and timing) across different cohorts of women have contributed to the observed evolution of TFR. In doing so the empirical analysis is more consistent with the life-cycle dynamic nature of childbearing decisions than the analysis that solely relates TFR with contemporaneous socio-economic variables. An obvious disadvantage of using cohort fertility is that one has to wait until the end of fertile age to know the completed fertility of a certain cohort. However, for those who have not completed their fertile age one can examine their fertility behaviour up to the ages observed and compare with other cohorts conditional on age.

As far as we are aware, no studies have focused on age-specific fertility rates by cohort relating directly to the socioeconomic variables faced in each single age by each cohort. We believe our approach is more consistent with the life-cycle dynamic nature of the fertility decision. As emphasised by Esping-Andersen (2013), the analysis based on socio-economic aggregates, that do not consider differences across cohorts, may be misleading due to the remarkable differences across cohorts.

We think our approach using pseudo-panel data (synthetic cohorts) which combines real cohort fertility and estimated socio-economic variables by cohort and age (year) is interesting when faced with the absence of the long panel micro data that would be the ideal data for our study. Pseudo-panel data has advantages and disadvantages. Availability of longer observation periods and avoidance of attrition and small sample size problems are the main advantages while the main inconvenience is errors in variables as the socio-economic variables are computed using sample surveys (Deaton 1985).

Our main findings are what follows. We document a continuous delay of childbearing across cohorts born from 1960 to 1980, in particular first births. The effect of this delay on fertility is only partially recovered at older ages. We also observe a rapid increase in childlessness among the younger cohorts. Regarding the fertility rates and the socioeconomic variables we find that female education and insecurity in the labour market, represented by temporary contract prevalence, as the most important covariates of cohort age-specific fertility rates, but male employment does not seem to be correlated with it.

The paper is organized as follows. In "Literature" we review the literature and in "Data and methods" we describe the data used for our analysis. In "Socio-economic and institutional changes in Spain" we document the main socio-economic and institutional changes over the period of analysis. "Evolution of cohort fertility in Spain" presents a detailed description of the fertility behaviour of different cohorts of women while in "Socio economic conditions on fertility: cohort approach" we discuss relationships between life-cycle profiles of several economic variables and age-specific fertility rates of different cohorts. Finally, in "Conclusions" we close with some concluding remarks.

2 Literature

There is a vast amount of literature that relates socio-economic conditions with fertility using either individual or aggregate data. Most studies document correlations

between fertility measures and socio-economic variables while some attempt to establish causal relationships between them. Some others have tried to account for the simultaneity (endogeneity) between labour market decisions and childbearing decisions.

At micro-level, many studies have examined the effect of socio-economic conditions such as female participation in the labour market, wages, incidence of unemployment, incidence of temporary contracts and work schedules on fertility using individual data (Hotz et al. 1997; Matysiak and Vignoli 2008; Neels et al. 2013; Ahn and Mira 2001; Gutiérrez-Domenech 2008; De la Rica and Iza 2005). Most studies have confirmed negative effects of female employment and unemployment (especially of male), and temporary contracts and positive effects of part-time work and flexible work hours.

Evidence at macro level is mostly based on US time-series data and cross-country data examining the relationship between fertility and socio-economic indicators such as GDP per capita, education, female employment, unemployment, prevalence of temporary contracts and the share of public sector work and the prevalence of part-time employment. Butz and Ward (1979) examined time-series (1948–1975) data from the US to study the relationship between fertility rates and male and female wages by age groups. However, they examined only contemporaneous relationships ignoring the cohort dimension of fertility. Ward and Butz (1980), on the other hand, studied single age-specific fertility rates during the same period in the US focusing on the effect of expected future male income and female wages in a sequential decision-making framework. They included cumulated fertility rate up to each age for each cohort as well as its interaction with age as additional control variables. They found significant positive (negative) effects of the expected future male (female) wages on fertility. With respect to cross-country data, initial evidence showed a negative correlation between fertility and economic development (Bongaarts and Watkins 1996; Bryant 2007) although recent evidence among developed countries indicates a weakening or reversal in the correlation between fertility and some development indicators such as GDP per capita, education and female employment (Ahn and Mira 2002; Sobotka et al. 2011; Goldstein et al. 2013; Luci-Greulich and Thévenon 2013).

Another active area of research on fertility has been on the effect of public policies[2] in determining fertility behaviour of women. Evidence on the effects of financial incentives on fertility is mixed (Kearney 2004; Brewer et al. 2012; Laroque and Saliné 2008; Milligan 2004; Lalive and Zweimuller 2009; Bick 2016). In the case of Spain, Azmat and González (2010) estimate an increase of fertility by almost five percent as a result of subsidies to working mothers while González (2013) finds that the universal child birth subsidy also lead to a significant increase in fertility, part of this coming from an immediate reduction in abortions. Although many of these studies find a significant positive effect of certain family support policies, it remains unanswered whether such effect is a long lasting effect or a simple temporal overtaking effect. To answer this question one needs to focus on the completed fertility of different cohorts of women that were affected differently by those family policies.

[2] Gauthier (2007) provides a review of the literature on the impact of family policies on fertility in industrialized countries.

Finally, there are some recent studies which emphasise the role of gender equality in the home and in society on fertility amongst developed countries. Brodmann et al. (2007), Sacerdote and Feyrer (2008) and Arpino et al. (2013) provide evidence that changes in the status of women (for example, gender differences in the share of child care at home) drive the changes in fertility and that the differences across countries in this respect account for differences in fertility outcomes.

One criticism of previous studies, especially those done with macro-data, is its inability to accommodate the life-cycle nature of childbearing decisions as they relate period fertility rates with contemporaneous socio-economic conditions. As mentioned earlier, cohort approaches could amend this handicap by including both the contemporaneous and life history of socio-economic circumstances faced by each cohort along their life course.

As far as we know, empirical literature adopting a cohort approach for the analysis of fertility behaviour is scarce. However, two recent studies have employed a cohort approach to study fertility. Currie and Schwandt (2014) examined the effect of unemployment on completed fertility by cohort using state-level data from the US distinguishing between the short and the long-term effects of unemployment, while Pifarré i Arolas (2017) examined cumulated fertility rates over 5-year age groups with the data from nine developed countries contrasting the effects of structural versus cyclical unemployment. However, both used general (not age-specific) unemployment to explain completed or age-specific fertility rates by cohort, thus limiting the accuracy of their results.[3] A study by Bellou and Cardia (2014) links the Great Depression and subsequent recovery to the fertility Boom-Bust in the US in the second half of the 20th century. They argue the entry to and the exit from the labour market of D-cohort (women aged 20–34 in 1930) affected the labour market conditions of following cohorts of women leading to the baby-boom during the 1950s and subsequent baby-bust during the 1960s. In the case of Spain, Esteve et al. (2016) and Castro-Martín and Martín-García (2013) document the evolution of completed fertility across cohorts in Spain along with other European countries without any analysis of causal relationship with socio-economic variables.

3 Data and methods

There are several data sources for our analysis. First we use Birth Records from 1975 to 2013 that are provided by the National Statistical Institute. Using all live births registered each year we build our main statistics of analysis, age-specific fertility rates of different cohorts of women. We have 428 observations in total. Our fertility data consist of fertility rate in *each* single age (from 16 to 43 or maximum observed) for *each* birth cohort from 1960 to 1980. Table 1 illustrates the structure of our data for certain ages and certain cohorts. We observe up to age 43 for all the cohorts born until 1970. For the cohort 1971 and each subsequent cohort we do not observe age 43 and each additional year backward, thus for the 1980 cohort we only observe up to age 33.

[3] We appreciate a comment by a referee for drawing our attention to a smaller endogeneity bias with general unemployment rates than age-specific rates.

Table 1 Distribution by number of children at age 43 (38 for 1975 cohort)

	1960	1965	1970	1975
Childless	0.0917	0.1552	0.1874	0.2780
1	0.2666	0.2654	0.2716	0.2805
2	0.4744	0.4585	0.4363	0.3691
3+	0.1675	0.1229	0.1098	0.0724
3	0.1299	0.0980	0.0869	0.0604
4	0.0266	0.0167	0.0130	0.0090
5	0.0067	0.0040	0.0031	0.0020
6	0.0023	0.0014	0.0010	0.0006
7	0.0017	0.0010	0.0006	0.0004

Source: Birth records

We exclude foreign women from our sample because there have been dramatic changes in the presence of foreigners in Spain over the period of analysis and because their fertility is potentially different from that of the Spanish Nationals. Furthermore, immigration has been highly pro-cyclical which widens the fertility fluctuation of a country simply due to the changes in national-foreigner composition. In our birth register data, mothers' nationality was only recorded from the year 2002. We use all births until 2001 and only the births from Spanish Nationals since 2002. This will cause some discontinuity between these two years although it shouldn't be too large as foreigners were less than 2% of the population until 2000 and most foreigners before 2000 were mainly from other European countries whereas they were dominantly from Latin America and Mediterranean Africa after 2000.

Second we use data from the Labour Force Survey to build *age-specific* male and female employment rates and male temporary contract-incidence rates for each cohort. Spanish Labour Force Survey has been carried out each quarter of the year since 1977 using a large representative sample (about 200,000 individuals). We compute the above-mentioned labour market indicators by each single year age for each single year birth cohort. The large sample size warrants sufficient number of observations for each cell[4]. We also include an education indicator for each cohort. As schooling is completed by age 25 for a great majority of all cohorts and stays constant thereafter, we included the proportion with a university degree by age 30 for each cohort.

Finally, we use data on house prices for the period 1985–2013 provided by the ST-Sociedad de Tasación (Spanish Property Valuation Association).

In the next section our analysis starts with a brief description of socio-economic and institution circumstances in Spain during the last four decades. In "Evolution of cohort fertility in Spain", we describe fertility evolution in Spain from a cohort perspective which include age-specific fertility rates, cumulative fertility rates, parity progression rates and the distribution of number of children, all by cohort. In "Socio economic conditions on fertility: cohort approach", we examine relationships

[4] It is shown that sufficiently large sample size of each cell (cohort and age in our case) tends to ameliorate the bias due to errors in variables (see for example Verbeek and Nijman, 1992). In our sample, average cohort-age cell size is 1330 which can be considered sufficiently large.

between age-specific fertility rates on socio-economic variables, first by way of simple correlation coefficients between fertility rates and each socio-economic variable and later using a linear regression model which includes explanatory variables in a sequence. Finally, we assess the extent to which socio-economic conditions account for changes in fertility across cohorts. In order to do so, we use the linear regression model to predict what the age specific fertility rate (hereafter ASFR) of recent cohorts of women would be under the assumption that the socioeconomic conditions faced by each of these cohorts were the same as those faced by cohorts of women born in 1960.

4 Socio-economic and institutional changes in Spain

Over the last four decades, Spain underwent some important changes in socio-economic and institutional perspectives as shown in Fig. 2. First, there has been a large increase in the percentage of women with tertiary education, from below 10% in the beginning of the eighties to almost 30% since the late 2000s. This happened along with a substantial increase in female participation in the labour market with the employment rate of women at childbearing ages rising from 30% in the beginning of the 1980s to 60% in the 2000s. There is an obvious connection between these two facts as the participation and the employment rates tend to increase with education level. However, as reported by Guner et al. (2014) the increase in the female employment rate is a general phenomenon across education groups. Second, Spanish labour market suffered from wild fluctuations in economic conditions during this

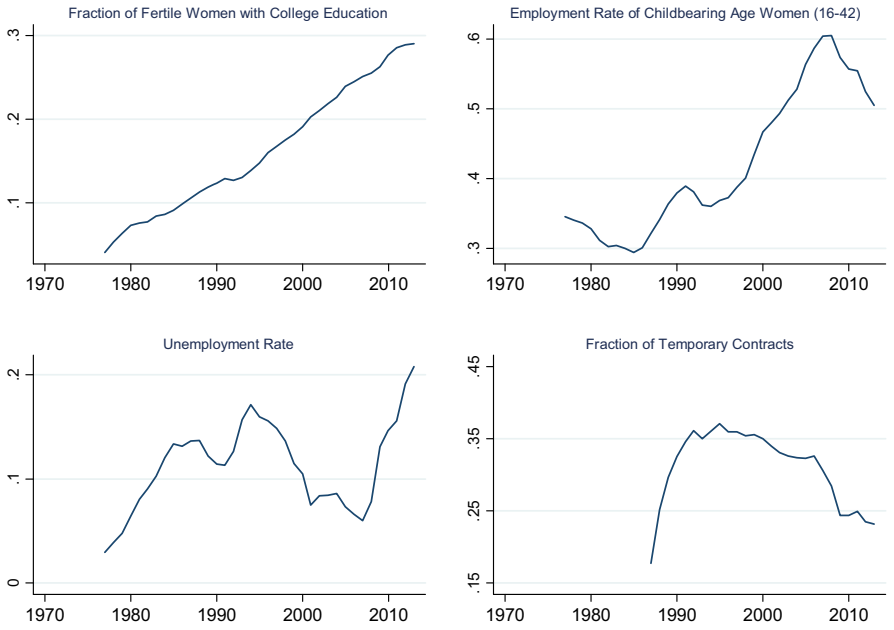

Fig. 2 Socio-economic changes in Spain excluding immigrants. Source: Labour Force Survey

period. There were two periods of profound recession with the unemployment rate over 20%, one relatively short 1992–1993 and the other much longer from the 2009–2015. Third, the prevalence of temporary contracts started to increase with a labour market reform in the mid-eighties which aimed at reducing the unemployment rate (Ley 32/1984). The percentage of temporary workers reached a high 35% during the early 1990s and remained above 30% until 2008 when it started to decrease as the deepening recession disproportionately affected workers with temporary contracts.

In addition to the above-mentioned socio-economic changes, there were also several important institutional changes over this period with a potential impact on the fertility decisions of women. Most of the policy changes were in principle favorable for childbearing. First, in 1989 paid parental leave of 16 weeks (Ley 3/1989) was introduced. Second, the education reform in 1990 (Ley 1/1990) introduced the possibility for children younger than four to be enrolled in the public school system. As a result of this the enrollment rate of three-year-old children went up from 17% in 1986 to 97% in 2007. Third, a monthly cash benefit of 100 euros for working mothers of children aged up to three was introduced in 2003 (Ley 46/2002). Forth, in 1998 a law aimed at promoting flexibility of working hours was passed (Ley 15/1998). The law removed discrimination against part-time workers as compared to full-time workers in terms of social welfare protection and job stability. All the aforementioned policies are still in place in the Spanish economy. Finally, a 2500 euros universal birth subsidy was launched in 2007 aimed at promoting fertility in Spain (*Ley* 35/2007). It was terminated on December 31, 2010 due to public budget constraints. All things being equal, the impact on fertility of these changes should be positive. In fact, Azmat and González (2010) and González (2013) find evidence of a positive effect on fertility of these policies.

Other institutional changes that occurred in this period may have had negative effects on fertility. First, in 1981 divorce was legalized (Ley 30/1981) in Spain. Divorce rate in Spain is nowadays similar to other EU countries. Instability in marriage may reduce the incentives to have children. Evidence on this regard is found by Bellido and Marcén (2014) in cross-country analysis. Second, the use of contraceptive methods has spread widely across the population after its use was legalized in 1978 (Real Decreto 2275/78). The contraceptive prevalence rate today is comparable to other developed countries. Third, the first legalising abortion in Spain was introduced in 1985 (Ley Orgánica 9/85).

Finally, one important recent socioeconomic development has been the large inflow of immigrants that started in the beginning of the 2000s. The number of immigrants went up from 637,085 (1.6% of population) in 1998 to 5,648,671 (12% of population) in 2009. Besides the apparent positive effect of immigration on fertility through the compositional change due to an increasing proportion of high fertility foreign women, it is likely to affect Spanish Nationals' fertility rate indirectly. Most foreign women are employed in domestic services. This has potentially reduced the cost of these types of services and therefore could have positively affected the fertility rate among Spanish Nationals.[5]

[5] Farré, González and Ortega (2011) and Hazan and Zoabi (2015) find that unskilled immigrants can potentially have a positive effect on fertility via an increase in the supply of cheap home production substitutes.

5 Evolution of cohort fertility in Spain

In this section, we document and analyse cohort fertility rates of Spanish women born between 1960 and 1980. Figure 3 shows the age-specific (left) and the cumulative fertility rate (right) for five different birth cohorts between 1960 and 1980. ASFR across cohorts show a clear tendency of delay in childbearing. It also clearly shows the decreasing cumulative fertility rate over time. While the 1960 cohort had 1.8 children on average at age 43, the 1965 cohort had 1.6 and the 1970 cohort had 1.5 children at the same age. The average number of children born to the 1975 cohort up to age 38 was 1.25 and among the 1980 cohort only 0.75 children were born until age 33.

Comparing the cumulative cohort fertility (hereafter CCF), we can measure delay and recuperation in childbearing of a certain cohort relative to earlier cohorts. Delay-recuperation pattern may be appreciated more clearly in Fig. 4 which graphs the difference in the cumulative number of children between cohorts. A common pattern is that later cohorts tend to delay childbearing during young ages usually up to age 30 when recuperation starts, thus, making wider the cross-cohort gap around age 30.

Compared to the 1960 cohort, the 1965 cohort delayed their childbearing pace continuously from age 20 to age 30 having 0.3 children less at this age. From age 30 the 1965 cohort had a higher childbearing pace than 1960 cohort recuperating 0.1 children until age 43, a 33% recuperation rate. Between the 1965 and 1970 cohorts the pattern is similar but also somewhat different. Up to age 30 the 1970 cohort had 0.25 children less than the earlier cohort and recuperated 0.15 children thereafter

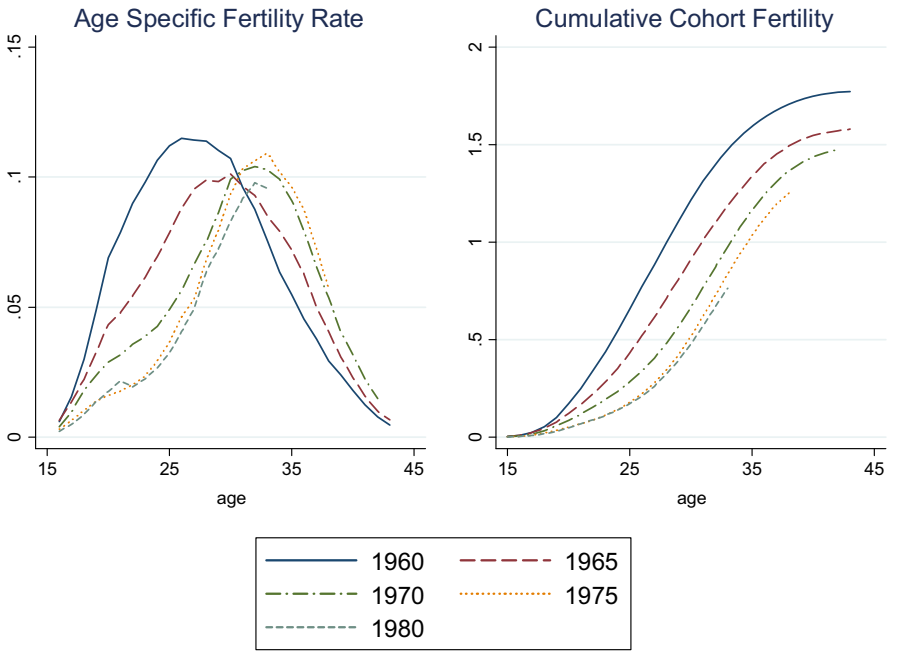

Fig. 3 Fertility by birth cohort. Source: Birth records

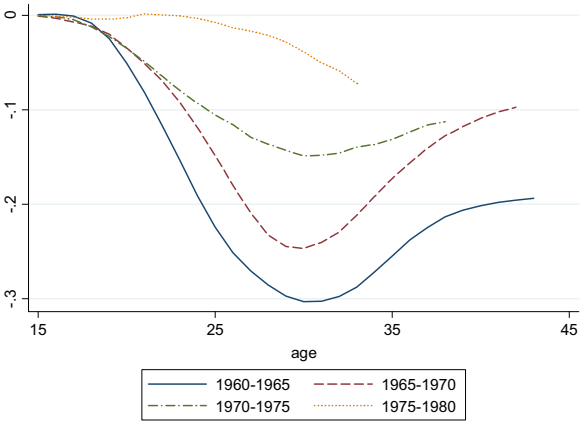

Fig. 4 Differences in cumulative cohort fertility between cohorts. Source: Birth records

resulting in a mere 0.1 children less at age 43. For the 1975 and 1980 cohorts the delay-recuperation pattern is quite different. For the 1975 cohort the intensity of delay is much milder remaining at 0.15 fewer children at age 30 relative to the 1970 cohort and the recuperation was only 0.04 children during the ages 30–38. The 1980 cohort had the same pace up to age 25 when a mild delay started relative to the 1975 cohort resulting in 0.08 children less up to age 33.

It remains to be seen how much more recuperation will take place for the cohorts of 1975 and 1980. For the 1975 cohort they would need to have 0.25 children between ages 38 and 43 to reach the fertility rate of the 1970 cohort. Similarly, the 1980 cohort would need to have 0.75 children between ages 33 and 43 years.

In Fig. 5 we also compare the parity progression rate[6] to each parity between different cohorts to know if the differences between the cohorts in cumulative fertility rates are attributable to a certain parity.

The parity progression rate to the first birth (PPR1) shows substantial differences between the cohorts. While more than 90% of the 1960 cohort women had their first child before age 43, the rate decreased to 85% for the 1965 cohort and to about 80% for the 1970 cohort. For the 1975 cohort, the PPR1 is about 70% up to age 38, meaning that, to reach the level of the 1970 cohort, about 33% of the childless women at age 38 need to have their first child in the next 5 years at ages 39–43. The PPR1 of the 1980 cohort is 50% at age 33, meaning that, to reach the level of the1970 cohort, 60% of childless women at age 33 should have their first child during the next 10 years (ages 34–43).

The parity progression rate to the second child (PPR2) shows smaller differences between the cohorts than in the case of the PPR1. About 70% of the women of the

[6] Parity progression rate is computed as the proportion of women who had a child of each parity among the women who had a child of the previous parity. For example, the parity progression rate to two is the ratio of women who had a second child over all women who have at least one child.

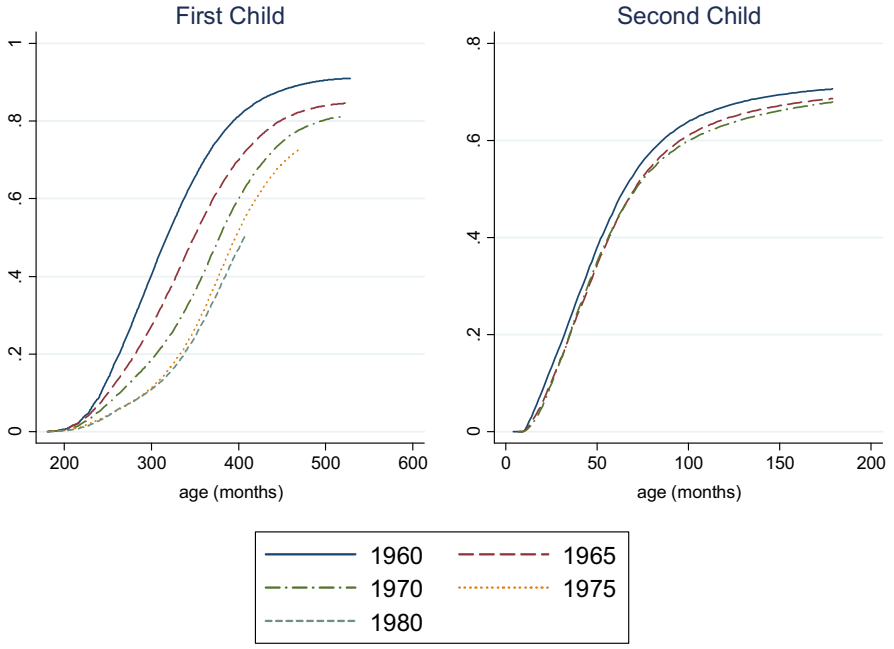

Fig. 5 Progression Rates. Source: Birth Records. In second birth, age (months) refers to duration in months since the first birth

1960 cohort with one child had the second child before age 44. PPR2 declined to 68% for the 1965 cohort and to 65% for the 1970 cohort.

Finally, in Table 1 we report the distribution of the number of children at age 43 (38 for 1975 cohort) for four cohorts of women. There are several interesting changes in the distribution. There is a substantial increase in the percentage of women who remain childless until age 43, as shown above in the PPR1. The figure goes from 9% for the cohort of women born in 1960 to 16% for the cohort of women born in 1965 and to 19% for the cohort of women born in 1970. The fraction of women who have one child is similar across the cohorts of women and therefore it is the fraction of women with 2 or more children that has decreased in favor of childless women. The proportion of childlessness among the 1975 cohort stands at 28% at age 38. To maintain the same childlessness rate as the 1970 cohort, almost a third (9% out of 28%) of these childless women has to have a child at ages 39–43.

Summing up, three features stand out to describe the evolution of cohort fertility in Spain. First, childbearing ages have been delayed substantially over time. Second, completed fertility has decreased continuously, about 0.2 fewer children for each 5-year younger cohorts. Across the observed cohorts (1960–1975), about 50% of delayed childbearing were recuperated later. Third, although parity progression rate has decreased in every parity, it has been most conspicuous in the progression to the first child, which is reflected in the disproportionate increase of childless women across cohorts.

6 Socioeconomic conditions on fertility: cohort approach

6.1 An overview

In this section we discuss correlations and possible causal effects of socioeconomic and institutional conditions on age-specific cohort fertility rates. Our approach here is novel in the sense that we relate age-specific fertility rates with socioeconomic and institutional conditions faced by each cohort at and up to each particular age.

6.1.1 Labour market

We start with a graph (Fig. 6) which shows evolutions of total fertility rate (right-hand y-axis) and labour market conditions (left-hand y-axis) as most studies have included to study the issue (see for instance De la Rica and Iza (2005), Adserá (2006, 2011), Gutiérrez-Domenech (2008) and Da Rocha and Fuster (2006)).

The evolution of TFR appears to be dominated by a decreasing secular trend until the mid-1990s. Since then it has fluctuated modestly according to economic cycles, which is partly due to the compositional changes resulting from pro-cyclical flows of immigrants. On the other hand, male employment rates appear to be affected mostly by business cycle with a slight decreasing trend. The female employment rates show a strong increasing secular trend with some effects of economic cycles. The proportion of temporary contract holders, another labour market variable often included in fertility studies, appears to be affected predominantly by institutional settings. It jumped from below 20% until the mid-1980s to about 35% during the 1990s and then decreased to about 25% during the last recession as the temporary contract workers lost their jobs disproportionately. Most previous studies on fertility in Spain examined contemporaneous relationships between TFR and socio-economic conditions using annual data as shown in Fig. 6 with some refinement on ages in calculating the labour market situations. In our view, it seems too fragile to establish any causal relationship between the labour market and fertility based on the data shown in this Figure.

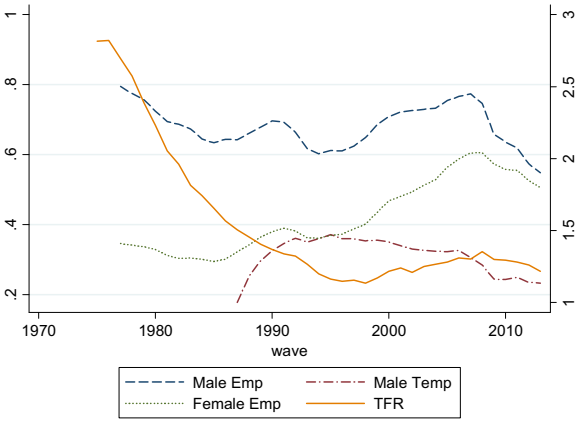

Fig. 6 TFR and the labour market conditions. Source: Birth Records and Labour Force Survey

As mentioned earlier, an improvement in the investigation of fertility may be achieved by examining the socioeconomic conditions of each cohort in each single age to study age-specific fertility rates of women. Furthermore, earlier labour market experience faced by each cohort can be easily incorporated in the analysis of fertility behaviour at certain ages.

We first carry out some visual inspections using two sets of graphs, one contrasting the ASFR to the labour market situation over the life-course for 4 different birth cohort groups (1960–1964, 1965–1969, 1970–1974 and 1975–1980) and the other contrasting the ASFR to the labour market situation across cohorts for 4 different age intervals (16–24, 25–29, 30–34 and 35–43). Included in the labour market situation are female and male (potential husband) employment rates and the prevalence of temporary contracts. To compute labour market conditions of potential husbands, we use men who are two years older than women which is the average age difference between spouses in Spain. Figures 9 and 10 in the Appendix present graphical results for 4 birth cohort groups and for 4 age intervals respectively.

It is clear that the life-cycle patterns of most variables are dominated by a typical age pattern. Age-specific fertility rates are typically of an inverted U-shape. The highest point has shifted to later ages over time reflecting delayed childbearing preferences among younger cohorts. The male employment rate increases up to age 30 and stabilizes thereafter with some business cycle fluctuations. A small decline experienced after age 35 among the cohort 1970–74 and after age 30 among the youngest cohort apparently reflects the Great Recession. The female employment rate follows an increasing secular trend at all ages with a steeper age profile among younger cohorts. Increasing education over time has been an important factor for this secular trend. Relatively high and flat employment rates at early 20s among the eldest cohort reflect the fact that tertiary education was still rare among the women of this cohort. The prevalence of temporary contracts is dominated by a decreasing age profile among younger cohorts for whom the mid-80s labour market reform was most relevant.

As a summary of statistics of bivariate relationships we report in Table 2 simple correlations between the set of labour market variables and ASFR for the different cohort and age groups. The correlation coefficients show a considerable volatility as seen by changes in the sign and magnitude across cohorts. Although we are tempted to draw some conclusions on the correlations between the variables included in the graphs, we have to be cautious in interpreting them as they only represent bivariate contemporaneous relationships whereas age-specific fertility rate is usually strongly conditioned by cumulative fertility rates and cumulative labour market experience up to each age as well.

Looking at the evolutions of the same variables across cohort at given ages (Fig. 10 in the Appendix), we can observe some interesting patterns. Within each age group it is quite general that male employment is uncorrelated with the ASFR. However, for the youngest age group there is a strong negative correlation between the ASFR and the incidence of temporary contracts among men. The same is true for the age group 25–29 up to the cohort born in 1970. Finally, for this group there is a clear negative correlation between female employment and the ASFR, which is not observed for the other age groups.

Table 2 Correlation coefficients of socio-economic variables with ASFR

	By Cohort			
	1960–1964	1965–1969	1970–1974	1975–1980
Male employment	−0.31	0.02	0.74	0.84
Male temporal work	−0.36	0.35	−0.54	−0.92
Female employment	−0.53	−0.17	0.65	0.90
House price	−0.59	−0.64	0.53	0.72
	By Age			
	<24	25–29	30–34	35–40
Male employment	0.40	0.12	0.31	−0.13
Male temporal work	−0.86	−0.66	0.04	0.24
Female employment	0.47	−0.37	0.66	0.24
House price	−0.41	−0.39	0.62	0.03

Source: Birth Records and Labour Force Survey

6.1.2 Housing prices

Another economic variable relevant for the fertility decisions of a couple is housing costs[7]. The higher the property or rental price, the greater costs of childrearing. Housing costs in Spain has fluctuated considerably during the last few decades. Average house prices doubled between 1985 and 1990. After several years of stability during the 1990s it has increased incessantly between 1998 and 2008, more than doubling in most areas and tripling in some big cities. This jump in house price was found to be mostly due to the housing bubble, which finally exploded in 2008 causing a substantial downward adjustment over the following years. Rental price has evolved similarly although on a somewhat smaller scale. This large fluctuation of housing costs is supposed to have affected young people's fertility decision. In particular, as different birth cohorts underwent the last house price cycle at different ages, their fertility behaviours are likely to be affected differently.

In Fig. 11 in the Appendix we show the evolution of ASFR and average house price of each cohort. If we compare 1960–1964 cohort with 1975–1980 cohort, while the 1960–1964 cohort women went through most of their intensive childbearing ages (25–35) under modest housing prices the 1975–1980 cohort women faced much higher housing prices at the same age interval. However, the visual inspection seems to suggest a caution in interpreting any causal relationship solely based on the bivariate evolution as shown in the figure. For example, as shown in Table 2, there is a high negative correlation between the two variables among the two older cohorts but a high positive correlation among the younger cohorts.

In Fig. 12 in the Appendix we plot the ASFR by birth cohort for different age groups, as we did in the case of the labour market conditions. As summarized in Table 2, among those individuals younger than 30 there seems to be a negative

[7] See Dettling and Kearney (2014) for evidence.

correlation between house prices and ASFR across cohorts, but a positive correlation at ages 30–34 and no correlation at ages 35 or more. This difference by age might be due to a different home ownership rate by age. As the owner-occupation rate among Spanish couples increases with age, a higher house price means a greater wealth and thus a greater affordability of children.

6.2 Multivariate analysis

One important challenge when exploring the impact of socioeconomic conditions on the fertility decisions of different cohorts of women is that some of the variables that are potentially relevant for fertility decisions, such as education or employment status, are likely to be endogenous. As we discussed in "Literature", there is no easy way to deal with such a problem. Another important difficulty in identifying the role of the variables of interest with our aggregated data is that some of the variables of interest are highly correlated (as for instance the incidence of temporary contracts among women and their potential husbands). Nevertheless, in this section we undertake a multivariate analysis to assess the plausibility of the different socio-economic changes in accounting for the evolution of fertility.

In Table 3 we provide the estimated coefficients of OLS regressions[8] of the log of the ASFR on several economic variables. We start with a regression which include age dummies, CCF (cumulative cohort fertility), and the interaction between CCF and three age groups, less than 25, 25–29 (omitted category) and 30 or more. We think it is important to include the CCF because the decision to have a child at a certain age is likely to depend on the stock of children. Furthermore, it is possible that the CCF has a different impact on the ASFR depending on age as shown in Ward and Butz (1980). In the subsequent columns, we add several economic variables in a sequence. In column 2 we add the percentage of college educated women in each cohort measured at age 30, whereas in column 3 we add male (potential husband) employment rates, their accumulated[9] employment rates up to each particular age and the fraction of temporary workers among employed men. In column 4 the log of the house price index is included and, finally, a dummy variable that indicates if each cohort was eligible for the universal child birth benefit (2007–2010) at a particular age is considered. All the explanatory variables are lagged one year to reflect the time of conception decision. We did not include women's employment rate due to the obvious endogeneity problem and we cannot include cohort dummies as controls since the education variable is invariant within each cohort. Some other interesting variables which are not included in our analysis due to lack of data are male and female wages by age and cohort and their expected future values.

Our main findings are the following. In the first column the coefficient on the current stock of children (CCF) shows a positive correlation at ages below 25 relative to ages 25–29 but turning to a negative correlation at older ages. This may reflect that those with larger CCF at early ages have stronger preference for children and

[8] Given a potential auto-correlation in residuals across age within a cohort, due to unobserved fertility preferences (such as ideal number of children), we estimate standard errors of estimated coefficients correcting for clustering of our data at cohort level.

[9] Accumulated employment rate up to a certain age is just the sum of the employment rates up to that age.

Table 3 Regression results (dependent: logarithm of age-specific fertility rate)

	(1)	(2)	(3)	(4)	(5)
CCF[a]	0.949***	−0.303	−0.368**	−0.337**	−0.340**
	(0.050)	(0.167)	(0.097)	(0.096)	(0.096)
CCF* age < 25	4.737***	2.980***	1.478***	1.554***	1.543***
	(0.189)	(0.267)	(0.191)	(0.241)	(0.239)
CCF* age > 29	−1.746***	−1.659***	−1.358***	−1.346***	−1.326***
	(0.054)	(0.090)	(0.089)	(0.103)	(0.104)
Female university (%)		−4.092***	−3.395***	−3.416***	−3.488***
		(0.534)	(0.414)	(0.475)	(0.471)
Male current emp.			−0.207	−0.349	−0.332
			(0.115)	(0.261)	(0.261)
Male cumul. emp.			0.039 (0.026)	0.047 (0.027)	0.040 (0.028)
Male temp. emp.			−0.931***	−0.898***	−0.880***
			(0.124)	(0.132)	(0.132)
House price				0.057 (0.073)	0.047 (0.073)
Baby subsidy					0.050* (0.024)
Constant	−3.905***	−2.541***	−2.092***	−2.420***	−2.346***
	(0.086)	(0.185)	(0.137)	(0.286)	(0.284)
Age dummies	Yes	Yes	Yes	Yes	Yes
N	428	428	428	413[b]	413[b]
Adj. R^2	0.938	0.956	0.971	0.971	0.971

[a]CCF: cumulative cohort fertility

[b]We lose 15 observations in these specifications since there were no house price data before 1985

***, ** and * indicate 0.1%, 1% and 5% significance level respectively

therefore are more likely to give birth. However, as women get older, a smaller stock of children increases the probability of having a new born. Although the inclusion of other variables seems to reduce the magnitude of the coefficients, the result is in general consistent across specifications and supports a pattern of postponement and recuperation. In particular, the inclusion of the fraction of women with a college education reduces both the size and the significance of these variables, which seems reasonable as women's fertility preferences would be controlled at least partially through education. As expected, female college education is strongly negatively correlated with ASFR in all specifications. When the labour market history of potential husbands are included in the regression (column 3), the sign of the coefficient on CCF becomes negative even at ages between 25 and 29. This is reasonable because a larger CCF at early ages may reflect more favorable labour market history of women's potential partners. All in all, there is clear evidence in favor of a postponement and, at least partial recuperation pattern.

Regarding the covariates that capture the labour market history of potential husbands the results are somewhat surprising. As reported in the third column, the potential husbands' employment rate seems to be uncorrelated with the ASFR and the same is true for their accumulated employment. However, the percentage of temporary workers among employed men is strongly negatively correlated with the ASFR, suggesting the harmful effect of job insecurity on fertility. However, this

large correlation of temporary contracts and ASFR along with the insignificant correlation with male employment suggests a potentially statistical artifact as these two variables are strongly correlated (−0.73 correlation coefficient).

The correlation of house prices and ASFR (column 4) turns out positive but insignificant. One reason for a positive coefficient could be due to reverse causality as economic and employment booms facilitate household formation and childbearing which in turn activate the demand for housing resulting in a house price inflation. Finally, we find a positive significant effect of the universal child birth subsidy, as in González (2013). The sign and size of the coefficients of the other variables are similar to the previous column.

6.3 Counterfactuals

Finally, we use the estimated model with the set of controls included in the last column of Table 3 to predict what the ASFR of the cohorts born in 1965, 1970 and 1975 would be under the assumption that the socioeconomic conditions faced by each cohort were the same as those faced by the cohort of women born in 1960. In specific, we compute counterfactuals for the case of a constant female education level and for the case of a constant male labour market situation (employment, accumulated employment up to each particular age and prevalence of temporary contracts) in addition to constant education.

Given the continuous increase in female education over cohorts we showed in Fig. 2 and the negative coefficient of education, the ASFR will be increasingly higher under the assumption of a constant education across cohorts. Under the assumption of a constant male labour market situation, we expect an increase in the fertility rate of younger cohorts due to the negative coefficient that we estimated in the last column of Table 3 and the much lower prevalence of temporary contracts among the 1960 cohort. However, the impact of assuming constant accumulated employment up to each particular age also depends on the timing of recessions faced by each cohort. Overall, as shown in Fig. 7, younger cohorts would have much higher fertility rate if their labour market conditions and education were the same as the 1960 cohort.

7 Conclusions

In this paper we implement a cohort-based approach for the analysis of the evolution of fertility behaviour in Spain. We first provide a detailed descriptive analysis of the evolution of fertility across cohorts of women to show that the completed fertility rate of the younger cohorts is substantially lower than the one observed for older cohorts. This is the results of a continuous delay of childbearing across cohorts born from 1960 to 1980, in particular first births, which is only partially recovered at older ages. This is also shown in a rapid increase in childlessness among the younger cohorts. Second, we discuss the correlation of several socioeconomic variables and fertility using a cohort approach that relates age specific fertility rate of each cohort with socioeconomic conditions up to each particular age for that cohort. According to our analysis, male employment does not seem to be correlated with ASFR. We find female education and insecurity in the labour market represented by temporary

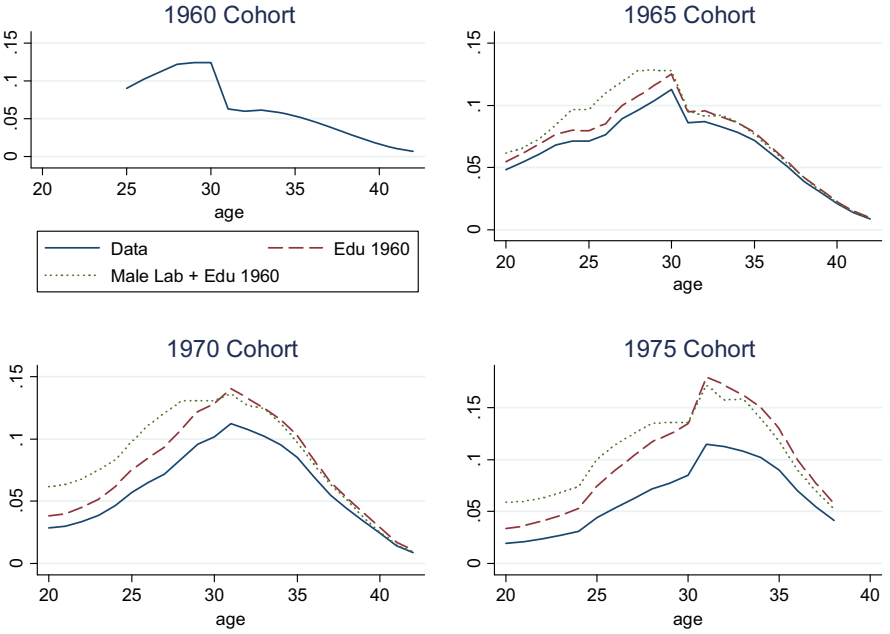

Fig. 7 ASFR by birth cohort, counterfactuals

contract prevalence as the most important covariates of cohort age-specific fertility rates.

We think our approach connecting cohorts' age-specific fertility with their socio-economic conditions faced in each single age is a promising area of study to enhance our understanding of fertility evolution. For the purpose, it is essential first to prepare richer information on labour market and institutional conditions by each age and cohort. Given ever-growing micro and macro data, we really look forward to seeing further research on the topic.

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Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

8 Appendix

Figures 8–12, Table 4

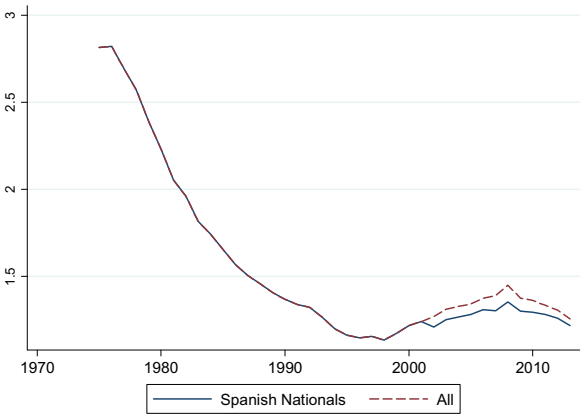

Fig. 8 Total fertility rate in Spain

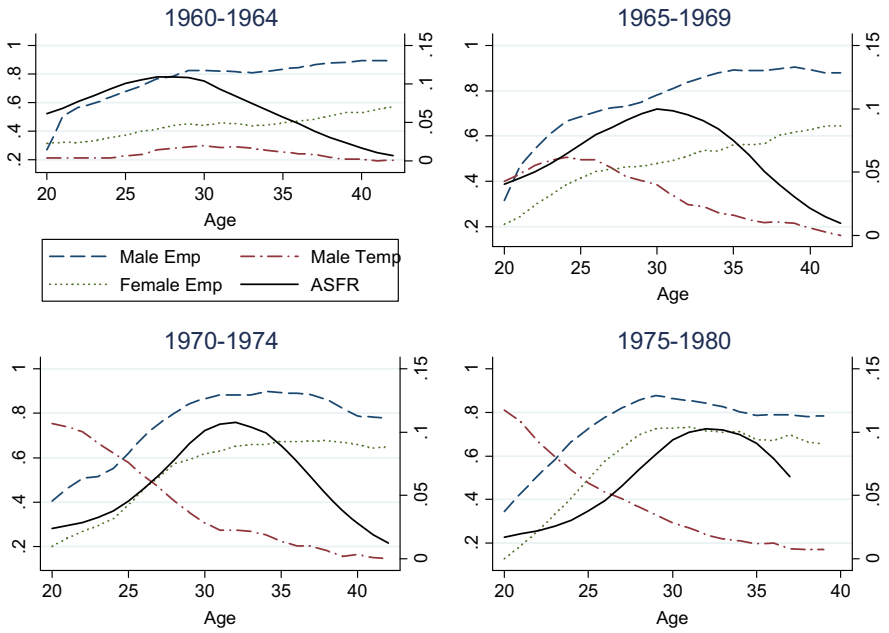

Fig. 9 ASFR and the labour market conditions by age for different cohorts. Source: Birth Records and Labour Force Survey

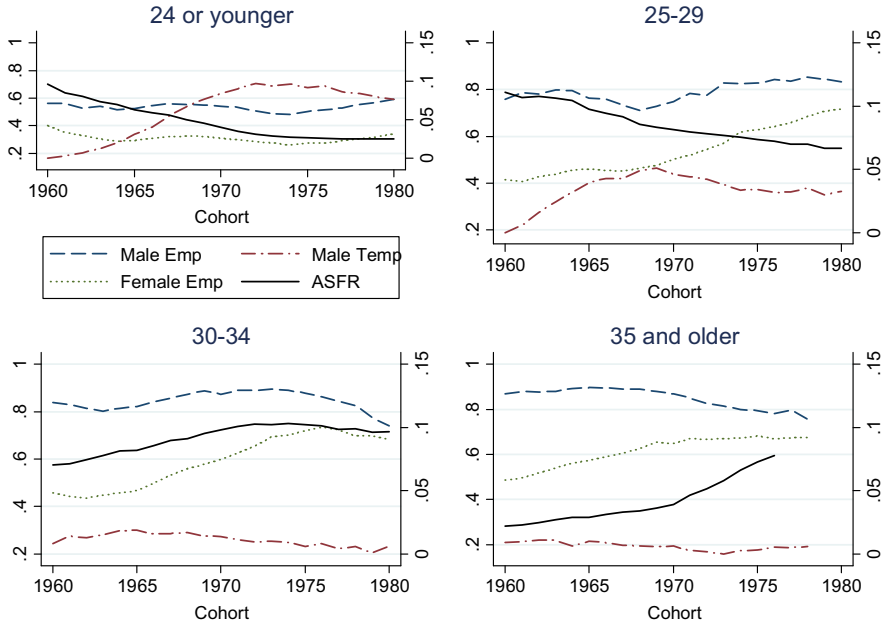

Fig. 10 ASFR and the labour market conditions by birth cohort at different ages. Source: Birth Records and Labour Force Survey

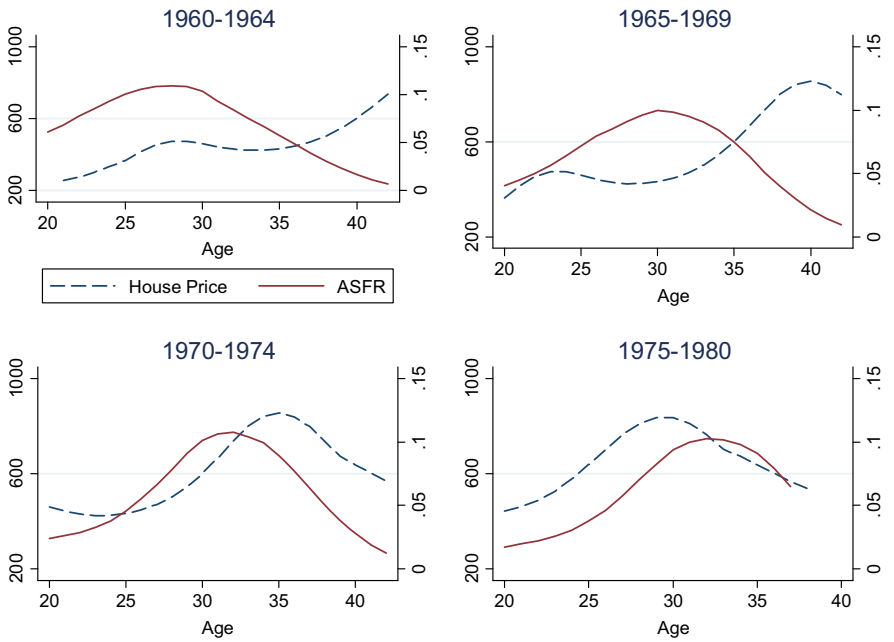

Fig. 11 ASFR and house prices by age for different cohorts. Source: Birth Records and Ministerio de Fomento

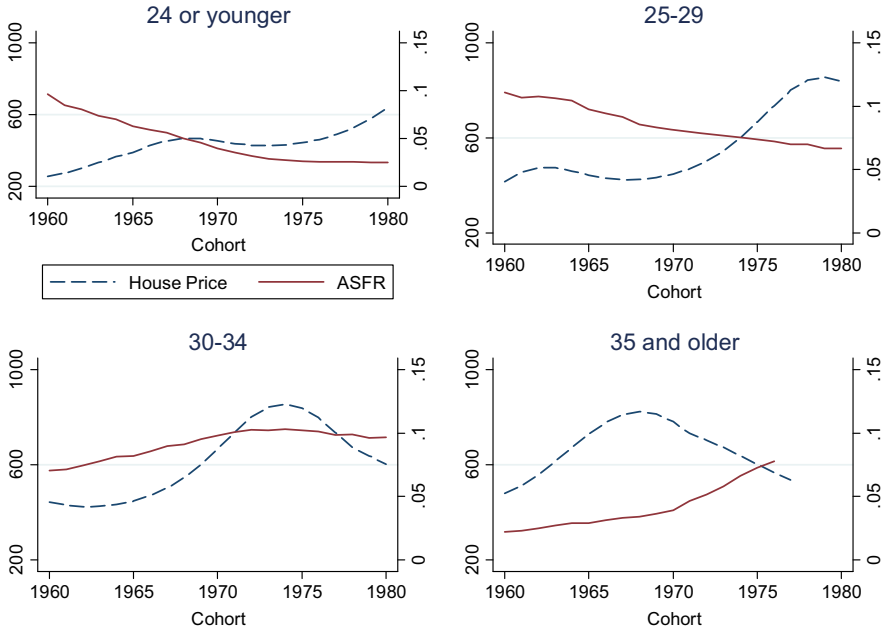

Fig. 12 ASFR and house prices by birth cohort for different age groups. Source: Birth Records and Ministerio de Fomento

Table 4 Some examples of year of registered births used for age-specific fertility rate

	Age				
Birth cohort	20	25	33	38	43
1960	1980	1985	1993	1998	2003
1970	1990	1995	2003	2008	2013
1975	1995	2000	2008	2013	
1980	2000	2005	2013		

Source: Birth records

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