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Article

# Growing Pains: Can Family Policies Revert the Decline of Fertility in Spain?

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**Abstract**

This article aims to analyze the capability of family policies to reverse the sharp decline in fertility that has been observed in Spain in recent decades. The analysis was carried out by applying two mathematical techniques: the genetic algorithm and the strategic scenarios. Firstly, a mathematical model was designed and validated adjusting the combined performance of fertility and family policies during the 2008–2019 period. Subsequently, this model was applied to the future (2020–2060) to extrapolate the evolution of fertility considering different models of family policies. The results demonstrate that a model of family policies that is coherent with other socially desirable objectives, such as gender and social equality, will be insufficient to reverse the current downward trend in fertility. Therefore, these outcomes point to the need to articulate and harmonize diverse public policies considering the principles of equality and well-being to modify the recent decline in fertility. An increase in fertility must therefore be identified as a socially desirable goal and public policies must be adapted to this objective, in the understanding that fertility not only requires family policies but also their coherence with the employment and educational policies and work–life balance mechanisms offered by public institutions.

**Keywords**

family policies; fertility; genetic algorithms; Spain; strategic scenarios

**Issue**

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## 1. Introduction

This article aims to contribute to a line of research that analyzes the relationship between the fertility levels of a country and the existing family policies, providing new evidence to a field of study—the sociology of the family and population—that has a long academic tradition in the European context (see, for example, Gauthier, 2013; Lappegård, 2010; Thévenon & Gauthier, 2011).

The analysis is based on a structural perspective, in the understanding that public policies generate responses in citizens' behaviors and attitudes. Public policies thus constitute resources that influence families' decisions about whether and when to have children. Simultaneously, public policies provide symbolic messages to the population about collective goals and desirable objectives, and these public resources are key elements to advance towards these socially desirable goals. This is the case with increasing fertility rates and, more specifically, helping families to have the number of children they wish to have.

However, family policies do not operate in a vacuum but rather interact with the economic, cultural, and social context, and therefore they must provide coherent messages linking the desirable increase in fertility with other collective goals like gender equality or social cohesion (Szalma et al., 2020).

Based on these premises, this article aims to answer the following research question: Is it possible to modify the current downward trend in fertility through family policies? To respond to this question, our specific goal is to forecast what the trend in fertility rates will be in the future (2019–2060) in Spain based on different scenarios of family policies. The mathematical techniques that were applied for this purpose are the genetic algorithm and strategic scenarios since both techniques allow the design of diverse combinations of family policies projected into the future. Specifically, three dimensions of public support for families have been taken into consideration: parental leaves (time), public pre-school services (education), and monetary transfers (money). In this way, this article tries to provide useful empirical evidence for policy-makers to design family policies, bearing in mind their impact on fertility.

## 2. Family Policies as Tools for Advancing Towards Larger Common Goals

### *2.1. The Lowest Low Fertility in Spain*

Spanish women are among those who have the lowest number of children within the current European context of low fertility, a phenomenon that has been named the "lowest low fertility" (Billari & Kohler, 2004; Castro-Martín & Martín-García, 2016) and which constitutes a peculiarity shared with other countries in Southern Europe, such as Italy (Luppi et al., 2020). Certainly, Spain is one of the countries in the world with the lowest fertility (1.16 children per woman in 2021; see INE, 2021), which is partially explained by the delay in the decision to have children due to the perception that economic and social conditions are not favorable (Esteve & Treviño, 2019). Indeed, in 2021, the average age of motherhood stood at 32.6 years (INE, 2021).

In the current European context of continued fertility decline, a growing interest has been observed in studying the relationship between family policies and fertility levels, but so far no definitive conclusions have been reached (Neyer et al., 2013). Gender inequality has been identified as a determining factor in explaining low fertility rates, with fertility increasing when women share domestic and care tasks with men (Goldscheider et al., 2015). Along these lines, McDonald (2000) indicates that fertility decline is more evident when there is a conflict between the perception of gender equality and the possibilities offered by institutions to ensure that this equality is operationalized.

In the specific case of Spain, social research has analyzed the explanatory variables for this extremely low fertility, identifying, alongside the transformation of traditional family values common to other Western societies, specific elements in Spanish society such as job insecurity, housing problems, and unsatisfactory work–life balance mechanisms (Bueno & García Román, 2020; Castro-Martín et al., 2020; Gietel-Basten & Sobotka, 2020; Matsyak et al., 2021), as well as insufficient public aid and an erratic and incoherent architecture of family policies (Castro-Martín & Martín García, 2013; Castro-Martín et al., 2018; Esteve & Treviño, 2019; Moreno, 2008; Moreno Mínguez, 2013).

On the other hand, uncertainty constitutes an element with negative effects on fertility, since "historically, economic and health crises have never been preferred periods for a couple to decide to have a baby" (Luppi et al., 2020, p. 1340). In this sense, precariousness and economic insecurity have been significant obstacles to having children in Spain for decades (Esteve et al., 2021). These obstacles, together with the recent Covid-19 crisis and the current context of international conflict, configure a growing scenario of uncertainty and insecurity that aggravates the decline in fertility (Luppi et al., 2020; Sobotka et al., 2021).

In this sense, the low fertility in Spain contrasts with the number of children that Spanish families desire to have, which has remained stable at around two in recent decades and coincides with the ideal family size of other European countries (Castro-Martín et al., 2020; Sobotka & Beaujouan, 2014). This distance between the facts and the ideal aspirations shows that Spanish families are facing a material and welfare deficit that affects their family projects (Goldscheider et al., 2015; Raybould & Sear, 2021) and explains why an increase in fertility rates is a desirable collective goal.

Along similar lines, low fertility is also connected with other social challenges such as the adequacy of the current welfare state model to the new sociodemographic dynamics of population ageing, family diversification, and transformation of gender relations (Castro-Martín & Martín-García, 2016; Thévenon, 2011). From both perspectives—micro and macro—low fertility in Spain can be conceptualized as a tendency that needs to be reverted, given that it is a reflection of deficits on several levels.

### *2.2. Family Policies in Spain*

Despite the fact that low fertility constitutes a collective problem, Spanish public policies reflect neither the commitment nor the intention to reverse this decline. Spain, framed within the Mediterranean welfare state (Ferrera, 1996), has traditionally been characterized by low public investment in family policy, with erratic and incoherent family policies (Castro-Martín & Martín García, 2013; Castro-Martín et al., 2018; Esteve & Treviño, 2019; Moreno, 2008; Moreno Mínguez, 2013). The Spanish political agenda has been dominated by partial initiatives by different governments that have not satisfactorily facilitated the entry of women into the labor market by guaranteeing effective work–life balance measures. Childcare has been channeled through family solidarity, either through the total or partial exit of women from the labor market or the support of grandparents—especially maternal grandmothers—which has traditionally been used as a frequent resource to balance work and care responsibilities (Tobío Soler, 2012).

The defamiliarization process has been promoted in recent years with family policies aimed at reducing family responsibility in regard to care (León et al., 2021), but the outcome is yet insufficient and unsatisfactory for families, especially for those with fewer resources. Certainly, this converges with another feature of the Spanish care model: the high presence of private initiatives, either through the use of private pre-school services or hiring professional care providers as full-time or part-time caretakers (Elizalde-San Miguel et al., 2019; Silvestre, 2022; Tobío Soler, 2012).

This research focuses on family policies aimed at the stage 0–3 years and, based on the definition of family policies established by Daly and Ferragina (2018), the measures available have been classified into three broad categories:

- Policies defined as time, which are those intended to guarantee that children can be cared for by the parents in the first stages of their lives or if they are ill. Paid birth leave has been the only policy included in the Spanish case (with a maximum of 16 weeks for each, the father and the mother), although the Family Law currently being developed by the Spanish government is planning to introduce a new paid leave of seven days a year to care for children until the age of eight (Sosa Troya & Torres Menárguez, 2022).
- The offer of public pre-school services and the degree of coverage they entail with respect to the entire population aged 0–3 years old. In Spain, the coverage varies between regions because it is a competence delegated to the autonomous communities, although it is estimated that at the national level only 20% of children under three years of age attend public pre-school services. Nonetheless, this resource has been identified as an important equalizing resource, aiding the most vulnerable segments of the population to improve their social situation. There is therefore a wide margin for improvement in the provision of these services in Spain (Elizalde-San Miguel et al., 2019; Save the Children, 2019).
- Monetary benefits, which "represent society's recognition of the financial burden of maintaining a family" (Flaquer, 2000, p. 40). However, these resources have not been sufficiently developed in Spain to mitigate the high rates of child poverty (Jurado-Guerrero & Naldini, 2018). The Child Benefit is the only policy common to all regions in the country; it is an economic transfer of EUR 1,200 a year that is limited to families with employed mothers.

The Family Policy Index (XFPI) is a synthetic index that brings together, in a single value, the set of family support measures existing in a given country (Elizalde-San Miguel et al., 2019). Considering the three dimensions just mentioned, the XFPI places Spain around values of 0.2 out of 1, and points to clear deficiencies in the provision of resources together with the lack of coherence of public policies with other social objectives (Elizalde-San Miguel et al., 2019). There is, therefore, the potential for improvement to develop family policies in Spain, so that they become facilitating elements to achieve socially desirable objectives, understanding as such not only fertility itself but also gender and social equality or the reduction of child poverty.

Indeed, the concept of "family policy" is complex and incorporates diverse measures that might be ideologically opposed (Ayuso Sánchez & Bascón Jiménez, 2021; Comas d'Argemir et al., 2016; Flaquer, 2000). Traditionally, population policies had a pro-natalist perspective that considered women only as providers of children, above any other social role (Comas d'Argemir et al., 2016; Pérez Díaz, 2020). It was the incorporation of women in the labor market that generated a new social challenge: designing new instruments to guarantee childcare in the absence of traditional care providers, the mothers, giving space to new paradigms in the design of family policies. As such, family policies are very much linked with gender equality. In this regard, the Nordic countries were pioneers in designing a model of public policies with a gender perspective that today prevails as the most generous in Europe (Brandth & Kvande, 2018).

## 3. Methods

The analysis carried out in this article is located within the frame of mathematical sociology, a field of study that applies techniques from mathematics to shed light on complex social challenges that require multidisciplinary perspectives. This research aims to contribute to the study of family policies using two mathematical techniques: the genetic algorithm and strategic scenarios, two methodologies that allow us to predict the behavior of fertility based on different combinations of family policies. The usefulness of these two methods to analyze social problems has been proved in previous investigations (Caselles et al., 2020).

The methodological basis used for this analysis comes from two previous investigations:

- The XFPI, a synthetic index composed of three sub-indexes that mirror the three most common family policies: pre-school services index, parental leave index, and monetary transfer index;
- A demographic model that includes the variables related to family policies needed to obtain the XFPI and the following demographic variables: births, deaths, and emigrations and immigrations defined by gender and age. The usefulness of the model is validated by applying it to the past period, reflecting that the model fits and replicates the previous fertility behavior and family policies. Once the model was validated, it was projected into the near future to predict the forthcoming fertility behavior if the current family policy model is maintained. In this sense, the results indicate that the current

model of family policies is exhausted and proves insufficient to reverse the present decline in fertility (Díaz Gandasegui et al., 2021).

Based on the results obtained in these previous investigations, this article aims to contribute to this line of analysis by studying the impact that a different model of family policies would have on fertility depending on the generosity or precariousness in terms of public funding and the degree of coherence with other socially desirable goals previously identified, namely gender equality and the reduction of social inequality.

### *3.1. The Demographic Model*

The design of the demographic model has been carried out based on the model mentioned above, designed by Díaz Gandasegui et al. (2021), with the introduction of two new features that improve the scientific soundness of that model:

- The XFPI has been improved by limiting the number of seats in public pre-schools to the forecasted population of children aged 0–2;
- The function that incorporates the Synthetic Fertility Index (XSFI) has been adjusted with higher precision to reflect recent trends in the age of maternity for the first child since maternity is being postponed significantly in Spain in the last decades. Indeed, every three years the average age of maternity in the first child is delayed by approximately 1.5 years. Consequently, the initial function needed to be modified.

With these two modifications, the demographic model was validated in the period 2008–2019 for the set of input variables. First, the adjustment of the input variables was done through mathematical equations that allow adjustment of the behavior of the historical data in the mentioned period (shown in Annex 1 of the Supplementary File). Once the input variables were adjusted, the mathematical model was validated in two ways (see Figure 1): through the visual representation of the two trends, the historical-real one (in points) and the tendency simulated by the model (in line), with both trends evolving equally, reflecting the validity of the model; and through the value of $R^2$, which in both cases is high. Both validation methods—visual representation and $R^2$—show that the model fits with precision the real behavior of the output variables. Figure 1 represents the validation of the model to the XSFI and the XFPI. The validation of the other output variables related to the demographic variables is included in Annex 2 of the Supplementary File.

Once the model is validated, it is considered valid to be applied for the forecasting methods, the genetic algorithm and the strategic scenarios.

### *3.2. Optimization of the Synthetic Fertility Index (2020–2060)*

As stated earlier, the goal of this research is to find the best combination of family policies to achieve the highest possible fertility, taking into consideration that current fertility rates are lower than families' real desires. Consequently, the optimization of the XSFI was carried out using the genetic algorithm and strategic scenarios, two different forecasting techniques that not only predict the evolution of fertility rates in the future but also identify the changes necessary in the design of family policies to reach the maximum fertility level.

The genetic algorithm is automatically programmed in SIGEM, the simulation mathematical software. Genetic algorithms allow optimizing, at each moment, the previously defined target variable (in this case, fertility), named objective variables (OBJE), based on other variables included in the demographic model (in this case, family policies), identifying the maximum possible value that can be achieved in each year. Hence, the equation calculated by OBJE is:

$$\text{OBJE} = -\text{XSFI}$$

The simulation with genetic algorithms requires three reference values for each input variable: minimum,

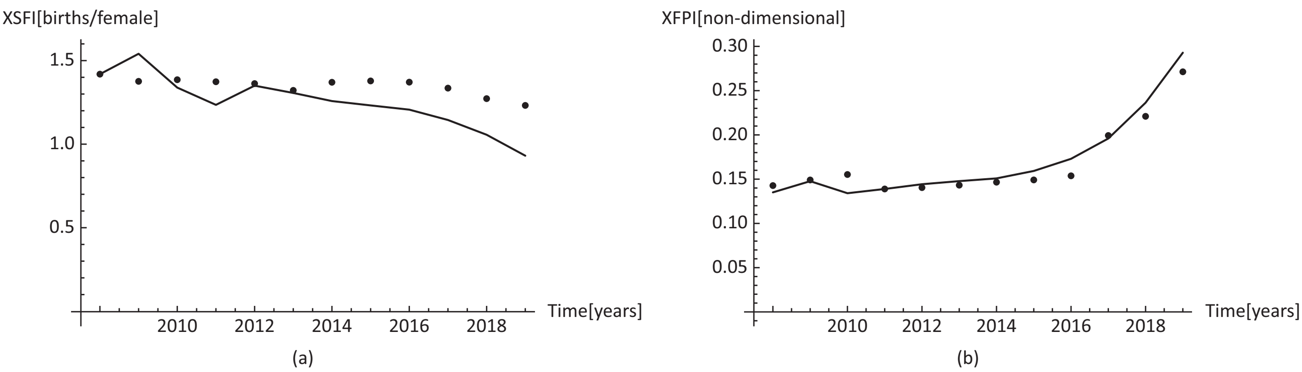


**Figure 1.** Validation of the model (2008–2019). Notes: (a) XSFI, $R^2$ = 0.79087; (b) XFPI, $R^2$ = 0.972928; the points indicate historical values and the lines indicate simulated values.

maximum, and an annual variation window (AVW). These reference values can be obtained in different ways; in this study, we have used two methods to generate two genetic algorithms. Genetic Algorithm 1 (GA1) is a "free scenario" in which the only limitations are pre-existing reference values, identified from the previous period and/or place. Genetic Algorithm 2 (GA2) has been labeled as "intentional," and, in this case, experts define the reference values based on the existing findings in this field of study.

The second forecasting technique, the strategic scenarios, requires extrapolating all input variables which are temporarily defined. EXTRAPOL is the tool that allows the extrapolation of the future trend of the input variables taking as a reference a confidence interval—maximum and minimum values—from a function previously obtained with REGINT. It should be noted that input variables are classified into two types: (a) control variables that can be modified by policymakers (an example would be the number of public places available in pre-school services), and (b) scenario variables, which are the ones that cannot be controlled by policymakers. All the input variables used in this study are control variables.

The strategic scenarios are designed considering the possible alternative strategies to be designed in family policies directed at families with children in the stage 0–3 years old. This technique allows us to observe the potential impact these different strategies will have on the evolution of fertility and the OBJE. In this way, the strategies are defined on the control variables.

The family policies included in these two techniques are those integrated into the XFPI. They do not cover the whole range of existing family policies but those that are most common in European countries and therefore allow comparative research.

### *3.3. Simulation of Fertility Using Genetic Algorithms*

The first scenario generated by the model, GA1, was identified as a "free" scenario, which seeks to determine the best combination of family policies without explicitly introducing any intentionality in terms of coherence with other collective goals. In this case, the reference values have been obtained from Spain and Norway during the period 2000–2018. Based on these reference values (Table 1), the simulation software seeks the best combination of family policies that will lead to the maximum fertility rate.

The second scenario, GA2, was identified as "conditional/intentional." This scenario seeks, like the previous one, to maximize the target variable—fertility—but, in this case, the minimum and maximum reference values were defined by experts considering the current context and also its coherence with other socially desirable values. The difference between the two genetic algorithms is the conditionality or unconditionality of the optimization with a context of values that, in the case of GA2, guarantees coherence between increasing fertility and social and gender equality. Therefore, the values provided as a reference (Table 2) are defined considering the optimization of fertility from a perspective of gender equality and social cohesion. Hence, this second algorithm ultimately constitutes the moment of greatest dialogue between mathematics and sociology, as the techniques and data provided by the former converge with the necessary interpretation and contextualization of the latter.

The criteria used to define the minimum and maximum values of the GA2 were as follows. In relation to paid birth leave, the values provided incorporate a gender equality perspective. It is considered that: (a) both parents must have the same number of days,

**Table 1.** Reference values for the GA1.

| Chromossome | Variable | Initial value | Min | Max | AVW (%) |
|---|---|---|---|---|---|
| 1 | Purchasing power parity (XPPP) | 0.631 | 0.5 | 1 | 5 |
| 2 | Simultaneity or not of the parental leaves (OVLP) | 0.01 | 0.01 | 1 | 20 |
| 3 | Days of parental leave corresponding to mothers (DMAL) | 112 | 112 | 240 | 20 |
| 4 | Divisible part of the parental leave (DPLS) | 0.01 | 0.01 | 350 | 300 |
| 5 | Length of Child Benefit (TICB) | 1,095 | 30 | 1,095 | 60 |
| 6 | Coverage of Child Benefit (XCCB) | 0.6927 | 0.01 | 1 | 60 |
| 7 | Monetary value of Child Benefit in PPP (ECCB) | 100 | 100 | 1,000 | 20 |
| 8 | Length of Cash for Care (TICC) | 0.01 | 0.01 | 1,095 | 200 |
| 9 | Monetary value of Cash for Care in PPP (ECCC) | 0.01 | 0.01 | 6,000 | 200 |
| 10 | Monetary value of Birth Grant in PPP (ECBG) | 0.01 | 0.01 | 2,500 | 200 |
| 11 | Coverage of Birth Grant (XCBG) | 0.01 | 0.01 | 1 | 10 |
| 12 | Public places in public schools (XPUB) | 214,356 | 30000 | 500,000 | 10 |
| 13 | Days of parental leave corresponding to fathers (DFAL) | 28 | 28 | 240 | 20 |

Notes: The AVW sets a limit in the annual oscillation to avoid sudden jumps in the trend; Annex 3 of the Supplementary File includes the complete list of variables.

**Table 2.** Reference values for the GA2.

| Chromossome | Variable | Initial value | Min | Max | AVW (%) |
|---|---|---|---|---|---|
| 1 | Purchasing power parity (XPPP) | 0.631 | 0.5 | 1 | 5 |
| 2 | Simultaneity or not of the parental leaves (OVLP) | 0.01 | 0.01 | 1 | 20 |
| 3 | Days of parental leave corresponding to mothers (DMAL) | 112 | 112 | 240 | 20 |
| 4 | Divisible part of the parental leave (DPLS) | 0.01 | 0 | 0 | 10 |
| 5 | Length of Child Benefit (TICB) | 1,095 | 1,095 | 1,095 | 10 |
| 6 | Coverage of Child Benefit (XCCB) | 0.6927 | 0.7 | 1 | 10 |
| 7 | Monetary value of Child Benefit in PPP (ECCB) | 100 | 100 | 300 | 15 |
| 8 | Length of Cash for Care (TICC) | 0.01 | 0 | 0 | 10 |
| 9 | Monetary value of Cash for Care in PPP (ECCC) | 0.01 | 0 | 0 | 10 |
| 10 | Monetary value of Birth Grant in PPP (ECBG) | 0.01 | 0.01 | 2,500 | 60 |
| 11 | Coverage of Birth Grant (XCBG) | 0.01 | 0.01 | 1 | 10 |
| 12 | Public places in public schools (XPUB) | 214,356 | 208,516 | 1,200,000 | 20 |
| 13 | Days of parental leave corresponding to fathers (DFAL) | 28 | 112 | 240 | 20 |

Note: The list of variables is included in Annex 3 of the Supplementary File.

the minimum being 112 days and the maximum 240, a reference value taken from Sweden; (b) the transferability of the leave is eliminated, understanding that the days assigned to each parent should respond to a "take it or lose it" logic (minimum value = 0) or could only exist when there is a quota for both (maximum duration of the total leave of 480 days, with a mother's quota of 112 days and a father's quota of 112 days); (c) simultaneity ranges between values of 0 (*simultaneous*) and 1 (*not simultaneous*). With regard to pre-school services, the minimum value is the number of places existing in the last year and the maximum number of places is the foreseen number of children with 0–3 years of age (adjusting this value to the duration of birth leave, as it is a stage during which these services are not used). GA2, therefore, seeks universality. Finally, the values of the cash transfers meet the following criteria: The Child Benefit would range between the current value and a maximum of EUR 300 per month and its coverage would be universal (currently it is only for employed mothers). Likewise, the Birth Grant, existing in Spain between 2007 and 2010, would be resumed, with a lump sum at the birth of EUR 2,500 and universal coverage.

### *3.4. Simulation of Fertility Using Strategic Scenarios*

The six strategies that are foreseen as possible future developments of family policies in Spain correspond to different models that could come into being depending on the decisions that future policymakers adopt in this area:

- Strategy 1: Maintenance of the current situation, characterized by being a scenario in which family policies have not managed to stimulate or maintain previous fertility levels.
- Strategy 2: Policies aim at increasing parental leave, but the rest of the sub-indexes (services and money transfers) remain unchanged. This strategy would complete the recent trend of increasing parental leave that has occurred in Spain. Thus, the days of birth leave for both parents would increase, similar to the duration of the most generous countries in Europe. The model designed consists of non-transferable leaves, based on empirical evidence that has demonstrated that non-transferability and the so-called "fathering alone" model, that is, no overlap in time when taking the birth leave, is a measure that contributes to parental involvement and gender equality in regards of care and home task distribution (O'Brien & Wall, 2017).
    - Total duration of parental leave (DMAL + DFAL) increases to 240 days. DMAL and
- Strategy 3: Policies aimed at leave and pre-school services increase, but monetary transfers remain unchanged. This strategy includes a design of leave with a gender equality perspective and universal places in public pre-schools services to guarantee access to this educational stage for the entire population aged 0–3.
    - Total duration of parental leave (DMAL + DFAL) increases to 240 days. DMAL and DFAL are not concurrent (OVLP goes from 0 to 1).
    - Number of seats in public schools (XPUB) increases from 208,516 places to a maximum scenario in which XPUB is equal to the total number of children aged 0–2, reaching universality.

- Strategy 4: Places in pre-school services increase, but leave and monetary transfers remain unchanged. In this model, priority would be given to educational services.

    - Number of seats in public schools (XPUB) increases from 208,516 places to a maximum scenario in which XPUB is equal to the total number of children aged 0–2, reaching universality.

- Strategy 5: Monetary transfers are increased aimed to reduce child poverty, but the rest of the policies remain unchanged. In this scenario, the Birth Grant would be recovered and the Child Benefit would be universal, eliminating its current conditional nature, as is nowadays only for employed mothers.

    - The amount of the Child Benefit (ECCB) increases from EUR 100 to EUR 300 throughout the 0–3 period and with universal coverage (XCCB).
    - The Birth Grant (RBIG) is resumed with the previous conditions, a lump sum of EUR 2,500 euros, and with universal coverage (XCBG).

- Strategy 6: Designs a scenario in which all the policies increase simultaneously. In this strategy, all the new values for the variables mentioned in the previous strategies are incorporated.

As mentioned above, these different scenarios have ideological connotations and reflect diverse perspectives on social and gender equality, so their impact should not be analyzed solely in terms of fertility, but also regarding other dimensions. The complete list of input control variables is listed in Annex 3 of the Supplementary File.

## 4. Results

### *4.1. Expected Trends in Fertility Rates Applying Genetic Algorithms (2020–2060)*

The results obtained from the application of the two genetic algorithms and the strategies designed in public policies to modify the evolution of fertility in the period 2020–2060 are presented below. Figure 2 shows how each of the policies—input variables—will evolve to achieve the maximum possible fertility according to GA1 ("free") and GA2 ("intentional"). It must be noted that when both algorithms coincide the figure seems to reflect just one since both trends overlap.

The analysis carried out using the two genetic algorithms makes it possible to identify which model of family policies—GA1 (free) or GA2 (conditioned to gender and social class perspectives)—would produce a higher increase in fertility.

In relation to the policies included in the parental leave sub-index, both genetic algorithms agree on two elements: They consider positive, in terms of fertility, the simultaneity of the mother's and father's birth leaves (OVLP) and they also identify the relevance of increasing the maternity leave (DMAL) up to double the current one, that is, from 112 to 240 days. Nonetheless, they show differences with respect to the father's leave (DFAL): The GA2 considers it is positive to increase the leave of the father to the level of the mother's leave, while GA1 does not contemplate the equalization of leaves. Both algorithms, in short, point to the need to increase the total duration of parental leave, but the unequal distribution in terms of gender proposed by GA1 would make it difficult to move towards a model of co-responsibility and paternal involvement that requires a parental leave design known as "fathering alone" (O'Brien & Wall, 2017).

With respect to monetary transfers, the two genetic algorithms propose different scenarios. They both identify that it is beneficial in terms of improving fertility rates to increase the amount assigned by the Child Benefit, but GA1 proposes reducing its duration and coverage significantly, which would actually imply a decrease in female employment, as it currently depends on the employment status of the mother. This model is intended to boost fertility by adopting traditional gender roles in which gender inequality is assumed and care is delegated to the mother. Likewise, GA1 proposes to re-introduce policies that have already disappeared or have not existed in Spain, such as the Birth Grant and Cash for Care, a monetary transfer that is given to families who decide not to enroll their children in pre-school institutions, a measure which is controversial in countries such as Norway as it is normally used by vulnerable segments of the population and constitutes a barrier to early schooling, reproducing existing inequalities (Aassve & Lappegård, 2009).

Finally, with regard to the provision of public schools for children aged 0–2, GA1 may seem to offer a higher number of seats in public schools. However, this initial interpretation needs further clarification. XPUB, defined as the number of seats offered in public schools, has a limit: the total number of children aged 0–2 since it would make no sense in offering more seats than children. Thus, the apparently higher provision offered by GA1 needs to be analyzed with the data shown in Figure 3, showing the coverage of pre-school public places existing for the total number of children aged 0–2.

Figure 3 shows that indeed the coverage of XPUB is significantly lower under GA1, since the total number of children (XCHI) is higher than the offer of seats in public schools (XPUB), whereas both data (XCHI and XPUB) are coincident under GA2, meaning universal coverage. It is important to remember that pre-school seats are the most useful resource for achieving a satisfactory work–life balance and enhancing gender and social equality, elements which help to increase fertility and fulfill other aforementioned social demands (Sanz et al., 2019).

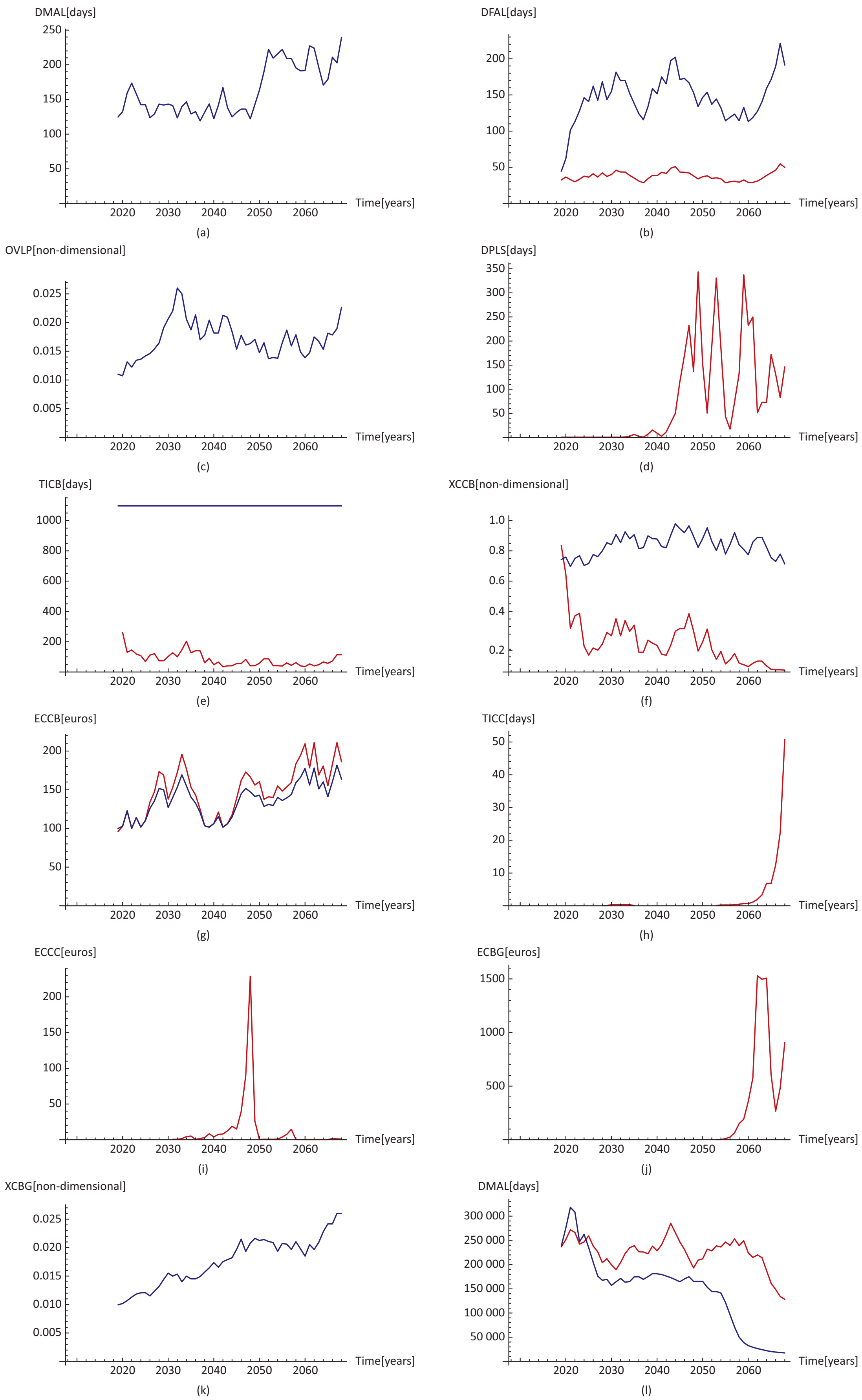


**Figure 2.** Future simulation (genetic algorithm) of family policies (disaggregated): Spain, 2020–2060. Notes: The GA1 (free) is presented in red and the GA2 (conditional on goals consistency) is presented in blue.

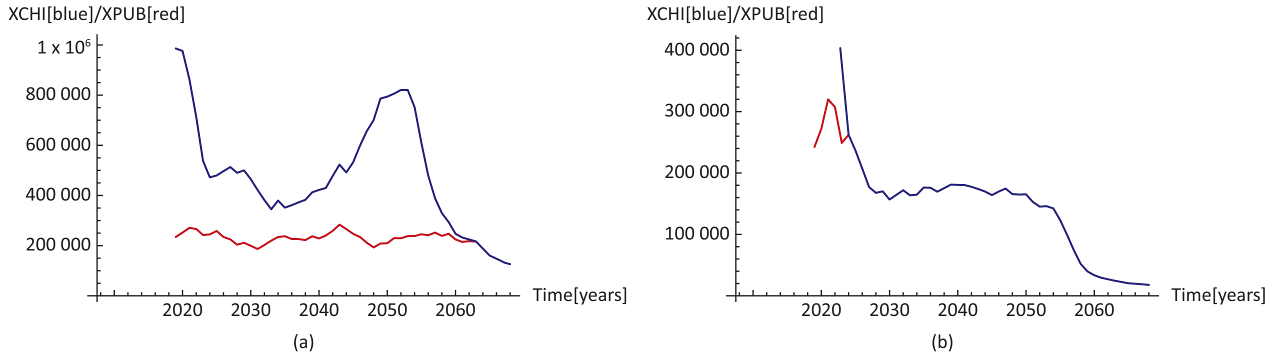


**Figure 3.** Future simulation (genethic algorithm) of XCHI and XPUB: Spain, 2020–2060. Notes: (a) GA1 (free) and (b) GA2 (conditional on goals consistency).

These results show that the algorithms designed in this research reflect the intentionality of the policies in the different models considered. In this sense, GA2 incorporates gender and social equality in the proposal and consequently mirrors recent trends in fertility rates in Spain, while GA1, in which there is no explicit intentionality in the target, represents reference values provided from past periods when family policies were designed based on traditional gender roles.

Based on the evolution of family policies proposed by each of the algorithms, Figure 4 shows the future evolution of fertility depending on the model of family policies, measured with the XFPI.

Furthermore, the results obtained from the future extrapolation of the two genetic algorithms show that GA1 foresees the potential boost in fertility associated with an archaic model of family policies, based on an involution in terms of gender equality. Moreover, GA2 represents the other side of the coin, as it predicts that a significant increase in investment in family policies would not be sufficient to reverse the current decline in fertility.

### *4.2. The Expected Evolution of Fertility Rates Applying Strategic Scenarios (2020–2060)*

Figure 5 shows the impact on fertility of the six strategies defined above with diverse evolutions on the set of family policies.

The six strategies designed oscillate between stagnation in the current model of family policies and different versions of growth and development of family policies, strategies that would imply a very uneven growth in terms of the Family Policies Index and, ultimately, of public investment. However, despite the diversity of scenarios in family policies, none of the outcomes represents a significant increase in fertility; they all forecast a future sharp decline in fertility rates, as can be observed in the first part of Figure 5. This trend indicates that reversing the current—and already prolonged—decline in fertility requires collective solutions that are beyond public policies aimed at families.

The model used incorporates family policies but does not include other structural barriers that have been mentioned at the beginning of this article as determinants of fertility, such as the instability of the labor market, the lack of work–life balance resources, or, more recently, the scenario of uncertainty provoked by international conflicts and the pandemic. In this sense, it is worth noting the slight recovery in fertility that is being observed in the Nordic countries after the Covid-19 pandemic is probably explained by the increasing support received by families to care for minors in a critical context, in which work and care conditions had to be adapted to the socio-sanitary requirements. These measures generated confidence in the citizens in the public support provided to develop their vital projects and also reduced

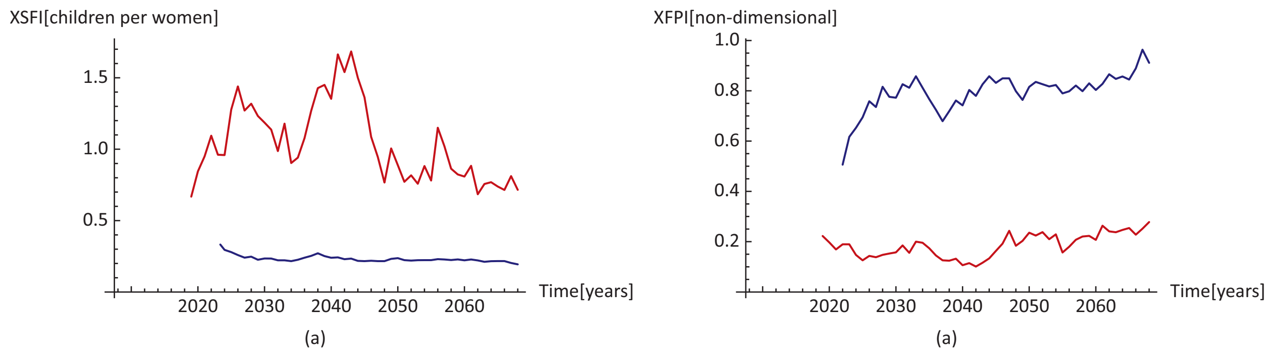


**Figure 4.** Future simulation (genetic algorithm) of fertility and the Family Policies Index: Spain, 2020–2060. Notes: The GA1 (free) is presented in red and the GA2 (conditional on goals consistency) is presented in blue.

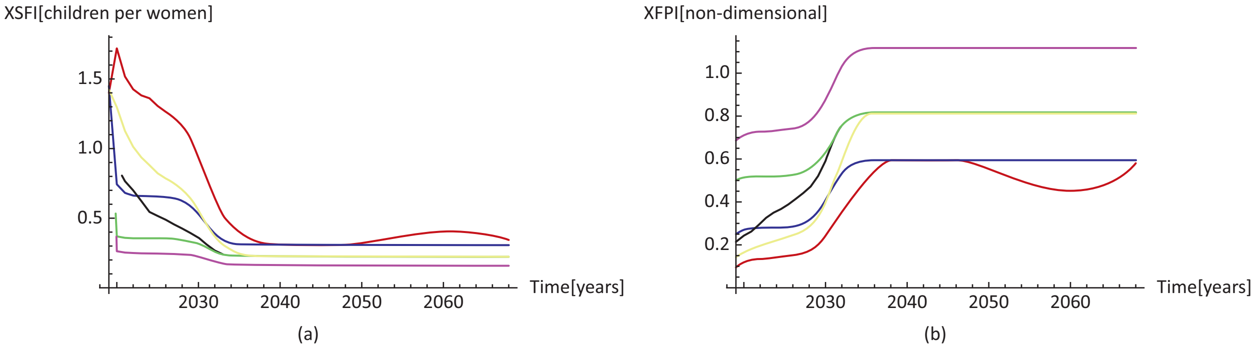


**Figure 5.** Future simulation (2019–2060) of fertility in Spain depending on different strategies. Notes: The red line represents Strategy 1; the black line represents Strategy 2; the green line represents Strategy 3; the blue line represents Strategy 4; the yellow line represents Strategy 5; the purple line represents Strategy 6.

uncertainty against a background of risk, ultimately influencing the decision to have children (Lappegård et al., 2022; Nisén et al., 2022). The inadequacy (or absence) of these measures in Spain certainly explains the limitations that the family policies included in this research face to become drivers to reverse the acute fertility decline that this country is experiencing.

## 5. Conclusions

Family policies have the capacity to generate social change processes in matters that are socially useful and which constitute social commitments, such as gender equality or the reduction of social inequality. Their development is therefore a positive goal in itself, regardless of the impact they may have on fertility.

The results of this research reflect, ultimately, that the use of mathematical models in the design of public policies requires a rigorous approach and awareness of the intentionality associated with those models. In this line, GA1 is effective in terms of increasing fertility rates but nonetheless represents a very significant regressive scenario in terms of gender equality. The outcome of the scenarios in which family policies move towards a more equal society shows that the decline in fertility will not reverse. Nonetheless, this apparently contradictory situation in terms of fulfilling social demands might find a solution if there were a reduction in uncertainty and an enhancement of citizens' well-being. This article shows how family policies seem insufficient to reverse declining fertility trends, and the outcomes obtained may be useful to redesign the conditions offered to families by public institutions to compensate for growing contextual risks. Certainly, the context of social, political, and economic uncertainty has increased in recent years with a pandemic, climatic and economic crises, and wars, but the institutions have not been able to cushion the effects of these contingent events to provide favorable circumstances for having children.

Indeed, Spanish society is making significant progress towards equality, but other objectives, such as family satisfaction and well-being, seem to be suffering noteworthy setbacks in recent years. This is reflected in the widening distance between the number of children families desire and the children they actually have. Although this gap is not always visible, it represents the existence of material limitations or shortcomings in public resources that prevent families from developing their life projects. The decline in fertility is undoubtedly a social problem that affects Western societies at large in the progressive process of ageing. But families too, at a micro level, demonstrate that their desires are gradually diverging from reality.

New social policies are needed to improve social equality and also increase fertility. Otherwise, the apocalyptic scenarios indicated by the mathematical models used in this research could lead to dystopias that we only know today through the metaphors provided by fiction, which activates latent social fears concerning the absence of births. In this sense, *The Handmaid's Tale*, a novel written by Margaret Atwood in 1985 that has been successfully adapted to a television series, reflects these anxieties together with the involution of social equality. Therefore, this research should prompt us to rethink the current situation and avoid moving along a path that we already know, translating our fears into a real scenario.

The results of this research provide new empirical evidence, applying an innovative methodology, to the field of study of family policies, challenging us to reconsider the current architecture of resources offered to families to reverse the decline in fertility and move towards a more equal society.

However, it is important to point out the limitations of the analysis carried out: The demographic model is fed with a specific—and limited—menu of family policies to facilitate international comparison, but it might integrate additional family policies; also, the study is restricted to the period when children are aged 0–3 years old but this period might be expanded to show different approaches towards work–life balance that may influence reproductive decisions. This article proposes to open future research lines related to the above limitations, incorporating new input variables in the model, such as issues related to the functioning of the labor market or income-related inequalities, among others.

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## Conflict of Interests

The authors declare no conflict of interests.

## Supplementary Material

Supplementary material for this article is available online in the format provided by the authors (unedited).

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