Rural History (2025), 1–21
doi:10.1017/S0956793324000244

CAMBRIDGE UNIVERSITY PRESS

RESEARCH ARTICLE

Life and death under son preference: Economic stress, fertility, and early-life mortality in rural Spain, 1800–1910

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Abstract
Based on longitudinal micro data from 13 Spanish rural villages between 1800 and 1910, this paper assesses whether discriminatory practices affected fertility and sex-specific mortality in infancy and childhood during economic crises. Our contribution is twofold. On the one hand, there is a connection between short-term economic stress, fertility, and sex ratios at baptism: high-price years were followed by a decline in the number of registered baptisms and by an increase in sex ratios at baptism. These results, therefore, suggest that families mortally neglected a significant fraction of their female babies during economic crises. On the other hand, there is a connection between short-term economic stress, mortality, and sex ratios at death. Using death registers further supports this interpretation, since our evidence shows that the female biological advantage was not visible after an economic shock.

Introduction

Traditional societies have often treated sons and daughters differently due to economic, social, and/or cultural considerations that affected the relative value of boys and girls (Williamson, 1976; Das Gupta et al., 2003). Son preference usually translated into an unequal allocation of resources. This can be clearly observed when examining investments in education. Gender discriminatory practices, however, could have also affected the relative survival of boys and girls if they also involved differential treatment in terms of food and/or care. In contexts characterised by low standards of living and high-mortality rates, this kind of discriminatory behaviour could, in turn, have affected girls' health and, subsequently, their chance of survival. More extreme manifestations of female neglect, including female infanticide, were also common in contexts where women and girls suffered an especially disadvantageous status.

These practices are still visible in South and East Asia and other developing societies and have resulted in millions of "missing girls" (Sen, 1990; Klasen and Wink, 2003; Jayachandran, 2015). Although the prevailing view argues that historical Europe hardly suffered from these issues (Derosas and Tsuya, 2010; Lynch, 2011), recent studies relying on nineteenth-century population censuses and parish registers have documented both unbalanced child sex ratios and excess female mortality. This suggests that discriminatory practices associated with son preference unduly increased female mortality during infancy and childhood, especially in some regions in Southern and Eastern Europe (Beltrán Tapia and Gallego-Martínez, 2017, 2020; Beltrán Tapia, 2019; Marco-Gracia and Beltrán Tapia, 2021; Beltrán Tapia and Raftakis, 2022; Szoltysek et al., 2022).[1]

By limiting access to resources, economic crises can trigger or accentuate gender-discriminatory practices. Families facing difficult circumstances need to implement different strategies to ensure their survival. Many studies have indeed stressed the link between short-term economic stress and demographic behaviour in the past, in terms of fertility control, marriage, and mortality rates (Bengtsson, 2004; Dribe and Scalone, 2010; Van Bavel and Kok, 2010; Jennings et al., 2017). Similarly, in the Spanish context, we have observed similar results in the nineteenth century, where a connection was established between economic crises and a decline in fertility rates, coupled with an increase in mortality, particularly in infants and children (Pérez Moreda, 1988; Reher, 1988, 1990; Reher and Ortega, 2000; Reher and Sanz-Gimeno, 2000; Catalán and Lanza, 2015). Furthermore, within the same field of research, a clear association has been found between short-term economic stress and a decrease in fertility, with a one-year delay particularly evident among the lower socio-economic groups (Marco-Gracia, 2021a).

According to the cited articles, the response to short-term economic stress varied depending on socio-economic status (SES). For the lowest SES groups in the nineteenth century and earlier, a year of economic stress could mean the difference between the survival of an entire family or the loss of one or more members due to malnutrition (i.e., Bengtsson, 2004). Alternatively, it could severely impact their physical well-being. Consequently, there has been a prolonged debate in historical demography regarding whether families employed strategies to manage these short-term economic crises (such as prioritising the nutrition and health of those family members with the greater potential to generate income or exercising control over fertility). Therefore, socio-economic status could have played a pivotal role in how families navigated short-term economic stress. Potentially, more pronounced effects of mortality and fertility control could be observed in the poorest socio-economic groups (Jennings et al., 2017; Molitoris and Dribe, 2016).

Less attention, however, has been paid to the differential effect that these crises had on boys and girls. Recent research on Southern Europe, nonetheless, argues that parents resorted to female neglect as a mechanism to control the size and sex composition of their offspring (Marco-Gracia and Beltrán Tapia, 2022; Beltrán Tapia and Raftakis, 2022; Beltrán Tapia and Marco-Gracia, 2022). These studies suggest that poverty indeed played an important role in fostering discriminatory practices, increasing female mortality in infancy and childhood in nineteenth-century Spain. Interestingly, harsh years appear to be associated with higher sex ratios at birth in Modern France and Italy (Hanlon, 2016). Following this argument, it is thus plausible to hypothesise that, in areas where son preference was strong, males were prioritised during periods of economic stress.

Unveiling patterns of gender discrimination in infancy and childhood is, however, especially challenging because males are biologically more vulnerable and their mortality rates are naturally higher, especially during the first year of life. Due to poor living conditions, the lack of hygiene and the absence of public health systems, this male frailty was especially visible in the high-mortality environments that characterised pre-industrial Europe (Beltrán Tapia, 2019), and particularly so in the harsh circumstances resulting from periods of scarcity (Zarulli et al., 2018). We can indeed argue that the effect of economic crises on early-life mortality is confounded by the interaction between biological factors and discriminatory practices: while prioritising boys can mitigate the male vulnerability, similar practices, or even more extreme forms of female neglect, will reduce the female biological advantage.[2]

Based on longitudinal micro data from a rural region in north-eastern Spain between 1800 and 1910 (almost 34,000 individuals), the aim of this article is to analyse whether short-term economic stress affected the birth rate[3] and relative mortality of males and females both around birth and during infancy and childhood. Using relative prices as a measure of scarcity, our results show that harsh years had a particularly negative effect on the survival of girls, both right after birth and during infancy and childhood. In particular, the empirical exercises carried out here show that the number of female baptisms declined following a price crisis. It should be noted that, although baptism was free, the funeral costs for both adults and children represented a financial burden for

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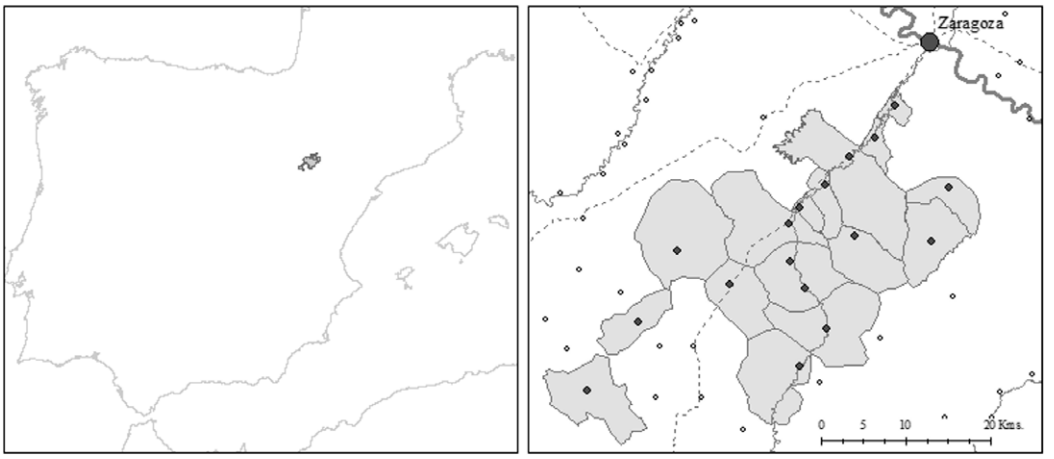

Figure 1. Area of study: Middle Huerva (Aragón, Spain).
Note: Dark dots refer to the localities studied here (except Zaragoza, the provincial capital) and the corresponding shaded areas to their municipal boundaries. Apart from rivers (in grey) and main roads (dotted lines), the map also depicts neighbouring villages (white dots).

the family. Therefore, during times of resource scarcity, there may have been incentives to avoid baptisms if there was a belief that the baby was at risk of early death.

In addition, our results show that, despite the biological female advantage, economic crises did not take a greater toll on boys, thus suggesting that discriminatory practices helped to counterbalance the biological male vulnerability. Behavioural practices against girls are visible in children aged six months and above. This suggests the possibility of structural disparities in the allocation of care and food resources in favour of males.

By focusing on the behaviour occurring during economic crises when families were most vulnerable, this article sheds more light on previous studies arguing that discriminatory practices unduly increased female mortality during infancy and childhood in historical Europe (Beltrán Tapia and Szoltysek, 2022). In this regard, this article explores the role played by resource constraints in fostering discriminatory practices in contexts where son preference is strong, as demonstrated in previous studies for the same study area (Marco-Gracia and Beltrán Tapia, 2021; Beltrán Tapia and Marco-Gracia, 2022).[4] Taking these practices into account is, therefore, crucial to fully understand both the traditional demographic regime and the subsequent transition to lower fertility and mortality rates. In regions where son preference was strong, the biological female advantage was compromised by discriminatory practices during infancy and childhood, especially in periods of economic deprivation. The gradual disappearance of these practices, in the context of increasing living standards, would therefore contribute to explaining the improvement in girls' health that took place during the demographic transition.

Area and data

Area

This study uses longitudinal micro-data from a rural area in north-eastern Spain. Located around 6–40 kilometres away from Zaragoza, the regional capital (see Fig. 1), this area is formed by a combination of plains and foothills near the Huerva river and comprises 13 small municipalities.[5] Most of the population lived in nuclear households and was essentially engaged in agriculture (mostly wheat and some wine) and sheep grazing. Throughout the study period, agricultural labourers made up approximately 80% of individuals with declared occupations in the census.

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About 10% were low-skilled artisans, while a little over 5% held upper-class occupations, primarily teachers, doctors, and veterinarians.

The predominance of nuclear families did not imply a detachment from extended family ties, as over 50% of children who survived to adulthood remained in their birthplace or nearby localities, allowing them to maintain familial and friendship support networks (Reher, 2004). This represents a classic demographic model of nuclear family structures within an agrarian setting, which would only come under strain with the demographic transition and subsequent socio-economic changes (Devolder, 1999). Inheritance systems were characterised by relatively equal distribution among sons and daughters, with marriage and the death of the first parent serving as key moments in the transmission of assets (Jarque and Salas Auséns, 2007). Households were officially headed by the husband/father, who maintained greater control over family property, except for assets received by the wife at the time of marriage.

In terms of land access, the study area was characterised by small plots that were divided among heirs, resulting in a predominant pattern of families owning some land yet unable to sustain themselves solely through that ownership. Approximately 15% of household heads were farmers able to subsist exclusively on their land, though none were large landowners. Large estate owners were rare but included, during the study period, the marquises who had retained manorial rights over these areas (and thus kept property ownership) and a few large proprietors from neighbouring localities who purchased land in the area to expand their holdings. It was only in the first half of the twentieth century (after the period studied) that the sale of extensive properties by heirs of the nobility enabled substantial groups of local owners to acquire sufficient land for self-sustenance (Marco-Gracia and González-Esteban, 2024).

In relation to literacy acquisition, it was significantly influenced by parental education and the broader socio-economic context. Studies on the region indicate that a child's likelihood of reporting literacy was closely tied to whether their parents were literate, reflecting a strong intergenerational correlation, especially during the 19th century when illiteracy was widespread (Luque de Haro and Marco-Gracia, 2024). Access to education was often constrained by the opportunity cost of children's labour in agriculture and the limited value placed on basic education by many parents, who were themselves often illiterate. Although the Moyano Act of 1857 established compulsory schooling, aiming to provide free education to those unable to afford it, its impact was limited. Compliance with compulsory schooling laws was low, as local councils, responsible for funding schools, faced financial challenges and varied attitudes towards education. These constraints, coupled with broader social, cultural, and political attitudes towards literacy, and the region's low level of development, restricted both the supply and demand for education (Martínez Galarraga and Beltrán Tapia, 2018). As a result, literacy rates improved only gradually in this rural area, where economic necessity frequently prioritised labour over schooling.

Demographically, prior to the onset of the demographic transition, most of the population in these villages practised natural fertility, meaning that married couples had children without actively using fertility control methods. This practice led to high fertility rates with no restrictions on the timing of childbirth within marriage. Consequently, families had large numbers of children, with births continuing until the mother reached menopause (Marco-Gracia, 2018). On average, Aragonese families had around seven children until the early twentieth century. However, this high number of births, combined with a greater survival rate of children, eventually contributed to population growth, thereby increasing demographic pressure over time. Infant and child mortality rates remained high, with only about half of infants surviving beyond age five. Similar to broader national trends, mortality rates began to decline toward the end of the nineteenth century, due to a decrease in epidemic crises and a reduction in water- and food-borne infectious diseases.

The demographic transition began during our study period in the study area. The peak of mortality occurred in the 1860s, and since then, childhood mortality began a slight decline, which continued to increase over the decades. Fertility control began in the early twentieth century (with women born in the 1870s and 1880s) and intensified particularly in the 1930s and 1940s,

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with the impact of the Civil War. The fertility transition was based on stopping, with very little use of spacing throughout the study period (Marco-Gracia, 2018). Regarding the evolution of gender preferences in the study area, previous research has shown that a preference for sons persisted into the first half of the twentieth century (Beltrán Tapia and Marco-Gracia, 2022; Marco-Gracia and Beltrán Tapia, 2022). However, it is possible that during the early decades of the twentieth century, these preferences shifted towards a preference for mixed-gender offspring, while still maintaining a greater interest in sons than in daughters (Marco-Gracia, 2021b). The inheritance systems, access to land, and the predominance of men as heads of household were not significantly altered during the study period.

In terms of living standards, the average height of Aragonese men during the nineteenth century was approximately 160 centimetres, according to historical measurements. These measurements indicate that biological well-being was low, as the height was considerably below the European average and even lower than that of other regions of Spain (Hatton and Bray, 2010). Even by 1924 (after the period studied here), the average household income was insufficient to support a nuclear family of two adults and two children with an adequate diet, even in the nearby city of Zaragoza, where wages were slightly higher than in rural areas (Marco-Gracia and Delgado, 2024). This, along with additional qualitative evidence, such as records from archbishops' delegates during pastoral visits, leads us to categorize the study area as a poor region, where most of the population lived close to subsistence levels. Under these conditions, economic shocks, like those caused by price crises, often jeopardise the survival and well-being of entire families.

Spanish women suffered a subordinate position that was not only visible in legal terms but also in the public and the private sphere (Borderías et al., 2010; Borderías and Muñoz, 2018). As well as cultural and religious values, the status of women was linked to the importance of male labour in agricultural contexts (Alesina et al., 2013; Giuliano, 2018). As well as being less able to contribute monetary income to the household (Camps, 1998; Germán, 2009), girls had to provide a dowry for their marriage and inheritance practices tended to favour male heirs. Economic considerations alone could therefore justify potential son preference. The gender literacy gap in the area of study was indeed remarkable, thus evidencing that parents invested differently in boys' and girls' education.[6] Recent research goes further and argues that discriminatory practices, including neglect, affected female mortality rates right after birth and during infancy and childhood (Marco-Gracia and Beltrán Tapia, 2021; Beltrán Tapia and Marco-Gracia, 2022).

In an area where poverty was widespread and son preference prevailed, the way families allocated their scarce resources mattered and discriminatory practices could have had lethal consequences. Periods of economic stress increased the need for rationing scarce resources, so studying these events can further test this hypothesis. In order to explore whether short-term economic difficulties affected boys and girls differently, this article links information on prices with the complete church registers of these villages. The latter provides high-quality information on all births, marriages, and deaths, thus enabling the reconstitution of their complete life histories.[7] In total, this article employs information on almost 34,000 individuals born between 1800 and 1910, including name, sex, place and date of birth, parents' names and date of death, among others.

Data

This longitudinal dataset has also been complemented with the information on occupation and literacy contained in population lists (1747–1830), population censuses (1857, 1860), and electoral rolls (1890–1955). The population censuses contain data on occupation and literacy for all individuals in the study area, while the population lists include only the occupation of individuals over the age of 7, and the electoral rolls contain occupation and literacy data for all adults (with women appearing only after gaining the right to vote in 1931). The information was linked through an automated record linkage process using matching on the first name, both surnames (following the Spanish system), and year of birth (calculated from age) using Stata 14, with a

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matching threshold of 90%. When the match was not exact, the record linkage was manually reviewed on an individual basis to ensure the quality of the matching. Data on family characteristics (such as the number of children/siblings of each sex) were extracted from parish records once the family had been reconstituted (and therefore not from the census data). In cases where an individual changed profession throughout their life (or was recorded with different occupations in various censuses), the occupation closest to adulthood (typically around 40 years of age) was used as the reference.[8]

We should nonetheless bear in mind that, since we rely on local records, we do not have all the information on those individuals who migrated to or out of our study area.[9] For the study period, we have no additional demographic events (such as marriage or death) recorded for 27% of children initially registered at baptism. Nearly 10% of these children came from families that did not record any further demographic events in the study area (suggesting that they likely left the area). Additionally, from occasional annotations (which were not mandatory) in the baptismal records – providing information on sacraments like confirmation, marriage, or death – we know that at least 15% of this 27% survived into youth, while only 2% were noted as having died before age 10 in another parish (although these data should be treated cautiously, as they were neither mandatory nor systematic). In any case, based on available information, we have several indications and safeguards suggesting that we are generally not introducing a bias by inaccurately capturing childhood mortality. However, small selection biases may be introduced that could influence the intensity of the coefficients, though they should not affect the sex distribution. In addition, given that we focus on children (young ages), this issue is somewhat limited.

This information is complemented with data on wheat prices from the city of Zaragoza (Peiró, 1987). Leaving aside self-consumption, the surplus of the wheat harvest from our area of study was sold, directly or through intermediaries, in Zaragoza, the regional capital. In order to ensure the quality of the demographic information, we focus on the period from 1800 to 1910. Likewise, instead of calendar years, we contemplate annual harvest years. We, therefore, consider prices from the summer harvest to the beginning of the following year's harvest (from July to June) and associate each birth and death with the corresponding harvest season. For instance, a child born in August 1862 would be considered to have been born in the harvest year spanning from July 1862 to June 1863.[10] Figure 2, panel A, plots the raw data used here: the major economic crises took placed during the early nineteenth century (around 1802 and 1810) and price variations became more moderate over time. The evolution of wheat prices in Zaragoza is similar to that in the whole of inland Spain (Gallego Martínez, 2004).

In this context, high wheat prices were generally a result of reduced production, leading to food scarcity rather than increased income for local producers. Throughout the 19th century, there was a gradual process of market integration, beginning before the construction of the railway linking Zaragoza with Barcelona in 1862 and intensifying afterwards (Pinilla Navarro, 1995). Even so, studies confirm that years of high prices corresponded with declines in birth rates and increased mortality, indicating severe economic and nutritional stress for the community (Marco-Gracia, 2021a).

Following the pioneering studies that analyse the link between short-term economic stress (Bengtsson et al., 2004; Bengtsson and Dribe, 2006),[11] the data have been detrended using a Hodrick-Prescott (1997) filter and harsh years are subsequently identified as those showing an increase equal to or greater than 10 per cent from the average price.[12] This figure serves to delimit the threshold at which the effects of an economic stress year were visible and affected the majority of the population. In this regard, while a 10-per cent variation in prices is serious enough to affect household consumption, it also allows prices to reach this threshold several times during the nineteenth century and therefore provides enough variation to identify its effects on demographic processes. In particular, following this method, we have identified 23 wheat-price crises between 1800 and 1910 (out of 110 years; see Fig. 2, Panel B).[13] In our area of study, these kinds of price variations disappeared at the end of the nineteenth century, so it is not necessary to extend the

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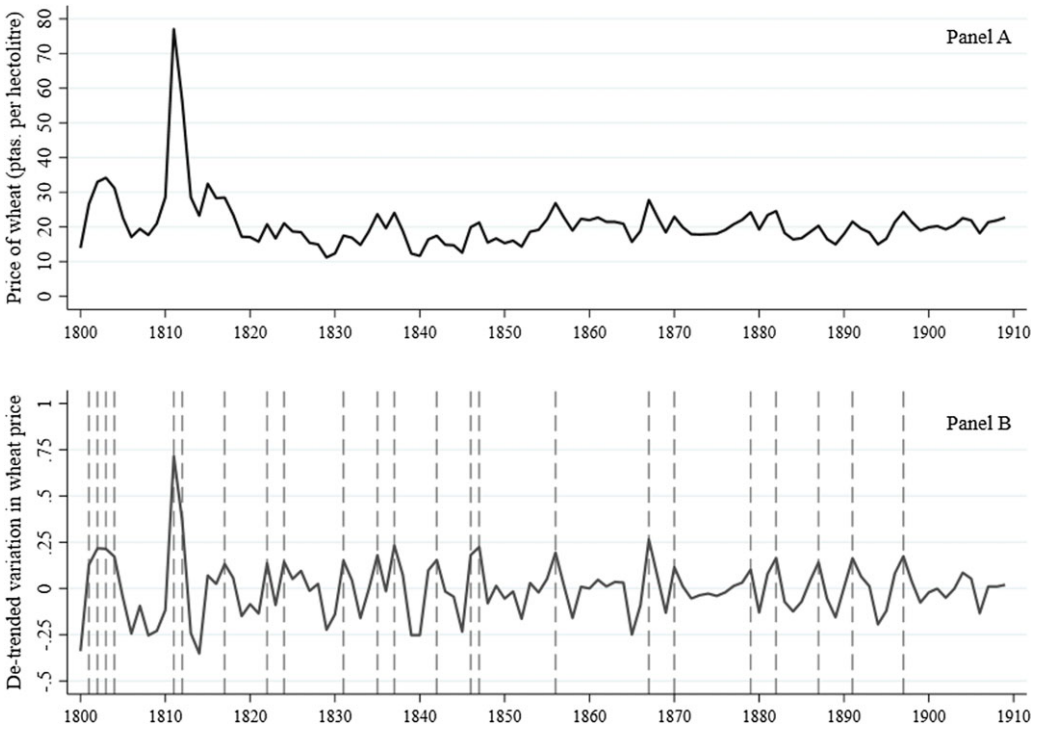

Figure 2. Annual evolution of the price of wheat in the city of Zaragoza.
Note: In Panel A, the unit of measure is *pesetas* per hectolitre. In the detrended price in Panel B, prices are measured in logs (average price = 0). High-price years, denoted by dashed lines, are those when the annual price is over 10% compared with average price.
Source: Peiró (1987).

period of study. Once we have identified the crisis years, we can assess how economic crises affected demographic behaviour. While "Methodology" focuses on births and potential neglect right after birth, "Gender discrimination around birth in times of short-term economic stress" explores whether high-price years affected sex-specific mortality during infancy and childhood.

Methodology

The estimations included in the article are mainly based on the logit method and the Cox Proportional-Hazards (onwards COX PH) survival analysis model. We have used logit models to analyse events for which we have no observation period (e.g., probability of being baptised as a man or woman) or for which the observation period is very short (e.g., deaths during the first day of life, first week or first month). Logit models are a probability-based methodology that is useful when dealing with a binary dependent variable (such as being male or female) and various independent variables, both linear and categorical (Cramer, 2003; Hess and Train, 2017). The logit models can be expressed as follows:

$$P_i\ (male = 1) = \frac{1}{1 + e^{-(\alpha+\beta_1 * X_{1i}+\beta_2 * X_{2i}+\ldots)}} + \varepsilon$$

where *P* (left-wing=1) is the dependent variable (being male or female), for an individual i, βn, is the parameter, Xn denotes the independent variables used in each model, and ε is the error term. In addition, in order to analyse the joint significance of the independent variables, we have

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performed a likelihood ratio test and found that the test statistics follow a χ^2 distribution, which supports the explanatory power of the model.

In this case of analysing a long observation period, we have used COX PH regressions when studying the probability of death between 1 month and 10 years. The Cox regression method offers significant advantages in terms of flexibility, the ability to handle censored data and less restrictive assumptions compared to other analysis methods. Over the last few decades, the COX PH model has become widely used in studying disparities in mortality (Bengtsson and Lindström, 2000; Edvinsson and Broström, 2012; Edvinsson and Lindkvist, 2011; Schenk and van Poppel, 2011).

To prepare the underlying data for the COX PH models, we have applied the counting process format, enabling the use of multiple lines of data for a single individual. This approach subdivides the total at-risk follow-up time into smaller intervals. This format is recommended when using age-at-follow-up time as the outcome variable rather than time of follow-up. It also enables the inclusion of time-dependent variables, such as years of high prices, both at t and t−1 (Kleinbaum and Klein, 2012). One of the reasons for this selection is that using a model based on age at the time of the event rather than one based on the observation time of the individuals may be preferable if age is a stronger determinant of the event of interest (in our case death) than the observation time. In any case, the control variables include the date of birth to consider the impact of economic improvements, advances in health and medical knowledge, as well as possible cultural changes on the probabilities of survival.

The risk function of the COX PH model for an individual with the characteristics of vector X can be formulated as follows:

$$h(a,\ X) = h_0(a|a_0)\exp[\sum \beta_i X_i]$$

where $h(a,\ X)$ is the hazard of death; $h_0(a|a_0)$ is the baseline hazard – that is, the hazard function for an individual having on all covariates the value 0.

$$i = [\text{Sex, year, village of residence, } \ldots \text{ n}], \text{ with n being the number of variables}$$

$$X_i = \begin{bmatrix} X_{Sex} \\ X_{year} \\ \vdots \\ X_n \end{bmatrix}, \text{ where } X_i \text{ corresponds to the value of variable i.}$$

$\beta_i = [\beta_{Sex}\beta_{year} \ldots \beta_n\ ]$, where β_i corresponds to the value 'beta' of variable i.

The main output of this regression is the relative risk exp(β): If the variable is categorical, the relative risk reflects the ratio between two risk functions; one associated with the value of the variable and the other with the reference category. In case of a continuous variable, the relative risk indicates the impact on the outcome of increasing its value by one unit while keeping all other variables unchanged (Kleinbaum and Klein, 2012).

Gender discrimination around birth in times of short-term economic stress

Panel A in Fig. 3 contrasts the evolution of baptisms with the occurrence of high-price years in our dataset. On average, harsh years experienced around 228 registered baptisms, 12 fewer than in the other years of the sample. Interestingly, the average sex ratios increased during years subject to high prices: while sex ratios during normal harvest years were around 108.3 males per hundred females, this figure increased to 112.2 in bad years (Fig. 3, Panel B).

Observing more males being baptised during harsh years is somewhat surprising because, as mentioned in the introduction, males are biologically more vulnerable both in utero and right after birth (Waldron, 1998; Drevenstedt et al., 2008; Di Renzo et al., 2007; Dipietro and Voegtline, 2017;

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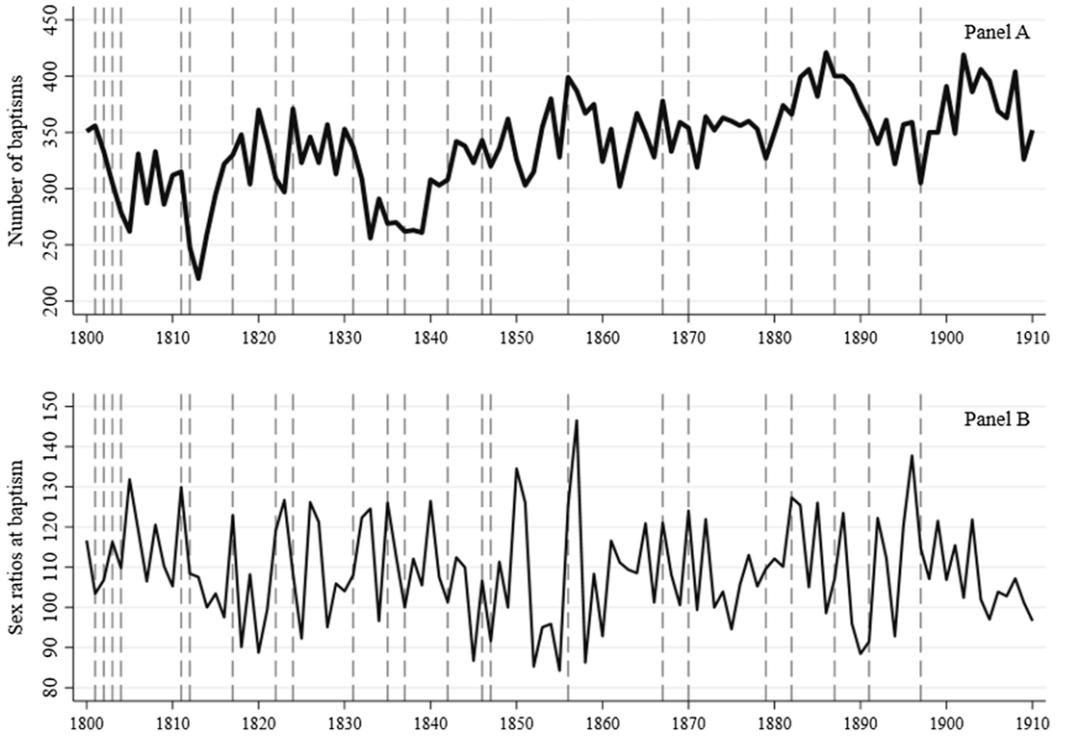

Figure 3. Economic crises, number of baptisms, and sex ratios, 1800–1910.
Note: The dashed vertical lines indicate the years experiencing high prices.

Zarulli et al., 2018). This feature was not only especially visible in the high-mortality environments that characterised pre-industrial Europe (Woods, 2009; Beltrán Tapia, 2019)[14] but should have been even more pronounced in the harsher circumstances characterising those years affected by economic crises. The female biological advantage around birth, therefore, implies that, if anything, harsher circumstances will result in (1) more male foetuses dying before birth (thus decreasing the probability of being born male) and (2) more males dying shortly after birth. This is particularly relevant for our study because, instead of registered births, we use baptismal records. Some infants could have, therefore, died before being baptised and this issue would especially affect boys due to their higher vulnerability.

Apart from less dramatic forms of fertility control, this evidence, therefore, suggests that economic crises fostered the neglect of female babies, thus accentuating discriminatory practices that were also visible in normal harvest years (Beltrán Tapia and Marco-Gracia, 2022). These patterns could, of course, have arisen from other causes, including the possibility of random variation, so they should be subject to a more sophisticated statistical analysis. In order to further explore whether economic crises resulted in female neglect around birth, we have analysed the individual-level information associated with all births occurring in our area of study between 1800 and 1910. Table 1 reports the results of estimating a logit model assessing whether the probability of being baptised male was different during bad years while controlling for individual and household characteristics. While column (1) shows the baseline specification that accounts for birth order and the number of children alive at the moment of birth (as well as a time trend, its square and village fixed effects),[15] column (2) adds a set of additional control variables: mother's age, father's occupation, and literacy. In addition, given that it is unclear whether our variable of interest would be affected by an economic crisis occurring during the same year (t) or the previous

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Table 1. Economic crises and the probability of being baptised male

	Dep. variable: Being baptised male (1/0)					
	(1)	(2)	(3)	(4)	(5)	(6)
High Price (t)	0.048*	0.048*			0.054*	0.053*
	(0.028)	(0.028)			(0.028)	(0.028)
High Price (t−1)			0.048*	0.048*	0.050*	0.051*
			(0.028)	(0.028)	(0.028)	(0.028)
Basic controls	YES	YES	YES	YES	YES	YES
Additional controls	NO	YES	NO	YES	NO	YES
Observations	33,759	33,759	33,437	33,437	33,437	33,437
Pseudo R2	0.0004	0.0005	0.0004	0.0005	0.0005	0.0006

Robust standard errors in parentheses (clustered at the household level); ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$. The basic controls include the number of siblings at birth, parity FE, village FE, year and year squared. The additional set of controls includes mother's age, father's occupation, and literacy.

year (t−1), columns (3) and (4) replicate the analysis but focus on the latter. Finally, columns (5) and (6) consider these two variables simultaneously.

The results clearly indicate that more boys were baptised during high-price years and the following year, even though we would expect the opposite results due to the higher male vulnerability. Although the coefficient is only statistically significant at the 90 per cent level, its impact is considerable: the probability of being baptised male increased from 51.4 per cent in normal harvest years to 52.7 per cent in high-price years (equivalent to going from a sex ratio of 105.8 to 111.4). The effect of the lagged variable is quite similar, and both are visible when considered simultaneously,[16] so the compound impact of an economic crisis on sex ratios at baptism was extremely high.

It can be argued that female under-registration of baptisms may affect the previous analysis.[17] Examining death registers therefore provides further evidence that baby girls were neglected because if under-registration systematically targeted girls, it would have affected both births and deaths around birth. The latter is actually more plausible because, unlike baptisms, registering deaths implies paying a fee. The bias would however now work in the opposite direction, and we would be observing fewer female deaths, thus making it more difficult to identify neglect against infant girls. Therefore, we will now explore whether high-price years affected the probability of dying during the first days of life differently for boys and girls.

Table 2 reports the results of estimating a logit model assessing whether high-price years (both in t and t−1) affected the probability of dying during the first days of life. We have distinguished between those deaths described in the sources as "*nonatos*" (stillbirths), those happening during the first day of life, those during the first week, and those occurring during the rest of the first month. All these specifications control for the same dimensions as before: parity, the number of previous children alive, year, year squared and village fixed effects; (odd columns), plus mother's age and father's occupation and literacy (even columns). In order to explore whether crises affected males and females differently, we have included a dummy variable identifying females as well as the interaction between a high-price year and being female. The latter variable therefore captures the distinct effect of bad years on female mortality right after birth.

Again, we should stress that the female biological advantage implies that more male infants were dying during this crucial period. This is apparent in the coefficient on the variable *female,* which clearly shows that the survival chances were significantly higher for baby girls.[18] The male vulnerability would be more accentuated in bad years, so we would expect that the coefficient capturing the interaction between high-price years and being female to be negative. Our results

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Table 2. Dep. variable: Dying during the period considered (1/0)

	Nonatos		Day 0		Days 1–7		Days 8–30	
	(1)	(2)	(3)	(4)	(7)	(8)	(9)	(10)
High Price (t)	0.026	0.028	0.057	0.056	−0.021	−0.022	−0.016	−0.016
	(0.157)	(0.157)	(0.139)	(0.139)	(0.132)	(0.132)	(0.115)	(0.115)
Female	−0.363***	−0.365***	−0.258**	−0.258**	−0.331***	−0.330***	−0.226***	−0.225***
	(0.128)	(0.128)	(0.112)	(0.112)	(0.104)	(0.104)	(0.087)	(0.087)
High Price (t) × Female	0.149	0.146	0.092	0.093	0.092	0.094	0.164	0.166
	(0.236)	(0.236)	(0.209)	(0.209)	(0.207)	(0.206)	(0.166)	(0.166)
High Price (t−1)	−0.036	−0.042	0.064	0.062	−0.090	−0.090	0.142	0.143
	(0.166)	(0.166)	(0.141)	(0.141)	(0.138)	(0.138)	(0.111)	(0.111)
High Price (t−1) × Female	−0.032	−0.031	−0.203	−0.209	0.273	0.267	−0.064	−0.070
	(0.256)	(0.256)	(0.221)	(0.221)	(0.205)	(0.206)	(0.171)	(0.171)
Basic controls	YES	YES	YES	YES	YES	YES	YES	YES
Additional controls	NO	YES	NO	YES	NO	YES	NO	YES
Observations	33,437	33,437	32,971	32,971	32,898	32,898	32,315	32,315
Pseudo R2	0.0170	0.0231	0.0136	0.0182	0.0129	0.0157	0.0082	0,0099

Robust standard errors in parentheses (clustered at the household level); ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$. The basic controls include the number of siblings at birth, parity FE, village FE, year and year squared. The additional set of controls includes mother's age, father's occupation, and literacy.

actually indicate the opposite: compared to males, females suffered higher mortality rates right after birth during the economic crises defined here. Although the effect is not statistically different from 0, we should bear in mind that we should be expecting a negative coefficient, so the benchmark for comparison is not 0 but a negative value. Discriminatory practices may have, therefore, offset the natural male vulnerability. These results hold regardless of whether we are exploring the contemporary effect (t) or the lagged effect (t−1). These findings support the previous evidence with respect to how high-price years increased the probability of being baptised male. In fact, these two sets of findings should be interpreted jointly: if female under-registration is an issue, our results either overestimate or underestimate female neglect depending on whether we are using baptismal or death registers. Taken together, and bearing in mind the female biological advantage, these results suggest that, in periods of economic hardship, behavioural decisions were acting against the survival of females right after birth.

Discrimination during infancy and childhood in times of short-term economic stress

Apart from parental behaviour right after birth, short-term economic stress may have also fostered discriminatory practices in older infants and children and therefore their sex-specific mortality rates. In order to explore this possibility, Table 3 analyses whether high-price years (both in t and t−1) affected the probability of dying during the first months and years of life. As explained previously, we use COX PH models for analysing long observation periods (however, in Table A1 in the Appendix, we have included logit regression models for individuals older than six months, similar to those presented in Table 2, confirming that both methodologies – logit models and COX PH regressions – yield similar and consistent results aligned with our initial hypothesis).

Table 3 presents the results of the survival model estimation to evaluate whether years of high prices influenced the probability of death in age groups separated into two panels: Panel A: 1–6 months, 6–12 months, and 1–2 years; and Panel B: 2–5 years and 5–10 years and 6 months to 10 years. All these exercises are repeated twice depending on whether they are accounting for the basic or for the extended set of controls described above (odd columns and even columns, respectively). In order to explore whether crises affected males and females in rural Spain differently, we have included a dummy variable identifying females as well as the interaction between a high-price year and being female. The latter variable, therefore, captures the distinct effect of bad years on female mortality risk. Again, we should bear in mind that the female biological advantage implies that boys would have suffered more under adverse circumstances, so not observing mortality differences between boys and girls would constitute indirect evidence of gender-discriminatory practices.

The exponent of the coefficient on the dummy variable female confirms the well-known female advantage, especially during the first six months of life. This advantage was reduced as children grew older and eventually reversed into a female penalty, suggesting that families prioritised their sons even in normal harvest years (Marco-Gracia and Beltrán Tapia, 2022). The exponent of the coefficient that captures the interaction between being female and the variable representing high-price years shows values greater than 1 in all the age groups analysed, although with a reduced degree of statistical significance. However, if, instead of looking at smaller age groups, we analyse the effect between six months and 10 years (columns 11–12), we can see how the value of this coefficient becomes statistically significant. These results are at odds with the male frailty already discussed, thus suggesting again that the distribution of resources and family care clearly affected the sex-specific survival chances and offset the male vulnerability. This effect is particularly telling because the introduction of solid food typically commenced at six months of age in the area of study (see Marco-Gracia and Beltrán Tapia, 2021) and was linked to an increased probability of acquiring gastrointestinal ailments owing to prevailing sanitary conditions (Guinnane and Ogilvie, 2014; Pérez Moreda et al., 2015).

In order to strengthen our estimations and conduct a more detailed analysis of the individual effects of different variables, we have replicated the analyses by including the full set of variables but excluding the gender interaction with high-price years (Table 4). When the price increase

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Table 3. Cox proportional hazard models of mortality for children aged 1 month to 10 years

	Event: Dying during the period considered (1/0)					
	Months 1–6		Months 6–12		Year 1–2	
PANEL A	(1)	(2)	(3)	(4)	(5)	(6)
High Price (t)	0.954	0.951	1.006	0.983	0.980	0.948
Female	0.837***	0.837***	0.959	0.956	1.040	1.040
High Price (t) × Female	1.034	1.031	1.092	1.095	1.074	1.081
High Price (t−1)	0.821**	0.821**	1.109	1.089	0.943	0.922
High Price (t−1) × Female	1.289**	1.278**	0.957	0.953	1.029	1.021
Basic controls	YES	YES	YES	YES	YES	YES
Additional controls	NO	YES	NO	YES	NO	YES
Person months	112,973	112,973	121,658	121,658	202,271	202,271
Deaths	2,496	2,496	2,324	2,324	4,221	4,221
	Event: Dying during the period considered (1/0)					
PANEL B	Year 2–5		Year 5–10		6 months to 10 years	
	(7)	(8)	(9)	(10)	(11)	(12)
High Price (t)	0.916	0.894*	0.968	0.963	0.963	0.939*
Female	1.118***	1.114***	1.232***	1.225**	1.062***	1.059**
High Price (t) × Female	1.107	1.110	1.086	1.089	1.09*	1.095*
High Price (t−1)	1.119*	1.098	1.125	1.120	1.047	1.028
High Price (t−1) × Female	0.854*	0.854*	0.846	0.847	0.937	0.934
Basic controls	YES	YES	YES	YES	YES	YES
Additional controls	NO	YES	NO	YES	NO	YES
Person months	447,272	447,272	632,403	632,403	1,403,604	1,403,604
Deaths	3,499	3,499	1,089	1,089	11,133	11,133

***$p < 0.01$, **$p < 0.05$, *$p < 0.1$; The basic controls include the number of siblings alive at birth, parity FE, village FE, year and year squared. The additional set of controls includes mother's age, father's occupation, and literacy. Note: These models have been replicated employing logit methodology as a robustness check (see Table A1 in the Appendix).

Table 4. Cox proportional hazard models of mortality for children aged 6 months to 10 years. Wheat prices increase by 10 % (PANEL A), 15 % (PANEL B) and 20 % (PANEL C)

	All individuals		Females		Males	
A: Wheat prices increase 10 %	(1)	(2)	(3)	(4)	(5)	(6)
Female	1.065***	1.063**	–	–	–	–
High Price (t)	1.006	1.007	1.061*	1.062*	0.951	0.951
High Price (t−1)	1.013	1.015	0.99	0.991	1.035	1.037
Basic controls	Yes	Yes	Yes	Yes	Yes	Yes
Additional controls	No	Yes	No	Yes	No	Yes
Person months	1,403,604	1,403,604	678,380	678,380	725,224	725,224
Deaths	11,133	11,133	5,625	5,625	5,508	5,508
	All individuals		Females		Males	
B: Wheat prices increase 15 %	(7)	(8)	(9)	(10)	(11)	(12)
Female	1.065***	1.062**	–	–	–	–
High Price (t)	1.006	1.009	1.042	1.046	0.970	0.972
High Price (t−1)	1.067	1.069*	1.040	1.041	1.093**	1.096**
Basic controls	Yes	Yes	Yes	Yes	Yes	Yes
Additional controls	No	Yes	No	Yes	No	Yes
Person months	1,403,604	1,403,604	678,380	678,380	725,224	725,224
Deaths	11,133	11,133	5,625	5,625	5,508	5,508
	All individuals		Females		Males	
C: Wheat prices increase by 20 %	(13)	(14)	(15)	(16)	(17)	(18)
Female	1.065***	1.063**	–	–	–	–
High Price (t)	1.071*	1.072*	1.107*	1.109*	1.033	1.032
High Price (t−1)	1.041	1.043	1.006	1.007	1.078	1,079
Basic controls	Yes	Yes	Yes	Yes	Yes	Yes
Additional controls	No	Yes	No	Yes	No	Yes
Person months	1,403,604	1,403,604	678,380	678,380	725,224	725,224
Deaths	11,133	11,133	5,625	5,625	5,508	5,508

***$p < 0.01$, **$p < 0.05$, *$p < 0.1$. The basic controls include the number of siblings alive at birth, parity FE, village FE, year and year squared. The additional set of controls includes mother's age, father's occupation, and literacy.

surpasses 10% or 15%, there is an increase in the risk of death for the entire population; however, the statistical significance is low. The increase is more substantial (7.4%) and statistically significant when price increases exceed 20%. When we disaggregate the data between males and females, we can observe that the rise in the risk of death during high-price years is concentrated among women. The increase in female mortality risk during high-price years (more than 10%) compared to normal years is 6.3%, and 11.2% if it exceeds 20%. In the case of males, the variations are not statistically significant, and in the first two thresholds, they are even negative. The presence of high prices in year t−1 also results in an overall increase in mortality compared to normal years (1.5% at a 10% price increase, and 4.3% at 20%).

https://doi.org/10.1017/S0956793324000244 Published online by Cambridge University Press

Our results suggest that, in difficult times, families may have prioritised boys in terms of the quantity or quality of the food and perhaps also in the duration of the breastfeeding period. Alternatively, it is also plausible that parents devoted more attention and care to their sons than to their daughters when fighting against the diseases resulting from weaning and the subsequent deployment of the protective effect of breastfeeding.

In high-mortality contexts such as the one in our area of study, minor differences in how these children were treated were likely to have had lethal consequences, especially at sensitive ages. It is probable that other age groups also experienced similar discriminatory practices but their effect on mortality is less visible because they were not so high-risk: infants were protected by breastfeeding (a non-competitive resource) and older ones were subsequently stronger and had survived the dramatic weaning period. The expected male penalty, however, is not visible either. This strongly suggests that this kind of behaviour was also counterbalancing the female biological advantage at these ages.

The impact of socio-economic status and knowledge on mortality differences by sex during short-term economic stress crises

Previous studies on the effect of short-term economic stress have confirmed that socio-economic status has historically been related to changes in family demographic behaviour in response to these crises (Bengtsson, 2004; Dribe and Scalone, 2010; Van Bavel and Kok, 2010; Jennings et al., 2017). The poorest socio-economic groups were compelled to adjust their fertility and experienced the greatest impact on child mortality.

At the same time, in relation to literacy, having greater knowledge had a positive impact on the ability to access better-paying jobs (Vogl, 2014; Bargain and Zeidan, 2017; Bossavie et al., 2021) and being literate was related to having better knowledge about biological well-being and caregiving (Reynolds, 2021). Advanced levels of education tend to be more concentrated in wealthier and more resourceful classes and are frequently used as an indicator of socio-economic status (Link and Phelan, 2002; Link et al., 2018). This factor has received significant attention in the literature as one of the key resources to explain the existence of social disparities in mortality (Clouston et al., 2016; Luque de Haro, 2024). In rural settings like ours, occupational categories are often broad (e.g., 'farmer'), with limited variation. However, significant differences in wealth and resources may still exist within these categories. Literacy therefore serves as an additional, nuanced indicator of socio-economic status, capturing differences that occupation alone may not reveal. This is why in this section, we will explore the relationship between short-term economic stress and child mortality while controlling for parental literacy. Whereas in previous sections, socio-economic status was only used as a control variable (based on parental occupations and father´s literacy), at this point, we will examine the effect of socio-economic level by dividing parents into two groups based on whether either parent was literate or not.

Table 5 displays the models examining the impact of paternal literacy as a proxy for socio-economic status on female care discrimination. In columns 1 and 2, we have investigated models without interactions. The analysis reveals that the coefficient associated with the father's literacy variable is significantly less than 1. This suggests that children aged between six months and ten years with literate parents had a reduced likelihood of mortality during childhood. When analysing the interaction of this variable with the occurrence of high-price years (columns 3 and 4), we can determine that children of literate parents had a noticeably reduced risk of mortality during those years and the subsequent year, compared to children without literate parents.

Furthermore, we have conducted a stratification based on parents' literacy levels. The results distinguish between children of parents possessing reading skills (columns 5 and 6) and those who did not (columns 7 and 8). It is evident from the analysis of models studying the mortality levels of the children of illiterate fathers that, in high-rice years, the mortality risk for females aged between

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Table 5. Cox proportional hazard models of mortality for children aged 6 months to 10 years stratifying by father´s literacy

	(1)	(2)	(3)	(4)
Female	1.065***	1.064***	1.065***	1.064***
High Price (t)	1.006	1.006	1.021	1.020
High Price (t−1)	1.013	1.014	1.037	1.037
Father´s literacy	0.948*	0.951*	0.989	0.991
High Price (t) × Father´s literacy	–	–	0.874*	0.876
High Price (t−1) × Father´s literacy	–	–	0.812**	0.814**
Basic controls	YES	YES	YES	YES
Additional controls	NO	YES	NO	YES
Person months	1,403,604	1,403,604	1,403,604	1,403,604
Deaths	11,133	11,133	11,133	11,133
	Sons of literacy fathers		Sons of non-literacy fathers	
	(5)	(6)	(7)	(8)
Female	1.160***	1.165***	1.041	1.041
High Price (t)	0.874	0.874	0.965	0.965
High Price (t−1)	0.785**	0.792**	1.077**	1.078**
High Price (t) × Female	0.998	1.004	1.115**	1.114**
High Price (t−1) × Female	1.102	1.095	0.925	0.925
Basic controls	YES	YES	YES	YES
Additional controls	NO	YES	NO	YES
Person months	211,143	211,143	119,2461	119,2461
Deaths	1,748	1,748	9,385	9,385

***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.
The basic controls include the number of siblings alive at birth, parity FE, village FE, year and year squared. The additional set of controls includes mother's age.

six months and ten years is higher than that for males. However, the hazard ratio is almost one among the descendants of literate parents, implying the lack of gender disparities in mortality rate between six months and ten years during years of high prices. On the contrary, during 'normal' years, the risk is significantly higher for girls than for boys whose parents are literate, while among the children of illiterate parents, the differences in 'normal' years are not significant.

The findings suggest that discrimination against girls during childhood may have multifaceted causes. One of these factors is associated with the unequal distribution of resources, which appears to have a more pronounced impact on the daughters of families with lower socio-economic status during periods of short-term economic stress. However, the higher number of female fatalities during average harvest years among the general population, as well as among the daughters of literate parents, indicates the presence of an additional form of bias in caregiving. This cannot be solely attributed to financial limitations but is certainly linked to cultural factors and gender-specific role distinctions. It is plausible that in households with literate fathers, literacy was especially valued due to its economic and social benefits, potentially reinforcing son preference. Given the role of sons as carriers of literacy within the family, it is possible that these households directed resources preferentially to male children, further disadvantaging daughters.

https://doi.org/10.1017/S0956793324000244 Published online by Cambridge University Press

Conclusions

Faced with short-term economic stress, parents treated their sons and daughters differently and these discriminatory practices negatively affected the survival chances of girls both around the time of birth and during infancy and childhood, at least in the Spanish rural area studied here between 1800 and 1910. These findings extend previous studies by revealing that discriminatory practices are accentuated during bad years, thus stressing the importance of economic considerations when explaining these practices. This behaviour reflects the perceived value that boys and girls had in many rural areas in pre-industrial Spain. Males were not only privileged by inheritance patterns but also girls had fewer employment opportunities, received lower wages, and had to provide a dowry at marriage. Son preference is therefore firmly rooted in the relative benefits and costs of raising sons and daughters. In resource-constrained families living in a high-mortality context, parents had to make difficult choices that favoured boys in terms of the allocation of food and/or care and therefore acted against the survival chances of girls. Some families practised even more extreme forms of gender discrimination and neglected their female babies right after birth.

These results not only support previous studies showing that the phenomenon of the "missing girls" was more prevalent in historical Europe than previously thought, especially in Southern and Eastern Europe (for a review, see Beltrán Tapia and Szoltysek, 2022), but they confirm that girls especially suffered during short-term economic stress crises due to an unequal allocation of household resources (Tabutin, 1978; Johansson, 1984; Alter et al., 2004). This article has shown that households with lower levels of education (which is linked to lower socio-economic levels) were especially prone to excess mortality of girls when faced with short-term economic stress. However, further studies are needed to better understand how family behaviour affects their health and survival. In particular, studying individual-level information would allow us to identify which types of families are more prone to suffering from an 'excess' of boys. In this regard, it is important to distinguish between nuclear and extended families, number and sex-composition of siblings, socio-economic status, etc.

In any case, this research highlights that sex-specific mortality rates during infancy and childhood are not always biologically determined. In regions where son preference was strong, the female biological advantage was partially offset by discriminatory practices that either benefited boys or penalised girls. The interaction between behavioural and biological factors may indeed prevent the detection of the true demographic effects of economic crises. In more general terms, considering these practices is crucial to properly understand the traditional demographic regime and the subsequent transition to lower fertility and mortality rates.

Supplementary material. To view supplementary material for this article, please visit https://doi.org/10.1017/S0956793324000244

Competing interests. None.

Notes

1 See also Tabutin (1978); Johansson (1984); Pinnelli and Mancini (1997); Baten and Murray (2000); McNay et al. (2005); Horrell and Oxley (2016); Beltrán Tapia and Gallego-Martínez (2017; 2020) and Beltrán Tapia (2019).

2 The biological advantage at birth for girls over boys has been demonstrated in several studies (see, for example, Di Renzo et al., 2007; Dipietro and Voegtline, 2017; Zarulli et al., 2018). Similarly, in the study area, it has been observed that there was an excess of male mortality in the first days of life from the beginning of parish records until infant mortality approached zero (Marco-Gracia and Beltrán Tapia, 2021; Beltrán Tapia and Marco-Gracia, 2022).

3 In using parish records, we actually rely on baptism records rather than birth records. However, until the last quarter of the nineteenth century, *quam primum* baptisms were generally practiced in the study area, meaning baptisms were performed within hours of the baby's birth, making the birth and baptism dates very close (Marco-Gracia, 2022, 2023). Additionally, for children at risk of death, emergency baptisms were performed. Furthermore, by the end of the nineteenth century and the first

half of the twentieth century, we were able to confirm, for the case of the town of Alfamén, the near complete correspondence between civil (birth) records and religious (baptism) records.

4 At the same time, this study allows us to revisit the question of whether there was a preference for sons in the study area (and in rural Spain in general), and if so, what the intensity of this preference was during difficult times.

5 The municipalities studied are: Alfamén, Aylés, Botorrita, Cadrete, Codos, Cosuenda, Cuarte de Huerva, Jaulín, Longares, María de Huerva, Mezalocha, Mozota, Muel, Torrecilla de Valmadrid, Tosos, Valmadrid, and Villanueva de Huerva. Their total population was approximately 7,050 inhabitants in 1750, 11,097 in 1857, 10,908 in 1857 and 12,162 in 1910.

6 While around 40 per cent of men were literate in 1860, less than 5 per cent of women were able to read and write. See also Sarasúa (2002).

7 We consider the quality of the records to be high based on the analysis of the source, studying the absence of gaps in the period prior to fertility control and the consistency of values with expected patterns (Beltrán Tapia and Marco-Gracia, 2022). Furthermore, an advantage of the study area is that, until the last quarter of the nineteenth century, *quam primum* baptisms predominated, meaning the temporal gap between birth and baptism (when the record was made) was minimal, averaging only a few hours (Marco-Gracia, 2022, 2023). Additionally, the family reconstitution method was applied without issues, with very few records of individuals claiming to have been baptized in the study area but lacking a baptismal certificate. Finally, it is worth noting that we focused on the nineteenth and twentieth centuries, which, according to historical literature and our own analyses, exhibit the best record quality.

8 Literacy remained consistent across censuses.

9 Therefore, individuals born outside the study area are treated as left-truncated until their first recorded event within the study area in the event history analyses. Meanwhile, individuals who leave the study area are considered right-censored in models that account for all these factors.

10 While Sánchez-Albornoz and Carnero (1975) provide the monthly wheat prices series reported in Zaragoza between 1858 and 1891, Barquín (1999) has an incomplete series between 1815 and 1860. The correlation coefficient between our data and these two series is 0.55 and 0.85, respectively.

11 This methodology has been validated in multiple historical contexts in Europe and Asia (Lundh et al., 2014).

12 The deviation from the average, is measured in logs. In order to focus on short-term variations in prices, we have applied a smoothing parameter of 6.25.

13 These crises affected the years 1801-1803, 1810-1811, 1836-1837, 1841, 1846, 1855-1856, 1867, 1881, 1891 and 1896–1897.

14 The probability of miscarriages is higher in high-mortality environments (Woods 2009). The mechanisms behind the higher vulnerability of male foetuses are still largely unknown (Dipietro and Voegtline, 2017). As well as in perinatal and neonatal mortality, the female biological advantage continues through infancy and childhood.

15 Although the villages are neighboring, differences in proximity to the river, altitude, and terrain, as well as variations in soil fertility and productive structure, could affect local resources and demographic behaviors. By including village fixed effects, we account for these subtle environmental and economic differences, ensuring that our results are not biased by unobserved heterogeneity across villages.

16 The coefficient of the lagged variable implies that the probability of being baptised male shifts from 51.4 to 52.6 (which is equivalent to an increase in the sex ratio from 105.8 to 110.9).

17 In addition, it should be noted that there are no differences in baptism patterns (the gap between birth and baptisms) between boys and girls in the study area, thus further suggesting that under-registration is not likely to be an issue here.

18 While the probability of dying during the first two days of life was 15.6 per cent for girls, it rose to 20.4 per cent for boys.

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Cite this article: Marco-Gracia F J, Beltrán Tapia F J, and Luque de Haro V A (2025). Life and death under son preference: Economic stress, fertility, and early-life mortality in rural Spain, 1800–1910. *Rural History*, 1–21. https://doi.org/10.1017/S0956793324000244