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

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### Abstract

Relying 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 during infancy and childhood during economic crises in an area with a strong preference for sons. 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 of the 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. In addition, gender discriminatory practices against girls during bad years seem to have compensated the male vulnerability at older ages as well.

JEL Codes: J11, J13, J16

Keywords: Economic crises, sex ratios, gender discrimination, infant and child mortality.

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# Life and Death under Son Preference: Economic stress, Fertility and Early-life Mortality in Rural Spain, 1800-1910

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## Abstract

Relying 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 during infancy and childhood during economic crises in an area with a strong preference for sons. 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 of the 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. In addition, gender discriminatory practices against girls during bad years seem to have compensated the male vulnerability at older ages as well.

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## Acknowledgments

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## **1. 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, an issue that was clearly visible when looking into investments in education. Gender discriminatory practices, however, could also affect 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 affect girls' health and, subsequently, their survival chances. 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 19<sup>th</sup>-century population censuses and parish registers have documented both unbalanced child sex ratios and excess female mortality, thus suggesting 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 and 2021; Beltrán Tapia and Raftakis 2021; Szoltysek et al. 2022)<sup>1</sup>.

By limiting access to resources, economic crises can trigger or accentuate gender-discriminatory practices. Families placed under difficult circumstances need to resort to different strategies to ensure their survival. Many studies have indeed stressed the link between short-term economic stress and demographic behaviour in the past, either in terms of fertility control, marriage and mortality rates (Bengtsson 2004; Tsuya et al. 2010; 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 19th century, where a connection has been 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 research domain, 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 socioeconomic groups (Marco-Gracia 2021a).

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; Beltrán Tapia and Cappelli 2023; Echavarri and Beltrán Tapia 2023). These studies suggest that poverty indeed played an important role in fostering discriminatory practices increasing female mortality in infancy and childhood

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<sup>1</sup> 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).

in 19<sup>th</sup>-century Spain. Interestingly, harsh years appear to be associated with higher sex ratios at birth in Modern France and Italy (Hynes 2011; 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, lack of hygiene and the absence of public health systems, this male frailty was especially visible in the high-mortality environments that characterized pre-industrial Europe (Beltrán Tapia 2019), and specially so under harsh circumstances resulting from periods of scarcity (Zarulli et al. 2018). We 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.

Relying 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 economic crises affected the 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 girls' survival, 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. 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 counterbalancing the biological male vulnerability. Behavioural

practices against girls are especially visible in children aged 6-12 months: economic stress increased female mortality in that age group which may indicate that girls were weaned earlier than boys.

By emphasising the behaviour occurring during economic shocks 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 stresses the role played by resource constraints in fostering discriminatory practices in contexts where son preference is strong. 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 a context of increasing living standards, would therefore contribute to explaining the improvement in girls' health that took place during the demographic transition.

## **2. Data and historical background**

This study relies on longitudinal micro-data from a rural area in North-Eastern Spain. Located around 6-40 kilometres away from Zaragoza, the regional capital (see Figure 1), this area is formed by a combination of plains and foothills near the Huerva river and comprises 13 small municipalities<sup>2</sup>. Most of the population lived in nuclear households

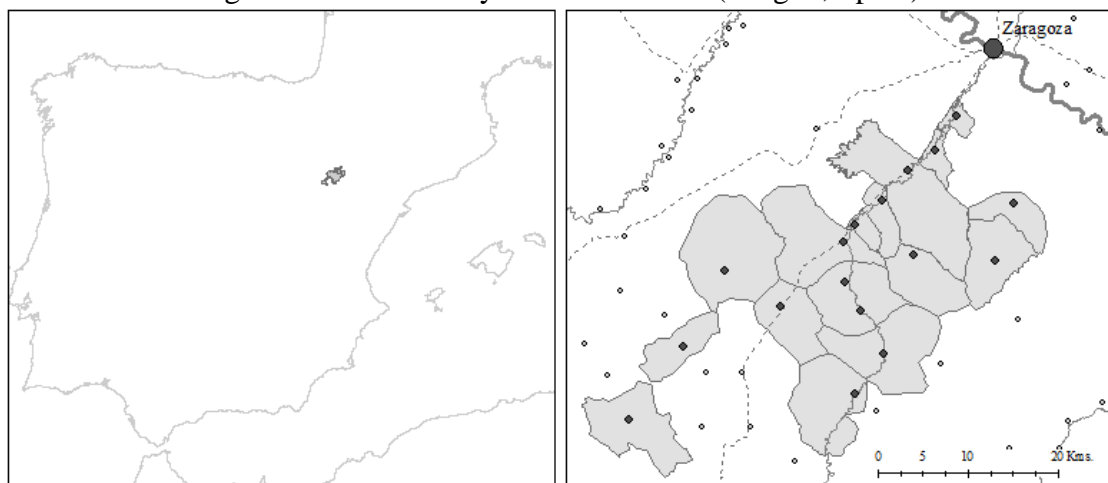
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<sup>2</sup> The studied localities are: Alfamén, Aylés, Botorrita, Cadrete, Codos, Cosuenda, Cuarte de Huerva, Jaulín, Longares, María de Huerva, Mezalocha, Mozota, Muel, Torrecilla de Valmadrid, Tosos, Valmadrid, and Villanueva de Huerva. Their total population was approximately 7,050 inhabitants in 1750, 11,097 in 1857, 10,908 in 1857 and 12,162 in 1910.



and was essentially engaged in agriculture (mostly wheat and some wine) and sheep grazing. Before the demographic transition, married couples could expect having an average of 6-7 children and standards of living were really low. Mortality rates were subsequently quite high and only around half of the children survived to age 10. It was only in the late 19<sup>th</sup> century when improvements in the mortality rates of older children started to materialise, which later spread to younger cohorts.

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).

Spanish women suffered a subordinated 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, women status was linked to the importance of male labour in agricultural contexts (Alesina et al. 2013; Giuliano 2018). As well as less able to provide 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 our area of study was indeed remarkable, thus

evidencing that parents invested differently in boys' and girls' education<sup>3</sup>. 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 is especially suited to 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 provide high-quality information on all births, marriages and deaths, thus allowing reconstituting their complete life histories. 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. 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).

As shown elsewhere (Beltrán Tapia and Marco-Gracia 2022), the quality of the parish registers is exceptionally high from the late 18<sup>th</sup> century. 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 in/out of our study area. Given that we focus on children, this issue is somewhat limited. In this regard, the results reported here do not change regardless we restrict the analysis to those individuals for whom we have complete

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<sup>3</sup> 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).

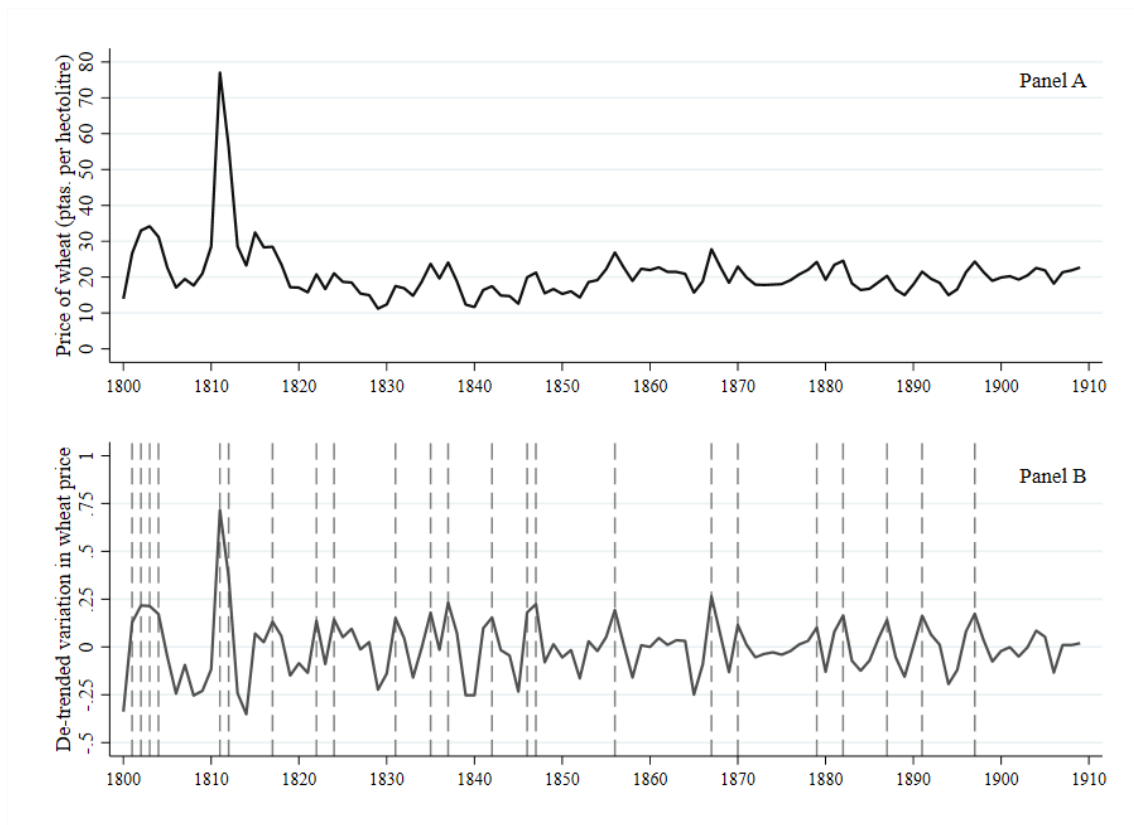
information or we assume that those whose data of marriage or death are unknown did not die during infancy or childhood.

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 rely on 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 born in the harvest year spanning from July 1862 to June 1863<sup>4</sup>. Figure 2, panel A, plots the raw data used here: the major economic crises took place during the early 19<sup>th</sup> 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 (Gállego Martínez 2004).

Figure 2. Annual evolution of the price of wheat in the city of Zaragoza

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<sup>4</sup> 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.



Note: In Panel A, the unit of measure is *pesetas* per hectolitre. In the de-trended 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 ten percent compared with average price.  
Source: Peiró (1987).

Following the pioneering studies that analysed the link between short-term economic stress (Bengtsson et al. 2004; Bengtsson and Dribe 2006)<sup>5</sup>, the data has 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<sup>6</sup>. 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

<sup>5</sup> This methodology has been validated in multiple historical contexts in Europe and Asia (Tsuya et al. 2010; Lundh et al. 2014).

<sup>6</sup> The deviation from the average, is measured in logs. In order to focus on short-term variations in prices, we apply a smoothing parameter of 6.25.

nineteenth century and therefore provide 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 Figure 2, Panel B)<sup>7</sup>. In our area of study, this kind of price variations disappeared at the end of the nineteenth century, so it is not necessary to extend the period of study.

Once we have identified the crisis years, we can assess how economic crises affected demographic behaviour. While section 3 focuses on births and potential neglect right after birth, section 4 explores whether high-prices years affected sex-specific mortality during infancy and childhood.

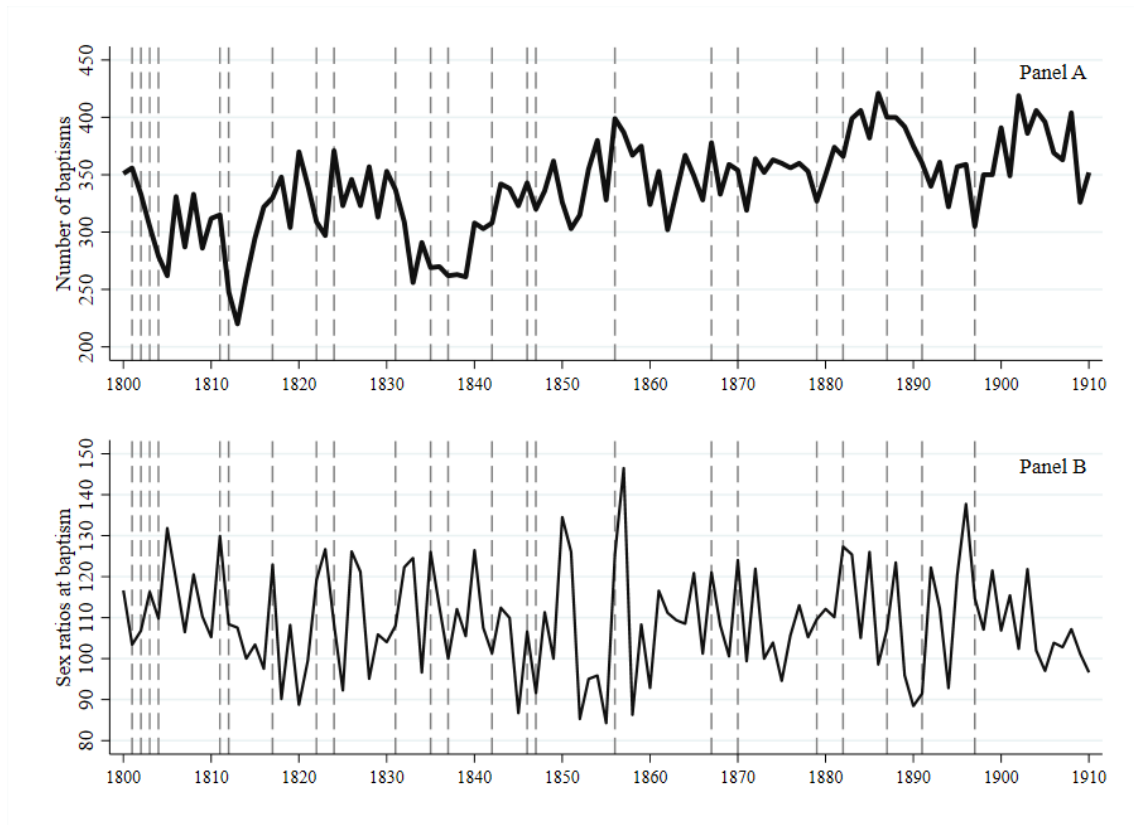
### **3. Gender discrimination around birth in times of short-term economic stress**

Panel A in Figure 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).

Figure 3. Economic crises, number of baptisms and sex ratios, 1800-1910

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<sup>7</sup> These crises affected the years 1801-1803, 1810-1811, 1836-1837, 1841, 1846, 1855-1856, 1867, 1881, 1891 and 1896-1897.



Note: The dashed vertical lines indicate the years experiencing high prices.

Observing more males being baptized 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; Peacock et al. 2012; Dipietro and Voegtline 2017; Peelen et al. 2017; Zarulli et al. 2018). Not only this feature was especially visible in the high-mortality environments that characterized pre-industrial Europe (Woods 2009; Beltrán Tapia 2019)<sup>8</sup>, but it 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

<sup>8</sup> 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.

shortly after birth. This is especially relevant for our study because, instead of registered births, we rely on 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 suggest that economic crises fostered neglect against female babies, thus accentuating discriminatory practices that were also visible in normal harvest years (Beltrán Tapia and Marco-Gracia 2022). These patterns of course could be 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 analyse the individual-level information associated to 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 baptized male was different during bad years while controlling for individual and household characteristics. While column (1) presents 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), 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 happening during the same year (t) or the previous year (t-1), columns (3) and (4) replicate the analysis but focusing on the latter. Lastly, columns (5) and (6) consider these two variables simultaneously.

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* (0.028)	0.048* (0.028)			0.054* (0.028)	0.053* (0.028)
High Price (t-1)			0.048* (0.028)	0.048* (0.028)	0.050* (0.028)	0.051* (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 alive at birth, parity FE, village FE, year and year squared. The additional set of controls include mother's age, father's occupation and literacy.

The results clearly indicate that more boys were baptized during high-price years and the following year, despite that 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 quite sizable: the probability of being baptized 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 considering simultaneously<sup>9</sup>, so the compound impact of an economic crisis on sex ratios at baptism was extremely high.

Although we have already discussed that the quality of the data assures that under-registration was negligible, it can be argued that female under-registration of baptisms may affect the previous analysis<sup>10</sup>. Examining death registers therefore provide 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 imply 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. We therefore now explore whether high-price years affected the probability of dying during the first days of life differently for boys and girls.

<sup>9</sup> 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).

<sup>10</sup> 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.



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 as “nonatos” in the sources (stillbirths), those happening during the first day of life and those occurred during the rest of the first week. 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 include 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.

Table 2

	Dep. variable: Dying during the period considered (1/0)					
	Nonatos		Day 0		Days 1-7	
	(1)	(2)	(3)	(4)	(7)	(8)
High Price ( $t$ )	0.026 (0.157)	0.028 (0.157)	0.057 (0.139)	0.056 (0.139)	-0.021 (0.132)	-0.022 (0.132)
Female	-0.363*** (0.128)	-0.365*** (0.128)	-0.258** (0.112)	-0.258** (0.112)	-0.331*** (0.104)	-0.330*** (0.104)
High Price ( $t$ ) x Female	0.149 (0.236)	0.146 (0.236)	0.092 (0.209)	0.093 (0.209)	0.092 (0.207)	0.094 (0.206)
High Price ( $t-1$ )	-0.036 (0.166)	-0.042 (0.166)	0.064 (0.141)	0.062 (0.141)	-0.090 (0.138)	-0.090 (0.138)
High Price ( $t-1$ ) x Female	-0.032 (0.256)	-0.031 (0.256)	-0.203 (0.221)	-0.209 (0.221)	0.273 (0.205)	0.267 (0.206)
Basic controls	YES	YES	YES	YES	YES	YES
Additional controls	NO	YES	NO	YES	NO	YES
Observations	33,437	33,437	32,971	32,971	32,898	32,898
Pseudo R2	0.0170	0.0231	0.0136	0.0182	0.0129	0.0157

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 alive at birth, parity FE, village FE, year and year squared. The additional set of controls include mother's age, father's occupation and literacy.

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<sup>11</sup>. 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 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 we explore the contemporary effect (t) or the lagged effect (t-1). These findings support the previous evidence regarding 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 over- or infra-estimate female neglect depending whether we are relying on 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 female right after birth.

### **3. Discrimination during infancy and childhood in times of short-term economic stress**

Apart from parental behavior 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, this section replicates the model followed in table 2 for older age-groups. In particular, table 3 reports the results of estimating a logit model assessing whether high-price years (both in t and t-1) affected

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<sup>11</sup> 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.

the probability of dying at the following age-groups divided in two panels for convenience: Panel A: 8-30 days, 1-6 months and 6-12 months; and Panel B: 1-2 years, 2-5 years and 5-10 years. All these exercises are repeated twice depending with are accounting for the basic or extended set of control described above (odd columns and even columns, respectively). In order to explore whether crises affected males and females in rural Spain differently, we include 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 bear in mind that the female biological advantage implies that boys should suffer more under adverse circumstances, so not observing mortality differences between boys and girls would be an indirect evidence of gender discriminatory practices.

Table 3

PANEL A	Dep. variable: Dying during the period considered (1/0)					
	Days 8-30		Months 1-6		Months 6-12	
	(1)	(2)	(3)	(4)	(5)	(6)
High Price (t)	-0.016 (0.115)	-0.016 (0.115)	0.122 (0.079)	0.120 (0.079)	-0.093 (0.086)	-0.087 (0.086)
Female	-0.226*** (0.087)	-0.225*** (0.087)	-0.137** (0.058)	-0.136** (0.058)	-0.123** (0.058)	-0.121** (0.058)
High Price (t) x Female	0.164 (0.166)	0.166 (0.166)	-0.028 (0.115)	-0.031 (0.115)	0.263** (0.120)	0.257** (0.120)
High Price (t-1)	0.142 (0.111)	0.143 (0.111)	-0.035 (0.082)	-0.033 (0.082)	0.040 (0.080)	0.040 (0.080)
High Price (t-1) x Female	-0.064 (0.171)	-0.070 (0.171)	0.131 (0.117)	0.130 (0.117)	-0.040 (0.117)	-0.040 (0.117)
Basic controls	YES	YES	YES	YES	YES	YES
Additional controls	NO	YES	NO	YES	NO	YES
Observations	32,315	32,315	31,439	31,439	29,477	29,477
Pseudo R2	0.0082	0.0099	0.0066	0.0072	0.0114	0.0123

PANEL B	Dep. variable: Dying during the period considered (1/0)					
	Year 1-2		Year 2-5		Year 5-10	
	(7)	(8)	(9)	(10)	(11)	(12)
High Price (t)	-0.162** (0.067)	-0.159** (0.067)	0.074 (0.071)	0.074 (0.071)	-0.021 (0.130)	-0.016 (0.130)
Female	0.056 (0.045)	0.060 (0.045)	0.132*** (0.050)	0.136*** (0.050)	0.192** (0.089)	0.193** (0.089)
High Price (t) x Female	0.044 (0.094)	0.041 (0.094)	-0.151 (0.101)	-0.151 (0.101)	0.143 (0.170)	0.142 (0.170)
High Price (t-1)	-0.042 (0.067)	-0.039 (0.067)	0.004 (0.072)	0.009 (0.072)	0.209* (0.123)	0.213* (0.123)

High Price (t-1) x Female	-0.008 (0.095)	-0.013 (0.095)	-0.011 (0.101)	-0.017 (0.102)	-0.010 (0.165)	-0.009 (0.165)
Basic controls	YES	YES	YES	YES	YES	YES
Additional controls	NO	YES	NO	YES	NO	YES
Observations	27,528	27,528	24,120	24,120	21,363	21,363
Pseudo R2	0.0139	0.0150	0.0164	0.0187	0.0097	0.0118

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 alive at birth, parity FE, village FE, year and year squared. The additional set of controls include mother's age, father's occupation and literacy.

The coefficient on the dummy variable female confirms the well-known female advantage, especially during the first year of life. This advantage gets reduced as children grew older and eventually reverses and becomes a female penalty, suggesting that that families prioritised their sons even in normal harvest years (Marco-Gracia and Beltrán Tapia 2022). The coefficient capturing the interaction between being female and the variable capturing high-price years tend to show values that are not different from 0, statistically speaking. 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.

However, discriminatory patterns under difficult circumstances become especially evident in those children aged 6-12 months: the coefficient on the interaction term between female and high-price years is positive and statistically significant (columns 5-6), indicating that girls suffered much higher mortality during bad years: their mortality rate was almost 30 per cent higher than that of boys<sup>12</sup>. This effect is especially telling because the introduction of solid foods usually started around this age and this was associated with a higher chance of contracting gastro-intestinal diseases due to the prevailing hygienic conditions (Guinnane and Ogilvie 2014; Pérez Moreda et al. 2015). Our results therefore suggest that, in difficult times, families may have prioritised boys

<sup>12</sup> According to the specification in column (6), while the probability that a boy died at age 6-12 months during a high-price years was 6.2 per cent, this figure rose to 7.9 per cent in the case of girls.

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 as the one present 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 likely 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, what strongly suggest that this kind of behaviour was counterbalancing the female biological advantage at those ages as well.

#### **4. Conclusions**

Faced by short-term economic stress, parents treated their sons and daughters differently and these discriminatory practices negatively affected the survival chances of girls both around 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 showing that discriminatory practices 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. Not only inheritance patterns privileged males, 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 practiced 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). Further studies are, however, needed to better understand how family behaviour affected their health and survival. In particular, studying individual-level information would allow identifying which types of families are more prone to suffer from an “excess” of boys. In this regard, it is important to distinguish between nuclear and extended families, number and sex-composition of siblings, socioeconomic status, etc.

This research in any case 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 female advantage was partially offset by discriminatory practices that either benefited boys or penalised girls. The interaction between behavioural and biological factors may indeed prevent detecting the true demographic effects of economic crises. More generally, considering these practices is crucial to properly understand the traditional demographic regime and the subsequent transition to lower fertility and mortality rates.

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