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WHERE ARE THE MISSING GIRLS? GENDER DISCRIMINATION IN MID-19TH CENTURY SPAIN

Francisco J. Beltrán Tapia
University of Cambridge
fjb38@cam.ac.uk

Domingo Gallego
University of Zaragoza
dgallego@unizar.es

Abstract: Drawing on a large dataset at the district level for mid-19th century Spain, this article shows not only that average (male-to-female) infant and childhood sex ratios were relatively high, but also that some regions experienced extremely high figures, thus pointing to some sort of excess female mortality. The analysis also suggests that economic deprivation was likely to trigger gender discrimination towards newborn and/or young girls. Although less conclusive, there is also evidence that certain social and cultural contexts could have also mitigated this behaviour.

1. Introduction

It is now twenty-five years since Amartya Sen (1990) forcibly drew the world's attention towards the phenomenon of missing girls in the developing world, especially in South and East Asia. Abnormal infant sex ratios pointed to gender discrimination in the form of sex-selective abortion, female infanticide and/or the mortal neglect of young girls (Klasen and Wink 2002; Das Gupta et al 2003; Hesketh and Xing 2006). Traditional son preference was actually being reinforced by the decline in fertility rates and the possibilities that modern techniques opened in terms of determining the gender of the foetus. Despite all the journalistic buzz and the considerable research directed towards analysing the situation in developing economies today[1], the historical experience of western countries has either received little attention or considered that these issues had little importance. Lynch (2011) argues, for instance, that there is little evidence for this kind of gender discrimination in pre-industrial Western Europe. According to this author, the European household formation system, together with prevailing ethical and religious values, prevented that these same impulses became more widespread. Other studies, however, point to the neglect of girls during infancy and childhood in 19th century Europe, especially under adverse economic conditions or where wage labour opportunities for women were scarce (Johansson 1984; Humphries 1991; Baten and Murray 2000; McNay et al. 2005)[2]. Gender discrimination within the household via an unequal intra-family allocation of food, care and workload may therefore have led to excess female mortality early in life[3].

Drawing on a large dataset at the district level for mid-19th century Spain, this paper shows not only that average (male-to-female) sex ratios at age 0-1were relatively high, but also that some regions experienced extremely high figures, thus pointing to some sort of excess female mortality. Apart from exploring sex ratios at older age-cohorts (1-5 and 6-10) and evidencing that differential treatment continued throughout childhood, this article examines what lies behind the unbalanced sex ratios with the aim of disentangling the underlying motives driving the observed gender discrimination.

[1] For relatively recent examples in the media, see 'The war on baby girls: Gendercide', *The Economist* (March 2010), '160 Million and counting', *The New York Times* (June 26, 2011) or 'It's a girl: The three deadliest words in the world', *The Independent* (January 18, 2012).

[2] Examining differential mortality, Harris (1998, 2008), however, does not find evidence of a systematic gender bias. According to Horrell and Oxley (2015) who analyse data on heights of children working in factories, greater deprivation for girls is only visible at older ages due to the additional burden that housework entailed for factory girls.

[3] Under son-biased preference, daughters may also enjoy shorter periods of breastfeeding (Jayachandran and Kuziemko 2011).

Instead of estimating causal mechanisms, this article attempts to unveil the general patterns behind the data in order to test existing hypothesis and set the basis for further research (Gelman and Imbens 2013). We find that, in the presence of son preference, adverse economic conditions are associated with higher sex ratios in early life, thus suggesting that families treated boys and girls differently. There is also evidence that certain social and cultural contexts could have also mitigated this behaviour.

Apart from the literature on skewed sex ratios and that on gender discriminatory practices in 19th century Europe, this article also relates to a growing wave of studies interested on gender inequality and economic development (Doepke et al. 2012; Eastin and Prakash 2013; Dilli et al. 2015). The latter usually claim that gender equality is not only a moral issue but also economically efficient[4]. Alesina et al (2013), for instance, find that female immigrants in the US who came from patriarchal societies where women's autonomy was traditionally limited enjoy lower levels of participation in the labour market. Having more educated mothers also significantly improves infant health (Currie and Moretti 2003). These gender gaps in the labour force participation and in educational levels considerably reduce economic growth (Klasen and Lamanna 2009). Furthermore, the greater the representation of women in parliament, the lower the level of corruption (Dollar et al. 2001). A recent World Development Report consequently puts gender equality on the spotlight as a crucial strategy for economic progress in developing countries (World Bank 2011). Unveiling thus forgotten patterns of gender discrimination and examining the causes behind that behaviour become of paramount importance.

The rest of the paper is organized as follows. While the next section reviews the literature on sex ratios and gender discrimination, section 3 presents the data object of this study. Section 4 discusses the methodology employed and the results of the empirical analysis. Lastly, section 5 provides some concluding remarks.

2. Literature review

The presence of unbalanced sex ratios in South and East Asia, especially in India and China, has been linked to practices of gender discrimination in early life (Sen 1990). Different methods to control the number and gender composition of families' offspring, such as female infanticide and the neglect of young girls, had been long practised by

[4] Although adhering with this view, Duflo (2012) offers a less optimistic picture of the potential of women's empowerment.

families in these regions (Lynch 2011, 252-253; King 2014). Son preference is widely related with economic factors regarding the perceived relative value of women. While sons provide a crucial labour force to the family farm, the daughters' contribution to the household is perceived as less relevant (Das Gupta et al. 2003)[5]. By increasing women's recognition and economic independence, the existence of female employment opportunities helps counterbalancing these trends (Sen 1990; Klasen and Wink 2002; Agnihotri et al. 2002).

Discrimination against girls seems to increase in adverse conditions due to the need to ration scarce household resources. Poor households are more likely to face choices at the margin of subsistence that are often resolved at the expense of women's well-being (Duflo 2012, 1054). Extreme events such as wars and famines also place families under severe resource constraints which lead to a rise in discrimination against daughters (Das Gupta and Shuzhuo 1999)[6]. Klasen and Wlink (2002, 299) argue that, by helping the poor, state policy can significantly reduce gender bias in mortality. Extensive dowry systems also constitute a major drain on household resources, thus further disadvantaging young girls. Likewise, old age support usually falls on sons, a moral obligation which is particularly important for the poor who cannot save (Chung and Das Gupta 2007).

The literature has also stressed the role that customs and cultural practices play on explaining son preference (Das Gupta et al. 2003). In India, China and South Korea, for instance, only sons are in charge of worshipping their ancestors. Religious factors are indeed important. Christianity and Islam both explicitly prohibit infanticide. This ban reduces the appeal to resort to female infanticide as a way to affect the sex of the offspring. These religions however have also created highly male-dominated societies, so son preference and gender discrimination may be present in different ways[7]. Furthermore, in China, lineage is traced solely through the male, so failure to have a son implies the extinction of the family line, whose continuity is extremely important to the

[5] In this regard, plough-based agriculture, especially in deep soils, decreases the participation of in agricultural tasks, reducing the relative value of girls with negative effects on gender roles and on the infant sex ratio (Alesina et al. 2013; Carranza 2012). The need for transplanting, fertilizing and weeding operations, which were typically performed by women, are reduced by plough cultivation. Similarly, relative to wheat areas, the contribution of female labour is higher in areas of rice cultivation (Bardhan 1974; Agnihotri et al. 2002).

[6] These authors argue that there seems to be little evidence that the poor discriminate more against their daughters (Das Gupta and Shuzhuo 1999, 620).

[7] In line with this interpretation, Almond et al. (2009) find that, although Christian and Muslim immigrants to Canada preferred sons as evidenced by continued fertility following only daughters, there is little evidence of sex selection.

Confucian creed (Almond et al. 2009, 5)[8]. Kinship systems that isolate women from their original kin and keep them in a subordinate position in the household into which they marry are especially deleterious to women's status (Dyson and Moore 1983). Das Gupta et al. (2003) argue that cultural factors dominate economic ones when explaining gender discrimination in South and East Asia. Patrilineal and patrilocal kinship systems exert a powerful influence even when female job opportunities are widespread and dowry systems do not constitute an important burden. These authors go indeed a step further and argue that economic factors are themselves culturally constructed.

Interestingly, these patterns do not seem to entirely vanish with economic development, which is normally associated with rising incomes, improving opportunities for women, etc. (Dilli et al. 2015). In this regard, the situation of China and India is telling because they have experienced worsening sex ratios at birth despite rapid economic growth. Das Gupta et al. (2003, 177) argue that urban settings diminish the centrality of sons in their parents' lives. Not only customary rules governing the inheritance of land and the patterns of post-marital residence become more flexible, but economic opportunities for women are also more widespread. Higher female education also seems to exert a positive impact, although the effect appears to be non-linear (Das Gupta 1987; Drèze and Sen 1996; Klasen and Wink 2002). Despite these improvements, discrimination against girls nonetheless still persists (Das Gupta et al. 2003, 176).

The relevance of cultural factors is confirmed by studies of migrants' reproductive behaviour. Unusually high boy-birth percentages are present among later children born to Chinese and Indian mothers in the US and Canada after 1980 (Almond and Edlund 2008; Abrebaya 2009; Almond et al. 2013)[9]. The availability of ultrasound technology from 1970s onwards has allowed these parents to determine the gender of the foetus and therefore practice sex-selective abortions, a pattern which is absent in families from other racial groups. These findings are especially interesting because other explanations of the preference for boys, such as extreme deprivation, the need to rely on sons for old age support, high dowry payments or state-imposed child limits, cannot be applied to the US and Canadian contexts, thus highlighting that overriding cultural son biases still

[8] The imposition of the one-child policy in China only aggravated the situation (Das Gupta et al. 2003).

[9] Recent research also reports extremely son-biased sex ratios at birth among Asian-born parents in Spain (González 2014).

persists even when more tangible factors are removed (Abrebaya 2009, 28; Almond et al 2009, 6-7).

Evidence of gender-discriminatory practices, on the contrary, in pre-industrial Europe is thin. Longstanding features present in European societies helped mitigating the underlying impulses to a more widespread mortal neglect of young girls (Gupta et al. 2003; Lynch 2011)[10]. Given the difficulties to find evidence of infanticide within marriage, studies of infanticide, and of the widespread practice of child abandonment, in Western Europe mostly focus on unmarried women (Lynch 2011, 254). Economic difficulties of supporting a newborn and shame at bearing a bastard child appear to be the main motives behind these practices, which were more prevalent among working-class women who had given birth to a child out of wedlock. However, information on the gender of victims of infanticide in pre-industrial Europe is usually lacking. Although research on unbalanced sex ratios at birth and family reconstitution data suggest the presence of gender discrimination in families' reproductive strategies (Bechtold 2001; Beise and Voland 2002), other studies, however, fail to find clear signs of this kind of practices (Derosas et al. 2004).

Much more evidence exists on the widespread practice of child abandonment. Foundling institutions proliferated throughout Europe to receive these children and prevent infanticide (Derosas et al. 2004; Lynch 2011, 255). Given the extremely high levels of mortality associated with these institutions, child abandonment has been considered as a kind of surrogate infanticide. Although some foundling hospital is Southern Italy systematically received more girls than boys, the evidence of gender selection in child abandonment is again scarce (Lynch 2011, 256)[11]. According to Lynch (2011, 256-257), certain features long present in European societies limited the extent of practices of gender discrimination towards newborns and young girls. On the one hand, non-universal marriage and higher ages at marriage, together with more paid employment opportunities for women, led to a more 'companionate' sort of marriage which fostered women's authority within the household, especially compared to their Asian counterparts. The Christian creed, on the other hand, proscribed infanticide and

[10] See also how King (2014, 2-7) discusses how these practices have been historically perceived in Asia and Europe.

[11] In a recent study about 18th century Seville, Tikoff (2008) argues that inferring gender biases from what it is observed in a single institution can be misleading because different institutions could be catering to different age and gender groups.

women's strong identification with the Church facilitated the application of its teaching to the family life[12].

Another strand of the literature, nonetheless, stresses that parents seem to have treated their sons and daughters differently throughout childhood both in Britain and continental Europe. During the 19th century, the living standards of girls, relative to boys', seem to have deteriorated as they grew older, especially in adverse economic conditions or where wage labour opportunities for women were scarce (Johansson 1984; Humphries 1991; Pinelli and Mancini 1997; Schofield 2000; McNay et al. 2005)[13]. Baten and Murray (2000), for instance, find that economic factors in early childhood had a more systematic impact on girls' than boys' heights, thus suggesting that sons and daughters were treated differently. The 'double burden' arising from working both in the labour market and in domestic chores also probably led to greater deprivation for older girls (Horrell and Oxley 2015). Klasen and Wink (2002, 289-290) argue that these discriminatory practices, either via an unequal intra-family allocation of food, care and workload, are likely to explain excess female mortality at these ages. Harris (1998, 2008), in contrast, does not find clear evidence of a systematic gender bias in differential mortality between boys and girls.

As in the rest of Europe, direct evidence of female infanticide or the mortal neglect of young girls is almost absent in the Iberian Peninsula[14]. However, women faced severe discrimination in many dimensions of 19th century Spain. A strongly patriarchal society, the gender division of labour pushed women to remain within the domestic realm: women were expected to fulfil their role as obedient daughters, submissive wives, caring mothers, and good Christians (Sarasúa 2002; Borderías et al. 2010)[15]. Unrecognised as legal subjects by the law, women had to rely on their fathers' or husbands' permission to make free use of their earnings or defend themselves in a trial. The reality was obviously not so extreme but, still, many women did not work in paid jobs and those who did received significantly lower wages (Camps 1998; Sarasúa

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[12] This does not imply that the Church did not promote values of patriarchy and women's subordination which resulted in other sorts of gender discrimination (Lynch 2011, 261). In this regard, there is evidence that catholic countries were far more gender discriminatory than Protestant ones, especially regarding female education (Houston 2002, 22).

[13] Recent research on medieval England also suggests excess female mortality probably arising from discriminatory practices (Bardsley 2014).

[14] On infanticide and child abandonment in Spain, see Pérez Moreda (1980, 167-187; 2005), Valverde (1994), Revuelta-Eugercios (2013) or Berraondo (2013). As in other parts of Europe, information on gender is often lacking.

[15] Influential thinkers played a crucial role in reinforcing patriarchal values in early modern Spain (Vollendorf 2005, 171-172; Howe 2008, 99-103).

2002)[16]. The inferior status of women was also reflected in an unequal allocation of resources within the household, both in terms of nutrition and educational investments. Women ate less food and of worst quality than men, thus reflecting in poorer health (Sarasúa 1998; Borderías et al. 2010; 2014)[17]. At the end of the 18th century, very few girls attended school and, although the situation improved throughout the 19th century, schools for girls prioritised teaching domestic skills and religious and moral values over reading and writing skills (Sarasúa 2002)[18]. The gender gap in literacy levels in Spain was indeed much wider than in other European countries (Viñao 1990; Núñez 2005).

Being such a male-oriented society, it is therefore licit to hypothesise that gender discrimination might have also involved other kind of mistreatment towards girls[19]. A glimpse of the existing son preference can be discerned from a popular proverb: 'Wish I had a boy, even if he becomes a thief'[20]. Although, as commented above, clear evidence is missing, Reher and Sanz-Gimeno (2004, 27-29) nonetheless argue that, in such a male-oriented society, preferential attention given to male infants and children may well have played a role for the survival of their female counterparts: in other words, excess male mortality should have been greater than it actually was[21]. In this regard, it appears that boys were breastfed longer than girls what may have resulted in a greater likelihood of girls falling ill (Gómez Redondo 1992, 205; Borderías et al. 2010, 183). Likewise, analysing the impact of mother's death in a medium-size Spanish town between 1870 and 1950, Reher and González-Quiñones (2003, 68-72) find that boys were comparatively better off than their sisters, thus suggesting that some sort of gender discrimination was in place. The influence of family intervention favouring male infants appears to have been even more important before the demographic transition (Reher and

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[16] Many occupations were closed to women as well (Sarasúa 2002, 608-609). The literature has nonetheless stressed that women's labour force, both at home and at the market-place, was a crucial element of 19th century Spain. See, for instance, the references mentioned in Borderías et al. (2010, 195; 2014, 118). Out of necessity, the female working poor, especially in the growing urban areas, challenged the 'angel of the house' ideal and was actively involved in the labour market (Arbaiza 2000).

[17] Furthermore, women served men who usually ate first, whereas women frequently had their food later in the kitchen (Borderías et al. 2014, 212). This hierarchical asymmetry already present in the patriarchal family system was reinforced by a medical discourse that stressed that women had different biological needs, especially in the context of the male breadwinner (109-112).

[18] Likewise, women could not attend secondary and tertiary education (Sarasúa 2002, 608-609).

[19] Gender discrimination still persists today in terms of wages, participation in the labour market, and political empowerment (World Economic Forum 2013). The most dramatic side of these issues takes the form of domestic violence. In this regard, see the survey data on violence against women in Spain examined by Tur-Prats (2015).

[20] My translation: '*Nazca mi hijo varón, aunque sea ladrón*'.

[21] Also in Dopico and Reher (1998, 86).

Sanz-Gimeno (2004, 29). The next sections gather evidence supporting that certain forms of gender bias against young girls were indeed present in mid-19th century Spain.

3. Data

Direct evidence of historical gender discrimination at birth or at young ages is unfortunately very difficult to obtain. The most accurate way to assess the gender mortality differential would be to directly look into sex-specific mortality patterns. Such information is however not available for the period we are examining. Due to their very nature, individuals and families tried to hide these practices and thus anecdotal evidence is also very scarce. Given that infant mortality was extremely high, it was relatively easy to disguise infanticide and/or the mortal neglect of infants as natural deaths (Derosas et al. 2004, 158)[22]. Instead, relying on the 1860 Population Census, we first employ data on the infant sex ratio, that is, the number of boys divided by the number of girls in the age 0-1 group. In the absence of manipulation, sex ratios tend to be remarkably regular, so comparing the observed figure to an expected gender-neutral sex ratio allows assessing the cumulative impact of gender bias in peri-natal and infant mortality and therefore the importance of potential discriminatory practices.

Estimating a gender-neutral sex ratio in the absence of discrimination is not straightforward (Klasen and Wink 2002, 287). The norm for sex ratios at birth somewhat revolves around 105.9 in most developed countries, including contemporary Spain (Klasen 1994, 1062)[23]. However, infant sex ratios in the mid-19th century should have been lower due to male excess mortality both in utero and early in life. In high-mortality environments, especially before the advent of modern medicine, sex ratios at birth can be relatively low even in the presence of gender-discriminatory practices. Evidence from the biomedical literature and comparative studies within and across countries suggest that the sex ratio at birth rises with the level of development (Klasen 1994; Waldron 1998; Hansen et al. 1999; Klasen and Wink 2002, 287). Improvements in nutritional status and overall health conditions reduce the general incidence of miscarriages and stillbirths and, given male excess pre-natal mortality, these

[22] According to Derosas et al. (2004, 158), “many infants died from smothering, suffocating, irregular feeding, and exposure to cold”.

[23] For different reasons, the “natural” sex ratio at birth differs from parity. On this issue, see James (1987) and Chahnazarian (1988).

improvements especially affect the survival probabilities of male foetuses[24]. Using life expectancy as a proxy for health conditions, Klasen and Wink (2002, 288) estimate that ten years of greater longevity are associated with a 0.9 percentage-point increase in the sex ratio at birth. Inadequate nutrition, poor living conditions, lack of hygiene and the absence of public health systems in 19th-century Spain imply that the expected sex ratio at birth in 1860 should therefore be lower than it is today. Life expectancy at birth in Spain increased from 29.8 to 79 years between 1860 and 2000 (Dopico 1987; World Bank 2000)[25], so this change, according to the previous estimate, would entail that sex ratios at birth in mid-19th century Spain should be reduced by 4.4 boys.

Moreover, our data relies on infant sex ratios and the female survival biological advantage is not only visible before birth but also during infancy, especially during the first month of life (Pinelli and Mancini 1997; Klasen and Wink 2002, 289, United Nations 2011). Again, excess male infant mortality should be more pronounced under adverse conditions. Infant mortality in Spain was extremely high during the period of study: in 1863-70, around 24.5 per cent of children died before reaching their first birthday, a figure much higher than other European countries (Dopico 1987, 176; Ramiro-Fariñas and Sanz-Gimeno 2000a)[26]. Excess male mortality during the first year of life would then imply that the sex ratio at age 0-1 should be around two boys lower[27].

Therefore, instead of around 105.9, infant sex ratios in the absence of gender discrimination should have been expected to be somewhat just below parity in mid-19th

[24] Long time-series from Belgium, Japan, England and Sweden suggest an increase in the sex ratio at birth between 2 and 3 percentage points over the past 120-200 years, during which life expectancy increased by about 30-40 years (Klasen and Wink 2002, 307). Johansson and Nygren (1991) show that, in Sweden, the sex ratio at birth rose from around 104.4 in the mid 18th century to 105.8 in the 1980s.

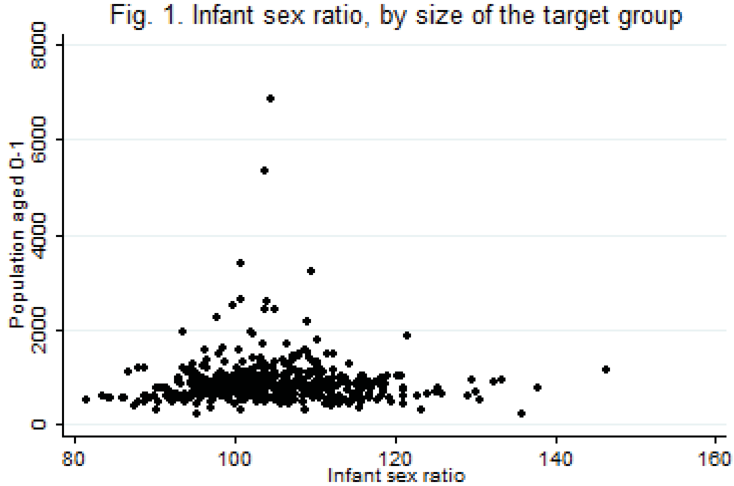
[25] The demographic transition in Spain did not start until the late 19th century and the early 20th century (Dopico and Reher 1998). Anthropometric evidence confirms the deplorable living conditions existent in mid 19th-century Spain. See, for instance, Martínez-Carrión and Pérez-Castejón (2000), Martínez-Carrión (2002) or Moreno-Lázaro (2006).

[26] If we add childhood mortality, 44.1 per cent of the children before reaching the age of 6. The high levels of infant and childhood mortality are related to the importance of infectious diseases. However, undernutrition was also a factor to be taken into account even well into the 20th century, especially if we consider that the lethality of infectious diseases also depends on the child’s nutritional status (Pérez Moreda 1985, 62). Major mortality crises kept recurring throughout the 19th century. Although some advances took place in the late 19th century, only improvements on nutritional status and public health systems allowed infant and child mortality rates to decline throughout the 20th century. On childhood mortality patterns during the demographic transition in Spain, see Reher et al. (1997), Ramiro-Fariñas and Sanz-Gimeno (2000a; 2000b) and Reher and Sanz-Gimeno (2004).

[27] In 1863-1870, infant mortality rates were around 25.5 and 23.4 for boys and girls respectively (Dopico 1987, 176). Nowadays, infant mortality rates are extremely low, around 0.5 per cent, so any gender differences in infant mortality is negligible (World Bank 2002). On differential infant and childhood mortality by sex, see also Reher and Sanz-Gimeno (2004, 27-29).

century Spain[28]. Our data, collected from the 1860 Population Census, shows that the average sex ratio at age 0-1 during this period was 104.7. This disparity relative to what would be expected from a gender-neutral figure suggests that some sort of gender discrimination was reducing the number of girls very early in life. As a matter of comparison, in Punjab (India) in 1931, where there is qualitative evidence of infanticide and a strong son preference, the sex ratio at age 0-1 was 102.3 (Gupta 2014, 7). Notwithstanding that the Spanish national average was already relatively high, infant sex ratios in some regions were extreme. If we disaggregate the data by districts, twelve districts (out of 471 observations) have figures above 1.25. Although some of these districts are relatively small, it is very unlikely that these results occurred by chance[29]. Nonetheless, and as shown in figure 1, the random component of our variable of interest decreases as districts grow in size and, as a result, the observed sex ratio tends to get closer to its hypothetical true value. Next section will therefore take this feature of the data into account when carrying out the econometric analysis.

Fig. 1. Infant sex ratio, by size of the target group



Source: see text.

[28] In India, where gender discrimination has been historically high, for instance, the sex ratio at age 0-1 was below parity in most states in 1931, reaching around 106 in 1981 (Bhaskar and Gupta 2007, 226-227). In the US, the sex ratio for those age 0-5 rose from 102 in 1900 to 105 in 2000 (224).

[29] In the absence of pre-natal sex selection, a child's sex is basically a random process. Due to the law of large numbers, sex ratios at birth tend to be quite homogenous at the societal level. Considering that there is no district whose target population (those children in their first year of life) is below 200 individuals, a binominal distribution involving 200 trials at parity (p=0.5) would imply an average sex ratio of 100 and a standard deviation of 7.071. The z-score of obtaining a sex ratio above 125 would then be 3.53. The probability of obtaining such a high value by chance alone is extremely low, an event that nonetheless occurs 12 times in our data.

The intrinsically random nature of our variable of interest is also evident in Map 1, which depicts infant sex ratios by county (see Appendix). It is indeed very difficult to discern regional patterns. It is also worth stressing that the fact that we also observe relatively lower infant sex ratios is not necessarily related to the absence of discriminatory impulses. It could be the case that although the incentives to discriminate were present, especially in unfavourable contexts, these impulses might be counterbalanced by social and cultural practices, practices that may not be present in other contexts.

The number of boys and girls admitted in foundling hospitals throughout the country provides further evidence of differential treatment towards newborns[30]. While infants could be left at the turning wheel of foundling hospitals by their relatives or by a third party, they were often abandoned where they could (sometimes) be found and then brought to these institutions (Pérez Moreda 2005). Some of these children died before arriving to the foundling hospital and it is also well-known that these places suffered extremely high levels of mortality (Revuelta-Eugercios 2013). As shown in table 1, between 1859 and 1864, these institutions received, on average, around 9.5 per cent more male than female infants. The numbers involved are relatively important, around 4.3-4.5 per cent of the 0-1 age-cohort, and they are quite consistent over time, thus suggesting that this was a regular behaviour.

Table 1. Newborns admitted to foundling hospitals. Spain, 1859-1864.

	Boys	Girls	Total	Ratio
1859	9,289	8,788	18,077	1.057
1860			17,912	
1861	9,564	8,843	18,407	1.082
1862	9,396	8,723	18,119	1.077
1863	9,704	8,226	17,930	1.180
1864	9,248	8,521	17,769	1.085
Total	47,201	43,101	108,214	1.095

Source: Junta General de Estadística (1866).

In order to assess whether gender discrimination is also visible during childhood, we have also collected data on later age-cohorts: 1-5 and 6-10 (see Maps 2 and 3 in the

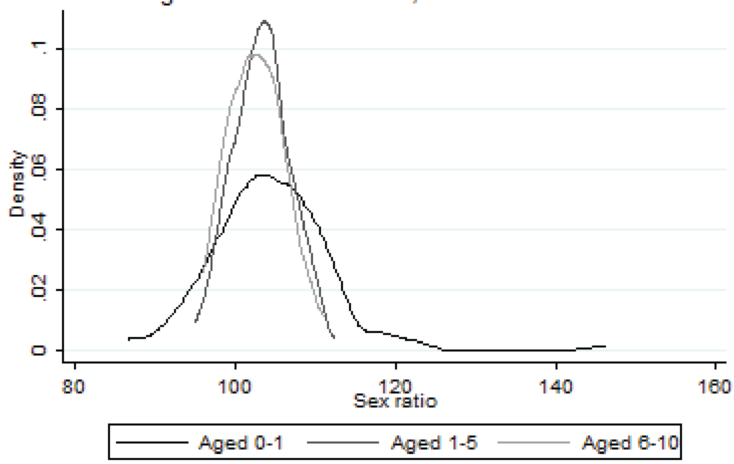
[30] In 1859, there was 49 foundling hospitals (*inclusas*), one for province, and 92 subsidiary branches (*hijuelas*). However, only the provinces of Alicante, Cáceres, Cádiz, Córdoba and Seville enjoyed a wide network of these institutions (Comisión de Estadística General del Reino 1860)

Appendix). Figure 2 compares the distribution of sex ratios of these three groups. The female survival advantage is also evident here: as expected, average sex ratios decrease from 104.7 to 103.8 and 102.6 as these children grew older. Given that these older cohorts include many more individuals than the infant population, their distributions contain much less random noise. In order to make sure that the differences between the plotted distributions are not driven by the stochastic variability arising from small populations, figure 2 is built using only those districts where the population in the age-cohort 0-1 is larger than 1,000 individuals. We should nonetheless bear in mind certain differences between the different age-groups when analysing this information. On the one hand, contrary to what happens in utero and infancy, girls at older ages seem to suffer higher mortality rates than boys in adverse environments (Klasen and Wink 2002, 289-290)[31]. These authors however argue that this excess female mortality, especially severe in the high-mortality environments typical of the 19th century, is likely to arise from discriminatory behaviour instead of reflecting a particular physiological disadvantage[32]. On the other hand, these sex ratios might be influenced by different processes that are very difficult to observe, thus making distinguishing gender-bias behaviour from other factors much more complicated. In this regard, migration processes, for instance, come readily to mind. The probability of sex-specific migration increases as children grow older. In addition, some regions may suffer higher mortality rates due to difficult economic conditions. The 1860 Population Census is particularly problematic in this regard because the 1850s were riddled with subsistence crises and epidemics (Pérez Moreda 1980). Although the 0-1 age-cohort is less affected by these processes, examining the three age-groups provides interesting insights on how gender discrimination continued throughout childhood.

[31] Anderson and Ray (2010) argue that infectious diseases explain an important part of missing women at younger ages.

[32] Their arguments are based on Klasen (1998, 1999), Humphries (1991), and McNay, Humphries and Klasen (1998). Contrary to what happens in developed countries in 2000 where male mortality exceeds female mortality in the age cohort 1-5, India, China and Sub-Saharan Africa show a pronounced excess female mortality (Anderson and Ray 2010, 1272; United Nations 2011).

Fig 2. Cohort sex ratios, smoothed densities



Source: see text.

Finally, it is important to note that under-enumeration may affect our analysis. If parents forgot to record female babies more than males, the sex ratio would be overestimating the number of boys and would therefore be a poor indicator of son preference[33]. The poor enumeration of females appears to have affected sex ratios at birth in India in 1991 (Dyson 2001). Reher (2007) argues that under-registration was an important issue in the population censuses of the period analysed here. This author however does not find that underreporting varied by sex (254). This problem may especially influence the 0-1 age-cohort because a high proportion of infant deaths went unreported, especially those who died in the first twenty-four hours of life (Dopico 1987)[34]. Given than we rely on the number of live children this issue is probably less worrisome. As shown later, the lack of association between infant and childhood sex ratios evidences that female under-registration was probably important during the first year of life. In any case, the older age-groups should be virtually free from this concern.

4. Empirical analysis

As shown in the previous section, high sex ratios suggest gender discrimination in some regions. We are now interested in analysing the large variation in infant sex ratios

[33] Although less worrying, the under-enumeration of girls would nonetheless point to some sort of gender discrimination.
[34] In this regard, Dopico (1987, 175) points that the under-reporting of early childhood deaths was larger for females.

across Spain.[35] In this regard, instead of trying to estimate causal relationships, we attempt to ask why we observe such variability (Gelman and Imbens 2013). The aim is to unveil the general patterns behind the data in order to test existent hypothesis and set the basis for further research. Apart from random variability, the regional disparities in the sex ratios may arise from multiple causes, including factors that are not related to the presence of a gender bias such as different disease environments that may harm girls more than boys. In order to shed more light on these issues, we identify economic, social and environmental factors that may theoretically explain this variability and then regress district sex ratios on that set of variables. Taking into account all these factors simultaneously allows us to isolate the ones that are directly associated with unbalanced sex ratios. It is also worth stressing that finding patterns from this type of data is particularly challenging. Not only our dependent variable is extremely noisy, but discriminatory practices are likely to have only taken place in the bottom part of the population, thus making those practices less visible when using information based on the whole population.

The dependent variable is the male-to-female sex ratio of each district described in the previous section. The independent variables aim to measure the economic, social, cultural and environmental factors characterising those areas. The first set of included variables tries to capture the economic context. Economic conditions directly affected the nutritional status of the population during this period. An important part of the population lived close to subsistence levels and their situation clearly worsened in times of economic stress. Apart from potential starvation, food deprivation reduces the capacity to survive infectious diseases. Malnourishment as a factor contributing to mortality rates in Spain did not disappear until the 20th century (Reher and Sanz-Gimeno 2004)[36]. Economic development is measured by population density and the level of urbanisation and industrialisation. Given that social standing also influences nutritional status and living conditions and, subsequently, infant care and mortality rates in infancy and childhood, economic conditions are further captured using the extent of

[35] Although primarily interested on a composite measure of the long-term evolution of gender equality, Dilli et al. (2015) also perform a cross-country analysis of the factors affecting sex ratios at age 0-5. They find that gender discrimination diminishes with higher incomes and increases in countries where stem family systems are more widespread.

[36] The economic depression of the 1930s, the Civil War (1936-1939) and the post-war period, however, involved a crucial setback for the modernization process that was underway (Reher and Sanz-Gimeno 2000, 146).

access to land and the incidence of poverty[37]. Due to the female biological survival advantage, sex ratios should theoretically be lower under severe economic conditions. If, on the contrary, economic deprivation shows a positive relationship with infant sex ratios, it would be evidence of potential gender discrimination either in the form of female infanticide or the neglect of young girls. It may be the case that both effects offset each other, so the lack of a clear relationship between these variables and the sex ratio might be (cautiously) interpreted as weak evidence of gender bias. It is worth noting that the adverse environmental conditions that urban and industrial areas suffered during this period resulted in mortality rates substantially higher than in rural areas (Ramiro-Fariñas and Sanz-Gimeno 2000a; Reher 2001)[38], thus potentially affecting sex ratios as well.

Likewise, demographic pressures, and the resource constraints involved, are proxied by the number of children (aged 0-10) per household. Infant mortality increases with family size (Reher and Sanz-Gimeno 2004, 30-32), what would again tend to reduce the male-to-female ratio but, in the presence of gender bias, competition for scarce resources could result in higher female mortality. Several authors have also stressed the presence of waged-labour opportunities for women as a crucial factor mitigating gender discrimination within the household (Klasen and Wink 2002; Lynch 2011). In order to include this variable, we have computed the fraction of the working-age female population (aged 16-40) that was involved in paid jobs[39]. In rural areas, although not remunerated, the commons and cattle rearing also constituted an important source of working opportunities for women (Humphries 1990), so the importance of these activities has also been considered[40]. Furthermore, our variable of interest could

[37] While access to land is measured as the fraction of landowners and tenants over the total agricultural population, the poverty ratio is computed as the percentage of destitute individuals over the active population. The 1860 Population Census refers to the poor as *pobres de solemnidad*.

[38] Higher population densities, together with lacking or deficient water and sewage systems, resulted in deplorable living conditions and facilitated the spread of diseases. The presence of orphanages and hospitals also contributed to raising mortality rates in cities. The incidence of respiratory diseases on childhood mortality was especially higher in towns than in the countryside (Reher 2001). Even in 1900, while life expectancy at birth only reached 29.5 years in the provincial capitals, it was about 36 years in rural areas (Dopico and Reher 1998, 14). The urban penalty would only disappear in the 1920s (77).

[39] The immense majority of women working outside the household fell within that age-range (Ferrer 1994; Camps 1998). Nevertheless, extending the definition of female working-age to older ages does not change the results reported here. The 1860 population census enumerates women working as school teachers, industrialists, artisans, factory workers and servants.

[40] According to Voigtländer and Voth (2013), women in pre-industrial societies had comparative advantage in animal husbandry. Alesina et al. (2013) argue that gender norms are more unequal in societies where agriculture has been traditionally based on the use of the plough. Exploiting the commons or rearing cattle stand here in contrast to farming. Obviously women in families devoted to agriculture also contributed but their role was, or at least perceived as, secondary.

be influenced by the type of settlement and its isolation from urban markets and administrative and political entities. The settlement pattern prevailing in each district, together with the distance to big cities and to provincial capitals, are therefore also included in the model. Including distance to provincial capitals is especially relevant because foundling hospitals were mostly based there (Pérez Moreda 2005).

As reviewed in section 2, social and cultural factors are also likely to have played an important role either fostering or mitigating gender discrimination. In this regard, the potential role of different families systems is unclear. Strong family ties have been related to lower levels of female labour force participation and more traditional views on gender roles (Alesina and Giuliano 2010). Family systems are also linked to inheritance rules and dowry systems, which are widely linked to skewed sex ratios in South and East Asia (Das Gupta et al 2003). Analysing the Spanish case, Tur-Prats (2015) however argues that co-residence with the mother-in-law increased the wife's contribution to farming work in traditional peasant families, which in turn has resulted in lower levels of intimate-partner violence nowadays. Valverde (1994) actually argues that extended families provided an environment that reduced the incidence of child abandonment in the Basque country during the pre-industrial period. Although nuclear households with partible inheritance prevailed, stem families were quite numerous in parts of northern Spain. In the latter, the heir brings a spouse to the family house where different generation then co-reside and, although inheritance rules prioritised sons, daughters could become heiress in case there were no male alternatives. Following Reher (1997), the complexity of family arrangements has been measured as the number of female adults (aged 26-80) per household.

Due to the explicit prohibition of infanticide, the role of the Catholic Church appears to have been very important in explaining European families' behaviour on this issue (Lynch 2011). Nevertheless, it is also true that religious authorities also favoured a strong patriarchal system, so its effect on gender discrimination may not be altogether clear. Although Catholicism was the only religion present in Spain during this period, the level of identification with Catholic teachings could vary across regions. The importance of the Church has been proxied computing the percentage of priests over the total active population. The educational level of the population, especially of mothers, has also been associated with the incidence of female excess mortality (Klasen and Wink 2002). More education helps overcoming long-lasting cultural practices, so literacy levels have also been included in the model.

Lastly, environmental factors have been put forward to explain part of the variation in sex ratios at birth[41]. Many diseases affect males and females differently, so sex ratios can also reflect these differences (Waldron 1998). Anderson and Ray (2010) argue that, in India, China and Sub-Saharan Africa, infectious, parasitic and respiratory diseases account for a significant fraction of excess female deaths in childhood[42]. It is well known that infant mortality in Southern Europe is highest in summer due to the incidence of digestive diseases (Wrigley et al. 1997). Regional variations in mortality rates are indeed pronounced within Spain and partly reflect diverse climatic conditions (Ramiro-Fariñas and Sanz-Gimeno 2000a; Cusso and Nicolau 2000), so it may therefore be possible that high sex ratios are not caused by gender discrimination, but by a different disease incidence and/or composition by region. In order to try to capture these environmental factors, measures of temperature and rainfall, together with altitude, ruggedness and distance to the coast, are included in the analysis and treated as controls[43]. Given the potential unobserved heterogeneity, such as the impact of the mortality crises in the 1850s or differences in sex-specific migration by region, it is important to test the model including provincial fixed-effects. Tables A.1 and A.2 in the Appendix outline how all the variables employed here have been constructed and report summary statistics.

The results of regressing infant sex ratios on the set of variables explained above are reported in table 2. While column (1) presents the baseline specification, column (2) extends the model by adding provincial fixed effects. The number of infants belonging to this age-cohort is relatively small in some districts, thus potentially introducing high levels of random variability in the dependent variable. In order to overcome this concern, columns (3) to (6) repeat the exercise restricting the sample to those districts in which the population aged 0-1 is larger than 500 and 1,000 individuals respectively.

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[41] James (1987), for instance, argues that the proportion of male births increases with family size and decreases with parental age and the incidence of multiple births. Using long-term time series data Catalano et al. (2008) and Helle et al. (2009) find that warm temperatures are related to higher sex ratios in Scandinavian countries.

[42] Oster (2005, 2006) also argues that women infected with hepatitis B are more likely to give birth to male children and that the high prevalence of this disease would explain a large part of the “missing women” in China. Her findings have nonetheless been forcefully contested (Das Gupta 2005, 2006).

[43] Coastal areas and northern Spain, colder and more humid, enjoyed lower mortality rates during the period of analysis (Dopico and Reher 1998; Ramiro Fariñas and Sanz Gimeno 2000a). Moderate temperatures in summer and abundant rainfall limited infectious diseases (especially digestive diseases so important for infant mortality). The interior of the Peninsula constituted a region of extremely high mortality (Dopico 1987; Pérez Moreda 1980), so distance to the coast has also been included as control. Although already captured by livestock density, the variable ruggedness may also further capture the relative importance of agriculture.

Given the noisy nature of our variable of interest, our model is only able to explain a small part of its variation. As expected, the model performs much better when we restrict the analysis to the larger districts, especially in columns (5) and (6)[44].

Table 2. Determinants of the infant sex ratio

	Dependent variable: Sex ratio, age 0-1					
	Whole sample		Pop. aged 0-1 > 500		Pop. aged 0-1 > 1,000	
	(1)	(2)	(3)	(4)	(5)	(6)
Population density (ln)	-0.86	0.02	-1.49	-0.61	-2.59	-0.72
	(1.13)	(1.15)	(1.21)	(1.24)	(2.59)	(2.22)
Urbanisation (%)	0.03	0.03	0.03	0.03	0.07	0.08
	(0.02)	(0.02)	(0.02)	(0.02)	(0.06)	(0.06)
Manufacturing (%)	0.23**	0.15	0.21*	0.13	0.57**	0.51**
	(0.11)	(0.11)	(0.12)	(0.11)	(0.24)	(0.22)
Poverty ratio (%)	0.41*	0.41*	0.44*	0.38	-0.35	-0.55
	(0.24)	(0.24)	(0.26)	(0.26)	(0.44)	(0.45)
Family size	7.69*	4.61	7.00*	5.48	-3.54	-0.72
	(4.15)	(4.76)	(4.22)	(4.89)	(6.28)	(9.03)
Women's waged labour (%)	-0.11	-0.08	-0.13	-0.10	-0.17	-0.20
	(0.08)	(0.08)	(0.08)	(0.08)	(0.18)	(0.19)
Land access (%)	0.02	0.03	-0.00	-0.00	0.05	0.05
	(0.05)	(0.05)	(0.05)	(0.05)	(0.10)	(0.12)
Settlement pattern	-0.01	0.00	0.00	0.01	0.00	0.02
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Livestock density	0.17	0.04	0.19	0.08	0.15	-0.12
	(0.18)	(0.19)	(0.19)	(0.20)	(0.31)	(0.27)
Commons (%)	0.81	1.03	0.39	1.09	0.39	-1.23
	(1.74)	(1.82)	(1.91)	(1.98)	(2.83)	(3.20)
Family type	-0.66	4.06	-1.53	2.13	12.01	19.49
	(5.98)	(7.40)	(6.66)	(8.33)	(16.72)	(21.66)
Priests (%)	-5.25***	-4.39**	-3.82*	-2.53	-2.62	2.97
	(1.82)	(1.96)	(2.06)	(2.08)	(3.75)	(4.65)
Literacy, male (%)	0.00	-0.06	0.02	-0.05	-0.11	-0.30*
	(0.06)	(0.08)	(0.06)	(0.09)	(0.11)	(0.15)
Distance to big cities (ln)	0.07	0.59	-0.03	0.39	1.99*	1.05
	(0.60)	(0.82)	(0.63)	(0.81)	(1.00)	(1.16)
Distance to provincial capital (ln)	0.14	-0.02	0.13	0.03	0.57	0.65
	(0.54)	(0.57)	(0.53)	(0.56)	(0.88)	(0.97)
Geography/Climate	YES	YES	YES	YES	YES	YES
Province Fixed-Effects	NO	YES	NO	YES	NO	YES
Observations	469	469	420	420	105	105
R-squared	0.060	0.078	0.057	0.075	0.188	0.300

Robust standard errors between brackets. *** p<0.01, ** p<0.05, * p<0.1

[44] As the target population becomes larger, sex ratios approximate their *true* value, thus reducing the random component. The explanatory power of the model using the most restrictive sample is between three and four times bigger than the previous specifications. As the increase in the R-square in column (6) evidences, relevant regional variations are captured by the inclusion of province dummies.

Focusing first on the whole sample, it appears that some economic factors, such as industrialisation, poverty and family size, were promoting some kind of gender discrimination. Although those effects are not that clear, statistically speaking, we should bear in mind that the higher overall mortality that those contexts were also provoking should have negatively affected boys more than girls, thus pushing infant sex ratios down. The fact that we observe a (weakly) significant and positive relationship points to a behavioural explanation of excess female mortality in the first year of life. Likewise, infant sex ratios are significantly lower in regions where the presence of priests is higher. Religious observance or the moral control exerted by the Catholic Church may have mitigated female infanticide and/or the mortal neglect of new-born girls. Alternatively, it may be possible that the proximity of priests would mitigate under-enumeration, both general and sex-specific.

Restricting the analysis to large districts, especially in columns (5) and (6), provides further insights on the issues at stake. Now, while the influence of priests disappears, the effect on industrialization becomes more pronounced. Social control was definitely more difficult in large towns than in small villages where everybody knew each other. In comparison with other large towns where agriculture was still a central economic activity, large industrial cities in mid-19th century Spain appear to have hidden an important excess female infant mortality. The analysis carried out here cannot shed light on the actual form of gender discrimination and/or the reasons behind this pattern. Female infanticide could be an explanation but it may also be possible that an unequal access to food, especially a shorter breastfeeding period, resulted in a higher susceptibility of female infants to digestive and respiratory diseases, which were more prevalent in industrial environments (Humphries 1991; Pinelli and Mancini 1997; Borderías et al. 2010, 183)[45]. Alternatively, it is also possible that the crowding living conditions existent in some industrial centres may have also facilitated the under-reporting of female infants.

Remarkably, male (but not female) literacy is negatively associated with infant sex ratios but only when the analysis is restricted to large districts and provincial dummies are included. Describing the practice of female infanticide in some parts of Asia, Lynch (2011, 254) stresses that the decisions about the survival of newborn

[45] The benefits of breastfeeding are especially acute in environments, such as large cities, where water- and food-borne diseases are prevalent (Jayachandram and Kuzienko 2011, 1486). These authors argue that, under son-biased preference, daughters enjoy shorter periods of breastfeeding. Pinelli and Mancini (1997) argue that girls could have indeed been weaned earlier than boys in 19th-century Europe.

infants primarily rested within the authority prerogative of the heads of households, lineages or clans. Although this finding is suggestive, we should be cautious due to its large standard error. Literacy levels in Spain were extremely low during this period and it is likely that discriminatory practices mostly occurred in the lower segments of the population, where illiteracy was widespread. Likewise, considering the poor knowledge about the spread of diseases, education could perhaps add little to improve child survival. Even in the early 20th century, women were apparently relatively slow to modify their habits regarding infant feeding and care (Reher and Sanz-Gimeno 2004, 27). It is interesting to note that the effect of literacy is only significant when analysing large districts. In this regard, Reher (2001, 121) argues that doctors (at least the best of them) preferentially lived in towns and suggests that they, together with midwives, played a crucial role in changing the way families cared for their children.

The rest of the variables included in the model do not show any clear association with the infant sex ratio. The intrinsic random nature of the dependent variable may mask the effect of some of these variables. As commented above, it may also be the case that the influence of the potential gender discrimination is offset by some counteracting effects. For instance, although the presence of waged labour opportunities for women may have enhanced their economic and social status, these occupations were usually filled by unmarried working women, a group that has been usually associated with infanticide and child abandonment (Lynch 2011, 263). Likewise, the positive effect that the existence of livestock and/or the commons may have had on the perceived value of women and, consequently, on lower sex ratios might have been counterbalanced by the resources they provided to families, especially meat and dairy products, thus improving their health what, in turn, reduced the male excess mortality present both in utero and during the first months of life.

In order to further analyse the patterns of female excess mortality, we repeat the same exercise but focusing now on the sex ratios of older age-cohorts. Table 3 presents the results of this analysis: while columns (1) and (2) focus on children aged 1-5, columns (3) and (4) centre on those aged 6-10. Given that the groups object of study are large enough, it is not necessary now to restrict the analysis to the larger districts[46]. It is worth noticing that R-squares are higher than those obtained examining infant sex

[46] Except one district whose sex ratio at age 6-10 is based on 879 children, all the remaining districts contain more than 1,000 children in each age-cohort. In any case, repeating the exercise restricting the sample to the larger district as done in table 1 hardly alters the results reported here.

ratios. This is likely due to the larger number of individuals that these age-cohorts contain, which allows for reducing the random variability affecting sex ratios. As evident in table A.3 in the Appendix, which repeats the exercise but including the sex ratio of the previous age-cohort in the model, the results reported in table 2 are not driven by potential discrimination occurring earlier in life. The lack of association between the sex ratios at age 0-1 and 1-5 suggests that under-enumeration was probably important during the first year of life.

The analysis strongly underscores a gender bias arising from large families. The negative effect of population density suggests that boys were more vulnerable to adverse conditions. The coefficients, as expected, are smaller for the older age-cohort when male excess mortality is less evident. Similarly, the fact that family size, measured as the average number of children per household, shows a stronger effect when analysing sex ratio at ages 1-5 and especially at ages 6-10 than in the case of infant sex ratios may be related with the fact that, at older ages, the female survival advantage decreases, so its counteracting effect is less powerful what allows gender discrimination to become more visible. Likewise, due to the protection afforded by breastfeeding, the closer infants are to birth, the lower the incidence of economic conditions on mortality (Reher and Sanz-Gimeno 2000, 139)[47]. Once older children are waned, their sensitivity to economic conditions increased due to insufficient hygiene in infant feeding practices[48].

Table 3. Determinants of the childhood sex ratio

	Dependent variable			
	Sex ratio, age 1-5		Sex ratio, age 6-10	
	(1)	(2)	(3)	(4)
Population density (ln)	-2.14***	-1.83***	-1.56***	-1.31**
	(0.55)	(0.55)	(0.53)	(0.58)
Urbanisation (%)	0.01	0.00	0.02	0.01
	(0.01)	(0.01)	(0.01)	(0.01)
Manufacturing (%)	0.02	-0.00	0.01	-0.02
	(0.04)	(0.04)	(0.06)	(0.06)
Poverty ratio (%)	0.03	0.07	-0.02	-0.02
	(0.07)	(0.09)	(0.09)	(0.11)
Family size	4.56**	2.10	10.27***	8.48***
	(1.80)	(2.24)	(1.95)	(2.32)
Women's waged labour (%)	0.02	0.02	-0.02	-0.01
	(0.03)	(0.03)	(0.04)	(0.04)

[47] Providing the health and nutritional status of the mother does not affect the health of the new-born.

[48] The authors however note that older children may be more able to resist certain forms of infection than very young infants (Reher and Sanz-Gimeno 2000, 140).

Land access (%)	-0.02	-0.01	-0.02	-0.02
	(0.02)	(0.02)	(0.02)	(0.02)
Settlement pattern	0.01	0.01*	-0.01	0.00
	(0.01)	(0.01)	(0.01)	(0.01)
Livestock density	0.18**	0.11	0.17**	0.09
	(0.08)	(0.09)	(0.08)	(0.09)
Commons (%)	0.70	0.76	1.33	1.15
	(0.94)	(0.98)	(1.04)	(1.10)
Family type	-0.93	1.39	-3.76	-0.35
	(2.95)	(3.58)	(2.86)	(3.15)
Priests (%)	-0.34	-0.83	0.05	-0.23
	(0.93)	(1.04)	(0.86)	(1.01)
Literacy, male (%)	0.01	-0.01	0.01	-0.01
	(0.03)	(0.04)	(0.03)	(0.03)
Distance to big cities (ln)	-0.55*	-0.62	-0.49	-0.54
	(0.30)	(0.42)	(0.31)	(0.44)
Distance to provincial capital (ln)	0.29	0.17	-0.74**	-0.85***
	(0.26)	(0.27)	(0.29)	(0.30)
Geography/Climate	YES	YES	YES	YES
Province Fixed-Effects	NO	YES	NO	YES
Observations	469	469	469	469
R-squared	0.101	0.120	0.166	0.189

Robust standard errors between brackets. *** p<0.01, ** p<0.05, * p<0.1

Although anecdotal evidence is scarce, a report from the doctor of Tineo, a small town in North Western Spain, suggests that girls continued to be treated differently as they grew older: deaths from anaemia and lung tuberculosis, resulting from nutritional deprivation and unhygienic conditions, disproportionately affected female children (Borderías et al. 2010, 183). Apart from discrimination in the allocation of resources within the household, Horrell and Oxley (2015) also point to the 'double burden', arising from working both outside and within the domestic sphere, that girls usually suffered without compensating nutrition. Under circumstances of economic deprivation, excess labour would reduce net nutritional status and increase girls' susceptibility to diseases. Sarasúa (2002) indeed claims that young girls were supposed to help their mothers with housekeeping and taking care of their siblings, an obligation which did not fall upon their male brothers. It is also possible, as pointed out in section 3, that these older age-cohorts were the ones affected by the major mortality crises that took place between 1855 and 1858. Furthermore, although the evidence of gender discrimination in infancy might be driven by the under-reporting of girls, this concern is less plausible at older ages. Therefore, despite that the particular mechanism remains obscure, this evidence points to differential treatment by sex.

Distance to the provincial capital is also negatively associated with sex ratios at age 6-10[49]. This result may indicate that geographical isolation resulted in high-mortality environments disadvantaging boys. However, it is more likely that this finding reflects the effect of sex-specific short-distance migration at this age. In this regard, the influence of distance is not visible when the analysis centres on the other age-cohorts. This is especially relevant because, on the one hand, the physiological survival advantage of girls is smaller as children get older and, on the other, sex-specific migration is less likely at younger ages. Although evidence on migratory patterns for children is lacking, it is plausible that, given the risks associated with migration, boys were more likely to move than girls, perhaps accompanying one of their parents in short-distance or temporary migrations.

Interestingly, Camps (1992, 239-240) finds evidence that economic deprivation, the family life-cycle and migratory patterns are closely linked. In 19th-century Catalonia, families were more likely to move during the first stage of family formation when their children were not old enough to contribute to the household budget. At this critical stage in the family life-cycle, the increase of expenditure arising from a larger family coincided with a heavier domestic work-load for women that reduced their opportunities to engage in waged labour. Relying on a single wage, the loss of employment of the male bread-winner due to fluctuations in the labour market would have dramatic consequences and therefore induce migration[50]. In the presence of son preference, this economic situation itself would put existent or future daughters in a comparatively higher risk than their brothers.

5. Concluding remarks

The results presented here indicate that, in a strongly patriarchal society, economic deprivation was likely to trigger gender discrimination towards newborn and/or young girls. In this regard, during the period under study here, excess female mortality in infancy appears to be extremely high in more industrial environments. Discriminatory practices were nonetheless limited by the presence of certain social and cultural contexts. Infant sex ratios, for instance, are lower in scarcely-populated areas where the presence of the Church was strong. Economic constraints resulting from large families

[49] Although statistically insignificant, distance to big cities also shows a negative coefficient.
[50] A similar pattern is also evident in families migrating to the industrialising area around Bilbao (Arbaiza 1999).

are especially relevant in explaining unbalanced sex ratios at older ages. Given that the female biological survival advantage implies that sex ratios should be lower under severe economic conditions and therefore may potentially disguise the effects of gender discrimination, these results are especially relevant.

The findings reported here are nonetheless tentative. On the one hand, given the random nature of the subject of study, research on sex ratios should rely on very large samples (Gelman and Weakliem 2009). Although our smallest districts never contain less than 200 children aged 0-1, this sample size may not be big enough as the high volatility of this variable evidences. It is reassuring however that the explanatory power of our model significantly increases when we focus on the larger districts. The analysis of the older age-cohorts, whose sex ratios are based on much larger populations, also helps mitigating this concern. Similarly, female under-enumeration might also affect infant sex ratios, an issue which is unlikely to be present in older age-groups. On the other hand, although we have tried to cover as many variables as possible, it is still possible that we may be missing some important factors. We cannot thus claim that there is a direct causal link between the variables examined here and unbalanced sex ratios. The evidence examined nevertheless is highly suggestive and should serve as a basis to further research.

Our main aim was nonetheless to look for patterns and unveil potential gender biases; explaining them is much more challenging. One of the difficulties involves disentangling the role played by gender discrimination from other biological or environmental factors that may also explain high female-to-male sex ratios. Excess female mortality was not necessarily the result of direct violence in the form of female infanticide or the mistreatment of young girls, but could have been just based on receiving less attention than would be directed to boys. In a period of extremely high mortality, a slight discrimination either in the way young girls were fed or treated when ill, as well as in the amount of work they were entrusted with, could easily have led to mortal consequences. This interpretation, compatible with the lack of anecdotal evidence on female infanticide or other extreme versions of mistreatment of young girls, would point to more passive, but pervasive, forms of gender discrimination. This article nonetheless raises more questions than it resolves. Given its own nature, subtle forms of gender discrimination are difficult to detect. The type of discriminatory practices suggested here probably only occurred among certain segments of the population, so relying on aggregate data is likely to conceal relevant information. As the example of contemporary Western countries illustrates (Almond and Edlund 2008; Abrebaya 2009; Almond et al. 2013; González 2014), unbalanced sex ratios are only visible among later births when there is no previous son in certain Asian migrant communities. Uncovering similar patterns of gender discrimination in pre-industrial Europe requires putting certain populations under a magnifying glass. We hope that this modest step will lead other scholars to become involved in such a neglected topic.

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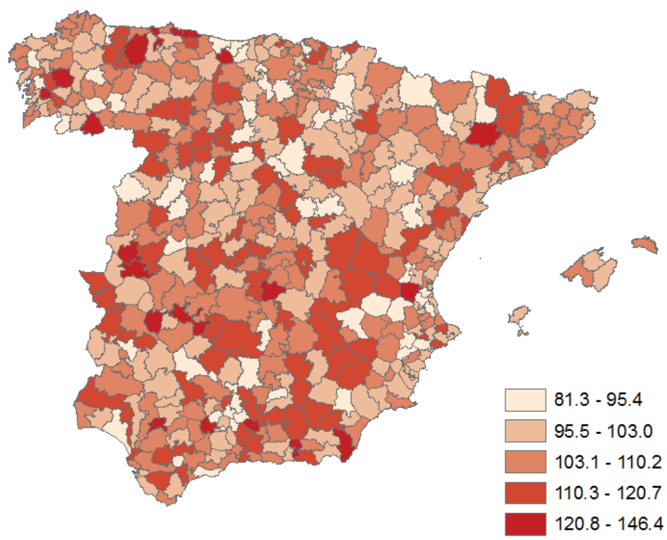
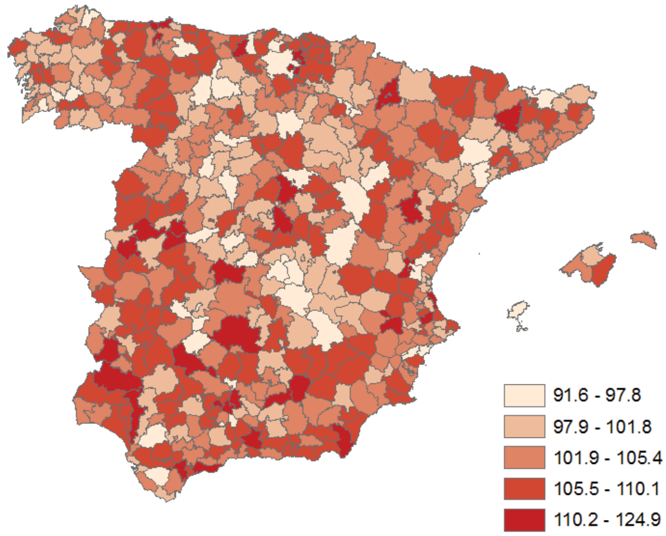
APPENDIX

Map 1. Male-to-female infant sex ratio (aged 0-1), 1860



Map 2. Male-to-female childhood sex ratio (aged 1-5), 1860



Map 3. Male-to-female childhood sex ratio (aged 5-10), 1860

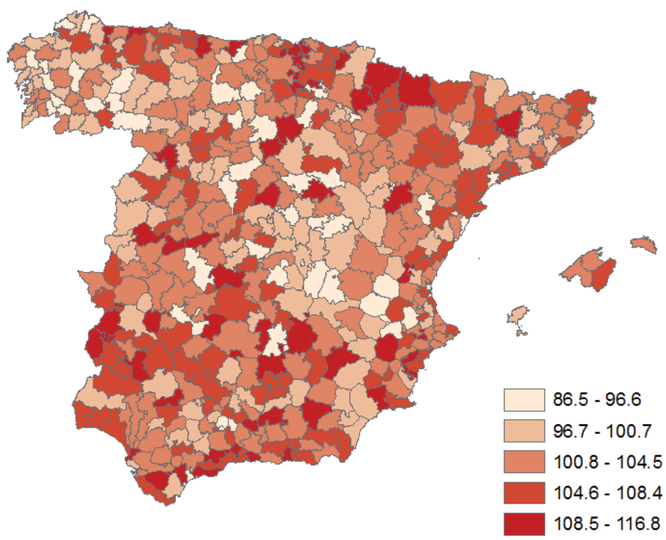


Table A.1. Description of the variables employed

Infant sex ratio	Number of boys aged 0-1 divided by the number of girls. This figure has been scaled multiplying it by 100. The sex ratio has also been computed for the age-cohorts 1-5 and 6-10.
Population density	Total population divided by district area.
Urbanisation (%)	Percentage of population living in towns larger than 10,000 individuals.
Manufacturing (%)	Fraction of the active population working in industrial and manufacturing occupations.
Land access (%)	Importance of landowners and tenants over the total agricultural population.
Poverty ratio (%)	Percentage of individuals that are considered *pobres de solemnidad* over the total active population.
Family size	Number of children aged 0-10 divided by the number of households.
Settlement pattern	Settlements per 100 km2. Settlements are *Ciudades*, *villas*, *lugares*, *aldeas* and *caseríos* taken from the 1860 *Nomenclator*.
Literacy, men (%)	Percentage of men able to read and write.
Women's waged labour (%)	Percentage of working-age female population (aged 16-40) who was involved in paid jobs. The Census enumerates women working as school teachers, industrialists, artisans, factory workers and servants (*maestras*, *industriales*, *artesanas*, *jornaleras en fábricas* and *sirvientas*).
Livestock density	Live weight per square kilometer. The numbers of horses, mules, oxen, donkeys, pigs, goats and sheep come from the *Censo de la ganadería* of 1865. These numbers have been transformed into live weights using the coefficients for each species provided by Flores de Lemus (1955) in 1917.
Family type	Number of female adults (aged 26-80) per household.
Commons	Fraction of common lands over the total district area. Taken from the *Catálogo de Montes Públicos* (1860).
Priests (%)	Percentage of priests over the active population.
Distance to big cities	Distance from the district geographical cenre (centroid) to the nearest city bigger than 50,000 inhabitants (in kms).
Distance to provincial capital	Distance from the district centroid to the provincial capital (kms).
Distance to coast	Distance is computed from the centroid to the nearest coastline (in kms).
Rainfall	Average median rainfall during the period 1950-2000. The WorldClim 1 kilometre digital data can be found in Hijmans et al. (2005) (http://www.worldclim.org/).
Temperature	Average median temperature during the period 1950-2000. The data comes from the same source as the data for rainfall.
Altitude	Median altitude in each district using the SRTM 90-meter resolution digital elevation data (http://srtm.csi.cgiar.org).
Ruggedness	Standard deviation of altitude.

Source: 1860 Population Census except when stated otherwise. The geographical data have been computed using ArcGIS.

TABLE A.2. SUMMARY STATISTICS

	Obs.	Mean	St. Dev.	Min.	Max.
Sex ratio, aged 0-1	469	104.68	8.91	81.34	146.42
Sex ratio, aged 1-5	469	103.78	4.57	91.59	124.88
Sex ratio, aged 6-10	469	102.61	4.66	86.50	116.76
Population aged 0-1	469	868.3	514.3	205	6,868
Population aged 1-5	469	3,870	2,197	1,116	25,304
Population aged 6-10	469	3,540	1,960	879	22,582
Population density	469	63.28	281.75	3.73	5,501.6
Urbanisation (%)	469	16.49	27.60	0	100
Manufacturing (%)	469	10.28	6.43	0.96	64.37
Land access (%)	469	46.79	13.26	13.20	88.98
Poverty ratio (%)	469	4.20	2.75	0.36	22.79
Family size	469	1.10	0.13	0.67	1.562
Settlement pattern	469	31.37	46.62	1.127	293.9
Women's waged labour (%)	469	15.71	9.69	3.72	79.90
Livestock density	469	7.48	5.62	1.02	40.75
Commons	469	0.22	0.22	0	0.75
Family type	469	1.03	0.14	0.75	1.57
Priests (%)	469	0.63	0.33	0.15	2.12
Literacy, male (%)	469	29.92	13.58	8.01	64.03
Ruggedness	469	183.4	120.1	6.53	765.0
Altitude	469	569.7	342.4	2	1,915
Distance to coast	469	101.4	89.89	0.33	356.2
Distance to provincial capital	469	44.57	25.15	1.08	163.3
Distance to big cities	469	176.8	191.0	3.02	1,404
Temperature (ºC)	469	13.75	2.52	4.10	19.10
Rainfall (mm)	469	638.8	264.6	129	1,517

Sources: see table A.1.

Table A3. Determinants of the childhood sex ratio

	Dependent variable: Sex ratio (males per 100 females)			
	Sex ratio, age 1-5		Sex ratio, age 6-10	
	(1)	(2)	(3)	(4)
Population density (ln)	-2.15***	-1.83***	-1.31**	-1.12*
	(0.55)	(0.54)	(0.54)	(0.59)
Urbanisation (%)	0.01	0.00	0.02	0.01
	(0.01)	(0.01)	(0.01)	(0.01)
Industrialisation (%)	0.02	0.00	0.01	-0.02
	(0.04)	(0.04)	(0.05)	(0.06)
Poverty ratio (%)	0.03	0.08	-0.02	-0.03
	(0.07)	(0.09)	(0.09)	(0.10)
Family size	4.70***	2.21	9.73***	8.27***
	(1.79)	(2.23)	(1.96)	(2.31)
Women's waged labour (%)	0.01	0.02	-0.03	-0.01
	(0.03)	(0.03)	(0.04)	(0.04)
Land access (%)	-0.02	-0.01	-0.02	-0.02
	(0.02)	(0.02)	(0.02)	(0.02)
Settlement pattern	0.01	0.01*	-0.01	-0.00
	(0.01)	(0.01)	(0.01)	(0.01)
Livestock density	0.19**	0.11	0.15**	0.08
	(0.08)	(0.09)	(0.07)	(0.08)
Commons (%)	0.71	0.79	1.25	1.07
	(0.94)	(0.97)	(1.04)	(1.10)
Family type	-0.94	1.48	-3.65	-0.49
	(2.96)	(3.60)	(2.84)	(3.15)
Priests (%)	-0.43	-0.93	0.09	-0.14
	(0.94)	(1.05)	(0.85)	(1.00)
Literacy, male (%)	0.01	-0.01	0.01	-0.01
	(0.03)	(0.04)	(0.03)	(0.03)
Distance to big cities (ln)	-0.55*	-0.60	-0.43	-0.48
	(0.30)	(0.42)	(0.31)	(0.45)
Distance to provincial capital (ln)	0.30	0.17	-0.77***	-0.87***
	(0.26)	(0.27)	(0.29)	(0.29)
Sex ratio, aged 0-1	-0.02	-0.02		
	(0.03)	(0.03)		
Sex ratio, aged 1-5			0.12**	0.10*
			(0.06)	(0.06)
Geography/Climate	YES	YES	YES	YES
Province Fixed-Effects	NO	YES	NO	YES
Observations	469	469	469	469
R-squared	0.102	0.122	0.178	0.197

Robust standard errors between brackets. *** p<0.01, ** p<0.05, * p<0.1