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It's Raining Men! Hallelujah?

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Abstract

We document the implications of missing women in the short and long run. We exploit a natural historical experiment, which sent large numbers of male convicts and far fewer female convicts to Australia in the 18th and 19th century. In more male-biased areas, women historically married more and were less likely to work. Today, in areas that were more male-biased historically, people have more conservative attitudes towards women working, women are less likely to have high-ranking occupations, and women earn a lower wage income. We document the role of vertical cultural transmission and of marriage homogamy in sustaining cultural persistence.

Keywords: Culture, gender roles, sex ratio, natural experiment, Australia

JEL codes: I31, N37, J16, Z13

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1. Introduction

Despite some improvements in the last century, gender disparities are persistent both in the workplace, where women work less, earn less, and do not reach the top positions; and at home, where women still do more than their fair share of housework (Bertrand et al. 2013). Gender-based discrimination manifests most severely in regions where highly skewed, male-biased sex ratios prevail: there is now an estimated 80 million women "missing" in China and India alone, due to sex-selective abortion and differential gender mortality (Hesketh and Xing 2006). An important question is how male-biased sex ratios further affect female outcomes. Answering this question is very difficult because of endogeneity issues, since a surplus of men is itself the product of lower opportunities for women (Qian 2008, Carranza 2014) and of cultural preferences for sons (Almond et al. 2013). The ideal natural experiment would consist of dropping a larger number of men than women on an isolated island, with these men and women being of a similar cultural background and operating in the same institutional environment, and then observe female outcomes from that point on.

We exploit such an experiment. Heavily male-biased sex ratios resulted from the British policy of sending convicts to Australia in the late 18th and 19th centuries. Men far outnumbered women among convicts, by a ratio of 6 to 1 (Oxley 1996). The vast majority of the white Australian population initially consisted of convicts.[1] Even among free migrants, men vastly outnumbered women well into the 20th century, as mostly men were seeking out Australia's economic opportunities in mining and pastoralism. As can be seen in Figure 1, a male-biased sex ratio endured in Australia for more than a century.

We rely on spatial and time variation in the historical sex ratio and study the short- and long-term effects of male-biased sex ratios on female outcomes at home and in the workplace. We find that historically, gender imbalance was associated with women marrying more, participating less in the labor force, and being less likely to work in high-ranking occupations. We then study the long-term implications by matching, for the first time, 91 historical counties from the Australian Colonial Censuses to postal areas in the 1933 Census, the 2011 Census, and in a nationally representative household survey

[1] There is still uncertainty and controversy about the number of Aborigines at the start of European settlement but in any case, they constituted a very different economy.

collected between 2001 and 2011. In areas that were more male biased historically, people today have more conservative attitudes towards women working, women are less likely to have high-ranking occupations, they work less, and as a result, they receive lower wage income. However, we find no evidence that the overall effect on women's welfare is negative, as measured by self-reported marital and overall life satisfaction. The "glass ceiling" effect was already present, and larger in magnitude in 1933, before the onset of large migration flows to Australia after the Second World War.

A one unit increase in the historical sex ratio moves the average Australian today towards conservative attitudes by 8 percentage points at the mean. This is comparable in magnitude to the relationship between attitudes and urbanization. Moreover, it is associated with a 1 percentage point decrease in the share of women employed as professionals. This represents nearly 5% of the population mean and 12% of its standard deviation. Historical circumstances explain 5% of the variation in the share of women employed as professionals that is left unexplained by traditional factors, even when accounting for the share of men employed in similar professions.

A concern for identification is that gender imbalance across localities was determined by characteristics that also influence the outcomes of interest. Our historical results are robust in a panel of historical counties, controlling for time and county fixed effects. These remove the influence of any time invariant county characteristics that could be associated both with local gender imbalance and with female work outcomes. Results pertaining to the legacy of the sex ratio on present day outcomes are only available in a cross section, so we cannot pursue a similar strategy. Instead, we start by carefully analyzing the characteristics that determined the allocation of men and women across counties and control for such factors in the regression analysis. Historically, economic opportunities consisted chiefly of agriculture, pastoralism and mining. To account for these, we flexibly control for geographic characteristics by including latitude and longitude in all specifications and control precisely for the presence of minerals and for terrain characteristics, as well as for the initial conditions in the county in terms of economic specialization. We also account for a wide range of present day controls. State fixed effects are used throughout in order to remove any unobserved heterogeneity related to differences in the legal environment or in the treatment of convicts.

Although we are able to account for the influence of a large number of geographic and historical characteristics, it remains possible that local gender imbalance in the past was influenced by unobservable characteristics that still underlie female opportunities as well as attitudes in the present. Endogeneity could arise, for example, from the systematic selection of women with stronger preferences for leisure or of men with a taste for gender discrimination to high historical sex ratio areas. To deal with this, we employ an instrumental variable strategy based on a unique feature of Australia's history: convict transportation from Britain. All the results are robust to instrumenting the overall sex ratio by the sex ratio among convicts. Although convicts had no choice on where to locate, they were not confined to prisons. They either worked under the government's supervision or were assigned to employers, who were either free settlers or former convicts. As before, we remove the potential endogeneity that arises from this process of convict assignment by controlling for the abovementioned geographic and historical characteristics. Since a legacy of a convict past independent of gender imbalance would violate the exclusion restriction, we also control for the number of convicts.

We undertake a number of additional robustness tests. In particular, we check that the results do not rely on a specific measure of the sex ratio at one point in time. The results are also robust to propensity score matching on the basis of geographic and historical characteristics. Placebo specifications, in which sex ratios are randomly allocated across counties while keeping the overall imbalance unchanged, give no significant results. Moreover, we find no significant effects of the historic sex ratio on male work outcomes. The results are specific to views about women working; historical gender imbalance does not explain sexism in general, proxied by other survey questions on attitudes towards women.

Our historical results, contemporaneous to gender imbalance, are in line with previous literature. Economic and evolutionary biology models predict more conservative gender roles as a result of male-biased sex ratios (Grossbard-Schechtman 1984, Chiappori 1988, 1992, Chiappori et al. 2002, Kokko and Jennions 2008). This is particularly relevant when job opportunities for women are few or unattractive, as it was the case in 19th century Australia, which was heavily specialized in the production of primary commodities.

What may be more surprising is that this effect has persisted to this day, after sex ratios have reverted back to parity. To explain persistence, we argue that past gender imbalance has shaped cultural beliefs about gender roles. We first rule out that other mechanisms explain persistence. Our results rely on within-country and even within-state variation, where formal legislation is identical. This rules out formal institutions as a persistence mechanism.[2] Another possibility is that past circumstances in the marriage market influenced respective incentives of men and women to invest in education (Chiappori, et al. 2009). We find no evidence for this mechanism. Initial gender imbalance could also have distorted industrial specialization towards male-intensive economic activities. Since we control for geographical endowments, such as land characteristics and mineral discoveries, and for initial economic specialization, we view the remaining variation as integrant to cultural persistence. We also analyze local historiographies and document differences today between areas that had and still have a similar economic specialization but different past sex ratios.

We next investigate the channels that underlie cultural persistence. Culture persists because of the transmission of cultural traits within families or across unrelated individuals (Cavalli-Sforza 1981, Bisin and Verdier 2001, Hauk and Saez-Marti 2002). We find, consistent with vertical transmission, that historical gender imbalance is only associated with conservative views about gender roles among people born of Australian parents.

Our focus on the marriage market suggests an additional persistence mechanism. Assortative mating in the marriage market makes gender norms strategic complements among potential spouses. Strategic complementarity implies that norms become evolutionary stable (Young 1998) so that even inferior conventions can persist over time, as shown theoretically by Tabellini (2008) and Belloc and Bowles (2013). Accordingly, we find that historical gender imbalance is only associated with conservative gender views in areas where homogamy is high.

[2] The legal framework operating in Australia with respect to gender discrimination has been constant across all states since the *Sex Discrimination Act 1984* (Cth), which operates at a federal level. This is a direct consequence of Australia's Constitution, with any state law inconsistent with this act invalid to the extent of the inconsistency (Constitution s 109). The *Family Law Act 1975* (Cth) unifies family law in Australia at this federal level.

The main contributions of this paper are two-fold. The first is to shed light on the long-term effects of gender imbalance. We show that the effects of gender imbalance on social norms and on female occupations have persisted for more than a hundred years, even though sex ratios have long reverted to normal. This has important implications for the world today, where it has been estimated that a hundred million women are missing (Hesketh and Xing 2006), namely in China, India, sub-Saharan Africa and the Caucasus.[3] The study of the determinants of such gender imbalances has attracted a large literature.[4] The study of its consequences is more limited because of evident reverse causality issues, and we contribute to this by exploiting a unique natural experiment.

Our second contribution is to the literature on the influence of culture on economic outcomes and, more precisely, on how culture emerges and persists. Until recently, the rise in female labor force participation, the expansion of women's economic and political rights, as well as the reduction in fertility that has been observed in developed countries were explained by technological change and the rise in returns to female labor.[5] However, several studies have also demonstrated how slow-changing cultural beliefs influence real work choices, family formation and welfare.[6] Regarding the origins of such beliefs, Alesina et al. (2013) show that conservative gender norms stem from the introduction of plough agriculture in pre-industrial societies. Our contribution is to illustrate a more rapid cultural change, which took place within a homogenous population, and to document how a large shock in the marriage market can shape cultural beliefs and have persistent effects in the long run.

[3] See Anderson and Ray (2010) for sub-Saharan Africa and Brainerd (2013) for the Caucasus.
[4] See Rao (1993), Hesketh and Xing (2006), Chung and Das Gupta (2007), Edlund and Lee (2009).
[5] See Goldin and Katz (2002), Greenwood et al. (2005), Doepke and Tertilt (2009), Doepke et al. (2012), Olivetti (2013).
[6] Fortin (2005) shows how gender role attitudes influence labor market outcomes. Alesina et al. (2013) establish a relationship between beliefs and participation of women in the economy and in politics. Bertrand et al. (2013) find that households in which women earn more than men are less likely to form and, once formed, are more likely to lead to divorce. Fernández (2008, 2013) and Fernández and Fogli (2009) show that preferences for fertility and for female labor force participation change slowly

2. Conceptual Background

In this section, we explain how a large shock to the marriage market, with a large excess of males, can move social norms towards more conservative views of gender roles. We also discuss how society can remain stuck in this new equilibrium, despite subsequent, smaller changes in gender ratios.

Work by economists, social psychologists, and evolutionary biologists predict that a male-biased sex ratio will result in conservative gender roles. In economic marriage models, the bargaining position of one gender is proportional to its scarcity (Becker 1973, 1974). Accordingly, Pollet and Nettle (2008) find that the importance of men's wealth for marriage in the US at the beginning of the 20th century is positively correlated with local sex ratios. Addressing the possible endogeneity between local marriage conditions and local sex ratios, Abramitzky et al. (2011) exploit variation in World War I related deaths in France. They find that a shortage of men is associated with men marrying more and marrying up. In the case of Taiwan after the influx of the Chinese Nationalist Army in 1949, Francis (2011) shows that, conversely, a shortage of women leads to women marrying more. An improvement in women's bargaining position, resulting from higher sex ratios, is also predicted to reduce female labor force participation (Grossbard-Schechtman 1984, Chiappori 1988, 1992, Chiappori et al. 2002). This is supported by empirical evidence based on the influence of contemporaneous changes in the sex ratios of recent migrants on the outcomes of second-generation migrants (Angrist 2002).

Guttentag and Secord (1983) relate sex ratios to the status and roles of women. When they are in the minority, the ability of women to use their bargaining power to gain freedom and independence is limited if political and economic power resides in the hands of men. In particular, the prediction is that in high sex ratio societies, women's extra-familial roles will be limited, although women may be treated with more respect and greatly valued in their roles as homemakers (Guttentag and Secord 1983, p. 20).

While all this work puts forward bargaining as the main mechanism through which the sex ratio affects gender roles, evolutionary biologists discuss others, including signaling (Kokko and Jennions 2008). Male-biased sex ratios may also have negative consequences for females when males divert resources from the female and offspring towards

competing with other males, or when males engage in mate guarding and restrict female freedom. Regardless, the prediction applied to humans is still that male-biased sex ratios will lead to more conservative gender roles and females working less outside the home.

As argued by Alesina et al. (2013), conservative gender roles and low female labor force participation can imprint onto cultural norms the appropriate role of women in society. Gender roles of the past then persist in the long run because culture changes slowly. Culture is defined, after Richerson and Boyd (2005), as "rules of thumb" that affect behavior in complex and uncertain environments and that people acquire from other people through "teaching, imitation and other forms of social transmission" (Richerson and Boyd 2005, p. 5). Cultural traits that are successful, which in our context means getting a wife, will spread.

The economic literature discusses two main channels of cultural transmission: horizontal and vertical (Cavalli-Sforza and Feldman 1981, Bisin and Verdier 2001). Culture spreads horizontally across peers, mainly through imitation. Culture spreads vertically from parents to children, through imitation and active parental socialization (Bisin and Verdier 2001, Doepke and Zilibotti 2008). Vertical transmission is inherently sticky, which explains why historical sex ratios may have persistent effects, even long after sex ratios have reverted back to normal.

Our focus on the marriage market suggests an additional and novel persistence mechanism. Assortative mating in the marriage market implies that views about gender roles are strategic complements among potential spouses. Individuals with similar backgrounds and similar views are more likely to marry one another and more likely to stay married (Becker et al. 1977, Lehrer-Chiswick 1993). In the marriage market, if certain norms make matching more likely, and a match more successful, these norms will prevail and persist over time. Conservative gender roles may thus persist in the long run solely because they are mutual best responses in the marriage market. Positive feedbacks of this kind are at the core of the persistence of cultural conventions in Belloc and Bowles (2013), even when such conventions are Pareto-dominated. Young (1998) shows theoretically that norms that are mutual best responses are evolutionary stable. Thus, conservative cultural traits may persist even when they are no longer adaptive and even long after sex ratios have reverted back to normal.

Belloc and Bowles (2013) discuss conditions that make the transition from one convention to another more likely. Cultural change has the characteristics of a collective action problem. The greater the cost of deviating from a given set of cultural traits and the bigger the population size, the less likely it is that any cultural change will occur. Deviation and experimentation may be particularly costly in the marriage market, where time is of the essence, uncertainty substantial, and search costs relatively high. If holding modern views leads to long delays in finding a spouse, people will conserve traditional views. However, immigration should make experimentation easier and may accelerate transition towards modern gender views. Conversely, homogamy in the marriage market, a proxy for the strength of strategic complementarity of gender views, should be associated with stronger persistence of norms.[7] We test these predictions in the empirical analysis that follows.

3. Historical Background, Data, and Results: Gender Imbalance, Female Work and Marriage in 19th Century Australia

3.1. Historical Background

European settlement in Australia commenced after independence of the United States, when it became the new destination of choice for the United Kingdom's overflowing jail population. Between 1787 and 1868, 132,308 and 24,960 convict men and women were transported to Australia, mostly to Tasmania and New South Wales (hereafter, NSW), which initially also included Queensland, the Australian Capital Territory, and Victoria (Oxley 1996, p. 3). These convict men and women were not "hardened and professional criminals" (Nicholas 1988, p. 3) but "ordinary working class men and women" (Nicholas 1988, p. 7). The majority of convicts were transported for property offences, such as petty theft (Oxley 1996).

[7] Homogamy interacts with vertical transmission in a very natural way, as discussed in Bisin et al. (2004). Parents want to instill in their children norms that will make them attractive in the marriage market. If they anticipate that the prevalence of conservative gender views is high among potential spouses, parents will try harder to transmit such views to their children. Data limitations prevent us from fully investigating this mechanism.

The extent of free migration to Australia was rather limited until the 1830s and the gender imbalance was sustained by ongoing convict transportation for nearly a century. Male convicts made up more than 80% of the adult male population of NSW in 1833. Even among free migrants, men outnumbered women. It was mainly men who were attracted to the economic opportunities offered in Australia, which consisted mainly of pastoralism and mining, especially after the discovery of gold in the beginning of the 1850s. As can be seen in Figure 1, a male-biased sex ratio endured in Australia for more than a century.

The settler population of Australia was ethnically homogenous. The vast majority of convicts and free migrants came from England and Ireland. In the 1846 NSW Census, 90% of people born outside the colony came either from England or Ireland, with very little heterogeneity across different localities within Australia.[8]

Essential to our identification strategy is to understand what determined the variation in population and sex ratios across space. Upon arrival, convicts were not confined to prison cells. Initially, they were assigned to work under government supervision. Later, as the cost of caring for large numbers of convicts became too high, convicts were assigned for private employment. Employers were government officials, free settlers, or ex-convicts, since convicts were freed after the term of their sentence, generally 7 years. The placement of convicts was dictated by labor requirements and decided in a highly centralized way, as described by Governor Bligh of NSW in 1812:

> "They (the convicts) were arranged in our book (…) in order to enable *me* to distribute them according" (cited in Nicholas 1988, p. 15, emphasis added).

As for free settlers, their spatial distribution was determined also by economic opportunities, namely in agriculture and mining, the two sectors in which Australia specialized in the 19th century (McLean 2012).

Male labor was at a high premium in the colonial economy. In 1816, Governor Macquarie of NSW announced that male and female convicts must be paid £10 and £7 per annum, respectively (Nicholas 1988, p. 131). Meredith and Oxley (2005, p. 56)

[8] 50% came from England and 40% from Ireland. The standard deviation of the two distributions is only 0.05.

document an even larger, 46%, gender pay gap in the non-convict population. One explanation is that only men had the physical strength required for agricultural work and building the country (Nicholas 1988). Alford (1984, p. 243) also suggests that the notion that remaining within the home was a "woman's proper place" already played a large role in explaining why women were "undervalued and underemployed" in the labor market (Nicholas 1988, p. 15).

Some convict women were confined to female factories, which were "a combination of textile factory and female prison" (Salt 1984, p. 142) for women who had borne a child out of wedlock, displeased their assigned master, or committed a crime.[9] Women worked in female factories for a very low or no wage.[10] Overall, Governor Macquarie of NSW put it best when he stated that convict women had 3 choices: become a domestic servant, live in a female factory, or marry (Alford 1984, p. 29). In the circumstances described above, marriage seemed like the most attractive option. And the demand for wives was high.

The authorities' concern that "the disproportion of the sexes" would have "evil effects" as men experienced "difficulty … in getting wives" (Select Committee on Transportation 1837-1838, p. xxvii) was well founded. Men were more than half as likely to be married than women (see Table 1), who were under great pressure to be married. According to the historical Census, more than 70% of women in Australia were married in the 19th century, a much higher rate than in Britain at the same time period (60%) (Alford 1984, p. 26).

The legal ability to divorce came rather late, particularly in NSW (1873). By the end of the 19th century (1892), there were a cumulated total of only 799 divorce petitions in NSW (Golder 1985). Moreover, marriage was enforced by strict laws, as well as by Victorian morality. For example, bearing a child out of wedlock was considered a crime for which women were sent to prison.

In sum, 19th century Australia was a context in which women's economic opportunities outside marriage were limited and unattractive. As a consequence, it is expected that

[9] No analogous male factory existed. NSW had 3 female factories in the counties of Cumberland, Northumberland and Macquarie. Queensland's county of Brisbane had 1 and Tasmania 5 (2 located in Hobart and the rest in Launceston, George Town and Campbell Town).
[10] Third class women, those who committed a crime in the colony or misbehaved in the factory, received no wage (Salt 1984, pp. 86, 105).

women would have been attracted to men who could fulfill the role of economic provider. The high bargaining power of women, due to their scarcity, would further reduce their incentives to work.

3.2. Historical Data

We collect data on the historical gender ratio and on the structure of the colonial economy from the Colonial Censuses taken in the 19th century in each of the six Australian states.[11] Other data sources, such as colonial musters that counted transported people, have high reporting error and are not representative of the entire population since participation was not compulsory (Camm 1978, p. 112).

Our main measure of the historical sex ratio in regressions with present day outcomes is taken from the first Census in each state. This is because we want to rely on the earliest possible measure of the gender imbalance and of its exogenous component, which came from convict transportation. We therefore rely mostly on the 1836 NSW Census (which also included the Australian Capital Territory at the time), the 1842 Tasmanian Census, the 1844 South Australian Census, the 1848 Western Australian Census, the 1854 Victorian Census, and the 1861 Queensland Census. These dates vary because states were independent colonies until 1901.

Descriptive statistics for this historical cross-section are displayed in Panel A of Table 1. Although the total population of Australia at the time was only about 255,000 people,[12] more than 60% of the current population of Australia now lives in the areas that were covered by the data. The unit of observation in the Census is a county.[13] The average county had 4,764 individuals, and the majority of counties (about 85%) had between 300 and 10,000 people. On average, the sex ratio stood at over 3 men for every woman in the

[11] The online data from the Historical Census and Colonial Data Archive was supplemented by the actual Census report due to errors in the 1881 Tasmanian Census. Only the Census reports are available consistently across the period, as some of the individual records were destroyed in a fire in 1882.

[12] These numbers do not include Aboriginal or Torres Strait Islanders, who were not counted in the Census until the 1960s. Only very rough estimates are available for these populations.

[13] "Counties" will be used here to refer to historical administrative divisions in the different colonies of Australia, which were variously called "counties", "police districts", "towns", or "districts".

population but it was much higher among convicts, at nearly 30 men for every woman. As an extreme example, in the county of Bligh, NSW, the sex ratio was 11 in the whole population[14] and reached 219 among convicts. The historical Census also contains information on the number of married males and females and on economic occupations by gender. Unfortunately, available records do not provide any further break down of occupation by age or marital status.

Table 1 compares how well covariates are balanced between counties with historical sex ratios above or below the median (2.05). Agriculture was the largest employer in Australia at the time, accounting for 23% of the employed labor force. Next were domestic services with 14%, and manufacturing and mining with a combined total of 12%. The shares of people employed in these different activities do not differ systematically across high and low sex ratio areas. Areas with high or low historical sex ratios are also broadly similar in terms of land characteristics and mineral endowments. Areas with high historical sex ratios are richer in major gold deposits, but poorer in major coal deposits. These statistics are displayed in Panel C of Table 1.

Figure 2 maps the sex ratio in the whole population and in the subset of the convict population in areas of Australia that were already settled at the time of the study. The population included in the historical Census came to Australia by sea. Yet, by the time we measure them, people of both sexes had made their way into the hinterland and along the coasts. The concentration of sexes has no definite pattern: high and low sex ratios were found in the hinterland as well as along the coast.

For the historical regressions that follow, we also consider the full panel of 19th century Censuses, roughly from 1836 to 1881, as described in Table A1. The panel is unbalanced across states because of their status as independent colonies until 1901 and for some of the years the maps of counties are not available for some of the colonies. The panel stops in 1881 because substantive redistricting occurred after that date and maps are not available. Descriptive statistics for this panel dataset are included in Panel B of Table 1.

[14] Hereon, "whole population" includes convicts, free settlers and emancipists (i.e. ex-convicts). Hence, the historical sex ratio is inclusive of the convict sex ratio.

Under the balancing influence of natural births,[15] the sex ratio over this whole period is lower than in the first Census, but still stands at 1.9 men for every woman. Female marriage rates were high throughout the period, particularly so in more male-biased areas. There, while they married more, women worked less. In high sex ratio areas, female labor force participation and the proportion of employed women in high-ranking occupations, which include clerical, legal, and medical professions and teaching, are statistically significantly lower.

3.3. Historical Regression Results

OLS panel estimates examining the historical relationship between gender imbalance and marriage rates, female labor force participation and the quality of female occupations are displayed in Table 2. All specifications control for county fixed effects to remove the influence of time invariant county characteristics that could be associated with gender imbalance and marriage or female work outcomes. For each dependent variable, specifications in the first column only include county fixed effects, and we add time fixed effects in the second column. As the panel is unbalanced, we have grouped years together and consider half decades as time fixed effects. Results are unchanged when we model time linearly from the 1836 start date.

Gender imbalance is associated with higher marriage rates for women and lower marriage rates for men. The effects are significant at the 1% level. More male-biased sex ratios are also associated with lower female labor force participation and with a lower proportion of women employed in high-ranking occupations. These effects are statistically significant at the 1% level. They are also robust to controlling for the county's male labor force participation or for males employed in similar occupations. The results are large in magnitude with an increase of one unit in the sex ratio associated with a 13 to 14 percentage points reduction in female labor force participation and in the share of women in high-ranking occupations, from means of 44% and 25%, respectively.

[15] Demographic studies of Australia have found no evidence of distorted or abnormal historical sex ratios at birth in Australia (Opeskin and Kippen 2012).

All these results carry through in the historical cross-section provided by the first Census in each state (see Table A2 in Appendix), even when controlling for geographical characteristics (latitude, longitude, presence of minerals and land type), initial economic specialization and state fixed effects.

To sum up, panel and cross section estimates indicate that in areas with higher gender imbalance, women married more, worked less and were less likely to work in high-ranking occupations.

In the next sections, we show how 19th century economic and marriage conditions have shaped cultural traits and how they still influence outcomes in the present day.

4. The Legacy of Gender Imbalance on Culture and on Women in the Workplace

In this section, we explore the long-term consequences of gender imbalance for female labor force participation and occupational choices and how it has shaped the cultural values of Australians. First, we discuss how we link historical gender imbalance to present-day opinion surveys and Census data.

4.1. Data

Postal areas in modern-day datasets are not equivalent to historical counties. Prior to this study, digitized shapefiles on Australian historical Census boundaries did not exist. We collected and digitized hard copies of maps from the National Library of Australia and from State Libraries in order to construct these boundaries and match historical counties to present-day boundaries. [16] The Appendix lists the maps used.

We explore the legacy of male-biased sex ratios on female labor force participation and occupational choices with data from the most recent Australian Census, taken in 2011. The unit of observation is the postal area. There are 2,515 postal areas in total. We match slightly less than 2,000 of these postal areas to historical counties, the remaining 500 or so being areas that were not settled at the time of the historical Censuses. To capture the

[16] When a postal area was found in multiple counties, we assigned it to the county in which it was mostly located.

legacy of gender imbalance on female work choices, we focus on women in high-ranking occupations: women employed as professionals as a proportion of the employed female labor force.

Data on cultural attitudes today are from the Household, Income and Labor Dynamics in Australia Survey (HILDA), a nationally representative survey available since 2001. The location of respondents is identified by the postal area. After matching to historical data, we are left with a sample of between 40,000 and 50,000 individual observations, depending on the questions used, in more than 1,500 postcodes. Due to restricted survey coverage, the number of postcodes is lower than that in the Census.

Questions on attitudes towards gender roles were included in the 2001, 2005, 2008 and 2011 waves. The main question that captures views about gender roles asks to what extent respondents agree that: "*it is better for everyone involved if the man earns the money and the woman takes care of the home and children*." Response categories range from 1 (strongly disagree) to 7 (strongly agree). We recoded this so that a higher value indicates stronger disagreement with this statement, which we interpret as more progressive attitudes.

We retain several individual characteristics from HILDA and variables from the Census as well as data on mineral and land type from Geoscience Australia as controls. Descriptive statistics are provided in Panels C and D of Table 1. The balance of these covariates across areas below or above the median historical sex ratio is also presented in the last two columns of Table 1. We observe no statistically significant difference across high and low historical sex ratio areas in terms of age, gender, ancestry composition, income, education, or gender balance today. We have already discussed how areas with high or low historic sex ratio have similar endowments and land types. Areas that were more imbalanced historically tend to be less urbanized today and, probably as a consequence, marginally still more male biased. We include urbanization and the sex ratio today as controls.

4.2. Specifications and OLS Results

Having matched historical gender imbalance to postal areas, we are able to examine its legacy on attitudes, female labor force participation and occupational choices. Figure A1 in the Appendix shows that progressive attitudes towards gender roles, female labor force participation, and the proportion of women employed in high-ranking occupations are all negatively correlated with the historical sex ratio. The unconditional relationships between all three outcomes and the historic sex ratio are all significant at the 1% level and robust to the removal of outliers, such as areas with a sex ratio above 10. The simple correlation coefficients between these variables stand well above the 0.1 mark considered in Chatelain and Ralf (2014) as critical in regards to the possibility of spurious regression.[17]

We explore the legacy of historical gender imbalance on present-day individual attitudes and on female work by estimating the following equations:

(1) $y_{ipc} = \alpha_1 + \beta_1 SexRatio_c + X_{pc}^{G}\Gamma_1 + X_c^{H}\Pi_1 + T_{pc}^{C}\Lambda_1 + X_{ipc}^{C}\Theta_1 + \delta_s + \delta_t + \varepsilon_{ipc}$

(2) $y_{pc} = \alpha_2 + \beta_2 SexRatio_c + X_{pc}^{G}\Gamma_2 + X_c^{H}\Pi_2 + T_{pc}^{C}\Lambda_2 + \delta_s + \varepsilon_{pc}$

where y_{ipc} is the survey-based measure of attitudes of individual *i* in postal area *p*, part of historical county *c*. y_{pc} are the Census-based measures of female labor force participation or occupations in postal area *p*, part of historical county *c*. $SexRatio_c$ is the historical sex ratio: the number of males over the number of females in historical county *c*. X_{pc}^{G} is a vector of time-invariant geographic county characteristics and X_c^{H} is a vector of historical controls. T_{pc}^{C} and X_{ipc}^{C} are vectors of postal area-level and individual-level contemporary controls, respectively. δ_s is a vector of state dummies. δ_t is a vector of HILDA wave dummies, when applicable. Since historical data at the level of our 91 historical counties is less granular than present-day data at the postal area or individual level, all standard errors are clustered at the county level.

[17] The correlation coefficients between, on the one hand, the historical sex ratio and, on the other hand, progressive attitudes and female labor force participation are -0.25. The correlation coefficient between the historical sex ratio and the proportion of female professionals is -0.15. A correlation coefficient below 0.1 is considered by Chatelain and Ralf (2014) as too weak and possibly leading to spurious regressions. To avoid this issue, we also present regression results without the full battery of controls.

X_{pc}^{G} and X_{c}^{H} are intended to capture geographic and historic characteristics that may have been correlated with the sex ratio in the past and may still influence present-day outcomes. In particular, as discussed in the preceding Section, Australia in the 19th century specialized in the production of primary commodities in agriculture and mining. Such economic opportunities influenced where convicts were assigned and where free settlers located. If economic specialization persists over time for reasons separate from the cultural channel we are interested in, these initial conditions could also influence present-day economic opportunities for women and ignoring them would bias our estimates. In order to flexibly account for geographic differences across counties that may be correlated with agricultural potential, we control for latitude and longitude in all specifications. To control more precisely for mining and agricultural opportunities, we control for 9 detailed categories of mineral deposits[18] and for land characteristics.[19] We do not include elevation because it shows very little variation, with 95% of our population being in a low-grade area. We also control directly for the county historical economic specialization, by including in X_{c}^{H} the historical shares of the population employed in the main categories of employment discussed in Section 3: agriculture, domestic services, mining and manufacturing, as well as in employment categories that could provide opportunities for women: government and learned professions (including teaching). Total historical population in the county is also included in X_{c}^{H}.

In the models of individual attitudes, present day individual controls include gender, marital status, age, income, education, and whether the respondent was born in Australia. Postal area-level controls include the sex ratio today and urbanization, taken from the Census.

In the models of female labor force participation and occupational choice, contemporary controls include the sex ratio today, urbanization and average education. Controlling for the proportion of married people or for the full range of industrial specialization is problematic, as these are endogenous outcomes. However, to account for sectorial

[18] Minor coal; minor other; major coal; major copper; major gold; major mineral sands; major oil and gas; major others. The excluded category is no deposits or traces only. Source: Geoscience Australia.

[19] Plains, plateaus and sand plains; hills and ridges; low plateaus and low hills; mountains. Source: Geoscience Australia.

differences across counties that influence the share of women employed as professionals, we control for the share of men employed in similar occupations. Considering that we are keeping the formal legislation constant by exploiting within-country and even within-state variation, controlling for the share of men employed in similar occupations should leave us with the variation that is due to culture, as opposed to formal institutions, technology, or employment opportunities.

The estimates displayed in Table 3 show that where the gender imbalance was most severe in the early days of colonial settlement in Australia, people are less likely to hold progressive views about gender roles, and women are less likely to participate in the labor force. When women do work, they are less likely to occupy high-ranking occupations.

The relationship between attitudes towards gender roles and historical gender imbalance remains statistically significant at the 1% level even when controlling for the full set of geographic, historic, and contemporary controls. At the mean, a one unit increase in the sex ratio moves the average Australian today towards conservative attitudes by nearly 8 percentage points (2.04*0.04). In magnitude, this is comparable to the relationship between attitudes and urbanization.[20] The relationship between the historical sex ratio and attitudes today is specific to views about women working. Gender imbalance does not explain sexist attitudes in general. For example, Table A3 includes the estimation results of equation (1) in which the dependent variable captures respondents' views about the quality of female leaders. There is no significant relationship between historical gender imbalance and such attitudes.

The relationship between female labor force participation and the historical sex ratio remains negative but is no longer significant when we include all contemporary controls. Female labor force participation may be too gross a measure as it pools together female executives and check out chicks. When we focus on the quality of female work instead, the relationship with historical gender imbalance remains statistically significant when controlling for the full set of controls, including the share of men employed in similar occupations. Additional results in Columns 4 and 5 of Table A3 in the Appendix show

[20] The coefficient on the urban dummy, not reported, is 0.11 (s.e.: 0.08).

that women are substituting full-time for part-time employment in high historical sex ratios. At the mean, a one unit increase in the historical sex ratio is associated with slightly under 1 percentage point decrease in the share of women employed as professionals, which represents nearly 5% of the population mean and 12% of its standard deviation. In terms of the share of the variation explained, adding historical characteristics to the full set of controls increases the R-squared by 2.5 percentage points. This is equivalent to 3% of the remaining unexplained variation in the share of women employed as professionals.[21]

All the results pertaining to attitudes and to the share of women in high ranking occupations are robust to non linear effects of the historical sex ratio and to excluding metropolitan areas, counties that had fewer than 300 people or more than 40,000 people, or counties that had very few women historically (less than 100). They are also robust to controlling for distance to major ports of entry and to the main metropolitan areas, to controlling for population density today, for the shares of different religions in the population, historically and today[22], or controlling for the average income in the county and its quadratic. Some of these additional robustness tests are presented in Table A4. We also check that the results are robust to propensity score matching. To do so, we predict the historical sex ratio as a flexible function of extended geographic characteristics (latitude, longitude, presence of minerals, land type) and historical employment shares in different sectors as well as all interactions between geographic and historical characteristics and second order polynomials. We then condition on this predicted propensity score in the main specification. All the results described so far carry through (see Columns 6 and 13 of Table A4). Columns 7 and 14 of Table A4 display the results of placebo specifications in which historical sex ratios are randomly re-allocated between historical counties, while keeping the overall average share of men relative to women constant. As expected, the results are not significant.

[21] (0.573-0.559) / (1-0.559). 0.559 is the R-squared of a regression with all but historical controls.
[22] Information on ethnicity is very sparse in the historical Census. Religion seems to be an adequate proxy. For example, in the above mentioned 1846 NSW Census, 50% of the population was Church of England, and 31% Roman Catholics, which corresponds well to the respective 50% and 40% shares of the population of English or Irish ancestry.

Placebo specifications in which male work outcomes, such as male labor force participation, the share of men employed as professionals and the share of men working full- or part-time time are regressed on the historical sex ratio bear no significant results. The results are in Table A5.

We implement a recent statistical test developed in Oster (2013). Based on the recommended assumption that the maximum R-squared is 1.3 times the R-squared obtained with the full set of controls, the influence of unobservable variables would need to be 14 times as large as the influence of all controls included in Column 3 of Table 4 to explain away the influence of the historical sex ratio for progressive attitudes. The influence of unobservable variables would need to be nearly twice as large as the influence of all controls included in Column 11 to explain away the influence of the historical sex ratio for the share of women in high-ranking occupations.

We also check that the results are not idiosyncratic to a specific measure of the historical sex ratio at a particular point in time. In Table A6, we present similar specifications as in Table 3 but we rely on a later measure of the sex ratio, in 1861, by which date the total population of Australia had increased nearly 5 fold. The 1861 sex ratio stood at an average of 1.71. The specifications, set of controls, and results in Table A6 are identical to those in Table 3.

4.3. Instrumental Variable Results

Our results are robust to a battery of observable geographic, historical, and contemporary controls. Yet, where men and women chose to locate historically may have been driven in part by unobservable characteristics, for example, on the basis of female preference for leisure or male taste for discrimination. To address this concern, we adopt an instrumental variable approach. We instrument the overall sex ratio by the sex ratio among the convict population. The rationale for this instrumentation strategy is that convicts were not free to choose where to go. Yet, convict assignment was not purely random and was influenced by economic opportunities. As before, we remove this potential endogeneity by controlling for the full set of geographic and historical employment sectorial shares. A legacy of convict past independent of gender imbalance due, for example, to convicts

holding different views about gender roles than the rest of the population, would violate the exclusion restriction. We therefore control for the number of convicts together with historical population size.[23]

Table 4 presents the results of these instrumental variable specifications. Here we regressed outcomes on the sex ratio instrumented by the convict sex ratio. These specifications are estimated on a reduced population because convicts were only present in 31 of our 91 historical counties; only in the states of Tasmania and NSW. In all specifications, we include the full set of geographic, historical and present-day controls, which are identical to those in Table 3. The first stages, for which statistics are displayed in the lower panel of Table 4, are very strong. All the results discussed in Section 4.2 are robust to this instrumental variable strategy.[24]

Because convicts were not present everywhere, the results in Tables 3 and 4 are not directly comparable. Where convicts were present, the OLS coefficient corresponding to Column 1 of Table 4 is -0.07 (s.e.: 0.019) and that corresponding to Column 2 is -0.25 (s.e.: 0.21). IV coefficients are larger in magnitude for two possible reasons. The first is that the IV measures the local average treatment effect on the convict subpopulation. The sex ratio was much higher in this subpopulation and while convict women married free men, the reverse was rarely true. Convict women were therefore in a particularly well-suited situation to extract a high bargain. The second is that the OLS coefficient may suffer from attenuation bias. Convicts were all of marriage age, being between 15 and 50 years of age when transported (Nicholas et al. 1988, p.14), whereas the rest of the population in the Census includes younger and older people. The convict sex ratio therefore measures more precisely the sex ratio that is relevant for marriage and the mechanisms we describe.

[23] The presence of female factories, which hosted some female convicts, may have influenced the convict sex ratio as well as attitudes towards these women, who were considered outcasts. Controlling for the location of these factories does not alter our results and the effect of female factories is never significant. The potential endogeneity bias would run against the direction of our main result: we would find more conservative attitudes where there were more women.

[24] We omit the results pertaining to female labor force participation, as these were neither significant in the OLS specification nor in the IV specification.

4.4. 1933 Results

We have so far documented the short-run implications of a male-biased sex ratio, and its implications in the long run, about 150 years later. It is important for the validity of our analysis to document medium-term implications, especially before the onset of massive migration to Australia. Australia experienced its first significant influx of free migrants after the discovery of gold in NSW and Victoria in the 1850s. However, deteriorating economic conditions in the late 19th century and the White Australia Policy in the early 20th century restricted migratory flows (McLean 2012). The second period of mass immigration into Australia occurred after the Second World War and the relaxation of the White Australia Policy in the 1970s. In order to capture outcomes before these changes, we rely on data on female work and occupations in the 1933 Census. We match 552 local government areas (the unit of observation in the 1933 Census) to our historical counties from the first Censuses. The total population of Australia in 1933 was 4.5 million people. In 1933, the sex ratio still stood well above parity, at 1.16 (see Figure 1).

Figure A2 in the Appendix shows that the bivariate relationships between female labor force participation or the proportion of women employed in high-ranking occupations in 1933 and the historical sex ratio are negative, statistically significant, and robust to the removal of outliers. To check whether these relationships are robust to multivariate analysis, we estimate specification (2) with female labor force participation and the share of women employed in high-ranking occupations in 1933 as the dependent variables. There is no urban/rural indicator in 1933, so we control instead for the share of people employed in agriculture, in addition to tertiary education and to the sex ratio in 1933. As before, we also control for male labor force participation or for the share of men in similar occupations when relevant.

Regression results with the full set of controls are reported in Table A7. Female labor force participation and the share of women in high-ranking occupations are negatively associated with the historical sex ratio. The relationship remains statistically significant at the 5% level for the quality of female work with the full set of controls.

To sum up, we have documented a large and persistent imprint of the historical sex ratio on the share of women employed as professionals in the short, medium, and long run.

These differences in women's employment outcomes are associated with persistent differences in attitudes towards women working. The next section is devoted to studying the underlying mechanisms of persistence, before turning to welfare implications in the last section.

5. Cultural Transmission: The Roles of Vertical Transmission and of Marriage Homogamy

We have documented in this paper a relatively rapid adaptation of cultural norms as a response to gender imbalance, even among a population that was ethnically and culturally homogenous to start with. These cultural norms have persisted over time, even after sex ratios have reverted back to parity. Our focus on the marriage market suggests specific cultural persistence mechanisms, which rely on homogamy in marriage and on child socialization within families, which we explore in detail in this section.

If gender norms are transmitted within families, and if Australia's past shaped a specific norm in the way we describe, people whose parents are born in Australia should be more likely to display this norm. To test for such vertical transmission in more detail, we add interaction terms between historical gender imbalance and a dummy indicating at least one Australian parent (mother or father).[25] The excluded category consists of persons born to two non-Australian born parents.

Regression results are in Columns 1 and 2 of Table 5. The coefficient associated with the historical sex ratio alone is no longer significant, suggesting that historical gender imbalance has no influence on people who are not born of Australian parents. The main effect of having an Australian parent is positive and significant, but its interaction with the historical sex ratio is negative, statistically significant and large in magnitude: more than twice as large as in the sample as a whole. In other words, Australian parents transmit more progressive norms, but not where the gender imbalance was high.

Consistent with the theoretical prediction regarding the role of migration in Belloc and Bowles (2013) discussed in Section 2, we find that migration has an attenuating influence

[25] Splitting this further into Australian born mother and Australian born father is problematic due to multicollinearity.

on cultural persistence. Belloc and Bowles (2013) discuss how immigration should make experimentation easier and may accelerate transition from one cultural convention to another. Consistent with this prediction, we find that the historical sex ratio is associated with more conservative gender norms in low migration areas, but not in high migration areas (Columns 3 and 4). These results also reveal that people of different ancestry systematically display different attitudes although they live in the same area. This implies that the relationship between historical imbalance and present-day outcomes is unlikely to be due to unobservable local characteristics or to self-selection of people to localities on the basis of taste.

We have discussed in Section 2 other mechanisms that might contribute to persistence and in particular the issue of coordination on the marriage market and homogamy. We document the relationship between homogamy in the marriage market and the persistence of conservative gender norms in Columns 5 and 6 of Table 5. We define homogamy as the probability that one's partner is born in Australia when one is born in Australia, 86% on average. Table A8 in the Appendix shows that homogamy brings direct benefits: people are happier in their relationship when married to someone ethnically similar.

As we are concerned that homogamy is an endogenous outcome to the degree of cultural persistence, we rely on a measure of homogamy predicted by several characteristics of the postal area: education, the degree of urbanization, ancestry composition, average median income, the sex ratio today and employment shares in 18 different sectors. We define high and low homogamy postal areas as above or below the median predicted homogamy.

The results show that historical gender imbalance is associated with conservative views only in areas where predicted homogamy is high. By contrast, no legacy is found in areas with low homogamy. Such strategic complementarities in the marriage market are compatible with the apparent paradox of rapid adaptation of cultural norms yet cultural persistence. The situation we study is that of a drastic shock to the marriage market, one able to lead to rapid adaptation towards social norms that guarantee success in wooing a wife. Our interpretation of persistence is that these norms locked in, even after sex ratios had reverted back to normal, because of strategic complementarity of gender views in the marriage market, together with vertical transmission within families.

In Appendix Table A9, we explore and rule out another transmission mechanism that could explain persistence. Past circumstances in the marriage market may have durably influenced respective incentives of men and women to invest in education (Chiappori et al. 2009). To test for this, we regress the share of men and women with a tertiary education in 2011 and in 1933 on the historical sex ratio, controlling for historical and contemporaneous employment in different sectors of the economy, the usual geographic controls and the contemporaneous sex ratio. The relationships are not statistically significant.

Another possible channel is that initial gender imbalance distorted industrial specialization towards male-intensive economic activities and that economic specialization persisted over time. Since we control for initial economic specialization and for geographical endowments, such as land characteristics and mineral discoveries, we view the remaining variation as integrant to cultural persistence. Moreover, high and low sex ratios areas actually did not differ systematically from one another in terms of initial economic specialization, land characteristics, or mineral discoveries. We also carefully analyzed local historiographies in order to contrast the fates of areas that had a similar economic specialization in the past and are highly comparable on most observable dimensions, but that had very different historic sex ratios. For example, county Bligh, which we have already mentioned, and county Dalhousie are two inland counties bordered by the Goulburn River and roughly equidistant from the nearest port. Both have major coal deposits and consist mostly of low hills terrain. Both are rural counties that were, and are still, predominantly specialized in agriculture. However, the sex ratio was much more male biased in Bligh, with nearly 11 men for every woman against slightly over 2 in Dalhousie. Today, in Bligh, female labor force participation is 47%, with 17% of women employed as professionals, against 54% and 21% respectively in Dalhousie. Our progressive attitude variable takes an average value of 2.05 in Bligh, against 3.78 in Dalhousie.

6. Welfare Implications

Our historical results indicate that women were less likely to work and more likely to marry in more male-biased areas. We have discussed how this may have been a beneficial outcome for women given the options available to them in 19th century Australia. We have documented negative implications of the historical sex ratio on the quality of female occupations today, and on progressive attitudes towards female work. Since conditions in the labor market have improved greatly for women since the 19th century, these present-day outcomes may seem paradoxical in regards to the expected enhanced bargaining power of women due to their historical scarcity. However, cultural persistence implies that norms that were adaptive at a certain period of time may endure even when they are no longer adaptive. Also, these outcomes are not direct indicators of welfare. Therefore, we turn to more direct indicators of welfare in this section by presenting evidence on the legacy of the historical sex ratio on wages and individual satisfaction. Overall, we find no evidence that the effect on women's welfare is negative.

6.1. Income

We have found that the historical sex ratio left an imprint on the quality of female occupations. Here, we want to study other labor market outcomes, notably the gender wage gap. In order to do so, we rely on reported individual wage information from HILDA since the Census only records total income.

We estimate an equation similar to (1) with the log of financial year gross wages and salary of individual *i* of gender *g* in postal area *p* in historical county *c* as the dependent variable:

$$(3)\ ln\, w_{igpc} = \alpha_3 + \beta_{3g} SexRatio_c + X_{pc}^{G}\Gamma_3 + X_c^{H}\Pi_3 + T_{pc}^{C}\Lambda_3 + X_{igpc}^{C}\Theta_3 + \delta_s + \delta_t + \varepsilon_{ipc}$$

The vectors of time-invariant geographic county characteristics, historical controls, postal area-level controls, and individual-level contemporary controls X_{pc}^{G}, X_c^{H}, T_{pc}^{C} and X_{ipc}^{C} include the full set of usual controls. In addition, we control for the individual's number of hours worked. Differences with estimation equation (1) are that we now allow the

coefficient associated with the historical sex ratio, β_{3g}, to be gender-specific. Standard errors are, as usual, clustered at the county level.

We restrict our attention to full-time employees, between the ages of 18 and 65, with non-zero reported wages.

Regression results are displayed in Columns 1 to 6 of Table 6. Column 1 includes only controls for latitude and longitude, Column 2 adds the usual geographic, historical, postal area and individual level controls. The coefficient associated with the main effect of historical sex ratio is only marginally significant when the full set of controls is included. Both the coefficients associated with female and with the interaction term between female and the historical sex ratio are negative and statistically significant. In other words, there is a gender gap in wage incomes, which is larger in areas that were more male-biased in the past. Based on estimates in Column 2, moving from a county with a historical sex ratio at parity (1) to a county with a historical sex ratio of 3 (the average) is associated with a 6% increase in the wage earnings differential between men and women. Moving from the county with the minimum sex ratio (1.01) to the county with the maximum sex ratio (18.83) is associated with a 70% increase in the earnings differential between genders.[26]

However, the earnings differential between genders that is explained by the historical sex ratio is entirely accounted for by labor supply decisions of women. In Columns 3 and 4, when we control for the number of hours worked, the interaction between gender and the historical sex ratio is no longer statistically significant. The earning differential has disappeared. Additional regressions in Columns 7 to 9, in which we regress the number of hours worked on the same set of controls as the wage regressions, confirm that women in high historical sex ratios areas work fewer hours.

As argued by Beaudry et al. (2012), industrial and occupational composition plays a large influence on the structure of wages. We have flagged before the concern that industrial specialization may be endogenous to the historical sex ratio, and including them as controls may bias our estimates, which is why we chose to focus on the estimates of (3).

[26] These figures are computed as: $\left(e^{|-0.03*3|} - e^{|-0.03*1|}\right)/e^{|-0.03*3|}$ and $\left(e^{|-0.03*18.83|} - e^{|-0.03*1.01|}\right)/e^{|-0.03*18.81|}$.

Nevertheless, our results are robust to the inclusion of gender-specific industry (2*19 industry categories) and occupation dummies (2*8 occupation categories), which enable a comparison of outcomes within industry and within occupation, as in Bidner and Sand (2012). The occupation-gender dummies are included to account for the heterogeneity in the quality of occupations between genders, which we have already documented. The industry-gender specific effects are included to account for the possible heterogeneity in income that could arise if men and women systematically sort into different industries and if some industries systematically pay higher wages.[27]

The results of these specifications are in Columns 5 and 6 of Table 6. The results are unchanged, except that the coefficient on female is no longer statistically significant once we fully account for differences in industry and occupations between genders.

In order to address concerns about incidental truncation in the wage regressions, we present in Appendix Table A10 the results of a Heckman correction for sample selection. The excluded instruments in the selection equation consist of marital status and dividend income. The null hypothesis of no selection bias is rejected in two thirds of the cases, but all the results discussed so far are unchanged and similar in magnitude.

We have just reported that women work fewer hours and as a result earn lower income in areas that had a high sex ratio historically, but this still says very little about women's welfare. To directly document this, we turn to self-reported satisfaction.

6.2. Satisfaction

We analyze self-reported satisfaction in two dimensions: marital satisfaction and overall satisfaction. Marital satisfaction is captured in HILDA by the following question: *"How satisfied are you with your relationship with your partner?",* with answers ranging from 0 (completely dissatisfied) to 10 (completely satisfied). The sample average is 8.30, with women less satisfied in their relationship than men (difference of -0.24, t-stat of 10.58).

[27] We have checked that all the results obtained with HILDA attitudinal data and discussed in Sections 4 and 5 are robust to controlling for the full set of gender-occupation and gender-industry dummies. For example, the coefficient with the full set of usual controls and these dummies, which corresponds to the coefficient in Column 3 of Table 3 is -0.026, with a t-stat of 4.12.

Overall satisfaction is captured by the question: *"How satisfied are you with your life?"*, with the same range of answers. The sample average is 7.91, with women more satisfied than men (difference of 0.07, t-stat of 5.00).

We analyze answers to satisfaction questions as the dependent variable, and we contrast the results for men and women. Regression results are in Table 7 and are first presented with the restricted and then the full set of usual geographic, historic and contemporary controls. We also add a control for the presence of small or dependent children.

Both men and women in high historic sex ratio areas are happier today in their relationship. However, there is no significant difference between men and women; both are happier. Yet, the relationship falls short of significance when the full set of controls is added. Although the interaction between female and the historical sex ratio is positive, it is not statistically different from zero.

People in high historic sex ratio areas are more satisfied in general. In contrast with marital satisfaction, answers to the general life satisfaction question reveal significant and robust differences between men and women as a function of the historical sex ratio. Even though women are in general more satisfied than men, the relationship is reversed in areas that had more men historically. In those areas, men are more satisfied than women. Nevertheless, the overall effect of the historical sex ratio on female life satisfaction remains positive and significant.

7. Conclusion

This paper documents the implications of missing women in the short, medium, and long run. In areas with higher gender imbalance, women historically married more, worked less, and were less likely to occupy high-rank occupations. In these areas today, people have more conservative attitudes towards women working, women are still less likely to have high-ranking occupations and they earn lower wage income because they work less. Although our results may be specific to a certain technological context -work opportunities for women were very poor in 19th century Australia- and although the average deviation from a balanced sex ratio that we study in this paper is larger than deviations observed today in certain parts of the world, a noteworthy implication is that a

temporary imbalance in the sex ratio has consequences that endure way beyond the imbalance itself.

Our results illustrate how cultural norms emerged as a response to a specific scarcity situation: the lack of women. Cultural norms can emerge as an adaptive evolutionary response to a large shock in the marriage market and persist in the long run, when they are no longer necessarily adaptive, despite subsequent but smaller changes to the conditions in the marriage market.

We find that the presence of strategic complementarities between cultural norms, which we discuss here in the context of the marriage market, underlies the persistence of culture. We believe that the presence of strategic complementarity between cultural norms solves the apparent paradox of rapid adaptation of cultural norms yet cultural persistence over long periods of time. One implication is that persistence will be stronger and last longer for norms that exhibit stronger strategic complementarities and in situations, like the marriage market, where experimentation is costly. A more detailed exploration of this mechanism is left for future research.

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TABLES
Table 1: Summary statistics and balance of covariates

Variables	Obs.	Mean	s.d.	Min	Max	Diff. above vs. below median historic sex ratio (i)	t-stat of diff. (ii)
Panel A: First historical cross section for use in present-day regressions							
Historic sex ratio	93	3.10	2.95	1.01	18.83	3.11	6.04***
Convict gender ratio	36	28.86	42.04	1.27	219.00	32.9	3.55***
Historical Population (in thousands)	93	4493	11876	36	101080	-4,019	-1.63
Sectors – % of pop. employed in:							
Agriculture, pastoral, horticulture or winegrowing	90	0.23	0.12	0.02	0.75	0.036	1.38
Domestic and personal service	90	0.14	0.14	0.03	0.81	-0.0094	-0.32
Manufacturing or Mining	90	0.12	0.20	0.00	1.23	-0.042	-0.95
Government and learned professions	90	0.02	0.02	0.00	0.13	-0.0042	-0.97
Panel B: Historical panel data (1836 - 1881)							
Historic sex ratio	446	1.88	1.57	0.93	18.83	1.23	8.63***
Prop. female married	406	72.37	26.60	6.26	284.36	12.3	6.05***
Prop. male married	406	39.53	12.93	5.34	138.58	-13.6	-8.75***
Female labour force particip. (% married women)	205	43.93	28.03	0	100.00	-20.6	-4.13***
Prop. women in high-ranking occupations	247	24.45	23.17	0	77.97	-10.3	-3.67***
Panel C: HILDA matched with the historical censuses and controls from 2011 Census and Geoscience Australia							
Progressive Attitude Gender Roles	42,918	4.47	1.98	1	7	-0.37	-2.07**
Log wages	24,263	10.52	0.92	0	13.93	0.00	0.07
Satisfied with partner	31,283	8.30	2.03	0	10	0.25	2.07**
Overall life satisfaction	48,971	7.91	1.51	0	10	0.14	1.50
Individual Controls:							
Married or de facto	48,991	0.62	0.49	0	1	-0.02	-0.50
Age	49,019	43.69	18.42	14	101	1.33	0.94
Beyond year 12 education	48,989	0.34	0.47	0	1	-0.03	-0.55
Australia born	49,006	0.76	0.43	0	1	0.03	0.64
Male	49,019	0.47	0.50	0	1	0.02	0.64
Postal area controls:							
Urban	49,019	0.93	0.25	0	1	-0.20	-2.05**
Contemporary gender ratio	49,017	0.97	0.09	0.64	13.53	0.04	2.10**
Plains and plateaus	49,017	0.48	0.50	0	1	-0.13	-1.20
Hills and ridges	49,017	0.03	0.16	0	1	-0.11	-2.02**
Low plateaus and low hills	49,017	0.06	0.23	0	1	0.07	1.82*
Minor coal	49,017	0.04	0.20	0	1	-0.01	-0.87
Minor other	49,017	0.01	0.04	0	1	0	0.90
Major coal	49,017	0.27	0.44	0	1	-0.21	-2.86***
Major copper	49,017	0.01	0.05	0	1	0.05	1.68*
Major gold	49,017	0.32	0.47	0	1	0.21	2.04**
Major mineral sands	49,017	0.06	0.24	0	1	0.06	1.08
Major other	49,017	0.00	0.01	0	1	0.00	0.97
Panel D: 2011 Census matched to the historical censuses							
Female labor force participation	1900	56.00	9.47	0	100	-2.04	-2.27**
Women in high-rank occupations	1890	21.31	8.48	0	46.50	-3.05	-3.29***
Additional Postal area controls:							
Prop. with professional college education	1895	0.21	0.05	0	1	-0.004	-0.87

Notes: (i) and (ii): differences and t-stat are from regressions at the county level with state fixed effects and robust s.e. In Panels A and B, observations are historical counties. In Panel C, observations are individuals. In Panel D, observations are present-day postal areas. The excluded land category is "mountains". The excluded mineral category is "no traces or deposits".

Table 2: Historical panel results: gender imbalance, female work and marriage between 1836 and 1881

	1	2	3	4	5	6	7	8	9	10
	Married women (% women)		**Married men (% men)**		**Female Labor Force Participation**			**Women in high-ranking occupations (% working women)**		
Sex ratio	2.396***	2.481***	-2.135***	-1.515***	-21.136***	-12.961**	-13.205**	-19.663***	-13.832***	-14.100***
	(0.714)	(0.794)	(0.495)	(0.285)	(6.482)	(5.076)	(5.579)	(3.452)	(3.551)	(3.603)
Male labour force participation							0.088***			
							(0.026)			
Male high-rank occupation										0.110
										(0.106)
Observations	412	412	412	412	205	205	205	247	247	247
R-squared	0.026	0.234	0.055	0.120	0.077	0.335	0.377	0.101	0.617	0.619
Number of counties	94	94	94	94	70	70	70	77	77	77
County FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	No	Yes	No	Yes	No	Yes	Yes	No	Yes	Yes

Notes: The table reports OLS estimates. The unit of observation is a historic county-year (see Table A1 for years in each state). 'Sex ratio' is the number of men to the number of women. 'Female (respectively, Male) Labor Force Participation' is the proportion of females (respectively, male) employed, as a proportion of married females (respectively, males). 'Women (respectively, Men) in high-rank occupations' is the proportion of women (respectively, men) employed in 'commerce and finance', as a percentage of the employed females (respectively, males). See Table 1 for summary statistics. All regressions are with a constant. Robust standard errors are reported in parentheses. ***, ** and * indicate statistical significance at the 1%, 5% and 10% level, respectively.

Table 3: Gender imbalance, gender role attitudes and female work today: OLS results

	1	2	3	4	5	6	7	8	9	10	11
	Progressive attitude			**Female labor force participation**				**Women in high-rank occupations**			
Historical sex ratio	-0.044***	-0.048***	-0.036***	-0.502***	-0.406***	-0.349**	-0.116	-1.125***	-0.704***	-0.662***	-0.445***
	(0.012)	(0.016)	(0.009)	(0.156)	(0.139)	(0.171)	(0.075)	(0.268)	(0.219)	(0.149)	(0.135)
Male labour force participation							0.788***				
							(0.040)				
Male high-rank occupation											0.394***
											(0.051)
State fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
HILDA wave fixed effects	Yes	Yes	Yes	-	-	-	-	-	-	-	-
Geographic controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Minerals and land type	No	Yes	Yes	No	Yes	Yes	Yes	No	Yes	Yes	Yes
Historic controls	No	Yes	Yes	No	Yes	Yes	Yes	No	Yes	Yes	Yes
Individual controls	No	No	Yes	-	-	-	-	-	-	-	-
Contemporary poa controls	No	No	Yes	No	No	Yes	Yes	No	No	Yes	Yes
Observations	42,916	42,334	42,284	1,898	1,871	1,862	1,862	1,888	1,861	1,861	1,861
Number of counties	81	78	78	91	88	88	88	91	88	88	88
R-squared	0.017	0.020	0.168	0.033	0.075	0.185	0.731	0.130	0.192	0.277	0.573

Notes: Columns 1 to 3 present results when the dependent variable is an individual's response to the statement "*it is better for everyone involved if the man earns the money and the woman takes care of the home and children*." Response categories range from 1 (strongly disagree) to 7 (strongly agree) (mean: 4.47), which we recoded so that a higher value indicates more progressive attitudes. The unit of observation is an individual in a postal area (hereafter, POA) in a historic county. 'Geographic controls' are a POA's centroid's latitude and longitude. 'Minerals and land type' is the presence and type of mineral deposit (minor coal; minor other; major coal; major copper; major gold; major mineral sands; major others) and land formation (plains and plateaus; hills and ridges; low plateaus and low hills; mountains), which are provided by Geoscience Australia. 'Historical controls' are: the historical county population, as well as the proportion of residents working historically in agriculture, domestic service, manufacturing, mining, government services and learned professions. 'Individual controls' are: gender, relationship status (married or de facto), age, whether one was born in Australia and whether one has education beyond year 12. These are all derived from HILDA. 'Contemporary poa controls' in Columns 1 to 3 are the number of men to women in a POA, whether POA is urban. 'Contemporary poa controls' in Columns 4 to 10 are the same as those in Columns 1 to 3 with an additional control of the average vocational tertiary education of a POA. Columns 4 to 6 present results when the dependent variable is the 2011 FLFP as reported in the 2011 Census. 'Male labor force participation' refers to the 2011 MLFP as reported in the 2011 Census. Columns 7 to 10 present results when the dependent variable is the proportion of employed women employed as professionals from the 2011 Census. 'Men in high-rank occupations' refers to the proportion of employed men employed as managers or professionals. The unit of observation in Columns 4 to 10 is a POA matched to its historic county. Standard errors are reported in parentheses and have been corrected for heteroskedasticity and for clustering at the county level. Results are robust to using robust standard errors. ***, ** and * indicate statistical significance at the 1%, 5% and 10% level, respectively.

Table 4: Gender imbalance and attitudes and female work today: IV results

	1	2
	Progressive attitude	**Women in high-rank occupations**
	Panel A: Second Stage IV estimation results	
Historical sex ratio	-0.120***	-0.572*
	(0.037)	(0.297)
Geographic controls	Yes	Yes
Minerals and land type	Yes	Yes
Historical controls	Yes	Yes
Individual controls	Yes	-
Contemporary poa controls	Yes	Yes
Number of convicts	Yes	Yes
Men in high-rank occupations	-	Yes
Observations	13,834	485
Number of counties	28	31
R-squared	0.166	0.815
State FE	Yes	Yes
HILDA wave FE	Yes	-
	Panel B: First stage estimation results	
Convict sex ratio	0.032***	0.037***
	(0.001)	(0.004)
Observations	16,082	485
Number of counties	28	31
F statistic	2033.9	110.15
Adjusted R-squared	0.861	0.854

Notes: See Table 3 for the list of controls. The table reports 2SLS estimates. All the controls are identical to those included in Table 3 and are identical in the first and second stages (Panel A and B). Standard errors are reported in parentheses and have been corrected for heteroskedasticity and for clustering at the county level.

Table 5: Persistence: vertical cultural transmission and homogamy

	1	2	3	4	5	6
			Progressive attitude			
Historical sex ratio	0.024	0.014	0.053**	0.038*	0.069	0.049
	(0.018)	(0.015)	(0.026)	(0.021)	(0.047)	(0.047)
Australian parent	0.304***	0.302***				
	(0.061)	(0.060)				
Australian parent * sex ratio	-0.060***	-0.059***				
	(0.022)	(0.021)				
Low migration			0.101*	0.102		
			(0.058)	(0.062)		
Low migration * sex ratio			-0.078***	-0.074***		
			(0.025)	(0.019)		
High homogamy					0.087	0.061
					(0.112)	(0.127)
High homogamy * sex ratio					-0.088*	-0.080*
					(0.048)	(0.049)
Geographic controls	Yes	Yes	Yes	Yes	Yes	Yes
Minerals and land type	No	Yes	No	Yes	No	Yes
Historical controls	No	Yes	No	Yes	No	Yes
Individual controls	Yes	Yes	Yes	Yes	Yes	Yes
Contemporary poa controls	Yes	Yes	Yes	Yes	Yes	Yes
Observations	42,866	42,284	42,866	42,284	42,947	42,947
R-squared	0.167	0.169	0.166	0.168	0.167	0.168
State FE	Yes	Yes	Yes	Yes	Yes	Yes
HILDA wave FE	Yes	Yes	Yes	Yes	Yes	Yes

Notes: See Table 3 for the list of controls. 'Low migration' refers to POAs where the proportion of residents born in Australia is higher than the mean proportion of residents born in Australia as per the 2011 Census. 'Australian parent': dummy equal one if respondent has an Australian father or an Australian mother (mean: 0.68). 'High migration' refers to POAs where the proportion of residents born in Australia is lower than the median proportion of residents born in Australia as per the 2011 Census. Homogamy refers to the average proportion of people of Australian descent in the POA who married someone also of Australian descent. 'Low Homogamy' are POAs whose predicted level of homogamy lies below the median level of homogamy, which is 86%. 'High Homogamy' refers to POAs whose predicted level of homogamy lies above the median. Homogamy is predicted by the sex ratio today, the degree of urbanisation, income, education, shares of employment in 18 different industries and respondents' parents' countries of birth in the POA. Standard errors are reported in parentheses and have been corrected for heteroskedasticity and for clustering at the county level.

Table 6: Welfare implications: wage income and hours worked

	1	2	3	4	5	6	7	8	9
	Log of gross financial year wages and salaries						**Hours worked per week**		
Historical sex ratio	-0.016**	-0.012*	-0.030***	-0.027***	0.001	-0.012***	0.603***	0.611***	0.397***
	(0.008)	(0.007)	(0.007)	(0.006)	(0.005)	(0.005)	(0.152)	(0.140)	(0.085)
Female	-0.425***	-0.407***	-0.118***	-0.116***	-0.232	0.122	-9.746***	-9.619***	-17.129***
	(0.043)	(0.039)	(0.027)	(0.024)	(0.146)	(0.133)	(0.693)	(0.682)	(1.341)
Female * Historical sex ratio	-0.028*	-0.030**	-0.003	-0.006	-0.024**	-0.009	-0.718***	-0.724***	-0.396***
	(0.016)	(0.014)	(0.010)	(0.008)	(0.010)	(0.007)	(0.218)	(0.209)	(0.148)
Hours worked per week			0.034***	0.033***		0.029***			
			(0.001)	(0.001)		(0.001)			
Geographic controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Minerals and land type	No	Yes	No	Yes	Yes	Yes	No	Yes	Yes
Historical controls	No	Yes	No	Yes	Yes	Yes	No	Yes	Yes
Individual controls	No	Yes	No	Yes	Yes	Yes	No	Yes	Yes
Contemporary poa controls	No	Yes	No	Yes	Yes	Yes	No	Yes	Yes
Occupation-gender dummies	No	No	No	No	Yes	Yes	No	No	Yes
Industry-gender dummies	No	No	No	No	Yes	Yes	No	No	Yes
Observations	24,275	23,936	24,275	23,936	23,810	23,810	28,840	28,465	28,313
R-squared	0.114	0.184	0.356	0.404	0.311	0.465	0.150	0.161	0.255
State FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
HILDA wave FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: See Table 3 for a list of controls. The level of observation is an individual. The dependent variable in Columns 1 to 6 is the log of individual yearly gross wages and salary. 'Occupation dummies': managers; professionals; technician and trade workers; community and personal service workers; clerical and administrative workers; sales workers; machinery operators and drivers; laborers. 'Industry dummies': agriculture, forestry, fishing; mining; manufacturing; electricity, gas, water, waste; construction; wholesale trade; retail trade; accommodation and food; transport, postal and warehousing; information, media and telecommunications; financial and insurance; real estate; professional, scientific and technical; public administration and safety; education and training; health care and social; arts and recreation; other services. Occupation- and Industry-gender dummies are the full list of, respectively, occupation and industry dummies interacted with *female*. Standard errors are reported in parentheses and have been corrected for heteroskedasticity and for clustering at the county level.

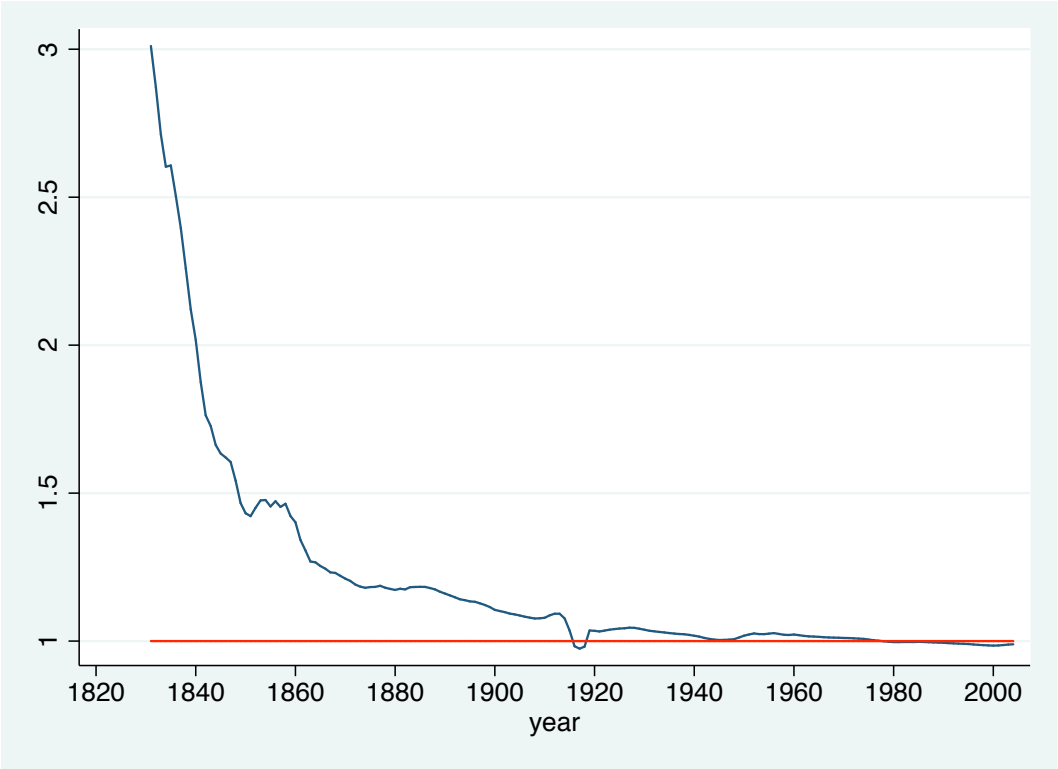
Table 7: Welfare implications: satisfaction

	1	2	3	4
	Satisfied with partner		**Overall life satisfaction**	
Historical sex ratio	0.039***	0.017	0.045***	0.027***
	(0.010)	(0.011)	(0.009)	(0.006)
Female	-0.245***	-0.253***	0.093***	0.088***
	(0.029)	(0.033)	(0.019)	(0.018)
Female * Historical sex ratio	0.001	0.004	-0.012*	-0.011*
	(0.012)	(0.011)	(0.006)	(0.006)
Geographic controls	Yes	Yes	Yes	Yes
Minerals and land type	No	Yes	No	Yes
Historical controls	No	Yes	No	Yes
Individual controls	No	Yes	No	Yes
Contemporary poa controls	No	Yes	No	Yes
Family structure controls	No	Yes	No	Yes
Observations	31,282	30,512	48,968	48,297
R-squared	0.009	0.063	0.003	0.019
State FE	Yes	Yes	Yes	Yes
HILDA wave FE	Yes	Yes	Yes	Yes

Notes: The level of observation is an individual. 'Geographic controls', 'Minerals and land type', 'Historical controls', 'Contemporary poa controls' and 'Individual controls' are as in Table 3. The dependent variable in Columns 1 and 2 is individual responses to the question: *"how satisfied are you with your relationship with your partner?"*. The dependent variable in Columns 3 and 4 is individual responses to the question: *"how satisfied are you with your life?"* Response categories to satisfaction questions range from 0 (completely dissatisfied) to 10 (completely satisfied). 'Family structure' indicates whether the household includes young children (under the age of 15) or dependent children. Standard errors are reported in parentheses and have been corrected for heteroskedasticity and for clustering at the county level.

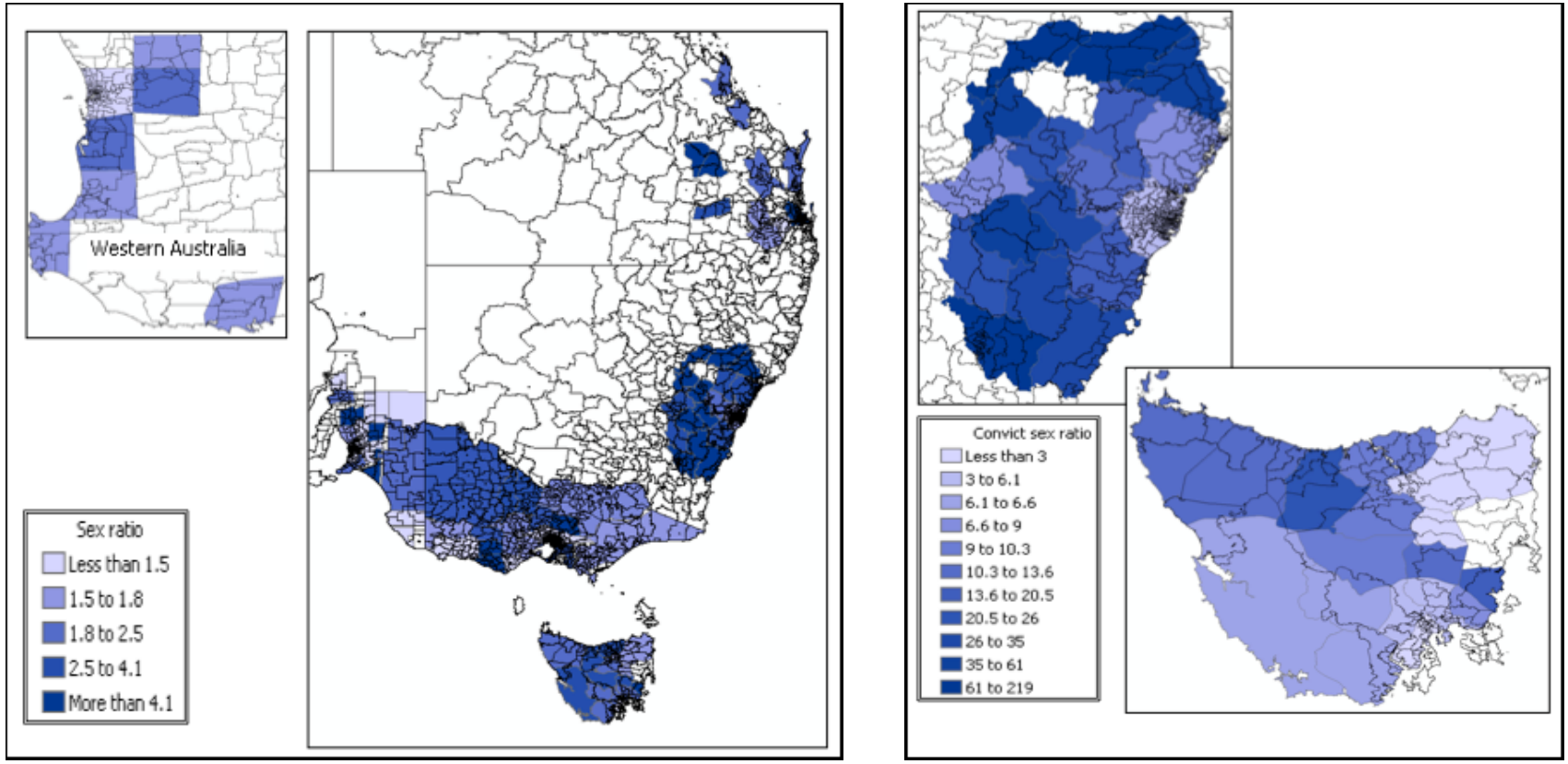
FIGURES

Figure 1: Sex ratio in Australia: number of men to every woman, 1830-2002



Source: Australian Bureau of Statistics

Figure 2: Gender imbalance in mid 19th century Australia: in the whole population (Left Panel) and among the subset of convicts (Right Panel)



Notes: The maps only show the parts of Australia for which Census data is available for the period of study. Left panel: Australian Capital Territory, New South Wales, Queensland, South Australia, Tasmania, Victoria, and Western Australia. Right panel: Australian Capital Territory, New South Wales, Tasmania.
Source: Australian Historical Census

For Online Publication

***APPENDIX:* It's Raining Men! Hallelujah?**

Pauline Grosjean and Rose Khattar

Table A1: Observations in the historical panel

	Colony					
Year	NSW	TAS	VIC	SA	WA	QLD (i)
1836	18					
1841	18					
1842		16				
1844				7		
1846	18					
1848		16			6	
1851	18					
1854			21		6	
1856	18					
1857		10	21			
1859					6	
1861	18	10	21	16	6	14
1866				16		
1870		10			6	
1871	18		21	16		
1876				16		
1881		10	21	16		

Notes: (i) Queensland was part of New South Wales until 1859. We lose observations after 1861 in Queensland because substantial redistricting took place and the maps indicating the new districts are not available for this study.

Table A2: Historical cross section results: gender imbalance and historical marriage rates, fertility and female work in the mid 19th century

	1	2	3	4	5	6	7	8
	Female marriage rate (%, women)		**Male marriage rate (%, men)**		**Female Labour Force Participation**		**Women in High-Ranking Occupations % working women)**	
Historical sex ratio	1.235***	0.947**	-2.382***	-2.024***	-0.343***	-0.302***	-0.255**	-0.172+
	(0.408)	(0.383)	(0.339)	(0.268)	(0.101)	(0.098)	(0.124)	(0.111)
Geographic controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Minerals and land type	No	Yes	No	Yes	No	Yes	No	Yes
Historical controls	No	Yes	No	Yes	No	Yes	No	Yes
Observations	83	80	83	80	83	80	66	65
R-squared	0.522	0.662	0.588	0.731	0.296	0.429	0.595	0.636
State FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: The table reports OLS estimates. The level of observation is a historical county. 'Historical sex ratio' is the number of men to the number of women in a county. 'Geographic controls' are a POA's centroid's latitude and longitude. 'Minerals and land type' is the presence and type of mineral deposit (minor coal; minor other; major coal; major copper; major gold; major mineral sands; major others) and land formation (plains and plateaus; hills and ridges; low plateaus and low hills; mountains) which are provided by Geoscience Australia. 'Historical controls' are the proportion of residents working historically in agriculture, domestic service, manufacturing, mining, government services and learned professions. All regressions are with a constant. Robust standard errors are reported in parentheses. ***, **, *, + indicate statistical significance at the 1%, 5%, 10% and 15% level, respectively.

Table A3: Not sexism in general: Gender imbalance and perceptions of female political leadership

	1	2	3	4	5
	Attitudes towards women as political leaders			**Female labour force participation**	
				Full-Time	***Part-Time***
Historical sex ratio	0.003	0.001	-0.001	-0.219***	0.215**
	(0.017)	(0.010)	(0.008)	(0.083)	(0.093)
Male labour force participation (same category)				0.581***	0.476***
				(0.071)	(0.098)
Geographic controls	No	Yes	Yes	Yes	Yes
Minerals and land type	No	Yes	Yes	Yes	Yes
Historic controls	No	Yes	Yes	Yes	Yes
Individual controls	No	No	Yes	Yes	Yes
Contemporary poa controls	No	No	Yes	Yes	Yes
Male labour force participation	No	No	Yes	Yes	Yes
Observations	32,054	31,625	31,589	1,861	1,861
Number of counties	81	78	78	88	88
R-squared	0.000	0.006	0.095	0.508	0.463
State FE	No	Yes	Yes	Yes	Yes
HILDA wave FE	No	Yes	Yes	-	-

Notes: See notes to Table 3 in main paper. The table presents results where the dependent variable is an individual's response to the question: "How much o you agree with the following statement: on the whole, men make better political leaders than women do." Response categories range from 1 (strongly disagree) to 7 (strongly agree), which we recoded so that a higher value indicates more progressive attitudes.

Table A4: Robustness

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
	Progressive attitudes							**Women in high-rank occupations**						
Robustness test	Non-linear effects	Excluding metrop. areas	No county with <100 women, historically	No county with <300 or >40,000 people, historically	Controlling for distance to ports	PS matching	Random historical sex ratio	Non-linear effects	Excluding metrop. areas	No county with <100 women, historically	No county with <300 or >40,000 people, historically	Controlling for distance to ports	PS matching	Random historical sex ratio
Log historical sex ratio	-0.197***							-4.941***						
	(0.066)							(0.929)						
Historical sex ratio		-0.029***	-0.051***	-0.064***	-0.031***	-0.027*			-0.331***	-1.446***	-0.910***	-0.651***	-0.530***	
		(0.008)	(0.017)	(0.016)	(0.006)	(0.015)			(0.099)	(0.367)	(0.285)	(0.149)	(0.163)	
Historical sex ratio (randomized)							-0.013							-0.125
							(0.008)							(0.079)
Geographic controls	Yes	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes	Yes	No	No
Extended geo. controls	Yes	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes	Yes	No	No
Historical controls	Yes	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes	Yes	No	No
Individual controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	-	-	-	-	-	-	-
Contemporary poa controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Distance to ports	No	No	No	No	Yes	No	No	No	No	No	No	Yes	No	No
Observations	42,284	17,890	40,439	38,773	42,284	42,284	40,552	1,861	1,031	1,734	1,700	1,861	1,861	1,861
R-squared	0.168	0.181	0.167	0.166	0.168	0.166	0.165	0.285	0.258	0.277	0.289	0.280	0.243	0.269
State FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
HILDA wave FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	-	-	-	-	-	-	-

Notes: See Notes to Table 3 in main paper for list of controls. Metropolitan areas are: Cumberland and Camden in NSW, Bourke, Evelyn, Grant and Mornington in VIC, Adelaide in SA, Stanley in QLD. There are 13 counties with less than 100 women historically and 19 counties with either less than 300 people or more than 40,000 people historically (only 5 of which have less than 100 women). "Distance to port" is the geodesic distance between the POA and Sydney, Melbourne, and Brisbane. In Columns 6 and 13, the matching estimator is estimated as a two-step procedure. In the first step, the Propensity score is predicted flexibly as function of the usual geographic, extended geographic and historical controls as well as the second order terms of all geographic and historical variables and interactions between all the geographic and historical variables. In the second step, the Propensity score is included as a repressor. Only the results of the second step pertaining to the historical sex ratio are displayed.

Table A5: Placebo specifications: male work outcomes today

	1	2	3	4
	Male labor force participation			***Men in high-rank occupations***
	All	***Full-Time***	***Part-Time***	
Historical sex ratio	-0.030	0.152	-0.167	-0.051
	(0.243)	(0.184)	(0.116)	(0.093)
State fixed effects	Yes	Yes	Yes	Yes
Geographic controls	Yes	Yes	Yes	Yes
Historic controls	Yes	Yes	Yes	Yes
Contemporary controls	Yes	Yes	Yes	Yes
Female high-rank occupation	No	No	No	Yes
Observations	1,862	1,862	1,862	1,861
Number of counties	91	88	88	88
R-squared	0.201	0.196	0.248	0.805

Notes: See Notes to Table 3 in main paper. ***, **, *, and + indicate statistical significance at the 1%, 5%, 10% and 15% level, respectively.

Table A6: Robustness with 1861 sex ratio

	1	2	3	4	5	6
	Progressive attitude		**Female labor force participation**		**Women in high-rank occupations**	
Historical sex ratio in 1861	-0.129**	-0.062**	-0.178	-0.323	-2.669**	-0.971+
	(0.058)	(0.031)	(0.568)	(0.213)	(1.159)	(0.628)
Geographic controls	Yes	Yes	Yes	Yes	Yes	Yes
Extended geo controls	No	Yes	No	Yes	No	Yes
Historical controls	No	Yes	No	Yes	No	Yes
Individual controls	No	No	-	-	-	-
Contemporary poa controls	No	No	No	No	No	No
Male labor force participation	-	-	No	No	-	-
Men in high-rank occupations	-	-	-	-	No	No
Observations	41,811	41,355	1,842	1,812	1,832	1,811
R-squared	0.008	0.161	0.024	0.733	0.118	0.567
HILDA wave FE	Yes	Yes	-	-	-	-
State FE	Yes	Yes	Yes	Yes	Yes	Yes

Notes: See Notes to Table 3 in main paper. ***, **, *, and + indicate statistical significance at the 1%, 5%, 10% and 15% level, respectively.

Table A7: Analysis with 1933 Census

	1	2	3	4
	Female labor force participation		**Women in high- rank occupations**	
Estimation method	*OLS*		*OLS*	
Historical sex ratio	-0.583***	-0.152	-0.341**	-0.103**
	(0.146)	(0.101)	(0.160)	(0.048)
Sex ratio in 1933		-28.969***		1.116
		(4.096)		(1.658)
Geographic controls	Yes	Yes	Yes	Yes
Extended geographic controls	Yes	Yes	Yes	Yes
Historic controls	Yes	Yes	Yes	Yes
Contemporary 1933 poa controls	Yes	Yes	Yes	Yes
Male labor force participation	Yes	Yes	No	No
Men in high-rank occupation	No	No	Yes	Yes
Convict numbers	No	No	No	No
Observations	552	552	552	552
R-squared	0.269	0.578	0.325	0.678

Notes: See Table 3 in main paper for the list of controls. The unit of observation is a POA in 1933. '1933 poa controls' are: the sex ratio in 1933, the proportion of people employed in agriculture in 1933, and average tertiary education in 1933, at the POA level. 'Female labor force participation' and 'Male labor force participation' are computed in the same way and represent proportion of female (respectively male) breadwinner as the percentage of the female (respectively male) population of working age (15 to 70 years old). The population averages are: 27.59% for females and 103.34% for males (some men either below 15 or above 70 are breadwinners, bringing the ratio above 100% for men). 'Women in high-rank occupations' and 'Men in high-rank occupations' are computed in the same way and represent the proportion of employed females (respectively males) employed in 'commerce and finance' in 1933. The population averages are: 9.18% for females and 9.15% for males. Standard errors are reported in parentheses and have been corrected for heteroskedasticity and for clustering at the county level. ***, **, *, and + indicate statistical significance at the 1%, 5%, 10% and 15% level, respectively.

Table A8: Welfare implications: Satisfaction

	1	2
	Satisfied with partner	
Australian born	-0.042	-0.237***
	(0.037)	(0.074)
Partner Australian born		-0.126
		(0.101)
Australian born * Partner Australian born		0.330**
		(0.147)
Geographic controls	Yes	Yes
Minerals and land type	Yes	Yes
Historical controls	Yes	Yes
Contemporary poa controls	Yes	Yes
Individual controls	Yes	Yes
Observations	25,969	25,969
R-squared	0.022	0.023
State FE	Yes	Yes
HILDA wave FE	Yes	Yes

Notes: See Notes to Tables 5 and 7 in main paper.

Table A9: Education as an outcome

	1	2
	Proportion of females with tertiary education	
	2011 Census	1933 Census
Historical sex ratio	0.018	-0.012
	(0.042)	(0.010)
Geographic controls	Yes	Yes
Minerals and land type	Yes	Yes
Historical controls	Yes	Yes
Contemporary poa controls	Yes	Yes
Prop. of males with tertiary education	Yes	Yes
Observations	1,862	1,872
R-squared	0.778	0.803
State FE	Yes	Yes

Notes: See Notes to Table 3 in main paper. The unit of observation is a POA (either 2011 boundaries or 1933 boundaries). "Contemporary poa controls" are 2011 poa controls for Column 1 (see Columns 4 to 7 in Table 3 in main paper for a full list) and 1933 poa controls for Column 2 (see Table A6 for a full list).

Table A10: Heckman sample selection correction for wage income results (Table 6 in paper)

Panel A: Heckman Selection Correction: Wage equation						
	1	2	3	4	5	6
	Log of gross financial year wages and salaries					
	Heckman					
Historical sex ratio	-0.016**	-0.008	0.011**	-0.029***	-0.024***	-0.001
	(0.008)	(0.007)	(0.005)	(0.006)	(0.006)	(0.005)
Female	-0.422***	-0.421***	-0.033	-0.118***	-0.127***	0.252*
	(0.040)	(0.037)	(0.143)	(0.025)	(0.023)	(0.135)
Female * Historical sex ratio	-0.029*	-0.028*	-0.012	-0.003	-0.003	0.000
	(0.016)	(0.015)	(0.010)	(0.009)	(0.008)	(0.007)
Hours worked per week				0.034***	0.033***	0.027***
				(0.001)	(0.001)	(0.001)
Geographic controls	Yes	Yes	Yes	Yes	Yes	Yes
Minerals and land type	No	Yes	Yes	No	Yes	Yes
Historical controls	No	Yes	Yes	No	Yes	Yes
Individual controls	No	Yes	Yes	No	Yes	Yes
Contemporary poa controls	No	Yes	Yes	No	Yes	Yes
Occupation-gender dummies	No	No	Yes	No	No	Yes
Industry-gender dummies	No	No	Yes	No	No	Yes
Observations	27,940	27,584	27,439	27,940	27,584	27,439
Log likelihood	-41422.71	-39937.12	-35400.38	-37698.71	-36228.44	-32814.41
Panel B: Selection Equation						
	7	8	9	10	11	12
	Selection equation					
Historical sex ratio	-0.048***	-0.042***	-0.032***	-0.034*	-0.043***	-0.028***
	(0.014)	(0.014)	(0.008)	(0.020)	(0.014)	(0.009)
Female	0.129***	0.125***	-0.340**	0.133***	0.151***	-0.406***
	(0.028)	(0.028)	(0.143)	(0.028)	(0.028)	(0.140)
Female * Historical sex ratio	-0.015*	-0.015*	0.006	-0.017**	-0.013	0.002
	(0.008)	(0.008)	(0.009)	(0.008)	(0.008)	(0.008)
Hours worked per week					0.003*	-0.003***
					(0.001)	(0.001)
Married or de facto	-0.138***	-0.019	0.089***	-0.132***	-0.021	0.110***
	(0.036)	(0.032)	(0.015)	(0.035)	(0.030)	(0.012)
Financial dividends	-0.005***	-0.005***	-0.001	-0.005***	-0.005***	-0.001*
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Geographic controls	Yes	Yes	Yes	Yes	Yes	Yes
Minerals and land type	Yes	No	Yes	Yes	No	Yes
Historical controls	Yes	No	Yes	Yes	No	Yes
Individual controls	Yes	No	Yes	Yes	No	Yes
Contemporary poa controls	Yes	No	Yes	Yes	No	Yes
Occupation-gender dummies	Yes	No	No	Yes	No	No
Industry-gender dummies	Yes	No	No	Yes	No	No
Observations	27,940	27,584	27,439	27,940	27,584	27,439
Wald statistics	63.41	3.55	3496.76	64.89	4.22	2070.15

Notes: See Notes to Table 6 in main paper.

Map and Data Sources

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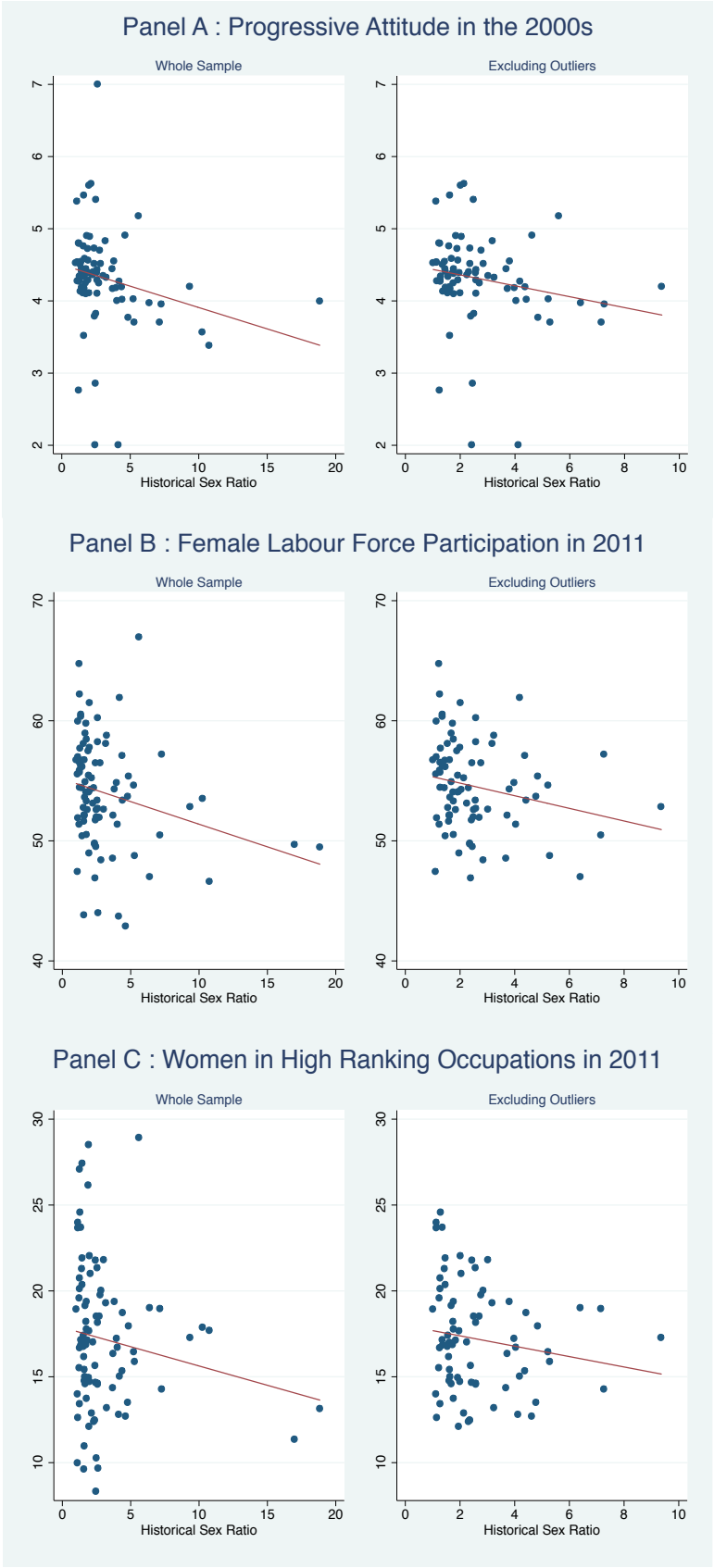
Note: 12 counties from the Colonial Censuses had to be dropped because of incomplete maps.

Figure A1: Bivariate correlations of outcomes today by historic sex ratio



Notes: Each dot is the average value, by historical county. All relationships are statistically significant at the 1% level. Estimated coefficients (with robust standard errors) are: A) -0.06 (t-stat: 2.66) and -0.08 (t-stat: 2.21), B) -0.38 (t-stat: 3.56) and -0.53 (t-stat: 2.08), C) -0.22 (t-stat: 2.27) and -0.30 (t-stat: 1.59)
Sources: HILDA and Australian Census

Figure A2: Bivariate correlations of outcomes in 1933 by historic sex ratio

Notes: Each dot is the average value, by historical county. All relationships are statistically significant at the 1% level. Estimated coefficients (with robust standard errors) are: A) -0.35 (t-stat: 5.12) and -0.48 (t-stat: 2.60), B) -0.30 (t-stat: 2.16 and -0.78 (t-stat: 3.30).
Sources: HILDA and Australian Census