

## **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 18<sup>th</sup> and 19<sup>th</sup> century. In areas with higher gender imbalance, women historically married more, had more children, and were less likely to occupy high-rank occupations. Today, people living in those areas have more conservative attitudes towards women working and women are less likely to have high-ranking occupations. We discuss how conservative gender norms were beneficial historically, but are no longer necessarily so; and we document the role of vertical cultural transmission and homogamy in the marriage market in sustaining cultural persistence. The implication is that cultural norms can evolve rapidly to serve reproductive fitness but may harm overall fitness in the long run. Historical gender imbalance is associated with an aggregate income loss estimated at \$800 per year, per person. Our results are robust to a wide array of geographic, historical and present-day controls, including migration and state fixed effects, and to instrumenting the overall sex ratio by the sex ratio among convicts.

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

JEL codes: I31, N37, J16, Z33

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## 1. Introduction

Traditional economic models link the division of labor between men and women to the available technology, which determines the relative returns to male and female labor, and to the conditions in the marriage market, which determine the outcome of bargaining between men and women. However, recent work has highlighted the importance of cultural norms and beliefs about appropriate gender roles (Fernandez 2009, 2014, Bertrand, Kamenica, and Pan 2013). This opens the question of how such beliefs emerge and persist. To answer this question, Alesina, Giuliano and Nunn (2013) point to the technology that was available in pre-industrial times. Past technology still matters because it shaped the division of labor between men and women, which was then integrated into cultural norms that persisted over time. Taking a natural step, we ask whether, and how, past shocks to the marriage market have similarly enduring effects. Our focus on the marriage market also suggests specific cultural persistence mechanisms, which rely on homogamy in marriage and on child socialization within families, which we explore in details.

We exploit variation in marriage markets conditions, which arose from an exogenous variation in the sex ratio among an otherwise homogeneous population. Heavily male biased sex ratios resulted from British policy to send convicts to Australia in the late 18<sup>th</sup> and 19<sup>th</sup> century. Men far outnumbered women among convicts, by a ratio of 6 to 1 (Oxley 1996). This was at a time when the physical skills required to build the country gave a large premium to male labor. We rely on the variation across Australian counties in the historical sex ratio, measured around the time at which convict transportation ceased. Historically, gender imbalance was associated with women marrying more, having more children, and being less likely to work in high-ranking occupations. We then study the long-term implications by matching our 91 historical counties to contemporary postal areas in the 2011 Census and in a nationally representative household survey. In areas that had a larger imbalance historically, people today have more conservative attitudes towards women working and women are less likely to have high-ranking occupations.

A one unit increase in the historic sex ratio -one more man for a given number of women- moves the average Australian today towards conservative attitudes by 6% at the mean. This

additional man is also associated with a 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. 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.

We demonstrate an effect of gender imbalance: it is the gender imbalance that has shaped the patterns we document, not the convict settlement that created the imbalance. The results are unaffected by controlling for the share of convicts in the overall population. The results are also specific to views about women working; historical gender imbalance does not explain sexism in general.

A concern for identification is that the gender imbalance was determined by characteristics that still influence outcomes today. A careful study of historical circumstances enables us to alleviate this concern. Convict transportation and the resulting gender imbalance reflected British penal imperatives. Male convicts were in the majority because men caused more crime than women in the United Kingdom. Even though prostitution was considered a crime, it was not punished by transportation. Once in Australia, convicts would have to complete the term of their sentence, generally around 7 years, after which they were freed. However, they were not confined to prisons. They either worked under the government's supervision or, later, were assigned to employers. Potential employers were either free settlers or former convicts. They would locate as a function of economic, mostly agricultural, opportunities. Convicts were assigned to them as a function of their labor needs.

To account for the influence of economic opportunities on the sex ratio, we control for geographical characteristics and historical sectoral composition. We also control for state fixed effects throughout, which remove any unobserved heterogeneity due to differences in the legal environment or in the treatment of convicts. We also account for a wide range of individual and contemporary controls, including the industrial classification of all economic activities.

Our results are robust to an instrumental variable approach. We instrument the overall sex ratio by the sex ratio among convicts, who had no choice where to locate. As before, we

remove the potential endogeneity in convict assignment by controlling for sectoral composition. A legacy of a convict past independent of gender imbalance would violate the exclusion restriction. We therefore control for the number of convicts together with historical population size. Our IV estimates are consistent with our OLS estimates and similar in magnitude.

Our historical results, contemporaneous to gender imbalance, are hardly surprising. Economic and evolutionary biology models predict more conservative gender roles as a result of male-biased sex ratios. Bargaining models namely predict that women will select a wealthier partner, extract a better bargain and work less as a result (Grossbard-Schechtman 1984, Chiappori 1988, 1992, Chiappori, Fortin and Lacroix 2002). This is particularly important when job opportunities for women are few. What is more surprising is that we find that this effect has persisted to this day, more than a century after sex ratios have reverted back to parity. The welfare implications are substantial. Women today are happier in their relationship in areas that experienced more male biased sex ratios. Men, by contrast, are not. However, women forego significant income. At the mean, historical gender imbalance is associated with women foregoing \$1,500 of yearly income. This is not fully compensated by higher male income. A possible interpretation is that conservative gender norms are inherited from a past in which they were adaptive because technology favored male labor, but are no longer adaptive today.

Our interest is in whether and how past gender imbalance shaped cultural beliefs about gender roles. However, other mechanisms may explain persistence. For example, initial gender imbalance may have influenced formal institutions, or distorted industrial specialization into male-intensive economic activities. We rule out the first channel by relying on within-country and even within-state variation, where formal legislation is identical.<sup>1</sup> To account for the second channel, we control for industrial specialization today. Another possibility is that past circumstances in the marriage market influenced respective incentives of men and women to invest in education (Chiappori, Iyigun, and Weiss 2009).

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<sup>1</sup> 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 laws 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.

We find very little evidence for this mechanism but still include education as a control. Finally, strong sexual selection in the heavily male-biased situation that we describe may have selected particular genotypes. While we cannot rule this possibility out, it seems unlikely that genetic factors alone explain the large and systematic differences in attitudes, labor force participation, and occupational choice that we document in this paper.

Even if we are confident that cultural beliefs explain our results, the question of how they have persisted remains. Culture may persist because of the transmission of cultural traits within families (vertical) or across unrelated individuals (horizontal) (Cavalli-Sforza 1981, Bisin and Verdier 2001). We find, consistently with vertical transmission, that historical gender imbalance is only associated with conservative views about gender roles among people born of an Australian father. This is true both in high and low migration areas. Such differences between people of different ancestry in the same areas also make it unlikely that the relationship between historical gender imbalance and present-day outcomes is due to unobservable local characteristics or to self-selection of people to localities on the basis of taste.

Our focus on the marriage market suggests an additional persistence mechanism. Assortative mating implies that cultural norms on gender roles among potential spouses are strategic complements. Accordingly, we find that historical gender imbalance is only associated with conservative gender views in areas where homogamy, defined either along ethnic or cultural lines, is high. We also find evidence for a positive interaction between homogamy and vertical transmission, which has a natural interpretation: parents want to instill in their children norms that will make them attractive in the marriage market.<sup>2</sup> A positive feedback of this kind, here between marriage and culture, underlie Belloc and Bowles (2013)'s model of persistence of cultural-institutional conventions. It also suggests that our result may be partly due to the particular institutional environment of monogamous marriage.

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<sup>2</sup> Bisin, Topa and Verdier (2004) discuss different circumstances under which child socialization effort and homogamy are complements or substitutes. However, we do not observe the child socialization effort. We only observe the inheritability of cultural traits, which is the result of socialization effort and environmental factors, so that we cannot comment on whether effort and homogamy are substitutes or complements.

A potential criticism is that our results lack external validity because of Australia's convict history. We identify that our results are a legacy of gender imbalance, not convict heritage. Besides, Australia only has a convict history because British convict transportation to the US was no longer possible after US independence.

Our work is the first to shed light on the long-term effects of gender imbalance. We find that a surplus of men reinforces conservative gender roles, keeps women under the glass ceiling, and has substantial long-term welfare implications, with much lower independent incomes for women. The effects persist 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). This problem is not limited to the most famous cases of China and India, but also concerns sub-Saharan Africa, the US and Canada.<sup>3</sup> The sex ratio that our results are based upon (about 3 men for every woman) is higher than in China and India today<sup>4</sup> but comparable to that prevailing in the West of the US at the end of the 19<sup>th</sup> century (2.13<sup>5</sup>). The study of the determinants of such gender imbalances has attracted a large literature.<sup>6</sup> The study of its consequences is more limited because of evident reverse causality issues. We discuss this literature in more detail in Section 2 of this paper.

Most of the literature links variation in female labor force participation and gender roles across regions and time in the available technology and conditions in the marriage market. The rise in female labor force participation, the expansion of women's economic and political rights, as well as the reduction in fertility that we have observed in developed countries are explained by technological change and the rise in returns to female labor (Goldin and Katz 2002, Greenwood, Seshadri and Vandenbroucke 2005, Doepke and Tertilt 2009, Doepke, Tertilt and Voena 2012, Olivetti 2013). However, the stubbornness of the gender wage gap, even in the most advanced economies, has pushed economists to consider the role of culture. Fernandez (2008) and Fernandez and Fogli (2009) show that preferences for fertility and for

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<sup>3</sup> See Anderson and Ray (2010) for sub-Saharan Africa, Almond and Edlund (2008) for the US, and Almond, Edlund, and Milligan (2013) for Canada.

<sup>4</sup> The sex ratio prevailing in China and India today is estimated at 1.06 on average (Anderson and Ray 2010), but sex ratios at birth are much higher, at 1.20 and 1.09 respectively (Edlund and Lee 2009).

<sup>5</sup> Authors' calculation from US 1870 Census (Ruggles et al. 2010).

<sup>6</sup> See Rao (1993), Edlund and Lee (2009), Chung and Das Gupta (2007), Hesketh and Xing (2006).

female labor force participation change slowly. This, our, and other work show that cultural beliefs influence real work choices, family formation and welfare.<sup>7</sup> Alesina, Giuliano and Nunn (2013) show that conservative gender norms stem from the introduction of plough agricultural in pre-industrial societies. We illustrate a much more rapid cultural change. We show that past conditions on the marriage market also play a role and how they interacted with a particular technological context to shape cultural beliefs. We show that cultural norms can emerge to serve reproductive fitness.

## **2. Conceptual Background**

Economic and evolutionary biology alike predict that a male biased sex ratio will result in conservative gender roles. Economic marriage models predict that 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 20<sup>th</sup> century is positively correlated with local sex ratios. Addressing the possible endogeneity between local marriage conditions and local sex ratios, Abramitzky, Delavande and Vasconcelos (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. Our results, as well as Francis (2011) in the case of Taiwan after the influx of the Chinese Nationalist Army in 1949 show that, conversely, a shortage of women leads to women marrying more.<sup>8</sup> 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, Fortin and Lacroix 2002). This is supported by empirical evidence (Angrist 2002, Chiappori, Fortin and Lacroix 2002).

While economists put forward bargaining as the main mechanism through which the sex ratio affects gender roles, evolutionary biologists discuss others. Males may respond to

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<sup>7</sup> Fortin (2005) shows how gender role attitudes influence labor market outcomes. Alesina, Giuliano and Nunn (2013) establish a relationship between beliefs and participation of women in the economy and in politics. Bertrand, Pan and Kamenica (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.

<sup>8</sup> Pollet and Nettle (2008) find, based on the 1910 US Census, that the effect of socioeconomic status on men's marital success was stronger in states in which males outnumbered women. However, they do not address the potential endogeneity of sex ratios.

competitive pressures by making themselves more attractive to females, which involves resource transfers as in bargaining models, but not only (Kokko and Jennions 2008). Any signal correlated with the future possible reproductive success of offspring, such as a beautiful tail or the tidiness of a nest, will be valued. In humans, signals of wealth or of one's commitment to provide economic resources will be attractive to women. Male-biased sex ratios may also have negative consequences for females. These ensue when males divert resources from the female and offspring towards competing with other males, or when males engage in mate guarding, which restricts female freedom. However, in all these circumstances the prediction applied to humans is that male-biased sex ratios will lead to more conservative gender roles with females working less outside the home.

We study a particular society, in which the mating system consists of monogamous marriage. Marriage markets are plagued with asymmetric information, which is a particularly severe problem for women. As shown by the recent dating literature, men are principally attracted to looks, an essentially observable characteristic. Fisman et al. (2006) show, in the context of speed dating experiments, that women are attracted to intelligence, a proxy for income generation capacity that is not as easily observable. Men have to signal their qualities to potential spouses. While everybody easily imagines the behavior that the speed-dating Americans in Fisman et al. (2006)'s study adopt as a response, the circumstances of 19<sup>th</sup> century Australia may have led to another kind of behavior.

The opportunity cost of a bad match for a woman depends on the technology. It is particularly high if women's economic opportunities outside of marriage are limited or unattractive, as it was in 19<sup>th</sup> century agricultural Australia. In this context, convincing a woman of one's commitment to work enhances marriage prospects. Adhering to the view that "a man should earn the money and a woman should stay at home" may achieve this.

As argued by Alesina, Giuliano and Nunn (2013), conservative gender roles and low female labor force participation imprint onto cultural norms about the appropriate role of women in society. Gender roles of the past then persist in the long run because culture changes slowly. Following Richersen and Boyd (2008), culture is defined as "rules of thumb" that affect behaviour in complex and uncertain environments and that people acquire from other people through "teaching, imitation and other forms of social transmission" (Richersen and Boyd



2008, 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 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. The implied hysteresis 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 another persistence mechanism. Assortative mating on the marriage market implies that views about gender roles are strategic complements among potential spouses. More similar individuals are more likely to be married to each other, more likely to stay married (Becker et al. 1977, Heaton 1984, Lehrer-Chiswick 1993), and are happier in their relationship, as we show in the empirical part of this paper. Conservative gender roles may persist in the long run solely because they are mutual best responses in a homogamous marriage market. Young (1998) shows theoretically that norms that are mutual best responses are evolutionarily stable. Positive feedbacks of this kind are at the core of the persistence of possibly Pareto-dominated conventions in Belloc and Bowles (2013). Thus, conservative cultural traits may persist, even when they are no longer necessarily Pareto dominant once the sex ratio has reverted back to normal and economic opportunities for women have increased.

Belloc and Bowles (2013) discuss conditions that make the transition out of a convention 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 any cultural change will occur. Deviation and experimentation may be particularly costly in the marriage market, where time is of the essence 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. This does not necessarily require immigrants to hold modern views. Uncertainty should be enough to lead more people to

experiment with different 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 conservative views. We test both predictions in the empirical analysis.

Homogamy will interact with vertical transmission in a very natural way, as discussed in Bisin, Topa and Verdier (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.

It is also possible that genetic selection explains persistence. A male biased sex ratio is associated with severe sexual selection. The behaviors and cultural traits that were successful at securing mates in 19<sup>th</sup> century Australia may have spread through natural genetic-selection, precisely because they lead to marital success. This is certainly a possibility but given the complex nature of the interactions between genes, traits and behaviors, it is unlikely that this process alone drives the specific and systematic differences in attitudes, labor force participation, and occupational choice that we document in this paper.

There are other reasons, apart from its influence on cultural norms, why initial gender imbalance may also have persistent effects. For example, initial gender imbalance may have shaped formal institutions. We rule out this channel by relying on within-country and even within-state variation, where formal legislation is identical.<sup>9</sup> Initial abundance of males and low participation of the few females around in the labor force possibly distorted industrial specialization into male intensive economic activities. Persistent effects until today may have nothing to do with culture, but with the kind of jobs available. To account for this, we will control extensively for industrial specialization, historically and today. Bargaining conditions in the marriage market may also influence educational choices by men and women (Chiappori, Iyigun, and Weiss 2009). We find very little empirical evidence for this but still control for education to account for this possible channel.

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<sup>9</sup> 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 laws 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.

### **3. Historical Background: Gender Imbalance, Female Work and Marriage in 19<sup>th</sup> Century Australia**

After independence of the United States, Australia 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, which initially also included Queensland, the Australian Capital Territory, and Victoria (Oxley 1996, p. 3). The crimes punishable by transportation were commonly property offences, such as petty theft.

Even though natural births and free migration acted to reduce the extent of the gender imbalance, the extent of free migration to Australia was rather limited until the 1830s' and the imbalance sustained by ongoing convict transportation over nearly a century. Male convicts consisted more than 80% of the adult male population of New South Wales in 1833. The sex ratio stood at 3.54 men for every woman in the general population, and at more than 8 among the convict population in the state at that time.<sup>10</sup> The sex ratio among the convict population averaged 6 men for every woman transported over the whole period of transportation (Bateson 1974). This imbalance made the authorities worry 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). Free migration was also biased towards men, given that economic opportunities consisted mainly of first pastoralism, and then mining after the discovery of gold in the beginning of the 1850s'.

We collect data on the historical gender ratio and on the structure of the colonial economy from the Censuses first taken in each of the six Australian states.<sup>11</sup> Figure 1 in Appendix list data sources and details. We take the first Census because we need to rely on the earliest possible measure of the gender imbalance and of its exogenous component, which came from

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<sup>10</sup> Authors' calculation from the 1833 NSW Census (Historical Census and Colonial Data Archive).

<sup>11</sup> The online data from the Historical Census and Colonial Data Archive was supplemented by the actual Census report due to errors for the 1881 Tasmanian Census. Only the Census reports are available, individual records have burned.

convict transportation. More than 60% of the current population of Australia now lives in areas that were already covered by the first Censuses in each state.

The unit of observation in the Census is the historical administrative district: a county or police district. 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). We therefore rely on the measure of the gender ratio from the Census. The overall sex ratio reported in the first Census, at 3 men for every woman, underestimates the sex ratio that prevailed in early Australia. As illustrated in Figure 1, the first Censuses were taken after convict transportation ceased in Queensland and Victoria. Still, the Censuses for Tasmania, New South Wales, and the Australian Capital Territory include separate categories for convicts, so that we can recover the convict sex ratio, which was not influenced by free settlers. As expected, the sex ratio is much larger in the convict population than in the general population by over 5 times. As an extreme example, in the county of Bligh, New South Wales, there were 219 men for every woman.

Figures 2 and 3 map the sex ratio among the general and convict populations. All convicts and most of the population included in the historical Census - Aboriginal people were generally not counted in the Census -- came to Australia by sea.<sup>12</sup> Yet, by the time we measure them, people of both sexes had made their way in 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.

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 to private individuals for employment. Employers consisted of government officials, free settlers, and ex-convicts. The placement of convicts was dictated purely by labor requirements and decided centrally. Governor Bligh of New South Wales described the system in 1812:

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<sup>12</sup> There were three main ports of entry: Port Jackson (New South Wales), Port Phillip (Victoria), and Hobart (Tasmania).

“They (the convicts) were arranged in our book (...) in order to enable *me* to distribute them according” (cited in Nicholas 1988, p. 15, italics added)

Table 1 provides descriptive statistics on the historical gender imbalance and the structure of the economy. Table A1 in the Appendix replicates Table 1 but compares counties with high and low sex ratios. Agriculture was the largest employer in Australia at the time, with 25% of the employed labor force. Next were domestic services with 15%. Areas with high or low sex ratio were not statistically different from one another in any of these two categories. There are a few significant differences across high and low sex ratio areas in some employment categories but these represent a small fraction of the employed labor force, 10% in total.

Cheap convict labor seem to have been particularly valued in men. One explanation is that only men had the physical strength required for agricultural work and building the country (Nicholas et al 1988). Despite accounting for 19% of the convict population, convict women accounted for only 6% of the convict labor force (Nicholas et al 1988, p. 70). In 1810, of the “190 jobs advertised in the Sydney Gazette, only seven were for women” (Bloodworth 1990). Yet, convict women possessed analogous skills to British women (Oxley 1996, p. 171) and their domestic service skills were greatly needed in the settlement (Oxley 1996, p. 189). Moreover, female labor was even cheaper than male’s. Wages were set by the government. In 1816, Governor Macquarie of New South Wales announced that male and female convicts must be paid £10 and £7 per annum, respectively (Nicholas et al 1988 p. 131). Meredith and Oxley (2005, p. 56) document an even larger, 46%, gender pay gap. Hence, traditional economic determinants alone cannot explain that convict women were “undervalued and underemployed” in the labor market (Nicholas et al 1988, p. 15). Alford (1984, p. 243) infers that the notion that remaining within the home was a “woman’s proper place” played, already, a large role.

Some convict women were confined to female factories.<sup>13</sup> Female factories were “a combination of textile factory and female prison” (Salt 1984, p. 142) for women who had

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<sup>13</sup> No analogous male factory existed. New South Wales 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.

borne a child out of wedlock, displeased their assigned master, or committed a crime. Women worked in female factories for very low or no wage.<sup>14</sup>

Overall, Governor Macquarie of New South Wales 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, together with a high demand for wives, marriage seemed like the most attractive option.

The authorities' concern that the scarcity of women would lead to a "difficulty in getting wives" was well founded. Men were half as likely to be married than women, who were under great pressure to be married. In 1851, nearly 70% of women in Australia were married against only 60% in Britain (Alford 1984, p. 26). In their marriage, if not in the formal economy, they were busy. The number of births per marriage in New South Wales in 1844 was 4.38, against only 4.09 in England (Alford 1984, p. 56). In areas with sex ratios above the mean, women were more likely to be married and they had nearly one more child, compared with women in areas with sex ratios below the mean.

OLS estimates examining the historical relationship between gender imbalance and marriage rates, fertility, and female labor force indicators are displayed in Table 2. For each dependent variable, the specification in the first column only includes state fixed effects. The specification in the second column adds controls for geographical characteristics (latitude and longitude) and for the main employment categories -agriculture, domestic services and manufacturing- in order to account for differences in sex ratios that were dictated by the imperative of the labor assignment scheme. This results in the loss of 20 observations because of redistricting and because in 4 states, the data on employment is only available at a different point in time (see Figure 1).

In areas with higher gender imbalance, women were more likely to be married. The effects are significant at the 1% level, and large in magnitude. An increase by one unit in the sex ratio, that is to say an additional man for a constant number of women, was associated with a 1.4 to 2.2 points increase in the female marriage rate. At the population mean, differences in gender imbalance across areas are associated with 4 to 7 points differences in female

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<sup>14</sup> Third class women, those who committed a crime in the colony or misbehaved in the factory, received no wage (Salt 1984, pp. 86, 105)

marriage rates. Fertility was also higher in those areas with an additional man for a constant number of women yielding nearly a third of a child more per woman. However, the number of children is only available in 70 counties and the relationship falls short of significance when controls are included. Higher imbalance is also associated with a lower proportion of women employed in high-ranking occupations, such as learned professions (legal and medical) and teaching.

To sum up, in areas with higher gender imbalance, women married more, had more children and were less likely to work in high-ranking occupations. In the circumstances of 19<sup>th</sup> century Australia that we have described, marriage was the most appealing option for women, and they were probably better off as a result, even though we cannot directly measure this from available data. In the next sections, we show how 19<sup>th</sup> century economic and marriage conditions have shaped cultural traits and how they still influence outcomes in the present day. Section 4 explores the implications for cultural attitudes and for women in the workplace. Section 5 explores the implications for satisfaction and welfare.

#### **4. The legacy of gender imbalance on culture and women in the workplace**

In this section, we explore how gender imbalance has shaped the cultural values of Australians and its long-term consequences for female labor force participation and occupational choices. We also investigate the channels of transmission that underlie the persistence of attitudes towards gender roles over more than a century. First, we discuss how we link historical gender imbalance to present-day opinion surveys and Census data.

##### ***4.1. Data***

Data on cultural attitudes today are from the Household, Income and Labor Dynamics in Australia Survey (HILDA), a nationally representative survey available since 2001. Questions on attitudes towards gender roles were included in the 2001, 2005, 2008 and 2011 waves. HILDA also includes questions about satisfaction with one's spouse and links

partners' attitudes and socio-demographic characteristics. We exploit the linked husband and wife data set in Section 5.

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), which we recoded so that a higher value indicates stronger disagreement with this statement, which we interpret as the respondent holding more progressive attitudes.

We also retain several individual characteristics notably gender, age, education, marital status, state of residency and parent's country of birth. Descriptive statistics are provided in Panel B of Table 1. The balance of covariates across areas below or above the mean historical sex ratio is presented in Table A1. As discussed already, there are a few significant differences across high and low sex ratio areas in some employment categories historically but these represent a small fraction of the employed labor force, 10% in total. Today, there is no statistically significant difference across high and low historical sex ratio areas in terms of age, gender, or ancestry composition, income, employment, education, or share of the people employed in agriculture as a rural proxy.

The location of respondents is identified by the postal area. After dropping multiple responses and non-responses, we are left with a sample of 42,917 individuals in 1,518 postcodes.

Data on female labor force participation and occupational choices are from the most recent, 2011, Census. The unit of observation is the postal area. There is a total of 2,516 postal areas. To capture the 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.

We also retain information from the Census on 18 categories of industrial specialization, migration, and sex ratio today. Some areas of Australia still have a gender imbalance (see



Panel C of Table 1), particularly those areas heavily involved in the mining industry, but these represent only a small fraction of postal areas.<sup>15</sup>

Postal areas are not equivalent to historical counties. Prior to this study, shape files on Australian historical census boundaries did not exist. We digitized hard copies of maps from the National Library of Australia and from State Libraries in order to construct these boundaries. The Appendix describes the list of maps used. 12 counties had to be dropped because of incomplete maps. We were then able to match historical districts to postal areas.

The matching process undertaken is illustrated through an example in Figure A1 in the Appendix. When a postal area was found in multiple counties, we assigned it to the county in which it was mostly located. For the shaded area in Figure A1, this was Hunter. Figure A2 illustrates the final matched output.

#### 4.2. 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 A3 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 historic sex ratios are all significant at the 1% level.

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

$$(1) \quad y_{ipc} = \alpha_1 + \beta_1 \text{SexRatio}_c + X_{pc}^G \Gamma_1 + X_c^H \Pi_1 + X_{ipc}^C \Lambda_1 + \delta_s + \delta_t + \varepsilon_{ipc}$$

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

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 2011 Census-based measures of female labor force

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<sup>15</sup> 5% of postal areas have sex ratios above 1.2 and 1% above 1.5.

participation or females employed as professionals in postal area  $p$ , part of historical county  $c$ .  $SexRatio_c$  is the historic 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.  $X_{ipc}^C$  and  $T_{pc}^C$  are vectors of individual-level and county-level contemporary controls, respectively.  $\delta_s$  is a vector of state dummies and  $\delta_t$  is a vector of HILDA wave dummies. All standard errors are clustered at the county level, with 80 to 90 clusters observed in each regression.

$X_{pc}^G$  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 19<sup>th</sup> century was an agricultural country. Agricultural opportunities influenced where the government assigned convicts initially and then where free settlers, and their assigned convicts, located. 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. We also control directly for the county historical economic specialization, by including in the historical shares of the population employed in 11 sectors, from mining to carrying to legal and medical to government. Due to data limitations outlined in Figure 1, some of these measures are unfortunately not contemporaneous to our first measures of the sex ratio in all states. This may result in lowering the coefficient on the sex ratio for these observations if industrial specialization was influenced by the sex ratio. We do not include these measures in the most basic specifications but check that all our results are robust to their inclusion.

In the models of individual attitudes, contemporary individual controls include gender, marital status, age, income, education, and whether the respondent was born in Australia. County-level controls include the sex ratio today, and 18 categories of industrial specialization from the standard classification. All county-level controls are from the Census.

In the models of female labor force participation and occupational choices from the Census, contemporary controls at the postal area include the sex ratio today, average education, and the share of people employed in agriculture as a proxy for urbanization. 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 sectoral differences across counties that influence the share of women employed as professionals, we control for the share of men employed in a similar occupation. Considering that we are exploiting within-country and even within-state variation, where legislation is identical,<sup>16</sup> controlling for the share of men employed in a similar occupation 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 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, one more man historically for a given number of women moves the average Australian today towards conservative attitudes by 6 percentage points ( $3.102 \times 0.023$ ). All the results are robust to taking a historical county as the unit of observation. Table A2 in Appendix displays the results of estimation of (1) and (2) when averaging all variables at the historical county level.

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. Table A3 includes the estimation results of (1) in which the dependent variable captures respondents' views about the quality of female leaders. There is no significant effect of historical gender imbalance on these attitudes.

The relationship of historical gender imbalance with labor force participation is no longer significant even when we include all historical and contemporary controls. Female labor force participation may be too gross a measure: it pools together female executives and check out chicks. When we focus on the quality of female work instead, the relationship with

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<sup>16</sup> 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 laws 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.

historical gender imbalance remains statistically significant when controlling for the full set of controls, including the share of men in similar occupations. At the mean, one more man historically is associated with a 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.

The share of men employed in the same occupations explains a very large part of the variation in the share of female professionals. By controlling for this, state fixed effects and other controls, we are eliminating any influence of the legal environment, technology, and employment opportunities for professionals. Still, we find a significant effect of historical gender imbalance. In terms of the share of the variation explained, adding historical characteristics to the full set of controls increases the R-squared by 2 percentage points. This is equivalent to 5% of the remaining unexplained variation in the share of women employed as professionals.<sup>17</sup>

#### ***4.3. Additional robustness and instrumental variable results***

One concern is that due to the penal origins of the gender imbalance in Australia, we may be identifying a legacy of convict history rather than gender imbalance history. One may further argue that convicts were not representative of the rest of the population and were more prone to hold conservative attitudes. Yet, historical accounts suggest otherwise. Convict men and women were not “hardened and professional criminals” (Nicholas et al 1988, p. 3) but “ordinary working class men and women” (Nicholas et al 1988, p. 7). We still check that our results are robust to controlling for Australia’s convict past. We are unable to control directly for the proportion of convicts because it is so highly correlated with the sex ratio.<sup>18</sup> We instead control for the number of convicts together with total population.

Convicts were only present in 36 of our 90 historical counties, only in Tasmania and early New South Wales, which also included the Australian Capital Territory. We estimate

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<sup>17</sup> This is calculated as  $(0.567 - 0.546) / (1 - 0.546)$ . 0.546 is the R-squared of a regression with all but historical controls.

<sup>18</sup> Correlation coefficient of 0.88.

equations (1) and (2) on this reduced population, controlling for the convict population. Due to the reduction in population size, we drop the full industrial specialization of the county today (18 categories) but we keep the share of people in agriculture. Results are presented in Appendix Table A4. They are robust and the magnitude of the coefficients becomes larger. The results for female labor force participation and occupational choice are also similar in terms of statistical significance and larger in magnitude. The coefficient associated with the number of convicts is not statistically significant with controls included. Conservative gender views today are thus due to the gender imbalance that was caused by Australia's convict past, not to convict character per se. The jump in the magnitude is not surprising. Censuses were taken early in New South Wales and Tasmania (see Figure 1) and their gender ratios are both larger and more representative of early Australia because of being less subject to the balancing influence of natural births and free migration.

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 for a 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. Convicts, by definition, were not free to choose where to go. Where they ended up was not purely random, as we have discussed, but it was influenced by agricultural opportunities and other employment prospects, which we control for in both stages. 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 in both stages for the number of convicts.<sup>19</sup>

Table 4 presents the results of OLS specifications, where we regress outcomes on the general sex ratio in this sub-population for which we have convict information. Table 5 presents the results of instrumental variable specifications, where we regress outcomes on the general sex ratio instrumented by the convict sex ratio. Reduced-form estimates when we regress

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<sup>19</sup> 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. Besides, the endogeneity bias would run against the direction of our main result: we would find more conservative attitudes where there were more women. The effect of female factories is never significant.

outcomes of interest on the convict sex ratio are in Table A5. The first stage is extremely strong. All the results discussed in Section 4.2 are robust to the instrumental variable strategy. The IV estimates are slightly higher than the OLS estimates for attitudes, but slightly lower for female professionals. A larger magnitude of IV coefficients could be explained by the fact that our mechanism rests upon the marriage market. Convicts were only people of marrying age. The maximum age for transportation was 45 for women and 50 for men and the sentence 7 years in most cases. By contrast, the general population also includes children and older people, out of the marriage market. An underestimation bias is thus to be expected in the OLS model.

#### ***4.4. Cultural transmission***

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. The average age of the respondents in HILDA is 44 years old. This makes their parents roughly born in the mid 1900s. If these parents were born in Australia, the White Australia Policy makes it likely that they too were born of Australian parents. The White Australia Policy, as its name indicates, strongly restricted migration to Australia from 1901 until the early 1970s.

We can test vertical transmission in more details by distinguishing between the mother and the father. To do this, we add interaction terms between historical gender imbalance and a dummy indicating an Australian father as well as a dummy indicating an Australian mother. The excluded category consists of persons born to two non-Australian born parents.

Regression results are in Columns 1 and 2 of Table 6. The coefficient associated with the historical sex ratio alone is no longer significant. This means that historical gender imbalance has no influence on people who are not born of Australian parents. The main effect of having an Australian father 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, an Australian father transmits more progressive norms, but not where the gender imbalance was high. With controls included, mothers do not

influence attitudes. This provides supportive evidence of vertical transmission from the father only.

The crucial role played by fathers is consistent with our interpretation that a conservative gender attitude is an investment by the male, who needs to transmit it to his son, so that he can find a wife, and to his daughter, so that she can find a “good” husband.

We test for the presence of horizontal transmission in Columns 3 to 6 of Table 6. We distinguish areas with high and low migration, based on the median proportion of migrants at the postal area level in the 2011 Census. We find no evidence of horizontal transmission. People with no Australian parents are not influenced by the historical gender imbalance, even in low-migration areas that had a distorted sex ratio, where they are surrounded by Australians who are more likely to hold conservative views. Indeed, the coefficient associated with the historic sex ratio is never significant, even when we restrict the sample to low-migration areas and we include the usual controls in Column (4).

Vertical transmission is strong and overcomes the attenuating influence of other norms brought by migrants. Even in areas with a lot of migration, Australian fathers still have a fundamental influence on their children’s view. The coefficient associated with the dummy for Australian father is significant both in high and low migration areas and similar in magnitude. Even though the magnitude is slightly higher in low migration areas, it is not significantly so.<sup>20</sup>

The differences among people of different ancestry within the same areas rule out that the relationship between historical imbalance and present-day outcomes is due to unobservable local characteristics or to self-selection of people to localities on the basis of taste.

We document in this paper a relatively rapid adaptation of cultural norms as a response to gender imbalance, even among a homogenous population. We then argue that these new cultural norms have persisted over time, even after sex ratios have reverted back to parity, and document that vertical transmission has contributed to the persistence. We have discussed before other mechanisms that might contribute to persistence, and in particular

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<sup>20</sup> The coefficient on the interaction between historic sex ratio, Australian father, and low migration area is 0.01 with a t-stat of 0.37. The results of this triple interaction are not included here.

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 7 to 10 of Table 6. We can define homogamy either along ethnic or cultural lines. Ethnic homogamy is measured by the probability that one's partner is Australian, when one is born in Australia. This probability averages 86%. Table A6 in Appendix shows that homogamy brings direct benefits: people are happier in their relationship when married to someone ethnically or culturally similar. We define high and low homogamy areas if the average probability in the postal area lies above or below the overall average. Historical gender imbalance is only associated with conservative views today in areas where homogamy is high (Column 9). By contrast, no legacy is found in areas with low homogamy (Column 7).

We can also measure homogamy directly along cultural lines, by the probability that one's partner has the same views, when one has certain views, and the results are similar. A potential concern is that homogamy itself is endogenous, so that the results cannot be given a causal interpretation. However, the correlation between the historic sex ratio and homogamy is less than 0.05. In addition, if we can rely instead on the level of homogamy predicted by exogenous factors, such as urbanization, industrial sectors, and the share of Australians in the population, the results are unchanged.

We also find evidence of a positive interaction between homogamy and vertical transmission in Columns 8 and 10 of Table 6. This has a natural interpretation: parents want to instill in their children norms that will make them attractive in the marriage market.

Strategic complementarities in the marriage market are compatible with the apparent paradox that we document in this paper of rapid adaptation of cultural norms and yet their persistence. The situation we study is that of a drastic disequilibrium in the marriage market, one able to lead to rapid adaptation of norms towards norms that guarantee success in wooing a wife. Our interpretation of persistence is that of a lock-in of these norms, even after sex ratios have reverted back to normal, because of strategic complementarity of gender views in the marriage market, complemented with vertical transmission of norms within families.

## **5. Welfare Implications**



We argue that conservative gender attitudes developed as an attractive male feature for a rare potential spouse. In Section 3, we documented that women were more likely to marry in in more male-biased areas. We also discussed how, given the options available to women in 19<sup>th</sup> century Australia, this outcome was beneficial for women, too. However, we had no direct measure of their welfare. We do for women today.

We analyze self-reported satisfaction. HILDA asks: “*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 slightly unhappier than men (difference of -0.24, t-stat of 10.58).

We estimate equation (1) with answers to this marital satisfaction question as the dependent variable, and we contrast the results for men and women. Regression results are in Table 7. We first present specifications with only geographic controls and then with geographic, historic and contemporary controls. The first two columns include an interaction term between the gender of the respondent and the historic sex ratio. Women in areas where they were fewer in the past are happier today, but only when their husband works. This is shown in Columns 3 and 4 when we differentiate by partner’s employment status. This is consistent with our interpretation. In an environment with a shortage of women, the highest quality men get the women. In an environment with an equal number of women, as now, they get the “better” women (the dating literature would argue: the prettier). Nowadays, there is no shortage of women, but a shortage of jobs. The lower-quality men hence may have a (possibly ugly) wife, but no job. But still, all women are taught by their father to value a working husband in those areas. The ones with working husbands are the happy ones, not those left with unemployed husbands.

While men are, in general, happier in their relationship than women, they are not more so in areas with high historic gender imbalance. If anything, they are less happy, with a negative coefficient associated with the interaction term in Column 1 and 2, although it is insignificant. A particularly interesting result is that in high gender imbalance areas, those men who were successful at getting married and who end up with the housewife that the preceding section has shown corresponds to their wishes, are not happier (see Column 5). In fact it is the man who ends up with a working woman who is happier (see Column 6). This makes intuitive

sense as the working woman shares the economic burden of the household. But the question is then: why did men adopt the norm that men should work and women stay at home? Our answer is that they inherited this norm from a time at which it was beneficial. Conservative gender attitudes are like the peacock's tail. Like the male peacock with the big tail, which is so attractive to the female but makes him unable to run away from predators, the man who defends conservative gender roles may still be attractive to the woman but he is not happier as a result.

The evidence on the positive effect on the happiness of women is consistent with a bargaining model, in which women are able to extract a better bargain from their scarcity. However, these women are foregoing \$1,500 dollars every year (more than \$2,000 pre tax – and more than \$60,000 post-tax over a lifetime of employment). To see this, we estimate a regression in which the dependent variable is the respondent's personal annual income. We include the full set of geographic, historical and contemporary controls, including the 18 categories of industrial specialization. We include an interaction term between a male dummy and the historical gender imbalance. Results are in Column 1 of Table 8. Men make much more money than women, \$15,354 a year, on average. Women in high gender imbalance areas make, at the mean, \$1,500 less ( $\$434 \times 3.10$ ). Meanwhile, the interaction term between the male dummy and the historic sex ratio is small and insignificant. This means that the shortfall in women's earnings is not compensated by higher earnings by men in those areas, as the economists' models would predict. Bargaining models predict a zero sum game. It is not so. Analysis with Census data in Column 2 confirms that high historic gender imbalance is associated with a sizeable aggregate welfare loss today. On average, every year, every person in these areas loses out on nearly \$800 of income.

## **6. Conclusion**

This paper documents how cultural norms emerged as a response to a specific scarcity situation: the lack of women. We show how sexual selection interacted with technology to shape cultural beliefs. Our results illustrate how cultural norms can emerge as an evolutionary response. This suggests that cultural norms, like the peacock's tail, serve

reproductive fitness. Cultural evolution has a decisive advantage over genetic evolution. Adopting cultural norms is faster than growing a tail, easier, and cheaper. However, while certain cultural norms may increase reproductive fitness, like the peacock's tail, they may harm overall fitness. Certain cultural norms may be adaptive in the short run, but not necessarily in the long run. This is especially so since technology changes much faster than culture.

Our last set of results suggests that industrial specialization was influenced by the initial gender imbalance. In Columns 3 and 4 of Table 8, the effects on lost income are twice as large as when we control for industrial specialization. To a large extent, one could argue that industrial specialization today is endogenous to the occupational choices of all the generations that followed the first settlers and therefore to the initial gender imbalance. Developing a full-fledged structural framework to investigate to what extent initial gender imbalance has shaped industrial specialization is beyond the scope of this paper and left for future research.

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TABLES  
Table 1: Summary statistics

Variables	Obs.	Mean	Standard deviation	Min	Max
<b>Panel A: Historical Censuses</b>					
Historic sex ratio	92	3.075	2.95	1.014	18.833
Convict gender ratio	35	27.654	42.014	1.27	219
<i>Historical Population</i>					
<i>Industrial sectors – % of county pop. employed in:</i>					
Government	89	1.148	1.647	0	12.791
Learned professions (such as legal and medical)	89	0.45	0.786	0	4.945
Literature, fine arts and sciences (such as teachers)	89	1.795	3.138	0	16.502
Trade or commerce (such as accounting and retail)	89	1.978	2.76	0	17.638
Domestic and personal service	89	14.169	13.32	2.887	80.812
Manufacturing	89	6.802	8.836	0	56.162
Mining	89	5.7	13.201	0	67.011
Agriculture, pastoral, horticulture or winegrowing	89	23.497	13.504	1.873	93.309
Carrying	89	2.279	4.291	0	23.75
Food	89	1.589	2.446	0	16.089
Male married	91	23.628	7.517	5.882	40
Female married	91	45.876	10.615	35.915	100
Female married in convict settlements	35	66.655	25.833	8.339	100
Fertility (# children per adult woman)	68	2.161	3.624	0.438	27.583
Women in Learned professions, and Literature, fine arts	89	6.042	6.406	0	26.087
<b>Panel B: HILDA matched with the historical Censuses</b>					
Progressive Attitude Gender Roles	42,931	4.473	1.982	1	7
<i>Individual Controls:</i>					
Above 40 years old	42,931	0.506	0.500	0	1
Log of income plus 1	42,931	6.620	4.988	0	14.509
Male dummy	42,931	0.467	0.499	0	1
Australia born	42,931	0.772	0.420	0	1
Australian Father dummy	42,931	0.607	0.489	0	1
Beyond year 12 education	42,931	0.328	0.470	0	1
Legally married dummy	42,931	0.512	0.500	0	1
<i>State of residency dummy:</i>					
New South Wales	42,931	0.275	0.447	0	1
Victoria	42,931	0.283	0.451	0	1
Queensland	42,931	0.18	0.384	0	1
SA	42,931	0.102	0.303	0	1
WA, Tasmania and ACT	42,931	0.159	0.366	0	1
<i>Postal area controls:</i>					
Proportion of employed people employed in agriculture	42,930	0.025	0.058	0	0.685
Contemporary gender ratio	42,930	0.966	0.066	0.644	3.565
<b>Panel D: 2011 Census matched to the historical Censuses</b>					
Female labor force participation rate	1,898	56.008	9.473	0	100.000
Proportion of employed women employed as professionals	1,888	21.314	8.480	0	46.502
<i>Postal area controls:</i>					
Proportion with professional college education	1,893	0.213	0.049	0	1
Proportion in agriculture	1,871	0.157	0.118	0.019	0.941
Contemporary gender ratio	1,889	1.035	0.443	0.356	13.533

Table 2: Gender imbalance and historical marriage rates, fertility and female work

	1	2	3	4	5	6	7	8	9	10
	Female marriage rate (% , historic)		Female marriage rate (% , historic, in convict areas)		Male marriage rate (% , historic)		Fertility, historic		Women in Learned professions, and Literature, fine arts (% , historic)	
Historic sex ratio	2.159*** (0.615)	2.160*** (0.638)	2.857*** (0.988)	3.127*** (1.012)	-1.614*** (0.158)	-1.468*** (0.149)	0.215 (0.224)	0.225 (0.248)	-0.327** (0.140)	-0.221** (0.111)
State fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Geographic controls	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Historic sectors	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Observations	92	89	35	32	92	89	67	64	90	90
R-squared	0.776	0.785	0.798	0.858	0.641	0.717	0.070	0.109	0.602	0.669

*Notes:* The table reports OLS estimates. ‘Historical sex ratio’ is the number of men to the number of women in a county. ‘Geographic controls’ is a POA’s latitude and longitude. ‘Historic sectors’ are the proportion of the population in agriculture, domestic service and manufacturing, historically. A list of the industries is provided in Panel A of Table 1. The unit of observation is a historic county. All regressions are with a constant. Robust standard errors are reported in parenthesis. \*\*\*, \*\* and \* indicate statistical significance at the 1%, 5% and 10% level, respectively.



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

	1	2	3	4	5	6	7	8	9	10
	Progressive Attitude			Female labor force participation			Women in high-rank occupations			
Historical sex ratio	-0.043*** (0.012)	-0.027** (0.011)	-0.023*** (0.008)	-0.502*** (0.156)	-0.134 (0.145)	-0.124 (0.167)	-1.125*** (0.268)	-0.460*** (0.138)	-0.464*** (0.123)	-0.364** (0.162)
State fixed effects	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
Historic controls	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes	Yes
Individual controls	No	No	Yes	-	-	-	-	-	-	-
Contemporary controls	No	No	Yes	No	No	Yes	No	No	Yes	Yes
Male high-rank occupation	-	-	-	-	-	-	No	No	No	Yes
Observations	42,930	41,943	41,943	1,898	1,871	1,862	1,888	1,861	1,861	1,861
Number of counties	81	78	78	91	88	88	91	88	88	88
R-squared	0.017	0.019	0.174	0.033	0.064	0.181	0.130	0.218	0.263	0.517

Notes: See Table 2. 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), which we recoded so that a higher value indicates more progressive attitudes. The mean for this variable is 4.473. This is taken from HILDA. The unit of observation is an individual in a POA in a historic county. 'Historic controls' are the proportion of residents working historically in the industries provided in Panel A of Table 1 and the number of people living in the county, historically. 'Individual controls' are gender, whether one is married, a dummy indicating whether a respondent is aged above 42 years, log of income plus 1, whether one was born in Australia and whether one has education below year 12. These are all derived from HILDA. 'Contemporary controls' are the number of men to women in a POA, the proportion of those employed in a POA employed in agriculture and 18 variables accounting for the proportion of those employed in a POA employed in certain industries. Columns 4 to 6 present results when the dependent variable is the 2011 FLFP as reported in the 2011 Census. The mean of the variable is 56.01 and it ranges from 0 to 100. Columns 7 to 10 present results when the dependent variable is the proportion of employed women employed as professionals. This is computed from the 2011 Census. It ranges from 0 to 46.50 and its mean is 21.31. 'Male high-rank occupation' 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 and 'contemporary controls' is the proportion of residents in a POA who have a tafe education and the number of men to women in a POA. Standard errors are reported in parenthesis and have been corrected for clustering at the county level. Results are robust to using robust standard errors.

Table 4: Gender imbalance and attitudes and female work today: OLS results in sub-population with convict information

	1	2	3	4	5	6
	Progressive Attitude		Female Labor Force Participation		High-rank Occupations	
Historical sex ratio	-0.065*** (0.011)	-0.056*** (0.015)	-0.731*** (0.231)	0.092 (0.281)	-1.427*** (0.180)	-1.108*** (0.172)
State fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
HILDA wave fixed effects	Yes	Yes	-	-	-	-
Geographic controls	Yes	Yes	Yes	Yes	Yes	Yes
Historic controls	No	Yes	No	Yes	No	Yes
Individual controls	No	Yes	-	-	-	-
Contemporary controls	No	Yes	No	Yes	No	Yes
Male high-rank occupation	-	-	-	-	No	Yes
Observations	14,436	13,850	511	483	688	661
Number of counties	31	28	34	31	34	31
R-squared	0.023	0.156	0.110	0.257	0.305	0.806

*Notes:* See Table 3. This analysis is restricted to NSW and Tasmania. ‘Geographic controls’ is the latitude of a POA. ‘Historic controls’ is the number of people living in a county, the share of the population employed in domestic service and agriculture and the number of convicts living in a county, historically. ‘Contemporary controls’ for the attitudinal analysis are the number of men to women and the proportion of the population employed in agriculture, as per the 2011 Census. Robust standard errors are reported in parenthesis.

Table 5: Gender imbalance and attitudes and female work today: IV results

	1	2	3	4	5	6
<i>Panel A: Second Stage</i>						
	Progressive Attitude		Female Labor Force Participation		High-rank Occupations	
Historical sex ratio	-0.084*** (0.015)	-0.059** (0.027)	-0.654** (0.292)	0.412 (0.464)	-1.094*** (0.219)	-0.979*** (0.219)
State fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
HILDA wave fixed effects	Yes	Yes	-	-	-	-
Geographic controls	Yes	Yes	Yes	Yes	Yes	Yes
Historic controls	No	Yes	No	Yes	No	Yes
Individual controls	No	Yes	-	-	-	-
Contemporary controls	No	Yes	No	Yes	No	Yes
Male high-rank occupation	-	-	-	-	No	Yes
Observations	14,436	13,850	511	483	688	661
Number of counties	31	28	34	31	34	31
R-squared	0.023	0.156	0.110	0.257	0.302	0.806
<i>Panel B: First Stage: Historical Sex ratio</i>						
	Progressive Attitude		Female Labor Force Participation		High-rank Occupations	
Convict sex ratio	0.055*** (0.001)	0.039*** (0.001)	0.048*** (0.003)	0.041*** (0.003)	0.049*** (0.003)	0.041*** (0.003)
Observations	14,436	13,850	511	483	688	661
Number of counties	31	28	34	31	34	31
F statistic	56781.29	371796.02	4144.92	2648.36	20699.85	2153.72
Adjusted R-squared	0.694	0.794	0.6827	0.794	0.702	0.811

*Notes:* See Table 3. The table reports 2SLS estimates. This analysis is restricted to NSW and Tasmania. ‘Geographic controls’ is the latitude of a POA. ‘Historic controls’ is the number of people living in a county, the share of the population employed in domestic service and agriculture and the number of convicts living in a county, historically. ‘Contemporary controls’ for the attitudinal analysis are the number of men to women and the proportion of the population employed in agriculture, as per the 2011 Census. The controls in each Column of Panel B are identical to those included in the same Column as Panel A. Robust standard errors are reported in parenthesis.

Table 6: Persistence: Vertical Cultural transmission by Fathers and Homogamy

	1	2	3	4	5	6	7	8	9	10
	Dependent variable: Progressive Attitude									
	All areas		Low migration		High migration		Low Homogamy		High Homogamy	
Historical sex ratio	0.004 (0.018)	0.016 (0.017)	-0.029*** (0.010)	0.001 (0.016)	-0.001 (0.152)	0.028 (0.155)	-0.227 (0.425)	-0.215 (0.424)	-0.052*** (0.010)	-0.009 (0.021)
Australian father	0.348*** (0.064)	0.162** (0.067)		0.067 (0.075)		0.193*** (0.066)		0.076 (0.114)		0.133* (0.068)
Australian father * historical sex ratio	-0.092*** (0.034)	-0.074*** (0.027)		-0.039* (0.020)		-0.045* (0.027)		-0.019 (0.019)		-0.055** (0.023)
Australian mother	0.121* (0.069)	-0.029 (0.067)								
Australian mother * historical sex ratio	0.044 (0.027)	0.029 (0.022)								
State fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
HILDA wave fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Geographic controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Historic controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Individual controls	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Contemporary controls	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	41,943	41,943	20,982	20,982	20,961	20,961	21,295	21,295	20,651	20,651
R-squared	0.026	0.175	0.155	0.155	0.175	0.175	0.183	0.183	0.172	0.173

*Notes:* See Table 3. ‘Low migration’ refers to POAs where the proportion of residents born in Australia is higher than the median proportion of residents born in Australia as per the 2011 Census. ‘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. Robust standard errors are reported in parenthesis for columns 5 and 6 as the number of clusters is small.

Table 7: Marital satisfaction: women are happier; men are not

	1	2	3	4	5	6
	Satisfied with partner					
	All		Female with an employed partner	Female with an unemployed partner	Male with an employed partner	Male with an unemployed partner
Historical sex ratio	0.040*** (0.009)	0.028** (0.011)	0.046*** (0.013)	0.036* (0.020)	0.019 (0.015)	0.025** (0.012)
Male	0.245*** (0.029)	0.267*** (0.030)				
Male * Historical sex ratio	-0.001 (0.012)	-0.001 (0.011)				
State fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
HILDA wave fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Geographic controls	Yes	Yes	Yes	Yes	Yes	Yes
Historic controls	No	Yes	Yes	Yes	Yes	Yes
Individual controls	No	Yes	Yes	Yes	Yes	Yes
Contemporary controls	No	Yes	Yes	Yes	Yes	Yes
Observations	31,282	30,526	9,480	3,160	4,931	7,607
Number of counties	80	77	74	71	69	70
R-squared	0.009	0.030	0.013	0.050	0.043	0.016

*Notes:* See Table 3. The dependent variable is an individual's response to the question "how satisfied are you with your relationship with your partner?" Response categories range from 0 (completely dissatisfied) to 10 (completely satisfied). 'Contemporary controls' are the number of men to women and the proportion of the population employed in agriculture, as per the 2011 Census.

Table 8: Income

	1	2	3	4
	Annual income		Median income weekly	
Historical sex ratio	-898.410*** (318.586)	-434.217* (264.281)	-7.302** (3.550)	-5.055* (2.940)
Male	15,093.182*** (1,201.921)	15,356.249*** (1,209.566)		
Male * Historical sex ratio	65.199 (489.808)	33.762 (487.969)		
State fixed effects	Yes	Yes	Yes	Yes
HILDA wave fixed effects	Yes	Yes	-	-
Geographic controls	Yes	Yes	Yes	Yes
Historic controls	Yes	Yes	Yes	Yes
Individual controls	Yes	Yes	-	-
Contemporary controls	No	Yes	No	Yes
Observations	47,975	47,975	1,871	1,861
Number of counties	78	78	88	88
R-squared	0.157	0.175	0.227	0.264

*Notes:* See Table 3. Columns 1 and 2 present the results where the dependent variable is an individual's annual income, as reported in HILDA. Columns 3 and 4 present the results where the dependent variable is the median weekly income of a postal area, as reported in the 2011 Census. 'Contemporary controls' in Columns 3 and 4 refers to the share of the employed population employed in agriculture.

## FIGURES

Figure 1: Data sources in the Australian states and territories

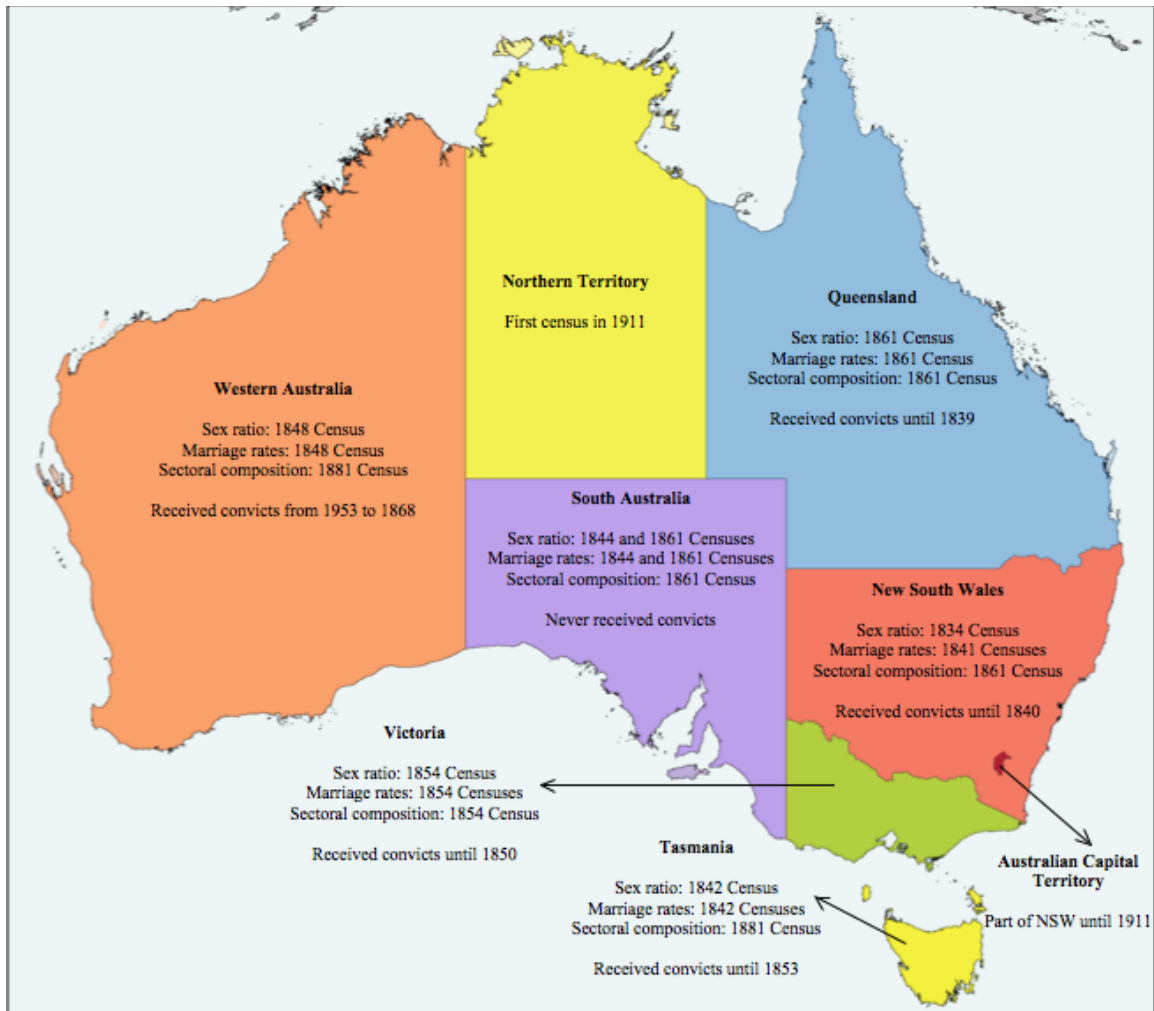


Figure 2: Gender imbalance in mid 19<sup>th</sup> century Australia

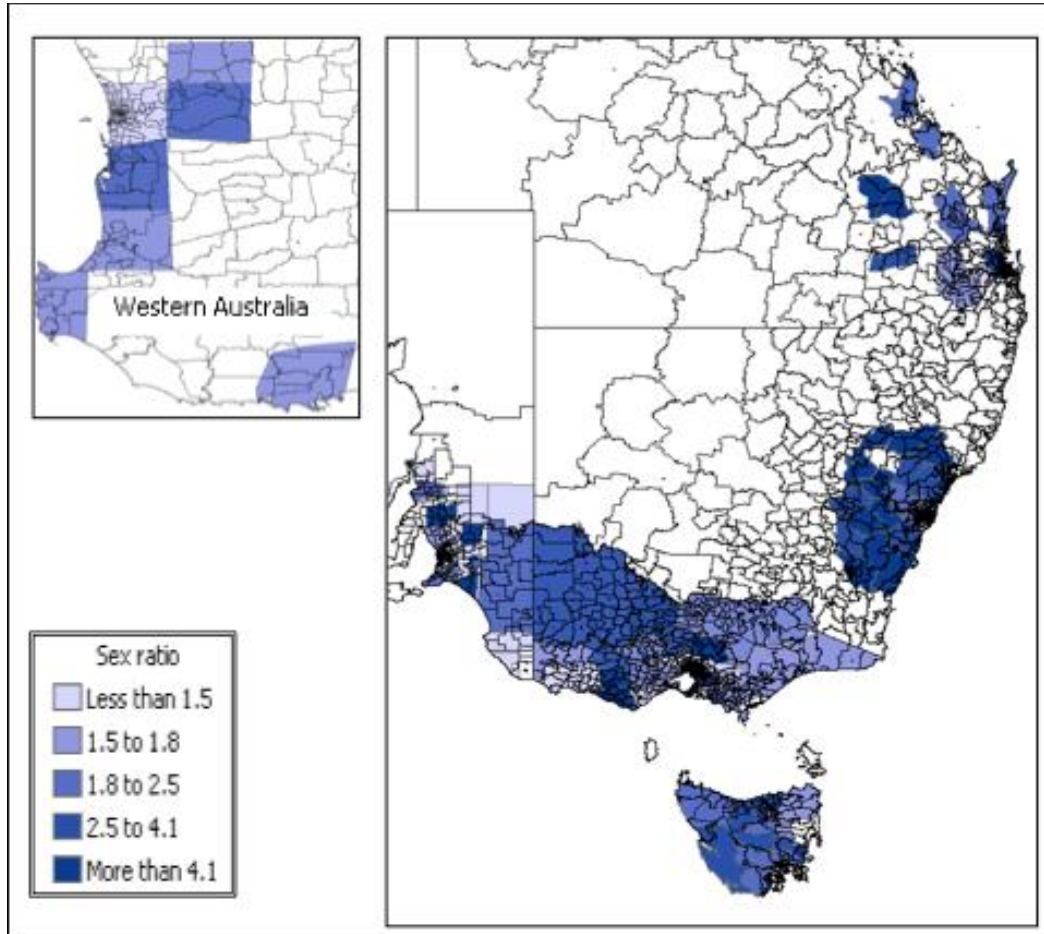




Figure 2: Gender Imbalance among Convicts in News South Wales and Tasmania

