

Men. Roots and Consequences of Masculinity Norms

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Abstract

Recent research has uncovered the historical roots of gender norms about women and the persistent impact of such norms on economic development. We find similar long-term effects of masculinity norms: beliefs about the proper conduct of men. We exploit a natural historical experiment in which convict transportation in the 18th and 19th century created a variegated spatial pattern of sex ratios across Australia. We show that areas that were heavily male-biased in the past (though not the present) remain characterized by more violence, higher rates of male suicide and other forms of preventable mortality, and more occupational gender segregation. Further evidence indicates that in these historically male-biased areas, more Australians recently voted against same-sex marriage, an institution at odds with traditional masculinity norms. Moreover, boys—but not girls—are significantly more likely to be the victim of bullying in school. We interpret these behaviors as manifestations of masculinity norms that emerged due to intense local male-male competition and that persisted over time.

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1 Introduction

What makes a ‘real’ man? Traditional stereotypes suggest that men ought to be competitive, to the point of being aggressive, and should suppress their emotions (‘to man up’). However, the extent to which such manly behavior is expected of men differs across societies and cultures (Traister, 2000). This raises the question: Where do norms about masculinity come from? And what economic and social consequences do they have? In this paper, we suggest that masculinity norms can originate in specific historical circumstances that determine the relative return of adhering to a traditional masculine identity. These norms can then persist over time, even when the circumstances that gave rise to them change.

Three current debates illustrate how such entrenched masculinity norms can have profound economic and social impacts. A first debate concerns the fact that in many countries men die younger than women, and are consistently less healthy (IHME, 2010; Baker et al., 2014). Recent evidence indicates that masculinity norms—especially a penchant for violence and risk taking—are an important cultural driver of this gender health gap (WHO, 2013; Schanzenbach, Nunn and Bauer, 2016). A second debate links masculinity norms to occupational gender segregation. Technological progress and globalization have disproportionately affected male employment (Autor, Dorn and Hanson, 2019). Many newly unemployed men nevertheless refuse to fill jobs that do not match their self-perceived gender identity (Akerlof and Kranton, 2000, 2010; Katz, 2014). Instead, they choose to remain unemployed or leave the labor force. Third, masculinity norms have become integral to debates about the socio-economic enfranchisement of women and minorities in Western society. These cultural changes can threaten the identity of men who adhere to conservative masculinity norms, provoking backlash against racial and sexual minorities (Kimmel, 2013; Horvilleur, 2019; Inglehart and Norris, 2019).

The origins of gender norms that constrain the behavior of women have been the focus of an important recent literature (Alesina, Giuliano and Nunn, 2013; Carranza, 2014; Xue, 2016). By contrast, the origins of norms that constrain the behavior of *men* in the ways just described have received no attention. In this paper, we show how masculinity norms can be shaped by historical circumstances that result in a shortage of women and hence in heightened male-male competition. In line with models of the marriage market (Becker, 1973, 1974), previous studies show how a relative scarcity of women increases competition among men, thereby affecting how men and women interact within the household (Grossbard-Shechtman, 1984; Chiappori, Fortin and Lacroix, 2002; Grossbard and Amuedo-Dorantes, 2008; Grossbard, 2015). Over time these interactions shape norms about the role of women in society (Gay, 2018; Grosjean and Khattar, 2019). Instead, we focus on how a scarcity of women determines how men interact and compete with *each other* and thus shape behavioral norms for men: masculinity norms.¹ We show how entrenched masculinity norms manifest themselves in various ways, such as men avoiding stereotypically female occupations, engaging in excessive violence against others as well as themselves, and opposing the enfranchisement of sexual minorities.

¹Such an emphasis on within-sex competition also follows an extensive literature in biology (Bachtrog et al., 2014) and evolutionary psychology (Buss, 2016) on the sex ratio (the number of males relative to females) as the primary driver of male-male competition and of behavioral differences between the sexes, including male aggressiveness, excessive risk taking, and dominant behavior over lower-ranked males and females.

To provide a causal link from sex ratios to the manifestation of masculinity norms, we exploit a natural experiment—the convict colonization of Australia—which imposed a variegated spatial pattern in sex ratios. This in turn led to local variation in male-to-male competition in an otherwise homogeneous environmental, cultural, and institutional setting. Between 1787 and 1868, Britain transported 132,308 convict men but only 24,960 convict women to Australia. Convicts constituted the founder (white) population of Australia. Voluntary migration was very limited until the discovery of gold in the 1850s and was heavily male-biased as well. Convicts were not confined to prisons but allocated across different areas in a highly centralized manner. We argue that the resulting quasi-exogenous pattern of local male-to-male competition shaped masculinity norms that persist in today’s Australia. We test this idea by combining information on historical sex ratios, using data from 90 historical counties from Australian colonial censuses compiled by (Grosjean and Khattar, 2019) [henceforth GK], with various proxies for present-day masculinity norms. Our main proxy for the political expression of masculine identity is opposition against same-sex marriage, which we measure using voting records from the 2017 nation-wide referendum on same-sex marriage. We also analyze detailed information on other important social and economic manifestations of masculinity norms such as violent behavior, crime, bullying, and occupational choice.

Our results paint a consistent picture of how skewed sex ratios instilled masculinity norms that still deeply influence the social and economic landscape. By way of preview, we find that areas that were more male-biased in the past (though not the present) remain characterized by more violent behavior, elevated rates of suicide and other forms of preventable mortality due to help avoidance (such as prostate cancer) as well as greater gender segregation of men in male-stereotypical occupations. For example, a one unit increase in the historical sex ratio (i.e. one more man for every one woman) is associated with a 11 percent increase in incidents of assault, a 16 percent increase in incidents of sexual assaults, a 23 percent increase in male suicide rates, and a 4 percent increase in rates of prostate cancer. Other forms of male mortality that are not so symptomatic of help avoidance behavior, such as diabetes or cardiovascular disease, are unaffected, as are female causes of mortality. A one unit increase in the historical sex ratio is also associated with a one percentage point shift from feminine or neutral occupations to stereotypically male occupations, even controlling for the overall share of employment in those occupations at a very granular level (SA1: the smallest administrative unit with an average of 400 inhabitants). Finally, we find that in areas that were heavily male-biased, fewer Australians support same-sex marriage today, and that boys are more likely to fall victim to bullying in school. A one standard deviation increase in the historical sex ratio is associated with a 3 percentage point decrease in the probability of voting “yes” to same-sex marriage in the 2017 referendum and a 5 to 14 percent increase in the bullying of boys. By contrast, we see no variation in the rates of non-violent crime, in political opinions unrelated to the status of sexual minorities, or in rates of bullying of girls.

To gain a deeper understanding of our results, we consider several explanations. These include differences in legislation across Australia today, initial differences across areas with high or low sex ratios, and the persistence of criminal and violent behavior of initial convicts. Different states in Australia vary in their criminal legislation and in whether they harbored

convicts historically. Our results include state fixed effects throughout to account for the influence of such time-invariant state characteristics. In addition, we check that historical sex ratios were not systematically different as a function of environmental, cultural, or economic characteristics. Even then, our results are robust to controlling for such initial circumstances, including geographic characteristics and economic specialization, which may have influenced sex ratios and may still influence outcomes of interest. Our results also hold in a wide range of robustness tests, such as correcting for spatial autocorrelation of the error terms and including additional present-day controls such as the present-day sex ratio, urbanization, share of various religious groups, and unemployment.

Nevertheless, variation in historical sex ratios could reflect unobservable characteristics that varied within states. Male and female migrants to Australia could have sorted across geographic areas based on unobservable taste characteristics that are related to our outcomes of interest. For example, fewer female migrants may have chosen to settle where men were more violent or more opposed to sexual minorities. To tackle this issue, we instrument the population sex ratio by the ratio among convicts only. The rationale for this instrumentation strategy is two-fold. First, the instrument is highly relevant since most of the white Australian population initially consisted of convicts and, in the historical period we consider, convicts represented a large part of the population. Second, convicts were not free to move: a centralized assignment scheme determined their location as a function of labor needs, which we proxy by initial economic specialization. This circumvents the possibility that our results are driven by self-selection across different areas of Australia. A related concern, however, is that convicts were different from the rest of the population in ways that are correlated with our outcomes of interest. In particular, convicts may have been more prone to violence, crime, risk taking, and, perhaps, homophobia and it could be the persistence of this convict ‘stain’ that we observe today.² Historical evidence argues against such a mechanism. As we describe in the historical background section, convicts transported to Australia were not “hardened and professional criminals” (Nicholas, 1988, p. 3) but rather “ordinary working-class men and women” (Nicholas, 1988, p. 7). The majority was transported for a first offense, usually a minor property offense, such as petty theft (Oxley, 1996). Nevertheless, we control for the number of convicts throughout our IV specifications.

Our results allow us to contribute to several strands of the literature. First and foremost, we provide a new perspective on the causes, nature, and consequences of gender norms (Giuliano, 2018). Recent work has explored the historical origins of norms about women, including differences in technology (Alesina, Giuliano and Nunn, 2013; Xue, 2016), soil structure (Carraza, 2014), political institutions (Lippmann, Georgieff and Senik, 2016) or, as in this study, historical sex ratios (Gay, 2018; GK). Related work assesses the implications of the resulting female identity for household formation and female work choices (Bertrand, Kamenica and Pan, 2015). In contrast, we consider the origin and manifestation of persistent norms about men.³ Moreover, the mechanism through which historical circumstances affect gender norms,

²Fear of a ‘convict stain’ emerged during the anti-transportationist movement in the mid-1850s (Holdridge, 2015).

³Our findings align with a literature that highlights how cultural norms originate in critical junctures in history (Nunn and Wantchekon, 2011; Grosfeld, Rodnyansky and Zhuravskaya, 2013), how founder populations leave persistent identities (Grosjean, 2014; Bazzi, Fiszbein and Gebresilasse, 2018) and how cultural evolution is charac-

according to most of the existing economic literature, is male-female bargaining. We focus instead on a different, and novel, mechanism: within-sex competition.

Second, our results contribute to an emerging literature on the economic role of norms and identity (Akerlof and Kranton, 2000, 2010) and stereotypes (Bordalo et al., 2016). Several studies highlight the role of perceived threats to one's honor or reputation (Nisbett and Cohen, 1996; Grosjean, 2014) or one's masculinity (Wilson and Daly, 1985) as drivers of violence. We suggest that concerns about status or male identity are heightened in more competitive environments and can have long-lasting effects on violent tendencies, towards others but also one-self (suicide). Relatedly, masculine identity has been hypothesized to be an important cause of stubborn male unemployment despite the availability of (stereotypically female) service jobs (Katz, 2014). We provide the first empirical evidence to show that masculinity norms can indeed manifest themselves in the labor market through occupational gender segregation.

Third, we add to the literature on the consequences of skewed sex ratios. Increased male competition for scarce female partners has been shown to correlate with violent crime in general (Hesketh and Xing, 2006; Edlund et al., 2013; Cameron, Meng and Zhang, 2017) and molestation and rape in particular (Ullman and Fidell, 1989). Although most papers find a positive association between male-biased sex ratios and crime and violence, others document a negative relationship (Schacht, Tharp and Smith, 2016). A possible reason for such ambiguous results is that the variation in sex ratios exploited in these papers results from sex-selective migration, abortion, or mortality (Hesketh and Xing, 2006)—which are themselves endogenous cultural outcomes (Qian, 2008; Almond and Mazumder, 2011; Carranza, 2014; Xue, 2016)—or from incarceration (Schacht, Tharp and Smith, 2016), an endogenous confound. In contrast, we rely on a unique natural experiment that generated quasi-random variation in the sex ratio. Our results confirm the existence of a positive relationship between sex ratios and crime. We suggest a novel mechanism, the role of masculinity norms, which underpins this relationship. This mechanism also speaks to contemporary depictions of increased violence and suicide in male-biased areas of modern India (Chowdhry, 2005).

Fourth, we contribute to an emerging literature on the determinants of support for the enfranchisement of minorities, such as same-sex relationship recognition. Most studies have concentrated on the individual correlates of attitudes towards sexual minorities, highlighting the role of gender (Kite, 1984); education and rural residence (Stephan and McMullin, 1982; Lottes and Kuriloff, 1994; Herek and Capitano, 1996); and age and religion (Inglehart, 1990; Edwards, 2007).⁴ A recent paper by Fernández, Parsa and Viarengo (2019) explores how (media coverage of) political discussions about the ban on gays in the U.S. military changed people's attitudes towards same-sex relationships, especially in states more exposed to the AIDS epidemic. Our contribution is to uncover historical roots of cultural attitudes towards homosexuality and to suggest a mechanism through which such attitudes can become entrenched.⁵ A unique feature

terized by strong hysteresis (Bisin and Verdier, 2001; Doepke and Zilibotti, 2008; Fernández, 2013).

⁴At an aggregate level, countries with English common law, a communist past, or high (contemporary) sex ratios are less accepting of homosexuality (Asal, Sommer and Harwood, 2013; Andersen and Fetner, 2008; Chang, 2015). These studies do not address the potential endogeneity of such broad cross-country differences.

⁵Related to our work, Brodeur and Haddad (2018) find that same-sex relationships are more prevalent in places in the U.S. that experienced a Gold Rush. While their hypothesized mechanism consists of the self-selection of gay men to Gold Rush places, we study a setting without self-selective migration on the basis of sexual preferences.

of our study is that the Australian postal referendum provides us with unbiased and high-quality data on citizens' revealed preferences for enfranchising sexual minorities. Given that real legislation was at stake, and turnout was high (at 79.5 percent), these data arguably better reflect people's true convictions than the surveys that have so far been used to elicit attitudes towards same-sex marriage and sexual minorities more generally.

Lastly, we also contribute to a longstanding debate among historians and commentators about the legacy of the 'convict stain' in Australia, and especially the long-run effects of convictism on crime.⁶ Our analysis highlights that this legacy must be distinguished from that of the radical distortion in sex ratios that convict transportation imposed.

We proceed as follows. Section 2 describes the conceptual background after which Section 3 provides some historical detail about colonial Australia. Section 4 describes the various data. Sections 5 and 6 then discuss our empirical approach and results. Section 7 considers other mechanisms and Section 8 concludes.

2 Conceptual background

This section provides a conceptual discussion of the link between sex ratios and reproductive competition (Section 2.1.), the impact of sex ratios on various outcomes (Section 2.2.) and the mechanisms through which sex ratios can have persistent impacts (Section 2.3).

2.1 Sex ratios, male-male competition, and male-female bargaining

The sex ratio, the number of males relative to females, is a central concept in evolutionary biology. The idea that behavioral differences between the sexes originate in the conditions of reproductive competition, among which the sex ratio plays a central role, is the cornerstone of Darwin's *The Descent of Man* (1871). Skewed sex ratios intensify male-male competition for scarce females, with direct (eliminating or repressing rivals with violence) or indirect (accumulating resources to woo females) behavioral consequences. While females also compete for mating opportunities, it is well accepted since Darwin that males compete more intensely and overtly. The reason is that the price of reproduction is lower for males because their sex cells are widely available compared to those of females and because their investment in offspring (though gestation, lactation, and provisioning) is more limited.⁷ Across a wide range of taxa, strong male-male competition induces risk taking, violence, and control over the reproductive opportunities of dominated males and females (Emlen and Oring, 1977; Buss, 2016).⁸

Unlike the focus of evolutionary biology on intrasexual competition, economics has largely neglected how male-male competition, or for that matter female-female competition, affects gender roles and related outcomes. Instead, economists have focused exclusively on the effect of sex ratios on bargaining between men and women (intersexual competition). That re-

⁶See <https://theconversation.com/stain-or-badge-of-honour-convict-heritage-inspires-mixed-feelings-41097> for a recent summary.

⁷Although human males are often involved in provisioning and parenting, their effort is on average both lower and more variable than that of their female partners in most, if not all, cultures (Hrdy, 2011).

⁸Experimental studies of lizards, birds, and primates find that male-biased sex ratios increase male aggression towards males as well as females (Sapolsky, 1990, 1991).

search has uncovered how male-biased sex ratios increase female bargaining power and hence shift resources and family structures in a way that benefits females. Women are then less likely to participate in the labor force and instead enjoy more leisure (Grossbard-Shechtman, 1984; Chiappori, Fortin and Lacroix, 2002; Grossbard and Amuedo-Dorantes, 2008; Grossbard, 2015). Men, in contrast, work and save more to become attractive partners (Wei and Zhang, 2011) and adopt behavior consistent with female preferences for conservative mating strategies (Guttentag and Secord, 1983; Pedersen, 1991).⁹ In particular, male-biased sex ratios correlate with more monogamy, more committed relationships and higher marriage rates (Grosjean and Khattar, 2019; Schacht and Kramer, 2016), greater marital stability and satisfaction (Otterbein, 1965; Grosjean and Brooks, 2017), and more paternal involvement (Schmitt, 2005).

2.2 Sex ratios and masculinity norms

We hypothesize that skewed sex ratios, and the resulting intense male-male competition for scarce females, can instill masculinity norms that normalize and respect violence, aggression, bullying and risk taking. In line with this, many studies have highlighted that unmarried men are more likely to commit crimes, including rape, murder, and assault (Sampson, Laub and Wimer, 2006; Henrich, Boyd and Richerson, 2012). Intense male-male competition can also result in extreme self-reliance and help-avoiding behavior, which may lead to increased morbidity and earlier death.¹⁰

While an increase in the sex ratio (and male-male competition) is hypothesized to foster violence and risk taking, the effect on attitudes towards homosexuality is a priori ambiguous. Female homosexuality should be viewed negatively and repressed, as it reduces even further the availability of women. By contrast, male homosexuality should at first sight be welcomed, as it reduces the number of male competitors for scarce women. However, the primary effect of a male-biased sex ratio is to increase male-male competition and to heighten the strife for dominance amongst males. More dominant males will gain a higher status, control a larger share of resources, and make themselves more attractive to women.¹¹ In their strife for dominance, men will aim to (often publicly) subdue other men, and in particular those who do not display strong markers of masculinity, thereby encouraging bullying and homophobia (Parrott and Zeichner, 2008). This mechanism of hegemonic masculinity is central to gender-order theory in sociology (Connell et al., 1982). Mahalik et al. (2003) show, for example, that disdain for homosexuals is a distinct masculinity norm in the United States.¹²

A second mechanism that may underlie the relationship between sex ratios and attitudes towards homosexuality is that men tend to be more hostile to homosexuality than women (Kite, 1984; Britton, 1990; Winegard et al., 2016). In regions with high sex ratios (that is, an

⁹Parental investment theory advances that from an evolutionary perspective the potential reproductive benefits from promiscuity and multiple mating are higher for men than for women (Symons, 1979; Buss, 2016).

¹⁰It is worth stressing that the effects of sex ratios that operate through male-male competition and male-female bargaining likely go in opposite directions. The behaviors we describe in this paper and that emanate from male-male competition do not necessarily benefit women. In particular, male violence can, and generally will, be directed not only towards other men in a strife for dominance, but also towards women. If anything, the effect of male-female bargaining should dampen the effects of male-male competition on risk taking and violence.

¹¹See Mulder (1987, 1990), Hill (1984) and von Rueden and Jaeggi (2016) for cross-cultural evidence.

¹²Gay men are also often viewed as unreliable coalition members by heterosexual men (Winegard et al., 2016).

abundance of men) hostility against homosexuals is thus more likely to become the dominant social norm. This effect can be particularly strong in settings, such as the Victorian era, in which men hold significantly more power than women in determining social norms and laws.

A final manifestation of male identity for which we test in this paper, is occupational choice. The role of identity in determining job choice has been discussed since [Akerlof and Kranton \(2000\)](#). More recently, the role of *masculine* identity in preventing men from taking up occupations that are perceived as stereotypically female has attracted attention as a driver of so-called retrospective wait unemployment ([Katz, 2014](#)) and of occupational sorting between stereotypically male and female jobs (that is, occupational gender segregation).

To sum up, we expect that historically male-biased sex ratios led to heightened norms of masculinity as expressed in (a) more violence, bullying and risky behavior, (b) more negative attitudes towards the enfranchisement of sexual minorities, and (c) occupational gender segregation. How can one explain that these effects persist in the long run?

2.3 Persistence mechanisms

Earlier work on cultural norms suggests two persistence channels. First, short-run outcomes of male-male competition, such as heightened norms of masculinity and a penchant for risk taking, can persist in the long-run through cultural transmission within families ([Bisin and Verdier, 2001](#)). For instance, in line with other studies of the persistence of gender roles since the Paleolithic Revolution until today [Alesina, Giuliano and Nunn \(2013\)](#), GK and [Grosjean and Brooks \(2017\)](#) document long-term effects of male-biased sex ratios on female labor force participation, leisure, and relationship satisfaction.

Second, cultural traits may also continue to provide direct benefits that further add to their persistence ([Grosjean, 2014](#)). In our setting, masculinity norms may remain beneficial on the marriage market. Displaying stereotypical masculine behavior can still give an edge, for example by maintaining a strict male hierarchy that legitimizes dominant men's position in society and justifies the subordination of other, more 'feminine' gender identities (either female or male). It can also be the case that strict masculinity norms that emerged in response to historical circumstances have become standard and are held by both men and women. In that case, adhering to such norms can have direct benefits on the marriage market because of marriage homogamy. People with similar views prefer to marry one another, and they form more stable unions ([Becker, Landes and Michael, 1977](#); [Lehrer and Chiswick, 1993](#)).

3 Historical background

Between 1787 and 1868, 132,308 male and 24,960 female convicts were transported from Britain to Australia. The 1836 and 1842 censuses in New South Wales (NSW) and Tasmania showed that the average convict sex ratio stood at more than 28 men for every woman (Table 1). Convicts were quite representative of the Victorian working class at the time ([Nicholas, 1988](#); [Oxley, 1996](#)). Two thirds of transported convicts were first offenders of minor property crime, such as petty theft ([Nicholas, 1988](#)), rather than hardened criminals guilty of violent crime

(these tended to be readily executed in England).¹³

Once in Australia, convicts were not confined to prisons but were assigned to work, first under government supervision and later, as the number of free settlers and emancipists (ex-convicts) grew, under the direction of private employers. Convicts were generally freed after seven years. When we examine population sex ratios, we include convicts, emancipists, free migrants as well as people born in the colony, of all ages. Although the adult sex ratio (ASR) would be a better proxy of the intensity of mating competition, which is at the core of our mechanism, the historical Census does not provide a consistent breakdown of population by sex and age, making it impossible to compute the ASR.¹⁴ However, given the absence of imbalance at birth documented by demographers of historical Australia (Opeskin and Kippen, 2012), local population sex ratios provide unbiased, if noisy, proxies of local ASRs.¹⁵

Convicts and ex-convicts represented the majority of the population in Australia well into the mid-19th century. Male convicts made up 80 percent of the adult population of NSW in 1833. Later immigrants were also predominantly male and often migrated in response to male-biased economic opportunities available in agriculture and, after the discovery of gold in the 1850s, mining. Because of the predominance of male convicts and migrants, male-biased population sex ratios endured in Australia for more than a century, although less severely after the end of convict transportation (Figure 1).

4 Data

We combine various data sets on historical and modern-day Australia by matching the first historical Census in each state to (i) modern-day postcode-level data on violence and crime; (ii) modern-day nationally representative surveys of attitudes (HILDA) and of the lives and experiences of children (LSAC); (iii) present-day Census data on occupations; and (iv) data on the 2017 referendum on same-sex marriage.

4.1 Historical data

Our measure of the historical sex ratio comes from the first reliable census in each state as available from the Historical Census and Colonial Data Archive. We focus on the first Census in each state to measure population before the onset of mass migration and to rely on measures of population in which the quasi-exogenous component stemming from convict transportation represents a larger share of the population. Although the total population of Australia at the time was only about 255,000 people, more than 60 percent of the current population of Australia now lives in areas covered by these historical data. We use the 1836 New South Wales

¹³In total, five convicts were ever transported to Australia for ‘culpable homicide’ and 141 for ‘murder’. This is close to the number of convicts deported for ‘stealing a handkerchief’ (113) and much less than the numbers deported for ‘stealing a watch’ (189), ‘pickpocketing’ (191), or ‘stealing a sheep’ (732). These statistics are obtained from convict records and are available at convictrecords.com.au/crimes (accessed 16 March 2018). These data were digitized from the British convict transportation registers, which contain information on the characteristics of each convict in each shipment but not on where such convicts were assigned once in Australia.

¹⁴Several individual Census records were destroyed in a fire in 1882.

¹⁵None of our historical data include Indigenous Australians (Aboriginal and Torres Strait Islanders), who were not counted in the Census until the 1960s. Only very rough historical estimates are available for this population.

Census¹⁶ (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.¹⁷ Importantly, the Censuses in the penal colonies of New South Wales and Tasmania also include information on the number and gender of convicts.

The unit of observation in the census is a county.¹⁸ There are a total of 90 counties, 34 of which harbored convicts. The average county had 4,480 individuals, and most counties (about 85 percent) had between 300 and 10,000 people. Although the average sex ratio was about 3 men for every woman, it was much higher among convicts, at more than 28 men for every woman. The historical censuses also contain data on economic occupations.

Table 1 shows how well covariates are balanced between counties with historical sex ratios above or below the median (2.24). Agriculture was the largest employment sector in Australia at the time, accounting for 22 percent of the labor force. Domestic services followed at 13 percent, and then manufacturing and mining with a combined total of 10 percent. The shares of people employed in agriculture were slightly higher in areas that were above the median sex ratio, but the share of people employed in domestic services, mining and manufacturing are not statistically different from one another (see Panel A of Table 1). We will control throughout our analysis for the historical shares of employment in different sectors. We also control for land characteristics and mineral endowments.

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 concentration of sexes does not have a definite pattern: high and low sex ratios were found in the hinterland as well as along the coast.

4.2 Data on present-day outcomes

To explore the long-run effects of male-biased sex ratios, we use several data sources (the online Appendix provides more details). First, we obtain crime statistics at the postcode level from the police or statistical agencies.¹⁹ As described in the online Appendix, crime reporting varies across states. Certain categories of crime, such as assault, homicide, and robberies and burglaries are reported in a homogeneous manner across states, while others, including sexual assault, are not. This explains why the number of observations varies for different categories of crime. The dates for which the data are available to researchers also vary, but we obtain consistent crime estimates between 2006 and 2016, except for South Australia (2012-2016). We match these data to the 2006, 2011, and 2016 Census and interpolate the population between Census years to compute crime rates per capita.

Second, we use mortality statistics to obtain rates of death attributable to suicide and other forms of preventable mortality due to excessive risk-taking and help avoidance behavior. Data

¹⁶This is the second oldest Census for New South Wales. The 1833 Census lacks sufficient geographic granularity for our purpose.

¹⁷The dates of the Censuses vary because states were independent colonies until 1901.

¹⁸"Counties" is used here to refer to historical administrative divisions within the different colonies of Australia, variously called "counties", "police districts", "towns", or "districts".

¹⁹We obtained data for Australian Capital Territory, Queensland, New South Wales, South Australia, Tasmania, and Victoria. These are the states for which the historical Census data is available.

is from the Mortality over Regions and Time 2011-2015 data set (Australian Institute of Health and Welfare). The data set lists the top 20 causes of death by gender and Local Government Area (LGA) over this time period, as well as the total number of deaths in each year. Our main proxy for excessive risk-taking consists of mortality from lung disease, a proxy for excessive smoking. Our proxies for help avoidance behavior consist of mortality from prostate cancer and suicide.

Third, we use data from the 2016 Census on the share of men and women in different occupations at the 4-digit occupation code level. To be left with a manageable number of occupations, we retain all occupations with employment shares higher than 0.7 percent. We then categorize the remaining occupations as 'male' (85 percent of employment or more is male), 'female' (15 percent of employment or less is male) or 'neutral' (the remaining category). Examples of the most masculine occupations are 'Carpenters and Joiners', 'Metal Fitters and Machinists', and 'Motor Mechanics' (all 99 percent male). Examples of the most feminine occupations are 'Child carers' (4.9 percent male), 'Receptionists' (5.2 percent male), or 'Education Aides' (9.6 percent male). Examples of neutral occupations are 'Real estate sale agents' (50.0 percent male) and 'Retail managers' (50.5 percent male).

Fourth, to measure the extent to which historical sex ratios have shaped social norms, we use the results of the 2017 referendum on same-sex marriage. The Australian Marriage Law Postal Survey was conducted by the Australian Bureau of Statistics (ABS) as a postal vote between 12 September and 7 November 2017. Unlike compulsory electoral voting, responding to the survey was voluntary. A survey form was mailed to everyone on the electoral roll, asking the question "*Should the law be changed to allow same-sex couples to marry?*".²⁰ Data is available at the electoral district level (150 districts). The results showed that 61.6 percent had voted in favor of marriage equality while 38.4 percent voted against it. Turnout was high, at 79.5 percent. While the postal survey was non-binding, the Liberal–National Coalition government had pledged to support a Parliamentary bill to legalize same-sex marriage in case of a "Yes" outcome. A few weeks after the vote, Australia's House of Representatives voted in favor of legalizing same-sex marriage. The district-level postal vote data provide us with a clean manifestation of masculinity norms, as negative attitudes towards sexual minorities are often seen as at the heart of such norms. The vote data are also unique in that they provide us with an 'undiluted' measure of people's support for a salient normative cause (electoral voting would conflate these issues with many others, including economic considerations). Moreover, anonymous voting is not susceptible to response bias that plagues surveys. As a validation of this measure, we use a nationally representative survey, HILDA, which identifies respondents through their residential postcode. Of interest is the question on attitudes towards enfranchisement of sexual minorities: "*Homosexual couples should have the same rights as heterosexual couples do*". Answers range from 1 (strongly disagree) to 7 (strongly agree), and we categorized individuals as broadly supportive of same-sex rights if they answered 4 (neutral) or above.

Lastly, to refine our understanding of possible socialization mechanisms that sustain the relationship between historical sex ratios and modern-day male identity and behavior, we use data on bullying in schools from a nationally representative survey of Australian youth

²⁰The ABS ensured that Australians without access to postal services could vote nevertheless.

(LSAC). LSAC is a longitudinal study of 10,000 children since 2003. It follows two cohorts (aged 0-1 in 2003-2004, and 4-5 in 2003-2004) and examines a broad range of questions on development and well-being. In particular, the survey measures the incidence of child bullying at school as reported by parents, children, and teachers. Due to a large number of missing observations from children’s reports, as well as to the young age of some of the children, we focus on responses by parents and teachers.

4.3 Data matching

To match present-day to historical data and combine our diverse sources of data, we project all our data on the smallest geographic unit in the Census (SA1). We rely on the historical boundaries established by GK, which we project again at the SA1 level (as opposed to the larger postcode level used in GK). We then match all our outcome data to the 2011 or 2016 Census at the SA1 level and to the historical data.

We retain the following SA1 characteristics from the Census as controls: present-day sex ratio, population, urbanization, religious composition, unemployment, education, age, and percentage Australian born. Across all specifications, controls are consistently measured at the SA1 level. We also collect data on mineral and land type from Geoscience Australia. Panels B-G of Table 1 provide descriptive statistics. The balance of covariates across areas below or above the median historical sex ratio is presented in columns 3-4. We observe no statistically significant differences of meaningful size across high versus low historical sex ratio areas in terms of present-day age, ancestry composition, income, or education. Areas that historically had more men than women tend to be still somewhat more male-biased. We therefore retain the present-day sex ratio as a covariate in all baseline specifications.

5 Empirical strategy

We examine the long-term effects of male-biased sex ratios on present-day outcomes by estimating the following equation:

$$y_{ijcs} = \alpha_1 + \beta_1 \text{SexRatio}_{cs} + X_{jcs}^G \Gamma_1 + X_{cs}^H \Pi_1 + T_{jcs}^C \Lambda_1 + X_{ijcs}^C \Theta_1 + \delta_s + \varepsilon_{ijcs} \quad (5.1)$$

Where y_{ijcs} are the measures of violent behavior (against self or others), health, or vote in favor of same-sex marriage for individual i in modern statistical area j (SA1 - the smallest administrative unit for which Census data is available, with an average population of 400 people, or postcode), part of historical county c , in state s . SexRatio_{cs} is the historical sex ratio: the number of males to females in historical county c , as per the first census in each state or colony s . δ_s is a vector of state dummies. Outcomes are either measures at the individual level, SA1 level, or postcode depending on available data. Since historical data at the level of the 90 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.

X_{jcs}^G and X_{cs}^H are vectors of time-invariant geographic and historic characteristics that may have correlated with the historical sex ratio and might still influence present-day outcomes.

Economic opportunities in 19th century Australia, which consisted primarily of agriculture and mining, influenced where convicts were assigned and where free settlers and ex-convicts located. This could bias our estimates if they are also related to our outcomes of interest. If, for example, economic specialization persisted over time, these initial conditions could directly influence present-day economic conditions including our outcomes of interest. To flexibly account for geographic differences across postcodes 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 nine detailed categories of mineral deposits and land characteristics.²¹ We also control for county historical economic specialization by including in X_{cs}^H the historical shares of the population employed in the main categories of employment in 19th century Australia: agriculture, domestic services, mining and manufacturing, government, and learned professions. Total historical population in the county is also included in X_{cs}^H .

T_{jcs}^C and X_{ijcs}^C are vectors of SA1-level and individual-level present-day controls. Areas that were more male-biased in the past tend to be marginally more male-biased today and one concern is that we would observe the influence of present-day, not past, sex ratios. Urbanization and population density are important drivers of attitudes towards sexual minorities (Stephan and McMullin, 1982) and crime (Glaeser and Sacerdote, 1999). For these reasons, we include controls for present-day sex ratio, population, and degree of urbanization at the postcode level.

A concern is the potential influence of religion. There was little variation across historical counties in religious affiliation, with the main groups being evenly distributed across areas. In the 1836 New South Wales Census, 67 percent of the population was Protestant and 33 percent was Catholic, with a standard deviation of 0.13 for the two distributions across counties, and we observe no statistically significant difference across high and low sex ratio areas. Today, we observe some statistically significant differences for the shares of Anglican and agnostics and for some minority religions, albeit small in magnitude (see Table 1). Because of such present-day differences, and because of the potentially large influence of religiosity on risk-taking, violent behavior and attitudes towards same-sex marriage, we include the shares of religious groups at the postcode level as additional controls in robustness tests (see section 6.6).

In the models of individual outcomes using survey data, individual controls are gender, marital status, age, income, education, and whether the respondent was born in Australia. Postal area-level controls include present-day sex ratio, population, and urbanization, taken from the Census closest in time to the implementation of the survey (either 2011 or 2016).

To identify a causal effect of the historical sex ratio in (5.1), we need to assume that the spatial distribution of the relative number of men and women was random, conditional on our proxies for economic opportunities and total population at the time. While economic opportunities were an important dimension of the decision where to settle, it is possible that the latter was also influenced by unobservable characteristics, such as a taste for risk and violence. These could subsequently have been transmitted to present-day populations and influence

²¹Deposit types include ‘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’. Land types include ‘plains’, ‘plateaus’, ‘sand plains’, ‘hills and ridges’, ‘low plateaus and low hills’, and ‘mountains’. Source: Geoscience Australia.

outcomes of interest. In a second part of the analysis, we therefore adopt an instrumental variable strategy based on a subpopulation that was not free to choose where to live: convicts. We instrument the overall sex ratio by the sex ratio among the convict population only. This instrument is relevant because convicts constituted a large proportion of the population, so that the sex ratio among convicts is an important component of the overall sex ratio. The raw correlation between total population and convict population is 0.94, and the raw correlation coefficient between the convict and population sex ratios is 0.72. Since convicts were not free to move, using the sex ratio among them as an instrument alleviates the self-selection issue that historically men and women chose their location based on unobservable preferences. That said, as discussed in the historical background section, convict assignment was not purely random but also influenced by labor requirements. We remove this potential endogeneity bias by controlling for historical employment sector shares and for the full set of geographic factors, including the location of minerals and land type.

Causal identification requires that (i) conditional on our proxies for labor needs, allocation of convicts was random, and (ii) the convict sex ratio only influenced present-day outcomes through its effect on the historical population sex ratio (exclusion restriction). We have just defended (i). A potential source of violation of (ii) resides in the possibility that the presence of convicts itself had a direct effect on crime and electoral outcomes today, independently of the effect on sex ratios—a genuine concern since we are talking, after all, about convicts. Furthermore, it is possible that more hardened, risk-loving and violent convicts were systematically sent to more male-biased areas. This would be a form of endogenous selection generating a correlation between, on the one hand, the convict sex ratio and, on the other hand, preferences for risk and violence stemming from convictism itself, which may have persisted until today.

Historical evidence reduces this concern. First, as we describe in Section 3, convicts that were deported to Australia were not hardened criminals guilty of violent crime. Instead, they were mostly first-time offenders of petty property crime. Second, the placement of convicts was decided in a highly centralized way, making it unlikely that the spatial distribution was determined by unobservable taste for risk. As described by Governor Bligh of New South Wales in 1812: “They (the convicts) were arranged in our book (...) in order to enable *me* to distribute them according” (Nicholas, 1988, p. 15, emphasis added). Indeed, in the first stage of our IV framework the county-level variable ‘Number of convicts’ is never a statistically significant correlate of the historical sex ratio, and the first stage point estimate of the convict sex ratio is unaffected by whether we control for number of convicts or not (see Table A1). This indicates that sex ratios were not especially high in small (and potentially more remote and challenging) communities where only few convicts were present while ratios were also not less skewed among the largest convict populations. Third, it is likely that the endogeneity bias, if it existed, would go the other way and lead us to underestimate impacts. Indeed, as shown by Parliamentary debates on transportation to Australia, authorities became concerned about unrest and the potential negative consequences of male-biased sex ratios. This would have provided incentives to send fewer males, especially potentially violent ones, to areas where sex ratios were already heavily male-biased. However, such concerns by the authorities only emerged later than the historical period we consider, mostly after the 1850s, and thus

should not affect our results.²² Nevertheless, throughout all IV specifications we control for the overall number of convicts. This absorbs the legacy of convictism as separate from the legacy of the sex ratio. To address the possibility that the relationship between overall number of convicts and sex ratio among convicts was not mean preserving, i.e., that only the more hardened, risk-loving and violent *male* convicts were systematically sent to more male-biased areas, we perform the analysis with the total number of *male* convicts rather than the overall convict population.²³

As only New South Wales and Tasmania were penal colonies, convicts were present in about a third of the historical counties. In the Appendix, we use randomization inference, which also corrects for the small number of clusters. We also consider the possibility that our results might (partially) reflect a high degree of spatial autocorrelation in the residuals (Kelly, 2019). In appendix Table A2 we present Moran statistics that should assuage concerns that our results reflect spatial noise.

6 Empirical results

This section discusses the long-term consequences of male-biased sex ratios on violence and crime; mortality and suicide; and occupational gender segregation. We then provide evidence from the outcome of the 2017 same-sex marriage referendum that suggests that these behavioral effects reflect masculinity norms. Lastly, we investigate to what extent such masculinity norms manifest through, and are potentially sustained by, bullying in schools. We mostly focus on the IV results.

6.1 Violence, suicide, and health

We investigate the long-term consequences of male-biased sex ratios on violence in Table 2. The unit of observation is a postcode. The dependent variables are the natural logarithm of the mean number of assaults and sexual offenses per 100,000 inhabitants between 2006 and 2016. The number of observations varies across the different types of offenses because, as described in the online Appendix, crime reporting is not uniform across states.

The estimates show that today, the rates of assault and sexual assault are higher in areas that were more male-biased in the past. The coefficient associated with the historic sex ratio is statistically significant at the 1 to 5 percent level for assault and sexual assault in our preferred IV specifications, and borderline statistically significant for assaults in the OLS specification. The first stage of the IV is strong for all crime and violence regressions, with an F-statistic of around 15 (see also Table A1). In our preferred IV specification, a one unit increase in the historical sex ratio (one additional man competing for a single woman) is associated with a 11 percent increase in the rate of assault²⁴ and a 16 percent increase in sexual assaults.

²²The sex ratio among convicts is measured from the 1836 NSW Census and the 1842 TAS Census. The first parliamentary committee headed by Sir William Molesworth started discussions on ending transportation to NSW in 1837. It took several years of debate until the Colonial Government decided to cease transportation to NSW in 1852. Transportation continued to TAS, then Van Diemen's land, until 1853.

²³We do not show those results as they are nearly identical. This is not surprising given that the correlation coefficient between total convict number and total convict men is 0.999.

²⁴According to a more detailed breakdown of assaults by gender that we were able to obtain for New South Wales,

We investigate the long-term consequences of male-biased sex ratios on suicide and mortality in Table 3. The dependent variables consist of the (log) rates of male mortality from suicide, prostate cancer, lung disease, as well as a broader index of morbidity: the mean age of male death. The unit of observation is a LGA. All the results control for the usual historic, geographic, and present-day SA1 controls as well as total male deaths. We find strong and robust evidence of elevated rates of male suicide, prostate cancer, and lung disease in formerly male-biased areas. The magnitude of the results is large. For suicide, the main cause of death for Australian males under 45 years of age, a one unit increase in the historical sex ratio is associated with a 26 percent increase in the male suicide rate according to our preferred IV specification. For prostate cancer, the most common cancer in men in Australia, it is associated with a 4.3 percent increase; and for lung disease, a 6.4 percent increase.²⁵ As a result, men who live today in areas that were more male-biased in the past die younger (column 4).

We provide evidence that these results are not driven by generally higher crime or worse general health in formerly high sex ratios areas. We show in Appendix Table A4 that these areas do not have higher rates of property crime. Moreover, men in those areas are not more likely to have diabetes, or cardio-vascular disease. Similarly, we show in Appendix Table A5 that the causes of mortality (including suicide) for *women* are not sensitive to the historical sex ratio, except for lung disease, which could be due to secondary smoking by their partners, and for which the effect is borderline statistically significant. Instead, we argue that male-biasedness in sex ratios and elevated male-male competition have forged a locally variegated culture of male violence, help avoidance, and self-harm, which has persisted until this day. We present in the next section some of the economic consequences of such masculinity norms.

6.2 Occupational gender segregation

To explore the relationship between historical sex ratios and occupational gender segregation, we regress, separately, the SA1-level shares of men and women employed in 2016 in feminine, neutral, and masculine occupations, as defined in Section 4.2. The first (last) three columns of Table 4 present the results for men (women). We present only the results of our preferred specification. In addition to our usual controls, in each case we also control for total employment in the relevant employment category. This captures variation due to local labor-market circumstances. The coefficient associated with the historical sex ratio thus measures how much this ratio explains of the share of workers (by gender) in a specific gender-stereotypical occupation, relative to the local share of this occupation in the postcode.

The results paint a striking picture. Historical sex ratios significantly contribute to occupational gender segregation for Australian males today. In our preferred IV specification, the coefficient associated with the historical sex ratio is significant for males for all categories of employment. The sign of the coefficient is consistent with our interpretation that historical sex ratios forged a culture of masculinity, which still leads men to seek employment in stereotypically male occupations, and to shun employment in stereotypically female occupations (and

83 percent of assaults are committed by men and 72 percent of the victims are male. This variable thus broadly proxies for male-on-male violence.

²⁵Prostate cancer is curable if treated early, but avoidance of diagnosis and treatment is a major public health concern.

even in neutral occupations). Overall, a one unit increase in the sex ratio is associated with a nearly 1 percentage point shift from the share of men employed in neutral or stereotypically female occupations combined (the sum of the two point estimates: 0.003 and 0.006) to stereotypically male occupations. The historical sex ratio is also significantly associated with the share of women employed in same-gender occupations but is not statically significant for opposite gender occupations.

Our measures of stereotypically female or male occupations reflect, by definition, norms, since they are computed from the general averages in the Census. We now turn in the next subsection to a more direct measure of norms by examining voting in the 2017 same-sex marriage referendum.

6.3 Support for same-sex marriage

Table 5 presents the estimation results of Eq. 5.1 using the share of votes in favor of same-sex marriage as the dependent variable in Column 1 and the share of abstention in Column 2. Abstention can be interpreted as the expression of (a weaker form of) opposition to same-sex marriage. Several Members of Parliament who were opposed to same-sex marriage, expressed their intention to abstain and some constituents may have followed suit in this silent opposition.²⁶ We express votes or abstention as percentages of total voting population. That is, although "Yes" won 62 percent of all expressed suffrage, it only represented 49 percent of the total voting population, given the 21 percent abstention rate. We check the robustness of our results to another measure of attitudes towards same-sex marriage at the individual level from the HILDA survey, which includes a question on attitudes towards same-sex couples (respondents are asked whether they agree that *"Homosexual couples should have the same rights as heterosexual couples do"*).

The results show that both the share of votes in favor of marriage equality and the participation rate are substantially lower in areas where sex ratios were more male-biased in the past. These results are statistically significant, consistent, and large in magnitude in all specifications. The first stage of the IV is strong, with an F-statistic above 15 (see also Table A1). In our preferred IV specification, the coefficient associated with the historic sex ratio indicates that a one unit increase in the historical sex ratio is associated with a nearly 3 percentage point decrease in the vote share in favor of same-sex marriage (Column 1). This amounts to slightly over 6 percent of the mean. These estimates suggest that accounting for historical factors explains 9 percent of the variation in the "yes" vote that is unexplained by a wide range of socio-demographic and economic factors, including religious background, unemployment, urbanization, or the present-day sex ratio.²⁷ The third column of Table 5 confirms these results, in direction and magnitude, with individual-level survey data.

²⁶The members of the Liberals/Nationals coalition who were the most prominent opponents to same-sex marriage abstained during the vote for the final bill that legalized same-sex marriage.

²⁷This figure is obtained by comparing the R-squared of the specification with the full set of extended controls (0.614) to the R-squared of the same specification, but without historical controls (0.563).

6.4 Bullying

The results in Table 6 show how boys, but not girls, are more likely to be bullied at school in areas that used to be more male-biased in the past. The magnitude of the results is considerable and in line with the magnitude of the results for assaults (measured in adults). A one unit increase in the historical sex ratio is associated with a higher likelihood of parents reporting bullying of their sons by 13.7 percentage points. Rates reported by teachers are lower, at 5.2 percentage points, but statistically significant at the one percent level.

These bullying results are suggestive of two mechanisms. First, they lend credence to the idea that traditional masculinity norms are enforced through intimidation, with (perceived) homosexuals being likely targets. This further cements a violent, homophobic and emotionally repressed (male) social order.²⁸ Second, they suggest that masculinity norms are perpetuated through horizontal peer pressure, starting at a young age in the playground. This is consistent with [List, Momeni and Zenou \(2019\)](#) who find evidence for large peer-level externalities in non-cognitive skills correlated with violence, such as inhibitory control, among boys.

6.5 ATE versus LATE

Almost universally, the IV estimates are somewhat larger than the OLS ones. We expect this to be the case for two main reasons. First, our suggested mechanism is that the sex ratio shapes attitudes through its effect on mating competition. Evolutionary biologists generally focus on the sex ratio among adults of reproductive age (ASR). However, the historical censuses do not systematically break down the population by age, so that we cannot compute the ASR. However, convicts were of marriageable age, so that the sex ratio among convicts, used in the IV regressions, is effectively an ASR. The population sex ratio used in OLS is, by contrast, a noisier measure of the treatment of interest, and we therefore expect the OLS estimates to be biased downwards due to such attenuation bias.

Second, mating competition was much stronger among convicts than in the full population because the convict population was more male-biased. Moreover, female convicts could (and did) marry free men while it was very rare for convict men to marry free women. In other words, mating competition was much more intense in the convict subpopulation. We therefore expect the local average treatment effect (LATE) among convicts to be larger than the average treatment effect (ATE) in the whole population.

6.6 Robustness

In Appendix Tables A2 and A3, we subject our main results to a battery of robustness tests. In Table A2, we replicate our baseline IV results in the odd columns and contrast them with comparable specifications in the even columns that include additional present-day controls at the most granular (SA1) level. These are education (share of the local population that has completed year 12), unemployment rate (by gender), religion shares, median age, median household income, and the proportion of the local population that was born overseas. To the extent

²⁸LGBTQ youths are at much higher risk of bullying in schools, with two thirds of LGBTQ young people reporting school bullying ([Guasp, 2012, accessed 17 December 2019](#)).

that these variables are endogenous to the historical sex ratio, they are bad controls and might bias our estimates. Yet, GK find no evidence supporting the hypothesis that historical sex ratios explain investments in education or current industrial specialization (neither historically nor today). Reassuringly, Table A2 shows that our results are robust to including these additional (potentially 'bad') controls.

One might worry that our results (partially) reflect spatial autocorrelation in the residuals (Kelly, 2019). To investigate whether this is the case, we calculate Moran statistics (a spatial version of the Durbin-Watson statistic) and report the related p-values in Table A2. These statistics suggest that correlation in spatial noise is limited and unlikely to drive our results.

Next, we assess in Appendix Table A3 the robustness of our results to controlling for the distance of the SA1 to the nearest port (Panel A) and to controlling for whether an SA1 is part of a metropolitan area (Panel B). Lastly, in Panel C we remove outliers in the historical sex ratio by trimming the top and bottom 1 percent of the historical sex-ratio distribution. All our results continue to hold.

7 Alternative explanations

In this section, we explore alternative explanations for the long-term relationship between male-biased sex ratios and what we suggest are manifestations of masculinity norms: opposition to sexual minorities' rights, violence, suicide and help avoidance, and occupational gender segregation. First, we rule out that broad conservatism or institutional differences across Australia explain our results. Second, we examine whether our findings could be due to the long-term effects of convictism, rather than the sex ratio. We conclude that the most likely explanation for our results is that male-biased sex ratios instilled strong masculine identities, which then persisted over time and still manifest themselves in a consistent way across political, economic, and social domains.

7.1 Conservatism

We already discussed the possibility that the cross-sectional variation in historical sex ratios is endogenously determined in a way that would influence present-day outcomes. We provided evidence in Section 4.1. and in Section 5 that this is unlikely. The relationship between historical sex ratios and present-day attitudes towards same-sex marriage could also reflect a legacy of sex ratios on social conservatism more broadly. Past work has shown that sex ratios are associated with more conservative gender roles, and that these effects have persisted in the long run in Australia (GK). However, GK are unable to document differentiated effects by gender. Moreover, conservative individuals and societies are less, not more, prone to violence and substance abuse (Sampson, Laub and Wimer, 2006; Henrich, Boyd and Richerson, 2012). Last, we provide direct evidence in Appendix Table A4 that broad political attitudes, which go beyond the single issue of rights for homosexuals, are unaffected. Column 1 shows that the coefficient associated with the historical sex ratio does not have a significant effect on the share

of votes for conservative parties²⁹ in the general election in the year immediately preceding the same sex marriage referendum, in 2016. Hence, this explanation cannot account for the results we document on crime, violence, and risk-taking.

7.2 Institutional differences

The different states in Australia were independent colonies until 1901. As such, some were convict colonies: New South Wales (which included the Australia Capital Territories and parts of Queensland at the time), Tasmania, and in later periods Western Australia. Others, such as South Australia and Victoria, never were convict colonies. This may have affected the reputation of different areas and rendered them more or less attractive to free migrants in a way that could have affected the sex ratio (for example if families or single women were not willing to migrate to convict colonies). Moreover, different states today vary in their criminal legislation and, until recently, in legislation that affects sexual minorities, in ways that could be correlated with historical circumstances. For example, South Australia was the first state to decriminalize homosexuality in 1975, and Tasmania the last, in 1997. However, all our results include state fixed effects that remove the influence of time-invariant state characteristics or differences in legislation across states.

7.3 Convictism or skewed sex ratios?

The extent to which present-day violence, crime, and attitudes towards homosexuality are all stained by Australia's convict past has been the object of a long-standing and intense debate. Studies highlighting the potential role of genes as a determinant of violent behavior (Tiihonen et al., 2015) are particularly anxiogenic for many Australians.³⁰ Authorities were so concerned about "*blasphemy, rage, mutual hatred, and the unrestrained indulgence of unnatural lust*" among convicts that it became one of the main arguments of transportation abolitionists.³¹ This in turn has led some to go so far as stating that: "*prejudice toward LGBTI people [in Australia] can be summed up in one word: convictism*".³²

We control in all specifications for the total number of convicts, so that our results are immune to the potential legacy of convictism in and of itself. For assaults and sex offenses, the coefficient associated with the number of convicts is actually *negative* but statistically insignificant in the IV estimation. For explaining the share of men employed in male occupations, the coefficient is positive but insignificant. We explore more directly the role played by the share of convicts as a determinant of attitudes towards homosexuality in a short companion paper (Baranov, De Haas and Grosjean, 2020).

²⁹Australia is by and large characterized by a two-party system, consisting of a socially conservative and economically liberal Liberal-National Coalition and a more socially progressive Labour Party. The dependent variable in Column 1 of Table A4 consists in the share of votes for the Liberal-National Coalition in the 2016 general election.

³⁰See <https://theconversation.com/stain-or-badge-of-honour-convict-heritage-inspires-mixed-feelings-41097>.

³¹*There could have been no better breeding ground for the ferocious bigotry with which Australians of all classes, long after the abandonment of Norfolk Island and the System itself, perceived the homosexual. And this in turn seemed like an act of cleansing—for homosexuality was one of the mute, stark, subliminal elements in the 'convict stain' whose removal (...) so preoccupied Australian nationalists*" (Hughes, 2003, p. 272)

³²See <https://www.theguardian.com/commentisfree/2017/sep/30/australias-homophobia-is-deeply-rooted-in-its-colonial-past>.

8 Discussion and conclusions

We exploit a historical experiment, the colonization of Australia in the 18th and 19th century, to identify the long-lasting impact of male-biased sex ratios on masculinity norms. We find that areas that were heavily male-biased in the past (though not the present) remain characterized by more violent behavior, help avoidance that leads to higher rates of suicide and preventable diseases such as prostate cancer, and a higher likelihood of men selecting more (less) into stereotypically male (female) occupations. Moreover, we provide direct evidence that norms differ, as significantly fewer people voted in favor of same-sex marriage in areas that were historically more male-biased. Taken together, our results indicate that male-biased sex ratios fostered a culture of masculinity that persists until today. Indeed, the consequences of uneven sex ratios have persisted long after contemporary sex ratios returned to their natural rate. We provide suggestive evidence that early socialization and male peer pressure contribute to the persistence of such norms of behavior.

While our experimental setting, which allows for rigorous identification, is unique, we believe that our findings have wider applicability. In particular, our results can inform the debate about the long-term socio-economic consequences and risks of skewed sex ratios as currently observed in many developing countries such as China, India, and parts of the Middle East. In these settings, sex-selective abortion and mortality, polygamy, the cultural relegation and seclusion of women, as well as migration have created societies with highly skewed sex ratios. Our results suggest that the masculinity norms that develop as a result, may not only be detrimental to (future generations of) men themselves, but can also have important repercussions for other groups in society, in particular women and sexual minorities.³³

Our results also inform discussions about norm setting in heavily male-biased settings *within* societies with otherwise balanced sex ratios, such as the army, police, gender-segregated schools, prisons, management and supervisory boards of large companies, and some academic departments. This is important because we find that the cultural biases due to uneven sex ratios can be both strong and persistent. Our results are thus in line with recent research revealing that decision makers that spent their formative years in all-male high schools or neighborhoods with greater gender inequality, display more gender-biased behavior during their subsequent professional career (Duchin, Simutin and Sosyura, 2018).³⁴

³³A recent literature demonstrates that legally allowing sexual minorities to marry, one of the main outcome variables in this paper, can have positive impacts on a wide range of outcomes including health (Sherbourne and Hays, 1990; Dee, 2008), access to health insurance (Gonzales, 2015), financial access (Miller and Park, 2018), and reduced suicide rates (Raifman et al., 2017).

³⁴Dahl, Kotsadam and Rooth (2018) show that in environments with highly skewed sex ratios, such as the military, gender stereotypes can be altered by integrating members of the opposite sex.

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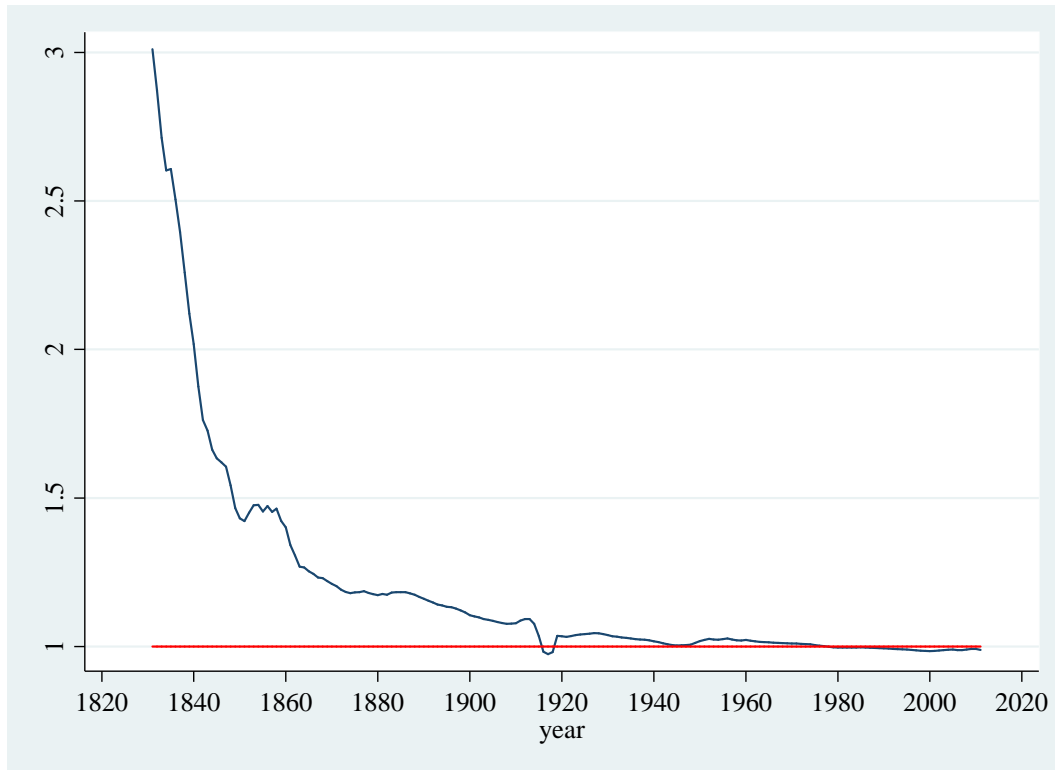
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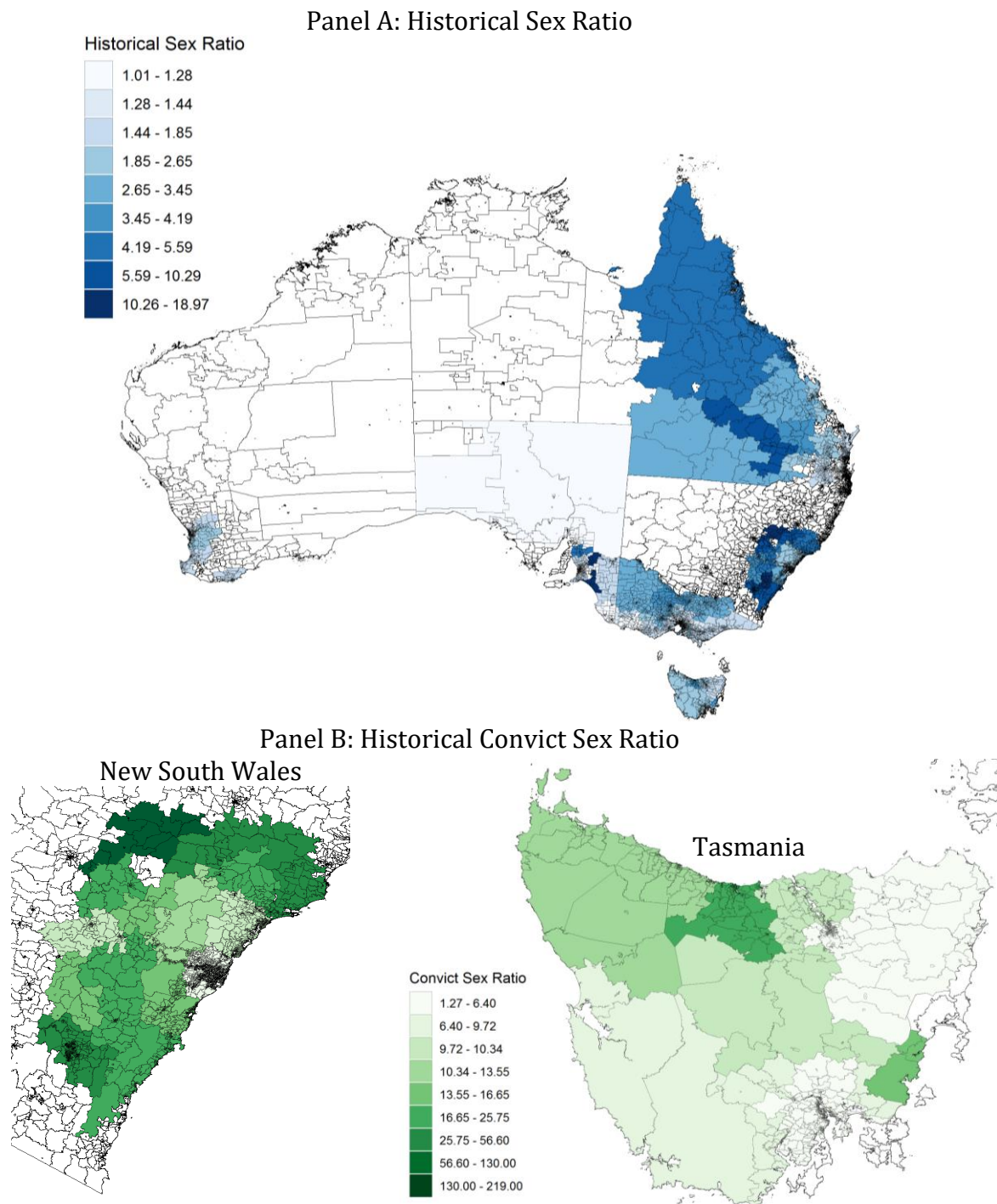
FIGURES

Figure 1: Sex Ratio in Australia: Number of Men to every Woman, 1830-2011



Source: Australian Bureau of Statistics

Figure 2: Sex Ratios in Mid-19th Century Australia: Whole Population (Panel A) and Among Convicts (Panel B)



Notes: The maps only show the parts of Australia for which census data is available for the period of study. Panel A: Australian Capital Territory, New South Wales, Queensland, South Australia, Tasmania, Victoria, and Western Australia. Panel B: Australian Capital Territory, New South Wales, and Tasmania. Boundaries depicted are for the 2016 Statistical Areas Level 1 (SA1), the smallest unit for the release of census data. *Source:* Australian Historical Censuses and Volume 1 of the Australian Statistical Geography Standard.

Table 1 – Sample characteristics and balance

	Mean	SD	Coefficient on Historical SR (standardized)	<i>p</i> -value	Observations
	(1)	(2)	(3)	(4)	(5)
Panel A: Historical data & Geographic features (county level)					
Historical sex ratio	3.11	3.0	1.00		90
Convict sex ratio	28.39	42.4	0.87	0.00***	34
Historical population (1000s)	4.53	12.1	-0.14	0.19	90
Number of convicts (1000s)	0.37	1.0	0.00	0.98	90
Share employed in agriculture	0.22	0.1	0.19	0.08*	87
Share employed in domestic service	0.13	0.1	0.10	0.35	87
Share employed in manufacturing/mining	0.10	0.2	-0.04	0.72	87
Minerals: None	0.15	0.2	-0.12	0.26	90
Minerals: Coal	0.22	0.3	-0.02	0.83	90
Minerals: Gold	0.43	0.4	0.09	0.37	90
Landforms: Plains, plateaus	0.37	0.4	-0.21	0.04**	90
Landforms: Mountains	0.50	0.4	0.12	0.24	90
Panel B: 2016 Census (SA1 level)					
Contemporary population (100s)	4.82	1.8	-0.13	0.24	46,634
Contemporary sex ratio	1.00	0.1	0.20	0.06*	46,634
Urban	0.60	0.4	-0.05	0.62	46,634
% under 30 years old	0.36	0.0	-0.16	0.14	46,634
% foreign born	0.12	0.1	-0.23	0.03***	46,634
Unemployment rate	0.06	0.0	-0.03	0.76	46,583
% completed high school (year 12)	0.29	0.1	-0.20	0.05*	46,634
Median HH weekly income	1221.81	279.7	-0.07	0.49	46,634
Buddhist	0.01	0.0	-0.18	0.10*	46,634
Anglican	0.20	0.1	0.19	0.08*	46,634
Catholic	0.21	0.1	0.04	0.72	46,634
Other Christian	0.19	0.1	0.07	0.49	46,634
Muslim	0.01	0.0	-0.16	0.12	46,634
No Religion	0.26	0.1	-0.32	0.00***	46,634
Panel C: Crime (postcode level)					
Assault (incidents per 100,000)	682.61	324.4	0.24	0.03**	1,712
Sex offenses (incidents per 100,000)	355.98	1452.0	0.72	0.00***	1,460
Property crime (incidents per 100,000)	1825.72	1474.0	0.14	0.21	1,712
Panel D: Male mortality (LGA level)					
Median age of death (male)	76.73	2.2	-0.10	0.34	322
Prostate cancer (male deaths per 100,000)	184.55	63.4	0.11	0.32	342
Lung disease (male deaths per 100,000)	268.61	66.4	0.09	0.39	342
Suicide (male deaths per 100,000)	107.92	48.9	0.12	0.27	342
Panel E: Occupations (SA1 level)					
Share of men in feminine occupations	0.08	0.0	-0.20	0.06*	46,623
Share of men in neutral occupations	0.19	0.0	-0.18	0.10*	46,623
Share of men in masculine occupations	0.73	0.1	0.19	0.07*	46,623
Panel F: 2017 Same-sex marriage referendum (electoral division level)					
% voted 'Yes' (of total registered)	0.47	0.1	-0.23	0.03**	141
% abstention from referendum	0.21	0.0	0.22	0.04**	141
Panel G: HILDA survey on attitudes and norms (individual level)					
Age	37.91	8.9	0.13	0.24	23,791
Male	0.51	0.2	0.17	0.13	23,791
Australia-born	0.66	0.2	-0.19	0.08*	23,791
Beyond year 12 education	0.37	0.2	0.21	0.06*	23,791
Income (log)	11.10	0.3	-0.14	0.21	23,788
Supports same-sex marriage	0.56	0.2	0.02	0.87	15,581
Identifies as straight	0.92	0.1	0.09	0.44	13,489

+ 0.15, * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Notes: Column (3) contains the coefficient from a county-level regression of the variable in the first column on Historical Sex Ratio (SR), with both variables standardized such that the coefficient is interpreted as the change (in standard deviations) due to a one standard deviation increase in Historical SR. Column (4) provides the *p*-value from the test of whether the coefficient in column (3) is equal to zero. Column (5) contains the number of observations for which we have data at the level the data are reported (historical counties, postcodes, SA1s, electoral divisions, LGAs, or individual-level). All data that is not individual-level is matched to SA1s (the smallest statistical geographical unit) for use in regressions.

Table 2 – Historical sex ratios and violence

	Assault log(Incidents/100K) (1)	Sexual offenses log(Incidents/100K) (2)
<i>Panel A: OLS</i>		
Historical sex ratio	0.032 ⁺ (0.021)	-0.009 (0.043)
Observations	41,654	37,919
R^2	0.25	0.66
Mean of dependent var	683.58	131.13
Number of clusters	83	70
<i>Panel B: IV</i>		
Historical sex ratio	0.112** (0.054)	0.163*** (0.057)
Observations	16,578	16,578
R^2	0.26	0.59
Mean of dependent var	834.00	125.14
Number of clusters	34	34
F-statistic (1st stage)	15	15
State FE	Yes	Yes
Geographic controls	Yes	Yes
Historical controls	Yes	Yes
Minerals and land type	Yes	Yes
Present-day SR and population	Yes	Yes

⁺ 0.15, * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Notes: Standard errors clustered at the historical county level. ‘Geographic controls’ are at the postcode level and include the postcode’s centroid and the minerals and land type of the postcode. ‘Minerals and land type’ is the presence and type of mineral deposit (major coal; major gold; other) and land formation (plains and plateaus; mountains; other) as provided by Geoscience Australia. ‘Historic controls’ are the historical county population, convict population, and the proportion of residents working historically in agriculture, domestic service, manufacturing and mining, and government services and learned professions. ‘Present-day SR and population’ are the number of men to women (SR) at the postcode level, the total population density of the SA1, whether it is urban, and its population. Demographic data are averages from the 2011 and 2016 Census.

Table 3 – Historical sex ratios and male morbidity and mortality

	Suicide (1)	Prostate cancer (2)	Lung disease (3)	Median age of death (4)
<i>Panel A: OLS</i>				
Historical sex ratio	0.083** (0.041)	-0.009 (0.010)	-0.000 (0.014)	-0.254 ⁺ (0.156)
Observations	45,609	45,609	45,609	45,566
R ²	0.14	0.69	0.57	0.43
Mean of dependent var	337.70	591.38	913.05	77.90
Number of clusters	90	90	90	90
<i>Panel B: IV</i>				
Historical sex ratio	0.263*** (0.072)	0.043*** (0.012)	0.064*** (0.024)	-0.944** (0.454)
Observations	15,600	15,600	15,600	15,600
R ²	0.18	0.82	0.62	0.55
Mean of dependent var	267.27	489.80	850.40	77.93
Number of clusters	34	34	34	34
F-statistic (1st stage)	16	16	16	16
State FE	Yes	Yes	Yes	Yes
Geographic controls	Yes	Yes	Yes	Yes
Historical controls	Yes	Yes	Yes	Yes
Minerals and land type	Yes	Yes	Yes	Yes
Present-day SR and population	Yes	Yes	Yes	Yes

⁺ 0.15, * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Notes: Standard errors clustered at the historical county level. ‘Geographic controls’ are at the postcode level and include the postcode’s centroid and the minerals and land type of the postcode. ‘Minerals and land type’ is the presence and type of mineral deposit (major coal; major gold; other) and land formation (plains and plateaus; mountains; other) as provided by Geoscience Australia. ‘Historic controls’ are the historical county population, convict population, and the proportion of residents working historically in agriculture, domestic service, manufacturing and mining, and government services and learned professions. ‘Present-day SR and population’ are the number of men to women (SR) at the postcode level, the total population density of the SA1, whether it is urban, and its population. Demographic data are averages from the 2011 and 2016 Census.

Table 4 – Historical sex ratios and occupational gender segregation

	Share of men employed in			Share of women employed in		
	Feminine occupations (1)	Neutral occupations (2)	Masculine occupations (3)	Feminine occupations (4)	Neutral occupations (5)	Masculine occupations (6)
<i>Panel A: OLS</i>						
Historical sex ratio	-0.002** (0.001)	-0.003 (0.002)	0.004* (0.002)	-0.005*** (0.002)	0.001 (0.002)	0.004*** (0.001)
Observations	46,623	46,623	46,623	46,623	46,623	46,623
R ²	0.61	0.82	0.82	0.42	0.48	0.34
Mean of dependent var	0.12	0.27	0.62	0.60	0.30	0.10
Number of clusters	90	90	90	90	90	90
<i>Panel B: IV</i>						
Historical sex ratio	-0.003* (0.002)	-0.006*** (0.002)	0.009*** (0.003)	0.005* (0.003)	-0.007*** (0.002)	0.002 (0.002)
Observations	16,609	16,609	16,609	16,609	16,609	16,609
R ²	0.54	0.87	0.86	0.55	0.61	0.37
Mean of dependent var	0.12	0.28	0.59	0.59	0.31	0.10
Number of clusters	34	34	34	34	34	34
F-statistic (1st stage)	17	17	17	17	17	17
State FE	Yes	Yes	Yes	Yes	Yes	Yes
Geographic controls	Yes	Yes	Yes	Yes	Yes	Yes
Historical controls	Yes	Yes	Yes	Yes	Yes	Yes
Minerals and land type	Yes	Yes	Yes	Yes	Yes	Yes
Present-day SR and population	Yes	Yes	Yes	Yes	Yes	Yes

[†] 0.15, * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Notes: Standard errors clustered at the historical county level. ‘Geographic controls’ are at the postcode level and include the postcode’s centroid and the minerals and land type of the postcode. ‘Minerals and land type’ is the presence and type of mineral deposit (major coal; major gold; other) and land formation (plains and plateaus; mountains; other) as provided by Geoscience Australia. ‘Historic controls’ are the historical county population, convict population, and the proportion of residents working historically in agriculture, domestic service, manufacturing and mining, and government services and learned professions. ‘Present-day SR and population’ are the number of men to women (SR) at the postcode level, the total population density of the SA1, whether it is urban, and its population. Demographic data are averages from the 2011 and 2016 Census.

Table 5 – Historical sex ratios and support for same sex marriage

	% voted 'Yes' (of total registered) (1)	% abstention from referendum (2)	Supports same-sex marriage (HILDA) (3)
<i>Panel A: OLS</i>			
Historical sex ratio	-0.011*** (0.003)	0.003*** (0.001)	-0.013*** (0.005)
Observations	46,633	46,633	25,527
R ²	0.32	0.35	0.10
Mean of dependent var	0.49	0.20	0.61
Number of clusters	90	90	80
<i>Panel B: IV</i>			
Historical sex ratio	-0.028** (0.013)	0.007* (0.004)	-0.071** (0.033)
Observations	16,611	16,611	8,826
R ²	0.36	0.30	0.11
Mean of dependent var	0.47	0.20	0.60
Number of clusters	34	34	28
F-statistic (1st stage)	15	15	14
State FE	Yes	Yes	Yes
Geographic controls	Yes	Yes	Yes
Historical controls	Yes	Yes	Yes
Minerals and land type	Yes	Yes	Yes
Present-day SR and population	Yes	Yes	Yes
Individual-level controls	–	–	Yes

[†] 0.15, * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Notes: Same-sex marriage postal survey data are originally at the electorate level and matched to SA1s. The dependent variable in column (3) is an indicator variable corresponding to the response to the statement: "Homosexual couples should have the same rights as heterosexual couples do". Positive responses are coded as 1, neutral or negative responses as 0. Source: HILDA waves 2011 and 2015. Individual-level controls include age, gender, and if born in Australia. Standard errors clustered at the historical county level. 'Geographic controls' are at the postcode level and include the postcode's centroid and the minerals and land type of the postcode. 'Minerals and land type' is the presence and type of mineral deposit (major coal; major gold; other) and land formation (plains and plateaus; mountains; other) as provided by Geoscience Australia. 'Historic controls' are the historical county population, convict population, and the proportion of residents working historically in agriculture, domestic service, manufacturing and mining, and government services and learned professions. 'Present-day SR and population' are the number of men to women (SR) at the postcode level, the total population density of the SA1, whether it is urban, and its population. Demographic data are averages from the 2011 and 2016 Census.

Table 6 – Historical sex ratios and bullying of boys and girls

	Boys		Girls	
	Bullying reported by teacher (1)	Bullying reported by parents (2)	Bullying reported by teacher (3)	Bullying reported by parents (4)
<i>Panel A: OLS</i>				
Historical SR	0.001 (0.003)	0.001 (0.008)	-0.002 (0.003)	0.009 ⁺ (0.006)
Observations	9,379	9,376	9,015	8,876
R ²	0.01	0.03	0.01	0.02
Mean of dependent var	0.12	0.31	0.08	0.29
Number of clusters	54	54	55	55
<i>Panel B: IV</i>				
Historical SR	0.052*** (0.019)	0.137* (0.076)	-0.012 (0.015)	0.008 (0.030)
Observations	3,281	3,395	3,178	3,183
R ²	0.02	0.01	0.01	0.02
Number of clusters	21	21	22	22
F-statistic (1st stage)	5	4	8	8
State FE	Yes	Yes	Yes	Yes
Geographic controls	Yes	Yes	Yes	Yes
Historical controls	Yes	Yes	Yes	Yes
Minerals and land type	Yes	Yes	Yes	Yes
Present-day SR and population	Yes	Yes	Yes	Yes
Child-level controls	Yes	Yes	Yes	Yes

⁺ 0.15, * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Notes: Standard errors clustered at the historical county level. ‘Geographic controls’ are at the postcode level and include the postcode’s centroid and the minerals and land type of the postcode. ‘Minerals and land type’ is the presence and type of mineral deposit (major coal; major gold; other) and land formation (plains and plateaus; mountains; other) as provided by Geoscience Australia. ‘Historic controls’ are the historical county population, convict population, and the proportion of residents working historically in agriculture, domestic service, manufacturing and mining, and government services and learned professions. ‘Present-day SR and population’ are the number of men to women (SR) at the postcode level, the total population density of the SA1, whether it is urban, and its population. Demographic data are averages from the 2011 and 2016 Census. Child individual-level controls include age, gender, and if born in Australia.

Appendices

Table A1 – First-stage results: Historical convict sex ratios and population sex ratios

	Dependent variable: Historical sex ratio				
	Crime data	Mortality data	Occupations data	Same-sex marriage data	HILDA survey data
	(1)	(2)	(3)	(4)	(5)
Convict sex ratio	0.035*** (0.009)	0.034*** (0.009)	0.036*** (0.009)	0.035*** (0.009)	0.031*** (0.008)
Number of convicts (1000s)	0.802* (0.461)	0.760+ (0.471)	0.849* (0.477)	0.777+ (0.460)	0.640+ (0.393)
Observations	16,578	15,600	16,609	16,611	14,993
Number of clusters	34	34	34	34	29
R^2	0.89	0.84	0.89	0.88	0.92
F-statistic (1st stage)	15	16	17	15	14
State FE	Yes	Yes	Yes	Yes	Yes
Geographic controls	Yes	Yes	Yes	Yes	Yes
Historical controls	Yes	Yes	Yes	Yes	Yes
Minerals and land type	Yes	Yes	Yes	Yes	Yes
Present-day SR and population	Yes	Yes	Yes	Yes	Yes
Individual-level controls	–	–	–	–	Yes

+ 0.15, * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Notes: Standard errors clustered at the historical county level. 'Geographic controls' are at the postcode level and include the postcode's centroid and the minerals and land type of the postcode. 'Minerals and land type' is the presence and type of mineral deposit (major coal; major gold; other) and land formation (plains and plateaus; mountains; other) as provided by Geoscience Australia. 'Historic controls' are the historical county population, convict population, and the proportion of residents working historically in agriculture, domestic service, manufacturing and mining, and government services and learned professions. 'Present-day SR and population' are the number of men to women (SR) at the postcode level, the total population density of the SA1, whether it is urban, and its population. Demographic data are averages from the 2011 and 2016 Census.

Table A2 – Robustness: Controlling for present-day locality covariates (IV specification)

	Assault log(Incidents/100K)		Sex offenses log(Incidents/100K)		Suicide log(Incidents/100K)		Share of men in masculine occupations		Percent voted 'Yes' (of total registered)	
	Standard controls	Extended controls	Standard controls	Extended controls	Standard controls	Extended controls	Standard controls	Extended controls	Standard controls	Extended controls
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Historical sex ratio	0.112** (0.054)	0.077** (0.034)	0.163*** (0.057)	0.132** (0.057)	0.263*** (0.072)	0.221*** (0.076)	0.009*** (0.003)	0.006*** (0.002)	-0.028** (0.013)	-0.016*** (0.004)
Observations	16,578	16,555	16,578	16,555	15,600	15,580	16,609	16,586	16,611	16,588
R ²	0.26	0.34	0.59	0.61	0.36	0.41	0.86	0.91	0.36	0.70
Number of clusters	34	34	34	34	34	34	34	34	34	34
F-statistic (1st stage)	15	16	15	16	16	16	17	17	15	16
Moran statistic <i>p</i> -value	0.369	–	0.104	–	0.369	–	0.188	–	0.116	–
RI <i>p</i> -value		–		–		–		–		–
State FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Geographic controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Historical controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Minerals and land type	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Present-day SR and population	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

+ 0.15, * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Notes: Standard errors clustered at the historical county level. 'Geographic controls' are at the postcode level and include the postcode's centroid and the minerals and land type of the postcode. 'Minerals and land type' is the presence and type of mineral deposit (major coal; major gold; other) and land formation (plains and plateaus; mountains; other) as provided by Geoscience Australia. 'Historic controls' are the historical county population, convict population, and the proportion of residents working historically in agriculture, domestic service, manufacturing and mining, and government services and learned professions. 'Present-day SR and population' are the number of men to women (SR) at the postcode level, the total population density of the SA1, whether it is urban, and its population. Demographic data are averages from the 2011 and 2016 Census. 'Extended controls' include the following present-day SA1 controls: education (share completed year 12), unemployment rate (by gender), religion shares, median age, median household income, and proportion born overseas at the SA1 level.

Table A3 – Additional robustness tests (IV specification)

	Assault	Sex offenses	Suicide	Share of men in masculine occupations	Percent voted 'Yes'
	(1)	(2)	(3)	(4)	(5)
Panel A: Controlling for distance to port					
Historical sex ratio	0.059 ⁺ (0.037)	0.136*** (0.048)	0.311*** (0.093)	0.008** (0.003)	-0.019** (0.008)
Observations	16,578	16,578	15,600	16,609	16,611
R ²	0.29	0.61	0.40	0.88	0.38
Number of clusters	34	34	34	34	34
F-statistic (1st stage)	16	16	16	17	16
Panel B: Controlling for metropolitan areas					
Historical sex ratio	0.111** (0.055)	0.172*** (0.057)	0.263*** (0.071)	0.009*** (0.003)	-0.028** (0.012)
Observations	16,578	16,578	15,600	16,609	16,611
R ²	0.26	0.60	0.36	0.86	0.36
Number of clusters	34	34	34	34	34
F-statistic (1st stage)	18	18	19	20	18
Panel C: Dropping outliers in SR (trimming 1 from top and bottom)					
Historical sex ratio	0.162* (0.088)	0.177** (0.072)	0.286*** (0.077)	0.007* (0.004)	-0.035** (0.016)
Observations	16,142	16,142	15,164	16,173	16,175
R ²	0.26	0.59	0.36	0.85	0.33
Number of clusters	32	32	32	32	32
F-statistic (1st stage)	14	14	15	15	13

⁺ 0.15, * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Notes: Standard errors clustered at the historical county level. 'Geographic controls' are at the postcode level and include the postcode's centroid and the minerals and land type of the postcode. 'Minerals and land type' is the presence and type of mineral deposit (major coal; major gold; other) and land formation (plains and plateaus; mountains; other) as provided by Geoscience Australia. 'Historic controls' are the historical county population, convict population, and the proportion of residents working historically in agriculture, domestic service, manufacturing and mining, and government services and learned professions. 'Present-day SR and population' are the number of men to women (SR) at the postcode level, the total population density of the SA1, whether it is urban, and its population. Demographic data are averages from the 2011 and 2016 Census.

Table A4 – Placebo tests (IV specification)

	Conservatism	Property crime	Male mortality		
	Conservative vote share in 2016	log(Incidents /100K)	Other cancer	Diabetes	Cardio- vascular
	(1)	(2)	(3)	(4)	(5)
Historical sex ratio	0.008 (0.014)	0.026 (0.041)	0.039* (0.024)	0.090 (0.088)	0.006 (0.010)
Observations	16,611	16,578	15,600	15,600	15,600
R^2	0.22	0.42	0.97	0.40	0.99
Mean of dependent var	0.47	3617.64	426.97	92.81	728.99
Number of clusters	34	34	34	34	34
F-statistic (1st stage)	15	15	16	16	16
State FE	Yes	Yes	Yes	Yes	Yes
Geographic controls	Yes	Yes	Yes	Yes	Yes
Historical controls	Yes	Yes	Yes	Yes	Yes
Minerals and land type	Yes	Yes	Yes	Yes	Yes
Present-day SR and population	Yes	Yes	Yes	Yes	Yes

⁺ 0.15, * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Notes: Standard errors clustered at the historical county level. ‘Geographic controls’ are at the postcode level and include the postcode’s centroid and the minerals and land type of the postcode. ‘Minerals and land type’ is the presence and type of mineral deposit (major coal; major gold; other) and land formation (plains and plateaus; mountains; other) as provided by Geoscience Australia. ‘Historic controls’ are the historical county population, convict population, and the proportion of residents working historically in agriculture, domestic service, manufacturing and mining, and government services and learned professions. ‘Present-day SR and population’ are the number of men to women (SR) at the postcode level, the total population density of the SA1, whether it is urban, and its population. Demographic data are averages from the 2011 and 2016 Census.

Table A5 – Historical sex ratios and female morbidity and mortality

	Suicide in top 20 (1)	Breast and ovarian cancer (2)	Lung disease (3)	Other cancer (4)	Diabetes (5)	Cardio- vascular (6)	Median age of death (7)
Panel A: OLS							
Historical sex ratio	0.015 (0.012)	0.005 (0.009)	0.024* (0.015)	0.019** (0.008)	-0.045 (0.063)	0.007+ (0.004)	-0.269** (0.122)
Observations	45,609	45,609	45,609	45,609	45,609	45,609	45,538
R ²	0.37	0.93	0.91	0.96	0.49	0.99	0.35
Mean of dependent var	4.78	156.55	142.27	255.46	88.49	730.13	83.80
Number of clusters	90	90	90	90	90	90	89
Panel B: IV							
Historical sex ratio	0.037 (0.033)	0.039* (0.023)	0.135* (0.073)	0.010 (0.020)	0.182 (0.180)	0.012 (0.013)	-0.810** (0.343)
Observations	15,600	15,600	15,600	15,600	15,600	15,600	15,594
R ²	0.25	0.94	0.89	0.95	0.29	0.99	0.61
Mean of dependent var							
Number of clusters	34	34	34	34	34	34	33
F-statistic (1st stage)	16	16	16	16	16	16	16
State FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Geographic controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Historical controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Minerals and land type	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Present-day SR and population	Yes	Yes	Yes	Yes	Yes	Yes	Yes

+ 0.15, * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Notes: Standard errors clustered at the historical county level. 'Geographic controls' are at the postcode level and include the postcode's centroid and the minerals and land type of the postcode. 'Minerals and land type' is the presence and type of mineral deposit (major coal; major gold; other) and land formation (plains and plateaus; mountains; other) as provided by Geoscience Australia. 'Historic controls' are the historical county population, convict population, and the proportion of residents working historically in agriculture, domestic service, manufacturing and mining, and government services and learned professions. 'Present-day SR and population' are the number of men to women (SR) at the postcode level, the total population density of the SA1, whether it is urban, and its population. Demographic data are averages from the 2011 and 2016 Census.

For Online Publication Only

APPENDIX

Men. Roots and Consequences of Masculinity Norms

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December 22, 2019

1 Variable description

Below we describe the data sources and definitions of the variables used in the paper.

1.1 Historical variables

Our data to calculate historical sex ratios is based on the earliest reliable Census in each state, which we take from the Historical Census and Colonial Data Archive (HCCDA). In all colonies, except for New South Wales, this was the first administered Census. While the first county-level Census in New South Wales took place in 1833, adequate information on county boundaries is not available for this colony until 1834 when Surveyor General Major Thomas Mitchell was commissioned to map New South Wales into 19 formal counties. We therefore use the second New South Wales Census (which includes the Australian Capital Territory) which was held in 1834. The other Censuses we use are Tasmania (1842), South Australia (1844), Western Australia (1848), Victoria (1854), and Queensland (1861). Only the Census reports are consistently available across the relevant period, as some of the individual records were destroyed in a fire in 1882.

For all historical variables, the unit of observation is the county or police district (as applicable). Data on economic occupations comes from the Census in which it is first available (see Table A13 in the Online Appendix of Grosjean and Khattar (2018)). For a full list of maps and a description of historical data sources used in the construction of the historical variables, we refer the reader to Section 3 in that appendix.

Variable	Description
Historical Sex Ratio	Number of men to the number of women
Convict Sex Ratio	Number of convict men to the number of convict women
Prop. agriculture	Proportion of population employed in agriculture
Prop. domestic services	Proportion of population employed in domestic services
Prop. mining and manufacturing	Proportion of population employed in mining and manufacturing
Prop. government and learned professions	Proportion of population employed in government and learned professions, including teaching

1.2 Referendum on same-sex marriage

The Australian Marriage Law Postal Survey was conducted by the Australian Bureau of Statistics (ABS) as a postal vote between 12 September and 7 November 2017. Turnout was 79.5 per-

cent. The results of the referendum were released at the Federal Electoral Division level (150 Federal Electoral Divisions) by the ABS on 15 November 2017 (abs.gov.au/ausstats/abs@.nsf/mf/1800.0) and accessed by the researchers on 15 November 2017 at 7PM.

Variable	Description
% voted 'Yes'	Percentage of total eligible registered voters who voted 'Yes' to the question posed in the Marriage Law Postal Survey: " <i>Should the law be changed to allow same-sex couples to marry?</i> "
% abstention	Percentage of total eligible registered voters who did not send back their reply in the Marriage Law Postal Survey

1.3 Census

We use the following postcode-level controls from the 2016 Australian Census.

Variable	Description
Contemporary sex ratio	Number of men to the number of women
Contemporary population	Total population
Urban	Dummy variable equal to one if a postal area is classified as urban by the Australian Bureau of Statistics
Unemployment rate	Percentage of people not working more than one hour in the reference week; actively looking for work in previous four weeks; and being available to start work in the reference week.
Religious shares	% of the population self-declaring as: <ul style="list-style-type: none"> - Buddhist - Anglican - Catholic - Other Christian - Islam - No religion
% under 30 years old	Percentage of the population under 30 years of age
% completed high school	Percentage of people who completed year 12 education (graduated from high school)
% parents born in Australia	Percentage of the population with both parents born in Australia

1.4 Violence and crime data

We obtain crime data at the postcode level for each state. Australian states are separate criminal jurisdictions and crime classification and reporting therefore varies. For New South Wales, South Australia and Victoria crime data is publicly available through dedicated statistical agencies (the NSW Bureau of Crime Statistics and Research, the South Australian Office of Crime Statistics and Research, and the Crime Statistics Agency of Victoria). For New South Wales, we were also able to obtain further data on offenders and victims of assault and homicide (excluding driving causing death) by gender, age, postcode of residence of offenders, and postcode where the offense took place. Publicly available crime data from Queensland was obtained from the Queensland Police Service while data was obtained from the Tasmanian department of police after filing a special request. Lastly, in both Western Australia and the Australian Capital Territory additional procedures and filing of a Freedom of Information act are necessary. We are in the process of obtaining data for both these states. Many states (see the table below) do not provide information on domestic violence because of confidentiality issues.

Violence and crime data available in Australia

State	Type of crime reported	Reporting years
NSW	- Homicide - Assaults (broken down by assault against police, domestic violence, non-domestic violence) - Sexual offenses - Robbery - Theft - Drug offenses - Disorderly conduct (with several subcategories) - Other offences	1995–2016
TAS	- Homicide - Assaults - Sexual assault - Offences against property	1999–2016
VIC	- Homicide - Assaults - Sexual offenses - Robbery	2005–2016
SA	- Homicide - Assaults - Disorderly conduct - Robbery - Theft - Other offenses	2012–2016
QLD	- Homicide - Assaults - Sexual offenses - Robbery - Disorderly conduct - Other offences	1998–2016

We only retain data between 2006 and 2016. We merge these crime data with early counts of population from the 2006, 2011, 2016 Censuses. We interpolate in between Census years to compute rates of assaults per 100,000 people. Below is a description of the variables used in the paper and information related to the available data:

Violence and crime variables used in the paper

Variable	Description
Assault	Natural logarithm of the mean of the number of all assaults per 100,000 people between 2006 and 2016 (+1)
Non-domestic assault	Natural logarithm of the mean of the number of all non-domestic assaults per 100,000 people between 2006 and 2016 (+1)
Domestic assault	Natural logarithm of the mean of the number of all domestic assaults per 100,000 people between 2006 and 2016 (+1)
Sexual offenses	Natural logarithm of the mean of the number of all domestic assaults per 100,000 people between 2006 and 2016 (+1)
Property crime	Natural logarithm of the mean of the number of all robbery and theft/offences against property per 100,000 people between 2006 and 2016 (+1)
Homicide	Natural logarithm of the mean of the number of homicide per 100,000 people between 2006 and 2016 (+1)

1.5 Minerals and land formation

We take data on minerals and land formation from Geoscience Australia

(<https://ecat.ga.gov.au/geonetwork/srv/eng/catalog.search;jsessionid=AA779B91F9E5623DAD7B242B094803CD#/search?resultType=details&from=1&to=20&sortBy=changeDate>). We downloaded topology and mineral deposits maps and aggregated this information at the post-code level.

Variable	Description
Landform	Main classification of the postcode in different categories: <ul style="list-style-type: none">- Plains, plateaus, sand plains- Hills and ridges- Low plateaus and low hills- Mountains
Minerals	Main classification of the postcode in different categories: <ul style="list-style-type: none">- Minor coal- Minor others- Major coal- Major copper- Major gold- Major mineral sands- Major oil and gas- Major other- No minerals or traces
