DISCUSSION PAPER SERIES

DP14493

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DEVELOPMENT ECONOMICS

ECONOMIC HISTORY

LABOUR ECONOMICS

ISSN 0265-8003

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Discussion Paper DP14493
Published 15 March 2020
Submitted 11 March 2020

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www.cepr.org

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JEL Classification: I31, J12, J16, N37, Z13

Keywords: Masculinity, identity, Sex ratio, Natural Experiment, Cultural persistence

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Acknowledgements
We thank Christopher Burnitt, Jane Carroll, Eugene Kwok, Peter Robertson, Victoria Robinson, Alexander Stepanov, and Donnamarie Vanderhost for excellent research assistance and Cevat Giray Aksoy, Marianne Bertrand, Christopher Carpenter, Simon Chang, Ernst Fehr, Andy Ferrara, Guido Friebel, Sergei Guriev, Seema Jayachandran, Nidhiya Menon, Daniel Oto-Peralias, Andrew Postlewaite, Joachim Voth, and seminar participants at the ASSA 2020 Annual Meeting (San Diego), University of Alicante, the AusClio and LEW workshops at the University of Adelaide, Harvard University, University of Auckland, Boston University, the Conference on Cultural Transmission and the Economics of Cultural Change (Paris School of Economics), University of Gothenburg, Reserve Bank of Australia, Monash University, Pablo de Olavide University, Tinbergen Institute, Deakin Workshop on Natural Experiments in History, and the Australasian Public Choice and AASLE conferences for useful comments. Stephanie Ramey and Don Weatherbun from the NSW Bureau of Crime Statistics and Research and Ben Young from the Tasmanian Department of Police, Fire, and Emergency Services kindly shared data with us. The authors gratefully acknowledge financial support from Australian Research Council DP Grant 160100459 awarded to Rob Brooks and Pauline Grosjean and from Australian Research Council Future Fellowship FT190100298 awarded to Pauline Grosjean. The findings and views reported in

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Victoria Baranov[*] Ralph De Haas[†] Pauline Grosjean[‡]

March 11, 2020

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We thank Christopher Burnitt, Jane Carroll, Eugene Kwok, Peter Robertson, Victoria Robinson, Alexander Stepanov, and Donnamarie Vanderhost for excellent research assistance and Cevat Giray Aksoy, Marianne Bertrand, Christopher Carpenter, Simon Chang, Ernst Fehr, Andy Ferrara, Guido Friebel, Sergei Guriev, Seema Jayachandran, Nidhiya Menon, Daniel Oto-Peraliás, Andrew Postlewaite, Joachim Voth, and seminar participants at the ASSA 2020 Annual Meeting (San Diego), University of Alicante, the AusClio and LEW workshops at the University of Adelaide, Harvard University, University of Auckland, Boston University, the Conference on Cultural Transmission and the Economics of Cultural Change (Paris School of Economics), University of Gothenburg, Reserve Bank of Australia, Monash University, Pablo de Olavide University (Seville), King's College London, Tinbergen Institute (Amsterdam), Deakin Workshop on Natural Experiments in History, and the Australasian Public Choice and AASLE conferences for useful comments. Stephanie Ramey and Don Weatherbun from the NSW Bureau of Crime Statistics and Research and Ben Young from the Tasmanian Department of Police, Fire, and Emergency Services kindly shared data with us. The authors gratefully acknowledge financial support from Australian Research Council DP Grant 160100459 awarded to Rob Brooks and Pauline Grosjean and from Australian Research Council Future Fellowship FT190100298 awarded to Pauline Grosjean. The findings and views reported in this paper are the authors' and should not be attributed to the institutions they are affiliated with. All errors and omissions are ours alone.

1 Introduction

What makes a 'real' man? Traditional gender norms posit that men ought to be self-reliant, assertive, competitive, violent when needed, and in control of their emotions (Mahalik et al., 2003). Three current debates illustrate how such 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 (Case and Paxson, 2005; IHME, 2010; Baker et al., 2014). 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) and choose instead to remain unemployed or leave the labor force (Katz, 2014). Third, masculinity norms have become integral to debates about the socio-economic enfranchisement of women and sexual minorities in Western society. These cultural changes can threaten the identity of men who adhere to conservative masculinity norms, provoking a backlash against women and minorities (Kimmel, 2013; Horvilleur, 2019; Inglehart and Norris, 2019).

The extent to which men are expected to conform to masculinity norms differs across societies and cultures (Traister, 2000). This raises the question: Where do masculinity norms come from? The origins of gender norms that guide and constrain the behavior of *women* have been the focus of an important recent literature (Fernández, Fogli and Olivetti, 2004; Alesina, Giuliano and Nunn, 2013; Carranza, 2014; Giuliano, 2018; Grosjean and Khattar, 2019). By contrast, the origins of norms that guide and constrain the behavior of men have received no attention in the economics literature to date. In this paper, we show how masculinity norms can be shaped by historical circumstances that skewed sex ratios, creating a shortage of women and heightening competition among men.

To establish 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 setting. Between 1787 and 1868, Britain transported 132,308 convict men but only 24,960 convict women to Australia. Convicts were not confined to prisons but allocated across 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 Australian colonial censuses compiled by Grosjean and Khattar (2019) [henceforth GK], with proxies for present-day masculinity norms, such as violent behavior, crime, bullying, and stereotypically male occupational choice. Moreover, we capture the political expression of masculine identity by opposition against same-sex marriage, which we measure using voting records from a unique nation-wide referendum on same-sex marriage in 2017.

Our results paint a consistent picture of how skewed sex ratios instilled masculinity norms that deeply influence the social and economic landscape to this day. 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 partly preventable male mortality (such as prostate cancer), as well as greater segregation of men into stereotypically male occupations. For example, a one unit increase in the historical sex ratio (that is, one more man for every woman) is associated with an 11 percent increase in incidents of assault, a 16 percent increase in sexual assaults, a 26 percent increase in male suicide rates, and a 4 percent increase in rates of prostate cancer. 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.[1] Finally, we find that in areas that were heavily male-biased, fewer Australians support same-sex marriage today, and boys are more likely to fall victim to bullying in school. A one unit increase in the historical sex ratio is associated with a 3 percentage point decrease in the probability of voting "Yes" to same-sex marriage and a 5 to 14 percentage point increase in the bullying of boys. We interpret this last result as evidence of peer socialization and the transmission of masculinity norms, which explains the persistent effects of historical sex ratios.

We interpret these strong local impacts of historical sex ratios on present-day outcomes as manifestations of traditional masculinity norms. We back up this interpretation by bringing additional survey data to bear that reveal a tight relationship between measurements of Australian men's conformity to masculinity norms and outcomes such as suicide attempts; violent behavior; smoking; and health care avoidance. Moreover, we show that other forms of male mortality that are not symptomatic of help avoidance behavior, such as diabetes or cardiovascular disease, are unrelated to the historical sex ratios, as are causes of female mortality. We also see no variation in the rates of non-violent crime, in political opinions unrelated to the status of sexual minorities, or in the rates of bullying of girls.

The main empirical challenge in estimating the impact of male-biased sex ratios on masculinity norms is that variation in historical sex ratios could reflect unobservable characteristics arising from selection. Male and female migrants to Australia might have sorted across geographic areas based on unobservable characteristics related to our outcomes of interest. For example, fewer female migrants may have chosen to settle where men were more violent. To tackle this, we instrument the historical population sex ratio by the sex 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. 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.

Throughout, our estimates include state fixed effects to account for the influence of time-invariant state characteristics such as legislation. 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

[1] Our level of analysis is the smallest administrative unit (SA1), with an average of 400 inhabitants (that is, larger than a US Census block but smaller than block group), or the postcode.

sex ratios and may still influence outcomes of interest. Our results also hold in a wide range of robustness tests—such as including additional contemporaneous controls like the present-day sex ratio, urbanization, share of various religious groups, and unemployment. Finally, Moran statistics show that our findings do not merely reflect spatial autocorrelation of the error terms.

A related concern 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, and risk taking 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 (Carranza, 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 focus of the existing economic literature on the effects of sex ratios is on male-female bargaining. 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 a different, and novel, mechanism: how a scarcity of women determines how men interact and compete with *each other* and thus shape behavioral norms for men.[4] We show how such entrenched masculinity norms continue to manifest themselves in various ways, such as men avoiding stereotypically female occupations, engaging in violence, and opposing the enfranchisement of sexual minorities. Hence, we provide a novel mechanism, the role of masculinity norms, that perpetuates the relationship between skewed sex ratios and various societal outcomes that have been studied in the literature, including 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

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

[3]Our 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 characterized by strong hysteresis (Bisin and Verdier, 2001; Doepke and Zilibotti, 2008; Fernández, 2013).

[4]Our 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.

Fidell, 1989).[5] This mechanism also speaks to contemporary depictions of increased violence and suicide in male-biased areas of modern India (Chowdhry, 2005).

Our results also contribute to an emerging literature on the economic role of norms and identity (Akerlof and Kranton, 2000, 2010; Bénabou and Tirole, 2011; Gennaioli and Tabellini, 2019) as well as stereotypes (Bordalo et al., 2016). Several studies highlight the role of perceived threats to one's honor or reputation (Nisbett and Cohen, 1996; Cohen et al., 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 oneself (suicide). Relatedly, conforming to traditional masculinity norms has been hypothesized to be an important cause of stubborn male unemployment despite the availability of (steoreotypically female) service jobs (Akerlof and Kranton, 2010; Katz, 2014). We provide the first empirical evidence to show that masculinity norms can indeed manifest themselves in the labor market through male-stereotypical occupational segregation.

Lastly, we contribute to the literature on the determinants of support for the enfranchisement of minorities, such as same-sex relationship recognition. Most studies concentrate 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 Capitanio, 1996); and age and religion (Inglehart, 1990; Edwards, 2007).[6] 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 attitudes towards same-sex relationships, especially in states more exposed to the AIDS epidemic. Our contribution is to uncover historical roots of attitudes towards homosexuality and to suggest a mechanism through which such attitudes can become entrenched.[7] A unique feature of our study is that the Australian referendum provides 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 surveys that have so far been used to elicit attitudes towards sexual minorities.

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 mechanisms and Section 8 concludes.

[5] Although most papers find a positive association between male-biased sex ratios and crime and violence, some document a negative relationship (Schacht, Tharp and Smith, 2016). A possible reason for these 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), another 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.

[6] At 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 cross-country differences.

[7] Related 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, our setting, based on the quasi-random allocation of British convicts, rules out self-selective migration on the basis of sexual preferences.

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 masculinity norms and related outcomes (Section 2.2) and the mechanisms though 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). When the sex ratio is more male biased, male-male competition for scarce females will be more intense and have 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, or at least more overtly. The main reason suggested to explain this difference 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.[8] 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).[9]

Unlike the focus of evolutionary biology on intrasexual competition, economists have focused exclusively on the effect of sex ratios on bargaining between men and women (*inter*sexual competition). This research has uncovered how male-biased sex ratios increase female bargaining power and consequently shift resources and family structures in a way that benefits women. 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). 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).[10]

[8] Although 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).

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

[10] Parental 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).

2.2 Sex ratios, masculinity norms, and present-day outcomes

Masculinity norms are the culturally accepted rules and standards that guide and constrain men's behavior within society. To measure the extent to which men adhere to such norms, Mahalik et al. (2003) developed the Conformity to Masculinity Norms Inventory (CMNI). The CMNI is a multi-dimensional scale that measures to what extent an individual man's actions, thoughts, and feelings conform to the dominant masculinity norms in Western societies. The CMNI captures 11 distinct masculinity norms: winning; emotional control; risk-taking; violence; dominance; playboy; self-reliance; primacy of work; power over women; disdain for homosexuals; and pursuit of status.

We hypothesize that skewed sex ratios can reinforce masculinity norms which, once ingrained in local culture, continue to manifest themselves in present-day outcomes.[11] The underlying mechanism relies on the intensification of male-male competition and the related strife for dominance. Dominance grants higher status and control over a larger share of resources which in turn makes dominant males more attractive to (scarce) women.[12] Based on the CMNI framework, we expect that areas that were historically characterized by high sex ratios and, therefore, intense male-male competition, developed stricter masculinity norms that continue to manifest themselves across four broad domains: (i) violence and bullying; (ii) risk taking, help avoidance and unhealthy behavior; (iii) occupational gender segregation; and (iv) negative attitudes towards homosexuals.

First, in line with an effect of skewed sex ratios on violence and aggression, studies have highlighted that unmarried men—those exposed to intense competition for access to females—are more likely to commit crimes, including rape, murder, and assault (Sampson, Laub and Wimer, 2006; Henrich, Boyd and Richerson, 2012). Accordingly, we examine outcomes such as violent assault, sexual offenses, as well as bullying in schools.[13] Bullying in schools should also be understood as capturing the socialization process through which masculinity norms are imposed and transmitted to younger generations. Peers at school are a major influence on the development of gender normative behavior in childhood and adolescence (Adler, Kless and Adler, 1992; Leaper and Farkas, 2014).

Second, intense male-male competition is expected to favor self-reliance and help avoidance, which may lead to increased morbidity and earlier death. Earlier work has shown that men adhering to traditional masculinity norms attach a stronger stigma to mental health problems, are more likely to avoid health services (Good, Dell and Mintz, 1989; Latalova, Kamaradova and Prasko, 2014) and are more likely to think about suicide (Pirkis et al., 2017). As a proxy for the avoidance of preventative health care we use local suicide and prostate cancer rates. Prostate cancer is often curable if treated early, but avoidance of diagnosis and treatment

[11] In Section 7.4, we present detailed CMNI-based survey data from Australia and show that the extent to which individual men adhere to traditional masculinity norms is indeed highly predictive of real-world outcomes related to violence, risk taking, unhealthy behavior, suicide and help avoidance.

[12] See Mulder (1987); Buss (2016), Hill (1984) and von Rueden and Jaeggi (2016) for cross-cultural evidence.

[13] It 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.

is a major public health concern. A large medical literature has established a clear relationship between adherence to a masculine identity and the avoidance of prostate cancer screening.[14] We also focus on the impact of smoking (as proxied by the incidence of lung disease). A previous literature has documented that endorsement of strict masculinity norms is associated with poor health behaviors in the form of excessive smoking and drinking (Mahalik, Burns and Syzdek, 2007).

A third manifestation of male identity for which we test, 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). Milner et al. (2018) show for Australia that men in male-dominated jobs report greater adherence to masculine norms.

Fourth, the effect of higher historical sex ratios (and male-male competition) on attitudes towards homosexuality is a priori ambiguous. Male homosexuality should, at first sight, be welcomed, as it reduces the number of male competitors for scarce women. However, as explained above, the primary effect of a male-biased sex ratio is to intensify male-male competition. In their strife for dominance, men will aim to (often publicly) subdue other men, in particular those who do not display strong markers of masculinity, thereby encouraging bullying and anti-gay aggression (Franklin, 2000; Parrott and Zeichner, 2008; Vincent, Parrott and Peterson, 2011). Men display sexual prejudice both to establish and reaffirm their own masculinity and to punish other men who fail to meet gender role requirements (Herek and McLemore, 2013). Indeed, the dread of being perceived as gay and the primacy of being thought to be heterosexual are among the strongest components of the CMNI scale, and correlate positively and significantly with other dimensions of masculinity, such as dominance, risk-taking, an inclination for violence, and negatively with emotional openness and help-seeking behavior. We will proxy this masculinity norm by opposition against same-sex marriage, which we measure using voting records from the 2017 nation-wide referendum on same-sex marriage.[15]

To sum up, we expect that historically male-biased sex ratios led to heightened norms of masculinity as expressed in violent behavior and bullying; help avoidance and unhealthy behavior; occupational gender segregation; and less support for the enfranchisement of sexual minorities. How can one explain that these effects persist in the long run?

[14] Many men who conform to traditional masculinity norms are put off by the prospect of an invasive screening procedure, also because of the perceived homosexual associations of a digital rectal examination. Moreover, these men often fear that a diagnosis of prostate cancer and a possible prostatectomy may cause sexual dysfunction and impotence and hence threaten their manhood. See James et al. (2017) and the references therein.

[15] A second but related 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 abundance of men) hostility against homosexuals is thus more likely to become the dominant 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 (Guttentag and Secord, 1983).

2.3 Persistence mechanisms

Earlier work on cultural norms suggests two persistence channels. First, short-run outcomes of male-male competition, such as increased conformity to masculinity norms, can persist in the long-run through cultural vertical transmission within families and horizontal peer-to-peer socialization (Bisin and Verdier, 2001). Several studies describe the persistence of female gender roles since pre-industrial times until today (Alesina, Giuliano and Nunn, 2013; Hansen, Jensen and Skovsgaard, 2015) as well as the persistent effects of male-biased sex ratios on male-female bargaining and female labor force participation (GK). The mechanisms underlying the persistence of *male* gender roles are likely similar; and we provide direct evidence on peer-to-peer transmission through bullying in schools. The importance of horizontal peer transmission of masculinity norms resonates 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.

Second, cultural traits may also continue to provide direct benefits that further add to their persistence (Grosjean, 2014). In our setting, adhering to stricter masculinity norms may remain beneficial to achieve higher status and can therefore confer benefits on the marriage market. Displaying stereotypical masculine behavior can still give an edge by maintaining a strict male hierarchy that legitimizes dominant men's position in society (Connell et al., 1982; Mahalik et al., 2003). In addition, 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. Adhering to such norms can then 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 and Tasmania showed that the average convict sex ratio stood at more than 28 men for every woman (Table 1). These convicts, who constituted the founder (white) population of Australia, 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 were readily executed in England).[16]

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

[16] In 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 'steeling 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.

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.[17] However, given the absence of imbalance at birth, as documented by demographers of historical Australia (Opeskin and Kippen, 2012), local population sex ratios provide unbiased, if noisy, proxies of local ASRs.[18]

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 New South Wales in 1833. Voluntary migration was very limited and mainly involved men migrating 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 the largest share. Although the population of Australia at the time was only about 255,000 people, more than 60 percent of the current population of Australia lives in areas covered by these historical data. We use the 1836 New South Wales Census[19] (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.[20] 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.[21] There are a total of 90 counties, 34 of

[17] Several individual Census records were destroyed in a fire in 1882.

[18] None 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.

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

[20] The dates of the Censuses vary because states were independent colonies until 1901.

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

which harbored convicts. The average county had 4,530 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 displays descriptive statistics and shows how 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 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 detail). First, we obtain crime statistics at the postcode level from the police or statistical agencies.[22] As described in the online Appendix, crime reporting varies across states. Certain categories of crime, such as assault, homicide, robberies and burglaries are reported in a consistent 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. Data is from the Mortality over Regions and Time 2011-2015 data set (Australian Institute of Health and Welfare). The dataset 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 smoking. Our proxies for help avoidance behavior are mortality from prostate cancer and suicide.

Third, we use data from the 2011 and 2016 Census on the share of men and women across all 4-digit occupations. We first classify occupations into three groups: feminine, masculine, or neutral. To ensure that we pick up occupations that are known to be "stereotypically male/female", we classify the most common occupations at the 4-digit level (occupations with

[22] We 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.

total employment shares greater than 0.5 percent, approximately 55 of a total of 469 occupations, with 55 percent of the workforce represented in these occupations). These common occupations are then considered feminine, neutral, or masculine if their national male share in the occupation is less than 33 percent (feminine), between 33-66 percent (neutral), or over 66 percent (masculine). 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) or 'Retail managers' (50.5 percent male).

Fourth, to measure the extent to which historical sex ratios have shaped attitudes towards homosexuals, 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. 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?"*. Data is available at the level of 150 electoral districts. The results showed that 61.6 percent 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 at the heart of such norms (Mahalik et al., 2003). 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 can plague surveys. As a cross-validation of this measure, we also use a nationally representative survey, HILDA, which identifies respondents through their residential postcode. Of interest is the question on attitudes towards the 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 (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 we focus on responses by parents and teachers.

4.3 Data matching

To match present-day to historical 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 possible 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. Panel B of Table 1 provides descriptive statistics. We present the balance of covariates across areas below or above the median historical sex ratio 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:

$$y_{ijcs} = \alpha_1 + \beta_1 SexRatio_{cs} + X^G_{jcs}\Gamma_1 + X^H_{cs}\Pi_1 + T^C_{jcs}\Lambda_1 + X^C_{ijcs}\Theta_1 + \delta_s + \varepsilon_{ijcs} \tag{5.1}$$

Where y_{ijcs} are outcomes for individual i in modern statistical area j (SA1 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 state s. δ_s is a vector of state dummies. Outcomes are either measured at the individual level, SA1 level, or postcode depending on the available data. Since historical data at the level of the 90 historical counties is less granular than present-day data at the SA1 or individual level, all standard errors are clustered at the historical county level. 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 accounts for the limited 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) and we present in the Appendix Moran statistics that mitigate concerns that our results merely reflect spatial noise.

X^G_{jcs} and X^H_{cs} are vectors of time-invariant geographic and historic characteristics that may correlate 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. To flexibly account for geographic differences across post-

codes 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 mineral deposits and land characteristics. 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. 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 urbanization at the SA1 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 using individual survey data, individual controls are gender, age, and whether the respondent was born in Australia.

To identify a causal effect of the historical sex ratio in Equation 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 this decision 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 outcomes of interest. To avoid such potential confounds, our preferred specification relies on 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 (Appendix Table A1 shows the first stage). 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 only a weak correlate of the historical sex ratio (Table A1), and the first stage point estimate of the convict sex ratio is unaffected by whether we control for the number of convicts or not. 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 after the historical period we consider, mostly after the 1850s, and thus should not affect our results.[23]

Nevertheless, throughout all IV specifications we control for the 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 the number of convicts and the sex ratio among convicts was not mean preserving, that is: 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.[24]

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

[24] We 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 0.99.

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 on the 2017 same-sex marriage referendum. Lastly, we investigate whether masculinity norms manifest through, and are potentially sustained by, bullying in schools.

6.1 Violence, suicide, and health

We investigate the long-term consequences of male-biased sex ratios on violence in Table 2. Crime data are reported at the postcode level, which we project to the SA1 level. 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 assault[25] and a 16 percent increase in sexual assaults.

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 local government area (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. 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. First, Table 7 shows 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 A2 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

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

effect is borderline statistically significant. Instead, we argue that male-biased 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 postcode-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). In addition to our usual controls, in each case we also control for total employment in very masculine/feminine occupations in the postcode. 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 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 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. We now turn to a direct measure of masculinity 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 Equation 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 and 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

[26] The 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.

from the HILDA survey, in which 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. The first stage of the IV is strong, with an F-statistic above 15 (see also Table A1). In the 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, and the present-day sex ratio.[27] The third column of Table 5 confirms these results, in direction and magnitude, with the individual-level survey data.

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. The increase in rates reported by teachers is 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) weaker individuals and especially (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

[27] We obtain this figure by comparing the R-squared of the OLS specification with the full set of extended controls described in Section 6.6 (0.614) to the R-squared of the same specification without historical controls (0.563).

[28] LGBTQ 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).

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 A3 and A4, we subject our main results to a battery of robustness tests. In Table A3, 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 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 A3 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 A3. These statistics suggest that correlation in spatial noise is limited and unlikely to drive our results. We also conduct permutation inference, which accounts for the small number of clusters as well as other issues with Two Stage Least Squares estimation such as weak identification and short-tailed responses (Imbens and Rosenbaum, 2005). These randomization inference p-values are reported in Table A3 and indicate that our results, which are generally significant at the 10 percent level, are not driven by inappropriate asymptotic assumptions.

Next, we assess in Appendix Table A4 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 trim the data by removing the two historical counties with the most and the least skewed historical sex ratio. All our results continue to hold.

7 Mechanisms

We now explore a number of mechanisms that may drive the long-term relationship between male-biased sex ratios and our main outcomes: violence; suicide and help avoidance; occupational gender segregation; and opposition to sexual minorities' rights. First, we rule out that

broad conservatism or institutional differences across Australia explain our results. Second, we show that our findings do not reflect the long-term effects of convictism per se. Lastly, we present direct evidence in support of our interpretation of the links between historical sex ratios and present-day outcomes as manifestations of masculinity norms.

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. Table 7 shows that this is not the case: broad political attitudes, which go beyond the single issue of rights for homosexuals, are unaffected. In particular, 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 parties[29] in the general election in the year immediately preceding the same-sex marriage referendum. Hence, general conservatism cannot explain our results on crime, violence, and risk-taking.[30]

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 Australian Capital Territory 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.[31] Authorities were so concerned about *"blasphemy, rage, mutual hatred, and the unrestrained*

[29] Australia 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 7 is the share of votes for the Liberal-National Coalition in the 2016 general election.

[30] 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).

[31] See https://theconversation.com/stain-or-badge-of-honour-convict-heritage-inspires-mixed-feelings-41097.

indulgence of unnatural lust" among convicts that it became one of the main arguments of transportation abolitionists.[32] This in turn has led some to go as far as stating that: *"prejudice toward LGBTI people [in Australia] can be summed up in one word: convictism"*.[33]

We control in all specifications for the 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. These results highlight that the convict legacy must be distinguished from that of the radical distortion in sex ratios that convict transportation imposed. 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).

We now turn to additional data in support of masculinity norms being the mechanism that links historical sex ratios to present-day economic, social, and health outcomes.

7.4 Masculinity norms and outcomes: Evidence from *Ten to Men*

This section provides direct evidence on the relationship between masculinity norms and a range of attitudes and behavioral patterns among Australian men. We use data from the Australian Longitudinal Study on Male Health (*Ten to Men*), a study of 16,000 boys and men aged 10 to 55 years at baseline.[34] The study collects comprehensive data on demographic and socioeconomic characteristics; physical and mental well-being; and health behaviors including the use of health services.

Importantly, the second wave of this survey allows us to construct for each respondent a score on the Conformity to Masculinity Norms Inventory (CMNI-22) and thus gauge the extent to which he adheres to a traditional masculine identity.[35] As discussed in Section 2.2, the CMNI is a multi-dimensional scale that measures to what extent an individual man's actions, thoughts, and feelings conform to traditional masculinity norms in Western societies, such as emotional control; risk-taking; violence; dominance; self-reliance; and disdain for homosexuals. To create the CMNI score, *Ten to Men* asks respondents "*Thinking about your own actions, feelings and beliefs, how much do you personally agree or disagree with each statement*", followed by statements capturing the dimensions in the CMNI-22. Answers range on a four-point Likert scale from 0 (*strongly disagree*) to 3 (*strongly agree*).

Appendix Table A5 presents correlations between the CMNI-22 score and its primary components of interest. We restrict our sample to adult self-declared heterosexuals (N=13,317). The

[32] *"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 nationalist"* (Hughes, 2003, p. 272)

[33] See www.theguardian.com/commentisfree/2017/sep/30/australias-homophobia-is-deeply-rooted-in-its-colonial-past.

[34] The survey is oversampled in rural and remote areas. Sampling and other survey methods are described in more detail in Bandara et al. (2019). While the *Ten to Men* survey contains geographic identifiers, so that respondents can be linked to SA1 areas, the survey only overlaps with 11 out of the 34 historical counties with convicts. For this reason, we cannot analyze directly the impact of historical sex ratios on the CMNI-22 using the empirical framework we have used so far.

[35] The CMNI-22 is a shorter version of the original 94-item CMNI as developed by Mahalik et al. (2003) and uses the two highest loading items for each of the 11 factors from the original study.

table shows tight correlations, all with the expected sign, between the various expressions of a traditional masculinity identity. We find that the strongest correlates of the overall CMNI-22 consist of norms related to dominance ("*I make sure people do as I say*" and "*I love it when men are in charge of women*); disdain for homosexuals ("*It is important to me that people think I am heterosexual*" and "*It would be awful if someone thought I was gay*"); violence ("*Sometimes violent action is necessary*"); and winning ("*Winning is the most important thing*").

Unfortunately, the survey's geographic coverage is too limited to enable us to relate norms directly to the historical sex ratio. Nevertheless, we can use this survey to relate masculinity norms to the outcomes that we study in this paper. Appendix Table A6 shows how well the overall CMNI-22 score predicts a number of real-life outcomes measured in *Ten to Men*. These correspond closely to the outcomes we have considered in this paper (and measured using various other data sources). In column 2, each cell is the coefficient associated with the standardized CMNI-22 score in an OLS regression controlling for respondent age (mean = 34.9), Aboriginal or Torres Strait Islander indicator (mean=0.03), marital status (6 categories), language spoken at home (9 categories), as well as state fixed effects. Column 3 shows the coefficient on the CMNI-22 score after also adjusting flexibly for household income, respondent education level, and a socio-economic index based on place of residence. The results confirm that men who adhere to strict masculinity norms systematically self-report types of behavior that align closely with our earlier outcomes. In particular, in line with our results in Table 2 on violent assault and sexual offenses, we find that men who score higher on the CMNI-22 scale are significantly more likely to admit they had engaged in intimate partner violence. In line with Table 3, we find that these men are also more likely to have thought about, planned, or attempted to commit suicide and are more likely to display signs of depression (as measured with the standard PHQ-9 Depression Score). They also engage in more risky health behavior, including smoking cigarettes, heavy drinking (*"Injured while drinking"*), and taking hard drugs. In line with medical help avoidance (and our prostate cancer results in Table 3), they are also significantly less likely to have consulted a GP in the past 12 months.

In all, we conclude that the most likely explanation for our main 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.

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 treatable 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. Ancillary evidence from the Australian *Ten to Men* survey lends further support for a tight relationship between individuals' adherence to masculinity norms

and the economic, social, and health outcomes we consider in our main analysis. Taken together, these 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 socialization and male peer pressure at an early age (in the form of bullying behavior) contribute to the persistence of such behavioral norms.

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 socioeconomic 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.

Our findings 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 who 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).

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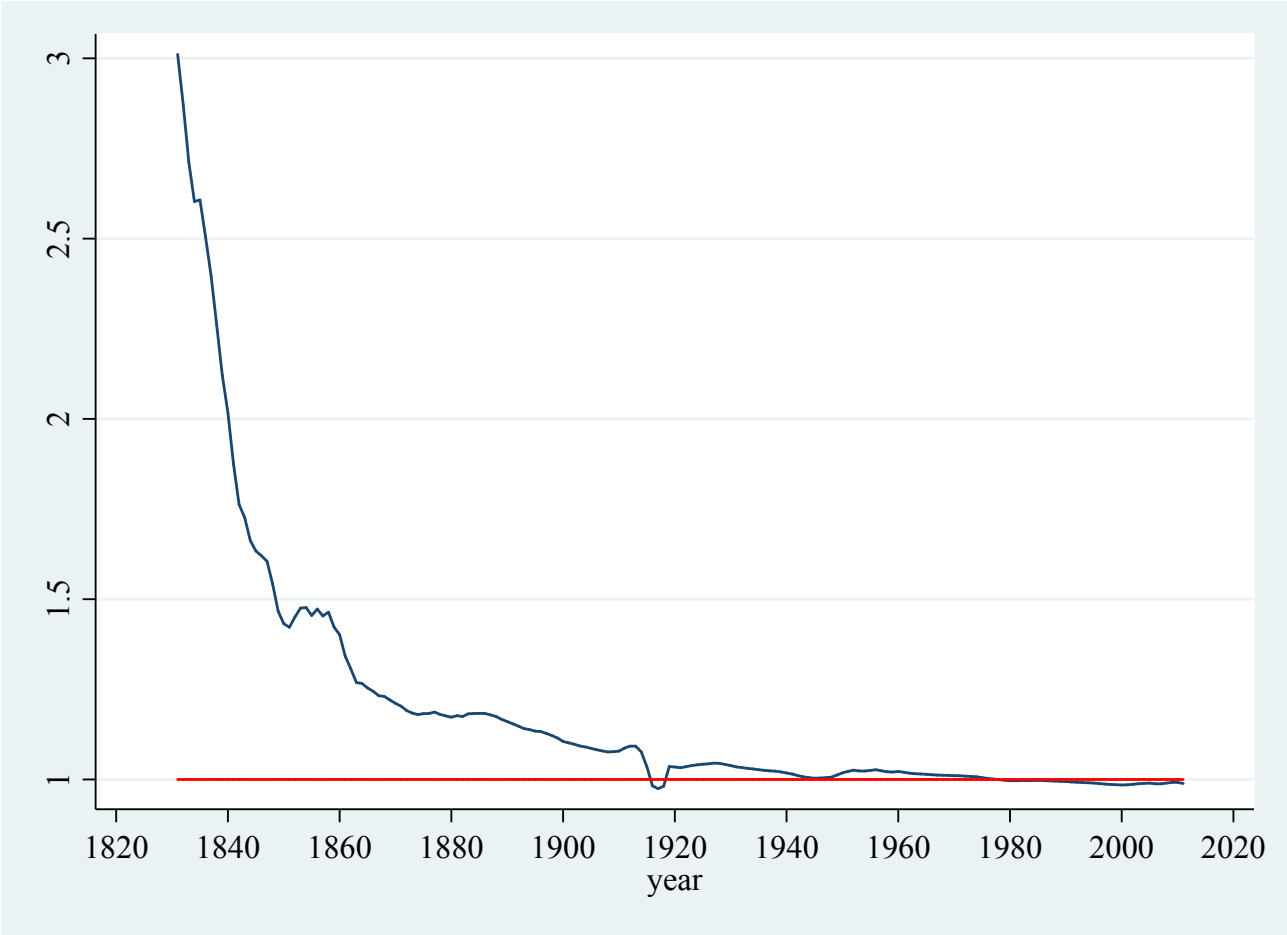
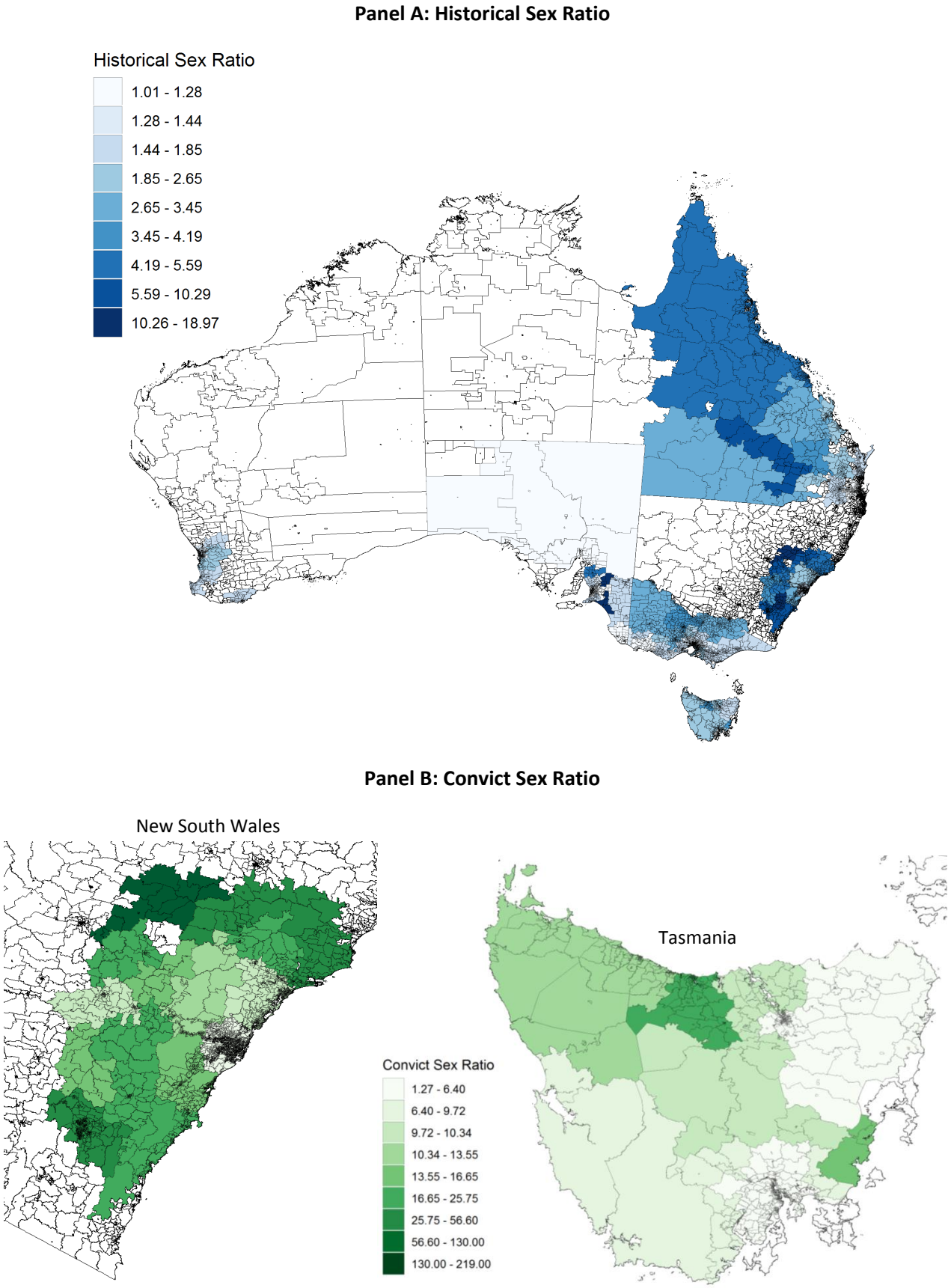
Figures and tables

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)	*p*-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
Percent under 30 years old	0.36	0.0	−0.16	0.14	46,634
Percent foreign born	0.12	0.1	−0.23	0.03**	46,634
Unemployment rate	0.06	0.0	−0.03	0.76	46,583
Percent 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 (deaths/100K males)	184.55	63.4	0.11	0.32	342
Lung disease (deaths/100K males)	268.61	66.4	0.09	0.39	342
Suicide (deaths/100K males)	107.92	48.9	0.12	0.27	342
Panel E: Occupations (postcode level)					
Share of men in feminine occupations	0.08	0.0	−0.20	0.06*	1,897
Share of men in neutral occupations	0.19	0.0	−0.18	0.10*	1,897
Share of men in masculine occupations	0.73	0.1	0.19	0.07*	1,897
Panel F: 2017 Same-sex marriage referendum (electoral division level)					
Percent voted 'Yes' (of total registered)	0.47	0.1	−0.23	0.03**	141
Percent 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
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
Panel H: LSAC survey of children (individual level)					
Child experienced bullying, reported by parents	0.32	0.1	0.17	0.21	6,986
Child experienced bullying, reported by teacher	0.11	0.0	0.08	0.59	7,501

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

Notes: Column (3) contains the coefficient from a county-level regression of the variable listed in the first column on Historical Sex Ratio (SR), with both variables standardized such 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 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)
Panel A: OLS		
Historical sex ratio	0.032^{+}	–0.009
	(0.021)	(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
Panel B: IV		
Historical sex ratio	0.112**	0.163***
	(0.054)	(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

$^{+}$ $p < 0.15$, * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Notes: Standard errors clustered at the historical county level. 'Geographic controls' are at the postcode level and include the postcodes 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), which are provided by Geoscience Australia. 'Historic controls' are: the historical county population, convict population, as well as 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, the total population density of the SA1, whether it is urban, and its population. Demographic data are from averages from the 2011 and 2016 Census.

Table 3 – Historical sex ratio and male morbidity and mortality

	Suicide log(Incidents/100K) (1)	Prostate cancer log(Incidents/100K) (2)	Lung disease log(Incidents/100K) (3)	Median age of death (4)
Panel A: OLS				
Historical sex ratio	0.083**	−0.009	−0.000	−0.254^{+}
	(0.041)	(0.010)	(0.014)	(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	82.73	134.69	220.64	77.90
Number of clusters	90	90	90	90
Panel B: IV				
Historical sex ratio	0.263***	0.043***	0.064***	−0.944**
	(0.072)	(0.012)	(0.024)	(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	69.15	129.93	238.38	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

$^{+}$ $p < 0.15$, * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Notes: Standard errors clustered at the historical county level. 'Geographic controls' are at the postcode level and include the postcodes 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), which are provided by Geoscience Australia. 'Historic controls' are: the historical county population, convict population, as well as 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, the total population density of the SA1, whether it is urban, and its population. Demographic data are from averages from the 2011 and 2016 Census.

Table 4 – Historical sex ratio 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)
Panel A: OLS						
Historical sex ratio	−0.002**	−0.003	0.004*	−0.005***	0.001	0.004***
	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)	(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
Panel B: IV						
Historical sex ratio	−0.003*	−0.006***	0.009***	0.005*	−0.007***	0.002
	(0.002)	(0.002)	(0.003)	(0.003)	(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

$^{+}$ $p < 0.15$, * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Notes: Standard errors clustered at the historical county level. 'Geographic controls' are at the postcode level and include the postcodes 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), which are provided by Geoscience Australia. 'Historic controls' are: the historical county population, convict population, as well as 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, the total population density of the SA1, whether it is urban, and its population. Demographic data are from 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)
Panel A: OLS			
Historical sex ratio	−0.011***	0.003***	−0.013***
	(0.003)	(0.001)	(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
Panel B: IV			
Historical sex ratio	−0.028**	0.007*	−0.071**
	(0.013)	(0.004)	(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

$^{+}$ $p < 0.15$, * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

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 indicating corresponding to the response to the question: "Homosexual couples should have the same rights as heterosexual couples do". Positive responses are coded as 1, neutral or negative responses are coded 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 postcodes 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), which are provided by Geoscience Australia. 'Historic controls' are: the historical county population, convict population, as well as 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, the total population density of the SA1, whether it is urban, and its population. Demographic data are from 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)
Panel A: OLS				
Historical SR	0.001	0.001	–0.002	0.009^{+}
	(0.003)	(0.008)	(0.003)	(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
Panel B: IV				
Historical SR	0.052***	0.137*	–0.012	0.008
	(0.019)	(0.076)	(0.015)	(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

$^{+}$ $p < 0.15$, * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Notes: Dependent variables are all binary indicators. Standard errors clustered at the historical county level. 'Geographic controls' are at the postcode level and include the postcodes 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), which are provided by Geoscience Australia. 'Historic controls' are: the historical county population, convict population, as well as 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, the total population density of the SA1, whether it is urban, and its population. Demographic data are from averages from the 2011 and 2016 Census. Child individual-level controls include age, gender, and if born in Australia.

Table 7 – 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	0.026	0.039*	0.090	0.006
	(0.014)	(0.041)	(0.024)	(0.088)	(0.010)
Observations	16,611	16,578	15,600	15,600	15,600
R^2	0.22	0.42	0.82	0.18	0.94
Mean of dependent var	0.47	3617.64	1693.40	363.61	2927.06
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

$^{+}$ $p < 0.15$, * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Notes: Standard errors clustered at the historical county level. 'Geographic controls' are at the postcode level and include the postcodes 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), which are provided by Geoscience Australia. 'Historic controls' are: the historical county population, convict population, as well as 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, the total population density of the SA1, whether it is urban, and its population. Demographic data are from averages from the 2011 and 2016 Census.

Appendices

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

	Dependent var: Historical sex ratio				
	Crime data	Mortality data	Occupations data	SSM Data	HILDA
	(1)	(2)	(3)	(4)	(5)
Convict sex ratio	0.035***	0.034***	0.036***	0.035***	0.032***
	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)
Number of convicts (1000s)	0.802*	0.760^{+}	0.849*	0.777^{+}	0.587^{+}
	(0.461)	(0.471)	(0.477)	(0.460)	(0.392)
Observations	16,578	15,600	16,609	16,611	8,826
Number of clusters	34	34	34	34	28
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

$^{+}$ $p < 0.15$, * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Notes: Standard errors clustered at the historical county level. 'Geographic controls' are at the postcode level and include the postcodes 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), which are provided by Geoscience Australia. 'Historic controls' are: the historical county population, convict population, as well as 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, the total population density of the SA1, whether it is urban, and its population. Demographic data are from averages from the 2011 and 2016 Census.

Table A2 – Historical sex ratios and female morbidity and mortality

	Suicide in top 20	Breast and ovarian cancer	Lung disease	Other cancer	Diabetes	Cardio-vascular	Median age of death
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Panel A: OLS							
Historical sex ratio	0.015	0.005	0.024*	0.019**	−0.045	0.007^{+}	−0.269**
	(0.012)	(0.009)	(0.015)	(0.008)	(0.063)	(0.004)	(0.122)
Observations	45,609	45,609	45,609	45,609	45,609	45,609	45,538
R^2	0.37	0.46	0.32	0.66	0.13	0.94	0.35
Mean of dependent var	4.78	594.34	548.36	1163.59	389.83	3058.35	83.80
Number of clusters	90	90	90	90	90	90	89
Panel B: IV							
Historical sex ratio	0.037	0.039*	0.135*	0.010	0.182	0.012	−0.810**
	(0.033)	(0.023)	(0.073)	(0.020)	(0.180)	(0.013)	(0.343)
Observations	15,600	15,600	15,600	15,600	15,600	15,600	15,594
R^2	0.25	0.59	0.43	0.70	0.14	0.93	0.61
Mean of dependent var	4.04	541.15	522.35	1075.38	341.22	2711.50	83.76
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

$^{+}$ $p < 0.15$, * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Notes: Standard errors clustered at the historical county level. 'Geographic controls' are at the postcode level and include the postcodes 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), which are provided by Geoscience Australia. 'Historic controls' are: the historical county population, convict population, as well as 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, the total population density of the SA1, whether it is urban, and its population. Demographic data are from averages from the 2011 and 2016 Census.

Table A3 – 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		% 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**	0.077**	0.163***	0.132**	0.263***	0.221***	0.009***	0.006***	−0.028**	−0.016***
	(0.054)	(0.034)	(0.057)	(0.057)	(0.072)	(0.076)	(0.003)	(0.002)	(0.013)	(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	0.18	0.25	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 p-value	0.369	–	0.104	–	0.369	–	0.188	–	0.116	–
RI p-value	0.084	–	0.117	–	0.076	–	0.087	–	0.004	–
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

$^{+}$ $p < 0.15$, * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Notes: Standard errors clustered at the historical county level. 'Geographic controls' are at the postcode level and include the postcodes 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), which are provided by Geoscience Australia. 'Historic controls' are: the historical county population, convict population, as well as 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, the total population density of the SA1, whether it is urban, and its population. Demographic data are from averages from the 2011 and 2016 Census. 'Present-day SA1 controls' include education (share completed year 12), unemployment rate (by gender), religion shares, median age, median household income, and proportion born overseas at the SA1 level. Randomization inference is conducted by drawing 10,000 permutations of the instrument (convict sex ratios) at the county level and computing the test statistic for the IV coefficient on historical sex ratio. The randomization inference p-value is the proportion of permuted test statistics with an absolute value greater than the observed test statistic.

Table A4 – Robustness: Controlling for present-day locality covariates (IV specification)

	Assault	Sex offenses	Suicide	Share of men in masculine occupations	% voted 'Yes'
	(1)	(2)	(3)	(4)	(5)
Panel A: Controlling for distance to port					
Historical sex ratio	0.059^{+}	0.136***	0.311***	0.008**	−0.019**
	(0.037)	(0.048)	(0.093)	(0.003)	(0.008)
Observations	16,578	16,578	15,600	16,609	16,611
R^2	0.29	0.61	0.24	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**	0.172***	0.263***	0.009***	−0.028**
	(0.055)	(0.057)	(0.071)	(0.003)	(0.012)
Observations	16,578	16,578	15,600	16,609	16,611
R^2	0.26	0.60	0.18	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*	0.177**	0.286***	0.007*	−0.035**
	(0.088)	(0.072)	(0.077)	(0.004)	(0.016)
Observations	16,142	16,142	15,164	16,173	16,175
R^2	0.26	0.59	0.18	0.85	0.33
Number of clusters	32	32	32	32	32
F-statistic (1st stage)	14	14	15	15	13

$^{+}$ $p < 0.15$, * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Notes: Standard errors clustered at the historical county level. 'Geographic controls' are at the postcode level and include the postcodes 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), which are provided by Geoscience Australia. 'Historic controls' are: the historical county population, convict population, as well as 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, the total population density of the SA1, whether it is urban, and its population. Demographic data are from averages from the 2011 and 2016 Census.

Table A5 – The Conformity to Masculinity Norms Inventory (CMNI) and its main components

	CMNI	(01)	(02)	(03)	(04)	(05)	(06)	(07)	(08)	(09)	(10)	(11)	(12)	(13)	(14)
CMNI	1.00														
(01) - People do as I say	0.41*	1.00													
(02) - Awful if thought gay	0.37*	0.15*	1.00												
(03) - Men in charge of women	0.47*	0.24*	0.27*	1.00											
(04) - Talk about feelings	−0.32*	0.01	−0.07*	−0.04*	1.00										
(05) - Important thought of as heterosexual	0.39*	0.14*	0.58*	0.24*	−0.02*	1.00									
(06) - Violence never justified	−0.37*	−0.01	0.05*	−0.07*	0.11*	0.04*	1.00								
(07) - Share feelings	−0.32*	0.01	−0.05*	−0.04*	0.75*	−0.01	0.13*	1.00							
(08) - Hate to be important	−0.18*	−0.05*	0.07*	0.02*	−0.06*	0.03*	0.06*	−0.05*	1.00						
(09) - Violent action necessary	0.41*	0.06*	0.02*	0.14*	−0.07*	0.05*	−0.47*	−0.08*	−0.01	1.00					
(10) - Not bothered by losing	−0.36*	−0.12*	−0.06*	−0.09*	0.06*	−0.07*	0.09*	0.06*	0.16*	−0.05*	1.00				
(11) - Never ask for help	0.25*	0.02*	0.05*	0.05*	−0.23*	0.04*	−0.00	−0.23*	0.15*	0.03*	0.01	1.00			
(12) - Enjoy risks	0.35*	0.10*	−0.03*	0.07*	0.04*	0.02*	−0.12*	0.05*	−0.11*	0.15*	−0.05*	0.00	1.00		
(13) - Winning most important	0.49*	0.25*	0.15*	0.24*	−0.03*	0.15*	−0.06*	−0.02	−0.10*	0.09*	−0.36*	0.06*	0.15*	1.00	
(14) - Bothered by asking for help	0.34*	0.05*	0.09*	0.08*	−0.20*	0.09*	−0.06*	−0.20*	0.10*	0.10*	−0.08*	0.49*	0.02*	0.14*	1.00

* $p < 0.05$.

Notes: This table presents basic correlations between the CMNI score and its components. The analysis is based on a survey of 16,000 Australian men between 10 and 55 years old ((Bandara et al., 2019)). This survey is a nation-wide survey with oversampling in rural and remote areas. The analysis sample is restricted to self-declared heterosexuals (N=13,317) and unweighted.

This table presents raw correlations between the CMNI score its primary components of interest. For each component, respondents are asked: Thinking about you own actions, feelings and beliefs, how much do you personally agree or disagree with each statement, followed by statements capturing the several dimensions in the CMNI. Possible answers are on a scale from 0 to 3 (0= Strongly disagree; 1 = Disagree; 2 = Agree; 3 = Strongly agree). This table shows that the strongest correlate of the overall CMNI consists of dominance, disdain for homosexuals, violence, risk taking, and aversion to sharing or talking about feelings. In turn, dominance ("People do as I say" and "Not bothered by losing") correlates significantly and most strongly with disdain for homosexuals and risk taking. Disdain for homosexuals correlates strongly with inclination for hatred ("Hate to be important"), and help avoidance ("Never ask for help"); and violence with emotional openness ("Share feelings") and risk taking.

Table A6 – The association between masculinity norms (CMNI) and outcomes

	Mean	Coefficient on CMNI (z-score)	Coefficient on CMNI with income & education controls	Obs
	(1)	(2)	(3)	(4)
Partner violence (perpetrator) - frightened partner	0.222	0.038***	0.039***	10,286
		(0.004)	(0.004)	
Partner violence (perpetrator) - physically hurt partner	0.073	0.024***	0.024***	10,286
		(0.003)	(0.003)	
Partner violence (perpetrator) - forced partner to have sex	0.016	0.008***	0.009***	10,286
		(0.001)	(0.002)	
Suicidal thoughts (lifetime)	0.182	0.018***	0.021***	10,296
		(0.004)	(0.004)	
Suicide plan (lifetime)	0.107	0.020***	0.019***	10,295
		(0.003)	(0.003)	
Suicide attempt (lifetime)	0.048	0.005**	0.003	10,294
		(0.002)	(0.002)	
Currently depressed (PHQ9)	0.060	0.007***	0.010***	10,364
		(0.002)	(0.003)	
Injured while drinking	0.156	0.043***	0.041***	9,359
		(0.004)	(0.004)	
Smokes cigarettes	0.195	0.022***	0.019***	10,291
		(0.004)	(0.004)	
Has used hard drugs	0.289	0.044***	0.038***	10,178
		(0.004)	(0.005)	
Consulted GP (past 12 months)	0.826	−0.008**	−0.008**	10,365
		(0.004)	(0.004)	

$^{+}$ $p < 0.15$, * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Notes: This table presents how the CMNI score predicts these real life outcomes. The analysis is based on Ten to Men data, a survey of 16,000 Australian men between 10 and 55 years old). The analysis sample is restricted to self-declared heterosexuals and unweighted. In column 2, each cell is the coefficient associated with the standardized CMNI score in an OLS regression controlling for respondent's age (mean = 34.908, with 5 missing observations), Aboriginal or Torres Strait Islander indicator (mean=0.027 with 136 missing observations), marital status (6 categories), and language spoken at home (9 categories). Column 3 shows the coefficient on CMNI score after additionally adjusting flexibly for household income, respondent's education level, and a socio-economic index based on place of residence. Robust standard errors corrected for heteroskedasticity in parentheses.

Online Appendix

Men. Roots and Consequences of Masculinity Norms

A Variable description

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

A.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.

Historical variables used in the paper

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
Share employed in agriculture	Proportion of population employed in agriculture
Share employed in domestic services	Proportion of population employed in domestic services
Share employed in mining and manufacturing	Proportion of population employed in mining and manufacturing

A.2 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 postcode level.

Variable	Description
Landform	Main classification of the postcode in different categories: - Plains, plateaus, sand plains - Hills and ridges - Low plateaus and low hills - Mountains
Minerals	Main classification of the postcode in different categories: - Minor coal - Minor others - Major coal - Major copper - Major gold - Major mineral sands - Major oil and gas - Major other - No minerals or traces

A.3 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 percent. 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.

Same-sex marriage referendum vote

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

A.4 Census

We use the following SA1-level controls from the 2011 and 2016 Australian Census. The variables are constructed by averaging the values across both census waves. We also use the 2011 and 2016 Australian Census to construct employment shares by gender and occupation type (again, these are averages across both waves of the census). Employment by occupation (at the 4-digit level) is at the postcode level instead of SA1-level, due to small cell sizes and censoring at the SA1-level.

Census variables from 2011 and 2016 (SA1 level)

Variable	Description
	Main controls
Contemporary sex ratio	Number of men to the number of women
Contemporary population	Total population
Population density	Total population in SA1 divided by total land area of SA1
Urban	Dummy variable equal to one if SA1 is classified as urban by the Australian Bureau of Statistics
	Extended controls
Unemployment rate (by gender)	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: - Buddhist - Anglican - Catholic - Other Christian - Islam - No religion
Median age	Median age of persons in SA1
Percent completed high school	Percentage of people who completed year 12 education (graduated from high school)
Percent foreign born	Percentage of the population born outside of Australia
Median household weekly income	Median total household weekly income (calculated by the ABS)

Occupational gender segregation: 2011 and 2016 Census (postcode level)

Variable	Description
Share of men/women in feminine/masculine/neutral occupations	We first classify occupations into three groups (feminine/masculine/neutral). To ensure that we pick up occupations that are known to be "stereotypically male/female", we classify the most common occupations at the 4-digit level (occupations with total employment shares greater than 0.5%, approximately 55 of a total of 469 occupations, with 55% of the workforce represented in these occupations). Of the common occupations, they are then considered feminine/neutral/masculine if their national male share in the occupation is less than 33% (feminine), between 33-66% (neutral), or more than 66% (masculine). To compute the share of men in feminine/masculine/neutral occupations employed in a given postcode, we calculate the percent of men (of total men employed in a given postcode) that are employed in each of the three categories of occupations. This is done analogously for women.
Total masculine or feminine occupations	Total employed in most extreme male/female common occupations (defined as having 85% or more of one gender, employed nationally) in the postcode. Included as a control, log-transformed.

A.5 HILDA

HILDA is an Australian nationally representative survey available since 2001 on an annual basis (with the set of variables changing across years). We use data from the waves 2005, 2008 and 2011. HILDA provides a vast array of information on households and individuals across Australia. For all HILDA variables, the unit of observation is an individual living in an SA1.

HILDA survey variables

Variable	Description
Supports same-sex marriage	A dummy variable taking value 1 if the respondents' answer to the following question: "*How much do you agree with the statement: 'Homosexual couples should have the same rights as heterosexual couples do'*" is strictly above 3. Response categories range from 1 (strongly disagree) to 7 (strongly agree).

A.6 LSAC

The Longitudinal Study of Australian Children (LSAC) is a major study following the development of 10,000 young people and their families from all parts of Australia. The study began in 2003 with a representative sample of children (who are now teens and young adults) from urban and rural areas of all states and territories in Australia. Data are collected from two cohorts every two years. The first cohort of 5,000 children was aged 0-1 years in 2003-04, and the second cohort of 5,000 children was aged 4-5 years in 2003-04. Study informants include the young person, their parents (both resident and non-resident), carers and teachers. We use both cohorts of data over six waves between 2004 and 2014 (with age between 4 and 15). The unit of observation is a child living in a postcode during the wave/year of data collection.

LSAC survey variables

Variable	Description
Child experienced bullying, reported by parents	A dummy variable taking value 1 if either parent reported that their child experienced bullying
Child experienced bullying, reported by teacher	A dummy variable taking value 1 if the teacher reported that the child experienced bullying
Child experienced bullying, reported by child	A dummy variable taking value 1 if the child self-reported to have experienced bullying. This variable was not used because the sample is much smaller as it was only asked of children aged 10 or above.

A.7 Violence and crime data

We obtain crime data by postcode 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 from 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). Public 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. In both Western Australia and the Australian Capital Territory additional procedures and filing of a Freedom of Information act are necessary. 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 the population from the 2006, 2011, and 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 on 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)
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)

A.8 Mortality

We use the data set Mortality over Regions and Time 2011-2015 as published by Australian Government's Australian Institute of Health and Welfare. These data are available to download here. 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. We generated the following variables by LGA and gender, and then merged to the historical counties by matching LGAs to 2011 postcodes using ABS correspondence tables.

All death variables used as outcomes are transformed such that we use log of male (or female) deaths per 100,000 males (or females) in the LGA. Below is a description of the variables used in the paper and information related to the available data:

Mortality variables used in the paper

Variable	Description
Median age at death (years)	The age at which half the deaths are deaths of people above that age and half are deaths below that age. Median age at death is calculated based on the age at death in single years. Infants (aged under 1) are treated as aged 0 years. Median age at death is suppressed where there are fewer than 10 total deaths (excluding those with missing age at death) in an area, by year and sex. The cases of fewer than 10 total deaths account for the 20 fewer observations in Table 1 for median age of death compared to the other death rates, but all 20 LGAs are outside of the convict sample.
Total deaths	Average number of total deaths due to all causes between 2011-2015. The total number of deaths is reported for each year between 2011 and 2015, and we take the average over this period. Log-total deaths is used as a control to adjust for the age distribution over this particular period in a particular locality.
Suicide (male only)	Number of deaths due to suicide. We report results for males only because suicide appears in the top 20 causes of death approximately 20 percent of the time for females. For females, we only report a binary variable indicating that the LGA reports suicide as a top-20 cause of death for females.
Lung disease	Number of deaths due to lung cancer or lung diseases due to external agents.
Diabetes	Number of deaths due to diabetes.

Mortality variables used in the paper

Variable	Description
Breast and ovarian cancer (female only)	Number of deaths due to breast or ovarian cancers.
Prostate cancer (male only)	Number of deaths due to prostate cancer and other conditions related to male genital organs. Causes of death attributed to prostate cancer and other conditions related to male genital organs includes diseases of male genital organs; malignant neoplasms of penis, testis, other male genital organs; prostate cancer.
Cardiovascular	Number of deaths due to cardiovascular conditions. Causes of death attributed to cardiovascular conditions includes atherosclerosis; cardiac arrhythmias; cardiomyopathy; chronic obstructive pulmonary disease; chronic rheumatic heart disease; coagulation defects, purpura and other hemorrhagic conditions; coronary heart disease; diseases of arteries, arterioles and capillaries excl. atherosclerosis, aortic aneurysm and dissection; heart failure and complications and ill-defined heart disease; hypertensive disease; non-rheumatic valve disorders; pulmonary heart disease and diseases of pulmonary circulation; pulmonary oedema and other interstitial pulmonary diseases; selected other forms of heart disease; aortic aneurysm and dissection.
Other cancer	Number of deaths due to cancer, excluding lung and prostate cancer. Causes of death attributed to cancer include bladder cancer; brain cancer; cancer, unknown, ill-defined; colorectal cancer; gallbladder cancer; kidney cancer; laryngeal cancer; leukaemia; liver cancer; lymphomas; malignant immunoproliferative diseases, multiple myeloma and malignant plasma cell neoplasms; malignant neoplasm of small intestine; malignant neoplasms of bone and articular cartilage; malignant neoplasms of eye, adnexa, meninges, spinal cord, other parts of the central nervous system; malignant neoplasms of independent; malignant neoplasms of lip, oral cavity and pharynx; malignant neoplasms of mesothelial and soft tissue; malignant neoplasms of renal pelvis, bladder, other urinary organs; malignant neoplasms of thyroid and other endocrine glands; malignant neoplasms of vulva, vagina, other female genital organs, placenta; melanoma oesophageal cancer; other malignant neoplasms of skin; pancreatic cancer; selected malignant neoplasms of respiratory and intrathoracic organs; stomach cancer; uterine cancer.