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JEL Classification: I31, J16, N37, N47, O10, Z13, Z18

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The Long-Run Effects of Male-Biased Sex Ratios on Mateship and Social Capital[♣]

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[♣] This paper uses unit record data from the Household, Income and Labour Dynamics in Australia (HILDA) Survey. The HILDA Project was initiated and is funded by the Australian Government Department of Social Services (DSS) and is managed by the Melbourne Institute of Applied Economic and Social Research (Melbourne Institute). The findings and views reported in this paper, however, are those of the authors and should not be attributed to either DSS or the Melbourne Institute. We thank Thanh Huong Bui for research assistance and Pauline Grosjean for helpful suggestions on an earlier version of the paper. Any remaining errors are ours alone.

1. Introduction

This paper examines the causal effect of gender norms on social capital. Social capital is defined as "those features of social organization, such as trust, norms and networks that can improve the efficiency of society by facilitating coordinated action" (Putnam et al., 1993, p. 167). In *Bowling Alone,* Putnam (2000, pp. 27-28) makes the case that "our economy, our democracy, and even our health and happiness, depend on adequate stocks of social capital". *Bowling Alone* has been incredibly influential in informing our understanding of social capital. Writing in 2005, Gidengil and O'Neill (2005, p. 1) go as far as to suggest that it "has been one of the most influential contributions to the social sciences in the past decade". However, one of the main criticisms of *Bowling Alone* is that the role of gender is only addressed in a fairly cursory way (Arneil, 2005; Gidengil & O'Neill, 2005; Siegelman et al., 2019). As Gidengil and O'Neill (2005, pp. 1-2) describe it: "Putnam's work has certainly had something to say about gender, but gender has only been of interest to the extent that it might play a role in explaining the decline of social capital or else in replenishing its dwindling stocks". More generally, with a few exceptions, the role of gender and gender norms have largely been absent from the literature on social capital (Lowndes, 2000). Van Staveren (2002) suggests that much of the literature on social capital is "gender blind", while Fine (2010, p. 3) states that the role of gender and norms related to gender are regarded as a "no go area [for social capital] even though [gender and gender norms] are at the core of social interactions".

We examine the long-run effect of male-biased sex ratios on social capital. To do so, we exploit a natural experiment that is unique to Australia. Between 1787 and 1868, just under 160,000 convicts were transported from the United Kingdom to the British colonies of New South Wales and Van Diemen's Land, which subsequently became Tasmania.[1] The gender ratio among these convicts was heavily skewed towards men, with male convicts constituting approximately 85 per cent of those transported (Baranov et al., 2023; Grosjean & Khattar, 2019). These convicts composed the vast majority of the founding settlers in these penal colonies, meaning that the population in these colonies in the mid-nineteenth century overwhelmingly consisted of men. In the 1836 and 1842 New South Wales and Van Diemen's Land census, the average convict sex ratio was one woman for every 28 men (Baranov et al., 2023). In the other colonies that did not receive convicts, the sex ratio was not as skewed towards men, creating considerable spatial variation in the sex ratios in the eighteenth and nineteenth centuries across the colonies that were later to become Australia.[2]

Male bias sex ratios potentially shape both masculinity norms and conservative gender norms. Baranov et al. (2023) show that attitudes and behaviours associated with well-defined masculinity norms – higher levels of bullying and violence, higher risk taking; male stereotypical occupational segregation, and higher prevalence of negative attitudes towards homosexuals – are higher in areas of modern-day Australia in which the population was more male-biased in the past. The intuition is that well-defined masculinity norms emerged due to intense competition between men in locations with historically high male-female ratios.

[1] Van Diemen's Land was renamed Tasmania in 1856.

[2] Australia came into existence as a Federation in 1901, consisting of the six formerly British colonies of New South Wales, Tasmania, Victoria, Queensland, South Australia and Western Australia.

Grosjean and Khattar (2019) show that female labour force participation rates are lower in those same areas in which historical sex ratios were high, reflecting cultural norms about the relative bargaining position of men and women in a relationship and attitudes about gender roles. Baranov et al. (2023) and Grosjean and Khattar (2023) show that cultural gender norms, whether they be manifest in masculinity norms or conservative gender norms, have persisted over time through intergenerational socialisation in the household and assortative matching.

We posit that gender norms, manifest in both masculinity norms and conservative gender norms, have heavily influenced the evolution of mateship in Australia and that this underlies the causal effect of historical sex ratios on the formation of social capital. Mateship is defined in the *Australian National Dictionary* as "the bond between equal partners or close friends; comradeship [and] comradeship as an ideal" (Moore et al., 2016, pp. 938-939). The notion of mateship is strongly masculine in its origins and how it is perceived in the Australian psyche (Carlin et al., 2022). As Ward (1958) has argued, the concept of mateship had its origins in the bonds that were forged between the overwhelmingly male population in the convict era and harsh frontier environment of the Australian bush in the nineteenth century. It was popularised by famed bush writers, such as Henry Lawson and Banjo Patterson, who helped to promote the concept of a bush code whereby one's primary duty was to support one's mates 'through thick and thin' (Clark, 1978; Moore, 2016; Ward, 1958). There are direct links back to the convict era and the adversity and harsh conditions that the convicts endured. Ward (1958, p. 2) notes that "the first and most influential bush-workers were convicts or ex-convicts, the conditions of whose lives were such that they brought with them to the bush the same or very similar attitudes" (cited in Baranov et al., 2023, p. 352).

Grosjean and Khattar (2019) and Baranov et al. (2023) map data on the convict sex ratio, which they compile based on the earliest historical census in each state, to statistical area 1 (SA1), which is the smallest modern geographical unit, used by the Australian Bureau of Statistics.[3] We match the data on convict sex ratios compiled by Grosjean and Khattar (2019) and Baranov et al. (2023) to the Household, Income and Labour Dynamics in Australia (HILDA) survey, which is a household-based panel study that contains rich data on social capital and its correlates for a representative sample of Australians. HILDA commenced in 2001 and has collected information on the lives and employment of more than 17,000 Australians annually, such that there are 21 waves (years). We employ the restricted version of HILDA, which provides information on the postcode in which the participant lives.[4] We use this information to match data on social capital and its correlates at the household level with the convict sex ratios in that postcode compiled by Grosjean and Khattar (2019) and Baranov et al. (2023).

The main empirical challenge with estimating the effect of historical sex ratios on social capital is that sex ratios in specific locales might be endogenous. To address this issue, we employ

[3] SA1s have a population of between 200 and 800 people with an average population size of approximately 400 people. SA1s in remote and regional areas generally have smaller populations than those in urban areas. There are 61,845 SA1s. In aggregate, they cover the whole of Australia without gaps or overlaps.

[4] Postcodes define a geographical region used by Australia Post to deliver mail. In large towns and cities, postcodes generally map to a suburb. In regional and rural areas of Australia, a postcode might be an entire town. In sparsely populated areas, a postcode might encompass several towns.

convict sex ratios as an instrumental variable for the historical population sex ratio.[5] We also present reduced form estimates in which we regress our measures of social capital on the convict sex ratio. One source of endogeneity is that men and women might sort across geographical areas based on observable and unobservable characteristics that are related to social capital, leading to spurious correlations. The use of historical convict sex ratios ameliorates this problem. Convicts were allocated to specific geographical areas based on observable characteristics and were not free to relocate. A complication for identification is that the allocation of convict labour was not purely random. Rather, it depended on the labour requirements of specific localities, which, in turn, was dependent on mineral resources and land formation (Baranov et al., 2023). We address this issue by controlling for historical employment shares, mineral deposits (such as coal and gold) and land formation (such as plains, plateaus and mountains). We control for a host of contemporary time-varying household variables, such as age, education status and marital status, as well as time-invariant household characteristics, such as gender and whether the participant was born in Australia, which previous studies have shown to be correlated with social capital. We also control for year and state fixed effects to control for time-invariant state characteristics, such as variation in settlement patterns across regions, which could be correlated with social capital. We employ Oster (2019) bounds analysis to explore whether our estimates are sensitive to omitted variables bias and find that they are relatively stable. We present Moran statistics, which confirm that our results are also robust to potential spatial autocorrelation in the residuals (Kelly, 2019). One possible concern with focusing on the convict sex ratio is that convicts could have differed from the rest of the population in ways that are correlated with social capital. However, as Baranov et al (2023) discuss, the historical evidence suggests that convicts transported to Australia were mostly ordinary people, who were not particularly prone to violence, rather than hardened criminals that differed from the mainstream British population. Two-thirds of convicts transported to the British colonies were first time offenders (Nicholas, 1989). The overwhelming proportion of those transported were convicted of petty theft, rather than crimes that involved violence (Oxley, 1994).

Our results indicate that people who live in areas where sex ratios were high (i.e., male-biased), tend to have higher social capital. Specifically, our instrumental variable estimates suggest that a standard deviation increase in the historical population sex ratio causes a 12.3% increase in social capital, while the reduced form estimates indicate that a standard deviation increase in increase in the convict sex ratio causes a 5.4% increase in social capital.

We examine two mechanisms through which gender norms and traditional values that underpin mateship transmit from the convict-era period to modern Australia. First, we find evidence of vertical transmission of male hegemonic values and male sacrifice through shared remembrance, in the form of war memorials, in postcodes in which sex ratios were historically male-biased. Second, we find evidence of transmission within families and that this effect is reinforced through assortative matching via marriage. We find that the effects are weakened

[5] The convict sex ratio consists of convicts. The population sex ratio consists of emancipists (former convicts), colonial administrators, free settlers and Caucasians born in the colonies, in addition to convicts. It does not include the first nations/indigenous population that was not included in the census (Baranov et al. 2023).

through migration, with the effect of traditional gender norms weaker in neighbourhoods that are more ethnically diverse and experienced greater inward internal migration.

While it is difficult to distinguish between the role of masculinity norms from conservative gender norms in practice, we present suggestive evidence that the effect of historical sex ratios on social capital is stronger among men, but not women, expressing attitudes and exhibiting behaviours that are consistent with the operation of both sets of norms.

We examine frequency of physical activity, club membership and engagement in volunteering or charity work as contemporary mediators through which the historical convict sex ratio could influence social capital and find that sex ratios influence social capital via each of these variables. Specifically, those who live in areas in which sex ratios were high tend to engage more frequently in physical activity, have active club or association memberships and engage in volunteering or charity work, which increases social capital.

We also explore whether the effect of the historical sex ratio on increasing social capital in modern-day Australia is gendered; that is, is it due to higher social capital among men or are there spillover effects in which women exhibit higher social capital as well? We find that the observed increase in social capital is much more pronounced among men and that the mediators hold for men, but not women. This finding potentially reflects the role of conservative gender norms and masculinity norms, manifest in the negative aspects of mateship, promoting a dark side of social capital, in which attitudes and behaviour associated with masculine identity often evident at social gatherings (excessive alcohol use, gambling and negative attitudes to women) mean that women do not feel welcomed.

Our paper connects to three strands of literature. First, are studies on the sources of social capital generally and, specifically, studies that have examined the role of historical events in influencing the formation of contemporary social capital. Examples are the effect of the slave trade on the formation of trust in Africa (Nunn & Wantchekon, 2011); the effect of immigration on the formation of social capital in the United States (Algan & Cahuc, 2010); the effect of city-states realising self-government in the Middle Ages on levels of civic capital in modern Europe (Guiso et al., 2016); and the effect of historical irrigation patterns on development of social capital in modern Asia (Talhelm et al., 2014; von Carnap, 2017). None of these studies examine the role of gender norms in influencing social capital. We extend this literature to illustrate how the transport of convicts to British colonies in the eighteenth and nineteenth centuries in what was to later become Australia has shaped patterns of social capital through the effect of male-biased sex ratios on the evolution of gender norms and mateship.

Second are studies on the gender aspects of social capital and specifically how gender norms help shape social capital. To this point, most of this literature has been theoretical or descriptive (Arneil, 2005; Brands et al., 2022; Gidengil & O'Neill, 2005); and focused on gender gaps in social capital (Addis & Joxhe, 2017; Collischon & Eberl, 2021) or gender differences in the creation of social capital (van Emmerik, 2006; Westermann et al., 2005). The only authors who specifically examines how gender norms influence the formation of social capital are Siegelman et al. (2019), who examine the role of masculinity norms in forging social capital in small-scale community-based fisheries. These authors show how fishermen in Mexico's Baja

peninsula employ fabrications, joke telling and made-up stories about sexual prowess to strengthen bonds of trust and settle disputes about common pool resource extraction. Their findings suggest that masculinity norms can play a positive role in promoting social capital among men in the specific example of community-based fisheries. We extend their study to explore the role of gender norms in the formation of social capital for a representative sample of the population of a country, paying particular attention to causation. In addition to considering the implications of gender norms for the formation of social capital among men, we consider how gender norms influence the formation of social capital among women.

The third set of studies to which our contribution is connected are those on the influence of founder populations on long-run economic and social outcomes (see, e.g., Bazzi et al., 2020; Spolaore & Wacziarg, 2013; Waldinger, 2017). This includes a small number of studies that have employed data from convict-era Australia to examine the influence of male-biased sex ratios on other long-run societal variables. Baranov et al. (2020) examine the effect of convict settlement patterns on attitudes to same sex marriage; Baranov et al. (2023) examine the effect of convict settlement induced male-biased sex ratios on masculine attitudes and behaviours more generally; and Grosjean and Khattar (2019) focus on the long-run implications of male-biased sex ratios on differences in female labour force participation and attitudes towards women working. Each of these studies identify negative implications of gender norms due to Australia's convict past; for example, lower female labour force participation and gender-based occupational segregation, higher homophobia, bullying and violence, and higher rates of male suicide. We differ from these studies in showing that masculinity norms can a generate positive outcome in the form of higher social capital.

2. Australia's Convict Past and the Evolution of Gender Norms Underpinning Mateship

Between 1787 and 1868, 132,308 male convicts and 24,960 female convicts were transported to New South Wales and Van Diemen's Land (Grosjean & Khattar, 2019). The extent of free migration was relatively limited until at least the 1830s. In 1828, only 13% of the population in New South Wales were free immigrants (Robson, 1965). When free migration became more prevalent, migrants were overwhelmingly men, migrating to work in agriculture and mining (Grosjean & Khattar, 2019). There was a sharp increase in free migration in the 1850s, associated with the Victorian gold rush, but again overwhelmingly migrants were men (Packer, 1953). As a result, the spatial pattern in the sex ratio across the colonies and later states that were to become Australia persisted for over a century (Grosjean & Khattar, 2019).

The literature on cultural norms suggests various avenues through which gender norms, once established due to male-biased sex ratios, could transmit to present-day outcomes. Cultural norms are passed from parents to children through attitudes, behaviours and story-telling, making the evolution of norms inherently sticky in which a long-run stationary state of attitudes, behaviours and preferences emerge (see, e.g., Bisin & Verdier, 2001; Fernández, 2013; Fernández et al., 2004). Cultural persistence is reinforced through assortative matching in the marriage market, whereby men and women who have similar outlooks are more likely to partner and, in turn, pass those outlooks on to their children (Pencavel, 1998). Another way in which cultural norms can be transmitted is through shared remembrance. Monuments,

memorials and rituals that commemorate significant historical events, reinforce the cultural significance of those events in the collective memory (Dessi, 2008).

To the extent that generations continue to live and marry in broadly the same geographical location, the frequency of commemorative events are spatially uneven, and the distribution of monuments and memorials to historically relevant events vary, spatial variations in the evolution of cultural norms emerge tied to historical characteristics of that location. In this respect, heritage sites and events commemorating important historical events play an important role in the vertical transmission of cultural values (Amestoy, 2013). One would expect the transmission of gender norms to be stronger in locations with a higher historical sex ratio. Stories of the exploits of convict forebearers have been passed down through generations and this effect has been reinforced through a recent surge in the popularity of researching family histories (Barnwell, 2019). The transmission of values dating back to the convict period is further strengthened by the existence of historical convict sites in local geographical areas. Australia has 3,000 convict sites in concentrated geographical locations in New South Wales and Tasmania; of which, 10 are World Heritage listed (Australian Convict Sites, 2023). Art and artefacts featuring convict heritage is also featured prominently in galleries and museums in these local areas (Henri, 2012; Lennon, 2006).[6]

One might also expect memorials to masculine values, such as male sacrifice in war, to be higher in locations in which historical sex ratios were higher and for such monuments to reinforce a shared remembrance of those values among those living in these areas. The establishment of war memorials in Australia was decentralised to municipal councils following World War I and World War II. The number, and size, of memorials depended on fundraising efforts that were targeted at local residents (Inglis & Brazier, 2008). Thus, one would expect there to be a greater interest in establishing memorials in locations with stronger masculinity norms. In Figure 1, we show that there is a positive correlation between the number of war memorials per capita and the convict sex ratio in New South Wales (i.e., there are more war memorials per capita in neighbourhoods which had historically higher convict sex ratios).

Baranov et al. (2023) argue that well-defined masculinity norms evolved in locations with male-biased sex ratios. Baranov et al. (2023) show that local areas that were historically characterised by male-biased sex ratios, reflecting convict transportation, developed more intense male-male competition and stricter masculinity norms. Mahalik et al. (2003) developed a Conformity to Masculinity Norms Inventory (CMNI). Baranov et al. (2023) show that local areas with male-biased historical sex ratios have stricter masculinity norms reflected in four important domains of the Mahalik et al (2003) CMNI: (a) higher levels of bullying and violence; (b) higher risk taking (c) male stereotypical occupational segregation and (d) higher prevalence of negative attitudes towards homosexuals. Male biased sex ratios not only create the environment in which masculinity norms develop, but also potentially underpin the generation of conservative gender norms. Grosjean and Khatter (2019) show that male biased sex ratios shaped cultural norms about the relative bargaining position of men and women in

[6] For example, the Tasmanian Museum and Art Gallery in Hobart (https://www.tmag.tas.gov.au) has extensive convict-related exhibitions, telling the stories of the convicts and convict era. Each of the five World Heritage listed convict sites in Tasmania has similar exhibitions.

a relationship and conservative attitudes about gender roles that led to lower rates of female labour force participation in locations that had higher convict settlement.

Masculinity norms and traditional attitudes towards the role of women in Australia are interwoven with the notion of mateship. Mateship is associated with values such as equality, friendship, loyalty and, perhaps above all, stoicism among men. Reminiscent of Siegelman et al.'s (2019) description of masculinity norms among fishermen in Mexico's Baja peninsula, mateship is characterised by "a lack of emotional expression other than sharing jokes" (Edgar, 1997, pp. 79; cited in Baranov et al., 2023, pp. 352). Gambling, heavy drinking and telling jokes with one's mates are quintessential features of mateship (Baranov et al., 2023). Gambling, heavy drinking and lack of respect for authority, which are all characteristics of mateship, were widely prevalent in the convict era (Hirst, 2008; Reynolds, 1969). In particular, the close association between heavy drinking, gambling and sport as popular forms of social recreation in Australia began among male convicts (Dillon, 2008; Franklin, 2023; Hindmarsh, 1999). Powell (1988, p. 403) records that "alcohol was widely used and available from ... [the] very beginning to convict, gaoler, and free settler. For a while it was the major form of currency, a practice developed and promoted by the officer corps from 1794 until stamped out by Macquarie on his arrival in 1810".[7] Hindmarsh (1999, p. 152) suggests: "Drinking was an important convict recreation". Drinking was a main way in which assigned male convicts dealt with the social isolation and lack of female companionship that characterised the harsh frontier bush environment (Powell, 1988). Dillon (2008, p. 226) writes:

> for many assigned [convicts] drinking had cultural meaning. It marked the difference between work time and free time and was often associated with a number of leisure activities which were enjoyed collectively. It was accompanied by gambling, singing, yarning, smoking and reading and was probably almost always present when the men organized the popular pastimes of sparring, cock fighting or dog baiting.

Escaped convicts and emancipists frequently took up bushranging (Maxwell-Stewart, 1991).[8] These convicts turned bushrangers were formative in conceptualising hegemonic masculinity up until the mid-1850s. Ward (1958, p. 146) suggests that "if bushmen were the 'true Australians', runaway convicts were the first of their genus". Hartadi (2009) records that the first escaped convicts in New South Wales who became bushrangers date from 1789 and that by 1832, there were 112 convicts who escaped from Macquarie Harbour Penal station in New South Wales and took up bush ranging. Maxwell-Stewart documents 305 bushrangers in Van Diemen's Land between 1806 and 1846 that were escaped, or former, convicts. Bush ranging flourished in Victoria following the 1850s goldrush where many of the bushrangers were escaped convicts or emancipists from Van Diemen's Land (Maxwell-Stewart, 1991).

[7] Lachlan Macquarie became Governor of New South Wales and Van Diemen's Land in 1810 following the Rum Rebellion (26 January 1808 to 1 January, 2010). For an extensive discussion of the use of rum as currency in New South Wales in the lead up to the Rum Rebellion see Butlin (1983) and Evatt (1944).

[8] Bushrangers were originally escaped convicts in the early years of the British settlement of Australia who used the bush as a refuge to hide from the authorities. By the 1820s, the term had evolved to refer to those who took up "robbery under arms" as a way of life, using the bush as their base.

In Australia, bushrangers have become “popular media creatures whose criminal exploits have been celebrated in songs, newspapers, books, plays, movies, and even television dramas” (Hartadi, 2009, p. 21). In such depictions, bushrangers are typically described as "gentlemen outlaws" or "social heroes" (Hartadi, 2009, p. 21), responding to injustice due to a corrupt and/or inept police force and the hardship of the frontier environment.

Ward (1958) emphasises the role of bushrangers in the development of the notion of mateship in Australia. He emphasises their resourcefulness, that they often had groups of sympathisers in the communities where they operated and that they were loyal to each other and to their supporters. In popular culture, bushrangers have been depicted as both masculine and chivalrous. For instance, Smith (1982) stresses the physical capabilities of bushrangers as 'heroic bushmen', and their familiarity with the bush and their horse craft, which he contrasts with the dubious abilities of the police, who pursued them. Chivalry is often linked to mateship in the evolution of gender norms in Australia. Chivalry is underpinned by a sense of egalitarianism, fairness or 'doing what is right', which also underpins mateship. But, in addition, it implies gendered behaviours for men and women based on the model of a dominant, breadwinning male and a passive, dependent female, which underpins masculinity norms and traditional views of attitudes towards women (Lamont, 2014).

Although the notion of mateship in Australia has its origins in the convict era and later the nineteenth century outback, it was consolidated in the Australian psyche in World War I “with the ANZAC (Australian and New Zealand Army Corps) [legend] as the leading exemplar of masculinity” (Baranov et al., 2023, p. 352). Carlin et al. (2022, p. 198) suggest “a connection between the ANZAC legend and mateship has served to reinforce the historical trajectory of mateship as a core part of an Australian cultural mythology, albeit a deeply masculine one”. Baker (1945) puts forward the argument that mateship came to the fore in times of crisis, such as war. Many of the conditions that underpinned mateship in the nineteenth century outback were recreated in the trenches of Gallipoli in Turkey and on the battlefields of France in World War I.[9] Men were brought together in harsh conditions and there was a perceived need to be stoic and to not show outwards emotion to one's mates. The ANZACs had a culture of heavy drinking and gambling and shared a sense of irreverence and lack of respect for the British officers who commanded them, which channelled the lack of respect for authority that had developed in the convict area and later in the nineteenth century bush code (Seal, 2004).

Consistent with the literature on transmission of cultural norms, the exploits of Australia's frontier origins and ANZAC heroes have been passed on from one generation to the next within families through storytelling, reinforcing the role of mateship in defining the Australian identity (Janiewski, 2019). Most Australian children grow up being taught by their parents and in schools about the hardships endured by the early legendary explorers who mapped the

[9] When World War I commenced, Australia and New Zealand were part of the British Empire and fought with the Allies under the command of British forces. The main battlefields in which the ANZACs fought were the Gallipoli campaign in Turkey and in several battles in France, including Ypres, Somme and Villers-Bretonneux.

Australian outback, such as Burke and Wills. Until recently at least, such narratives were largely devoid of the role played by Australia's First Nation peoples (Shellam, 2014).[10]

The legend of the ANZACs in Australia has routinely been transmitted and celebrated from one generation to the next within families that had parents, grandparents or great grandparents who served in World War I and/or II (Holbrook, 2018). This is likely to be spatially uneven. Baranov et al (2023) find that men from local areas in Tasmania with higher convict sex ratios were more likely to volunteer for active service in WWI, reflecting the impact of male-biased sex ratios on the evolution of masculinity norms. The ANZAC legend has also been transmitted from one generation to the next and entered the Australian consciousness through the staging of a dawn service and parade each ANZAC Day (25 April), which is a national holiday in Australia. The origins of the ANZAC Day dawn service, which were first held in Australian capital cities in 1933, were overtly masculine. Women were not welcome at the ANZAC dawn service in the early years. Writing about the dawn service held at the Shrine of Remembrance in Melbourne in the 1930s, Inglis and Brazier (2008, pp. 314-315) state: "No whiff of rosemary[11] was to soften the hard, digger masculinity of the Shrine at dawn .... a clear message was put out in the newspapers: 'Men who are not returned soldiers and women are requested not to attend this ceremony. The beach at ANZAC was no place for women and children, no place for civilians'". In more recent years, this position has changed, and parents are now actively encouraged to bring their children to the dawn service and parade to help educate them younger generations about the ANZAC tradition.

In 2015, which was the centenary of the landing of Australian troops in Gallipoli, Turkey, over 300,000 people attended dawn services on ANZAC Day in the major capital cities. At ANZAC Cove, at Gallipoli, 10,000 Australians attended the dawn service on ANZAC Day in 2015, including the then Prime Minister of Australia, Tony Abbott (Fathi, 2019).[12]

3. How Do Gender Norms and Mateship Affect Social Capital?

There are several links between mateship and formation of social capital in modern Australia. Mateship underpins participation in a variety of community and sporting organisations. Messner (1992) discusses the significance of men's sporting friendships for the development of social capital. Sports are an important part of the Australian psyche, both in terms of participation and as a spectator. Australians pride themselves on their interest in sports, and this interest is often linked to their sense of self-identity (Martens, 1996). The connection between sense of self-identity and sports is particularly salient among Australian men and is often geographical based (Fiske et al., 1987). For example, generations of the same family who grew up and live in specific locations will follow the sporting teams representing that location, creating a tribal mentality often based on mateship (Blainey, 2010; Hughson, 1999).

[10] Indeed, the stories of heroics in adventure stories often involved 'overcoming' and 'subduing' indigenous/ First Nation Australians with the use of force (Crotty, 1999).

[11] Rosemary grows wild at Gallipoli in Turkey. This symbolic herb is often worn on ANZAC Day.

[12] The Australian population in 2015 was 23.8 million, meaning about 1.3 per cent of the population attended dawn services in the major capital cities. Most towns also have dawn services on ANZAC day. The overall turnout nationally, thus, was likely much higher than this figure to commemorate an event 100 years earlier.

Participation in sports in Australia is high: 41 per cent of Australians aged 15 and above participate in sport at least once a week, while the statistic for men alone is 50 per cent.[13] The numbers are even higher in regional Australia (Tonts, 2005). It has traditionally been common for men to play Australian Rules Football, Rugby League or Rugby Union in the winter and cricket in the summer on the weekends and this has led to the creation of several such sporting clubs across the country. Many of these clubs are founded on values associated with masculinity norms and mateship, with heavy drinking common after games. These cricket and football clubs are often the hubs of country and regional towns. For example, Tonts (2005) documents the role that competitive sporting clubs in regional Australia play as a vehicle for the creation of social capital. These sporting clubs are not merely an outlet to participate in physical activity, but provide a sense of belonging and act as nodes for regional social networks, consistent with Putnam's (1993) conceptualisation of bridging social capital (Tonts, 2005). In addition to those who play, most of the country town's residents will turn out to watch. Many will be involved in the club organisation in a volunteer capacity.

Most of the population in Australia live near the coast. Despite Australia's vast landmass, about 85 per cent of the Australian population live within 50 kilometres of the coastline (ABS, 2020), making going to the beach, particularly in the summer months, a popular social pastime. This has led to the creation of surf life-saving clubs, which are also predominantly male. Darcy et al. (2014) document the important role that Surf Life Saving Australia (SLSA) has played in the formation of social capital in coastal communities, with the clubs providing a strong sense of belonging and mutual support for members in times of financial hardship. Social capital is important to professional success. Many studies suggest that people who are more successful have higher levels of social capital (Seibert et al., 2001). The SLSA also provides professional networks that help secure employment in coastal communities.

Watching sport live in Australia is a national pastime. Average attendance at Australian Football League (AFL) games, the national competition for Australian Rules Football, is the fourth largest of any professional sports league in the world (Schmook, 2014). Annual attendance at the AFL Grand Final is typically in excess of 100,000 people. The annual attendance at the Boxing Day cricket test match at the Melbourne Cricket Ground is usually between 150,000 and 200,000 people over the five days. When the national men's rugby league (Kangaroos), rugby union (Wallabies) or soccer (Socceroo) teams play at the same venue, attendance is typically between 80,000 and 100,000 people. Watching these sports live is often gendered. It is common for groups of men ('mates') to go to the game together and to drink alcohol and gamble on the outcome.[14]

Watching sport together is a source of social capital. In a case study, Palmer and Thompson (2007) examine the role that a group of South Australian football spectators known as the 'Grog Squad' play in contributing to the formation of social capital.[15] The Grog Squad are a

[13] https://www.clearinghouseforsport.gov.au/participation-in-sport

[14] Watching Australian Rules Football is associated with traits associated with mateship such as gambling with gambling advertisements featuring prominently, particularly on sports radio (such as SEN - https://www.sen.com.au).

[15] Grog is a slang term in Australia for alcohol.

group of male football fans who attend every match played by the North Adelaide Australian Rules football team in the South Australian competition. Every week, members of the Grog Squad consume excessive amounts of alcohol and cheer aggressively for their team. Many of the chants are overtly masculine in nature and, fuelled by excessive alcohol consumption, often derogatory to women. As Palmer and Thompson (2007, p. 192) describe it: Although loyalty to the North Adelaide Football Club is a key marker of commitment to the Grog Squad, the ability to consume excessive amounts of alcohol is of equal importance in gaining acceptance among the group. Yet, despite exhibiting hegemonic masculinity, the friendships and solidarity developed among Grog Squad members were important sources of social capital. As one example, Palmer and Thompson (2007) document the positive role that the Grog Squad played in helping a member overcome depression and a suicide attempt. Grog Squad members came from a wide range of different professions. Similar to the SLSA, membership of the Grog Squad was an important source of professional networking.

The links between alcohol consumption and hegemonic masculinity in the Australian psyche and its role in social capital formation are reinforced through the exploits of the national sporting teams, such as the Australian cricket team, which attract wide media coverage. The Australian national cricket team was sponsored by leading beer company, Carlton and United Breweries, for two decades between the 1996–7 and 2016–17 seasons.[16] The alcohol consuming exploits of the leading Australian players were well known and celebrated. When the team travelled from Australia to England, players in the 1970s and 1980s vied for the record of the greatest number of cans of beer consumed on the flight.

The record was set by Australian opening batsmen and current Chair of Cricket Tasmania, David Boon on a 1989 flight between Sydney and London when he consumed 52 cans of beer. His teammates acted as 'pacemakers' (O'Brien et al., 2010). Siracusa and Dundas (2023) state that the “[a]irborne beer-drinking records were a long-celebrated part of the 'larrikin' culture of the Australian team”. They have been retold to 'groups of mates' at sportsman nights – typically used by sporting clubs as fundraisers[17] – reinforcing the link between excessive drinking and hegemonic masculinity in community sporting clubs (Hart, 2016).

David Boon has featured in national advertising campaigns for beer brand Victoria Bitter and in a 'Boonie' figurine promotion, sponsored by beer manufacturer Foster’s Lager, both of which tapped into the celebrated drinking exploits of Boon, particularly among Australian males (Siracusa & Dundas, 2023). The 'Boonie' figurine promotion did receive some criticism for promoting binge drinking. Responding to this criticism, Chris Maxwell, national sponsorship manager of Foster’s Lager, stated: “We thought that David Boon had a perfect fit with Victoria Bitter. He was a good Aussie bloke, with good Aussie values” (Saltau, 2009).

[16] Carlton and United Breweries has been a wholly owned subsidiary of the Asahi Group since 2020. In 2022, the Asahi Group had 57 per cent of the mainstream beer market in Australia (Statista, 2023).

[17] Sportsmen nights involve a collection of speakers and a Master of Ceremony (sometimes a comedian) talking to the audience, entertaining them with stories, anecdotes and tales of their time in the sporting arena. Such events often involve excessive consumption of alcohol. In Australia, well-known former cricketers and footballers (from all codes) routinely tell stories from their careers at sportsmen nights.

Mateship forged in war is an important source of social capital in Australia. The Returned Services League (RSL) have a number of clubs throughout Australia. These provide a vehicle for veterans to come together to support one another and share stories.[18] They have traditionally been an important source of professional networks and, as many veterans get older, have provided a source of friendship and age care for older Australian men (Shaw et al., 2014). The links between veterans within RSL clubs are founded on the mateship ethos that has its origins in the masculine norms of the ANZAC legend and the exploits of Australian diggers in World War II.[19] Other community groups have evolved to provide mental health support to men that are underpinned by mateship and masculinity norms. One such example is 'Men's Sheds'. The Australian Men's Shed Association was established in 2007 and there are almost 1,000 'Sheds' nationwide (Mulligan, 2018). The purpose of the Men's Shed movement is to provide a safe environment in which men "may do a variety of activities from manual crafts to gardening. Some may undertake community projects such as making toys for local childcare groups".[20] The motto of the Men's Shed movement is working shoulder to shoulder (Mulligan, 2018). The idea of making things, working shoulder to shoulder, is traditionally masculine in origins. Above all else, organisations like Men's Shed provide an outlet for men to support each other and this invariably involves telling stories and joke telling, while working on physical tasks, that are characterised by mateship and masculine norms (Shaw et al., 2014).

The discussion, thus far, centres on how gender norms affect the social capital of *men.* The effect of gender norms on the social capital of *women* remains controversial and unclear. In areas with conservative gender norms, one would expect there to be more conservative attitudes towards women working, lower female labour force participation and more time for women's leisure (Grosjean & Khattar, 2019). Initially, Putnam (1995) suggests that the increase in the female labour force participation rate was responsible for the decline in social capital in the United States. The reasoning was that as women moved into the labour force, their membership among voluntary organisations fell, meaning they produced smaller stocks of social capital than previously (Gidengil & O'Neill, 2005). The adverse effect on social capital may be exacerbated by gender differences in the production of social capital. For instance, women are more likely to pursue social causes than men and more likely to know their neighbours than men, contributing to civic engagement (Caiazza & Putnam, 2005). This implies that in areas with conservative gender norms, because female labour force participation is lower, that there would be more time for women to be engaged in voluntary organizations, contributing to higher social capital. However, this line of reasoning overlooks the social capital that is produced through greater engagement with paid work, including via professional networks. For example, Hall (1999) posits that in the United Kingdom, changing gender roles, more educational opportunities for women and more access to paid employment has contributed to women generating more social capital than ever before.

[18] According to the RSL website: "RSL sub-branches host regular events for the veteran community to connect and encourage camaraderie, mateship and recreation" https://www.rslaustralia.org

[19] Diggers is Australian military slang for soldiers.

[20] https://www.health.gov.au/our-work/mens-sheds/about-mens-sheds

4. Data and Variables

4.1. Historical convict and sex ratio data

Data on historical convict and sex ratios are taken from Grosjean and Khattar (2019), who compile this data from the first census in each of the British colonies which joined together to become Australia in 1901. The census for New South Wales, Tasmania, South Australia, Western Australia, Victoria and Queensland were from 1836, 1842, 1844, 1848, 1854 and 1861, respectively.[21] The unit of observation in the historical census was the county, with 91 counties across the colonies. The average population of a county was approximately 4,500 with about 85 per cent of the counties having a population size ranging between 300 and 10,000 people. The average sex ratio in the overall population was about three men per woman, with a much higher ratio of about 28 men per woman among convicts. Figure 2 presents an overview of the sex ratio in Australia over time, while Figure 3 presents the distribution of convict sex ratios across each state in the mid-nineteenth century.

4.2. Individual level present-day data

We use data from the HILDA survey to measure present-day social capital and its correlates at the household level. HILDA is an Australian nationally representative household longitudinal survey, which has been running since 2001. The Restricted Release of HILDA contains information on the postcode in which respondents live. Because postcodes in modern-day datasets such as the HILDA survey are not equivalent to historical counties, we use shapefiles provided by Grosjean and Khattar (2019) to match the present-day boundaries with historical counties. We use Release 21 of the HILDA survey, which contains 21 annual waves. However, because indicators of social capital are not available in all survey waves, regressions with the highest number of observations cover 118,922 individual-year observations.

4.3. Measuring social capital

Our main indicator of social capital is a composite index that reflects the dimensions of social networking and cohesion (Awaworyi Churchill & Farrell, 2020; Clark & Lisowski, 2018). Networks and cohesion are two of the fundamental components of social capital. Cohesion speaks to the solidarity and unity prevalent within a community or social group (Schiefer & van der Noll, 2017). Strong cohesion within a community or group signals robust social ties and trust among members, fostering a cooperative spirit and mutual support. It indicates a sense of belonging, shared responsibility, and a unified identity (Schiefer & van der Noll, 2017; Stanley, 2003). Likewise, social networks are an important component of social capital, reflecting the connections individuals or groups hold within a community or society (Son & Feng, 2019). Networks encompass personal, professional, and communal relationships. The significance of networks as a fundamental component of social capital is reflected in Putnam's (1996) seminal conceptualisation and definition of social capital which suggest that social

[21] The 1836 census for New South Wales included the Australian Capital Territory (ACT), which did not become a separate administrative region until 1911, and the Northern Territory. The Northern Territory was part of New South Wales from 1825 to 1863 and then South Australia from 1863 to 1911.

capital encompasses “networks, norms, and trust that enable participants to act together more effectively to pursue shared objectives” (Putnam, 1996, p. 56).

Drawing on a set of questions available in the HILDA survey, the composite indicator of social capital reflects the extent to which HILDA participants agree or disagree with sentiments relating to the level of social cohesion and networking in which they engage in with their neighbours. We use two sets of questions available in waves 6, 10, 14, and 18 of the HILDA survey to derive the composite index of social capital (see, e.g., Ackermann et al., 2023; Awaworyi Churchill & Farrell, 2020; Clark & Lisowski, 2018). In the first set of questions, respondents are asked: “How common are the following things in your local neighbourhood? 1) Neighbours helping each other out, and 2) Neighbours doing things together”. The answers to these questions are on a five-point scale where one is ‘never happens’ and five is ‘very common’. In the second set of questions, respondents are asked: “To what extent do you agree or disagree with the following statements about your neighbourhood? 1) This is a close-knit neighbourhood, 2) People in this neighbourhood can be trusted, 3) People in this neighbourhood generally do not get along with each other, and 4) People in this neighbourhood generally do not share the same values”. The replies to these questions are on a seven-point response scale where one is ‘strongly disagree’ and seven is ‘strongly agree’ with the replies to questions (3) and (4) reversed coded. The social capital index is calculated as the average of the six questions, where higher values indicate greater levels of social capital. We also consider each of the sub-dimensions of social capital in separate regressions.

In robustness checks, we consider three alternative indicators of social capital focused on the frequency of social gatherings, the extent to which people feel able to confide in others and the extent to which people feel able to depend on others. These indicators are consistent with dimensions of social capital that reflect level of interaction and social connectedness with others (Awaworyi Churchill & Farrell, 2020). We measure frequency of social gatherings using the HILDA survey question: “In general, about how often do you get together socially with friends or relatives not living with you?” Responses are on a seven-point scale where one means “everyday” and seven means “Less often than once every three months”. The second indicator is based on the HILDA survey question, which asks respondents the extent to which they agreed or disagreed to the statement: “I don’t have anyone that I can confide in”. Responses are on a seven-point scale where one means “strongly disagree” and seven means “strongly agree”. The third indicator is on a similar scale and is based on the question where respondents need to demonstrate the extent to which they agreed or disagreed with the statement: “I have no one to lean on in times of trouble”.

4.4. Measures of cultural persistence

To examine the role of vertical transmission of gender norms through generations, we employ data on whether the respondent's parents were born in Australia. We employ data on ethnic diversity in the postcode to examine the influence of migration on the transmission of gender norms. Our main measure of ethnic diversity is based on the Herfindahl fractionalization index, which captures the probability that two randomly selected individuals in a given postcode belong to different ethnic groups (Greenberg, 1956). The fractionalization index is often used to measure ethnic diversity in the literature (see, e.g., Awaworyi Churchill, 2017;

Awaworyi Churchill & Danquah, 2022; Awaworyi Churchill et al., 2019; Awaworyi Churchill & Smyth, 2017, 2020; Kanbur et al., 2011). To construct the index of fractionalization, we need to know the ethnicity of residents in each postcode. We obtain this information from the Australian Census of Population and Housing, which provides information on every person's country of birth and where they live. The Australian census is administered every five years and, thus, our indices of ethnic diversity cover 2001, 2006, 2011 and 2016. To measure assortative matching based on ethnicity, we define a dummy variable equal to one if the respondent was born in Australia and has a partner who were also born in Australia.

To measure shared remembrance of masculinity, we use the number of war memorials in each postcode per capita. There are no national data on the number of war memorials in each postcode. The New South Wales War Memorials Register provides a search engine, making it possible to search for war memorials by postcode in New South Wales.[22] We use that search engine and data on population in each postcode from the most recent national census to calculate the number of war memorials in each postcode per capita in New South Wales.

4.5. Measures of conservative gender norms and masculinity norms

To measure the importance of conservative gender norms, we construct an index based on responses in HILDA to a series of statements about attitudes towards parenting and work, which were asked in waves 1, 5, 8, 11, 15, and 19. Respondents were asked to indicate whether they agree or disagree with the following statements on a scale of 1-7: "(a) Many working mothers seem to care more about being successful at work than meeting the needs of their children. (b) If both partners in a couple work, they should share equally in the housework and care of the children. (c) Whatever career a woman may have, her most important role in life is still that of being a mother. (d) Mothers who don't really need the money should not work. (e) It is better for everyone involved if the man earns the money and the woman takes care of the home and children. (f) A working mother can establish just as good a relationship with her children as a mother who does not work for pay. (g) It is not good for the relationship if the women earns more than the man. (h) A pre-school child is likely to suffer if his/her mother works full-time." Responses to the statements in (b) and (f) are reverse coded, so that higher values reflect more conservative attitudes toward gender roles.

Intense competition between males can be expected to lead to behavioural manifestations reflecting excessive risk taking and help avoidance (Baranov et al., 2023). As a first proxy for risk taking, we use responses to a series of statements in HILDA about respondents' financial risk/return profile. Responses were on a four-point scale, ranging from "I am not willing to take any financial risks" to "I take substantial financial risks to earn substantial returns".

As a second proxy for risk taking, we employ a dummy variable if the respondent in HILDA had ever smoked cigarettes or other tobacco products (Yes=1). Smoking prevalence is gendered. In the early part of the nineteenth century smoking was largely restricted to men (Lopez et al., 2006). Recent statistics indicate that globally more than one third of men (37 per

[22] https://www.warmemorialsregister.nsw.gov.au

cent), but less than one in ten (8 per cent) women smoke cigarettes (Ritchie, 2019). Smoking is heavily influenced by masculinity norms. It is a complement to alcohol consumption (Tauchmann et al., 2013) and gambling (Potenza et al., 2004) that are quintessential features of mateship. Smoking is also a significant health risk and a strong predictor of lung cancer and heart disease, both of which may lead to morbidity and premature death (Lopez et al., 2006).

As a third proxy for risk-taking we use a variable denoting heavy alcohol use. To proxy heavy alcohol use, we use questions in HILDA that ask respondents about the frequency of drinking (e.g., daily or 5-6 days per week) and the number of drinks they have on a typical day that they have alcohol. We then calculate the total amount of alcohol use by multiplying these two indices and identify heavy alcohol use among those with consumption levels exceeding the 80th percentile in our sample. We do this separately by gender. Excessive alcohol consumption is more prevalent among men than women and is typically regarded as an indicator of masculine identity (Lemle & Mishkind, 1989). As discussed above, drinking heavily in Australia has deep masculine origins, dating back to the convict era. It is also a strong predictor of health risk, including premature death (see, e.g., Meyerhoff et al., 2005).

As a measure of health avoidance, we use a question in HILDA that asks respondents about hesitancy to be vaccinated for COVID-19. Masculinity norms have been identified as a barrier to the implementation of preventative measures, such as vaccination and wearing a mask, to stop the spread of COVID-19 (Reny, 2020). During the height of COVID-19, men were less likely to wear a protective mask (Cassino & Besen-Cassino, 2020), less likely to get vaccinated and generally less concerned about the health consequences of the pandemic (Galasso et al., 2021). At the same time, men were much more likely than women to die from COVID-19 (Reny, 2020). One explanation given for the reluctance of men to wear a mask or get vaccinated is that they do not want to appear 'weak' in the face of the pandemic.[23]

4.6. Measures of contemporary mediators

We focus on frequency of physical activity, active club membership and engagement in charity/volunteer work as potential contemporary channels through which the sex ratio could influence social capital. To measure physical activity, we use the HILDA survey question that asked respondents how often they participate in physical activity. The responses are coded on a six-point scale where one means “not at all” and seven means “everyday”.

Active club or association membership is measured using the HILDA survey question, which asks respondents: “Are you currently an active member of a sporting, hobby or community-based club or association?” We derive a binary variable from the response to this question

[23] Reny (2020) uses the reluctance of Donald Trump, whose Presidential style was often associated with overt hegemonic masculinity (see, e.g., Messerschmidt, 2021), to wear a mask during COVID-19 to illustrate this point. As Reny (2020, p. 1028) put it: “In late May 2020, when the United States had just surpassed 500,000 confirmed COVID-19 cases and was nearing 100,000 deaths, President Donald Trump refused to don a mask during a visit to a mask factory in Michigan. The president claimed that he did not want to give the press the ‘pleasure of seeing it’. He later mocked Democratic presidential candidate Joe Biden for wearing a mask. Trump’s refusal to “look weak” highlights how attitudes about masculinity could impede efforts by public health officials to stem the spread of infectious disease".

where one captures those who have active club membership. We measure volunteer/charity work using the HILDA survey question, which asks respondents: "How much time would you spend on each of the following activities in a typical week?" Volunteer or charity work is one of the sub-questions with our responses provided in hours. We use this to capture the level of engagement in volunteering or charity work. Table 1 presents summary statistics for the key historical variables and variables from the HILDA survey.

5. Empirical Strategy

To estimate the long-terms effects of male-biased sex ratios on social capital, we employ the following model:

$$SC_{ipcs} = \gamma_0 + \gamma_1 Ratio_{cs} + \boldsymbol{\gamma_2 X^G_{pcs}} + \boldsymbol{\gamma_3 X^H_{cs}} + \boldsymbol{\gamma_4 T^C_{pcs}} + \boldsymbol{\gamma_5 X^C_{ipcs}} + \varphi_s + \delta_t + \varepsilon_{ipcs} \quad (1)$$

SC_{ipcs} is the measure of social capital for individual i in postcode p contained in historical county c located in state s. $Ratio_{cs}$ is the historical sex ratio measured as the ratio of males to females in historical country c based on the first census in each colony or state s. φ_s represents state fixed effects, while δ_t represents time fixed effects corresponding with the HILDA survey waves. ε_{ipcs} is the error term with standard errors clustered at the individual level. T^C_{pcs} and X^C_{ipcs} are sets of postcode level and individual level contemporary covariates, known to be correlated with social capital. Individual level covariates are gender, age, marital status, educational attainment and place of birth. Postcode covariates are the urbanization rate and the contemporary sex ratio drawn from the Australian census. X^G_{pcs} and X^H_{cs} represent vectors of time-invariant geographic and historic characteristics, respectively, that are likely to influence both the historical sex ratio and present-day social capital.

In the nineteenth century, the distribution of convicts, free settlers, and emancipists across geographic areas in the colonies was influenced by economic opportunities, which could potentially influence social capital. If economic specialization persisted over time, these early circumstances might directly shape present-day social capital and, thus, neglecting these factors could skew our estimations. To account for geographic differences across counties, we control for latitude and longitude. To address variations across counties stemming from initial economic specialization, we control for specific mineral deposits and land attributes. We also control for the historical total population, as well as the historical shares of the population employed in the main employment categories, consisting of agriculture, mining, manufacturing, domestic services and professional occupations.

γ_1 is the parameter of interest that captures the effect of the historical sex ratio on social capital. A key assumption to causally estimate γ_1 is that the spatial distribution of the ratio of men to women was random, conditional on the proxies we include to account for economic opportunities and total population. However, as discussed in Grosjean and Khattar (2019), although economic opportunities played a vital role in choosing settlement locations, it is also plausible that various unobservable factors influenced this decision, which could subsequently have worked through various channels to influence present day outcomes, such as social

capital. Therefore, consistent with the approach in Grosjean and Khattar (2019), we use an instrumental variable strategy drawing on the segment of the population that lacked the freedom to select their place of settlement. Specifically, we instrument for the overall historical sex ratio using the sex ratio from the convict population.

Given that convicts made up a substantial portion of the population at the time, the instrument is relevant and should be highly correlated with the overall population sex ratio.[24] By utilising the sex ratio among convicts as an instrument, we address potential self-selection bias given that convicts lacked the free will to choose their place of settlement.

Allocation of convict labour was not random, but depended on private sector demand for labour in specific locations (Meredith & Oxley, 2005). Whenever possible, convicts were allocated to jobs, consistent with their skillset before transportation. As a result, Nicholas (1988, p. 200) suggests, "most skilled convict workers found themselves employed in the same jobs in Australia as they had held at home prior to conviction". Based on an exhaustive review of appropriation lists from convict ships between 1830 and 1835, Read (2020, p. 90) reaches the same conclusion stating: "convicts transported to Van Diemen's Land were distributed among applicants largely according to their former occupations".[25] The scarcity of female convicts meant that they were allocated as a priority to the largest landowners (Dillon, 2008; Reid, 2003). To account for the fact that convict placement was not random, but influenced by labour demand and the convict's skillset, we control for historical employment sector shares and incorporate a comprehensive range of geographical factors likely to influence labour demand in specific localities in our specification, as described above.

To satisfy the exclusion restriction, the convict sex ratio should influence present day social capital only through its effect on the historical population sex ratio. The exclusion restriction could be violated if the presence of convicts is expected to have direct effects on contemporary outcomes independent of the effects on the overall population sex ratio. One possible concern is if convicts differed from the rest of the population in ways that are correlated with social capital. For example, convicts might be more prone to anti-social behaviour that reduces neighbourhood trust and is the antithesis of social capital formation (Meier et al., 2016). These traits may be persistent in locations that had large numbers of convicts through the notion of a 'convict stain' – the idea that individuals who are descended from convicts are genetically predisposed to similar attitudes and behaviours (Lambert, 2002). It is estimated that 20 per cent of Australians are descended from convicts who were transported to the colonies (ABC, 2007). In Tasmania, it is estimated that almost three quarters of the population are descended from convicts who were transported to Van Diemen's Land (Williams, 2015). Economic historians now agree that transported convicts predominantly did not come from a criminal underclass. According to Nicholas (1990, p. 65), "the convicts appear to have been ordinary working-class men and women, who usually held regular employment but on occasion stole articles of small value". Donnachie (1986) draws the

[24] Grosjean and Khattar (2019) demonstrate that the correlation between: 1) the convict population and total population is 0.99, and 2) the convict sex ratio and total population sex ratio is 0.83.

[25] See also Tuffin (2018) who examines the allocation of convicts to coal mining based on appropriation lists of ships to Van Diemen's Land between 1835 and 1846 and reaches the same conclusion.

same conclusions about convicts transported to New South Wales from Scotland. Overwhelmingly, most convicts transported to the colonies were first time offenders convicted of single small-scale property crime, such as theft of food and clothing, which could result in transportation for up to seven years (National Museum of Australia, 2023).

Nineteenth century accounts depicted female convicts as prostitutes or 'whores', lacking in moral character, but these accounts were heavily distorted by Victorian mores. Oxley (1988, 1991, 1996) argued that the majority of female convicts had been domestic servants in Britain who were more affected by economic downturns than men and engaged in theft and casual prostitution to survive periods of hardship. Similar to Nicholas (1990), Oxley (1991, p. 96) concludes: "The women transported to New South Wales were not members of a professional criminal class. They were not known recidivists, nor were they cruel and vicious criminals; they were women guilty of single, small-scale property crimes".[26]

Nicholas and Shergold (1989, pp. 75-76) argue that the convicts transported to Australia were "better educated than the 'average' English worker left behind in Britain". Three-quarters of the English convicts who arrived in New South Wales could read and/or write, which was higher than the overall average of English workers who could sign the marriage register (58 per cent) (Nicholas, 1990). The nutritional status and labour productivity of convicts transported to Australia were at least as good as the British working class (Nicholas, 1990; Nicholas & Shergold, 1989). Butlin (1994, p. 97) concludes that average GDP grew at 13% per year in Van Diemen's Land in the 30 years up to 1840. Nicholas (1989, p. 201) suggests that the strong economic performance of the British colonies in the nineteenth century was "was highly correlated with the quality and quantity of its convict and ex-convict workforce".

Existing empirical evidence contradicts the convict stain idea. For instance, a common view in the eighteenth and nineteenth centuries was that convicts transported to New South Wales and Van Diemen's Land were homophobic. If there was a convict stain, one would expect that in locations where the historical sex ratio was male-biased that present day attitudes would be more homophobic. But Baranov et al. (2020) show that areas with more convicts historically were more likely to vote in favour of same sex marriage in the 2017 plebiscite on same sex marriage held in Australia. Additionally, to alleviate concern about convict stain persistence, we control for the number of convicts in our model.

6. Results

6.1. Baseline results

Table 2 reports baseline OLS results for the effects of the historical sex-ratio on social capital.[27] Each specification includes all covariates and relevant fixed effects previously discussed. Overall, the findings from Table 2 demonstrate that people who live in areas where sex ratios were high (i.e., male-biased), tend to have higher social capital. Focusing on the composite

[26] A small proportion of convicts – numbering about 3600 in total – were ostensibly political prisoners, who were transported from other British colonies such as Canada, Ireland, New Zealand and South Africa, for protesting against British rule (Carter, 2009; Graham & Bamford, 1985; Hopkins, 1997).

[27] The full set of results show coefficients on all control variables are reported in Table A1.

indicator of social capital, we find that the coefficient on the historical sex ratio is statistically significant at the 1% level with a coefficient of 0.021, signifying that a unit increase in the historical sex ratio is associated with an increase in social capital of 0.021 on the seven-point scale. To put this into context, a standard deviation (1.834 in Table 1) increase in the historical population sex ratio is associated with a 3.9% increase in social capital.

The results for the sub-dimensions of our social capital index suggest that the association between the historical sex ratio and social capital is significant in four out of the six indicators. Specifically, we find significant positive association between the historical sex ratio and neighbourhood trust, neighbourhood assistance, neighbourhood participation and the extent of connectedness within the neighbourhood (i.e., close-knit neighbourhood).

These results for the social capital sub-dimensions imply that people who reside in areas where sex ratios were high are more likely to hold the view that: their neighbours can be trusted, their neighbours help each other, they participate in activities or do things together with their neighbours, and their neighbourhood is close-knit. These findings are likely underpinning the positive relationship between the historical sex ratio and overall social capital, given that effects on the other two sub-dimensions are statistically insignificant.

6.2. Instrumental variable and reduced form results

Table 3 presents the instrumental variable results for effects of the historical sex ratio on our main indicator of social capital and the six sub-dimensions of social capital. The first stage F-statistics, which are greater than 104.7 in each of the seven specifications suggest that the convict sex ratio is not weakly correlated with the historical sex ratio (Lee et al., 2022). The point estimates here are relatively larger in magnitude compared to those in Table 2, suggesting that the OLS estimates a biased downwards. Specifically, the results in Column (1), which explain the impact of historical sex ratio on our index of social capital suggest that a standard deviation increase in the historical sex ratio causes a 12.3 per cent increase in social capital. The instrumental variable results for the sub-dimensions also reinforce the findings from Table 2 with significant effects observed for three out of the six sub-dimensions.

Table 4 presents the reduced form estimates in which we regress social capital on the convict sex ratio. The results in Column (1) for the composite indicator of social capital show that the coefficient on the convict sex ratio is statistically significant at the 1 per cent level, with a coefficient of 0.002, signifying that a unit increase in the convict sex ratio causes an increase in social capital of 0.002 on the 7-point scale. This equates to a standard deviation (26.753 in Table 1) increase in the convict sex ratio being responsible for a 5.4% increase in social capital. Regarding the sub-dimensions, the effects of the convict sex ratio are significant in three out of the six indicators. Specifically, we find significant positive effects of the convict sex ratio on neighbourhood assistance, neighbourhood participation and the extent of connectedness within the neighbourhood (i.e., close-knit neighbourhood).

6.3. Differential effect of gender norms on the social capital of men and women

Gender norms might also influence what has been described as the dark side of social capital (Graeff, 2009). If social capital develops in locations in which masculinity norms are stronger

or gender norms are more conservative, a lot of this social capital might be skewed toward benefiting men (and be exclusionary of women) (Gosling, 2008). A common criticism of sporting clubs in Australia is that they encourage behaviour (excessive alcohol, gambling and negative attitudes to women) that makes women feel unwelcome (Tonts, 2005). This is related to the dark side of mateship that encourages loutish behaviour. The same is true of watching sport, reflected, for instance, in the case study of the Grog Squad referenced earlier in the paper. This is particularly true of sporting teams in regional and rural areas (Tonts, 2005) and raises the question: who benefits from social capital formed in this way?

To examine if there are gender differences in the effects of gender norms on social capital, we conduct a sub-sample analysis of males and females. The results, which are reported in Table A2, show that the effects of the historical sex ratio on social capital are more pronounced for males than females. The positive effect of the historical sex ratio on composite social capital holds for the sub-sample of males. However, the effects are not statistically significant for the sub-sample of females. Considering the sub-dimensions of social capital, the positive effect of historical sex ratios on social capital is reinforced for neighbourhood assistance, neighbourhood participation and the extent of connectedness within the neighbourhood (i.e., close-knit neighbourhood) in the male sub-sample. However, in the sub-sample of females, we find that effects are only significant for neighbourhood participation and the extent of connectedness within the neighbourhood, although the magnitude of effect is relatively smaller compared to what we observe in the male sub-sample.

How does this translate to broader outcomes? To answer this question, we consider two of the well-established generic benefits of higher social capital: subjective wellbeing and general health (see, e.g., Appau et al., 2020; Awaworyi Churchill & Mishra, 2017; Helliwell & Wang, 2011; Portela et al., 2013). As general measures of wellbeing, we use indicators of health and life satisfaction, both of which are available in HILDA.[28] Health and life satisfaction are higher in postcodes with higher convict sex ratios for the full sample and for men and women separately and the effect sizes are very similar across genders (Table A3). In Table A4, we examine the role of social capital as a mediator between the convict sex ratio and health and life satisfaction for the full sample, as well as men and women separately. We find that convict sex ratios cause an increase in social capital, which in turn, cause with an increase in wellbeing and health. Thus, those who live in areas where sex ratios were high (i.e., male-biased) have higher health and wellbeing and this is mediated through higher social capital.

6.4. Robustness and sensitivity checks

We examine the robustness of our results to a series of tests and checks. One might be concerned that our results are confounded by spatial autocorrelation in the residuals. In Table

[28] We measure health using the self-reported general health indicator based on the HILDA survey question which asks how they would rate their health, in general, on a 5-point scale. This is the most widely used indicator of general health (see, e.g., Awaworyi Churchill & Smyth, 2021; Awaworyi Churchill et al., 2022; Crossley & Kennedy, 2002; Hosseinpoor et al., 2012; Mintah et al., 2022). We measure life satisfaction on a 10-point scale (where 0 is totally dissatisfied and 10 is totally satisfied) using the HILDA survey question: "All things considered, how satisfied are you with your life?"

4, as demonstrated by the reported Moran statistics, we find that our results are also robust to potential spatial autocorrelation in the residuals.

We employ Oster (2019) bounds analysis in Table 4 to explore whether our estimates are sensitive to omitted variables bias. Specifically, following the approach in Oster (2019), we calculate bounds using maximum $R^2=1.3xR^2$ with all standard controls. The bounded set is defined by the effect in the main specification with controls and the treatment effect, assuming observables are as important as unobservables. The results suggest that our estimates are relatively stable and robust to omitted variables bias in each model in which we observe a significant effect for the convict sex ratio.

Next, we consider alternative indicators of social capital focused on frequency of social gatherings as well as level of interconnectedness captured through respondents' views on the extent to which they can confide in, or lean on, others in times of trouble.

The reduced form results, which are reported in Table 5, suggest that people who reside in areas where historical sex ratios (i.e., male-biased) were high are more likely to get together socially with friends or relatives they are not living with and less likely to agree that they don't have anyone that they can confide in or lean on in times of trouble.

In Table 6, we examine the robustness of our reduced form estimates to various methodological approaches, different samples and different specifications. First, in Column (1), we examine the robustness of our results to clustering standard errors at the county level. Following Grosjean and Khattar (2019) we bias-correct the standard errors by inflating the standard errors to adjust for the relatively small number of county clusters, given that only New South Wales and Tasmania were penal colonies and, therefore, convicts were present in only one third of the historical counties. In Column (2), we examine the robustness of our results to non-linear effects of the convict sex ratio by taking the logarithmic transformation, which should smooth the data distribution. Some overtly masculine attitudes and behaviours such as violence might be more prevalent in metropolitan areas, and this could be influencing our results. Hence, in Column (3), we exclude metropolitan areas to examine if our results remain robust. To examine the robustness of our results to the exclusion of potential outliers, in Column (4) we exclude counties with less than 100 women historically while in Column (5), we exclude counties with less than 300 people or more than 40,000 people historically. In Column (6) we examine the robustness of our results to propensity score matching. Following Grosjean and Khattar (2019), we predict historical sex ratios as a function of historical employment shares in different sectors, geographic characteristics and the interaction between historical and geographic characteristics, and then condition on the predicted propensity score. In Column (7), we conduct a placebo test, in which we randomise the historical sex ratio across areas. Here a significant effect of the sex ratio suggests that the positive effects on social capital could be driven by factors other than the sex ratio.

Last, given that historical masculinity norms tend to create culture of violence, and violence could have an adverse effect on social capital, in Column (8), we examine the robustness of our results to controlling for local crime rates using postcode level crime data taken from Awaworyi Churchill and Smyth (2022). In Columns (1) to (6) and Column (8), consistently, we

find that the positive effect of the convict sex ratio on social capital is reinforced. In Column (7), consistent with expectations, the coefficient on the convict sex ratio is insignificant.

6.5. *Cultural persistence and the role of vertical transmission of gender norms*

To examine the role of vertical transmission of gender norms within families, we compare the effect of historical sex ratios on the social capital of respondents whose parents were, and were not, born in Australia (Baranov et al., 2023; Grosjean & Khattar, 2019; Nunn & Wantchekon, 2011). If gender norms have transmitted through generations since the mid-nineteenth century in areas with male-biased sex ratios through storytelling about bush legends, the exploits of the ANZACs and the like, then respondents whose parents were born in Australia will be more likely to have had these norms passed to them.

To test this conjecture, we regress our measure of social capital on the historical convict sex ratio, a dummy variable that indicates whether the respondent's parents were born in Australia and an interaction term between these two variables. The interaction term captures whether the historical convict sex ratio has a bigger effect on the social capital of respondents whose parents were born in Australia. The results, which are reported in Column (1) of Table 7, show that the effect of the historical convict sex ratio is relatively bigger for respondents whose parents were born in Australia compared to respondents whose parents were not.

To examine the role of assortative matching in perpetuating the transmission of cultural gender norms, we regress our measure of social capital on the historical convict sex ratio, a dummy variable that indicates whether the respondent's partner was born in Australia and an interaction term between these two variables. The interaction term captures whether the historical convict sex ratio has a bigger effect on the social capital of respondent's whose partner was born in Australia as a proxy for assortative matching. The results from Column (2) of Table 7 suggest that the effect of historical convict sex ratio on social capital is relatively larger for respondents whose partners are born in Australia.

Immigration attenuates the evolution of local cultural norms (Friedman-Sokuler & Senik, 2020; Schmitz & Weinhardt, 2019). Immigration may potentially attenuate the transmission of gender norms for two reasons. One is that greater ethnic diversity increases the range of potential marriage partners, increasing opportunities to find partners who do not share traditional views about the role of gender (Belloc & Bowles, 2013). The other is that migrants will be less familiar with the shared historical stories and traditions that underpin gender norms and, as such, be less likely to exhibit attitudes and behaviours consistent with them. They will also be less likely to pass them down to their own children. To examine the role of ethnic diversity, we regress our measure of social capital on the historical convict sex ratio, ethnic diversity at the postcode level and an interaction term between these two variables. From Column (3) of Table 7, we find that the effect of historical convict sex ratio is relatively smaller in magnitude for respondents who live in ethnically diverse neighbourhoods (i.e., postcodes). In Column (4) of Table 7, as an alternative test for the attenuating effect of migration, rather than ethnic diversity, we interact a dummy variable equal to one if respondents migrated across postcodes with the convict sex ratio. The effect of historical convict sex ratio is relatively smaller in magnitude for internal migrants.

Collective memory of masculine values is another transmission mechanism. One might expect shared remembrance of the values encapsulated in mateship exhibited in war to be higher in neighbourhoods with higher convict sex ratios. To examine the role of shared remembrance of masculine values, male sacrifice and mateship forged in war as a vertical transmission mechanism we use war memorials per capita, which we have at the postcode level for New South Wales. We regress social capital on the historical convict sex ratio, a variable denoting the number of war memorials per capita in each New South Wales postcode and an interaction term between these two variables. The interaction term captures the moderating effect of shared remembrance of war on the effect of the convict sex ratio on social capital. The results from Column (5) of Table 7 suggest that the effect of historical convict sex ratio on social capital is relatively larger for respondents who live in postcodes with more war memorials per capita. This result is consistent with Figure 1 and with the finding in Baranov et al (2023) that men from municipalities in Tasmania with higher convict sex ratios were more likely to volunteer for active service in WWI (i.e., become ANZACs).

6.6. Vertical transmission of conservative gender norms and masculinity norms

Gender norms could be manifest in the form of conservative gender norms, reflecting the effect of high sex ratios on male-female bargaining, or masculinity norms, reflecting the effect of high sex ratios on male-male competition. Our contention is that sex ratios influence the evolution of mateship and social capital through both types of gender norms. We present suggestive evidence on the moderating effect of conservative gender norms and masculinity norms on the effect of the convict sex ratio on social capital for men and women, separately. To do so, we regress social capital on the historical convict sex ratio, a variable denoting conservative gender norms or masculinity norms and an interaction term between these two variables. The interaction term captures whether the historical convict sex ratio has a bigger effect on the social capital of respondents expressing attitudes consistent with conservative gender norms or engaging in behaviour reflective of masculinity norms.

The results are presented in Table 8 Panel A (for men) and Panel B (for women). For men, conservative gender norms and masculinity norms (vaccine reluctance, being a heavy drinker, having smoked and preferring high risk-high return investment strategies) reinforces the positive effect of the convict sex ratio on social capital. However, the interaction terms are insignificant for women. These results suggest that cultural persistence is transmitted through behaviour and values consistent with both conservative gender norms and masculinity norms, reinforcing the effects of the convict sex ratio on social capital for men, but not women.

6.7. *Mediation analysis*

To examine the role of potential contemporary mediators, such as physical activity, club membership and engagement in volunteering or charity work as channels through which the sex ratio influences social capital, we perform a causal mediation analysis following the approach described in Liu et al. (2014). The discussion in Section 3 suggests that gender norms might be a cause of higher rates of participation in physical activity, and participation in sports in particular, as well as club membership, such as membership of sporting clubs, the SLSA, RSL clubs and men's groups, such as Men's Sheds. Although such engagement on the back of

gender norms is likely to be greater among men, there could be spillovers to women, through vertical transmission of cultural gender norms within families and assortative matching. For instance, women who are physically more active are likely to be attracted to men who are physically active and have shared cultural and sporting interests, which are likely to be reflected in club membership. For example, Cobb et al. (2016) find that rates of engagement in physical activity are higher among men whose wives also exercise. Houts et al. (1996) find evidence of assortative matching on the basis of leisure preferences, including interest in sports and proclivity to engage in volunteering. With respect to volunteering and charity work, because female labour force participation is lower in locations with conservative gender norms (Grosjean & Khattar, 2019), one might expect that there would be more time for women to be engaged in voluntary organisations (Putnam, 1995).

The results in Table 9 suggest that the sex ratio increases social capital through each of the mediators. Specifically, we find that historical sex ratio causes an increase in the frequency of physical activity, active club or association membership and an increase in engagement in volunteering or charity work, all of which, in turn, cause an increase in social capital.

Thus, those who live in areas where sex ratios were historically high (i.e., male-biased) engage more frequently in physical activity, have active club or association membership and engage in volunteering or charity work, all of which increases social capital. Overall, frequency of physical activity, club membership and engagement in volunteering or charity work mediate the relationship between the historical sex ratio and social capital.

In Section 6.3 we showed that while social capital develops in locations in which conservative gender and masculinity norms are stronger, much of this social capital is skewed towards benefitting men more than women. In Section 6.6, we showed that conservative gender norms and masculinity norms moderated the positive effect of historical sex ratios on social capital for men, but not women. In this section, we examine if further insights can be gained from the pathways through which gender norms influence social capital. The results, reported in Table A5, demonstrate that frequency of physical activity, club membership and engagement in volunteering or charity work mediate the relationship between the sex ratio and social capital for men. Specifically, for men, we find that the historical sex ratio causes an increase in the frequency of physical activity, active club or association membership and an increase in engagement in volunteering or charity work. However, for women, the historical sex ratio causes a decline in the frequency of physical activity and has no significant effect on active club or association membership and engagement in volunteering or charity work.

7. Conclusion

We employ a natural experiment – the transport of convicts to the British colonies of New South Wales and Van Diemen's Land in the eighteenth and nineteenth centuries – to examine the long-run effect of gender norms on the formation of social capital in modern-day Australia. Convicts who were transported to New South Wales and Van Diemen's Land were overwhelmingly men. Because convicts made up most of the early settlers in these colonies, the sex ratios were historically extremely male-biased. In the other colonies, which did not

receive convicts, early settlement was not as skewed towards men. This generated considerable spatial variation in the early sex ratios across the colonies that we exploit.

We find that neighbourhoods (postcodes) in which the sex ratios were heavily biased towards men in the past are characterised by higher levels of social capital. With respect to specific facets of social capital, we find that in neighbourhoods with historically high sex ratios that people are more likely to help each other and do things together and are more close-knit.

We present evidence consistent with gender norms being transmitted within families and that the transmission mechanism is reinforced through assortative matching via marriage. We find that the effect of gender norms on the formation of social capital is attenuated in neighbourhoods that are more ethnically diverse, reflecting the role of migration in diluting awareness of shared historical stories and traditions that underpin cultural norms. We also present evidence that shared remembrance of war, as proxied by war memorials per capita, moderates the effect of the convict sex ratio on the level of social capital. We find suggestive evidence that the persistent effects of historically high sex ratio operate through both conservative gender norms and masculinity norms, but the interaction term between proxies for both types of gender norms and the convict sex ratio is only significant for men.

We show that frequency of physical activity, membership of clubs and associations and volunteer and charity work mediate the relationship between historical sex ratios and social capital. This result is consistent with the argument presented earlier in the paper that in locations with historically male-biased sex ratios, physical activity and participation in organised sports is likely to be higher. The results are also consistent with the idea that in neighbourhoods with historically high sex ratios, there will be more engagement with sports clubs and other associations underpinned by mateship and shared values built on masculinity norms, such as the SLSA, RSL clubs and men's groups, such as Men's Shed.

While one might expect these mediating effects to be driven by engagement by men, conceptually, it is possible that there could be spillover effects to women. One way in which this could occur is through assortative matching. Another is through there being lower female labour force participation rates in neighbourhoods with more conservative gender norms (Grosjean & Khattar, 2019). This would mean that women spend more time in their neighbourhoods, reinforcing the role that women play in binding communities together – because women are more civically engaged (Caiazza & Putnam, 2005) – and in creating social capital through volunteering and charity work. However, our subsample analysis suggests that most of the increase in social capital is due to an increase in social capital among men. The mediators - frequency of physical activity, active club or association membership and engagement in volunteering or charity work - hold for men, but not for women.

Our findings add to existing studies on the role that founder populations can play in influencing the social future of countries centuries later. The existing literature on the long-term effects of the transportation of convicts to New South Wales and Van Diemen’s Land on socioeconomic outcomes in modern day Australia via the creation of gender norms has tended to paint a negative picture. Existing studies have found that conservative gender norms and masculine values have been responsible for lower female labour force participation rates

and gender-based occupational segregation, higher rates of homophobia, more violent crime and higher rates of male suicide (Grosjean & Khattar, 2019; Baranov et al., 2020; Baranov et al, 2023). We show that masculinity norms born out of Australia's convict past can have positive outcomes in the form of higher social capital. This conclusion is tempered somewhat to the extent that gender norms create social capital that is exclusionary of women. An often-made complaint is that socialising among mates is associated with loutish behaviour, fuelled by excessive alcohol consumption that excludes women and that the networks that are formed through such social capital benefits men, rather than women. Our subsample analysis suggests that our composite measure of social capital and its facets is higher among men than women in neighbourhoods with higher historical sex ratios. This said, the effects of historical sex ratios on health and life satisfaction – as two general indicators of wellbeing – are similar for men and women, and social capital mediates this relationship.

Our results are important because social capital is recognised as a vital enabler of outcomes that economists, and social scientists more generally, see as central to better societies. As the quote from *Bowling Alone* in the introduction referenced, having adequate stocks of social capital contributes to having better political outcomes, stronger economies and improved fundamental individual outcomes, such as better health and happiness (Putnam, 2000).

While our results are based on a unique historical natural experiment, our findings are potentially useful in informing debate about the implications of a male-biased sex ratio in other countries, such as China where the one-child policy and culturally based son preference has skewed sex ratios in favour of men. China's annual missing women ranged between 0.9 million and 1.7 million between 1950 and 2020 with an average of 1.3 million per year (Datt et al., 2022). In China, there is evidence that the adverse effect of masculinity norms on contributing to criminal violence, as identified by Baranov et al. (2023), has been a consequence of the one-child policy (Edlund et al., 2013). However, the extent to which our results for masculinity norms and social capital are applicable to a country like China, depends on the extent to which cultural norms in the two countries evolve in a similar way. The notion of mateship is not unique to Australia, but it takes on a special significance in defining the national identity that can be traced back to the convict period. This is central in understanding the transmission of cultural norms over time. More research would be needed to understand the transmission mechanism in other cultural contexts, such as that provided by China.

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Table 1: Summary statistics

Variable	Mean	Std. dev.	Min	Max
Panel A: Historical data				
Historical sex ratio	2.612	1.834	1.263	10.750
Convict sex ratio	16.625	26.753	1.270	219.000
Historical population (1000 s)	18,868.740	16,636.370	311.000	36,797.000
Number of convicts (1000 s)	0.965	0.056	0.764	2.019
Panel B: HILDA survey				
Social capital variables:				
Social capital	3.688	1.105	1.000	7.000
Neighbourhood trust	4.791	1.151	1.000	7.000
Neighbourhood assistance	3.587	1.091	1.000	5.000
Neighbourhood participation	2.989	1.130	1.000	5.000
Close-knit neighbourhood	4.042	1.242	1.000	7.000
Neighbourhood discord (reversed)	5.332	1.075	1.000	7.000
Neighbourhood value disparity (reversed)	4.902	1.108	1.000	7.000
Other variables:				
Single	0.366	0.482	0.000	1.000
Married	0.508	0.500	0.000	1.000
Cohabiting	0.125	0.331	0.000	1.000
Year 11 and below	0.316	0.465	0.000	1.000
Year 12	0.143	0.350	0.000	1.000
Vocational/Certificate	0.273	0.446	0.000	1.000
Degree	0.268	0.443	0.000	1.000
Female	0.535	0.499	0.000	1.000
Age	44.851	18.542	15.000	100.000
Australian born	0.774	0.418	0.000	1.000

Table 2: Historical sex ratio and social capital – baseline OLS results

	Social capital	Neighbourhood trust	Neighbourhood assistance	Neighbourhood participation	Close-knit neighbourhood	Neighbourhood discord (reversed)	Neighbourhood value disparity (reversed)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Historical sex ratio	0.021***	0.018***	0.023***	0.029***	0.030***	-0.004	0.004
	(0.004)	(0.007)	(0.004)	(0.005)	(0.008)	(0.007)	(0.007)
Individual control	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
State and Year FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Mean of dependent var.	3.688	4.791	3.587	2.989	4.042	5.332	4.902
Observations	118,922	110,400	113,266	111,047	110,417	110,417	110,420

Notes: Results of reduced form. Standard errors clustered at the individual level. Individual controls are age, gender, educational levels, marital status, and country of origin. Geographic controls are at the postcode level and include the postcodes centroid and the minerals and land type of the postcode. Historic controls are the historical county population, convict population, as well as the presence and type of mineral deposit (major coal; major gold; other) and land formation (plains and plateaus, mountains, other). *** p<0.01, ** p<0.05, * p<0.1

Table 3: Historical sex ratio and social capital (2SLS results)

	Social capital	Neighbourhood trust	Neighbourhood assistance	Neighbourhood participation	Close-knit neighbourhood	Neighbourhood discord (reversed)	Neighbourhood value disparity (reversed)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Second stage:							
Historical sex ratio	0.067***	0.025	0.056**	0.117***	0.137***	-0.064	-0.015
	(0.025)	(0.038)	(0.027)	(0.031)	(0.043)	(0.042)	(0.046)
First stage:							
Convict sex ratio	0.024***	0.023***	0.023***	0.023***	0.024***	0.024***	0.024***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Kleibergen-Paap F statistic	399.046	373.032	380.599	378.447	373.406	373.562	373.411
Individual control	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
State and Year FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Mean of dependent var.	3.688	4.791	3.587	2.989	4.042	5.332	4.902
Observations	39,815	36,861	37,991	37,225	36,879	36,891	36,890

Notes: Standard errors clustered at the individual level. Individual controls are age, gender, educational levels, marital status, and country of origin. Geographic controls are at the postcode level and include the postcodes centroid and the minerals and land type of the postcode. Historic controls are the historical county population, convict population, as well as the presence and type of mineral deposit (major coal; major gold; other) and land formation (plains and plateaus, mountains, other). *** p<0.01, ** p<0.05, * p<0.1

Table 4: Convict sex ratio and social capital (reduced form results)

	Social capital	Neighbourhood trust	Neighbourhood assistance	Neighbourhood participation	Close-knit neighbourhood	Neighbourhood discord (reversed)	Neighbourhood value disparity (reversed)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Convict sex ratio	0.002***	0.001	0.001**	0.003***	0.003***	-0.002	-0.000
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Spatial HAC *p*-value	0.035	0.525	0.004	0.001	0.007	0.083	0.693
Moran statistic *p*-value	0.720	0.513	0.879	0.966	0.192	0.253	0.552
Bounds on the treatment effect (Delta=1, Rmax=1.3*R)	(0.0012, 0.0026)	(-0.0006, 0.0010)	(0.0012, 0.0013)	(0.0017, 0.0027)	(0.0006, 0.0032)	(-0.0015, 0.0009)	(-0.0004, 0.0002)
Individual control	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
State and Year FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Mean of dependent var.	3.688	4.791	3.587	2.989	4.042	5.332	4.902
Observations	39,815	36,861	37,991	37,225	36,879	36,891	36,890

Notes: Results of reduced form. Standard errors clustered at the individual level. Individual controls are age, gender, educational levels, marital status, and country of origin. Geographic controls are at the postcode level and include the postcodes centroid and the minerals and land type of the postcode. Historic controls are the historical county population, convict population, as well as the presence and type of mineral deposit (major coal; major gold; other) and land formation (plains and plateaus, mountains, other). *** p<0.01, ** p<0.05, * p<0.1

Table 5: Alternative measures of social capital

	Frequency of social gatherings	No one to confide in (reversed)	No one to lean on (reversed)
	(1)	(2)	(3)
Convict sex ratio	0.002*	0.003**	0.004**
	(0.001)	(0.002)	(0.002)
Individual control	Yes	Yes	Yes
Geographic controls	Yes	Yes	Yes
Historical controls	Yes	Yes	Yes
State and Year FEs	Yes	Yes	Yes
Observations	73,391	73,704	73,714

Notes: Results of reduced form. Standard errors clustered at the individual level. Individual controls are age, gender, educational levels, marital status, and country of origin. Geographic controls are at the postcode level and include the postcodes centroid and the minerals and land type of the postcode. Historic controls are the historical county population, convict population, as well as the presence and type of mineral deposit (major coal; major gold; other) and land formation (plains and plateaus, mountains, other). *** p<0.01, ** p<0.05, * p<0.1

Table 6: Other robustness checks

	Clustering county level	Non-linear effects	Excluding metropolitan areas	No county with <100 women, historically	No county with <300 or >40,000 people, historically	PS matching	Random historical sex ratio	Controlling for crime rate
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Convict sex ratio	0.002**	0.063***	0.002***	0.002**	0.002***	0.002***	-0.000	0.0014**
	(0.001)	(0.024)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.0006)
Individual control	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Geographic controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Historical controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
State and Year FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	39,815	39,815	10,649	39,089	39,815	38,341	39,815	35,273

Notes: Standard errors clustered at the individual level. Individual controls are age, gender, educational levels, marital status, and country of origin. Geographic controls are at the postcode level and include the postcodes centroid and the minerals and land type of the postcode. Historic controls are the historical county population, convict population, as well as the presence and type of mineral deposit (major coal; major gold; other) and land formation (plains and plateaus, mountains, other). *** p<0.01, ** p<0.05, * p<0.1

Table 7: Cultural persistence and the role of vertical transmission of gender norms

	Social capital				
	(1)	(2)	(3)	(4)	(5)
Convict sex ratio	0.003***	0.002***	0.007	0.007	0.000
	(0.000)	(0.001)	(0.006)	(0.006)	(0.000)
Australian parent	0.139***				
	(0.013)				
Convict sex ratio*Australian parent	0.001**				
	(0.000)				
Australian partner		0.045**			
		(0.022)			
Convict sex ratio*Australian partner		0.002***			
		(0.001)			
Ethnic diversity			-0.968***		
			(0.075)		
Convict sex ratio*Ethnic diversity			-0.003**		
			(0.001)		
Migration				0.188***	
				(0.022)	
Convict sex ratio*Migration				-0.001**	
				(0.001)	
War memorials					64.057***
					(20.262)
Convict sex ratio*War memorials					0.963**
					(0.393)
Individual control	Yes	Yes	Yes	Yes	Yes
Geographic controls	Yes	Yes	Yes	Yes	Yes
Historical controls	Yes	Yes	Yes	Yes	Yes
State and Year FEs	Yes	Yes	Yes	Yes	Yes
Mean of dependent var.	3.688	3.688	3.688	3.688	3.688
Observations	39,482	23,707	10,827	39,815	35,384

Notes: Results of reduced form. Standard errors clustered at the individual level. Individual controls are age, gender, educational levels, marital status, and country of origin. Geographic controls are at the postcode level and include the postcodes centroid and the minerals and land type of the postcode. Historic controls are the historical county population, convict population, as well as the presence and type of mineral deposit (major coal; major gold; other) and land formation (plains and plateaus, mountains, other). *** p<0.01, ** p<0.05, * p<0.1

Table 8: Cultural persistence and the vertical transmission of conservative gender norms and masculinity norms for men and women

Panel A: Men

	Social capital				
	(1)	(2)	(3)	(4)	(5)
Convict sex ratio	0.001	0.004***	0.003***	0.004***	0.001
	(0.002)	(0.000)	(0.001)	(0.001)	(0.000)
Conservative gender norm	0.121**				
	(0.050)				
Convict sex ratio*Conservative gender norm	0.002**				
	(0.001)				
Vaccine reluctance		-0.157***			
		(0.023)			
Convict sex ratio*Vaccine reluctance		0.001*			
		(0.001)			
Smoking (ever)			-0.145***		
			(0.039)		
Convict sex ratio*Smoking			0.002*		
			(0.001)		
Risk preference				-0.035***	
				(0.012)	
Convict sex ratio*Risk preference				0.001***	
				(0.000)	
Alcohol use (heavy)					0.003
					(0.023)
Convict sex ratio*Alcohol use					0.002***
					(0.001)
Observations	1,283	18,546	8,276	15,635	14,007

Notes: Results of reduced form. Standard errors clustered at the individual level. Individual controls are age, educational levels, marital status, and country of origin. Geographic controls are at the postcode level and include the postcodes centroid and the minerals and land type of the postcode. Historic controls are the historical county population, convict population, as well as the presence and type of mineral deposit (major coal; major gold; other) and land formation (plains and plateaus, mountains, other). *** p<0.01, ** p<0.05, * p<0.1

Panel B: Women

	Social capital				
	(1)	(2)	(3)	(4)	(5)
Convict sex ratio	0.001	0.003***	0.003***	0.000	0.000
	(0.002)	(0.000)	(0.001)	(0.002)	(0.000)
Conservative gender norm	0.125***				
	(0.028)				
Convict sex ratio*Conservative gender norm	0.001				
	(0.002)				
Vaccine reluctance		-0.155***			
		(0.022)			
Convict sex ratio*Vaccine reluctance		0.000			
		(0.001)			
Smoking (ever)			-0.150***		
			(0.049)		
Convict sex ratio*Smoking			-0.002		
			(0.002)		
Risk preference				-0.054***	
				(0.014)	
Convict sex ratio*Risk preference				-0.000	
				(0.000)	
Alcohol use (heavy)					0.107***
					(0.023)
Convict sex ratio* Alcohol use					0.000
					(0.001)
Observations	1,522	21,295	7,783	17,231	14,586

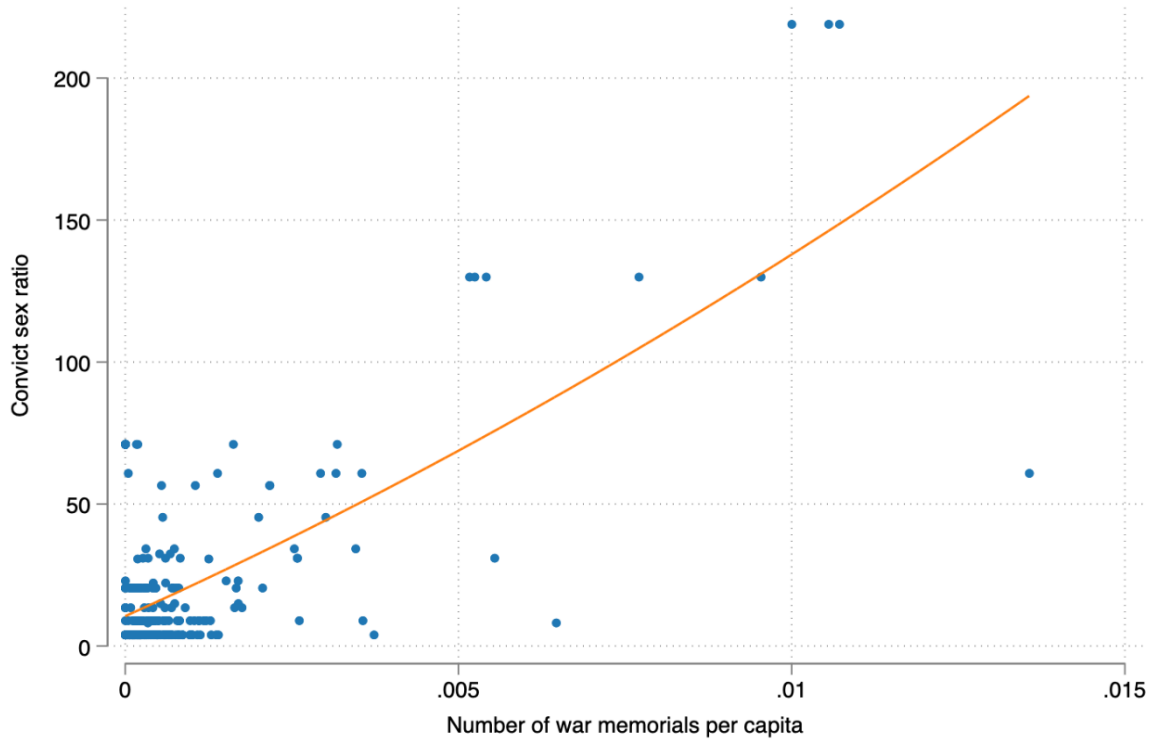
Notes: Results of reduced form. Standard errors clustered at the individual level. Individual controls are age, educational levels, marital status, and country of origin. Geographic controls are at the postcode level and include the postcodes centroid and the minerals and land type of the postcode. Historic controls are the historical county population, convict population, as well as the presence and type of mineral deposit (major coal; major gold; other) and land formation (plains and plateaus, mountains, other). *** p<0.01, ** p<0.05, * p<0.1

Table 9: Causal mechanism analysis

	Direct effect	Indirect effect
	(1)	(2)
Physical activity frequency	0.0012***	0.00009***
	(0.0002)	(0.00001)
Active club/association membership	0.0009***	0.0002***
	(0.0002)	(0.00001)
Volunteer/charity work	0.0012***	0.00002***
	(0.0002)	(0.000001)
Individual control	Yes	Yes
Geographic controls	Yes	Yes
Historical controls	Yes	Yes
State and Year FEs	Yes	Yes

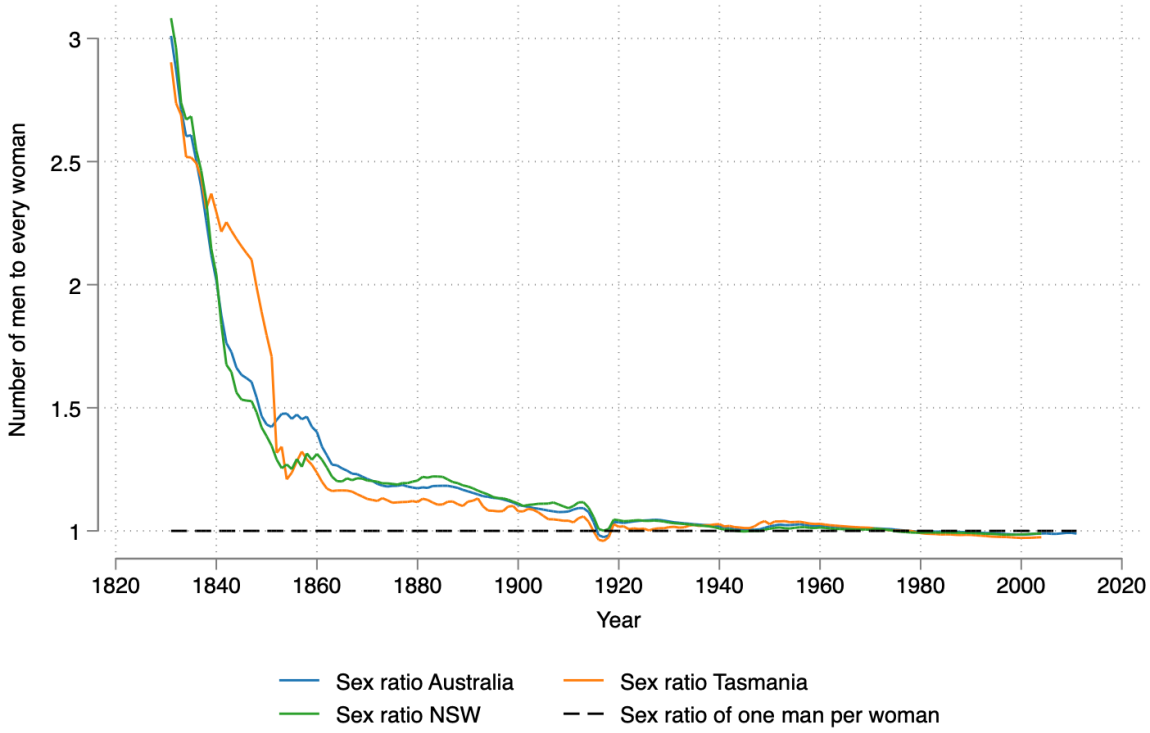
Notes: Results of reduced form. Standard errors clustered at the individual level. Individual controls are age, gender, educational levels, marital status, and country of origin. Geographic controls are at the postcode level and include the postcodes centroid and the minerals and land type of the postcode. Historic controls are the historical county population, convict population, as well as the presence and type of mineral deposit (major coal; major gold; other) and land formation (plains and plateaus, mountains, other). *** p<0.01, ** p<0.05, * p<0.1

Figure 1: Convict sex ratios and number of war memorials



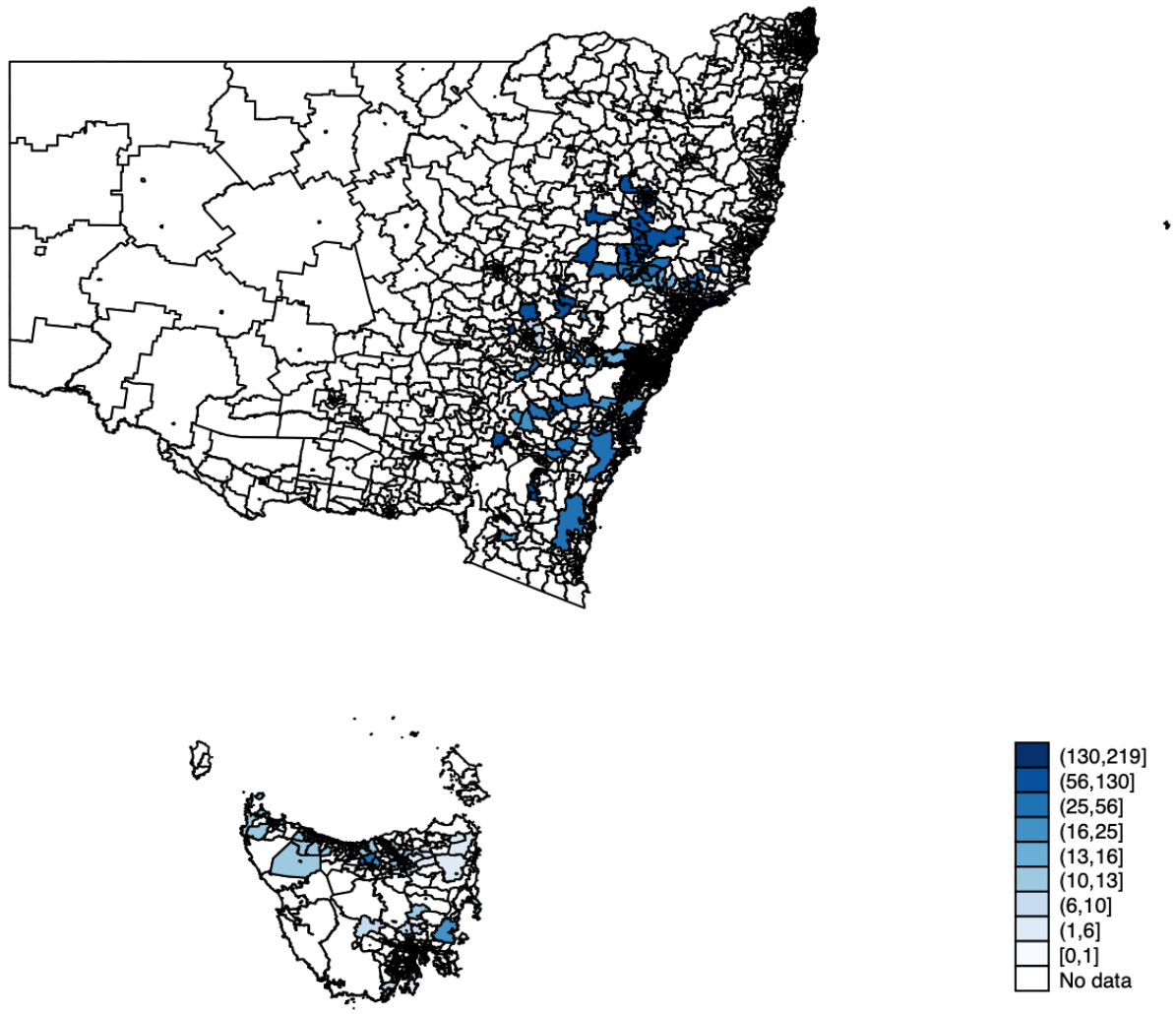
Notes: This figure shows the correlation between the convict sex ratio and number of war memorials per capita in New South Wales postcodes. For details on the construction of the variables see Section 4.

Figure 2: Sex ratio in Australia: number of men to every woman, 1830–2011



Source: Australian Bureau of Statistics.

Figure 3: Convict sex ratios in mid-19th century Australia



Notes: The maps show the parts of Australia that had convict settlement: 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.

Appendix

Table A1: Historical sex ratios and social capital – Results with controls

	Social capital	Neighbours help	Community collaboration	Tight-knit community	Trustworthy community	Harmonious neighbours	Unified values community
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Convict sex ratio	0.002***	0.001	0.001**	0.003***	0.003***	-0.002	-0.000
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Marital status (Ref: single)							
Cohabiting	0.135***	0.258***	0.161***	0.114***	0.232***	0.124***	0.210***
	(0.020)	(0.032)	(0.023)	(0.025)	(0.035)	(0.031)	(0.031)
Married	-0.040	0.009	-0.041	-0.048	0.068*	-0.001	0.060*
	(0.025)	(0.037)	(0.028)	(0.030)	(0.040)	(0.034)	(0.035)
Education (Ref: Year 11 and below)							
Year 12	0.088***	0.181***	0.081***	0.066**	0.016	0.158***	0.178***
	(0.027)	(0.043)	(0.031)	(0.032)	(0.046)	(0.043)	(0.044)
Diploma / Certificate	0.052**	0.053	0.060**	0.024	-0.004	0.081**	0.128***
	(0.024)	(0.039)	(0.027)	(0.029)	(0.043)	(0.038)	(0.039)
Degree	0.137***	0.264***	0.110***	0.072**	-0.017	0.291***	0.327***
	(0.026)	(0.041)	(0.028)	(0.031)	(0.046)	(0.038)	(0.040)
Other controls							
Gender (Female=1)	0.052***	0.008	0.087***	-0.008	-0.006	0.126***	0.208***
	(0.019)	(0.030)	(0.020)	(0.022)	(0.033)	(0.029)	(0.030)
Age	0.004***	0.012***	0.006***	0.001*	0.009***	0.004***	-0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Australian born	-0.105***	-0.169***	-0.094***	-0.091***	-0.061***	-0.179***	-0.196***
	(0.013)	(0.021)	(0.015)	(0.016)	(0.024)	(0.021)	(0.021)
Geographic controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Historical controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
State and Year FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Mean of dependent var.	3.688	4.791	3.587	2.989	4.042	5.332	4.902
Observations	39,815	36,861	37,991	37,225	36,879	36,891	36,890

Notes: Results of reduced form. Standard errors clustered at the individual level. Individual controls are age, gender, educational levels, marital status, and country of origin. Geographic controls are at the postcode level and include the postcodes centroid and the minerals and land type of the postcode. Historic controls are the historical county population, convict population, as well as the presence and type of mineral deposit (major coal; major gold; other) and land formation (plains and plateaus, mountains, other). *** p<0.01, ** p<0.05, * p<0.1

Table A2: Historical sex ratio and social capital by gender (2SLS results)

	Social capital	Neighbourhood trust	Neighbourhood assistance	Neighbourhood participation	Close-knit neighbourhood	Neighbourhood discord (reversed)	Neighbourhood value disparity (reversed)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Panel A: Men							
Historical sex ratio	0.082**	0.039	0.088**	0.121***	0.146**	-0.069	0.022
	(0.038)	(0.054)	(0.039)	(0.043)	(0.061)	(0.059)	(0.070)
Observations	18,527	17,044	17,744	17,448	17,049	17,053	17,057
Panel B: Women							
Historical sex ratio	0.050	0.011	0.026	0.109**	0.124**	-0.055	-0.047
	(0.034)	(0.052)	(0.037)	(0.046)	(0.060)	(0.058)	(0.060)
Observations	21,288	19,817	20,247	19,777	19,830	19,838	19,833
Individual control	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
State and Year FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Standard errors clustered at the individual level. Individual controls are age, gender, educational levels, marital status, and country of origin. Geographic controls are at the postcode level and include the postcodes centroid and the minerals and land type of the postcode. Historic controls are the historical county population, convict population, as well as the presence and type of mineral deposit (major coal; major gold; other) and land formation (plains and plateaus, mountains, other). *** p<0.01, ** p<0.05, * p<0.1

Table A3: Convict sex ratio, subjective wellbeing and health

	All persons		Men		Women	
	Well-being	Health	Well-being	Health	Well-being	Health
	(1)	(2)	(3)	(4)	(5)	(6)
Convict sex ratio	0.002***	0.001***	0.001***	0.001***	0.002***	0.001***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Individual control	Yes	Yes	Yes	Yes	Yes	Yes
Geographic controls	Yes	Yes	Yes	Yes	Yes	Yes
Historical controls	Yes	Yes	Yes	Yes	Yes	Yes
State and Year FEs	Yes	Yes	Yes	Yes	Yes	Yes
Observations	83,384	73,659	39,192	34,197	44,192	34,197

Notes: Results of reduced form. Standard errors clustered at the individual level. Individual controls are age, gender, educational levels, marital status, and country of origin. Geographic controls are at the postcode level and include the postcodes centroid and the minerals and land type of the postcode. Historic controls are the historical county population, convict population, as well as the presence and type of mineral deposit (major coal; major gold; other) and land formation (plains and plateaus, mountains, other). *** p<0.01, ** p<0.05, * p<0.1

Table A4: Convict sex ratio, subjective wellbeing and health – Mediation role of social capital

	All persons		Men		Women	
	Direct effect	Indirect effect	Direct effect	Indirect effect	Direct effect	Indirect effect
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: Well-being						
Social capital	0.0017***	0.0003***	0.0019***	0.0002***	0.0015***	0.0002***
	(0.0003)	(0.0001)	(0.0004)	(0.00001)	(0.0004)	(0.00001)
Panel B: Health						
Social capital	0.0001***	0.0009***	0.0006**	0.0005**	0.0014***	0.0013***
	(0.00002)	(0.0002)	(0.0003)	(0.0003)	(0.0003)	(0.0003)
Individual control	Yes	Yes	Yes	Yes	Yes	Yes
Geographic controls	Yes	Yes	Yes	Yes	Yes	Yes
Historical controls	Yes	Yes	Yes	Yes	Yes	Yes
State and Year FEs	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Results of reduced form. Standard errors clustered at the individual level. Individual controls are age, gender, educational levels, marital status, and country of origin. Geographic controls are at the postcode level and include the postcodes centroid and the minerals and land type of the postcode. Historic controls are the historical county population, convict population, as well as the presence and type of mineral deposit (major coal; major gold; other) and land formation (plains and plateaus, mountains, other). *** p<0.01, ** p<0.05, * p<0.1

Table A5: Causal mechanism analysis by gender

	Men		Women	
	Direct effect	Indirect effect	Direct effect	Indirect effect
	(1)	(2)	(3)	(4)
Physical activity frequency	0.0008*	0.0001***	-0.0018***	0.0001***
	(0.0004)	(0.00001)	(0.0006)	(0.00002)
Active club/association membership	0.0017***	0.0001***	0.0001	0.0003***
	(0.0004)	(0.00001)	(0.0005)	(0.0001)
Volunteer/charity work	0.0010***	0.00001	0.0002	0.00001
	(0.0003)	(0.00001)	(0.0004)	(0.00001)
Individual control	Yes	Yes	Yes	Yes
Geographic controls	Yes	Yes	Yes	Yes
Historical controls	Yes	Yes	Yes	Yes
State and Year FEs	Yes	Yes	Yes	Yes

Notes: Results of reduced form. Standard errors clustered at the individual level. Individual controls are age, gender, educational levels, marital status, and country of origin. Geographic controls are at the postcode level and include the postcodes centroid and the minerals and land type of the postcode. Historic controls are the historical county population, convict population, as well as the presence and type of mineral deposit (major coal; major gold; other) and land formation (plains and plateaus, mountains, other). *** p<0.01, ** p<0.05, * p<0.1