The hidden power of community: Unveiling social capital's role in Australia's disaster resilience

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Executive Summary

Disasters have profound impacts on businesses, the environment, and communities. Australia is prone to a variety of disasters such as floods, cyclones, and bushfires, with recent studies documenting an escalating annual cost of $38 billion (equivalent to 2% of our GDP). This cost is expected to double by 2060 (The Australian Business Roundtable 2021). The substantial tangible and intangible costs of disasters highlight the pressing need for disaster resilience strategies and investments to reduce disaster impacts.

A critical but underexplored dimension of disaster resilience and preparation is social capital. Social capital, which refers to the social ties and connections between people and communities, can play a critical role in disaster management by enabling collective action, information sharing, and trust-building.

While there is a growing understanding of the role of social capital in community resilience, more evidence is needed on the extent to which social capital can mitigate the adverse impacts of disasters and the extent of the economic value of the resulting benefits, and the value of investments in social capital, thereof.

This project examines the following questions:

- What is the conceptual relationship between social capital and disaster resilience?
- What does empirical evidence in the extant literature reveal about the role of social capital in disaster resilience?
- How does social capital affect the economic, mental health, and general well-being of households in Australia in the aftermath of disasters?
- What is the estimated monetary value of the impact of social capital on disaster resilience?

Social capital, manifested through networks, trust, and shared norms within communities, generally enhances disaster resilience and recovery by facilitating collective action, improving communication, and fostering support.

Our extensive literature review identifies nearly 60 studies examining the relationship between social capital and individual and community-level outcomes in the context of disaster resilience. Conceptually, the key theme that runs across these studies is that social capital, manifested through networks, trust, and shared norms within communities, generally enhances disaster resilience and recovery by facilitating collective action, improving communication, and fostering support. Consequently, the evidence broadly indicates that social capital can positively impact resilience in terms of both economic and health outcomes.

It must, however, be noted that different types of social capital (bonding, bridging, and linking) exhibit varied impacts on disaster resilience, influenced by their distinct characteristics. Paradoxically, in some instances, social capital, if not well considered, can also form a barrier to resilience due to the exclusion of outsiders or perpetuating problematic social norms. Despite these challenges, the potential benefits of social capital in disaster resilience are significant and should not be overlooked.

Despite the expanding number of empirical studies, there remains a significant need for more quantitative evidence, particularly in Australia, where studies estimating the moderating role of social capital in disaster resilience are limited.

To address the afore-mentioned gap, this project quantifies the effect of social capital in mitigating the adverse impact of disasters on the economic, mental health, and general well-being of Australian households.

Our analysis utilises nationwide data from the Household, Income and Labour Dynamics in Australia (HILDA) Survey, which tracks about 17,000 individuals over more than two decades (2001 – 2024). We intersect this survey with data on individuals' exposure to each bushfire and severe storm event in their vicinity. We obtain the latter data from various bushfire history records provided by Australian state and territory governments and the Severe Storms Archive from the Australian Bureau of Meteorology. To avoid the potential confounding effects of COVID-19, our final sample for analysis covers approximately 385,000 observations spanning the entire country over the period 2001 to 2019.

We focus on three outcomes to capture the overall well-being of individuals. Life satisfaction is measured by aggregating the responses provided by survey participants to the question, "How satisfied or dissatisfied are you with the following things happening in your life?" covering eight dimensions such as health, how safe they feel, their financial situation and other aspects of life. Mental health is measured with the responses from the 36-Item Short Form Survey within HILDA, while economic well-being is measured by annual gross total income.

The most severely impacted individuals amongst those affected groups are those who reside in low-social capital communities.

Social capital has been defined in multiple ways, commonly categorised into three types. Bonding social capital, which refers to close connections among individuals who share emotional attachments; bridging social capital, which entails interaction and trust between individuals from diverse cultural, racial, or ethnic backgrounds; and linking social capital, which describes vertical connections between individuals with differing levels of power and influence. In this study, we utilise two metrics motivated by the existing literature: (i) the perceived frequency of neighbourhood support and (ii) cognitive social capital. The former is based on survey responses to a question on the frequency of neighbours helping each other out, and the latter refers to the perceived sense of community and trust in neighbours (as average of the responses provided to five questions on the extent to which respondents agree or disagree with statements about their neighbourhood).

These social capital metrics can be considered indicators of bonding social capital in small, close-knit neighbourhoods. They could also represent bridging social capital if residents within the neighbourhood are only loosely connected, knowing each other primarily as friends of friends. Based on these metrics, we categorise each community in the sample into a low-, medium- or high-social capital community.

We employ a difference-in-differences modelling to identify the effect of social capital in mitigating the impacts of disasters. Our approach compares the well-being outcomes for individuals living in disaster-hit areas (treatment group) with those for individuals who reside in comparable areas and not hit by disasters (control group).
Based on some reasonable assumptions, the control group is assumed to provide the trajectory that the individuals in the treatment group would have followed had they not been hit by the disaster. The difference between the outcomes of the treatment and control groups permits us to quantify the effect of the disaster. Importantly, we compare the disasters' estimated impacts across individuals living in low, medium, and high social capital communities. This, in turn, allows to identify the extent to which social capital mitigates the negative impacts of disasters.

Our results show that the extent of the disaster impact and the role of social capital in mitigating the adverse outcomes vary substantially across disasters and different segments of the population.

On average, bushfires pose a more significant risk of negative impacts on individuals' well-being in the aftermath of the disasters, while severe storm events do not exhibit similar impacts. We should note that our study focuses on the short-term impacts following these disasters, and the effects may shift in the years following the disaster as people deal with ongoing stressors.

In addition, the impact of bushfires is most prominent among specific subgroups of the population, such as older people, people who are unemployed, people who are divorced, and people living in remote areas.

Strikingly, the most severely impacted individuals amongst those affected groups are those who reside in low-social capital communities. The effect of disasters on mental health and wellbeing outcomes for individuals from these subgroups who live in areas with moderate or high levels of social capital is much more diminished and, in many cases, negligible.

The windfall income-equivalent value of social capital can be substantial. In terms of mitigating the loss in life satisfaction, higher social capital is equivalent to receiving $3808 in windfall income annually per person in remote areas.

To investigate these nation-wide findings further, we supplement our analysis with a case study of the 2009 Black Saturday Bushfires (BSB). The findings from our BSB case study echo the results of our primary analysis using the nationwide sample.

Overall, our results show that, in disaster situations, social capital proves most beneficial for life satisfaction, followed by mental health, with a marginal impact on gross total income.

What is the monetary value of the role of social capital in mitigating the adverse impact of disasters on life satisfaction and mental health? To quantify this value, we estimate how much money (or windfall income) would generate an equivalent amount of life satisfaction or mental health improvement as that derived from living in a community with a higher level of social capital.

We find that the windfall income-equivalent value of social capital can be substantial. For instance, we estimate that in terms of mitigating the loss in life satisfaction, higher social capital is equivalent to receiving $3808 in windfall income annually per person in remote areas. This would translate to an amount of more than $25 million for a community of 6,770 people (the average size of the population in a remote community within our sample). Even if we restrict our focus to impacts on annual income, higher social capital mitigates an income loss of $2203 per person in remote areas, which translates to nearly $15 million for a community of 6,770.

Similarly, for older individuals (aged 66 or over) living in low social capital communities, increasing the social capital of the community to a higher level would be worth $396 per year per older person.

Our results show that the returns to social capital vary across outcomes and with the segment of the population, providing a nuanced insight into where and for whom social capital investments are likely to yield the highest benefits.

The findings of this project carry important Policy implications.

I. They underscore the necessity of prioritising investments that enhance social capital through initiatives such as trust-building, community engagement, and the development of collaborative networks. Disaster planning and response frameworks at local, regional, and national levels should include a greater emphasis on social capital considerations.

II. Targeted interventions are essential for groups that may be facing heightened risk. These include economically vulnerable groups, such as older people and people who are unemployed; individuals who may be undergoing disruptive changes within the household, such as people who are divorced; and populations for whom other support networks may be lacking, such as people living in remote areas. These groups benefit the most from enhanced social capital.

III. Finally, the cost-effectiveness analysis highlights particularly that investing in social capital in remote areas leads to significant returns in life satisfaction and mental health that considerably outpace the return to income alone.

While this study has some limitations, it provides an essential first step in the large-scale quantification of the returns to social capital in supporting disaster resilience. Future research is essential to refine methodologies and expand the empirical evidence base, particularly in understanding the nuanced impacts of different types of social capital, the underlying mechanisms of change, and identifying effective interventions for improving social capital.

Introduction

Burgeoning literature points to the increasing economic burden of disasters globally and in Australia. Annual costs of disasters to the Australian economy are estimated at $38 billion and are predicted to double by 2060 (Australian Business Roundtable for Disaster Resilience and Safer Communities 2021).[1] These substantial costs underscore the urgent need for disaster resilience strategies and investments to reduce disaster impacts. Effective preparation not only saves lives but also minimises the financial toll on communities and the economy at large.

A critical but underexplored dimension of disaster resilience and preparation is social capital. Social capital refers to the social ties and connections between people and communities and can play a critical role in disaster management by enabling collective action, information sharing, and trust-building.

People and communities with strong social capital can potentially demonstrate better coping mechanisms, faster recovery, and increased resilience to adverse shocks such as disasters. While there is a growing understanding of the role of social capital in community resilience, limited evidence exists on the extent to which social capital can mitigate the adverse impacts of disasters, the extent of the value of the resulting benefits, and the value of investments in social capital, thereof.

In February 2024, the Australian Red Cross commissioned the Centre for Disaster Resilience and Recovery at Deakin University to conduct an economic evaluation of social capital investment for community resilience in the context of disasters. While social capital may influence communities in non-adverse conditions, focusing on disaster contexts is particularly insightful to develop strategies for survival, recovery, and resilience. Consequently, this study aims to address the following research questions:

- What is the conceptual relationship between social capital and disaster resilience?
- What does empirical evidence in the extant literature reveal about the role of social capital in disaster resilience?
- How does social capital affect the economic, mental health, and general well-being of Australian households in the wake of disasters?
- What is the estimated monetary value of the effect of social capital on disaster resilience?

The purpose of this research is to inform funding decisions, investment prioritisation, and for projects designed to enhance community resilience for which strengthening social capital could be an important step. We define community as local geographical communities.

[1] These costs include asset damage (residential damage and commercial damage), financial costs (i.e., public asset damage, clean up costs, reduced activity from agriculture, emergency response costs, temporary housing costs, and evacuation costs), and social costs (i.e., family violence, high risk alcohol consumption, injuries, fatalities, exacerbated chronic illness, and mental health impacts).

Conceptual Framework

Definitions, types, and measurements

Various definitions of social capital are present in the literature. For instance, Putnam (1994) define it as "networks, norms, and trust that enable participants to act together more effectively to pursue shared objectives." Brehm and Rahn (1997) approach it from a political science perspective, describing it as "the web of cooperative relationships between citizens that facilitates resolution of collection action problems and is demonstrated by the reciprocal relationship between community involvement and trust in others." Social capital manifests at various levels, with its key components being networks, trust, and norms.

Based on types of networks, social capital is commonly categorised into three types. First, bonding social capital refers to close connections among individuals who share emotional attachments (e.g., friends and family members), resulting in strong bonds among members within the same group (Aldrich and Meyer 2015). At the individual level, it can be assessed by the engagement and trust an individual establishes within their close networks. Enfield and Nathaniel (2013) provide, through surveys, a summary of how each type of social capital, including bonding social capital, can be measured at the individual level. Bonding social capital, for instance, can be proxied by whether a respondent trusts the people on their block who live nearby. At the community level, social capital can be indicated by group homogeneity. For example, it can be approximated as the proportion sharing the same first language or belonging to the same ethnic group. Edwards (2004) offers a comprehensive guide for the measurement of bonding social capital and the other two types at the community level.

Bridging social capital entails looser connections compared to bonding social capital. At the individual level, it can be indicated by interaction and trust between individuals from diverse cultural, racial, or ethnic backgrounds (Enfield and Nathaniel 2013; Villalonga-Olives et al. 2021). For example, it can be assessed by whether an individual trusts new people moving to their area or people of different religious affiliations. At the community level, while bonding social capital is featured by group similarity, bridging social capital is assessed by group diversity and community openness. For instance, bridging social capital can be measured by the percentage of the population engaging in activities with few or no individuals sharing the same first language. Despite these distinctions, bonding and bridging social capital can overlap in practice. Groups with similar backgrounds may still display variations, facilitating bridging connections across generations, genders, or educational levels (Edwards 2004).

While bonding and bridging social capital refer to horizonal connections, linking social capital describes vertical connections between individuals with differing levels of power and influence (Aldrich and Meyer 2015). At the individual level, measurement may involve assessing engagement and trust between a person and those in positions of authority such as community leaders (Enfield and Nathaniel 2013). At the community level, it can be quantified by the percentage of individuals with personal ties to institutions (Edwards 2004).

Social capital is measured in various ways in the literature, often depending on data availability. Duncan et al. (2021) employed data from the HILDA survey to develop the Social Connectedness Index. This index is calculated from 29 question items grouped into four dimensions: social interactions (e.g., frequency of attending events, workshops, or community activities), social support (e.g., presence of someone to rely on in difficult times), interpersonal trust (e.g., trust in neighbours), and socioeconomic advantage (e.g., non-Indigenous origin, employed full time, graduate degree, or other factors).[2] Their research suggests that Australia's social connectedness declined by almost 10 percent over the past decade.

Shalley et al. (2023) construct the Social Capital Index for Northern Territory (Australia) using data from the Territory Connections survey. The index comprises of four dimensions: i) attachment to the Territory, ii) access to supportive networks, iii) community and civic participation, and iv) community cohesion. Their findings reveal that social capital varies across genders and age groups.

[2] We acknowledge that there are online and work-related communities as well, but we do not study these communities in this report.

Other studies also employ varied proxies of social capital. For instance, Sadri et al. (2018) use the principal component analysis to construct a social capital index based on 15 items available in their post-disaster survey in Indiana (United States). McClymont et al. (2020) builds a Social Capital Index for Scotland, encompassing social networks, community cohesion, social participation, and community empowerment.

Turning to resilience, several definitions of disaster resilience exist in the literature. For instance, resilience can be described as the intrinsic capability of a community or society to resist and recover from a disaster (Castleden et al. 2011). UNISDR (2009) referred it to the capacity of a system, community or society potentially exposed to hazards to adapt, by resisting or changing to reach and maintain an acceptable level of functioning and structure.2F

Resilience can be reflected through multiple dimensions. For instance, the Baseline Resilience Indicators for Communities cover six domains: social (e.g., the percentage of non-elderly population), economic (e.g., homeownership rate), housing and infrastructure (e.g., proportion of businesses located outside areas prone to natural disasters), institutional (e.g., proportion of residents covered under disaster mitigation programs), community (e.g., social capital), and environmental (e.g., proportion of land area with no wetland decline) (Cutter et al. 2014). Conversely, N. Lam et al. (2016) introduced the Resilience Inference Measurement model, focusing on two aspects of resilience – vulnerability and adaptability – using exposure, damage, and recovery indicators within. Other proxies for resilience in the literature include the social vulnerability index (Cutter et al. 2012) and the community assessment of resilience tool (National Research Council 2012).

Social capital and disaster resilience

Figure 1 illustrates the conceptual role of social capital as a moderating (bottom path) vs. mediating (top path) factor in disaster resilience.[3] This project focuses on exploring moderating role of social capital in disaster resilience.[4] Social capital, manifested through networks, trust, and shared norms in communities, generally enhances disaster resilience and recovery by promoting collective action, improving communication, and fostering support. Strengthening the social capital among individuals, communities, and organisations can potentially contribute to disaster preparedness (Richardson et al. 2023). However, it can also have negative impacts due its outsider exclusivity. Understanding the mechanisms through which social capital can mitigate or exacerbate adverse impacts of disasters[5] is crucial to maximise the benefits of social capital.

Social capital embodies belongingness, unity, cooperation, and mutual support among individuals and communities.[6] It not only functions as a vital source of materialistic assistance, providing basic amenities and long-term opportunities, but also offers psychological solace to those experiencing hardship.

However, social capital can also engender exclusion and reinforce vulnerability. Privileges bestowed upon individuals within networks may lead to an unequal distribution of support. Consequently, those in the direst need of assistance may find it most challenging to recover from the aftermath of disasters. Moreover, moral hazards can arise as individuals overly rely on support from their networks and community, potentially hindering their ability to overcome adversity independently and weakening their resilience in the long term. Conversely, those who can adapt independently may engage less with the community, which in turn weakens community resilience (Aldrich et al. 2016).

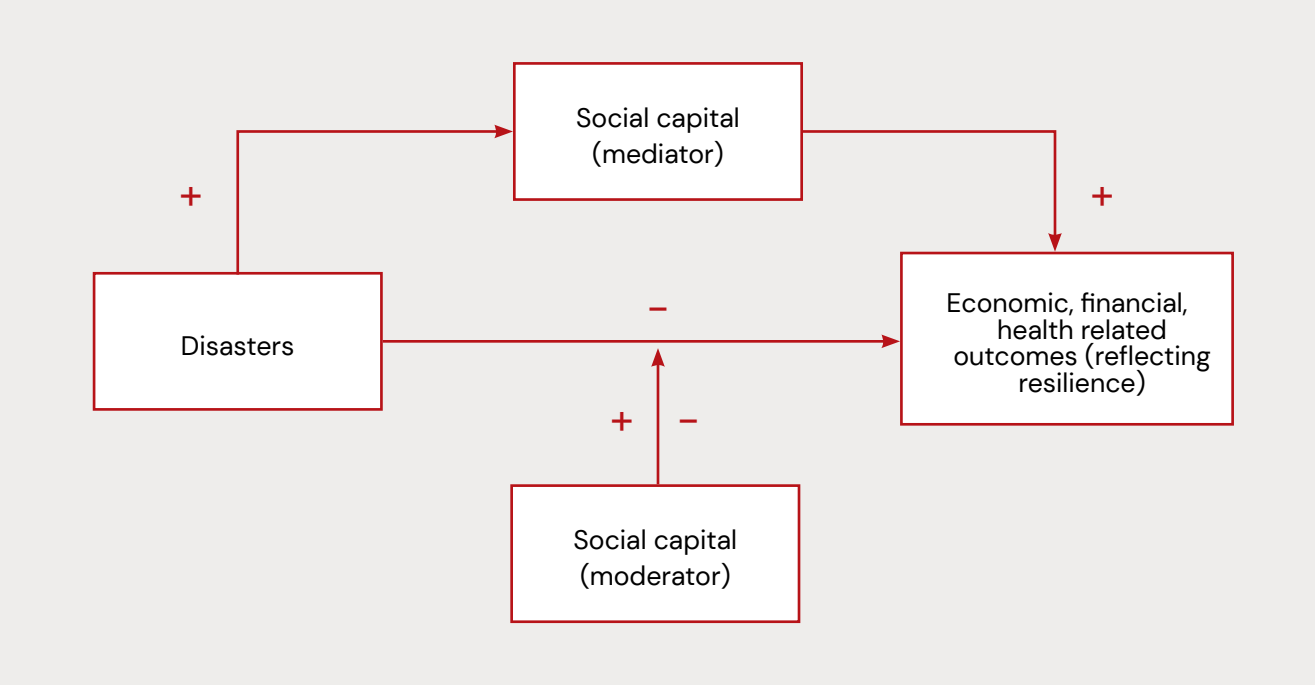


Figure 1. A simple conceptual framework on the moderating role of social capital

[3] See Koliou et al. (2018) for a literature review on community resilience after natural hazards.

[4] Social capital may also serve as a mediating factor in disaster resilience. From this perspective, social capital can be seen as a mediator that helps clarify the impact of disasters on specific outcomes. In other words, the effects of disasters on individuals and communities can be understood through their impact on social capital. Example of social capital as a mediating factor is that communities may increase cooperation (to maximize the collective action) in the face of disasters or in reconstruction post disasters.

[5] The impacts of disasters on economic, financial, and health-related outcomes of individuals and communities can be intricate, yielding both positive and negative effects. For example, while disasters cause immediate physical damages, post-disaster reconstruction may prompt capital replacement, potentially enhancing productivity as new capital often integrates more advanced technologies. These impacts are contingent on various factors such as the type and severity of the disaster, preparedness measures, individual demographic characteristics, community resilience, and government supports. Most studies, however, concur that disasters are costly.

[6] Refer to Behera (2023), for a recent summary on the role of social capital in disaster risk management.

The differences among the three types of social capital reveal the specific benefits and drawbacks associated with each. The tight-knit nature of bonding social capital fosters trust and shared norms among members, thereby facilitating knowledge sharing and collective action (Aldrich and Meyer 2015). This shared knowledge and trust not only enable individuals to prepare more effectively for disasters and empower them to better cope with their aftermath. Frequent exchanges of knowledge lead to early warnings and collaborative action plans developed before the event occurs.

For instance, family members in New Orleans gathered together to discuss strategies and coping actions before Hurricane Katrina arrived (Hawkins and Maurer 2010). During this phase, they exchanged physical, emotional, and financial support through homophilous network connections, aiding families in overcoming the storm's impact. Furthermore, strong trust also facilitates access to shelter, essential amenities, and prompt assistance during the early recovery phase (Heller et al. 2005; Hawkins and Maurer 2010). Therefore, bonding social capital often serves as the primary source of assistance (Garrison and Sasser 2009; Hawkins and Maurer 2010) and as the predominant form of aid (Meyer 2013).

Additionally, bonding social capital significantly influences decisions regarding leaving or staying in hazardous areas, thereby impacting the post-disaster recovery of the local economy.

Aldrich (2017) argued that bonding social capital, along with the other two types, contributes to retaining individuals in disaster-affected areas. Individuals with fewer connections and a weaker sense of belonging in the community are more inclined to leave, given the substantial financial and psychological costs associated with rebuilding damaged properties and remaining in a distressed community.

However, while bonding social capital offers numerous benefits, it also has some downsides. Close connections tend to be geographically limited, meaning that members of a bonded network may experience similar resource constraints during or after a disaster (Lancee 2012). In such situations, relying solely on tight-knit connections without developing other coping strategies can place individuals in more challenging circumstances both economically and mentally. Being aware that friends, family, and close acquaintances struggle without being able to help can be emotionally distressing. In addition, bonding social capital can reinforce problematic norms within the group, such as sectarianism, ethnocentrism, or sexism, as it favours members who share similar characteristics (Aldrich 2012; Aldrich et al. 2016). This can exacerbate inequalities among affected individuals over a long term even after disasters.

Furthermore, although bonding social capital facilitates coordination, it can lead to decreased diversity within the group over time (Newman and Dale 2007), which reduces long-term opportunities and development. Neighbourhoods with higher degrees of bonding social capital typically have weaker bridging and linking social ties (Costa and Kahn 2003; Hawkins and Maurer 2010). This is because tightly knit networks often focus on reinforcing existing bonds within groups rather than reaching out to connect with individuals or groups outside of their immediate circle. This leads to limited interaction and engagement with diverse communities or social networks, resulting in fewer opportunities for establishing bridging and linking social ties across different social groups or communities. These drawbacks highlight the complexities involved in balancing the benefits and limitations of bonding social capital in disaster resilience and recovery.

Bridging social capital is valuable not only in disaster contexts but also in everyday life, offering a wider array of resources and job opportunities through more distant connections, such as friends of friends (Granovetter 1983). Necessities like food, shelter, schooling, childcare, and healthcare services are often severely limited after calamities, making these informal networks from bridging and bonding social capital indispensable for people during such times (Hurlbert et al. 2000).

Linking social capital offers individuals and communities resources and administrative control that may otherwise unavailable (Dahal and Adhikari 2008). Furthermore, it enhances access to resources beyond the local sphere and can push up political transformation (Aldrich and Meyer 2015). While bonding social capital provides immediate supports, bridging and linking social capital are typically regarded as offering longer-term recovery benefits by providing broader opportunities and recovery options (Hawkins and Maurer 2010).

Like bonding social capital, however, both bridging and linking social capital can contribute to the exclusion of outsiders and reinforce problematic norms, consequently eroding resilience. Additionally, linking social capital may lead to corruption and lobbying for private benefits instead of providing support to those in need.

In conclusion, while social capital is generally viewed as positive, its role in disaster resilience is far more intricate than commonly understood. This emphasises the importance of empirically examining social capital from multiple dimensions to provide more comprehensive policy insights. Such research endeavours are essential for fostering individual and community resilience and recovery before, during, and after disasters.

Review of existing empirical studies

Scope

Due to the extensive body of literature on the subject, we focus on the recent work examining the impact of social capital on disaster resilience. The inclusion criteria for our review are as follows:

- Definition, types, and measurements: We include several studies that define, classify, and measure social capital and disaster resilience (see Section 3.1). We discuss only key studies in the literature without providing exhaustive details regarding social capital definitions, types, and measurements.
- Scope of empirical papers: Findings are presented from a review of empirical papers, including both qualitative and quantitative studies as well as synthetic literature reviews published since 2000. The literature review focuses particularly on recent research since 2018, including research not only from Australia but also from other countries.
- Search keywords: The search terms used included "social capital Australia," "social capital and disaster," "social capital in disaster," "bonding social capital, disaster," "bridging social capital, disaster," "linking social capital, disaster," "impact of disasters on trust," "disaster resilience definitions," and "measure social capital," among others.

While social capital may influence communities in non-adverse conditions, we focus on disaster contexts for the following reasons. First, during disasters, community ties are crucial for survival, recovery, and resilience, making the impact of social capital more pronounced and observable. Second, from a methodological standpoint, disasters can offer a natural experiment setting, providing a more robust identification strategy to measure the effects of social capital.

Consequently, our review excludes papers discussing the effects of social capital in non-disaster contexts. We also exclude works that discuss the effect of social capital without clear evidence and methodology, as this was necessary to maintain the quality of our assessment. We scan through approximately 270 academic and grey literature, ultimately identifying 58 academic papers and technical reports that meet our inclusion criteria.

We conduct an emergent thematic analysis. Each paper is classified based on whether it was related to disasters, type of social capital investigated, country where the disaster occurred, types of disasters, methodology, and main findings. From this review of empirical papers, the following findings emerge.

Most empirical studies find positive impacts of social capital on resilience

Many recent empirical studies consistently demonstrate the beneficial impact of social capital on disaster resilience and recovery. To investigate social capital's impact on some economic and social outcomes, Shahid et al. (2022) conduct interviews with 510 individuals in Nepal following an earthquake. They develop a social capital index based on three measures: family structure, engagement in volunteering activities, and the number of friends. Their findings indicate that those social capital measures positively influence food, water supply, and income, although they do not significantly impact housing. They add that social capital's effect is quantitatively no less than financial capital in post-earthquake recovery.

Concentrating on the speed of recovery, Sadri et al. (2018) gather primary data through a mail survey involving 390 households across four rural towns in Indiana following a severe tornado. Employing principal component analysis, they develop a social capital index based on 15 question items. Utilising ordered probit models, with the recovery time from tornado-induced damages to personal properties (such as real estate properties and vehicles) as the dependent variable, they illustrate that social capital accelerates the recovery process. More rapid recovery occurs in households with greater trust in the government, denser personal networks, closer geographic proximity to network connections, and assistance from neighbours.

Many studies examining the relationship between social capital and disaster resilience utilise interviews without quantitatively estimating the impact of social capital. For instance, Masud-All-Kamal and Monirul Hassan (2018) conduct interviews with 28 individuals and held two focused group discussions five years following a cyclone in Bangladesh. Their qualitative analysis indicates that social capital plays a significant role in assisting the disaster victims in multiple ways. These include rescuing vulnerable individuals such as older people, women, and children immediately after the cyclone, offering psychological solace, providing transportation for rescue operations, supplying food and short-term loans, and aiding in the construction of bridges and temporary shelters

Roque et al. (2020) carry out 13 interviews with community leaders from two rural areas in Puerto Rico following the 2017 Atlantic hurricane. They report that social capital plays an important role in disaster resilience and recovery. Similarly, Panday et al. (2021) apply several qualitative approaches including field observations, interviews (n=28 villagers) and focused group discussions (n=4) to compare impacts of different types of social capital following the 2015 Nepal earthquake. They conclude that both bonding and bridging social capital promoted community actions to rescue and support affected people.

In terms of health-related outcomes, Dar et al. (2018) survey n=87 adult survivors following the Kashmir flood to investigate the moderating role of bonding social capital on mental health. Bonding social capital is measured as the level of perceived support from friends and family based on 20 yes-no questions, while mental health is assessed using two proxies including the 17-item posttraumatic stress disorder checklist and the 21-item Beck depression inventory. Their findings reveal that friends and family's assistance alleviated the negative impact of experiencing the flood on survivors' mental health.

Australian literature

Within Australia, Matthews et al. (2020) implement a survey (n=1888) six months after the 2017 flood in New South Wales with a focus on marginalised groups including Aboriginal people and people with financial difficulty. They are characterised by lower social capital, measured by informal social connectedness, feelings of belonging, trust, and optimism, than general community respondents. Utilising logistic regressions, they conclude that informal social connectedness and a sense of belonging were significant factors in reducing the risk of post-disaster distress for all participants. To test the moderation effects, their models include interaction terms between sociodemographic factors, flood exposure, and social capital but they are not statistically significant at conventional error levels.

Noel et al. (2018) review 15 quantitative studies, aiming to provide a comprehensive understanding of the impacts of social capital on mental health outcomes. Instead of categorising social capital based on types of networks, they distinguish two components of social capital: a structural component (e.g., activities) and a cognitive component (e.g., attitudes or perceptions). They conclude that individual cognitive social capital reduced post-traumatic stress disorder, anxiety, and depression, while cognitive social capital improves mental well-being. Additionally, they find that individual structural social capital may be psychologically protective.

While our review of the extant literature has focused on the role of social capital within the context of natural disaster, we should also note that social capital not only benefits individuals and communities in adversity events but also appears valuable in everyday life. For instance, Fraser and Naquin (2022) analyse data from Japanese municipalities spanning 2000 to 2017, revealing that higher levels of bonding social capital within a community correspond to reduced vulnerability, which is constructed upon 19 economic and social indicators. In another investigation, Park et al. (2023) survey households in Wisconsin and find that individuals having a positive feeling to their community exhibit significantly lower odds of experiencing symptoms of depression, anxiety, and stress compared to those with a negative sense of community. Similarly, conducting telephone surveys of 700 participants in the United States, Beaudoin (2009) demonstrates that bonding neighbourliness, measured by engagement with neighbours of the same ethnic group, positively influences health outcomes.

Types of social capital matter

As discussed elsewhere, different types of social networks with different natures can affect disaster resilience in different ways. Bonding social capital commonly serves as the first provider of assistance and is the most common form of assistance. In comparison, bridging and linking social capital offer a wider range of opportunities and resources for long-term recovery (Aldrich and Meyer 2015).

Hsueh (2019) provides a detailed description on the accepted forms of informal support from bonding and bridging networks following a typhoon in Japan in 2013. They conclude that these two types of networks are complementary rather than being exclusive. Bonding social capital supports from families, relatives, friends, and coworkers living in the same community offered a wide range of support (e.g., commuting assistance, emotional solace, and information sharing). Bridging social capital, coming from neighbours, friends, and coworkers living outside the community supplements resources and provides partial psychological support (e.g., expressing worry for the victims).

Another study from Japan by Fraser and Naquin (2022) measures municipality-level bonding social capital as the share of residents belonging to the same demographic strata, bridging social capital as the rates of associations, and linking social capital by factors such as the rates of government employees per capita. They use principal component analysis on 19 economic and social variables to proxy municipality-level vulnerability. Applying the difference-in-differences framework (similar in spirit to the methodology used in our study) with disaster-induced damages being a control variable, their findings reveal that bonding social capital reduces municipality vulnerability. In contrast, the estimated effects of the other two types of social capital on vulnerability are not statistically significant, but they may exhibit delayed effects after several years.

While Fraser and Naquin (2022) highlight the importance of bonding social capital over the other types, Shahid et al. (2022) report that the positive impact of bridging social capital from volunteering activities outweighs that of bonding social capital coming from family status and the number of friends after a Nepal earthquake.

During the recovery period following a cyclone in Bangladesh, Masud-All-Kamal and Monirul Hassan (2018) observe, through qualitative evidence, a downside of linking social capital while bonding and bridging social capital prove to be valuable. Specifically, support coming from linking social capital is mostly directed to a small group. They assert that the partial distribution of disaster relief sources by local elites towards less affected households resulted from the existent patronage networks and class hierarchy.

Regarding health-related outcomes, Sato et al. (2020) document varied effects of social capital depending on the dimension under investigation. While a cognitive dimension of social capital, reflected through social cohesion, is found to reduce the risk of depression among women, higher levels of structural social capital, proxied by social participation at the community level, increase women's depression risk following an earthquake in Japan. These findings are derived from two surveys, one conducted three years prior to the Kumamoto earthquake and a follow-up conducted three years after the event, comprising a total of 828 participants, with 361 men and 467 women.

Beaudoin (2009) compares health-related outcomes associated with bonding neighbourliness, measured by interactions with neighbours of the same ethnic group, and bridging neighbourliness, measured by interactions with neighbours of different ethnic groups. Using ordinary least squares and logistic regressions on a sample of 700 telephone survey respondents in the United States, the study reveals that bonding neighbourliness has a positive influence on health outcomes (reflected through self-reported health status and stress level), whereas the effect of bridging neighbourliness is found to be moderate.

The level of social capital matters

While most studies in the literature assume that social capital has a linear impact on resilience, Gallagher et al. (2019) question the optimal degree of social capital. They examine how the number of groups in which a respondent is involved can affect mental health following the 2009 Victorian bushfires. The analysis was based on two surveys in 2012 and 2014, involving 736 individuals from 25 bushfire-affected communities in rural and regional Victoria. Their findings indicate that moderate involvement in groups is the most beneficial, while no participation or high levels of involvement lead to poorer mental health outcomes. Mental health is assessed using the 4-item posttraumatic stress disorder checklist and the 9-item depression index. This suggests that the impact of social capital on resilience can be non-linear.

In line with the findings of Gallagher et al. (2019), Wickes et al. (2015) observed that social capital reduces community problems in both disaster and non-disaster contexts, but it may exacerbate these issues if the connections in question are among the vulnerable residents. Specifically, higher levels of social capital are linked to reduced respondents' perceived problems in their community. However, areas with a higher concentration of vulnerable groups exhibit greater community problems compared to those with a lower concentration in the sample of flooded areas (not in the sample of non-flooded areas). Their findings are based on their survey data from two waves, encompassing over 4000 individuals residing in 148 urban communities in Brisbane.

Linking social capital does not always yield positive outcomes

Rahill et al. (2014) discover that although social capital helped accessing shelters, disaster victims lacking connections are not equally offered such opportunities. This disparity engenders tensions among the displaced disaster victims and perpetuates post-disaster recovery inequalities. Their findings stem from focus groups involving 62 participants, interviews with 54 individuals, field observations, and a review of secondary resources following the 2010 Haiti earthquake.

Social capital can reinforce problematic norms. For example, caste councils responsible for distributing aid in Tamil Nadu communities affected by the 2004 Indian Ocean Tsunami excluded widows, Dalits, Muslims, and other marginalised groups, deeming them unworthy of receiving support. Despite not measuring social capital and statistically estimating its effects, Aldrich (2011) argues that the benefits of social capital can be equally potent as its downsides in this context. In other words, linking social capital exacerbates the challenges faced by marginalised victims of the 2002 Indian Ocean Tsunami.

Consistent with the findings by Aldrich (2011), Masud-All-Kamal and Monirul Hassan (2018) show that patronage networks and class hierarchy fostered the uneven distribution of support towards less affected households by local elites after the Aila cyclone in Bangladesh. In these cases, linking capital with local leaders contributes to inequality in post-disaster recovery due to negative and exclusionary effects on marginalised groups.

Panday et al. (2021) utilise the case of the 2015 earthquake in Nepal to illustrate that while bonding and bridging social capital among residents promote collective action and provide other support, these channels gradually disappear once external relief materials (e.g., food, medicine) and funding become available.

Similar to findings from Aldrich (2011) and Masud-All-Kamal and Monirul Hassan (2018), Panday et al. (2021) document that vulnerable groups (e.g., women, older individuals, those residing at a distance from the community centre) encounter greater difficulties in and, in some cases, are even excluded from accessing rebuilding programs compared to individuals of higher socioeconomic status and those with linking social capital.

Chamlee-Wright and Storr (2011) observe that social capital enabled community leaders and residents to become skilled in lobbying and rent-seeking activities in the post-Katrina recovery of New Orleans. The lobbying skills of local leaders play a deterministic role in the timing of receiving disaster relief assistance. Their conclusion comes from 103 interviews with evacuees who stayed in the disaster-struck areas three years after the event.

Wolf et al. (2010) direct their attention to another climate change indicator: heatwaves. Despite being among the most perilous of natural hazards, heatwaves often receive insufficient attention. In their study, Wolf et al. interviewed 65 older individuals and their social contacts (family members, friends, and neighbours). They document that bonding social capital, instead of mitigating risks, exacerbates the vulnerability of older English individuals to heatwaves by reinforcing risky coping behaviours. The explanation for this finding lies in the tendency of bonding social capital to involve the same individuals, resulting in a lack of exposure to new narratives and updated information sharing.[7]

[7] For a systematic review on the role of social capital in building community resilience in a context of climate change, see Carmen et al. (2022).

Despite growing literature, more evidence is needed

There is a growing literature on the relationship between social capital and disaster resilience. Most studies rely on qualitative methods, such as field observations, post-disaster surveys, and interviews conducted after disasters (Sadri et al. 2018; Matthews et al. 2020; Monteil et al. 2020; Shahid et al. 2022). Some studies (e.g., Noel et al. 2018) highlight the prevalence of qualitative and cross-sectional studies in this area. These approaches are valuable in identifying emerging themes and providing contextual explanations for specific observations and correlations. Nonetheless, they may be subject to potential pitfalls (e.g., observer bias, social desirability bias, interviewer bias, recall bias), or their generalisability and replicability may be limited.

Quantitative methods using panel data, randomised control trials, or experiments can overcome some of these problems, enhance the objectivity and replicability of the analysis, and help quantify the inter-relationships among various indicators. Acknowledging that some quantitative methods can be "black box" approaches or may succumb to researcher-related biases (such as presenting only statistically significant results), at this critical juncture, the quantitative evidence is extremely limited.

From an economic perspective, Johar et al. (2022) examine the economic impact of self-reported experiences of natural disasters using HILDA data from 2009 to 2018. However, their study does not specifically focus on the role of social capital[8], which enters the estimation function as a controlling factor. The model shows a positive link between social capital and economic outcomes. To examine the moderating role of social capital, Zahnow et al. (2019) utilise data from the Australian Community Capacity Study survey conducted in 2006 and 2011. They distinguish between neighbourhood-level social capital and individual-level social capital. The former is based on the respondents' perceptions of their community's social cohesion, reflected through questions concerning the perceived frequency of community members doing favours for each other, visiting each other's homes, and seeking advice from one another about personal matters.

The latter directly relates to the connections of the survey respondents, assessed through the number of friend and kinship ties they have in the neighbourhood, the pre-flood number of associational ties they have in their neighbourhood, and the frequency of contacting their neighbours in the previous week. Their measure of resilience covers a range of dimensions, including the ability to fulfil familial and work roles, financial stability, and mental and physical health. The study finds no evidence for the effect of neighbourhood social capital prior to the Queensland floods in 2011. However, individual-level social support is found to moderate the effect of flood severity on these outcomes.

Huang et al. (2024) and Cao et al. (2022) conduct studies in China, and both find positive impacts of social capital. Huang et al. (2024) investigate the economic impact of multiple earthquakes in China using the difference-in-differences framework on prefecture-level panel data from 1999 to 2014. Although the study does not directly analyse the moderation effect of social capital, it conducts a heterogeneity analysis. This analysis reveals that prefectures with higher levels of social capital, measured by the number of family clans per million people, experience less severe economic shocks in terms of GDP per capita following earthquakes.

[8] Johar et al. (2022) calculate social capital index based on HILDA respondents' self-reported agreement with five statements (e.g., "I don't have anyone that I can confide in")

On the other hand, Cao et al. (2022) focus on the moderating role of social capital in disaster resilience during the China's Great Famine (1961-1965). They also employ difference-in-differences models on a county panel dataset and discover that intensity of family clans reduced mortality rates in that deadly famine period.

Islam and Nguyen (2018) employ a combination of survey data from cyclone-affected and cyclone-unaffected villages, with approximately 900 Bangladesh villagers, along with experimental data to investigate how individual networks influence investment decisions and income levels. They do not find evidence for the effect of experiencing the disaster on households' investment decision and income. However, the exposure of households to networks significantly affects those economic outcomes 2.5 years after the cyclone. Interestingly, they report that households sharing resources within their networks tend not to buy disaster-covered insurance, suggesting a crowding out effect of social capital against formal insurance.

For health-related outcomes, Hikichi et al. (2017) design two surveys with one before (n=5058 respondents) and one follow-up (n=3594 respondents) after the 2011 Great East Japan earthquake and tsunami to investigate the role of social capital on health-related outcomes. They find that the structural social capital, as measured by the frequency of meeting with friends, the number of friends, and participation in sports and clubs, mitigated the risk of cognitive decline resulting from housing damage. However, the cognitive social capital, indicated by respondents' trust, mutual help, and community attachment, does not statistically significantly affect cognitive health following housing damage. Additionally, as mentioned earlier, Gallagher et al. (2019), analysing longitudinal data from two survey waves demonstrated that the effect of social capital on mental health outcomes is positive but nonlinear.

Australian evidence on social capital and disaster resilience is limited

While there have been some small-scale studies and case studies focused on specific disasters in the Australian context discussed earlier, large-scale quantitative evidence on the role of social capital in disaster resilience is limited. A report that comes marginally close to our study was commissioned by the Special Broadcasting Service to Deloitte Access Economics (2019) to quantify the economic dividend of social inclusion from migrant communities and gender equality in senior executive positions. While the study was not in the context of disasters, the report estimated that a 14% improvement in social inclusion to match the top level in the world would lead to a return of $12.7 billion annually. Specifically, a large proportion of this dividend from improving social inclusion also comes from improving health, including mental health of migrant communities.

In contrast to the above study, this current study investigates the role of social capital (which is closely related to social inclusion) in mitigating the negative consequences of disasters on a wide range of economic and social outcomes. We then carry out a monetary valuation of the moderation impact of social capital that can be used to analyse the cost-effectiveness of investment into social capital improvement programs. Findings from this study are in line with the above studies in that we find a clear and prominent impact of bushfires on mental well-being. Meanwhile, neighbourhood-based social capital plays crucial role in alleviating the negative impacts of bushfires on mental health among the affected groups. Importantly, utilising a large dataset representative of Australians over the two decades, we are able to provide insights into the impact of disasters and the moderating role of social capital for very fine segments of the population.

Australian evidence on social capital and disaster resilience is limited

This is crucially important for policy intervention as certain groups, owning to their demographic and socio-economic characteristics, tend to be affected more than others, and these are points of vulnerability that need intervention the most. Thus, this study improves understanding of disaster impacts in a way that can offer valuable implications for policy intervention to achieve better disaster resilience in Australia.

While the existing literature significantly contributes to our understanding of social capital, further evidence is required to robustly elucidate its effects, optimise its benefits, and mitigate potential negative consequences. Given a consensus among most of the literature on the positive effects of social capital on disaster resilience, the more pressing questions revolve around how to strengthen social capital while still fostering inclusiveness

To summarise, social capital offers immediate economic and health-related support as well as long-term recovery opportunities to communities affected by disasters, influencing various decisions before (preparedness), during (response), and after (recovery) disasters strike. While different types of social capital may present varied benefits and drawbacks, they often complement each other rather than being mutually exclusive. Despite the significant economic and health-related advantages of social capital, it does not always operate properly. Instances of exclusion of outsiders, toxic norms, corruption, and moral hazards can occur.

Therefore, it is crucial to strike a balance between the benefits and potential downsides of social capital in practice. Although there exists a substantial body of empirical studies dedicated to examining the role of social capital in disaster resilience, many are qualitative or rely on cross-sectional data. Moreover, there is a dire lack of research into the moderating role of social capital. More rigorous analyses, such as those utilising larger and longer periods of data, are needed to establish more robust inferences regarding the role and operation of social capital. This research endeavour holds significant policy implications, with the potential to improve the lives of many individuals, particularly the most vulnerable, during times of greatest need.[9]

[9] The recent COVID-19 episode in the world has revealed substantial effects of social capital (or its lack, thereof), especially during lockdowns in several parts of the world. It has been shown that higher social capital led individuals to comply with public morality (Liu and Wen, 2021), and reduced the cumulative number of infections and deaths (Makridis and Wu, 2021). In an Australian context, the lockdowns meant that interventions were needed to increase social support, social cohesion, and social connectedness, especially in low socioeconomic areas (Green, Fernandez, Moxham, and MacPhail, 2022). Virtual networks have developed during COVID-19, which is the beyond the scope of this report.

Quantifying the effect of social capital on households following disasters in Australia

Data sources

To quantify the effect of social capital on disaster resilience, we built a large dataset that combines information from multiple sources, including the HILDA survey, various bushfire history datasets from Australian state and territory governments, and the Severe Storms Archive from the Australian Bureau of Meteorology.

The final dataset under analysis covers the period from 2001 to 2019, with approximately 385,000 observations.[10] The temporal and spatial variations in our large longitudinal dataset allow quantifying the effect of disaster exposure on key well-being outcomes for individuals who have access to varying levels of social capital. Additionally, the large sample size allows us to investigate the effects of disasters on various sub-groups who, owing to their demographic and socioeconomic characteristics, may experience varying levels of disaster impact. This information is crucial to better identify the target groups for intervention so as to assist the disaster resilience and recovery efforts more effectively.

HILDA is a nationally representative survey of the Australian households, which collects detailed annual information from about 17,000 households. Each household is revisited annually to retrieve information about the changing economic and non-economic conditions of households across Australia.

The HILDA Survey is well-suited for addressing the research questions in this study for several reasons. It covers a wide range of variables, including various economic, emotional, and physical well-being outcomes. Additionally, it includes respondents' perceptions of social connectedness, trust in the community, reciprocity, and other factors, allowing us to construct a multi-dimensional measure of social capital. Furthermore, it comprises information on demographic characteristics and socio-economic conditions of each individual, enabling subgroup analysis that is valuable for policy implications.

Our analysis requires data on disasters that are consistently measured at a national scale and cover the entire period under consideration. We identify two sets of data that meet these criteria and cover two of the most frequent natural hazards in Australia: bushfires and storms. Importantly, data on all these events are recorded by government agencies, including the geolocation and the date of the events. These features of the data enable us to link individuals in the HILDA data to their exposure of disaster incidents in their vicinity. We match individuals to every bushfire and severe storm event at Statistical Area Level 2 (SA-2). The Australian Bureau of Statistics (ABS) defines SA-2s as geographic entities that represent "communities that interact together socially and economically."

[10] The HILDA survey is conducted every calendar year starting from 2000-01. For brevity, we refer to this calendar year as 2001. Data from 2019-20 was not analysed due to the onset of the COVID-19 pandemic, which may have significantly impacted social capital, mental health, life satisfaction, and income. Excluding data from these years helps control for the bias introduced by the pandemic. This choice consequently means that the data period also excludes the 2019-2020 Black Summer bushfires. While this may look to be an omission, for the generalisability of findings, it is not. Our sample of nearly two decades across the entire country includes multiple severe bushfire events. Our results, therefore, reflect a range of bushfires and provide an overall quantification of the moderating role of social capital.

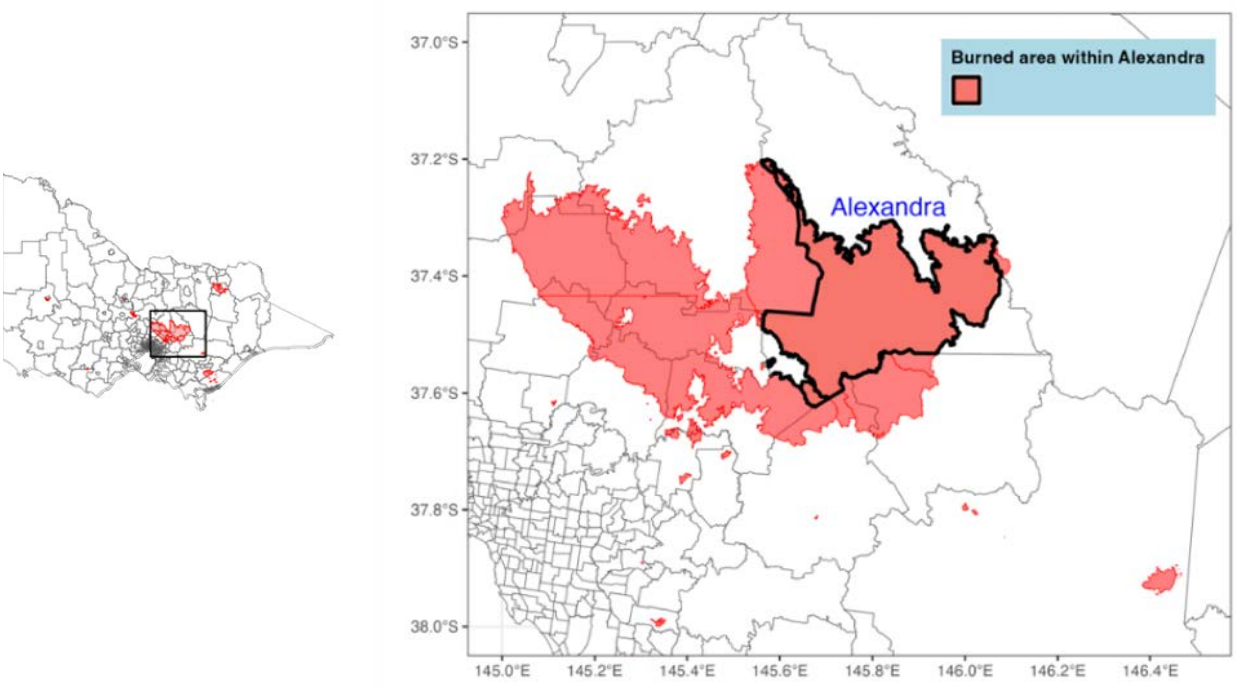


Figure 2. Spatial presentation of burnt SA-2s in Victoria, Australia

To construct bushfire exposure measures, we collect geospatial bushfire history data from 2001 to 2019, remove any prescribed burning, agricultural fires or other managed fires. We compute the area burnt within each SA-2 for each year. Figure 2 shows an example of the burnt area calculation for a particular SA-2 in Victoria during the 2009 Black Saturday bushfires. Our bushfire intensity measure is a measure of exposure, which is the total share of SA-2 area burnt each year, across all bushfires in that year. We also construct an alternative indicator for severe bushfire exposure, which identifies SA-2s in which the share of burnt area is in the top 5% of the sample. The choice of 5% is fairly a standard approach in the economics literature.

Severe storm occurrences are obtained from the Severe Storms Archive10F of the Australian Bureau of Meteorology. This rich dataset contains all recorded Severe Thunderstorm and related events dating back to the 18th century. Each storm event is geolocated by latitude- longitude, which we overlay on SA-2s. Our storm exposure measure is an indicator showing whether an SA-2 experienced a severe storm event in a given year.

Variable descriptions and exploratory profiling

We examine two measures of social capital: perceived neighbourhood support and cognitive social capital. Our three outcomes of interest are life satisfaction (as an indicator of general well-being), mental health quality (as a health outcome), and gross total income (an economic outcome). Disasters include all bushfires and occurrences of severe storms in Australia during the study period. Additionally, several demographic and socioeconomic variables are collected for subgroup analysis.

Social capital

Various measures and definitions of social capital exist in the literature (see Section 3.1). Based on the existing literature and combined with a data-driven approach (see below),[11] this study focuses on (i) the perceived frequency of neighbourhood support and (ii) the cognitive social capital (perceived sense of community and trust in neighbours).

[11] There is a range of options to proxy for social capital using the HILDA survey and in the literature. Most measures are highly correlated: 'People don't come to visit me as often as I would like', 'I often need help from other people but can't get it', 'I seem to have a lot of friends', 'I don't have anyone that I can confide in', 'I have no one to lean on in times of trouble', 'There is someone who can always cheer me up when I'm down', 'I often feel very lonely', 'I enjoy the time I spend with the people who are important to me', 'When something's on my mind, just talking with the people I know can make me feel better', 'When I need someone to help me out, I can usually find someone', 'This is a close-knit neighbourhood', 'People around here are willing to help their neighbours', 'People in this neighbourhood can be trusted', 'People in this neighbourhood generally do not get along with each other', and 'People in this neighbourhood generally do not share the same values.'

Another advantage of using these two proxies of social capital is that questions to construct them are available across all waves of the HILDA survey, providing the desired year-to-year variation for the analysis.

The available data do not allow for a definitive classification of these two proxies as either bonding or bridging social capital. While they can be considered indicators of bonding social capital in small, close-knit neighbourhoods, they could also represent bridging social capital if residents within the neighbourhood are only loosely connected, knowing each other primarily as friends of friends. Given the potential reverse causation problem that may run from well-being to individual-level social capital, we proceed by averaging individual responses at the SA-2 level. Thus, our two measures can be viewed as indicators of neighbourliness, serving as proxies for the social capital of each SA-2.

In particular, 'neighbourhood support-based social capital' is measured by the self-perceived frequency of neighbours in respondents' local neighbourhood helping each other out. It is on a scale from one ('never happens') to five ('very common') in response to the question:

"How common are the following things in your local neighbourhood? - Neighbours helping each other out"[12]

The second proxy of social capital, 'cognitive social capital', focuses on the perceived sense of community and trust in neighbours. It is measured based on responses to the question:

"To what extent do you agree or disagree with the following statements about your neighbourhood?

(a) This is a close-knit neighbourhood

(b) People around here are willing to help their neighbours

(c) People in this neighbourhood can be trusted

(d) People in this neighbourhood generally do not get along with each other

(e) People in this neighbourhood generally do not share the same value"

Each item in the above question is rated on a scale from one ('strongly disagree') to seven ('strongly agree'). With reverse coding applied to statements (d) and (e), cognitive social capital is calculated as the average of responses to the five statements. The resulting value ranges from one to seven, with seven indicating the highest level of cognitive social capital.

As an exploratory profiling exercise, we examine how our two measures of social capital vary across communities that have had at least one bushfire (which we refer to as "bushfire-prone" zones) and communities that have not seen any bushfires ("never-burnt" areas) during the period 2001-2019. In other words, we compare the simple long-run averages of social capital across never-burnt areas and bushfire-prone areas during 2001-2019. Noting this is only an exploratory analysis and that there are several confounding factors (which are addressed in Section 5.3 and 5.4), both neighbourhood support and cognitive social capital of residents in bushfire-prone zones are stronger than those in never-burnt areas on average.

Regarding neighbourhood support, Figure 3 on the next page shows that residents in bushfire-prone areas reported a higher frequency of neighbours in their local area helping each other (an average of 3.7 points out of 5) compared to those in never-burnt areas (an average of 3.43 points). Figure 4 indicates that residents in bushfire-prone areas have a stronger sense of community. For instance, respondents in bushfire-prone areas had higher agreement with the statement "this is a close-knit neighbourhood" (an average of 4.09 points out of 5) than those in never-burnt areas (an average of 3.75 points). These findings suggest a positive correlation between social capital and bushfire exposure.

[12] This question asks respondents about nine neighbourhood dimensions (neighbours doing things together, loud traffic noise, noise from aeroplanes or other sources, condition of homes and gardens, rubbish and litter, teenagers hanging around streets, hostile and aggressive people, vandalism and deliberate damage to property, burglary and theft). We conduct a Principal Component Analysis (PCA) of these nine factors. Analysing the factors that contribute to the principal component average "Neighbours helping each other out" appears to make the strongest contribution in the PCA.

Figure 3. Neighbourhood support in never-burnt SA-2s and bushfire-prone SA-2s 2001 – 2019.

Note: The y-axis shows the reported frequency of observing neighbour helping each other with 1 indicating 'never happens', 2 'very rare', 3 'not common, 4 'fairly common', and 5 'very common'. Long-run averages (2001-2019).

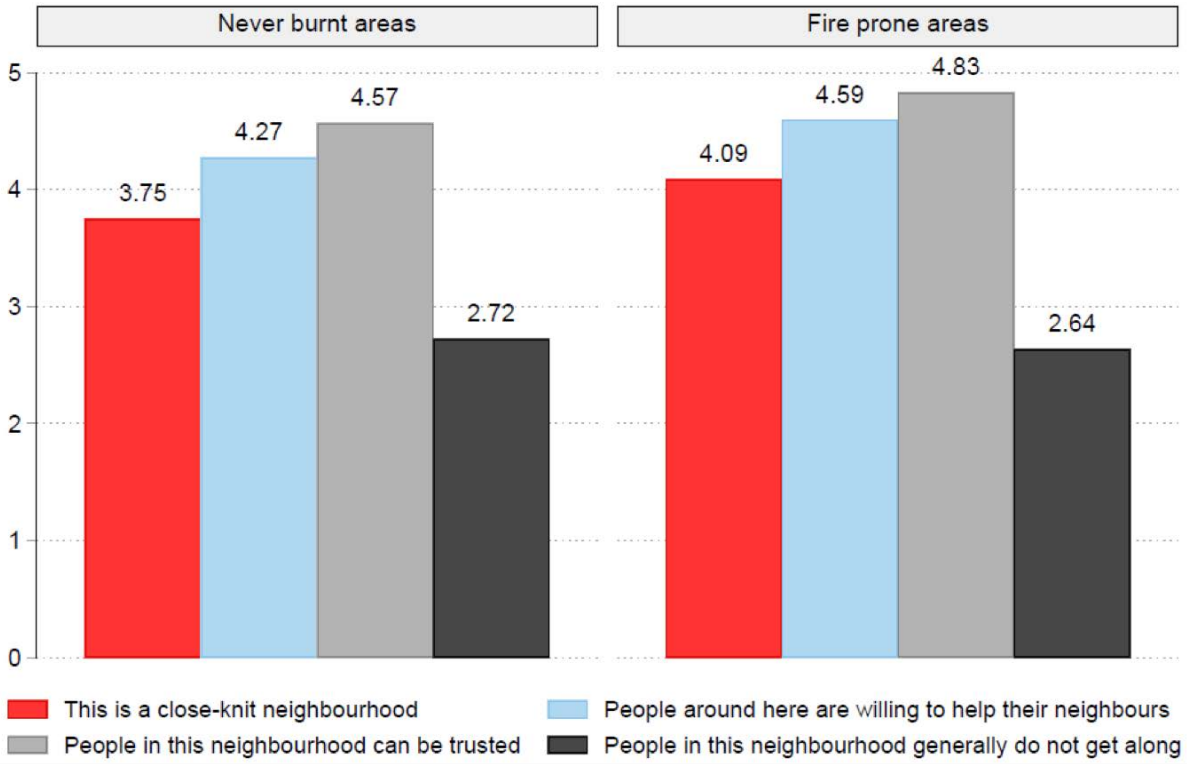
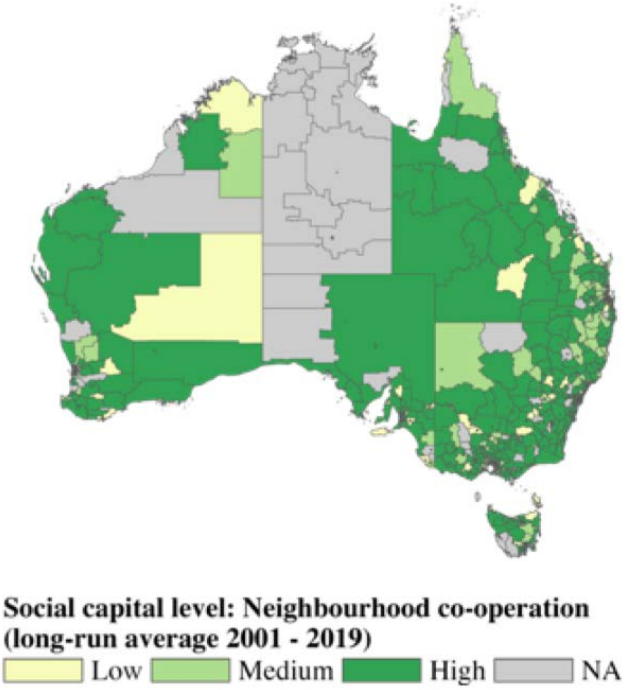


Figure 4. Cognitive social capital in never-burnt SA-2s and bushfire-prone SA-2s 2001-2019.

Note: The y-axis shows the reported agreement with a particular statement, ranging from 1 'strongly disagree' to 7 'strongly agree'. Long-run averages (2001-2019).

a) Neighbourhood support



b) Cognitive social capital

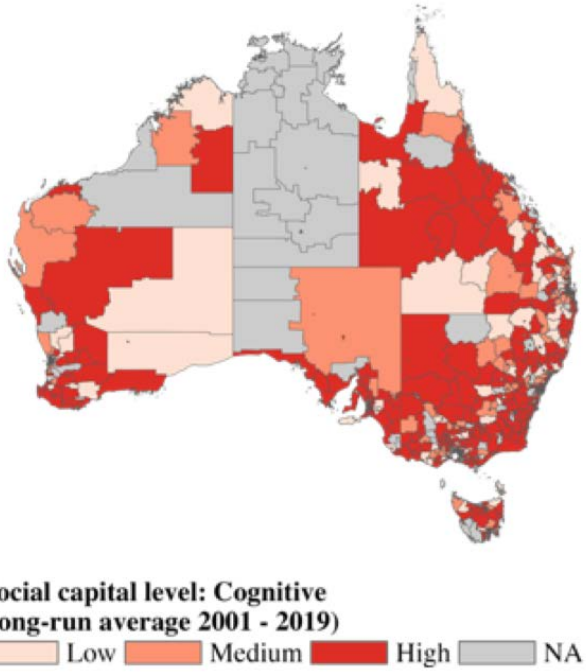


Figure 5. Spatial variation of SA2-level social capital

The above descriptive analysis suggests that disasters themselves may affect social capital. To overcome the empirical challenge that this association poses, the two proxies of social capital (SC) are aggregated to SA-2 level ('community level'). Social capital of each SA-2 in a given year is assigned into three groups: high social capital (high-SC), medium social capital (med-SC), and low social capital (low-SC). The assignment is based on the average social capital level of each SA-2 over time:

$$\overline{SC_r} = \frac{\Sigma_{t=2001}^{2019} SC_{rt}}{20}$$

where (SC)_rt indicates social capital level of SA-2 r in year t, ((SC)_r))- indicates the average social capital level of SA-2 r across two decades from 2001 to 2019. SA-2s with social capital each year that fall within the top tercile are categorised as high social capital for that year, the middle tercile as medium social capital, and the bottom tercile as low social capital. Using the "long run" level of social capital (i.e., the average social capital level over the entire sample period from 2001 to 2019) to distinguish communities with low, moderate, and high levels of social capital helps account for potential short-term changes in social capital that may occur in the aftermath of disasters, among other factors

Figure 5 demonstrates spatial variation of social capital across SA-2s in the sample. In the sample, there are 751 low-SC SA-2s, 540 med-SC SA-2s, and 710 high-SC SA-2s for cognitive social capital and 765 low-SC SA-2s, 516 med-SC SA-2s, and 720 high-SC SA-2s for neighbourhood supports. In terms of individuals, our sample comprises around 128,000 observations in each category.

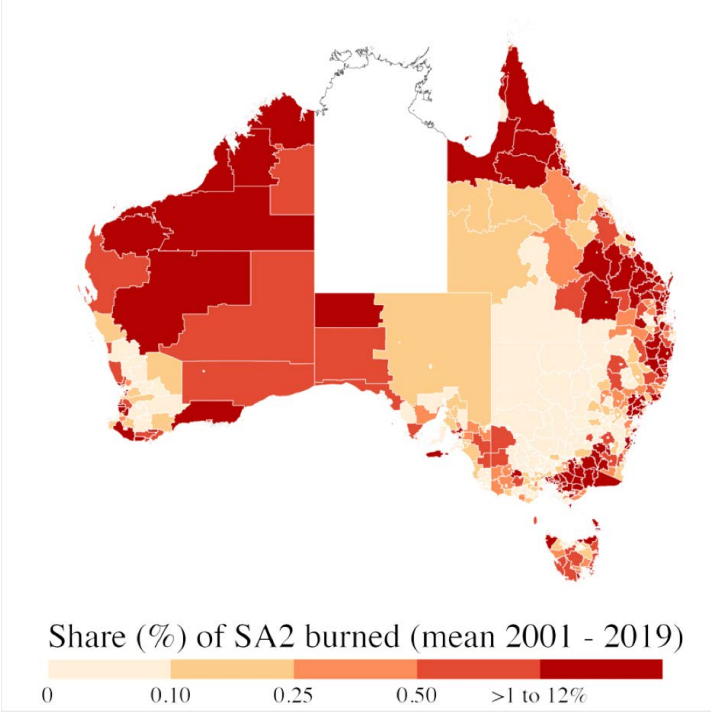


Figure 6. Average share of burnt area in SA-2s in the sample period

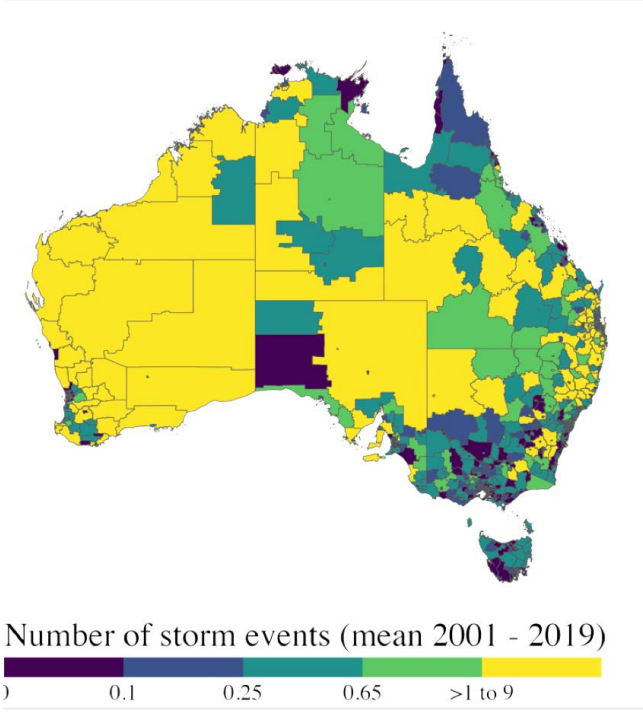


Figure 7. Average number of storm events at SA-2 level in the sample period

Disaster exposure

Figures 6 and 7 portray the spatial distribution of the disaster variables, bushfires and storms, respectively, over the sample period. Nearly half of the sample SA-2 areas (about 47%) experience at least one bushfire over the two decades. On average, an SA-2 has experienced about 3,050 hectares of area burnt. This translates to 0.37 percent in terms of the share of a SA-2 area burnt, on average, each year. Needless to say, this average masks the extent of variability, with the share of SA-2 burnt ranging from a minimum of zero to a maximum of 97 percent. Along with the share of SA-2 burnt, we also use an indicator to show extreme fires in our analysis. This indicator is based on a SA-2 having a burnt area share above the 95th percentile (i.e., greater than around 1.1 percent). More than 2000 SA-2 by year observations comprising 693 unique SA-2s experience an area burnt that is above this threshold.

Figure 7 shows the average number of severe storm events in each SA-2 per year. The number of severe storms vary between zero to a maximum of 42 in a year. On average, an SA-2 in the sample has about 0.25 severe storm events in a year.

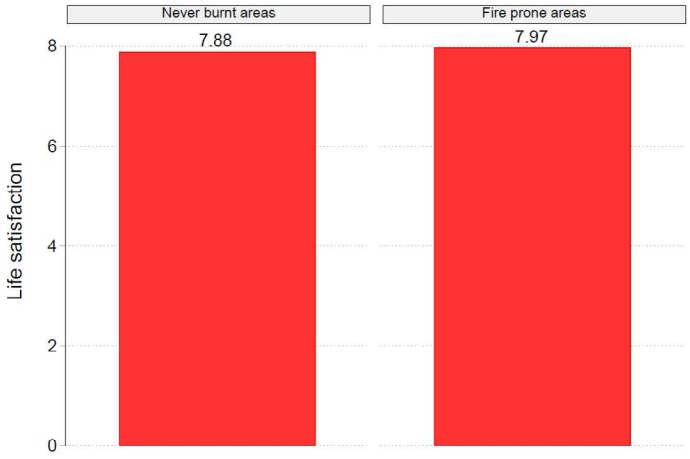


Figure 8. Average life satisfaction in never-burnt SA-2s and bushfire-prone SA-2s 2001-2109

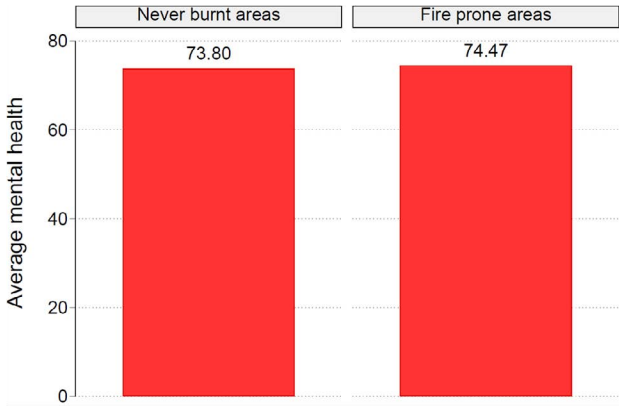


Figure 9. Average mental health in never-burnt SA-2s and bushfire-prone SA-2s 2001-2019

Life satisfaction, mental health, and income

We focus on three outcomes to capture the overall well-being of individuals: life satisfaction, mental health, and income. In general, residents in areas which have never experienced bushfires have slightly lower life satisfaction and worse mental health, but relatively higher total gross incomes.

Life satisfaction is measured as the average of responses to the following question:

"How satisfied or dissatisfied are you with the following things happening in your life?

(a) the home in which you live

(b) your employment opportunities

(c) your financial situation

(d) how safe you feel

(e) feeling part of your local community

(f) your health

(g) the neighbourhood in which you live

(h) the amount of free time you have"

For each aspect of life mentioned above, respondents select a number between 0 and 10, with higher numbers indicating greater satisfaction. Therefore, life satisfaction, calculated as the average value across these ten aspects, ranges from 0 (lowest satisfaction) to 10 (highest satisfaction).

The descriptive plot in Figure 8 shows that households in never-burnt SA-2s exhibit lower life satisfaction (by 2.3%) compared to those in bushfire-prone SA-2s. Our empirical analysis will investigate further whether these differences we see hold after we control for potential confounding factors.

Disasters can lead to a range of health consequences, including physical injuries, however our focus is on mental health because the potential benefits of social capital – built on social networks, trust, and connectedness – are more relevant to mental health. As discussed in Section 4, social capital can provide emotional support, reduces stress, and foster a sense of belonging, all of which are important to mental well-being. We measure individual mental health using the 36-Item Short Form Survey within the HILDA Survey. Scores range from 0 to 100, with 100 indicating the best mental health condition.[13] Figure 9 shows that households in never-burnt SA-2s exhibit slightly worse mental health (by 1.3%) than those in bushfire-prone SA-2s, on average, when we do not account for other confounding factors.

[13] The variable in the HILDA Survey used for analysis for mental health was '_ghmh'.

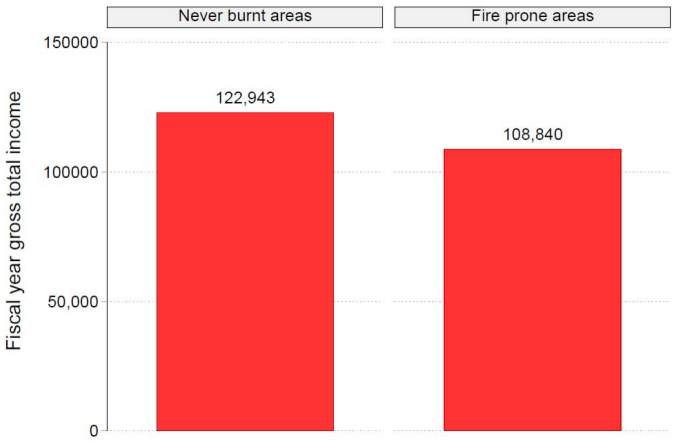


Figure 10. Average household income in never-burnt SA-2s and bushfire-prone SA-2s 2001-2019

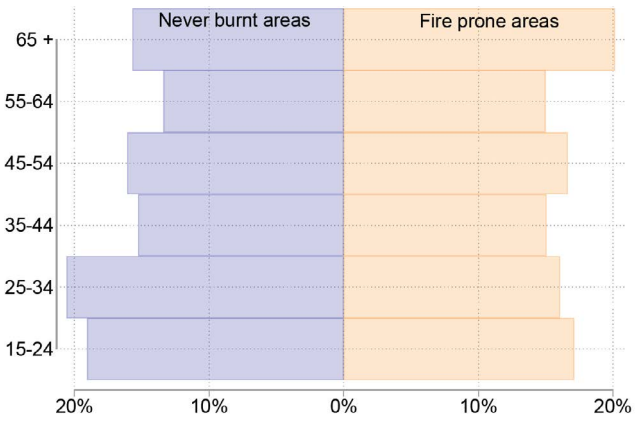


Figure 11. Age distribution in never-burnt SA-2s and bushfire-prone SA-2s 2001-2010

Figure 10 shows, descriptively, that households in never-burnt SA-2s have higher average household income (by 11.5%) compared to those in bushfire-prone SA-2s.

Demographic and socio-economic subgroups

The role of social capital in disaster resilience may vary across different community groups due to differences in their vulnerability and adaptability. The HILDA survey provides an opportunity to investigate this relationship across various demographic and socio-economic characteristics through subgroup analysis. Specifically, we examine groups based on respondents' self-reported age, gender, marital status, education, employment status, and area remoteness.

We provide a descriptive profile of the characteristics of the sample population in communities that have had at least one bushfire during the period of analysis compared to communities that have not experienced a bushfire between 2001-2019 in Figures 11 to 16. Overall, bushfire-prone areas are often regional and remote with higher percentages of people aged 65 and older, males, legally married, separated, or divorced individuals, those with relatively lower education, and higher unemployment. Understanding the impact of disasters on these groups and the role of social capital is crucial for informing targeted interventions and policy development.

Respondents' ages as of the survey date are classified into three groups: below 33 years, 33-66 years, and above 66 years. Figure 11 compares the age pyramid between never-burnt areas and bushfire-prone areas. The population in bushfire-prone areas tends to be older than that in never-burnt areas. While more than 20% of respondents in bushfire-prone areas are 65+ years old, only 15% of respondents in never-burnt areas are 65+ years old. People aged 65+ could be more severely affected by disasters than those of younger age.

Gender subgroups include males and females. Figure 12 shows that bushfire-prone areas have a slightly lower percentage of females compared to never-burnt areas.

Figure 12. Gender distribution in never-burnt SA-2s and bushfire-prone SA-2s 2001-2019

Marital status has six subgroups including never married, widowed, divorced, separated, de facto, and legally married. Bushfire-prone areas have higher percentages of individuals who are legally married, separated, and divorced compared to burnt areas (Figure 13). People who are divorced and widows can be more vulnerable and negatively affected by disasters more than other groups (Aldrich 2011).

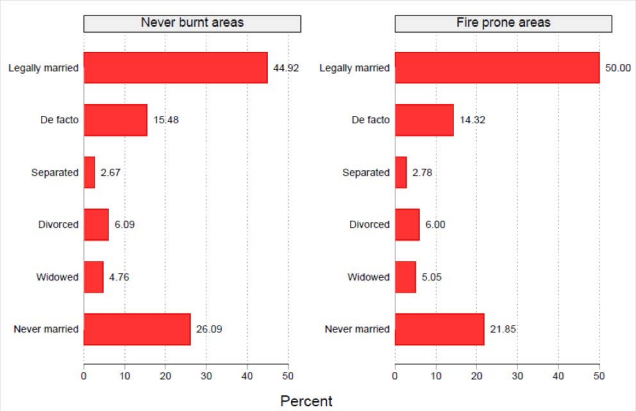


Figure 13 Marital status distribution in never-burnt SA-2s and bushfire-prone SA-2s 2001-2019

Education level is measured as the highest level of education attained. Individual education level is categorised into seven groups: Year 11 or below, Year 12, certificate III or IV, bachelor or honours, graduate diploma or graduate certificate, and postgraduate (master's or doctorate).

Figure 14 indicates that residents in never-burnt areas appear to have higher education compared to those in bushfire-prone areas, with 16.9% more residents holding graduate diplomas, bachelor's degrees, or higher degrees. This suggests that residents in bushfire-prone areas may have fewer recovery opportunities (e.g., employment) than those in never-burnt areas.

Employment status includes six subgroups: not in the labour force but marginally attached to the labour force, not in the labour force and not marginally attached to the labour force, unemployed and looking for part-time work, unemployed and looking for full-time work, employed part-time, and employed full-time.

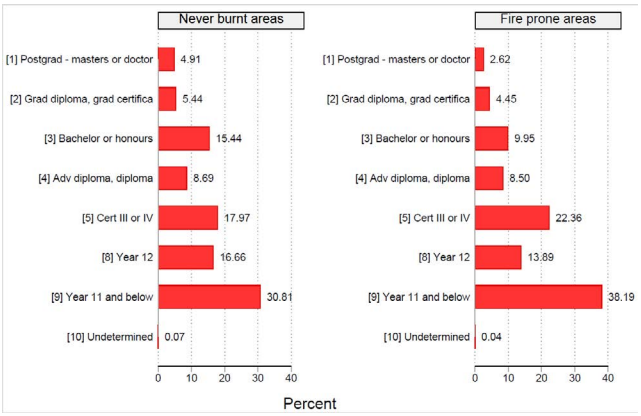


Figure 14. Education distribution in never-burnt SA-2s and bushfire-prone SA-2s 2001-2019

Note: 'Postgrad' refers to 'postgraduate,' 'grad' refers to 'graduate,' 'Adv' stands for 'Advanced,' and 'Cert III or IV' stands for 'Certificate III or IV'.

Figure 15 demonstrates that never-burnt areas have higher percentages of full-time workers (44.6%) than fire prone areas (40.73%). This suggests that residents in fire prone areas may be more vulnerable.

Figure 15. Employment status distribution in never-burnt SA-2s and bushfire-prone SA-2s 2001-2019

Note: 'FT' stands for full-time, 'PT' for part-time, 'MA' for marginally attached to the labour force, 'NMA' for 'not marginally attached to the labour force'

Household addresses are geocoded and classified into four groups: major cities, inner regional Australia, outer regional Australia, and remote Australia. As expected, regional and remote areas are more prone to bushfires than major cities. Among bushfire-prone areas, 58.33% are regional and remote, while 41.67% are major cities. Conversely, of all areas that have never experienced bushfires, only 19.12% are regional and remote, whereas 80.88% are major cities.

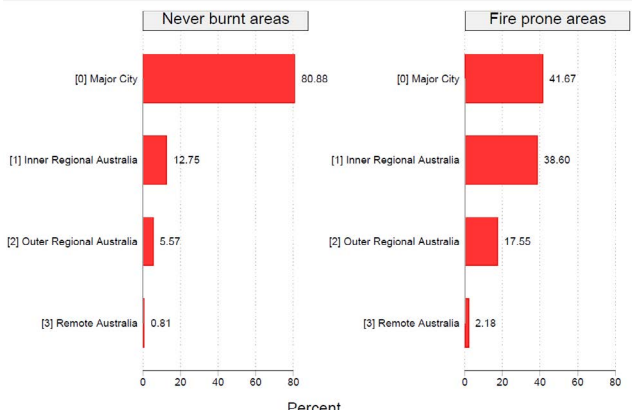


Figure 16. Remoteness in never-burnt SA-2s and bushfire-prone SA-2s 2001-2019

Analytical methods

We follow the state-of-the-art modelling approach in the economics literature, which is the difference-in-differences (DiD) modelling. This framework compares the changes in well-being outcomes for individuals living in SA-2s that have experienced a disaster, with well-being changes of individuals in comparable communities that have not been affected by disaster.

Figure 17 demonstrates the essence of our analytical approach. The well-being outcomes of disaster-affected individuals (the dashed orange line – the treatment group) would have followed the same trajectory as those shown by comparable disaster-unaffected individuals (the solid green line – the control group) living in SA-2s without a disaster effect. However, the well-being outcome for the affected individuals follows a different path, as demonstrated by the purple line.

The difference between the actual outcomes following a disaster of the affected group (the purple line) and its "counterfactual" (the dash orange line) points to the effect of the disaster. The model is estimated with the Ordinary Least Squares estimation.

There are two critical assumptions in this modelling. First, the treatment and control groups follow a similar trend before the disaster. The violation of this assumption makes it difficult to establish an appropriate counterfactual for the treatment group.

We test this assumption within our modelling framework, and our reported results rely on models that are free from the violation of this assumption. The second assumption is the absence of any other shock in the aftermath of the disaster that could afflict either of or both the treatment and control groups. Such a shock would confound the disaster effect.

Since we analyse very specific spatial and temporal variability in the share of burnt SA-2s due to bushfires, it is extremely difficult to consider a shock that follows a similar pattern as the bushfires. Nonetheless, there might be some government or NGO interventions or programs, such as that of Red Cross, that follow similar patterns (i.e., timing and locality) of disasters. This suggests that our estimates could comprise the possible effects of those interventions.

To ensure an accurate interpretation of the DiD estimate due to the disaster shock, we impose further restrictions on modelling, which account for individual-specific differences and year-specific variations in the sample. For example, we "wipe off" all individual characteristics that do not change over time, such as gender and ethnicity. The year-specific effects capture the changes occurring for all individuals every year, such as macroeconomic shocks (e.g., the Global Financial Crisis). These effects are also "wiped off." To the extent that these factors are potentially correlated with well-being outcomes, eliminating these factors from the model helps identify the true effect of disasters on economic, social and mental well-being.

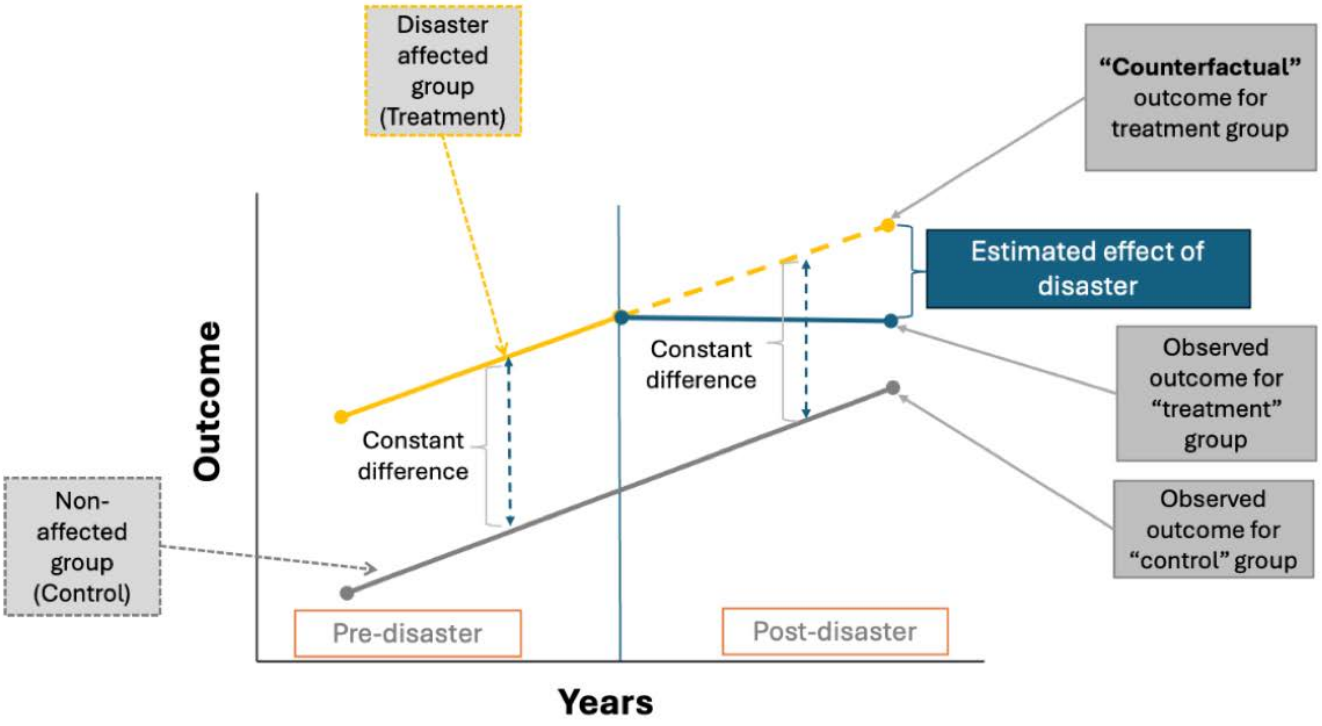


Figure 17. Difference-in-differences modelling

On a further note, while the DiD approach informs us of the overall disaster effect, we are interested in the mitigating role of social capital. To examine this question, we compare whether our DiD estimate varies across each social capital community – low, medium, and high. If the disaster effect is stronger (more adverse) for individuals living in low social capital-SA2s compared to those living in medium or high social capital groups, it would suggest that social capital helps mitigate the adverse impacts of the disaster.

Our DiD framework comprises three separate models (see Annex A for detailed model specifications). The benchmark model compares the impact of an average bushfire on mental health, life satisfaction, and income in low-SC areas with that in medium-SC and high-SC areas. The second model focuses on severe bushfires at the 95th percentile because severe bushfires may have more profound impacts on households and the role of social capital may be more significant. Finally, the third model uses the 2009 Black Saturday Bushfire as a case study. This is catastrophic disaster that afflicted a narrower geography than the whole of Australia and serves as a robustness check of our main findings in a different setting.

Findings

This section reports the model results related to the effect of social capital on life satisfaction, mental health, and income in the aftermath of bushfires and storms. Our analysis finds that storms typically have negligible effects on well-being outcomes considered, either in aggregate or for subgroups of population. Thus, for brevity, this discussion focuses on bushfires.

In general, we estimate a negative and significant impact of bushfires on economically vulnerable groups, including older people, unemployed individuals, individuals who are divorced, and individuals living in remote areas, particularly in low-SC SA2s. Conversely, we do not find any discernible effect of disasters in SA2s with higher levels of social capital. This suggests that social capital helps to neutralise, or alleviate, the adverse impacts of disasters.

We first present the findings for the full sample (i.e., the whole-of-Australia sample).

Neighbourhood support alleviates the negative impacts of bushfires on people who are 'vulnerable'

Considering the neighbourhood support-related social capital "neighbours helping each other out," we find that 'vulnerable' groups benefit the most from bonding with neighbours. In general, we document adverse impacts of bushfires on outcomes of interest in SA-2s with the lowest levels of social capital. This includes older individuals aged over 66, those who are not in the labour force, people who unemployed, people living in remote parts of Australia, males, people who are divorced, and people with a graduate diploma.

Figure 18 on the next page show that life satisfaction for people who are divorced, mental health for individuals whose highest educational attainment is Year 12, and total gross income for individuals residing in major cities of Australia experienced adverse effects following bushfires. These effects are observed in SA-2s with the lowest levels of social capital.

Specifically, divorced individuals living in low-SC areas experience a 0.04 unit reduction in life satisfaction (0.57% of the average) for each one percentage point increase bushfire intensity (coef -4.221, $p<0.1$). The effects of bushfire intensity on the life satisfaction of divorced individuals residing in medium-SC and high-SC SA2-s are not statistically significant. This suggests that social capital positively affects the life satisfaction of people who are divorced following bushfires.

Specifically, divorced individuals living in low-SC areas experience a 0.04 unit reduction in life satisfaction (0.57% of the average) for each one percentage point increase bushfire intensity (coef -4.221, $p<0.1$). The effects of bushfire intensity on the life satisfaction of divorced individuals residing in medium-SC and high-SC SA2-s are not statistically significant. This suggests that social capital positively affects the life satisfaction of people who are divorced following bushfires.

Individuals whose highest educational attainment is Year 12 experience a 0.1 unit reduction in mental health (0.14% of the average) for each one percentage point increase in bushfire intensity (coef -9.825, $p<0.1$). The effects of bushfire intensity on the mental health of this group living in medium-SC and high-SC SA2-s are not statistically significant. This suggests that social capital positively impacts the life satisfaction following bushfires for people whose highest educational attainment is Year 12.

Residents in major cities experience a 0.81% reduction in gross income for each one percentage point increase in bushfire intensity (coef 0.806, $p<0.05$). The effects of bushfire intensity on gross income for residents living in medium-SC and high-SC major cities are not statistically significant. This suggests that social capital positively impacts the total gross income of people living in major cities following bushfires.

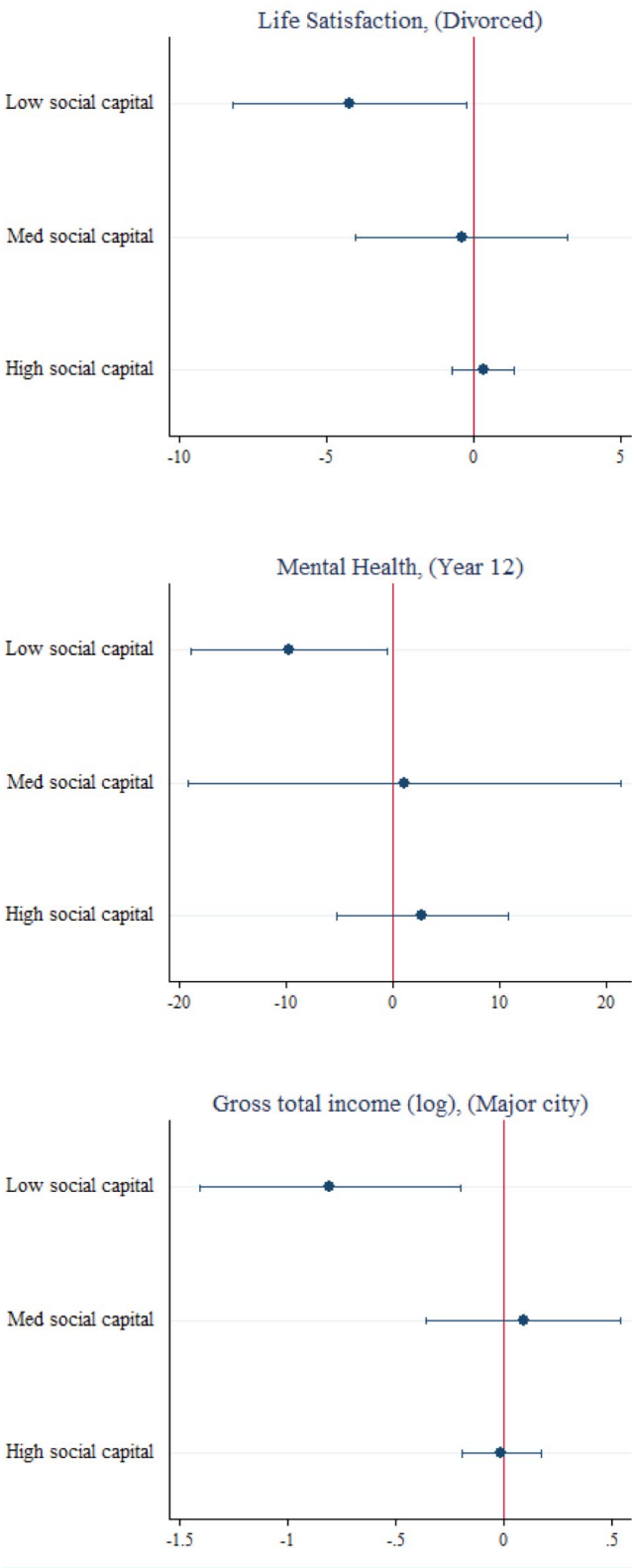


Figure 18. Neighbourhood support alleviates the negative impacts of bushfires

Note: The charts illustrate the estimated effects, with 90% confidence interval, of varying degrees of social capital using the fire intensity, specified in Equation 1. The upper chart shows the impact on life satisfaction for people who are divorced, the middle chart depicts the impact on mental health for individuals whose highest educational attainment is a "Year 12" degree, and the bottom chart displays the impact on gross total income for individuals living major cities of Australia.

Figure 19 on the following page displays the effects of severe fires (the top 95th percentile). The upper chart shows that life satisfaction for people who are unemployed is severely impacted in SA-2s with the lowest levels of social capital. The middle and bottom charts illustrate significant declines in mental health for people aged over 66 and for people who are not in the labour force. However, a higher level of social capital again neutralises the adverse impact of disasters.

Specifically, the unemployed living in low-SC SA-2s experience a 0.0078-unit reduction in life satisfaction (0.11% of the average) for each percentage point increase in areas burnt by severe bushfires (coef -0.78, $p<0.05$).

The effects of extreme bushfires on life satisfaction for people who are unemployed in medium-SC and high-SC SA-2s are not statistically significant. This suggests that social capital positively impacts the life satisfaction of people who are unemployed following extreme bushfires.

People aged over 66 living in low-SC SA-2s experience a 0.036 unit reduction in mental health (0.11% of the average) for each percentage point increase in areas burnt by severe bushfires (coef -3.596, $p<0.05$).

The effect of extreme bushfires on mental health for people aged over 66 in medium-SC and high-SC SA-2s are not statistically significant. This suggests that social capital positively impacts the mental health of people aged over 66 following extreme bushfires.

Similarly, people who are not in the labour force, not marginally attached to the labour force, and living in low-SC SA-2s experience a 0.03 unit reduction in mental health (0.04% of the average) for each percentage point increase in areas burnt by severe fires (coef -2.958, $p<0.1$). This negative effect of extreme fires on mental health is neutralised in areas with medium to high social capital levels.

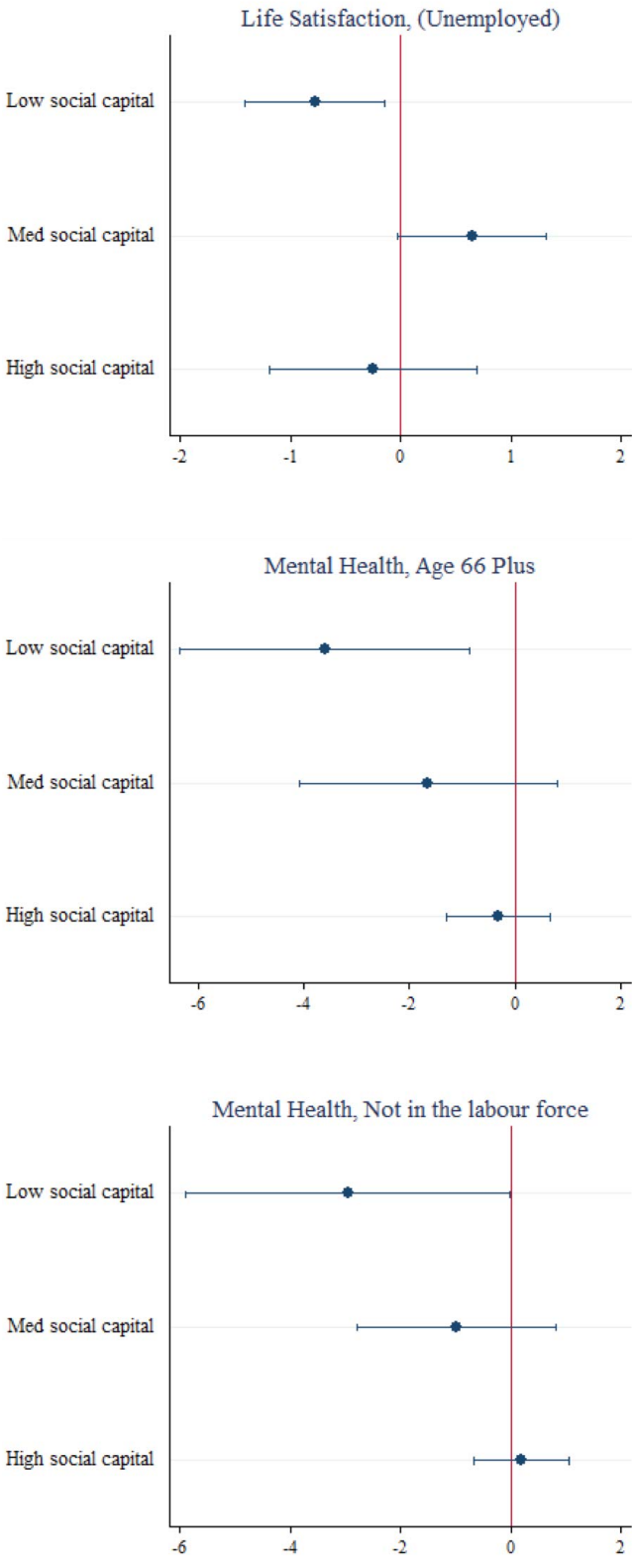


Figure 19. Neighbourhood support alleviates the negative impacts of severe bushfires

Note: The charts illustrate the estimated effects, with 90% confidence interval, of varying degrees of social capital using the measure specified in the Equation 2. The upper chart shows the impact on life satisfaction for unemployed, the middle chart depicts the impact on mental health for older people aged over 66, and the bottom chart displays the impact on mental health for respondents who are not in the labour force.

Cognitive social capital reduces the negative impacts of bushfires on people experiencing vulnerability

We now turn to cognitive social capital. Similar to the findings for "connectedness with neighbours," vulnerable groups tend to benefit the most from residing in SA2-s with high levels of cognitive social capital.

Figure 20 on the following page depicts the effects of varying degrees of cognitive social capital. The upper, middle, and lower charts of the figure show that life satisfaction drops significantly for older individuals aged over 66, for individuals living in remote areas of Australia, and for those who are not in the labour force, respectively. These effects are visible in SA-2s with the lowest levels of social capital. However, a higher level of cognitive social capital neutralises the adverse impact of disasters, highlighting the role of cognitive social capital in strengthening resilience.

Specifically, people aged over 66 living in low-SC areas experience a 0.025 unit reduction in life satisfaction (0.30% of the average) for each percentage point increase in bushfire intensity (coef -2.519, $p<0.05$). The estimated effect of bushfire intensity on life satisfaction for people aged over 66 residing in medium-SC and high-SC SA-2s are not statistically significant. This suggests that social capital positively impacts the life satisfaction of people aged over 65 following bushfires.

People who are not in the labour force, marginally attached to the labour force, and live in low-SC SA-2s experience a 0.032 unit reduction in life satisfaction (0.42% of the average) for each percentage point increase in bushfire intensity (coef -3.235, $p<0.05$). The effect of bushfire intensity on life satisfaction for this group living in medium-SC and high-SC SA-2s is not statistically significant. This suggests that social capital positively impacts the life satisfaction of people who are not in the labour force and or those who are marginally attached to the labour force.

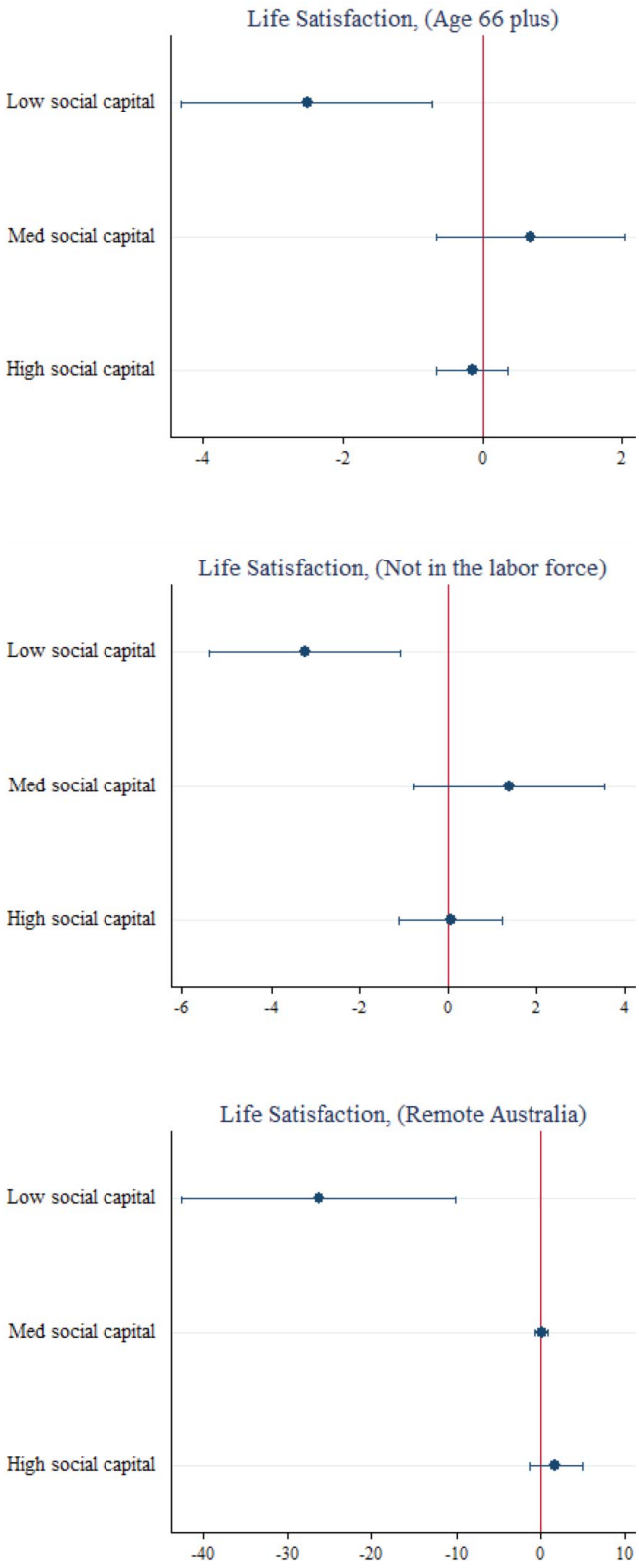


Figure 20. Cognitive social capital alleviates the negative impacts of bushfires

Note: The charts illustrate the estimated effects, with 90% confidence interval, of varying degrees of cognitive capital using the fire intensity measure specified in Equation 1. The upper chart shows the impact on life satisfaction for older individuals aged over 66, the middle chart depicts the impact for individuals living remote areas of Australia, the bottom chart displays the impact on life satisfaction for individuals who are not in the labour force.

Residents in remote low-SC SA-2s experience a 0.26 reduction in life satisfaction (3.23% of the average) for each percentage point increase in bushfire intensity (coef -26.26, $p<0.001$). The effect of bushfires on life satisfaction people living remote medium-SC and high-SC SA-2s is not statistically significant. This suggests that social capital positively impacts life satisfaction of people living in remote areas following bushfires.

Figure 21 reveals some important results on the effect of cognitive social capital in the case of severe bushfires. The upper chart consistently shows that life satisfaction drops significantly for older individuals aged over 66. In contrast, the middle and bottom charts indicate that life satisfaction drops significantly for individuals holding a graduate diploma and for males, respectively, who reside in SA-2s with the lowest levels of social capital. This adverse effect is neutralised or sometimes even turned positive in SA-2s with higher levels of cognitive social capital.

Specifically, people aged over 66 living in low-SC SA-2s experience a 0.006 unit reduction in life satisfaction (0.08% of the average) for each percentage point increase in extreme bushfire intensity (coef -0.641, $p<0.05$). The estimated effect of severe bushfires on life satisfaction for people aged over 66 is positive for those living in med-SC SA-2s and not statistically significant for those living in high-SC SA-2s. This suggests that social capital positively impacts the life satisfaction of people aged over 66 following severe bushfires.

Individuals whose highest educational attainment is graduate diploma experience a 0.005 unit reduction in life satisfaction (0.06% of the average) for each one percentage point increase in severe bushfire intensity (coef -0.465, $p<0.001$). The effects of severe bushfires on the life satisfaction of this group living in medium-SC and high-SC SA-2s are not statistically significant. This suggests that social capital positively affects the life satisfaction following severe bushfires for people whose highest educational attainment is graduate diploma. Males residing in low-SC SA-2s experience a 0.002 unit reduction in life satisfaction (0.02% of the average) for each percentage point increase in severe bushfire intensity (coef -0.195, $p<0.1$).

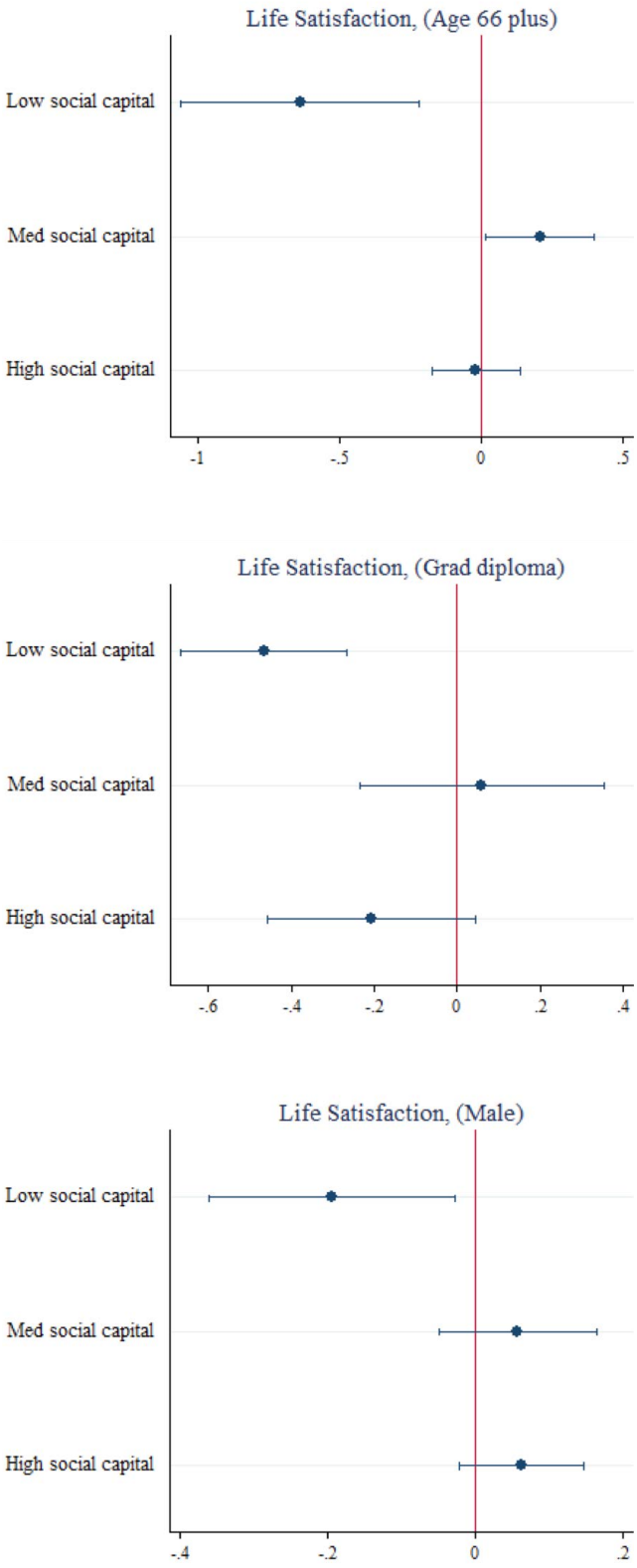


Figure 21. Cognitive social capital alleviates the negative impacts of severe fires following severe bushfires

Note: The charts illustrate the estimated effects, with 90% confidence interval, of varying degrees of cognitive capital using the measure specified in Equation 2. The upper chart shows the impact on life satisfaction for older individuals aged over 66, while the middle chart depicts the impact for individuals holding graduate diploma. The bottom chart displays the impact on life satisfaction for males.

The estimated effect of severe bushfires on life satisfaction males living in medium-SC and high-SC SA-2s are not statistically significant. This suggests that social capital positively affects the life satisfaction of males.

5.4.3 Social capital alleviates the negative impacts of the 2009 Black Saturday Bushfires on the vulnerable

We now complement our analysis with the deadliest fire to date, the BSB, again using the two social capital variables we developed earlier (i) neighbourhood support and (ii) cognitive social capital. Both social capital measures within our case study point to consistent findings. The BSB afflicted the vulnerable groups in areas with low social capital SA-2s and the negative effects were neutralised or disappeared in SA-2s with medium to high social capital. See Annex for some details of the estimation approach used for this case study.

Our analysis shows that the benefits of social capital in the aftermath of the BSB are most evident in the first year following the disaster. After this period, the effects diminish, with most of the estimated coefficients becoming statistically insignificant, economically small, or both. Due to the large number of coefficients, our discussion focuses on the effect of the BSB and the role of social capital in moderating its negative impact during the first year after the disaster.14

The upper left and right charts of Figure 22 show that life satisfaction for females and people who are divorced living in SA-2s with the lowest social capital has dropped significantly following the BSB. Specifically, the BSB is associated a reduction in life satisfaction of 0.477 units for females (coef -0.477, $p<0.001$; equivalent to 6% of the average) and 1.116 units for divorced individuals (coef -1.116, $p<0.001$; equivalent to 15 % of the average) living in low-SC areas. These negative impacts are not present or become less severe for cohorts living in med-SC and high-SC SA-2s.

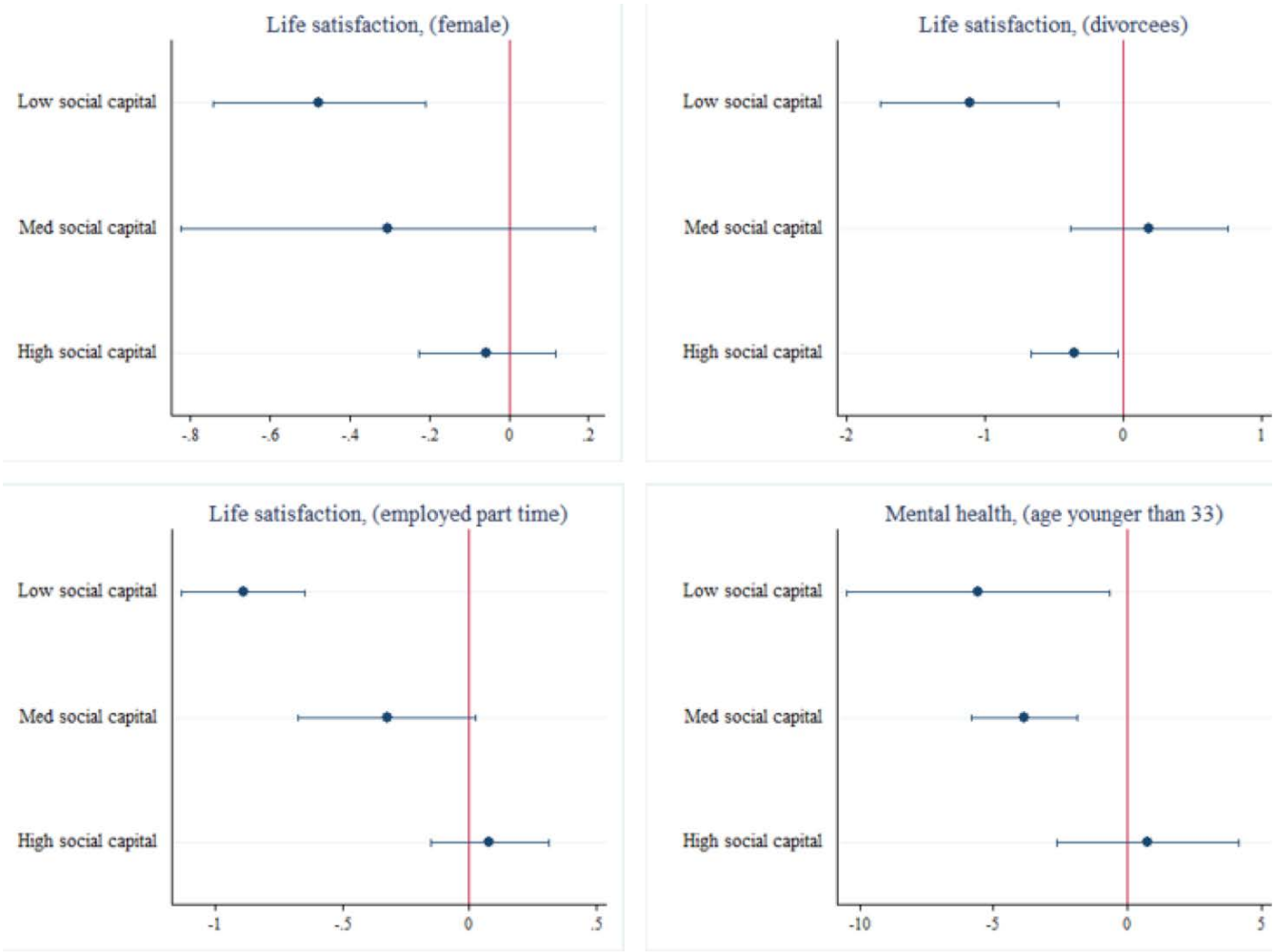


Figure 22. Neighbourhood support alleviates the negative impacts of the 2009 Black Saturday Bushfires

Note: The charts illustrate the estimated effects, with 90% confidence interval, of varying degrees of neighbourhood support using the measure specified in Equation 2.

The bottom left chart shows that individuals who work part-time experienced significant declines in life satisfaction, while the bottom right chart shows that the mental health of a relatively younger cohort, aged 33 and below, deteriorated significantly. Specifically, the BSB is associated with a reduction of 0.888 units in life satisfaction for part-time workers (coef -0.888, $p<0.001$; equivalent to 11.1% of the average) and a decrease of 5.568 units in mental health of people aged less than 33 (coef -5.568, $p<0.05$; equivalent to 7.8% of the average). These negative impacts are not present or become less severe for cohorts living in med-SC and high-SC SA-2s.

The cognitive social capital measure reveals consistent findings. Specifically, the upper left and right charts of Figure 23 show that females and individuals aged 33 and below living in SA-2s with the lowest social capital exhibit significant declines in life satisfaction.

Similarly, other charts in the figure reveal comparable patterns. Respondents who were never married or hold an advanced diploma or Year 12 as their highest earned degree also display significant declines in life satisfaction. However, all charts again highlight that these adverse effects are neutralised for respondents living in SA-2s with higher social capital.

The BSB is associated with reductions in life satisfaction of some vulnerable groups living low-SC SA-2s including people whose highest education attainment is Year 12 (coef -0.293, $p<0.1$; equivalent to 3.7% of the average) or advanced diploma or diploma (coef -0.215, $p<0.1$; equivalent to 2.7% of the average), those who are never married and not de facto (coef -0.559, $p<0.001$; equivalent to 7.2% of the average), females (coef -0.5, $p<0.001$; equivalent to 6.3% of the average), and aged below 33 (coef -0.3, $p<0.1$; equivalent to 3.8% of the average). These negative effects become less severe or disappear for those residing in medium to high-SC SA-2s.

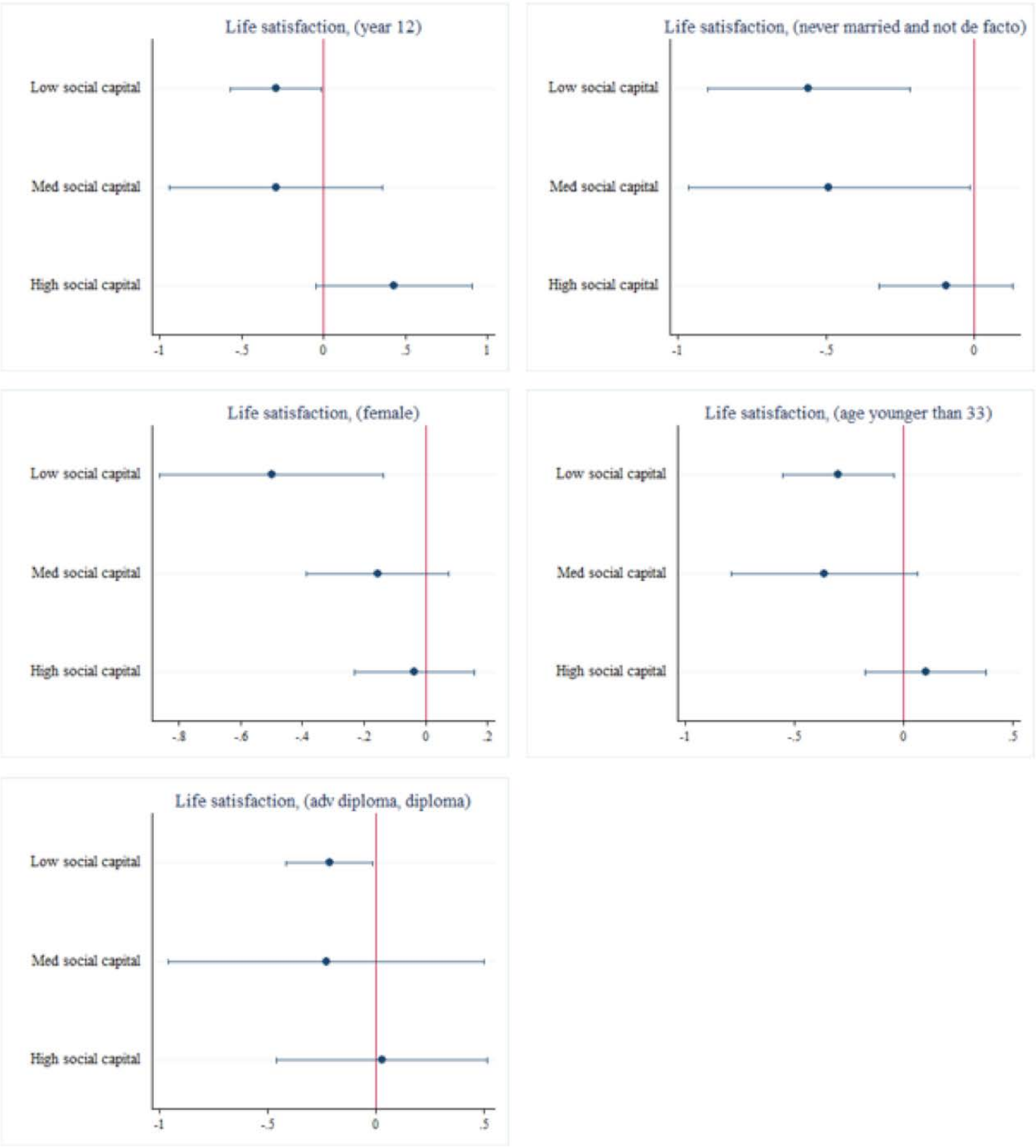


Figure 23. Cognitive social capital alleviates the negative impacts of the 2009 Black Saturday Bushfires

Note: The charts illustrate the estimated effects, with 90% confidence interval, of varying degrees of cognitive capital using the measure specified in Equation 2.

Cost effectiveness analysis

Analytical method

Our analysis focuses on the impact of bushfires on three outcomes – life satisfaction, mental health and income – and the role social capital plays in mitigating these impacts. As the first two outcomes are measured based on qualitative responses to survey questions, it is not immediately apparent how these results can be compared to economic impacts such as loss in income or property damage, which have been the traditional focus of disaster studies.

Economic impacts have a relatively straightforward policy interpretation. As an example, consider our finding that as an annual average, bushfires reduce the total income of individuals belonging to an SA-2 area of the lowest-tercile of social capital by $68.15[15] This effect is reduced to $54 for an SA-2 belonging to the middle-tercile of social capital. This allows us to say that increasing social capital from the low-tercile to a level comparable to the middle-tercile mitigates a loss of $14 per individual, annually. Hence a government contemplating a social-capital enhancing project in a low-SC region should proceed with the project if the cost is less than $14 per individual, annually. This $14 is what economists term a cost-effectiveness (CE) estimate.

One advantage of an outcome measure like life satisfaction is its dimensional inclusivity: it accounts for the total impact of a bushfire, including but not limited to the impact on economic factors. In the context of our study, consider the following example: annually, on average, bushfires reduce the life satisfaction of individuals belonging to a low-SC area by 0.2 life satisfaction units (henceforth, utils).16 This effect is entirely mitigated for a med-SC area. We can therefore say that:

[Illustrative Statement 1]: An intervention that increases social capital from the low-tercile to a level comparable to the middle-tercile mitigates a loss of 0.2 utils per individual, annually.

To make a cost-effectiveness estimate, we need to convert this 0.2 utils into a monetary equivalent. To do so, we first ask "how much money must an individual receive for their utils to increase by 0.2 (on average)." We utilise the same model utilised for our results on life satisfaction but include as an explanatory variable information from the HILDA on whether an individual experienced a "major improvement in financial situation occurring in the past year."

Step 1.

Estimate the impact of social capital on life satisfaction.

Example: Moderate levels of social capital reduce the negative impact of bushfires by 0.2 utils.

Step 2.

Estimate how much windfall income is required to generate the life satisfaction from Step 1.

Example: It takes $6850 windfall income to increase life satisfaction by 0.2 utils.

Step 3.

Map the impact of social capital to windfall income.

Example: Therefore, moderate levels of social capital reduce the negative impact of bushfires as if the individual was given $6850 of windfall income.

Figure 24. Steps for converting life satisfaction to equivalent windfall income

[15] The $68 effect is not statistically significant and simply presented here for illustrative purposes (i.e., the effect is relevant only to our specific sample).

[16] This 0.2 util effect is also not statistically significant and simply presented here for illustrative purposes.

Given we know from the HILDA data that on average, a major improvement in financial situation increases income by $13700, we effectively gain an estimate of the impact of a $13700 income increase on life satisfaction. Imagine that $13700 increases life satisfaction by 0.4 utils. As we only need half that amount to increase utils by 0.2, we can say that $6850 increases life satisfaction by 0.2 utils. This allows us to modify Illustrative Statement 1:

[Illustrative Statement 2]: An intervention that increases social capital from the low-tercile to a level comparable to the middle-tercile mitigates a loss of 0.2 utils per individual, annually. The amount of life satisfaction gained from this is equivalent to the individual receiving $6850 in windfall income annually.

Notice that illustrative Statement 2 mentions windfall income. In the utilised HILDA question, survey respondents are guided to answer "yes" if they have won a lottery or received an inheritance – promotions at work are excluded. Indeed, Au and Johnston (2015) have shown that this variable primarily reflects income from lotteries and inheritances. Hence, its estimated impact on life satisfaction is analogous to the impact of having received windfall income.

Annex B describes the models and methods in detail. However, we summarise the method in Figure 24.

This approach bears several limitations. First, as per the illustrative statements, the results from the monetary valuations are based on moving individuals from the lowest tercile to the medium tercile of social capital. This is a crude discretised estimate, as moving someone who is just below the medium tercile into somewhere just above the low tercile is unlikely to have much of an impact. A more accurate (but cumbersome) statement may be "making the distribution of social capital in the lowest tercile match that of the medium tercile." In addition, for brevity, we do not discuss the effects of moving from the lowest to highest tercile, as well as from the medium to highest tercile.

Second, the monetary valuations are based on several averages: the average annual area burnt, the average total income and the average income gain from a major improvement in financial situation, each of which are specific to the subgroup under consideration. Hence the estimates are highly dependent on the sampling properties of the HILDA dataset.

Third, disasters do not seem to have an overall statistical impact on our three outcomes on average. Indeed, we only find effects on certain population subgroups. As an individual may belong to multiple subgroups (e.g. is male and lives in a remote area), taking the total monetary impact across all the subgroups reported in the next subsection may result in counting the same effect multiple times. Hence, we would advise considering each of them in isolation.

Given the limitations above, one should take the estimates in the next subsection as a starting point for further investigation, rather than the final word in quantifying such effects.

Findings

The criteria for a subgroups' inclusion in our monetary conversions are:

i. The fires have a statistically significant negative effect on those in a low-SC area.

ii. This effect is mitigated (in a statistically significant sense) for those in a relatively higher SC area (i.e. for individuals in both a med- and high-SC area).

As we aim to make statements for the largest number of individuals as possible, we do not report conversions for the restricted 95th percentile of fire intensity.

[Cost Effectiveness Result 1]: An intervention that increases social capital from the low-tercile to a level comparable to the medium tercile in remote Australia mitigates a loss in life satisfaction that is equivalent to each individual there receiving $3808 in windfall income annually.

[Cost Effectiveness Result 2]: An intervention that increases social capital from the low-tercile to a level comparable to the medium tercile for those aged greater than 66 mitigates a loss in life satisfaction that is equivalent to each such individuals receiving $396 in windfall income annually.

[Cost Effectiveness Result 3]: An intervention that increases social capital from the low-tercile to a level comparable to the medium tercile in those who are marginally attached to the labour force mitigates a loss in life satisfaction that is equivalent to each such individual receiving $276 in windfall income annually.

We also perform the same conversions for mental health using the same framework but substituting life satisfaction with the mental health outcome indicator. This yields the following.

[Cost Effectiveness Result 4]: An intervention that increases social capital from the low-tercile to a level comparable to the medium tercile in remote Australia mitigates a loss in mental health that is equivalent to each individual there receiving $5940 in windfall income annually.

[Cost Effectiveness E Result 5]: An intervention that increases social capital from the low-tercile to a level comparable to the medium tercile for those in de facto relationships mitigates a loss in mental health that is equivalent to each such individuals receiving $113 in windfall income annually.

As a comparison, but with no need for monetary conversion, we consider the results for the direct impacts of bushfires on total income using the same criteria.

[Cost Effectiveness Result 6]: An intervention that increases social capital from the low-tercile to a level comparable to the medium tercile in remote Australia mitigates an income loss of $2203 to each individual annually.[17]

[Cost Effectiveness Result 7]: An intervention that increases social capital from the low-tercile to a level comparable to the medium -tercile in major cities mitigates an income loss of $66 to each individual annually.

The mitigating role of social capital in remote areas seems consistently large across all three outcome measures and lends itself to being targetable policy-wise. The relatively larger sizes of the life satisfaction ($3808) and mental health ($5940) result for remote areas relative to the direct income result ($2203) are not surprising, as the former outcomes account are inclusive of but not limited to the economic impacts of bushfires. However, the large size of the mental health result relative to the life satisfaction result can be accounted for by the finding that bushfires seem to have a larger negative impact on the mental health measure than the life satisfaction measure.[18] This, in turn, increases the mitigating role of social capital in the former.

[17] While there is no statistically significant difference between those in the low-SC and high-SC areas, we report this given the large effects that are found for the other outcomes in relation to remote Australia.

[18] Moderate levels of social capital grant the equivalent of 1.17 'major financial improvements' worth of life satisfaction, but 1.85 worth of mental health in light of bushfires.

Australian Red Cross volunteer supports bushfire affected community members at Maryborough Relief Centre, Victoria. February 2024.

Policymakers may prefer to use an estimate using the willingness-to-pay to avoid the negative effects of reduced mental health, as it will be more conservative than a measure accounting for the overall well-being effects. For this, we consider the method adopted in the Deloitte Access Economics report (2019). The negative effects on mental health are converted into the individual's willingness-to-pay using the EQ-5D index (Ara and Brazier, 2008) and the value of a statistical life estimate from the Australian Government's Department of Prime Minister and Cabinet (2023). The equivalents for our mental health results (4 and 5) utilising this method are $962 and $15, respectively. Table 1 of Annex B for a summary of the specific components of the cost-effectiveness estimates presented in this section.

Conclusion and limitations

Utilising the extensive data from the HILDA survey, the Severe Storm Archive, and historical bushfire records, this study reveals a consistent finding that 'vulnerable' groups in areas with higher social capital, such as older people, individuals who are unemployed, and people who are divorced, experience less severe negative effects from bushfires than those in lower social capital areas. Social capital plays a crucial role in mitigating these impacts, particularly in enhancing life satisfaction and mental health outcomes more significantly than income.

Our cost-effectiveness analysis highlights that increasing social capital from the low to middle tercile can mitigate substantial losses in life satisfaction and mental health.

For instance, this improvement in life satisfaction is equivalent to annual windfall incomes of $3808 for individuals in remote Australia, $396 for people aged over 65, and $267 for those marginally attached to the labour force. In terms of mental health, a policy increasing social capital from the low to middle tercile mitigates losses equivalent to $5940 annually for individuals in remote Australia and $113 for those in de facto relationships. For income, such an increase in social capital in remote Australia and major cities can offset losses equivalent to $2203 and $66 per individual annually (respectively).

This study has the following limitations:

Literature review scope: The literature review does not encompass all academic papers and grey literature relevant to the topic. It intentionally excludes reports and other sources that conclude the role of social capital, community strengths, and other similar terminologies without accompanying evidence and methodology, as this limits our assessment of reliability. Our choice of keywords could also limit the scope of our review. For instance, terms such as "social connection", "social cohesion" or other synonyms were not part of the search.

Methodological constraints: We do not cover all types of social capital, outcomes, and types of disasters due to their numerous combinations. The selected measurements are based on statistical methods (e.g. principal component analysis), economic and social reasoning, and existing literature. In addition, while findings were robust across many models, additional robustness checks and alternative methods could further strengthen results. Modelling the impact of severe bushfires may be downwardly biased because the control group includes residents who experienced less severe bushfires, affecting sample representativeness. Future research could refine these models by including non-exposed controls exclusively. Finally, our analysis focuses on the immediate aftermath of the disaster. The evolution of longer-term outcomes would vary depending on the persistence of the disaster impact as well as the effectiveness of the recovery processes.

Data limitations: Data limitations hinder pinpointing the exact mechanisms through which social capital mitigates disaster impacts, such as the frequency of community interactions or types of neighbourhood support provided. Also, owing to data limitations, the study does not explore bridging and linking social capital.

Cost-effectiveness analysis: Our monetary valuations give us the amount of annual windfall income that would have led to the same increase in life satisfaction or mental health observed from increasing social capital from the lowest to the medium tercile. This follows a holistic improvement ('overall wellbeing') approach. However, policymakers focussing, for example, on health care savings arising from improved mental health may instead want to know the impact of increasing social capital on health service utilisation. Unfortunately, without studies in Australia examining the link between the SF-36 mental health measure and service utilisation, we are unable to do such a conversion. Nonetheless the studies highlighted in Ahmad et al (2014) suggest that self-reported indices like the SF-36 have the potential to predict health service utilisation. This suggests that the mental health results here are likely to have impacts on health service utilisation; however, the quantification of these effects remain opportunities for future analysis.

Annex A

Model specifications

We explore the effect of social capital on mediating the impact of disasters on Australian households' well-being outcomes through three specifications: (i) a benchmark model that investigates the role of social capital on recovering from an average bushfire, (ii) a model that examines how social capital mediates the impact of severe bushfires, and (iii) a model that uses the 2009 Black Saturday Bushfires as a case study.

A1. Benchmark model

We use the following benchmark model to estimate the impact of social capital:

Equation 1:

$$y_{irt} = \alpha_0 + \beta_1 Fire_{rt} + \beta_2 Fire_{rt} \times SC_{rt,med} + \beta_3 Fire_{rt} \times SC_{rt,high} + \beta_4 SC_{rt,med} + \\ + \beta_5 SC_{rt,high} + \gamma_1 Storm_{rt} + \gamma_2 Storm_{rt} \times SC_{rt,med} + \gamma_3 Storm_{rt,high} \times SC_{rt,med} \\ + \delta_i + \vartheta_t + \varepsilon_{it} \quad (1)$$

where y_irt is the outcome variable, including logarithm (log) of income, life satisfaction, and mental health of individual i living in SA-2 area r in year t.

⟦Fire⟧_rt indicates the severity of bushfires in SA-2 area r in year t, computed as the share of burnt areas in the total area. ⟦SC⟧_rt is a categorical variable indicating social capital of SA-2 area r in year t with three levels: high, medium, and low. The omitted category (reference group) is ⟦SC⟧_(rt,low). ⟦SC⟧_(rt,med) equals 1 if area r has medium social capital, 0 if it has low social capital. ⟦SC⟧_(rt,high) equals 1 if area r has high social capital, 0 if it has low social capital. ⟦Storm⟧_rt is a binary variable indicating whether an extreme storm occurred in SA-2 area r in year t.

δ_i denotes individual fixed effects, controlling for individuals' time-invariant characteristics such as ethnicity and gender. ϑ_t indicates year fixed effects, controlling for factors affecting all individuals in each year, such as macroeconomic shocks. ε_it is an idiosyncratic error term.

The coefficients of interests are β_2, β_3, γ_2, and γ_3. The estimated coefficient β ̂_2 indicates that compared to areas with low social capital, the effect of a one-unit increase in the share of burnt area on the outcome is β ̂_2 higher (or lower) than areas with medium social capital. Specifically, the estimated effect of bushfire on the outcome in areas with low social capital is β ̂_1, while in areas with medium social capital it is ⟦⟦(β ⟧_1+β̂⟧_2).

The difference between these two estimated coefficients, β ̂_2, demonstrates the impact of social capital on mitigating the effect of bushfire on the outcome. If more severe bushfires are associated with negative changes in the outcome (e.g., worse mental health, lower income, and lower life satisfaction), β ̂_1 is expected to be negative. And if social capital mitigates the negative impact of bushfires, β ̂_2 is expected to be positive. Similarly, β ̂_3 shows that compared to areas with low social capital, the effect of a one-unit increase in the share of burnt area on the outcome is β ̂_3 (or lower) than areas with high social capital.

Annex A cont.

γ ̂_2 indicates that compared to areas with low social capital, the effect of experiencing a severe storm on the outcome is γ ̂_2 higher (or lower) than areas with medium social capital. If experiencing a storm is associated with negative changes in the outcome, γ ̂_1 is expected to be negative. And if social capital mitigates the negative impact of storms, γ ̂_2 is expected to be positive. Similarly, γ ̂_3 indicates that compared to areas with low social capital, the effect of experiencing a storm on the outcome is γ ̂_3 higher (or lower) than areas with high social capital.

A2. Severe bushfires

Severe fires, characterized by their unusually high intensity and large scale, can result in more substantial damages and recovery costs compared to moderate fires. The role of social capital can become particularly crucial in such events. However, if affected individuals receive significant government support during these events, the influence of social capital may diminish.

We explore the role of social capital on mediating the effects of severe bushfires through the following specification:

Equation 2:

$$y_{irt} = \alpha_0 + \sum_{j=2008}^{j=2011} \beta_{1j} \times BSB_r \times Year_j + \sum_{j=2008}^{j=2011} \beta_{2j} \times BSB_r \times Year_j \times SC_{rt,med}$$

$$+ \sum_{j=2008}^{j=2011} \beta_{3j} \times BSB_r \times Year_j \times SC_{rt,high} + \beta_4 SC_{rt,med} + \beta_5 SC_{rt,high} + \beta_6 BSB_r$$

$$+ \delta_i + \vartheta_t + \varepsilon_{it} \qquad (3)$$

where ⟦SFire⟧_rt is a binary variable, equal to 1 if SA-2 area r experienced severe bushfires in year t and 0 if it did not experience any bushfire or experienced non-severe bushfires. Severe bushfire is defined as areas with share of area burnt in the 95th percentile of all burnt area shares. Others are as defined in Equation 1.19

A3. Case study: The 2009 Black Saturday Bushfires

The 2009 Black Saturday Bushfires were a series of devastating bushfires that occurred in Victoria, Australia, primary on Saturday, February 7, 2009. The event resulted in the loss of 173 lives, 414 people injured, $1.07 billion of insurance costs, the destruction of 2029 homes and 61 businesses, and significant damage to infrastructure and natural habitat.20 Due to its unprecedented severity, this event can serve as a natural experiment to identify the impacts of social capital on household recovery following the disaster.

Following Johnston et al. (2021), we apply the difference-in-differences to quantify the effect of social capital on income, mental health, and life satisfaction following the 2009 Black Saturday Bushfires:

Annex A cont.

Equation 3:

$$y_{irt} = \alpha_0 + \beta_1 SFire_{rt} + \beta_2 SFire_{rt} \times SC_{rt,med} + \beta_3 SFire_{rt} \times SC_{rt,high} + \beta_4 SC_{rt,med} + \beta_5 SC_{rt,high} + \gamma_1 Storm_{rt} + \gamma_2 Storm_{rt} \times SC_{rt,med} + \gamma_3 Storm_{rt,high} \times SC_{rt,med} + \delta_i + \vartheta_t + \varepsilon_{it} \quad (2)$$

where ⟦BSB⟧_r is a treatment indicator for the 2009 Black Saturday Bushfires. ⟦BSB⟧_r is equal to one if individuals resided in SA-2 areas within 0-15 kilometres from the fires, and 0 for those residing in SA-2 areas 15 to 100 kilometres from the fires. ⟦Year⟧_j is an indicator for years. For example, ⟦Year⟧_2009 equals one if the year was 2009, and 0 otherwise. The years from 2003 to 2007 are the base category. Others are as defined in Equation 1.

β_1j are the differences between treatment (those residing in areas within 0-15 kilometres from the fires during the 2009 Black Saturday) and control groups (those residing in areas 15-100 kilometres from the fires) relative to the average outcome in the base years, 2003-2007.

The estimated effect of the 2009 Black Saturday on the outcome in areas with low social capital in year j with j=(2008;2009;2010;2011) is β ̂_1j, while in areas with medium social capital it is ⟦⟦(β ̂⟧_1j+β ̂ ⟧_2j). The difference between these two estimated coefficients, β ̂_2j, demonstrates the impact of medium social capital on mitigating the effect of the 2009 Black Saturday on a given outcome compared to low social capital. Similarly, β ̂_3j indicates the impact of high social capital on mitigating the effect of the 2009 Black Saturday on a given outcome compared to low social capital.

Annex B

Cost-effectiveness estimation

Consider Equation (1) in Annex A and assume that β_1 is negative in sign, and β_2 is positive. β_2 indicates the size of negative impact of a disaster that is mitigated by moving from low social capital to medium social capital. In the case where y_irt is life satisfaction, β_2 is measured in 'utils'. We can convert β_2 into a monetary equivalent as follows.

$$y_{irt} = \beta_1^+ Fire_{rt} + \beta_2^+ Fire_{rt} \times SC_{rt,med} + \eta_1^+ improve_{irt} \quad (4)$$

Equation (4) is simply Equation (1), with the inclusion of the HILDA variable 'improve' that takes a value of 1 if the individual experienced a major financial improvement in the past year. For brevity, we have omitted the other terms from Equation (1) in the notation. Those were included, along with a control for major financial worsening and serious personal injury or illness to self.

The ratio (β_2/(η_1^+)) therefore yields the improvement in life satisfaction that results from higher social capital in terms of units of major financial improvements. We can then check what the monetary value of each unit of financial improvement is as follows.

$$lnI_{irt} = \beta_1^I Fire_{rt} + \beta_2^I Fire_{rt} \times SC_{rt,med} + \eta_1^I improve_{irt} \quad (5)$$

where lnI_irt is the natural logarithm of total income, and the variables on the right-hand side of Equation (5) are identical to Equation (4). Since (η_1^I*(I_irt)¯) yields the average monetary value of a major financial improvement, the following yields our monetary valuation of β_2.

$$\beta_2(\$) = \frac{\beta_2}{\eta_1^+} * (\eta_1^I * \overline{I_{irt}}) * \overline{Fire_{rt}} \quad (6)$$

where (I_irt)¯ and (⟦Fire⟧_rt)¯ is the mean income and average proportion of region burnt in a low social capital area21F relevant to the subsample under consideration.

An identical method can be applied to the mental health outcome by simply substituting y_irt in Equations (3) and (4) with the mental health outcome.

This 'compensating equivalent' framework for converting causal impacts into monetary values was utilised in, for example, Frijters et al. (2011), Johnston et al. (2018), and Johnston et al. (2021), all of which use life satisfaction and major financial improvement data from the HILDA as per this study.

Table 1 summarises cost-effectiveness estimates for moving from low-SC to med-SC for Australian households in responding to average bushfires.

Annex B cont.

Table 1: Breakdown of cost-effectiveness estimates

(1) Life Satisfaction						
Subgroup (cognitive SC)	β_2	η_1^+	η_1^I	$\overline{I_{irt}}$	$\overline{Fire_{rt}}$	$\boldsymbol{\beta_2}(\$)$
remote Australia	26.35	0.202	0.087	112596.6	0.003	**3807.68**
age>66	3.205	0.0588	0.104	51347.23	0.0014	**396.35**
not in the labour force, m	4.597	0.214	0.113	71106.23	0.0016	**276.39**
(2) Mental Health						
Subgroup (cognitive SC)	β_2	η_1^+	η_1^I	$\overline{I_{irt}}$	$\overline{Fire_{rt}}$	$\boldsymbol{\beta_2}(\$)$
remote Australia	575.1	2.826	0.087	112596.6	0.003	**5940.22**
Subgroup (neighbourhood cooperation)						
de facto	24.68	2.562	0.0963	113139.8	0.0011	**113.31**
(3) Income calculations						
Subgroup (cognitive SC)	β_2	η_1^+	η_1^I	$\overline{I_{irt}}$	$\overline{Fire_{rt}}$	$\boldsymbol{\beta_2}(\$)$
remote Australia	6.566	-	-	112596.6	0.003	**2202.99**
Subgroup (neighbourhood cooperation)						
major city	0.895	-	-	107421.2	0.0007	**65.72**
(4) EQ-5D conversion of Mental Health						
Subgroup (cognitive SC)	Effect of mental health on EQ-5D	Value of Statistical Life Year	β_2	$\overline{Fire_{rt}}$	$\boldsymbol{\beta_2}(\$)$	
remote Australia	0.00239	235000	575.1	0.003	**962.49**	
Subgroup (neighbourhood cooperation)						
de facto	0.00239	235000	24.68	0.0011	**14.96**	

Annex C

Table 1. Summary statistics of key variables

Sample		Gross income	Life satisfaction	Mental Health	Intensity
All	mean	115,980.21	7.92	73.29	0.02
	sd	128,067.58	1.47	17.59	0.04
	N	454,116.00	337,416.00	303,210.00	224,704.00
Panel A. Gender					
Male	mean	118,468.54	7.90	74.66	0.02
	sd	126,233.29	1.45	17.05	0.04
	N	221,133.00	159,645.00	141,675.00	110,190.00
Female	mean	113,618.45	7.95	72.08	0.02
	sd	129,740.74	1.48	17.97	0.04
	N	232,983.00	177,771.00	161,535.00	114,514.00
Panel B. Remoteness					
Major City	mean	115,980.21	7.92	73.29	0.02
	sd	128,067.58	1.47	17.59	0.04
	N	454,116.00	337,416.00	303,210.00	224,704.00
Inner Regional Australia	mean	98,579.47	7.99	73.48	0.02
	sd	94,475.40	1.48	17.84	0.04
	N	115,529.00	85,098.00	77,259.00	86,489.00
Outer Regional Australia	mean	92,421.11	8.05	73.50	0.02
	sd	82,224.47	1.47	17.73	0.03
	N	51,856.00	37,979.00	33,415.00	39,319.00
Remote Australia	mean	107,357.70	8.14	76.89	0.01
	sd	107,556.00	1.41	16.82	0.01
	N	6,681.00	4,835.00	4,070.00	4,882.00
Panel C. Age groups					
age < 33	mean	120,614.37	7.97	71.09	0.02
	sd	118,391.21	1.39	17.72	0.04
	N	210,539.00	106,764.00	91,992.00	100,000.00
age >=33 and age <= 66	mean	125,882.53	7.79	73.50	0.02
	sd	129,503.29	1.49	17.59	0.04
	N	190,046.00	179,598.00	164,567.00	95,695.00
age > 66	mean	62,598.71	8.30	76.85	0.02
	sd	145,556.02	1.48	16.68	0.04
	N	53,531.00	51,054.00	46,651.00	29,009.00

Annex C Cont.

Table 1 cont.

Sample		Gross income	Life satisfaction	Mental Health	Intensity
Panel D. Marital status					
Legally married	mean	127,496.01	8.08	75.72	0.02
	sd	143,985.23	1.33	16.20	0.04
	N	159,716.00	159,975.00	147,902.00	82,782.00
De facto	mean	121,917.38	7.94	72.12	0.02
	sd	111,492.83	1.36	17.55	0.05
	N	50,291.00	50,307.00	44,613.00	23,704.00
Separated	mean	70,829.39	7.10	67.85	0.02
	sd	69,129.46	1.87	20.31	0.04
	N	9,182.00	9,190.00	8,040.00	4,607.00
Divorced	mean	63,939.06	7.46	70.96	0.02
	sd	76,230.75	1.77	19.59	0.04
	N	20,370.00	20,387.00	18,490.00	9,934.00
Widowed	mean	45,488.50	8.11	74.88	0.02
	sd	78,644.75	1.64	17.72	0.04
	N	16,552.00	16,514.00	14,359.00	8,366.00
Never married	mean	108,097.74	7.78	69.79	0.02
	sd	130,235.61	1.54	18.62	0.05
	N	80,953.00	81,017.00	69,790.00	36,181.00
Panel E. Employment status					
Employed FT	mean	138,083.62	7.89	75.10	0.02
	sd	124,049.02	1.26	15.91	0.05
	N	142,514.00	142,736.00	127,059.00	66,296.00
Employed PT	mean	124,106.11	8.01	73.28	0.02
	sd	139,234.38	1.33	16.78	0.04
	N	70,784.00	70,882.00	65,010.00	34,891.00
Unemployed, look for FT work	mean	80,617.09	7.27	65.18	0.02
	sd	80,250.57	1.92	20.18	0.04
	N	8,428.00	8,434.00	7,103.00	3,991.00
Unemployed, look for PT work	mean	103,036.52	7.79	66.90	0.02
	sd	141,336.97	1.64	19.52	0.04
	N	4,500.00	4,504.00	3,990.00	2,061.00
Not in the labour force, MA	mean	90,164.86	7.67	67.57	0.02
	sd	127,237.44	1.81	20.13	0.04
	N	20,858.00	20,888.00	18,568.00	10,536.00
Not in the labour force, NMA	mean	71,668.14	8.04	72.78	0.02
	sd	126,388.56	1.69	19.11	0.04
	N	89,674.00	89,636.00	81,208.00	47,635.00

Annex C Cont.

Table 1 cont.

Sample		Gross income	Life satisfaction	Mental Health	Intensity
Panel F. Education					
Postgraduate - masters or doctorate	mean	178,163.69	7.91	75.27	0.02
	sd	166,808.14	1.25	15.54	0.04
	N	15,834.00	15,845.00	14,675.00	5,336.00
Graduate diploma, graduate certificate	mean	155,649.85	7.94	75.33	0.02
	sd	171,829.93	1.30	15.85	0.05
	N	17,836.00	17,851.00	16,802.00	7,869.00
Bachelor or honours	mean	149,640.34	7.90	74.56	0.02
	sd	157,517.67	1.28	16.02	0.04
	N	46,235.00	46,275.00	42,578.00	18,061.00
Diploma	mean	119,177.94	7.92	74.59	0.02
	sd	110,241.54	1.36	17.12	0.04
	N	30,307.00	30,339.00	27,979.00	14,695.00
Certificate III or IV	mean	101,433.50	7.86	73.38	0.02
	sd	91,695.11	1.48	17.88	0.04
	N	71,368.00	71,455.00	64,083.00	39,471.00
Year 12	mean	115,320.51	7.88	72.34	0.02
	sd	152,423.77	1.40	17.68	0.05
	N	51,454.00	51,490.00	45,427.00	23,194.00
Year 11 and below	mean	83,140.82	8.00	72.00	0.02
	sd	107,585.61	1.64	18.63	0.04
	N	103,881.00	103,984.00	91,531.00	56,874.00

Note: Abbreviations: PT stands for 'part-time', FT for 'full-time', sd for 'standard deviation', 'MA' for marginally attached to the labour force, 'NMA' for 'not marginally attached to the labour force', and N indicates the number of observations.

Annex C Cont.

Table 2. Estimated effects of social capital on life satisfaction, mental health, and income following an all bushfires

	Life Satisfaction			Mental Health			Ln Total income		
Social capital level	*Low-SC*	*Med-SC*	*High-SC*	*Low-SC*	*Med-SC*	*High-SC*	*Low-SC*	*Med-SC*	*High-SC*
ALL - SC1	0.185	-0.261	-0.0162	-3.876	-0.971	5.474	-0.237	0.0498	0.110
ALL - SC2	-0.0446	0.230	0.224	-3.392	3.380	4.120	-0.0908	-0.208	0.0465
male - SC1	0.0826	-0.357	0.168	-4.890	-1.750	5.142	-0.435*	0.146	0.281
male - SC2	-0.298	0.406	0.631	-3.977	1.677	3.560	-0.171	-0.298	0.117
female - SC1	0.3	-0.214	-0.206	-2.842	-0.582	5.706	0.0190	-0.109	-0.120
female - SC2	0.190	0.0727	-0.149	-2.928	5.149	4.688	0.00466	-0.149	-0.0386
Major City - SC1	-0.272	0.440	0.554	-8.320	6.233	9.378	-0.806**	0.895*	0.792**
Major City - SC2	-0.0965	0.933	0.245	-5.472	5.031	6.128	-0.227	0.00152	0.220
Inner Regional Australia - SC1	-0.0354	-0.311	-0.153	-4.252	-0.586	3.780	-0.0815	0.0000981	-0.190
Inner Regional Australia - SC2	-0.112	-0.104	-0.101	-3.564	3.175	0.834	0.0685	-0.555***	-0.0803
Outer Regional Australia - SC1	0.410	0.0421	0.239	0.607	-4.014	4.552	-0.0162	-0.515	0.237
Outer Regional Australia - SC2	-0.710	1.668	1.429	7.572	-10.97	-2.935	-0.709	1.064	0.809
Remote Australia - SC1	4.350	2.641	-4.430	131.7**	-124.7*	-148.0***	-5.716***	4.325	5.291***
Remote Australia - SC2	-26.26***	26.35***	28.02***	-587.3***	575.1***	572.6***	-6.866**	6.566**	4.993
age < 33 - SC1	0.290	-0.157	0.0377	-4.135	-1.369	9.893	-0.0243	0.0519	-0.102
age < 33 - SC2	0.355	-0.315	0.0848	-7.731	12.82*	12.57*	-0.0392	-0.0391	0.0403
age >=33 & age <= 66 - SC1	0.258	-0.0887	-0.265	-2.349	0.274	3.339	-0.271	-0.200	0.0568
age >=33 & age <= 66 - SC2	0.0659	0.0376	-0.0440	0.346	-0.961	0.0303	-0.109	-0.520**	0.0383
age > 66 - SC1	-1.353	0.466	1.413	-11.07	2.102	7.138	-0.521	0.435	0.521
age > 66 - SC2	-2.519**	3.205**	2.364**	-5.823	-0.0746	0.384	-0.130	0.0400	0.107
Legally married - SC1	0.336	-0.0111	-0.252	6.499	-4.190	-5.738	-0.515**	0.269	0.474*
Legally married - SC2	0.136	0.0371	0.00503	7.553	-7.173	-6.975	-0.180	-0.0500	0.138
De facto - SC1	-0.949	1.461	1.336	-25.12**	24.68*	30.20**	-0.822*	0.307	0.977
De facto - SC2	-0.418	0.731	1.022	-13.30*	10.82	20.64*	-0.579*	0.438	0.554
Separated - SC1	2.692***	-7.063	-2.252*	-1.030	-15.90	-9.932	0.286	1.135	0.0778
Separated - SC2	2.756***	-1.966	-3.200*	6.097	-5.237	-36.00**	0.406	-0.553	0.194

Annex C Cont.

Table 2 cont.

	Life Satisfaction			Mental Health			Ln Total income		
Social capital level	*Low-SC*	*Med-SC*	*High-SC*	*Low-SC*	*Med-SC*	*High-SC*	*Low-SC*	*Med-SC*	*High-SC*
Divorced - SC1	-4.221*	3.799	4.542*	-30.11	14.02	33.23	0.517	-0.760	-0.626
Divorced - SC2	-1.406	1.740	1.486	-21.48	37.57*	17.11	0.275	-0.703	-0.333
Widowed - SC1	-0.792	-1.623	0.282	-0.948	-18.80	2.747	0.656	-1.210	-0.863
Widowed - SC2	-2.360	2.874	1.323	6.077	-13.51	-5.964	-0.119	-0.472	0.107
Never married - SC1	0.748	-0.771	-0.260	-2.370	-11.88	7.754	0.0718	-0.574	-0.437
Never married - SC2	0.662	-0.696	0.0964	-6.133	5.847	11.85*	0.279	-1.436	-0.101
Employed FT - SC1	0.0395	-0.0787	-0.0195	-11.38*	5.879	10.82	-0.365	0.209	0.265
Employed FT - SC2	0.124	-0.390	0.0454	-8.498**	5.755	7.671	-0.171	-0.155	0.181
Employed PT - SC1	0.445	-0.0563	0.0505	-0.403	0.732	4.997	-0.223	-0.0559	0.176
Employed PT - SC2	0.105	0.632	0.375	2.651	-5.233	3.473	-0.187	0.0230	0.214
Unemployed, look for FT work - SC1	0.383	5.115*	-2.700	-28.49	82.15	11.48	0.855	-8.814	-1.035
Unemployed, look for FT work - SC2	1.979	-1.903	-4.420	-27.59	38.75	22.11	-0.0428	-5.735	0.504
Unemployed, look for PT work - SC1	2.443	-4.378	14.36	61.51*	-45.46	29.00	0.137	1.773	-0.323
Unemployed, look for PT work - SC2	0.309	5.366	26.74*	49.78	28.24	19.69	-0.122	1.390	1.935
Not in the labour force, MA - SC1	-2.268	1.126	2.461	-3.026	3.096	4.883	-0.0846	1.416	-0.0482
Not in the labour force, MA - SC2	-3.235**	4.597**	3.297**	7.901	-15.12	-5.779	0.299	0.983	-0.870
Not in the labour force, NMA - SC1	-0.198	0.232	0.101	-11.21	5.955	9.617	-0.0286	-0.361	-0.136
Not in the labour force, NMA - SC2	-0.632	1.010	0.439	-4.504	4.837	0.387	0.265	-1.281**	-0.101
Postgraduate - SC1	0.0739	0.212	1.053	-0.693	-3.499	9.817	-0.413*	0.453	0.162
Postgraduate - SC2	0.849***	-0.561	0.0286	-3.111	-0.521	12.48*	0.680	-2.574**	-0.809
Grad diploma, grad certificate - SC1	3.331	-4.195*	-3.886*	-12.28	-14.60	4.135	-1.538	1.823	1.240
Grad diploma, grad certificate - SC2	-1.068	1.824	0.466	-1.934	-31.21	-6.469	0.630	-0.882	-0.959**
Bachelor or honours - SC1	1.187	-1.211	-1.305	-8.319	4.556	9.585	-0.854*	0.234	0.997**
Bachelor or honours - SC2	-0.0110	-0.0888	0.0684	7.858	-14.46	-9.189	-0.218	-0.318	0.348
Adv diploma, diploma - SC1	0.685	-0.0509	-0.512	12.36	-9.405	-11.78	0.229	-0.465	-0.719
Adv diploma, diploma - SC2	0.0306	1.059	-0.0409	3.416	-1.359	-1.010	0.226	-0.714	-0.652
Cert III or IV - SC1	0.239	-1.315	-0.265	-7.827	-4.992	11.69	-0.178	-0.0503	0.148
Cert III or IV - SC2	-0.568	0.223	0.655	-8.325	6.675	12.52	-0.0383	-0.243	0.125
Year 12 - SC1	-0.255	0.797	0.616	-9.825*	10.89	12.52*	-0.683**	1.249**	0.465
Year 12 - SC2	-0.198	0.453	0.676	-6.735	5.707	10.24	-0.306	0.116	0.178
Year 11 and below - SC1	0.0361	0.150	0.191	-4.186	4.019	5.799	-0.170	-0.527	-0.0416
Year 11 and below - SC2	-0.0269	0.237	0.291	-5.100	9.361	5.087	-0.265	-0.472	0.307

Note: The regressions are based on the benchmark model (Equation 1) where all fires were included. The estimated coefficients and p-values for medium social capital group in this table can differ from those in the correspondent graphs because this table presents the marginal effect (i.e., β_2 in Equation 1) while the graphs present the 'combined' effect (i.e., $\beta_1+\beta_2$ in Equation 1). Similarly, the estimated coefficients and p-values for high social capital group in this table can differ from those in the correspondent graphs because this table presents the marginal effect (i.e., β_3 in Equation 1) while the graphs present the 'combined' effect (i.e., $\beta_1+\beta_3$ in Equation 1). * $p<0.1$, ** $p<0.05$, *** $p<0.001$. 'SC1' refers to neighbourhood support, 'SC2' refers to cognitive social capital, PT stands for 'part-time', FT for 'full-time', 'MA' for marginally attached to the labour force, 'NMA' for 'not marginally attached to the labour force', 'Postgrad' refers to 'postgraduate,' 'grad' refers to 'graduate,' 'Adv' stands for 'Advanced,' and 'Cert III or IV' stands for 'Certificate III or IV'. 'N/A' means not available because the sample sizes were not sufficient for the regressions.

Annex C cont.

Table 3. Estimated effects of social capital on life satisfaction, mental health, and income following extreme bushfires

	Life Satisfaction			Mental Health			Ln Total income		
Social capital level	*Low-SC*	*Med-SC*	*High-SC*	*Low-SC*	*Med-SC*	*High-SC*	*Low-SC*	*Med-SC*	*High-SC*
ALL - SC1	0.00104	-0.0263	0.0572	-0.592	-0.206	0.806	-0.0464	-0.0170	0.0211
ALL - SC2	-0.0605	0.114	0.111	-0.789	0.630	0.873	-0.0724	0.0176	0.0725
male - SC1	-0.0963	0.0101	0.171*	-1.382	-0.114	1.049	-0.0834*	0.00231	0.0766
male - SC2	-0.195*	0.252**	0.257**	-1.338	0.753	0.623	-0.0825	0.0286	0.0892
female - SC1	0.0947	-0.0650	-0.0522	0.107	-0.283	0.617	-0.00663	-0.0397	-0.0365
female - SC2	0.0647	-0.0128	-0.0254	-0.311	0.559	1.120	-0.0617	0.00619	0.0557
Major City - SC1	-0.122	0.197	0.174	-0.801	1.514	0.168	-0.106	0.207***	0.0975
Major City - SC2	-0.101	0.250**	0.0530	-0.173	-0.0768	-0.228	-0.0434	0.0743	0.0567
Inner Regional Australia - SC1	-0.000837	-0.112	-0.0138	-0.723	-0.420	0.663	-0.0307	-0.0199	-0.0119
Inner Regional Australia - SC2	-0.117	0.0937	0.0870	-0.973	0.745	0.473	0.0160	-0.154***	0.00802
Outer Regional Australia - SC1	0.190***	-0.0983	0.000953	-0.549	-0.344	1.587	-0.0221	-0.238	0.00963
Outer Regional Australia - SC2	-0.0325	0.205	0.257*	-0.625	0.145	1.677	-0.324	0.330	0.290
Remote Australia - SC1	0.0669	N/A	N/A	-1.957***	N/A	N/A	-0.0349	-1.447***	N/A
Remote Australia - SC2	0.188	-0.130	N/A	-1.537	-0.471	N/A	-0.990***	0.956***	1.003***
age < 33 - SC1	0.0379	-0.0440	-0.0178	-1.095	0.703	1.564	-0.00000359	-0.0620	-0.0155
age < 33 - SC2	0.0521	-0.0942	0.0108	-2.233	2.940	2.791	-0.0877	0.0670	0.117
age >=33 & age <= 66 - SC1	0.0544	0.00840	-0.0193	0.728	-1.053	-0.328	-0.0893*	0.0164	0.0518
age >=33 & age <= 66 - SC2	0.0318	0.0328	0.00160	0.926	-0.957	-0.684	-0.0730	-0.0101	0.0554
age > 66 - SC1	-0.278	0.0433	0.377	-3.596**	1.945	3.268*	-0.0298	0.0417	-0.0137
age > 66 - SC2	-0.641**	0.847***	0.620**	-2.547	1.396	1.887	0.138	-0.267*	-0.138
Legally married - SC1	0.0793	-0.0676	-0.0404	1.633	-1.015	-1.771	-0.131***	-0.00289	0.102**
Legally married - SC2	0.00102	0.0324	0.0517	2.061*	-2.293*	-2.052	-0.205	0.114	0.197
De facto - SC1	-0.138	0.294	0.185	-6.283*	5.495	5.625	-0.191*	0.0411	0.186
De facto - SC2	0.0478	-0.0282	0.0651	-3.717	2.799	2.883	-0.222**	0.195	0.169
Separated - SC1	1.098***	-1.240	-0.969**	5.185	4.507	-6.236	0.0457	0.209	0.0384
Separated - SC2	0.714	-0.243	-0.746	8.843*	-8.841	-10.61*	0.125	-0.130	-0.000473
Divorced - SC1	-0.447	0.437	0.649	-4.254	3.633	7.502*	-0.0385	0.0628	0.0884
Divorced - SC2	-0.209	0.455	0.268	-4.104	9.721**	4.377	-0.0510	0.106	0.104
Widowed - SC1	-0.374	-0.0641	0.289	-0.588	-4.705	1.578	0.238	-0.282	-0.448
Widowed - SC2	-0.580	0.611	0.331	-1.883	-0.0883	1.968	0.169	-0.528	-0.212
Never married - SC1	0.142	-0.137	-0.0140	-0.367	-1.332	1.479	0.0204	-0.0999	-0.0136
Never married - SC2	0.0112	0.0447	0.189	-2.154	2.657	3.173	0.0404	-0.146	0.0540
Employed FT - SC1	-0.0331	-0.00369	0.0234	-2.490*	1.178	1.467	-0.0740	-0.0281	0.0530
Employed FT - SC2	-0.0347	-0.0225	0.0599	-2.078*	0.491	1.407	-0.172	0.112	0.192
Employed PT - SC1	0.237	-0.184	-0.128	2.815	-2.226	-1.682	-0.0673	-0.00204	0.0413
Employed PT - SC2	0.123	0.0330	-0.0422	3.176**	-3.138	-1.858	-0.105	0.0282	0.126
Unemployed, look for FT work - SC1	-0.780**	1.428**	0.527	2.992	-0.864	-4.628	-0.259	-0.963	0.351
Unemployed, look for FT work - SC2	0.357	-0.290	-0.675	-2.813	1.050	5.148	-0.323**	-0.673	0.560

Annex C cont.

Table 3 cont.

	Life Satisfaction			Mental Health			Ln Total income		
Social capital level	*Low-SC*	*Med-SC*	*High-SC*	*Low-SC*	*Med-SC*	*High-SC*	*Low-SC*	*Med-SC*	*High-SC*
Unemployed, look for PT work - SC1	0.744	-0.984	1.327	22.23**	-15.76	-15.78	-0.0407	0.160	0.0810
Unemployed, look for PT work - SC2	-0.187	0.845	2.440	18.37**	-8.085	-15.48	0.132	-0.0686	-0.0470
Not in the labour force, MA - SC1	-0.295	0.413	0.685*	1.322	-2.529	-0.897	-0.0678	0.212	0.131
Not in the labour force, MA - SC2	-0.480	0.932**	0.855**	2.951	-4.188	-2.326	0.125	-0.000314	-0.148
Not in the labour force, NMA - SC1	-0.1000	0.0214	0.144	-2.958*	1.970	3.144*	-0.0152	-0.0405	-0.0175
Not in the labour force, NMA - SC2	-0.209	0.287	0.214	-1.554	1.864	0.904	0.0715	-0.217**	-0.0584
Postgraduate - SC1	-0.228	0.409	0.547	-2.550	2.665	4.916	-0.106**	0.116	0.0575
Postgraduate - SC2	0.160	0.125	0.0404	-0.959	0.246	3.663	0.201	-0.477*	-0.159
Grad diploma, grad certificate - SC1	0.0497	-0.0953	-0.230	-1.402	-2.588	-0.536	-0.284***	0.290**	0.240*
Grad diploma, grad certificate - SC2	-0.465***	0.524**	0.258	2.267	-6.861*	-3.837*	0.0973	-0.210	-0.114
Bachelor or honours - SC1	-0.0263	0.0950	-0.0227	-0.132	-1.546	-0.641	-0.149	-0.148	0.169
Bachelor or honours - SC2	-0.0922	0.0294	0.146	1.443	-2.909	-3.141	-0.385	0.311	0.410
Adv diploma, diploma - SC1	0.0628	0.0790	0.0590	3.035	-1.122	-2.667	-0.171	0.0807	0.0677
Adv diploma, diploma - SC2	-0.0869	0.325	0.167	1.497	-1.574	0.940	-0.184	0.0867	0.0989
Cert III or IV - SC1	0.135	-0.387*	-0.143	-0.323	-2.408	1.015	-0.0910	-0.0305	0.0772
Cert III or IV - SC2	-0.0562	-0.0235	0.0300	-0.297	-0.435	0.482	-0.116*	0.0362	0.123*
Year 12 - SC1	-0.123	0.103	0.170	-2.497	4.109	1.845	-0.122	0.130	0.0572
Year 12 - SC2	-0.140	0.112	0.241*	-1.523	0.584	1.961	-0.131	0.117	0.0846
Year 11 and below - SC1	-0.0100	-0.0264	0.138	-0.867	-0.202	1.644	0.00969	-0.108	-0.0287
Year 11 and below - SC2	-0.0533	0.134	0.162	-2.127	3.026*	2.449	-0.0184	-0.0939	0.0462

Note: The regressions are based on the Equation 2 where extreme fires (the 95th percentile of fire intensity) were included. The estimated coefficients and p-values for medium social capital group in this table can differ from those in the correspondent graphs because this table presents the marginal effect (i.e., β_2 in Equation 1) while the graphs present the 'combined' effect (i.e., $\beta_1+\beta_2$ in Equation 2). Similarly, the estimated coefficients and p-values for high social capital group in this table can differ from those in the correspondent graphs because this table presents the marginal effect (i.e., β_3 in Equation 2) while the graphs present the 'combined' effect (i.e., $\beta_1+\beta_3$ in Equation 2). * p<0.1, **p<0.05, *** p<0.001. 'SC1' refers to neighbourhood support, 'SC2' refers to cognitive social capital, PT stands for 'part-time', FT for 'full-time', 'MA' for marginally attached to the labour force, 'NMA' for 'not marginally attached to the labour force', 'Postgrad' refers to 'postgraduate,' 'grad' refers to 'graduate,' 'Adv' stands for 'Advanced,' and 'Cert III or IV' stands for 'Certificate III or IV'. 'N/A' means not available because the sample sizes were not sufficient for the regressions.

Annex C cont.

Table 4. Estimated effects of social capital on life satisfaction, mental health, and income following the BSB

	Life Satisfaction			Mental Health			Ln Total income		
Social capital level	*Low-SC*	*Med-SC*	*High-SC*	*Low-SC*	*Med-SC*	*High-SC*	*Low-SC*	*Med-SC*	*High-SC*
ALL - SC1	-0.175	-0.118	0.0642	-1.462	0.683	1.744	-0.0102	-0.0378	0.152
ALL - SC2	-0.246*	0.0595	0.144	-0.273	-1.743	0.597	-0.00552	0.238	0.0650
male - SC1	0.148	-0.434*	-0.307	0.520	-2.170	-1.410	0.110	-0.362	-0.00593
male - SC2	0.0633	-0.270	-0.229	0.857	-5.091*	-1.206	0.0499	0.128	-0.0366
female - SC1	-0.477***	0.174	0.422**	-3.213	2.975	4.771	-0.135	0.235	0.309
female - SC2	-0.500**	0.343	0.463*	-1.278	1.010	2.388	-0.0462	0.336	0.147
Major City - SC1	-0.129	-0.190	0.438	-0.587	-0.845	1.696	-0.0493	0.0558	0.0741
Major City - SC2	-0.261*	0.0256	0.605	0.175	-3.288	-3.017	-0.0543	0.0401	0.306
Inner Regional Australia - SC1	-0.594*	1.167	0.390	-1.462	18.02*	1.029	0.592	-0.320	-0.414
Inner Regional Australia - SC2	-0.0346	-0.146	-0.186	3.112	-2.771	-3.641	0.633	-0.107	-0.552
Outer Regional Australia - SC1	0.545***	N/A	N/A	2.827*	N/A	N/A	0.813***	N/A	N/A
Outer Regional Australia - SC2	0.525***	N/A	N/A	2.890*	N/A	N/A	0.804***	N/A	N/A
Remote Australia - SC1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Remote Australia - SC2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
age < 33 - SC1	-0.225	-0.108	0.181	-5.568*	1.721	6.298*	-0.218	0.0969	0.400
age < 33 - SC2	-0.300*	-0.0656	0.400*	-3.260*	0.284	3.094	-0.168	0.449	0.214
age >=33 & age <= 66 - SC1	-0.173	-0.191	-0.0222	0.784	0.421	-1.278	0.154	-0.198	-0.163
age >=33 & age <= 66 - SC2	-0.245	0.208	-0.0123	0.641	-1.224	-0.846	0.0860	0.209	-0.195
age > 66 - SC1	0.289	-0.245	-0.469	2.655**	-5.267	-0.470	0.503***	-0.251	0.0893
age > 66 - SC2	-0.249	0.0183	0.336	3.891	-6.890	-1.874	0.662**	-0.512*	-0.0264
Legally married - SC1	-0.115	-0.261	0.138	0.531	-1.045	0.788	0.113*	-0.0838	0.149
Legally married - SC2	-0.239	0.321	0.220	1.479	-3.297	0.177	0.186***	0.0262	0.0136
De facto - SC1	0.244	0.263	-0.778	-4.638	-5.099	-4.707	0.271**	-0.465***	0.0145
De facto - SC2	0.572***	-1.388***	-0.231	-10.07**	-0.509	5.958	-0.0545	0.476*	0.125
Separated - SC1	-1.594*	N/A	N/A	-9.420	N/A	N/A	0.393	N/A	N/A
Separated - SC2	-1.604*	N/A	N/A	-9.482	N/A	N/A	0.379	N/A	N/A
Divorced - SC1	-1.116***	1.296***	0.759*	-8.909	14.32	1.094	0.354	-0.595	-0.356
Divorced - SC2	-0.352	N/A	-0.0463	-0.0582	N/A	-7.721	-0.0164	N/A	-0.0191
Widowed - SC1	0.113	-0.144	N/A	11.68***	-10.95**	N/A	-0.109	0.434	N/A
Widowed - SC2	0.0612	-0.292	0.356	5.203***	-1.825	2.415	0.695	-0.385	-1.061
Never married - SC1	-0.558*	0.0130	0.392	-6.439	4.684	6.289	-1.884	1.374	1.732
Never married - SC2	-0.559***	0.0693	0.465*	-0.649	3.866	-1.781	-1.157	1.219	0.789
Employed FT - SC1	-0.158	-0.235	0.117	-3.167	8.440**	2.227	0.0797	-0.362	0.0807
Employed FT - SC2	-0.174	-0.0500	0.0932	-0.0746	-3.127	-0.673	-0.0596	0.357***	0.115
Employed PT - SC1	-0.888***	0.565**	0.967***	-3.078	2.686	4.027	-1.068	1.290	1.186
Employed PT - SC2	-0.589***	0.216	0.777***	-0.960	-4.908	3.075	-0.590	0.840	0.714

Annex C cont.

Table 4 cont.

	Life Satisfaction			Mental Health			Ln Total income		
Social capital level	*Low-SC*	*Med-SC*	*High-SC*	*Low-SC*	*Med-SC*	*High-SC*	*Low-SC*	*Med-SC*	*High-SC*
Unemployed, look for FT work - SC1	1.321***	N/A	-2.758*	-26.97***	26.77***	N/A	-0.152	0.242	N/A
Unemployed, look for FT work - SC2	1.118**	N/A	-3.454**	7.407	N/A	-34.44***	0.625	N/A	-0.747
Unemployed, look for PT work - SC1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Unemployed, look for PT work - SC2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Not in the labour force, MA - SC1	0.0979	-0.266	-0.241	1.914	-6.510	1.509	0.228	0.00730	-1.330
Not in the labour force, MA - SC2	-0.226	N/A	-0.143	-3.001	N/A	5.124	0.257	N/A	-1.379
Not in the labour force, NMA - SC1	-0.172	0.0626	-0.00760	1.380	-6.124	-1.945	0.469***	-0.227	-0.252
Not in the labour force, NMA - SC2	-0.417	0.401	0.286	-1.264	-1.500	0.618	0.525**	-0.356	-0.314
Postgraduate - SC1	1.410***	N/A	-1.478***	4.549	N/A	-5.901*	0.431**	N/A	-0.542
Postgraduate - SC2	1.937***	N/A	-1.894***	3.158	N/A	-3.512	0.592***	N/A	-0.651*
Grad diploma, grad certificate - SC1	-1.303***	N/A	0.960***	-8.678***	N/A	7.951***	-0.176***	N/A	-0.0533
Grad diploma, grad certificate - SC2	-0.345**	-0.929***	N/A	-0.766	-7.549***	N/A	-0.138*	N/A	-0.0872
Bachelor or honours - SC1	-0.890***	0.576*	1.108***	0.795	1.872	-4.671	-0.316	0.414**	0.166
Bachelor or honours - SC2	-0.538***	0.614*	0.351	4.839***	4.354	-16.51***	-0.0256	0.0941	-0.365
Adv diploma, diploma - SC1	0.0453	-0.536	-0.102	2.030	-10.17	-4.390*	0.422	-0.718**	-0.128
Adv diploma, diploma - SC2	-0.215*	-0.0151	0.243	-6.618	5.766	6.319	-0.0440	-0.00608	0.496*
Cert III or IV - SC1	-0.476*	0.169	0.321	-3.859	4.327	3.630	0.0741	0.0564	-0.0863
Cert III or IV - SC2	-0.413	-0.0828	0.289	-0.648	-7.642	0.491	0.112	0.127	-0.182
Year 12 - SC1	-0.0268	-0.607**	0.353	-8.056	8.160	13.34**	0.103	-0.0126	0.174
Year 12 - SC2	-0.293*	0.00148	0.723**	-6.509	3.714	13.81**	0.156	0.0928	0.0330
Year 11 and below - SC1	-0.151	0.167	-0.106	3.182*	-4.005	-3.745*	-0.453	0.503	0.738
Year 11 and below - SC2	-0.0673	-0.0142	-0.247	2.622	-5.684	-2.656	-0.263	0.667	0.419

Note: The regressions are based on Equation 3 where the 2009 Black Saturday Bushfires were included. The estimated coefficients and p-values for medium and high social capital groups in this table can differ from those in the correspondent graphs because this table presents the marginal effect while the graphs present the 'combined' effect. * p<0.1, **p<0.05, *** p<0.001. 'SC1' refers to neighbourhood support, 'SC2' refers to cognitive social capital, PT stands for 'part-time', FT for 'full-time', 'MA' for marginally attached to the labour force, 'NMA' for 'not marginally attached to the labour force', 'Postgrad' refers to 'postgraduate,' 'grad' refers to 'graduate,' 'Adv' stands for 'Advanced,' and 'Cert III or IV' stands for 'Certificate III or IV'. 'N/A' means not available because the sample sizes were not sufficient for the regressions.

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