



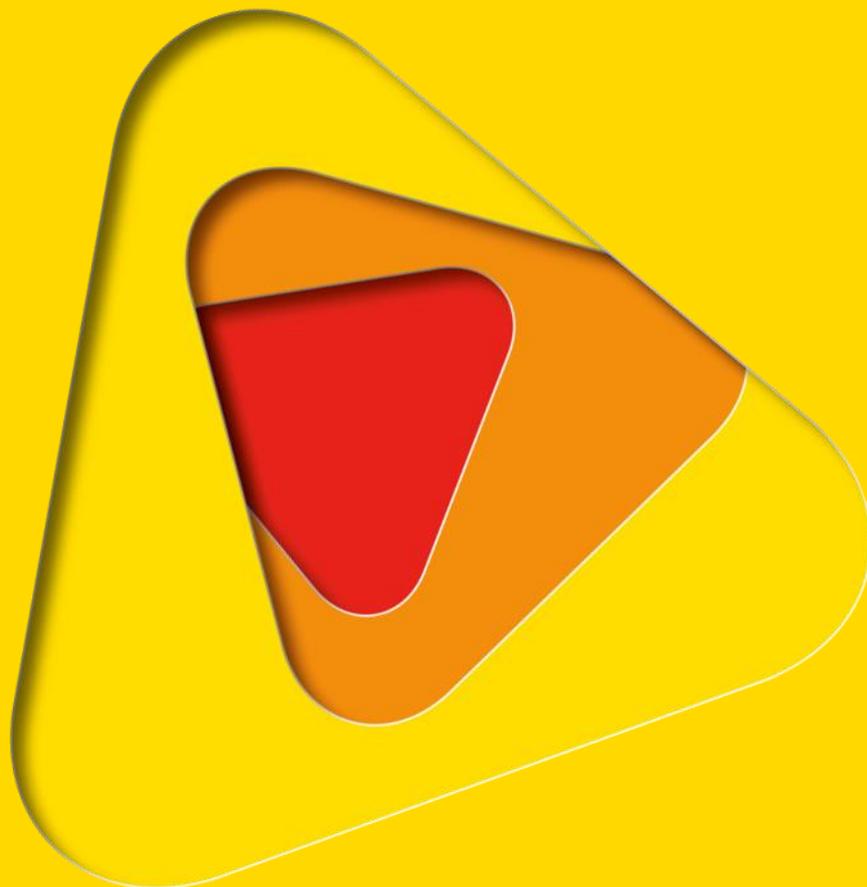
# DISASTERS AND ECONOMIC RESILIENCE: INCOME EFFECTS OF THE BLACK SATURDAY BUSHFIRES ON DISASTER-HIT INDIVIDUALS

Non-peer reviewed research proceedings from the Bushfire and Natural  
Hazards CRC & AFAC conference  
Perth, 5 – 8 September 2018

**Mehemet Ulubasoglu** <sup>1,2</sup>

<sup>1</sup> Centre for Energy, the Environment and Natural Disasters, Deakin University <sup>2</sup>  
Bushfire and Natural Hazards CRC

Corresponding author: [mehmet.ulubasoglu@deakin.edu.au](mailto:mehmet.ulubasoglu@deakin.edu.au)





Version	Release history	Date
1.0	Initial release of document	05/09/2018



**Australian Government**  
Department of Industry,  
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**Publisher:**

Bushfire and Natural Hazards CRC

September 2018



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## ABSTRACT

### DISASTERS AND ECONOMIC RESILIENCE: THE VICTORIAN BLACK SATURDAY BUSHFIRES

Mehmet Ulubasoglu, Department of Economics, Centre for Energy, the Environment and Natural Disasters, Deakin University, VIC

*Using the rich and extensive Australian Longitudinal Census Dataset (ALCD) of 2006 and 2011, this study investigates the effects of the Victorian Black Saturday Bushfires (BSB) 2009 on the incomes of individuals living in disaster-hit areas. In a unique approach, we compute the share of burnt areas in the total surface area of the Statistical Area-2 (SA2) to measure the geographical variations in disaster severity, and match this measure with the individuals' income and demographics data in the ALCD. Our methodology is based on a difference-in-differences approach, whereby we compare the incomes of individuals living in disaster-hit SA2s before and after the catastrophe with those of individuals who live in the neighbouring SA2s with no bushfire exposure. Our results are novel, informative, and have significant policy implications. We find that the average income effect of the BSB was negative and statistically significant for individuals who lived in the disaster-hit SA2s between 2006 and 2011. Our estimates suggest that an individual living in an SA2 with average bushfire severity measure experienced an estimated 14% to 21% income loss following the disaster. An additional crucial finding is related to the income differences between those who stayed in the disaster-hit areas following the disaster and those who moved out of the burnt areas. The negative income effect is not only significant for non-movers, but also greater in magnitude for those who migrated out of the disaster-hit SA2s following the catastrophe. This finding suggests that individuals might have made their out-migration decisions based on severe income losses after the disaster. We conclude that migration decisions of individuals into or out of disaster-hit areas is an important future avenue of research that could offer substantial policy implications for community resilience and economic recovery post disasters.*



## END-USER STATEMENT

*Ed Pikusa:*

*This project has illustrated the potential to use the national accounts and Australian Bureau of Statistics to determine a richer understanding of how disasters affect sectors of the economy, with potential utility to better plan and target relief and recovery programs. The analysis is one of the first examples revealing which parts of the economy are impacted, and which ones are stimulated. This work is unique to the CRC, based on the fundamental population and economics data of Australia.*



## INTRODUCTION

It would be a mistake to treat Black Saturday as a 'one-off' event. With populations at the rural–urban interface growing and the impact of climate change, the risks associated with bushfire are likely to increase (Parliament of Victoria, 2010)

Natural disasters in Australia are very costly, and often have devastating socioeconomic effects on impacted communities.

The 2009 Victorian Black Saturday Bushfires were the worst bushfire weather condition ever recorded globally; equivalent to 1500 Hiroshima style atom bombs going off (SMH, 2009). 173 people died; over 2,100 houses and 3,500 structures were destroyed, with thousands more suffering damage (Parliament of Victoria, 2010). The total area destroyed was around 400,000 square kilometres (Victorian Government DELWP, 2012), an area slightly larger than Japan.

With the severity and frequency from natural disasters set to increase (Intergovernmental Panel on Climate Change, 2014), there is a need—now more than ever—for Australia to have a sustainable disaster recovery model that:

- incorporates an evidence-based and disaster-specific assessment of potential damages and impacts of natural disasters on Australian communities, and
- helps build resilience within Australian communities to such disasters.

An important dimension of resilience to natural disasters is economic resilience (Rose, 2007). At an individual level, economic resilience can be defined as the ability to return to the pre-disaster income trajectory. This can happen if the individual has the necessary labour market skills, education and/or experience, the economy is sufficiently diverse to withstand firm/industry-specific losses, or if the government assists the individuals during the recovery and assistance period. As income stream represents the economic resilience of individuals to external shocks, it is important to understand how natural disasters influence the income trajectory of individuals. Indeed, Victorian BSB studies have found that other stressors, not just the bushfire event itself, affected both resilience and recovery from these disasters. These include experiencing changes of income, changes in accommodation and changes in personal relationships (Gibbs et al, 2016).

Thus, the aims of this research paper are to investigate the impacts of the VIC BSB on individuals' income and identify vulnerable groups that were most particularly hit by the disaster according to the individuals' demographic, socio-economic backgrounds and employment sectors.



## METHODS

### INDIVIDUAL DATA

The research exploits individual level economic information as retrieved from the 2006, 2011 and 2016 Australian Census Longitudinal Dataset. This dataset brings together a nationally representative 5% sample from the 2006 Census with records from the 2011 and 2016 Censuses. The availability of such data provides a unique opportunity to explore how Australian citizens are affected over time due to natural disasters, i.e. changes to the individual incomes of the disaster affected individuals as compared with the unaffected cohort, by economic sector. The richness of this data enables investigation of both social and economic dimensions as shown below:

**Table 1 Individual data collected, by dimension**

<b>Economic Dimension</b>	<b>Attributes</b>	<b>Social dimension</b>	<b>Attributes</b>
Income	Income levels	Gender	Male, Female
Employment Status	Employed, Unemployed, Not in Labour force	Age	Age groups
Employment Type	Full time, Part time	Marital Status	Married, Never Married, Separated, Divorced, Widowed
Employment Sector	ANZSIC classification	Parental Status	Number of children
		Educational level	Year 8 or lower, Year 9-12, Bachelor degree, Higher than Bachelor degree
		Property ownership	Owner (outright), Owner (mortgage), Renting
		Migration	Stayed in bushfire affected SA2, Migrated out of bushfire affected SA2



## MODELLING

We use difference-in-differences modelling to determine the difference between the incomes of bushfire-hit groups before and after the natural disaster, do the same for comparator groups, and see if there is any difference between the two differences (hence, “difference-in-differences”).

By incorporating a:

- Disaster severity measure, we consider the effect of the magnitude of the fires on affected groups
- Vulnerability dimension, we consider the possible differences in the effect of the fires on different subsets within the affected groups

As comparator groups, we use the neighbouring SA2s, which typically have similar characteristics to bushfire-hit areas, including:

- topography
- economically.

The comparator groups allow us to pinpoint the specific income effect of the natural disaster on the affected group.

**Figure 1 Victorian Bushfires groupings**





## BUSHFIRE SEVERITY

In a unique approach, we identify the geographical variations in bushfire severity by computing the share of the Statistical Area-2 (SA2) that was burnt, and then match this measure with the individuals' income and demographics data in the ALCD. To compute the bushfire severity, we use ArcGIS mapping and calculate the share of burnt areas in the total surface area of the SA2.

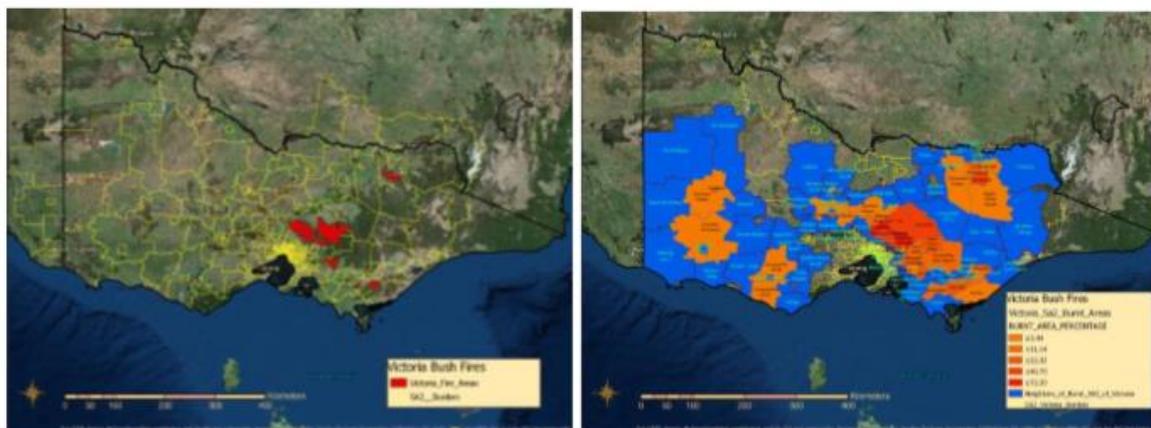
In our ArcGIS mapping, we followed the steps below.

**Step 1:** Determine bushfire areas by overlaying official bushfire maps with SA2s

**Step 2:** Determine disaster severity, that is, share of burnt area in SA2 Figure 2 summarises our mapping exercise: the darker the orange, the more burnt the area is, while the blue area is neighbouring SA2s of the burnt SA2s.

There were 12 different pockets of bushfires in the case of the Black Saturday Bushfires 2009. We found the average share of burnt area in SA2 was 15%.

**Figure 2. Construction of groups using ARGIS mapping**

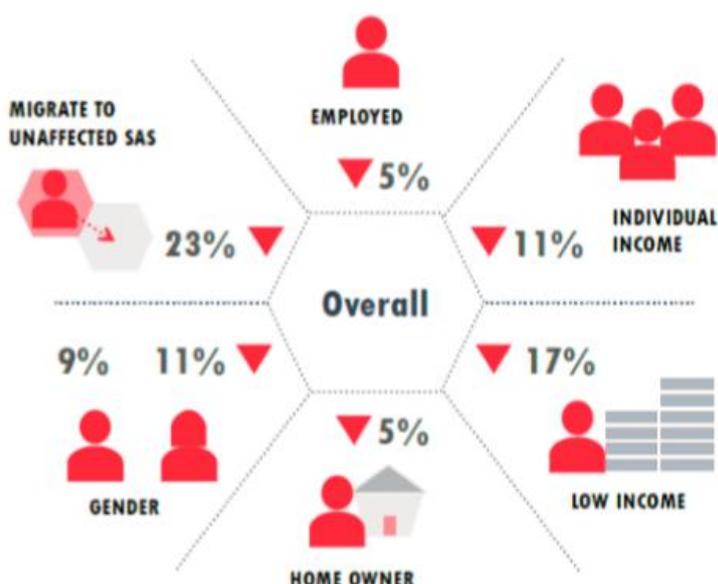




## RESULTS

We find that the average income effect of the BSB was negative and statistically significant for individuals who lived in the disaster-hit SA2s between 2006 and 2011. Post-disaster, we found significant declines in the income of individuals residing in bushfire-hit areas by 11%. In addition, low income earners were the worst hit among income groupings, while those who migrated out to unaffected areas were severely affected (22.5% decline in their income). Moreover, unemployed income changes were not statistically significant, likely because income sources (e.g. Centrelink) were not disrupted during this time.

**Figure 3 VIC BSB’s impacts on individual income, by demographic group (%)**



As for sectors of employment, of the 19 economic sectors, six were significantly and mostly negatively affected by the bushfires. Incomes of individuals employed in retail showed the most decline (-15%), while incomes in the rental and real estate sector were the only positively affected (10.5%).

**Figure 4 VIC BSB’s impacts on individual income, by sector of employment (%)**





A crucial finding of this research is the income differences between those who stayed in the disaster-hit areas following the disaster and those who moved out of the burnt areas. The negative income effect is not only significant for non-movers, but also greater in magnitude for those who migrated out of the disaster-hit SA2s following the catastrophe. This finding suggests that individuals might have made their out-migration decisions based on severe income losses after the disaster. This may subsequently affect perceived recovery of communities impacted by these disasters.



## CONCLUSIONS

The Victorian Black Saturday Bushfires had a significant negative effect on individual income (average of -11%) in disaster-hit areas. In the short term, some groups are more vulnerable to disruptions to their income level than others. In particular, low income earners, those employed in retail sector, and those who made the decision to migrate out of the bushfire-hit area were the most negatively affected by the bushfire disasters. These results confirm the need, when investigating disaster resilience and recovery, to dig deeper beyond aggregate and community trends and investigate the effects of such disasters at the individual level. In particular, the outward migration of the most affected by the disaster may mask the true effects of such disasters on community recovery. We conclude that migration decisions of individuals into or out of disaster-hit areas is an important future avenue of research that could offer substantial policy implications for the economy and society.



## REFERENCES

- 1 Gibbs L, Bryant R, Harms L, Forbes D, Block K, Gallagher HC, Ireton G, Richardson J, Pattison P, MacDougall C, Lusher D, Baker E, Kellett C, Pirrone A, Molyneaux R, Kosta L, Brady K, Lok M, Van Kessel G, Waters E., Beyond Bushfires: Community Resilience and Recovery Final Report. November 2016, University of Melbourne, Victoria, Australia
- 2 Intergovernmental Panel on Climate Change, 2014, Climate Change 2014 – Impacts, Adaptation and Vulnerability: Regional Aspects, Cambridge University Press.
- 3 Parliament of Victoria, 2010, The 2009 Victorian Bushfires Royal Commission, ISBN 978-0-9807408-1-3, Victoria.
- 4 Rose A., 2007, Economic resilience to natural and man-made disasters: Multidisciplinary origins and contextual dimensions, Environmental Hazards, Vol 7 (4), pp. 383–398.