

# GENDERED CONSEQUENCES OF NATURAL DISASTER EXPOSURE: EVIDENCE FROM AUSTRALIA

Australian Conference of Economists 2021

14 July 2021

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# Motivation

- Evidence suggests that natural disasters generate significant impacts on labour market outcomes both in the short-run and into the longer-term (Dell & Olken, 2014; Kichberger, 2017; Groen, et al., 2020).
- The gendered nature of these effects has received little attention – despite the relevance of gender to the achievement of national and international policy goals, including SDG 8.
- We study occurrences of bushfires, floods and cyclones over two decades in terms of their effects on individual:
  - » Labour market status,
  - » Incomes,
  - » Welfare dependence.



# Previous studies

## Australia

- Australian studies:
  - » Residential destruction due to natural disasters has no average impact on employment and income, but increases financial hardship and financial risk aversion (Johar, et al., 2020)
  - » Exposure to floods and bushfires, using state-level annual variation, has adverse and persistent effects on sectoral gross value added (Ulubasoglu et al., 2019)
  - » Exposure to bushfires can generate more severe income losses for women, while exposure to floods can generate income gains for women (Ulubasoglu et al., 2021)



# Previous studies

## International

- International studies:
  - » Earthquakes generate positive wage growth for workers in agriculture, using data from Indonesia (Kichberger, 2017)
  - » Short-term earnings losses to job separations and long-term gains to wage growth in the areas affected by Hurricanes Katrina and Rita in 2005 (Groen et al., 2020)



# Contribution

Our paper aims to contribute to existing literature in three ways:

1. Provides (**causal**) micro-evidence of both short and long-term impacts of natural disaster exposure at the SA4 level to the labour market in Australia
2. Provides evidence on the gendered impacts of natural disasters in Australia.
3. Using HILDA allows us to estimate of treatment of the treated (TOT) as well as reveal how natural disasters may affect both those directly affected (due to property damage) as well as those indirectly affected.



# Data

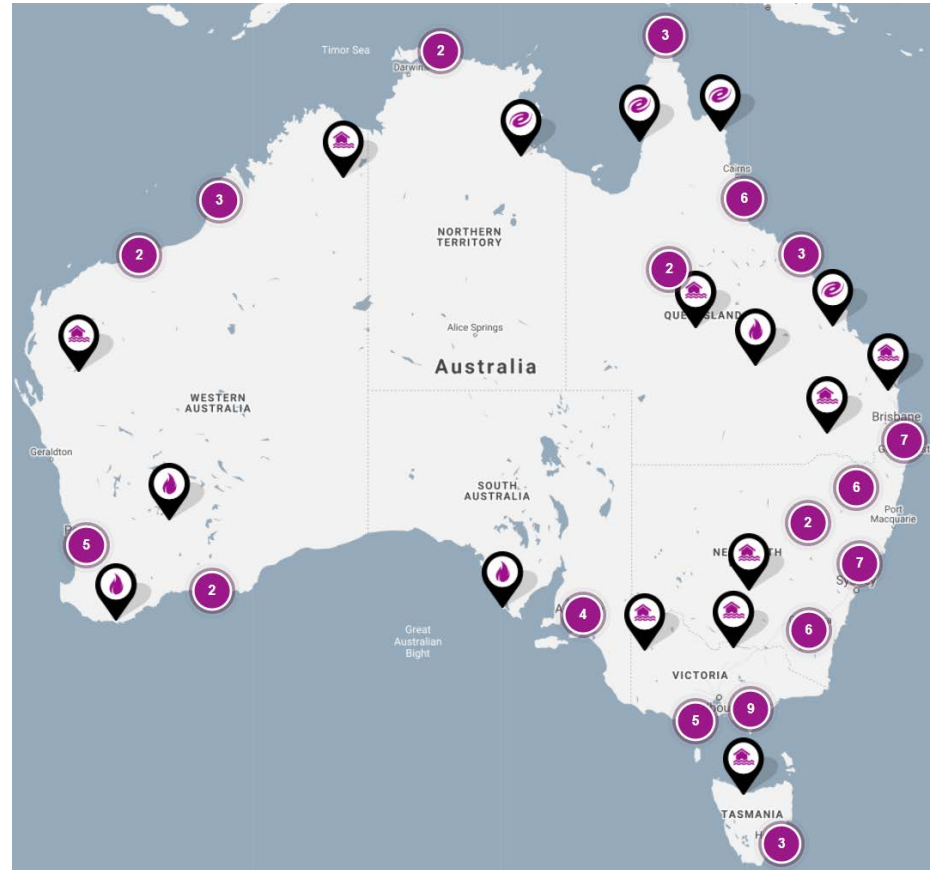
## Disaster events

- We collect natural disaster records from the Australian Institute for Disaster Resilience (AIDR) to construct natural disaster exposure at the local Statistical Area 4 (SA4) level.
  - » This database is the most comprehensive record of disasters in Australia: allowing us to collect information on floods, bushfires and cyclones from 2000-2019.
  - » To construct SA4 level information on the occurrence of natural disasters, we use the suburb-level event descriptions provided by this dataset.
  - » The consolidated list of disaster-affected suburbs was then mapped to postcodes and to SA4 regions based on geographic concordances published by Australia Bureau of Statistics (ABS).



# Data

Spatial distribution  
(source: AIDR)



# HILDA

## Individual information

- Individual analysis uses the Household and Income Longitudinal Data Australia Survey, from Waves 1 to 19.
  - » Nationally representative panel data set surveyed annually between 2001-2019.
  - » Collect individual and household characteristics: demographic, labour market, income, and welfare information.
  - » Direct exposure to disaster from self-completion questionnaire, each year since 2009:
    - *We now would like you to think about major events that have happened in your life over the past 12 months. For each statement cross either the YES box or the NO box to indicate whether each event happened during the past 12 months. A weather-related disaster (e.g., flood, bushfire, cyclone) damaged or destroyed your home*





# Data summary

## Person exposed to disaster

- Our HILDA dataset provides longitudinal information of 43,770 unique individuals (unbalanced) – 387,694 observations from 2000-2019
- About 34% of them live in an SA4 region affected by natural disaster events during 2001-2019.

	All	Never had disaster	Any disaster	Had floods	Had bushfires	Had cyclones	Property damaged
No. of unique individual	43,770	28,904	14,886	5,466	9,924	4,490	2,003
Proportion (%)	100	66.0	34.0	12.5	22.7	10.26	4.58



# Data summary

## Individual characteristics

	No disaster	Any disaster	Floods	Fires	Cyclones
Age at last survey	45.51 (14.11)	47.78 (12.57)	49.45 (11.76)	48.11 (12.42)	45.51 (14.11)
Male	0.487 (0.500)	0.485 (0.500)	0.485 (0.500)	0.482 (0.500)	0.487 (0.500)
Number of Persons in Household	3.04 (1.479)	2.99 (1.419)	2.93 (1.406)	3.04 (1.409)	3.047 (1.479)
Migrated (year < 1 in current)	0.199 (0.399)	0.195 (0.396)	0.186 (0.389)	0.176 (0.381)	0.199 (0.399)
Has college education	0.560 (0.496)	0.550 (0.498)	0.525 (0.499)	0.558 (0.497)	0.560 (0.496)
Observations	128812	77174	24317	48093	128812



# Data summary

## Labor outcomes (1)

	Never experience disaster		Experience once	
	Female	Male	Female	Male
Employed (=1)	0.639 (0.480)	0.698 (0.459)	0.640 (0.480)	0.714 (0.452)
Working full time (=1)	0.316 (0.465)	0.540 (0.498)	0.307 (0.461)	0.573 (0.495)
Participate in labor market	0.650 (0.477)	0.712 (0.453)	0.661 (0.474)	0.734 (0.442)
(Log) annual working hour	7.176 (0.776)	7.531 (0.620)	7.172 (0.779)	7.576 (0.572)
Casual job	0.258 (0.437)	0.194 (0.396)	0.246 (0.431)	0.188 (0.391)



# Data summary

## Income and welfare outcomes (2)

	Never experience disaster		Experience once	
	Female	Male	Female	Male
(log real) Weekly total salary, individual	4.303 (3.199)	5.166 (3.131)	4.190 (3.205)	5.093 (3.164)
(log real) Household labour income	9.851 (3.780)	10.17 (3.480)	9.614 (3.907)	9.949 (3.624)
(log real) Household rental value	6.673 (4.398)	6.505 (4.442)	6.509 (4.268)	6.351 (4.317)
(log real) Govt support, household	3.059 (4.390)	2.715 (4.248)	3.191 (4.443)	2.713 (4.250)
(log real) Govt income support, individual	2.093 (3.822)	1.497 (3.361)	2.324 (3.969)	1.562 (3.425)



# Identification strategy

## Overview

- Uses exogenous variation in the timing and location of natural disasters, in generating variation across SA4 regions.
- Define ‘treatment’ as an individual who is living in (and remains in) a disaster-affected SA4 in the year of disaster occurrence.
- Also exploits variation in the timing and location of property damage resultant from natural disasters in generating variation of individual outcomes within SA4 disaster-affected regions.
- Sample limited to working age population.



# Identification strategy

## Two-way Fixed Effects

- OLS framework at the individual level, controlling for fixed effects including year, age, SA4-region and individual, as well as time-location trends.
- Use clustered standard errors at the state level
- This exploits the exogenous variation in the timing and location of disasters, comparing individuals located in a disaster-affected SA4 region to a national control cohort.

$$y_{i,t,l} = \alpha + \beta Disaster_{t,l} + \delta Disaster_{t-1,l} + \gamma_{i,t} + \rho_i + \theta_t + \delta_l + \delta_l \times \theta_t + \varepsilon_{i,t,l}$$

Where the outcome for individual  $i$  in period  $t$  and  $l$  -SA4 as function of binary disaster variables, lagged disaster variables, age fixed effects, individual fixed effects, year fixed effects, SA4-level fixed effects and SA4-time trends

- Separate regression variable included for each disaster type: bushfires, floods and cyclones.



# Identification strategy

## Interaction with direct property damage

- We use the self-reported direct property damage due to natural disaster based on HILDA to infer treatment on the treated estimates,
- using variation in disaster occurrence across SA4-regions (indirect exposure) and within-region variation in direct property damage (direct disaster exposure).
- This specification allows us to test whether the causal effects of natural disasters differ for individuals experiencing direct disaster exposure or indirect disaster exposure.

$$y_{i,t,l} = \alpha + \beta Disaster_{t,l} + \delta Disaster_{t-1,l} + \eta Disaster_{t,l} \times Damage_{i,t,l} + \omega Disaster_{t-1,l} \times Damage_{i,t-1,l} + \gamma_{i,t} + \rho_i + \theta_t + \delta_l + \delta_l \times \theta_t + \varepsilon_{i,t,l}$$



# Identification strategy

## Event-study

- Finally, we also employ an event-study specification to understand whether the adverse effects of natural disasters persist over time.
- Sample limited to those who joined HILDA in 2001, and given the small sample size experiencing cyclones, restricted to those experiencing a flood or fire, versus no natural disaster.
- Each of these specifications is ran separately for males and females

$$y_{i,t,l} = \alpha + \sum_{D=1} \beta^D Disaster_{t,l} + \gamma_{i,t} + \rho_i + \theta_t + \delta_l + \delta_l \times \theta_t + \varepsilon_{i,t,l}$$

- Where D is a set of groups, cut by the period of post-disaster exposure: 1-2 years, 3-4 years, 5-6 years, and 7-10 years post-disaster.





# Results

## Baseline

- We find the following statistically significant results:
  - » Bushfires make women 1.4 ppts less likely to be employed full time, and lower the overall likelihood of employment for women by 1.5% in the year following. Bushfires also reduce household asset income for women by \$1,349 per annum.
  - » Bushfires increase the likelihood of employment for males by 1.1 ppts and labour force participation by 1.2 ppts. Fires also have a lagged effect: increasing weekly hours worked by 1.9% in the year following a fire; and lowering the likelihood of unemployment by 0.7 ppts.
  - » Floods reduce both the likelihood of women being unemployed by 0.6 ppts and the amount of individual government income support received by 19.97%.
  - » Floods were found to reduce the likelihood of male employment by 1.8 ppts in the year following a flood, and lower the likelihood of casual employment by 2.7 ppts.



# Results

## Baseline (Continued)

- We find the following statistically significant results from cyclones:
  - » Cyclones increase women's weekly total salary by 4.7%, likely through increased working hours – cyclones were found to increase weekly hours worked by 4.2%. Cyclones increase the likelihood of women being in the labour force by 0.7%, also have a lagged effect on household government income support reported by women, increasing the amount of received by 17.6%.
  - » Cyclones were found to reduce a male's individual weekly salary by 5.6% and increase individual government income support by 4.1%.



# Results

## Interaction with direct property damage

- The impacts of natural disasters were often more pronounced for those who experienced direct property damage, with these effects differing by gender and disaster type.
  - » For females who experienced direct property damage due to bushfire, employment losses were 10.1 ppts more severe.
  - » For males, direct property damage due to bushfire led to more pronounced increases to working hours (+32.5%) and weekly salary (+36.2%), and reduced government income support reliance (+7.8%).
  - » Direct property damage due to floods made females 12.0 ppts more likely to be employed and 13.2 ppts more likely to participate in the labour force.
  - » For males, direct property damage due to floods led to worsened labour market outcomes, reducing their likelihood of employment by 17.4 ppts, of full time work by 12.6 ppts, and of labour force participation by 11.9 ppts.



# Results

## Interaction with direct property damage

(continued)

- Effects from cyclones:
  - » Females experiencing direct property damage due to cyclones were 3.3 ppts more likely to be employed and 4.9 ppts more likely to participate in the labour market. More pronounced increases for working hours (+11.6%) and earnings (14.3%) were also observed.
  - » For males experiencing direct property damage due to cyclones, working hours reduced by 5.3%, the likelihood of unemployment by 5.8 ppts, and salary increased by 26.8%. Direct exposure also led to reduced welfare reliance (-42.6%).



# Results

## Event study

- We find suggestive evidence that the effects of natural disasters are significant, persistent up to 7-10 years following (indirect) disaster exposure.
  - » For example, females 7-10 years following a bushfire are less likely to be employed (-3.8 ppts), less likely to participate in the labour force (-3.4 ppts) and more likely to not be in the labour force (+2.9 ppts). Females were also 5.1 ppts less likely to work full time, and observed a reduced weekly salary (-8.0%).
  - » For males 7-10 years following a bushfire, the likelihood of employment was 1.2 ppts lower, unemployment was 2.1 ppts more likely, and participation increased by 1.8 ppts.
  - » Following a flood, females were 1.7 ppts more likely to be employed and 4.8 ppts more likely to participate in the labour market after 7-10 years. Full-time employment was 4.4 ppts less likely.
  - » Males 7-10 years on from a flood reported positive labour market outcomes, with the likelihood of employment increasing by 5.2 ppts, full-time employment by 5.5 ppts and participation increasing by 5.0 ppts.



# Robustness checks

## Baseline

- **Placebo treatment**
  - » To test the presence of disaster effects (and parallel trends), we replace the disaster variable with their +2 year lead indicator.
  - » We assume that people could not predict disasters two years before they occurred.
  - » Supports the robustness of our results, and parallel trends, with no significant effects found.
- **Varying the sample time horizon**
  - » Restrict period of study to 2005-2019 (arbitrarily), to test whether results driven by particular year.
  - » Results obtained were similar in strength, direction and statistical significance to those using the sample from 2001-2019.
- **Controlling for additional confounding factors**
  - » Additional controls added for occupation, educational attainment, disaster severity (using the share of SA4 respondents reporting direct property damage due to disaster).



# Synthesis of findings

- Provides evidence that natural disaster exposure has significant effects on an individual's labour market outcomes and income.
  - » In contrast, Johar et al (2020) only look at an individual's overall employment status and do not find significant results
  - » Our study shows that the effects of disasters differ according to gender, and type of disaster – highlighting importance of nuanced analysis of this issue.
  - » Our study provides evidence that the general equilibrium (indirect exposure) effects of natural disaster differ from the effects of direct disaster exposure (property damage).
- Our paper provides some evidence that the effects of natural disasters persist over time (raising issues of labour market scarring).



# THANK YOU

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