Extreme Climatic Events and Economic Vulnerabilities: Empirical Evidence from Australian Households

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Do extreme climatic events matter?

- Extreme climatic events in Australia are costly.
- Recent surge in extreme climatic events has worsened people's lifestyle through added expenses (Johar et al., 2022; Masozera et al., 2007).
- Considerable interest in understanding the economic, social and health impacts of natural disasters on households and communities.
- It is critical to understand the groups that are most affected and that are more resilient during a natural disaster.
- Such assessments will be critical important for identifying potential policy interventions for future disasters.

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Do extreme climatic events matter? Cont.

- Effects and magnitudes of extreme climatic events can vary across entities, leading to variations in the exposure and economic vulnerabilities (Masozera et al., 2007).
- Economic costs owing to extreme climatic events is likely to go up.
- Extreme climatic events are inevitable; however, better economic policies can be effective in mitigating economic costs, especially at the micro-level.

Motivation

- Extreme climatic events is a direct threat toward the economic resilience, especially at micro level.
- Over the last two decades economists have contributed strongly to understanding the impacts of natural disasters on households.
- Efforts have been made to explore the effects of natural disasters on insurance payments, migration, and other economic costs (Johar et al., 2022; Xie et al., 2024).
- However, existing studies lack in terms of assessing the effects of extreme weather events on economic vulnerabilities.
- Understanding how extreme climatic events affect economic vulnerabilities can be instrumental in designing economic policies to wind down the growing costs owing to extreme weather events.

Research questions & contribution

- How do extreme climatic events (i.e., floods, cyclone, bushfire) affect economic vulnerabilities in Australia?
- ❑ Do Australian households respond differently amid extreme weather events considering different levels of economic vulnerabilities (i.e., rent poverty, food poverty, energy poverty).
- ❑ Are high-income group families more resistant against extreme weather events compared to low-income groups?
- The main contribution of this study is that it justifies that extreme climatic events are costly, especially for households at risk of poverty.

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Data

- ❑The Household, Income and Labor Dynamics in Australia (HILDA) Survey data.
- ❑Climate data from Bureau of Meteorology (BOM)
- HILDA is household-based longitudinal study that collects valuable information about economic and personal well-being, labor market dynamics and family life.
- The HILDA survey follows the lives of more than 17,000 Australians each year.
- The HILDA database provides 22 years of longitudinal data on key parameters strongly associated with Australian households.
- For this study data from 2009 to 2022 have been used.

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Key variables of this study

- ‘Economic vulnerability’ is my dependent variable.
- Capacity to obtain emergency fund: Whether a household is able to obtain funds during an emergency.

❑ Food poverty: Whether the household skips meal on a regular basis.

❑ Rent poverty: Whether the household has missed recent rent payments or mortgages.

❑ Energy poverty: This is a subjective measure obtained from HILDA.

❑ Explanatory variable: ‘Disaster’ is the main explanatory variable of this study, which is a binary variable and obtained from the HILDA dataset that asks, “A weather-related disaster (e.g., flood, bushfire, cyclone) damaged or destroyed your home”?

❑ Control variables: Household characteristics, such as, number of bedroom, age, household type, loan burden, rural remoteness, gender, number of dependents, household income, marital status, long-term health conditions, education, and employment status have been used. I have also used weather controls.

Descriptive statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Emergency Fund	192362	.416	.493	0	1
Financial Help	178818	.12	.325	0	1
Food Pov	178566	.039	.195	0	1
Rent Poor	178168	.06	.237	0	1
Energy Pov	178475	.032	.176	0	1
Disaster	194103	.014	.119	0	1
Loan Burden	153064	.734	.442	0	1
Rural Remote Area	290609	.346	.476	0	1
Parenting Benefit	290663	.021	.144	0	1
Tax Benefit	290663	.307	.461	0	1
Wind S	290663	4.052	.604	2.41	5.72
Relative Hum	290663	71.225	4.572	57.25	79.69
Wind D	290663	190.748	65.026	24.25	351.19

Estimation equation

$$EV_{it} = \emptyset_0 + \gamma_l Disaster_{it} + \phi_p W_{pt} + \varphi_i + \theta_s + \phi_t + \rho_{it}$$

- EV_{it} is the economic vulnerabilities for household i in time t.
- $Disaster_{it}$ is the measure of the extreme weather events incorporating floods, bushfire and cyclone.
- W_{pt} is the weather control measures.
- A vector of household characteristics (φ_i), state fixed effects (θ_s) and time fixed effects (ϕ_t) are also included to absorb the effects of unobservable household, time-invariant state or time characteristics, and ρ_{it} denotes the error term.

Baseline model results

VARIABLES	(1) Financial_Help	(2) Food_Pov	(3) Rent_Poor	(4) Heating_Related_FuelPOV
Disaster	0.23729***	0.23391*	0.23339***	0.45864***
	(0.06929)	(0.12188)	(0.05879)	(0.06894)
Marginal effect	.0206404***	.0052891*	.0114473**	.0092721***
	(.0060307)	(.0027598)	(.004577)	(.0024452)
Constant	0.16868	-0.53309	-0.87245	1.41659
	(0.82149)	(1.50074)	(0.69362)	(0.88436)
Household controls	yes	yes	yes	yes
Weather controls	yes	yes	yes	yes
Year effect	yes	yes	yes	yes
State effect	yes	yes	yes	yes
Observations	92,372	92,291	92,181	92,282
Number of waveid	15,961	15,960		

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

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Key results

- Extreme climatic events are a key determinant of economic vulnerabilities.
- I find that disasters surge financial hardships among Australian households.
- Households are more likely to face financial hardship and rent poverty during disasters.
- Also, households are likely to face food and energy poverty.

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Results for lowest income group

VARIABLES	(1) Financial_Help	(2) Rent_Poor	(3) Food_Pov	(4) Heating_Related_FuelPOV
Disaster	0.46413***	0.29872	0.25235	0.71967***
	(0.17786)	(0.20013)	(0.28630)	(0.23007)
Marginal effects	0.30987***	0.00446	0.00822	0.13009***
	(0.03522)	(0.01245	(0.03224)	(0.06547)
Constant	-1.08964	-6.56737***	-4.06023	0.01237
	(2.36755)	(2.36546)	(3.50757)	(2.87373)
Household controls	yes	yes	yes	yes
Weather controls	yes	yes	yes	yes
Year effect	yes	yes	yes	yes
State effect	yes	yes	yes	yes
Observations	11,768	11,689	11,753	11,746
Number of waveid	4,307	4,294	4,302	4,303

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

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Results for highest income group

VARIABLES	(1) Financial_Help	(2) Food_Pov	(3) Rent_Poor	(4) Heating_Related_FuelPOV
Disaster	0.29717	0.80742**	0.47673**	0.95667***
	(0.18612)	(0.35082)	(0.21013)	(0.36418)
Marginal effect	0.00343	0.00533**	0.00077**	0.008283***
	(0.01237)	(0.20093)	(0.10039)	(0.00320)
Constant	-2.14620	-4.76022	3.22480	7.96765
	(2.25979)	(5.12113)	(3.10530)	(5.69892)
Household controls	yes	yes	yes	yes
Weather controls	yes	yes	yes	yes
Year effect	yes	yes	yes	yes
State effect	yes	yes	yes	yes
Observations	21,752	21,731	21,725	21,740
Number of waveid	7,381	7,373	7,371	7,375

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

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Heterogeneity (Moderating effects with parenting benefits)

Table: Moderating effects of parenting benefits

VARIABLES	(1) Financial_Help	(2) Food_Pov	(3) Rent_Poor	(4) Heating_Related_FuelPOV
1.Disaster	0.26242***	0.27662**	0.22069***	0.47716***
	(0.06957)	(0.12140)	(0.08089)	(0.10545)
1.Parenting_Benefit	0.42950***	0.12430	0.52478***	0.39716***
	(0.06841)	(0.13734)	(0.08556)	(0.10763)
Disaster*.Parenting_Benefit	-0.83216**	-1.89697***	-0.41469	-2.43465***
	(0.36661)	(0.58206)	(0.47389)	(0.67628)
Constant	0.45125	-0.51676	-0.88618	1.52624
	(0.82121)	(1.50859)	(0.95909)	(1.44428)
Household Controls	yes	yes	yes	yes
Weather Controls	yes	yes	yes	yes
State Effects	yes	yes	yes	yes
Year Effects	yes	yes	yes	yes
Observations	92,372	92,291	92,181	92,282
Number of waveid	15,961	15,960	15,953	15,961

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

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Marginal effects (emergency fund)

	Delta-method Margin	std. err.	z	P>|z|	[95% conf.	interval]
Disaster						
0	.055404	.0013181	42.03	0.000	.0528205	.0579874
1	.0779061	.0069976	11.13	0.000	.0641911	.0916211
Parenting_Benefit						
0	.0553306	.0013156	42.06	0.000	.052752	.0579092
1	.0957292	.0080762	11.85	0.000	.0799002	.1115582
Disaster#Parenting_Benefit						
0 0	.0550536	.001316	41.83	0.000	.0524743	.0576328
0 1	.0966489	.0081712	11.83	0.000	.0806337	.1126641
1 0	.0783359	.0070799	11.06	0.000	.0644596	.0922121
1 1	.045073	.0236705	1.90	0.057	-.0013203	.0914662

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Marginal effects (food poverty)

	Margin	Delta-method std. err.	z	P>|z|	[95% conf.	interval]
Disaster						
0	.0339742	.0010054	33.79	0.000	.0320037	.0359447
1	.0465542	.0053312	8.73	0.000	.0361052	.0570032
Parenting_Benefit						
0	.0338459	.0010033	33.73	0.000	.0318794	.0358123
1	.0699217	.0077806	8.99	0.000	.054672	.0851715
Disaster#Parenting_Benefit						
0 0	.0336927	.0010028	33.60	0.000	.0317272	.0356582
0 1	.0701628	.0078078	8.99	0.000	.0548597	.0854658
1 0	.0464777	.0053667	8.66	0.000	.0359592	.0569963
1 1	.0541769	.0349915	1.55	0.122	-.0144052	.122759

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Marginal effects (rent poverty)

	Delta-method					
	Margin	std. err.	z	P>|z|	[95% conf.	interval]
Disaster						
0	.0111505	.0006673	16.71	0.000	.0098427	.0124583
1	.0162291	.0028249	5.75	0.000	.0106925	.0217657
Parenting_Benefit						
0	.011192	.0006678	16.76	0.000	.0098831	.0125009
1	.0129517	.0026544	4.88	0.000	.0077492	.0181542
Disaster#Parenting_Benefit						
0 0	.0111286	.0006678	16.66	0.000	.0098198	.0124375
0 1	.01338	.0027396	4.88	0.000	.0080104	.0187495
1 0	.0166653	.0029122	5.72	0.000	.0109576	.022373
1 1	.000843	.000948	0.89	0.374	-.0010151	.0027011

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Marginal effects (energy poverty)

	Margin	Delta-method std. err.	z	P>|z|	[95% conf.	interval]
Disaster						
0	.0112184	.0006109	18.36	0.000	.0100211	.0124158
1	.021916	.0033081	6.63	0.000	.0154323	.0283997
Parenting_Benefit						
0	.0112593	.0006123	18.39	0.000	.0100593	.0124594
1	.0194057	.0030749	6.31	0.000	.0133791	.0254324
Disaster#Parenting_Benefit						
0 0	.0111457	.0006094	18.29	0.000	.0099512	.0123402
0 1	.0201657	.0031727	6.36	0.000	.0139475	.026384
1 0	.022589	.0034149	6.61	0.000	.015896	.0292821
1 1	.0006656	.0009265	0.72	0.473	-.0011504	.0024816

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Heterogeneity (Moderating effects with family payment benefits)

VARIABLES	(1) Financial_Help	(2) Food_Pov	(3) Rent_Poor	(4) Heating_Related_FuelPOV
Disaster	0.28428***	0.37610***	0.26333***	0.52563***
	(0.07936)	(0.14023)	(0.09668)	(0.12128)
Family_Payment_Benefit	0.14548***	0.05351	0.31526***	0.16194***
	(0.02760)	(0.05739)	(0.03388)	(0.05654)
Disaster#Family_Payment_Benefit	-0.14500	-0.61328**	-0.16389	-0.41858*
	(0.14646)	(0.28090)	(0.16606)	(0.24603)
Household controls	yes	yes	yes	yes
Weather controls	yes	yes	yes	yes
Year effect	yes	yes	yes	yes
State effect	yes	yes	yes	yes
Constant	0.17050	-0.55258	-1.39412	1.40306
	(0.82261)	(1.50284)	(0.96353)	(1.44135)
Observations	92,372	92,291	92,181	92,282
Number of waveid	15,961	15,960	15,953	15,961

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

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Marginal effects (emergency fund)

	Margin	Delta-method std. err.	z	P>|z|	[95% conf.	interval]
Disaster						
0	.0111245	.0006633	16.77	0.000	.0098245	.0124245
1	.0159861	.0028282	5.65	0.000	.0104428	.0215293
Family_Payment_Benefit						
0	.0110236	.0006777	16.27	0.000	.0096954	.0123519
1	.0117934	.0010739	10.98	0.000	.0096885	.0138982
Disaster#Family_Payment_Benefit						
0 0	.0109387	.0006775	16.15	0.000	.0096107	.0122666
0 1	.0118505	.0010788	10.98	0.000	.009736	.0139649
1 0	.0188639	.0037	5.10	0.000	.011612	.0261157
1 1	.0082564	.0032112	2.57	0.010	.0019625	.0145502

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Marginal effects (food poverty)

	Delta-method Margin	std. err.	z	P>|z|	[95% conf.	interval]
Disaster						
0	.0553415	.0013177	42.00	0.000	.052759	.0579241
1	.0778277	.0070164	11.09	0.000	.0640758	.0915795
Family_Payment_Benefit						
0	.0533167	.0013679	38.98	0.000	.0506356	.0559978
1	.0649588	.0023524	27.61	0.000	.0603482	.0695695
Disaster#Family_Payment_Benefit						
0 0	.0530256	.0013685	38.75	0.000	.0503433	.0557078
0 1	.0647921	.0023556	27.51	0.000	.0601752	.0694089
1 0	.0778175	.0080024	9.72	0.000	.062133	.093502
1 1	.077866	.0128287	6.07	0.000	.0527222	.1030098

Marginal effects (rent poverty)

	Delta-method Margin	std. err.	z	P>|z|	[95% conf.	interval]
Disaster						
0	.0334303	.0009921	33.70	0.000	.0314858	.0353747
1	.0467423	.0054801	8.53	0.000	.0360015	.0574831
Family_Payment_Benefit						
0	.030394	.0010045	30.26	0.000	.0284253	.0323628
1	.0481879	.0021326	22.60	0.000	.044008	.0523678
Disaster#Family_Payment_Benefit						
0 0	.0302262	.0010039	30.11	0.000	.0282585	.0321939
0 1	.0480955	.0021357	22.52	0.000	.0439095	.0522815
1 0	.0446747	.0062018	7.20	0.000	.0325194	.0568301
1 1	.0552276	.0104319	5.29	0.000	.0347814	.0756738

Marginal effects (energy poverty)

	Margin	Delta-method std. err.	z	P>|z|	[95% conf.	interval]
Disaster						
0	.0111442	.000609	18.30	0.000	.0099505	.0123378
1	.0213765	.0033332	6.41	0.000	.0148435	.0279094
Family_Payment_Benefit						
0	.0106888	.0006359	16.81	0.000	.0094425	.011935
1	.0135959	.0011115	12.23	0.000	.0114174	.0157743
Disaster#Family_Payment_Benefit						
0 0	.0105691	.0006322	16.72	0.000	.00933	.0118083
0 1	.0135658	.0011124	12.20	0.000	.0113856	.015746
1 0	.0230608	.0039884	5.78	0.000	.0152436	.030878
1 1	.015927	.0052181	3.05	0.002	.0056998	.0261542

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Robustness (Logit model)

VARIABLES	(1) Financial_Help	(2) Food_Pov	(3) Rent_Poor	(4) Heating_Related_FuelPOV
Disaster	0.24889***	0.25665*	0.26443***	0.47784***
	(0.06988)	(0.12564)	(0.07809)	(0.07694)
Marginal effect	.0238604***	.0045871*	.0126573**	.016443***
	(.0050707)	(.0021568)	(.005279)	(.003245)
Household controls	yes	yes	yes	yes
Weather controls	yes	yes	yes	yes
Year effect	yes	yes	yes	yes
State effect	yes	yes	yes	yes
Observations	92,372	92,291	92,181	92,282
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Concluding remarks

- Extreme weather events are detrimental for economic resilience among Australian households.
- Extreme weather events surge economic vulnerabilities by increasing financial insecurity, food and rent poverty and energy poverty.
- Households at the higher income groups are less prone to economic vulnerabilities due to climatic variations.
- Government income support (i.e., parenting benefits) is helpful to reduce the negative effects of extreme weather events.

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Thank You!

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