Introduction
○○○○

Literature
○

Background
○

Data
○○○○

Empirical Framework
○○○

Results
○○○○○○

Across-city analysis
○○○

Conclusion
○

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The Impact of Floods on Not-for-Profit Firms: Evidence from Administrative Data

Phan Duy-Anh

Coauthors: Prof. Anthony Scott, Prof. David Johnston, Dr. Trong-Anh Trinh

Centre for Health Economics (CHE)
Monash Business School

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Introduction
0000

Literature
O

Background
O

Data
0000

Empirical Framework
000

Results
000000

Across-city analysis
000

Conclusion
O

Table of Contents

Introduction
Motivation

- Not-for-profit organisations (NFPs)
  - *Operating for its purpose and not for the gain of its individual members*.
  - Example: Social welfare organisations, Churches, Charities.
- NFPs often serve vulnerable communities
  - Offering immediate relief and long-term support (Putnam et al., 2001).
  - Building community connections and serving marginalised populations through grassroots networks (Roberts, Archer, and Spencer, 2021).
- How such organisations emerge or remain at a time of disaster is important.
  - If a disaster can wipe out all NFPs, there may be bad social/economic consequences.
  - Understanding the resilience of social capital structures in the face of disaster.
- **Question**: How do NFPs respond to natural disasters?

Introduction
Conceptual Framework

How might disaster impact NFPs ?

- ***Direct effect:*** Loss of physical assets $\rightarrow$ Financial shock (Tuckman and Chang, 1991)
  - Damage to Infrastructure.
  - Disruption of Activities.

- ***Indirect effect:*** Macro changes affecting all NFPs
  - Increased Donations, Grants, and Support (List, 2011; Lin and Wang, 2016)
    - Response to Crisis.
    - Support from Larger Organisations.
  - Increased Demand for Services (Brown, Andersson, and Jo, 2016)
    - Community Needs.
    - Volunteer Engagement.

Introduction
Conceptual Framework

Why Might the Impact for NFPs Be Different Than for Other Businesses?

- Unique Characteristics of NFPs:
  - *Objective*:
    - Mission-Driven: Maximize the utility of the local community or their members.
    - Commitment: Committed to their cause and community
      $\rightarrow$ Do not exit and stay longer in response to shocks (Pena et al., 2014).
  - *Non-distribution constraint*
    - Profits are not distributed to owners.
    - Slower market response (Hansmann, 1987).
  - *External Support*
    - Community and donor support during crises.

  $\rightarrow$ Can not use estimates for "normal" businesses for NFPs

Introduction
Preview

- **Event:** The 2010-11 Queensland floods.
- **Data:**
  - The Business Longitudinal Analysis Data Environment (BLADE).
  - The flood-water inundation map.
  - Time period: 2007/08 to 2012/13.
- **Method:**
  - (i) Standard Differences-in-Differences
  - (ii) Event Study
- **Main findings:**
  - Reduction in activity of NFPs, measured by operating expenses and FTE employment.
  - No significant impact on the likelihood of exit.
  - Religious organisations are more likely to have a negative impact.

Introduction
0000

Literature
●

Background
○

Data
0000

Empirical Framework
000

Results
000000

Across-city analysis
000

Conclusion
○

Literature

- **Literature on the behaviour of not-for-profit organisations:**
  - The importance and differences in the volatility of revenue sources in each sub-sector
    (Dranove, Garthwaite, and Ody, 2017; Harrison and Oxley, 2023; Harrison and Seim, 2019; Bentzen, 2019).
  - The ability to withstand adverse economic shocks by using
    surveys (Salamon, Geller, and Spence, 2009), *interviews* (Park and Mosley, 2017), and *administrative data* (Brown, Andersson, and Jo, 2016; Exley, Lehr, and Terry, 2023).
  - The impact of natural disasters: Hurricane
    (Chen, 2022; Pena et al., 2014).

- **Literature on the resilience and survival of firms post-natural disasters**
  (Cole et al., 2019; Meltzer, Ellen, and Li, 2021; Indaco et al., 2021; Clò, David, and Segoni, 2024).

Background
The 2010-11 Queensland floods

Figure A: Inundation of the Brisbane area

Figure B: Released water from Wivenhoe Dam

- December 2010 to January 2011.
- Causes: Tropical Cyclone Tasha and Mismanagement of Wivenhoe Dam.
- Completely unexpected for local people.
- Impact: 2.5 million people affected, 33 fatalities, extensive damage to homes and infrastructure.

Figure C: Support from local Red Cross

Introduction
0000

Literature
0

Background
0

Data
●000

Empirical Framework
000

Results
000000

Across-city analysis
000

Conclusion
0

Data
Not-for-profit organisation data

- Admin firm-level data from BLADE.

- Australian Business Number (ABN) is an organisation identifier.

- Data Components:
    - **Indicative Data Items:** Categorises businesses by primary activity and structure. Utilises *"Not-for-profit Institution flag"* to identify not-for-profit organisations.
    - **Business Activity Statement (BAS):** Details on turnover and expenses for GST-registered businesses.
    - **PAYG Statements:** Provides employee headcount and full-time equivalent (FTE) calculations based on wage payments.
    - **Location Data:** ABN links with Meshblock information.

Data
Sample selection

- Sample restrictions:
  1. Organisations that register for GST tax (turnover $\geq$ AUD\$150,000).
  2. Organisations located in Brisbane.
  3. Organisations active at least two years consecutively before the event.
- Multiple locations of organisation:
  - Each location is an independent entity.
  - Aggregate outcome variables are equally divided among each location.
- Final data: 2,046 unique organisations.

Data
Sample selection

Figure: The number of organisations and their active status per year
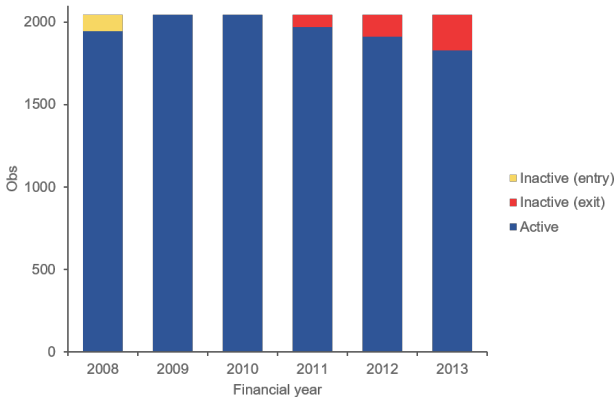
Data
Summary statistics

Table: Summary statistics

Variable	Obs	Mean	Std. Dev.	% Zero
Inundated	12,276	0.33	0.47	67.45%
Post	12,276	0.50	0.48	50.00%
Exit	12,276	0.03	0.18	96.53%
Activity outcomes				
Capital Expenses (000s AUD)	11,438	48.97	132.55	54.91%
Non-Capital Expenses (000s AUD)	11,438	620.98	1,327.36	8.30%
Labor Expense (000s AUD)	8,672	607.06	1,262.55	16.47%
Total Revenue (000s AUD)	11,438	1,374.26	2,968.24	10.70%
FTE	7,054	16.55	32.22	6.04%

▶ Description for variables

Empirical Framework

Treatment and Control group ▸ Inundation data source

Figure: The inundated Meshblock and SA2
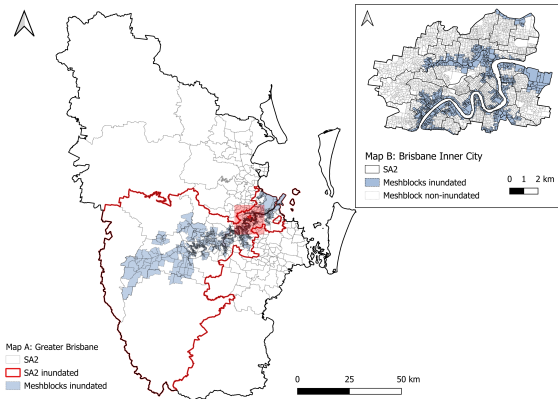
Empirical Framework
Standard Differences-in-Differences

- **Exit analysis**
  - Impact of inundation on the likelihood of exit:

$$Y_{it} = \beta_0 + \beta_1(\text{Inundate}_i \times \text{Post}_t) + \alpha_t + \delta_i + \varepsilon_{it} \tag{1}$$

  - Y_{it}: binary variable identify whether firm i survives after the event
  - Inundate_i: inundation in the area firm i is location.
  - Post_t: dummy variable for post-flood period .
  - α_t and δ_i : Year fixed effect and Firm fixed effects.
  - Standard errors clustered at the meshblock and industry level.
  - Dynamic impact of inundation:

$$Y_{it} = \beta_0 + \sum_{t \neq 2010} \beta_1^t(\text{Inundate}_i \times \text{Post}_t) + \alpha_t + \delta_i + \varepsilon_{it} \tag{2}$$

Empirical Framework
Non-linear Differences-in-Differences

- **Activity of organisation**
  - Issue: The performance variables have a *high proportion of zero* observation (from 15-25%).
  - Researchers commonly use log-like transformation ($log(x + 1)$ or $arsinh(x)$), but it can not be interpreted as percentage effects and can manipulate the magnitude of the results.
  - **Poisson regression** is well-defined for zero-valued outcomes (Chen and Roth, 2023) . ▶ Equations
  - *Output variables*: Capital Expenses, Non-Capital Expenses, Total Turnover, Labour Expenses, FTE.

Introduction
0000

Literature
0

Background
0

Data
0000

Empirical Framework
000

Results
●00000

Across-city analysis
000

Conclusion
0

Results

Baseline results

Table: Effect of inundation on not-for-profits: Baseline results

VARIABLES	Exit	Capital Expense	Non-capital Expense	Labour Expense	Total Revenue	FTE
	(1)	(2)	(3)	(4)	(5)	(6)
Inundate*Post	0.009	0.002	-0.083***	-0.018	-0.042	-0.048*
	(0.012)	(0.057)	(0.031)	(0.056)	(0.033)	(0.026)
Observations	12,276	11,438	11,438	8,672	11,438	7,054
Outcome mean	0.03	48.97	620.98	607.06	1,374.26	16.55
Model	OLS	Poisson	Poisson	Poisson	Poisson	Poisson

Note: All columns include organisation-fixed effects and year-fixed effects. The first row of the table shows the estimate $\hat{\beta}_1$. The standard errors in parenthesis are two-way clustered at the meshblock and industry levels. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

▸ Trends in firms' outcomes   ▸ Event study   ▸ Intensive margins

Results
Heterogeneity: Which not-for-profits are most affected?

Table: Number of NFPs by their purpose in 2010

Group	Obs	Describe
Community groups	543	Serves their members (e.g. social club, welfare fundraising, youth clubs, sport clubs).
Religious services	347	Churches, mosques, religious temples.
Social, health & emergency services	310	Serves the broader community (e.g. soup kitchens, disability assistance, childcare, aged care, allied health, fire services).
Others	846	Other groups (e.g. Business and Professional Association Services, Museum Operation, Administrative Services).

Results

Heterogeneity: Which not-for-profits are most affected?

Figure: Effect of inundation by purpose of NFP
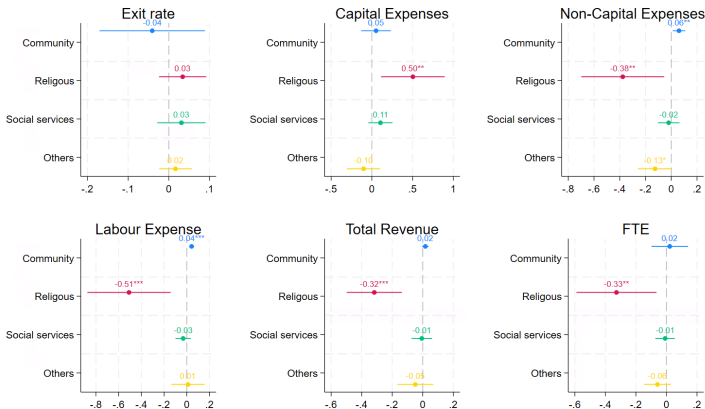
Results
Heterogeneity: Which not-for-profits are most affected?

- **Most of the impact comes from religious organisations**. Why?
  - *Displacement of Congregation:*
    - Members of religious groups might have relocated temporarily or permanently, reducing the congregation size.
    - Only intrinsic religiosity increases in response to natural disasters, while churchgoing is unchanged (Bentzen, 2019).
  - *Emergency Relief Focus:*
    - Post-disaster, the focus of many religious groups might shift towards emergency relief efforts, redirecting their resources and funding to immediate community needs rather than regular operations.
  - *Reliance on Donations*
    - The ability of individuals to contribute financially may be significantly reduced, leading to immediate financial strain for these organizations.

- The impact is persistent for a religious organisation.

Results

Heterogeneity: Which not-for-profits are most affected?

Figure: Dynamic effect of the inundation: Event study estimations for religious group
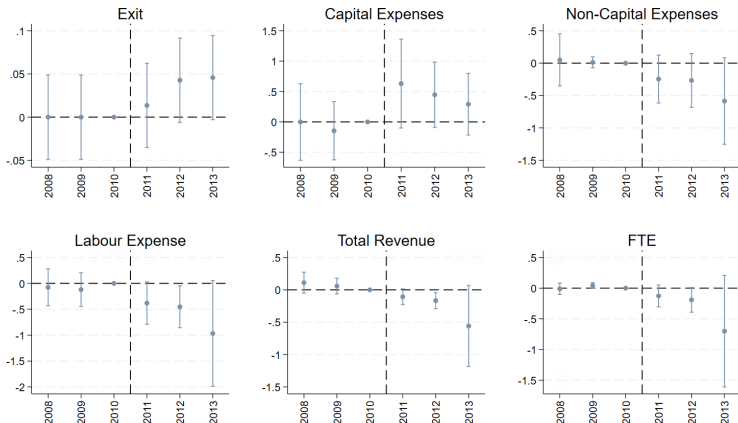
Results

Heterogeneity: Which not-for-profits are most affected?

- Heterogeneity by *size* of not-for-profit ▶ Group description ▶ Graphs
  - The impact of the flood was *size-dependent*
    - Small firms are the most negatively affected, followed by medium firms with moderate effects and large firms showing resilience.

- Heterogeneity by *age* of not-for-profit ▶ Group description ▶ Graphs
  - *Age-based disparity*
    - Young firms experienced significant negative impacts on non-capital expenses and total revenue, reflecting their vulnerability and limited financial resilience.
    - Mature organisations showed greater resilience in maintaining operations.

Across-city analysis

- **Compare all NFPs in Brisbane with other cities in Australia**

- How does this analysis support the main results?
  - *Strengthening Causal Inference:*
    - Isolating the impact of the flood from other simultaneous economic or regional developments.
    - Avoids the issue of spillover effects within Brisbane.
    - Matching reduces bias due to confounding variables that could differ across cities.
  - *Broader Geographic Context:*
    - Strengthens the argument that observed impacts are truly due to the flood and not other localized factors.
    - Provides insights into the scalability of the flood's effects.

Across-city analysis
Propensity Score Matching

- **Sample**
  - Treatment group:
    - All NFPs located in Greater Brisbane
  - Control group:
    - All NFPs located in Greater Adelaide, Grater Darwin, Greater Hobart, Greater Melbourne, Greater Perth, Greater Sydney, Australian Capital Territory.
- **Methodology**: *Propensity Score Matching + DiD*
  - Matching variable:
    - Non-Capital Expenses, Capital Expenses, Total Revenue, Labour Expenses, FTE at the baseline (2010)
  - Kernel matching on the score for each industry sector.
  - Estimate regression model, apply sample weight produced by the matching process.
- **Final matching sample**: 15,721 unique organisations ▸ Obs by city ▸ Balance test

Across-city analysis
Propensity Score Matching

Table: Effect of inundation on not-for-profits: PSM result

VARIABLES	Exit	Capital Expense	Non-capital Expense	Labour Expense	Total Revenue	FTE
	(1)	(2)	(3)	(4)	(5)	(6)
Flood*Post	0.005**	-0.060**	-0.040***	-0.064***	-0.018	-0.007
	(0.003)	(0.025)	(0.011)	(0.011)	(0.012)	(0.008)
Observations	94,326	93,522	93,522	93,170	93,522	86,730
Outcome mean	0.02	77.03	697.28	654.05	1,687.17	15.42
Model	OLS	Poisson	Poisson	Poisson	Poisson	Poisson

Note: All columns include organisation-fixed effects, year-fixed effects, and city-fixed effects. The standard errors in parenthesis are two-way clustered at the meshblock and industry levels. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

▸ Event study   ▸ Heterogeneity by purpose   ▸ Event study Religious

Conclusion

- This paper provides one of the first detailed investigations of the impact of natural disasters on not-for-profit organisations.
- The findings reveal ***a negative impact*** of the inundation on the performance of NFPs:
    - A decrease in *non-capital expenses* and *employment* → ***Downscale operation***.
    - But no significant impact on organisational *exit rates*.
- Most of the impact comes from ***religious organisations***.
- Small and young NFPs are also more vulnerable.
- Highlight broader impacts of the event compared with other cities,
    - shows significant effects on exit rates, capital, non-capital, and labour expenses.

Thank you!

◄ Return   ◄ Group description

Figure: Effect of inundation by size of NFP
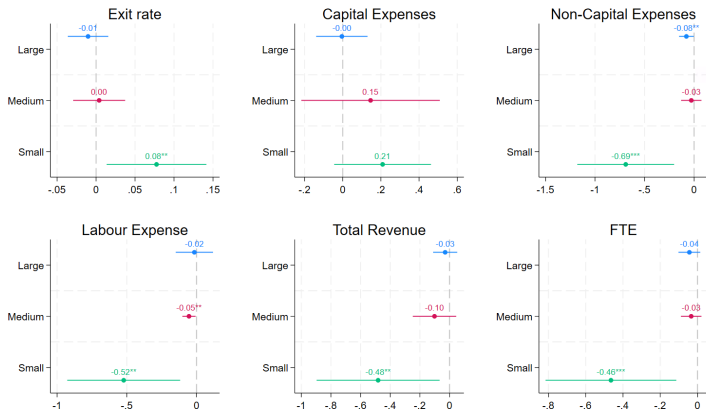
◄ Return ◄ Group description

Figure: Effect of inundation by age of NFP

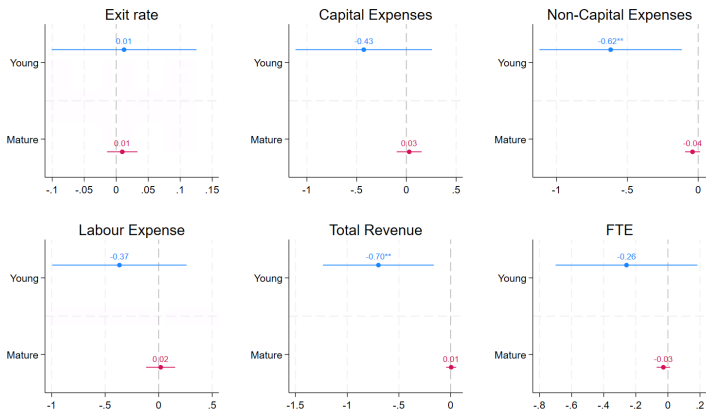# Appendix - Data Description for the selected variables

Table: Data Description for the selected variables

Variable	Description
Inactive	It is defned as missing or zero in the total revenue, total expenditure, and labour expense.
Exit	Organisations that are inactive after the event.
Total expenditure	The sum of capital and non-capital purchases.
Capital Purchases	This includes expenditures intended for long-term use exceeding a year.
Non-capital Purchases	Purchases related to the daily operations of a business, which benefits for less than a year.
Total Revenue	This aggregate of GST-taxable and GST-free sales.
GST-taxable sales	All sales subject to the GST, including fees for services, gross sales, membership fees, and subscriptions. Grants and sponsorships are included.
GST-free sales	Revenues exempt from GST, such as the non-commercial activities of charities, along with specific education and health services.
Labour expense	This covers all employment-related payments.
Headcount	This variable gives the total number of individuals employed.
FTE	The number of full-time equivalent employees at a firm.

◂ Return

Table: Descriptive of the subsample by their size in 2010

Group	Obs	Describe
Small	638	Total expenses at the baseline smaller than AUD 51,354
Medium	638	Total expenses at the baseline greater than AUD 51,354 and smaller than AUD 243,505
Large	639	Total expenses at the baseline greater than AUD 243,505

‹ Return

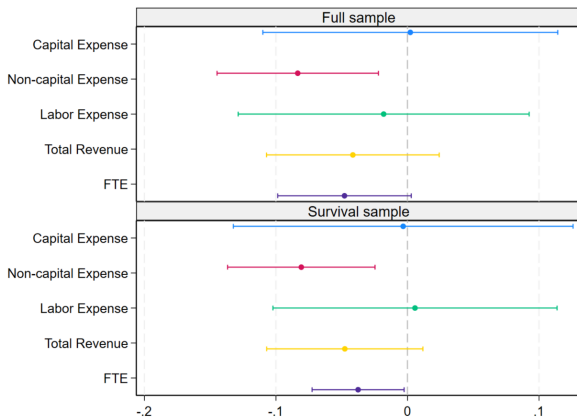Table: Descriptive of the subsample by their age in 2010

Group	Obs	Describe
Young	214	Age at baseline smaller than five years
Mature	1,832	Age at the baseline greater than five years

Figure: Dynamic effect of the inundation: Event study estimations
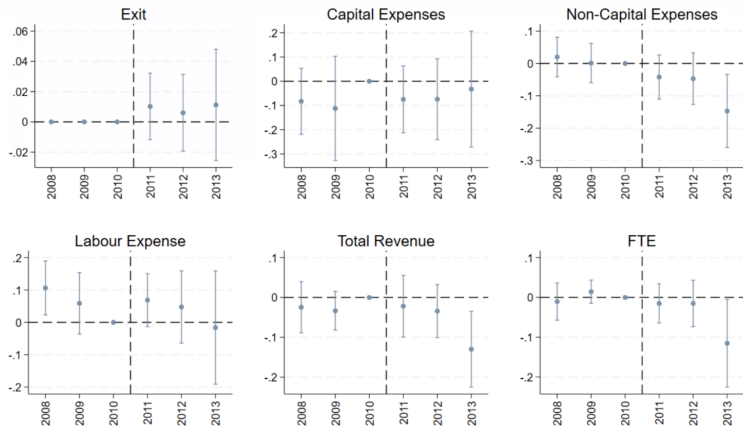
Return

Figure: Extensive vs Intensive margins of the event

◄ Return

Table: Number of obs in 2010 by city for matching sample

City	Obs
Adelaide	3,168
Brisbane	4,580
Canberra	1,349
Darwin	443
Hobart	795
Melbourne	9,340
Perth	3,736
Sydney	9,549

◂ Return

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Table: Balance test

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		Mean		t-test	
		Treated	Control	t	$p > |t|$
Non-Capital Expenses (000s AUD)	Unmatched	430.27	1275.1	-1.5	0.139
	Matched	430.27	441.89	-0.03	0.975
Capital Expenses (000s AUD)	Unmatched	34.153	180.77	-1.48	0.145
	Matched	34.153	27.582	0.15	0.887
Total Revenue (000s AUD)	Unmatched	1009.5	3355.8	-1.58	0.119
	Matched	1009.5	1070.1	-0.07	0.949
Labor Expense (000s AUD)	Unmatched	299.69	1221.7	-1.41	0.165
	Matched	299.69	281.46	0.06	0.951
FTE	Unmatched	8.3174	29.276	-1.34	0.184
	Matched	8.3174	7.9538	0.05	0.964

Figure: Event study for matching sample
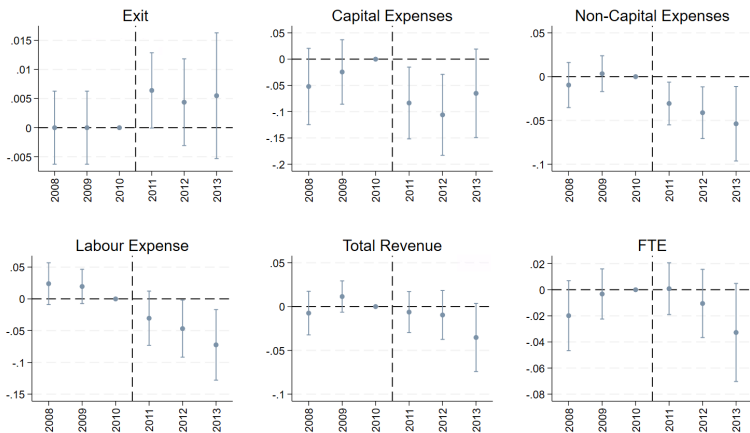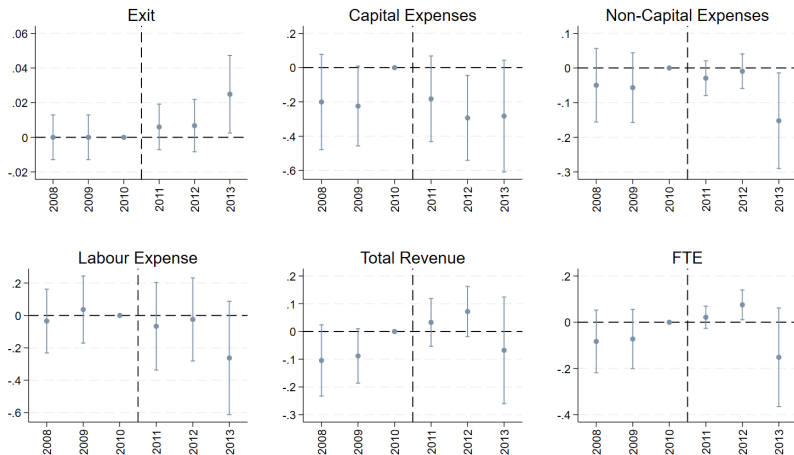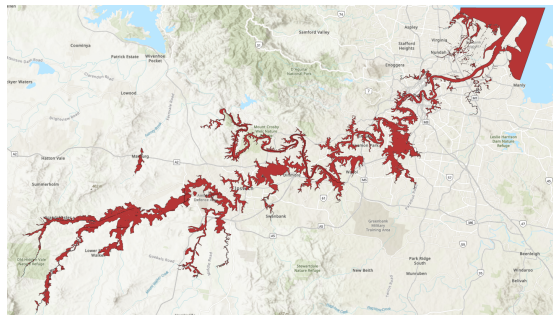
Figure: Effect of flood by purpose of NFP
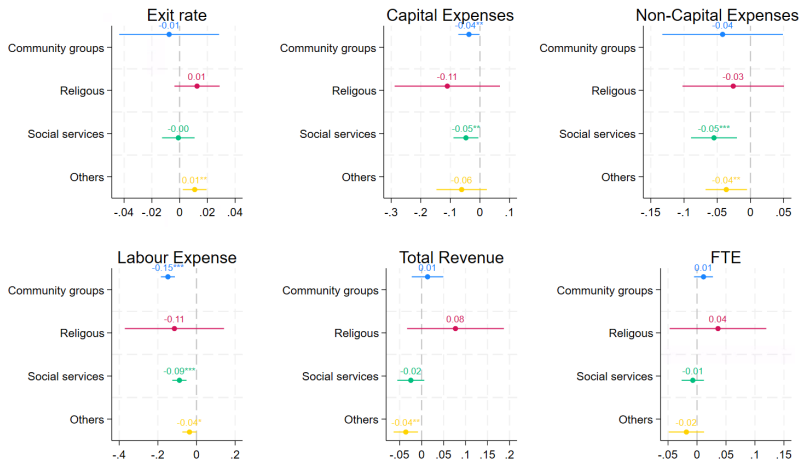
◂ Return

Figure: Event study for matching sample: Religious

- Data source:
  - The Department of Natural Resources and Mines, Government of Queensland.
- Why is it necessary?
  - Capture on January 2011 by the source aerial imagery
  - A layer of polygons, each delineating the approximate flood-water inundation areas

Figure: Flood extent

Appendix - Possion QMLE specification

- **Poisson QMLE specification**
  - DiD models

$$Y_{it} = \exp\left(\beta_0 + \beta_1(\text{Inundate}_i \times \text{Post}_t) + \alpha_t + \delta_i\right)\varepsilon_{it} \tag{3}$$

    - Y_{it} is the performance outcomes of organisation i, i.e., capital expenses, non-capital expenses, total turnover, labour expenses, FTE.
    - $\exp(\beta_1) - 1$ measures the percentage change in the average outcome of the post-period after the disaster.
  - Dynamic specification

$$Y_{it} = \exp\left(\beta_0 + \sum_{t \neq 2010} \beta_1^t(\text{Inundate}_i \times \text{Post}_t) + \alpha_t + \delta_i\right)\varepsilon_{it} \tag{4}$$

    - β_1^t are analogous to coefficients in typical DiD event studies.

Appendix - Raw means of outcome variables

Figure: Trend in organisation's outcomes
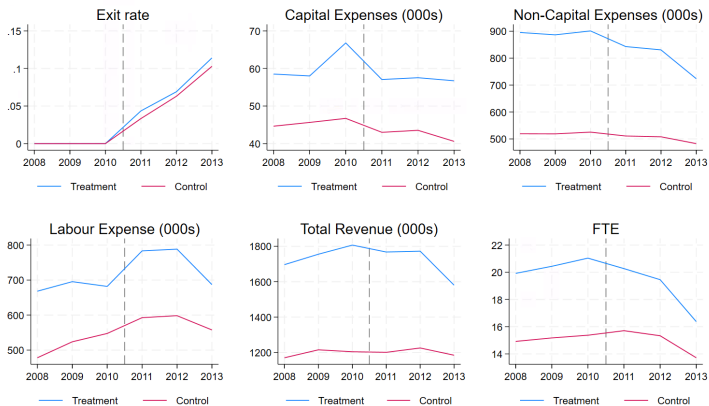
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