

Discussion: Firm Adaptation in Production
Networks: Evidence from Extreme Weather
Events in Pakistan by Clare Balboni,
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Summary

- Paper shows how firms in Pakistan are affected by and adapt to flooding
- Estimates **direct** effects of flood on firms' sales and purchases and ease of road transport
- Estimates how flood shock **propagates** through a firm's production network and how firms **adapt** to a flood shock
 - Impact of flood on firm's location choice
 - Number and composition of firm's suppliers
 - **Indirect** effect: how does firm respond when its suppliers are hit by flood
 - **Indirect** effect: how do firm-pairs respond when transport route between them is flooded

Summary

- Build a model of endogenous production network where firms choose suppliers that face flood risk
- Feed in reduced form changes in firm behavior following a flood (changes in sourcing shares across different geographic units hit by floods) to estimate aggregate effect of firms' adaptive behavior
- Find large effects from adaptation:
 - Overall damage in 2013 flood would have been 5% higher in the absence of adaptation, flood damages would have been at least twice as large in four regions.

My take on the paper

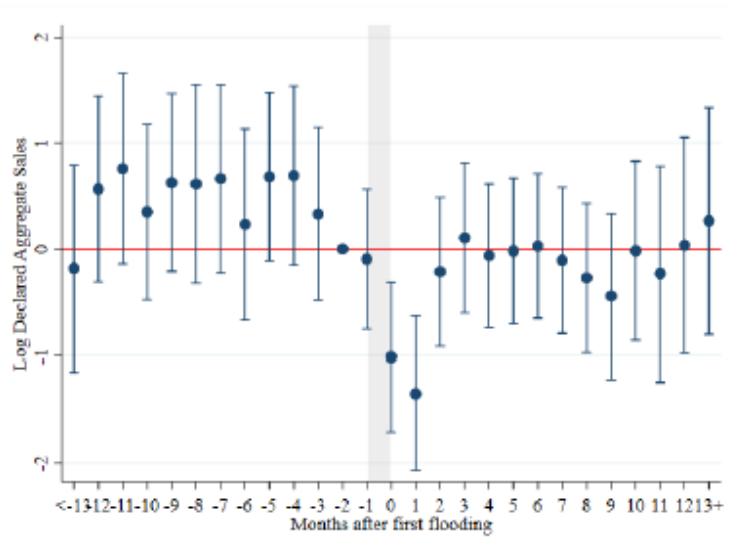
- This is a really great and incredibly rich paper.
- Superficially, the paper falls in the `estimating damages from climate change on outcome X,Y,Z' literature, but it does so much more than that.
- What makes this paper unique:
 - Rich and varied data sets the authors bring to bear on the question
 - Firms' transactions data
 - Road networks
 - Actual flood realizations
 - Flood risk
 - This allows them to not only estimate direct effects of floods, but also how firms adapt to others in their network being hit by shocks
 - Attempt to understand aggregate/general equilibrium implications of estimated reduced form effects

Some comments

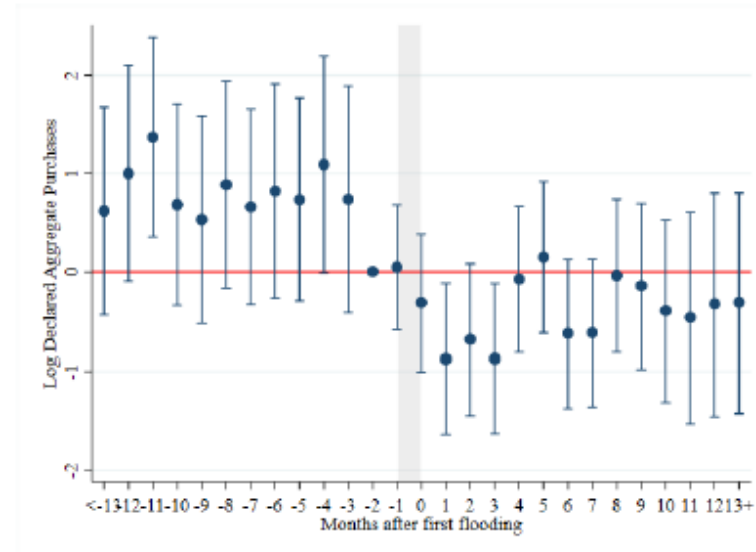
- Differences between direct effects and adaptive behavior of firms
 - Challenge: a flood is an instantaneous event, but effects may be long-lasting.
 - How to distinguish adaptation (“firm reacts to future flood risk after having been exposed to a flood”) from longer-term direct effects of a flood.
- Difference between realized flood and risk of flood
 - Optimal adaptive behavior should adapt to flood risk not to a realized flood
 - How to distinguish responses to flood risk (i.e. to the entire spatial and temporal distribution of flood risk) from responses to realized flood (i.e. a particular draw from the distribution).
- Modelling framework
 - Many moving parts, which are needed, why?
 - Exactly what reduced form information is used for estimation?

Direct versus long-lasting effects

- Claim: direct effects of floods are short-lived, so long-term responses of firms are evidence of adaptive behavior, not of long-term disruptions



(a) Log sales



(b) Log purchases

Figure 3. Impact of flooding on firm sales and purchases

Direct versus long-lasting effects

- Yes, there is a large dip directly after flood
- But also an overall downward trend comparing pre-and post-periods. Not significant, when looking at any particular period, but possibly when comparing all pre- and post-periods.

Difference between realized flood and flood risk

- Claim: firms' moves after flood and moves to less flood prone area are evidence of firms' adaptive behavior

	Move Dummy		Δ Flood Risk	
	(1)	(2)	(3)	(4)
Max Share of 2km Buffer Flooded	1.583** (0.754)	1.849** (0.805)	-1.952* (1.007)	-0.450 (0.526)
District FE	Yes		Yes	
District \times Fathom 1 in 100 FE		Yes		Yes
R^2	0.046	0.067	0.127	0.449
N	43,848	43,395	5,737	5,596

Difference between flood and flood risk

- Can we interpret this as adaptive behavior?
- Suppose that flooding is correlated with flood risk and flooded firms move to a random location.
- In this case, reduction in flood risk is mechanical.
- Can you address this by using floods in areas that do not have a higher than average flood risk?
 - You are controlling for decile of flood risk but can you restrict the regression on that basis?
- Even more mechanically, if firms' premises are destroyed by flood, they have to move. Can you say something about that?

Structural estimation

- Model of production network in which each firm sells a good that is considered differentiated by the representative household, but which is perfectly substitutable with goods produced by other firms
- Two stages: first stage, search for supplier, second stage: search results in arrival of technique

$$y_{j(\phi)} = a_{n(j)} b_{n(j)} \xi_j l_j^{1-\alpha} (z(\phi) x_j)^\alpha$$

- Many moving parts here: location-specific productivity levels, location-specific productivity shock common to all firms (comes from floods), firm-specific idiosyncratic flood shock, technique- or match-specific productivity draw.

Structural estimation

- Add to that trade across locations subject to iceberg costs $\tau_{n(j)n(s)}$
- Becomes complicated very quickly, firm's marginal cost of production depends on their suppliers' costs, which in turn depends on the suppliers' sourcing decisions

$$c_j(\phi) = \frac{1}{a_{n(j)} b_{n(j)} \xi_j} w^{1-\alpha} \left(\tau_{n(j)n(s)} \frac{c_s(\phi)}{z(\phi)} \right)^\alpha$$

- Distribution of match-specific productivity depends on search effort m in the first stage.

Estimating adaptation

- Using reduced form changes in sourcing shares between pre-and post-period, can estimate changes in search effort m (model's measure of adaptation)

$$\left(\frac{\hat{X}_{nn't}}{X_{nt}} \right) = \exp \left(\log \hat{m}_{nn'} - \zeta \log \hat{c}_{n'} + \frac{\zeta}{\alpha} \log \hat{m}_{nn'} \right)$$

Comments

- Model combines features from
 - Kopytov et al. (2022): firms choose suppliers with varying risk to production, how does this affect input-output linkages
 - Boehm and Oberfield (2018): how is production structure affected when firms have to make relation-specific investments with their suppliers but contract enforcement is weak
- Question: are all these pieces necessary here? What `work' do they do in your model?

Comments

- Link between reduced form and structural estimation
 - What exactly are the sourcing shares? How does it relate to reduced form evidence?
 - Is there more from reduced form evidence you could use? Transport network, etc.?

Back to the big picture

- Great paper
- Important contribution to understanding effects of climate change in low-income countries
- Super nice combination of methods
 - Reduced form
 - Theory
 - Structural estimation

Thank you!