Disasters, Capital, and Productivity

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This Paper

Climate changes + Fixed nature of physical capital

Q: How do floods impact plant capital, productivity, and allocative efficiency in the U.S. manufacturing?

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Climate changes + Fixed nature of physical capital

Q: How do floods impact plant capital, productivity, and allocative efficiency in the U.S. manufacturing?

- Use administrative micro data in the U.S. manufacturing sector combined with flood records
  - Detailed data on capital adjustment margins (scrapped, sold, investment, new or used, etc.)
- Adopt an event study design from declared flood events
- Document novel findings on flood impacts on plant entry/exit, capital investment, productivity, and aggregate outcomes
- Draw out mechanism through financing access and policy implications

Recap: Productivity Effects

Productivity outcomes in post-flood periods:

- Exit ↑ in general, but more for low-TFP plants

Table 2: Plants' 2-year exit likelihood increases after flooding, particularly for lowest performing units

	All plants	Heterogeneity by pre-flood performance	
		TFP	Value added/hour
1.Post flood	0.036***	0.049***	0.048***
	(0.005)	(0.006)	(0.006)
1.LowestQuartile		-0.002	-0.007
		(0.007)	(0.009)
1.Post flood#1.LowestQuartile		0.011**	0.02***
		(0.005)	(0.005)
N	422,000	257,000	257,000

Recap: Productivity Effects

Productivity outcomes in post-flood periods:

- Exit ↑ in general, but more for low-TFP plants
- General effects on labor productivity of plants in flooded areas are not statistically significant

Table 4: Investment and Productivity Outcomes

	Normalized Net Investment	IHS(Net Investment Normalized)	Log(Output/Hour)
Post flood	0.019*	0.015**	0.0005
	(0.0101)	(0.007)	(0.017)
N	66,000	66,000	66,000

Recap: Productivity and Reallocation Effects

Productivity outcomes in post-flood periods:

- Exit ↑ in general, but more for low-TFP plants
- General effects on labor productivity of plants in flooded areas are not statistically significant
- Labor productivity for plants w/ capital retirement in the flood year ↑ (but not in value added)

Table 7: Flooded plants which replace their capital see higher labor productivity

	Log(Output/hour)	Log(Hourly wage)	IHS(Value added/hour)
Post flood X Retire in flood year	0.045**	0.027*	0.021
	(0.019)	(0.014)	(0.035)
Post flood	-0.022	-0.032*	–
	(0.024)	(0.017)	
Retire in flood year	-0.043	-0.0006	–
	(0.038)	(0.026)	
N	68,000	68,000	68,000

Recap: Productivity and Reallocation Effects

Productivity outcomes in post-flood periods:

- Exit ↑ in general, but more for low-TFP plants
- General effects on labor productivity of plants in flooded areas are not statistically significant
- Labor productivity for plants w/ capital retirement in the flood year ↑ (but not in value added)
- Aggregate dispersion of output/capital declines; productivity effect is not statistically significant

Table 10: On average, post-flood reallocation enhances productivity

	IQR of Log(Output/Capital stock)	Log(Output/Hour)
Post flood	-0.014*	0.011
	(0.009)	(.016)
N	131,000	21,500

Robustness in Productivity effects

- Each measure of productivity can pick up different sources:

$$\ln\left(\frac{Output}{Labor}\right) = \ln\left(\frac{TVS}{Deflator}\right) - \ln(Labor)$$

$$\ln\left(\frac{ValueAdded}{Labor}\right) = \ln\left(\frac{TVS + \Delta Inventory}{Deflator}\right) - \ln\left(\frac{EnergyCosts}{Deflator_E}\right) - \ln\left(\frac{MaterialCosts}{Deflator_M}\right) - \ln(Labor)$$

$$\ln(TFP) = \ln\left(\frac{TVS + \Delta Inventory}{Deflator}\right) - \alpha_K \ln\left(\frac{CapitalCosts}{Deflator_K}\right) - \alpha_E \ln\left(\frac{EnergyCosts}{Deflator_E}\right) - \alpha_M \ln\left(\frac{MaterialCosts}{Deflator_M}\right) - \alpha_L \ln(Labor)$$

⇒ Not consistent use of measures and lacking robustness make it hard to interpret

- Is it true productivity improvement or something else?

⇒ Increases labor or VA productivity could be driven by capital deepening, not necessarily indicates improvement in productivity/efficiency (Syverson 2011); Any labor reductions after flooding?

⇒ Any effects through price heterogeneity or markups? (Foster et al. 2008, Syverson 2011)

Aggregate Implications

- The aggregate results seem subtle and may mask important dynamics
- Would be useful to decompose aggregate productivity changes into entry, exit, within-plant improvements and reallocation to investigate the relative importance and allocative efficiency (Olley-Pakes decomposition or Foster et al. 2001, 2006)

$$\Delta P_{st} = \underbrace{\sum_{f \in \mathbf{C}} \omega_{ft-1} \Delta P_{ft}}_{\textbf{within} \text{ term}} + \underbrace{\sum_{f \in \mathbf{C}} (P_{ft-1} - P_{st-1}) \Delta \omega_{ft}}_{\textbf{between} \text{ terms}} + \underbrace{\sum_{f \in \mathbf{C}} \Delta P_{ft} \Delta \omega_{ft}}_{\textbf{cross/covariance} \text{ terms}} + \underbrace{\sum_{f \in \mathbf{N}} \omega_{ft} (P_{ft} - P_{st-1})}_{\textbf{entry} \text{ terms}} - \underbrace{\sum_{f \in \mathbf{X}} \omega_{ft-1} (P_{ft-1} - P_{st-1})}_{\textbf{exit} \text{ terms}}$$

$\Rightarrow$ How is the aggregate change in productivity accounted for by each term?

Post-entry performance after floods

- Positive selection of entrants after floods, but how about their post-entry performance?
- The answer is unclear given the following results:
  - Entrants/young plants invest in second-handed capital after floods
  - The use of second-handed capital does not help for productivity or survival

$\Rightarrow$ How can we evaluate the reallocation of (used) capital from incumbents to young firms after floods? What would be the right policy to help with it?

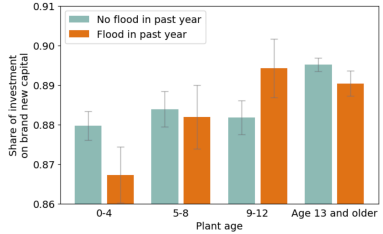

Table 9: Purchase of used capital and young plants' performance

	Entrant Plants (all single & multi-unit firms)			Small Young Firms
	Log(Output/hour)	Survival (Max age observed)		Log(Output/hour)
	(1)	(2)	(3)	(4)
Post flood	0.026	0.462	0.883	0.122**
	(0.0534)	(1.036)	(1.037)	(0.051)
Used machine	-0.026	-0.799		0.076
	(0.043)	(0.618)		(0.048)
Post flood X Used machine	0.0689	-0.769		-0.101*
	(0.051)	(0.799)		(0.06)
Used capital			-0.462*	
			(0.608)	
Post flood X Used capital			-1.455*	
			(0.819)	
N	5,300	5,300	5,400	7,800

Some other comments

- Contemporaneous capital retirement may not necessarily be a proxy for physical damage
  - It may rather reflect the responsiveness of plants for a given magnitude of shocks
  - Pre-trend pattern exists for their investment
  - The interpretation is likely an upper bound of the damage-replacement channel
- Any heterogeneity across “firms”?
  - The main analysis is conducted primarily at the plant level
  - Examining heterogeneity across “firms” would also be informative
  - All else equal, does the response of plants to the shock vary by firm characteristics?
  - Firm age, size, asset, and the number or geographic distribution of plants may play a role
  - Can potentially use MOPS to see the effect of managerial practices

Some other comments (cont'd)

- Direct evidence for financing mechanism
  - Non-declared events may have differences in flood severity or depend on president discretion
  - Can use the amount of federal assistance and directly interact with plant-level net investment, productivity, as well as the types of capital purchased (new vs used)
  - Any specific impacts on small/young firms?
- What if plants can forecast floods? Any variations across counties depending on flood frequency? Any relocation decisions of plants?

Conclusion

This paper:

- Provides new insights on the intersection of disaster response, capital allocation, and productivity
- Strengths lie in its rich data use, clear identification, and policy relevance

Comments: interesting paper asking an important question w/ great tools!

- Tightening empirical results and having a more thorough discussion of robustness will benefit it
- Explore productivity measures and robustness
- Clarify and strengthen the aggregate implications
- Investigate post-entry performance and the role of firm heterogeneity
- Direct evidence for financing mechanism