Dynamic Economic Impacts of Regional Flood Risks

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Introduction 1/2

Backgrounds

- Hashimoto and Sudo (2022): dynamic flood damage implications using a 2019 flood data and NGFS scenarios
- The paper mainly focuses on private capital roles on the economy
- Floods devastate private and public production factors, and the composition differs by region

Research Questions

- How much damages would a predicted maximum flood provide?
- How does regional heterogeneity affect macroeconomic damage?
- How does the delayed recovery of public infrastructure affect the recovery process?

Introduction 2/2

This paper: extends Hashimoto and Sudo (2022)

- Simulate economic damages by a predicted maximum flood
- Regional Heterogeneity with DSGE
- Counterfactural: Role of the public infrastructure in the recovery process

Literature

Flood Risks

- Deryugina et al. (2018); Ashizawa et al. (2022); Bakkensen and Barrage (2021); Fried (2021)

Climate change and stress testing of financial institutions

- Brainard (2021); Dunz et al. (2021)

Indirect damage caused by natural disasters

- Carvalho et al. (2020); Arrighi et al. (2021); Arosio et al. (2020); Hallegatte (2015)

Model 1/2

Hashimoto and Sudo (2022): Three channels

1. Damage to private capital stock
2. Deterioration of entrepreneurial balance sheets
3. TFP

We add:

4. Damage to public capital stock

Model 2/2: Add a public capital factor

$$Y_{g,t} = \frac{Z_{a,t} A_{a,t}}{\Omega(e_{fdr_t})\Omega^g(e^g_{fdr_t})} \Phi_t^{\gamma} \left[L_t^{\alpha}\right]^{1-\gamma} \left[\left(\left(1 - fdr_t\right) K_{t-1} U_t\right)^{1-\alpha-\alpha_E-\alpha_{FI}}\right]^{1-\gamma} - F_t$$

$$e_{fdr_t} = \rho_{fdr} e_{fdr_{t-1}} + fdr_t$$

$$e^g_{fdr_t} = \rho^g_{fdr} e^g_{fdr_{t-1}} + fdr^g_t$$

where

$$\Omega(e_{fdr_t}) = \exp(\theta_{fdr} e_{fdr_t})$$

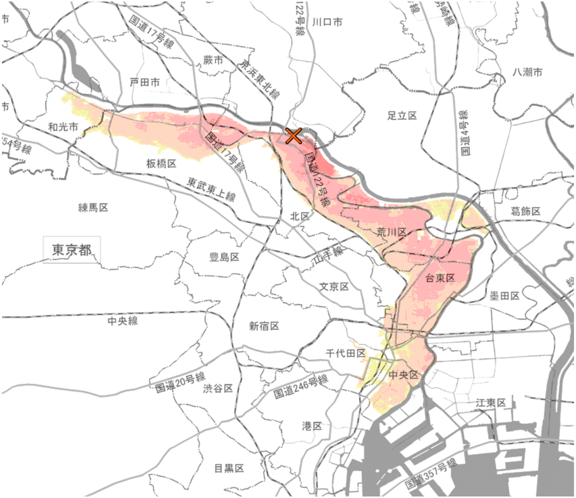
$$\Omega^g(e^g_{fdr_t}) = \exp(\theta^g_{fdr} e^g_{fdr_t})$$

fdr^g_t: exogenous shock to the public capital
$\theta^g_{fdr_t}$: express the sensitivity of flood damage to TFP shocks

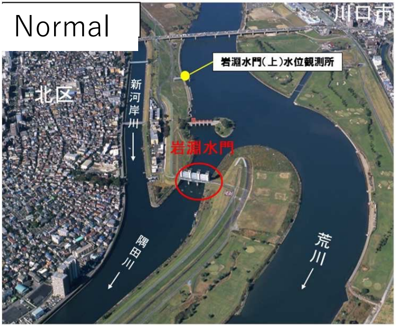
→ **need private and public damage data for simulations**

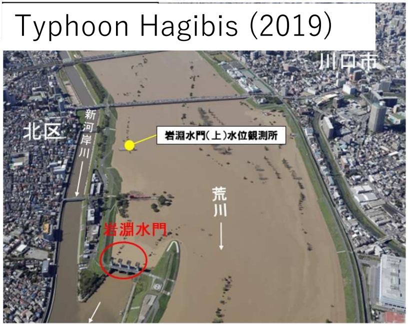
Data 1/2: Predicted maximum flood in Arakawa river

- Direct property damage: about 25 trillion JPY



Typhoon Hagibis (2019): The levee protected capitals





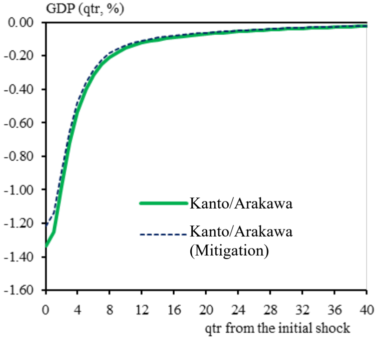
Data 2/2: Public/Private Damage Ratio by Region

Region	River	Private (trillion JPY)	Public (trillion JPY)	Public/ Private (%)
Tohoku	Abukuma	0.13	0.12	97.6
Kanto	Tone·Edo	12.2	3.6	29.1
Hokuriku	Shinano	1.2	0.5	38.2
Chubu	Shonai	2.9	1.4	49.4
Kinki	Yamato	4.2	2.1	50.0
Chygoku	Takahashi	1.2	0.5	46.3
Shikoku	Yoshino	0.8	0.7	89.3
Kyushu	Chikugo	0.1	0.1	97.0

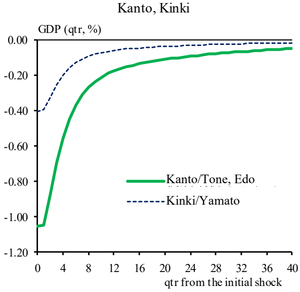
Result 1: Predicted maximum flood in Arakawa

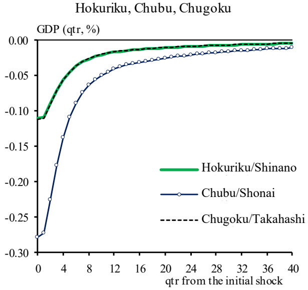
		Arakawa	Arakawa (Mitigation)	R1 Typhoon
GDP Loss	1 year	-5.91	-5.37	-0.51
	3 year	-8.91	-8.06	-0.85
	5 year	-9.97	-9.00	-0.99
	10 year	-11.19	-10.07	-1.19

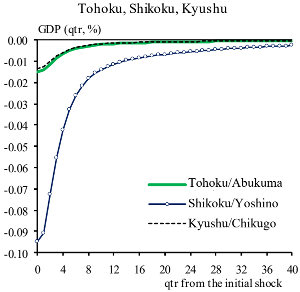
(trillion JPY)



Result 2-1: Regional Heterogeneity

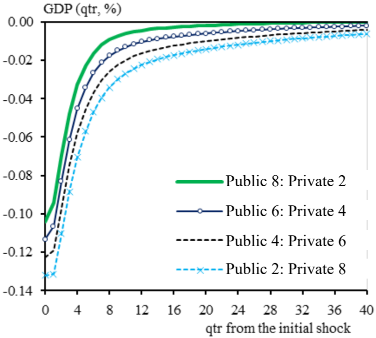






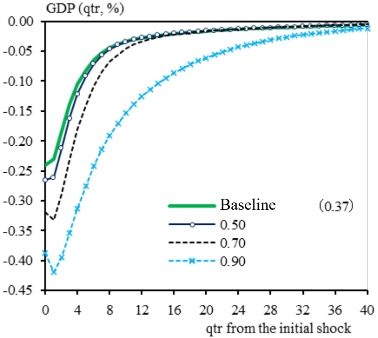
Result 2-2: Composition of private and public capital stock

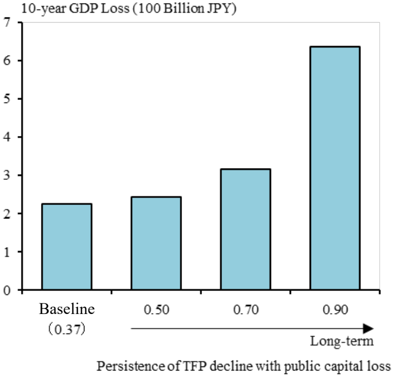
- Maintain a constant total damage and allocate the damage proportionally to each capital stock
- Damage to private capital stock has larger effects
  - TFP and balance sheet cause downward pressure on GDP



Result 3: Delayed Recovery of Public Infrastructure

- Change ρ^{g}_{fdr} to discuss the recovery speed of public capital
  - financial constraints, supply constraints of construction industry
- Quick restoring public capital stock is important





Conclusion

- The economic effects of a catastrophic flood event
- The regional heterogeneity
- The role in private and public capital

Future

- production networks that differ by region
- nonlinearities

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