Cascade Regimes and Corridor Backbones in Indonesia's Production Network

Ardian Maulana Hokky Situngkir
[2] Bandung Fe Institute, West Java, Indonesia
*) Correspondence: Ardian Maulana (ardianmaulanaeff@gmail.com)

Keywords: intranational MRIO; cascading failures; systemic risk; corridor networks

Extended Abstract

Motivation. Local disruptions in production systems can escalate into economy-wide failures when supply-chain dependencies transmit shocks across sectors and regions [1]. This is especially relevant for Indonesia, where an archipelagic spatial structure and uneven economic concentration may shape how disruptions spread. Existing MRIO studies describe interregional dependence well, but most remain essentially static and do not capture threshold effects, cumulative exposure, or abrupt shifts between contained and systemic cascades [2,3,4]. This study asks how robustness changes shift Indonesia's province–sector production network between fragile and resilient cascade regimes, and whether interprovincial contagion is routed through persistent corridor backbones linked to core–periphery structure [5].

Approach and Methodology. Using the 2016 Indonesian IRIO table [6], we build a 578-node directed weighted province–sector network and simulate deterministic threshold cascades with cumulative exposure. A single robustness ratio, $\Omega = b/c$, governs buffering relative to shock severity. We summarize cascade size, large-cascade probability, and corridor routing across fragile, transition, and resilient regimes.

Results. Cascading failures within an intranational province–sector production network display nonlinear regime behavior and structured routing (Fig. 1a). The network exhibits a sharp regime shift from frequent large avalanches to mostly contained cascades, with a narrow near-critical band around $\Omega^* \approx 0.0432$ (Fig. 1b). Near and beyond this transition, aggregate vulnerability falls, but residual systemic hazard condenses into a shrinking set of catastrophic origins. Across the full robustness scan, sector rankings are more persistent than province rankings, with Processing/Manufacturing, Construction, Wholesale and Retail Trade, and Transportation and Warehousing forming the most influential functional tier. Interprovincial propagation is concentrated in a stable mesoscale corridor backbone rather than diffusing uniformly (Fig 1c-d). Jakarta is the dominant province source, Processing/Manufacturing the dominant sector source (Table 1), and these roles align strongly with rich-core density and economic scale, indicating a core–periphery transmission structure [2,6].

Conclusions and Outlook. Systemic risk in Indonesia's production network is governed by both a tipping-like regime shift and persistent corridor backbones. Robustness mainly rescales traffic on existing routes rather than rewriting the routing map. Future work will incorporate heterogeneous buffering and evaluate nodes' critical fragility and exposure

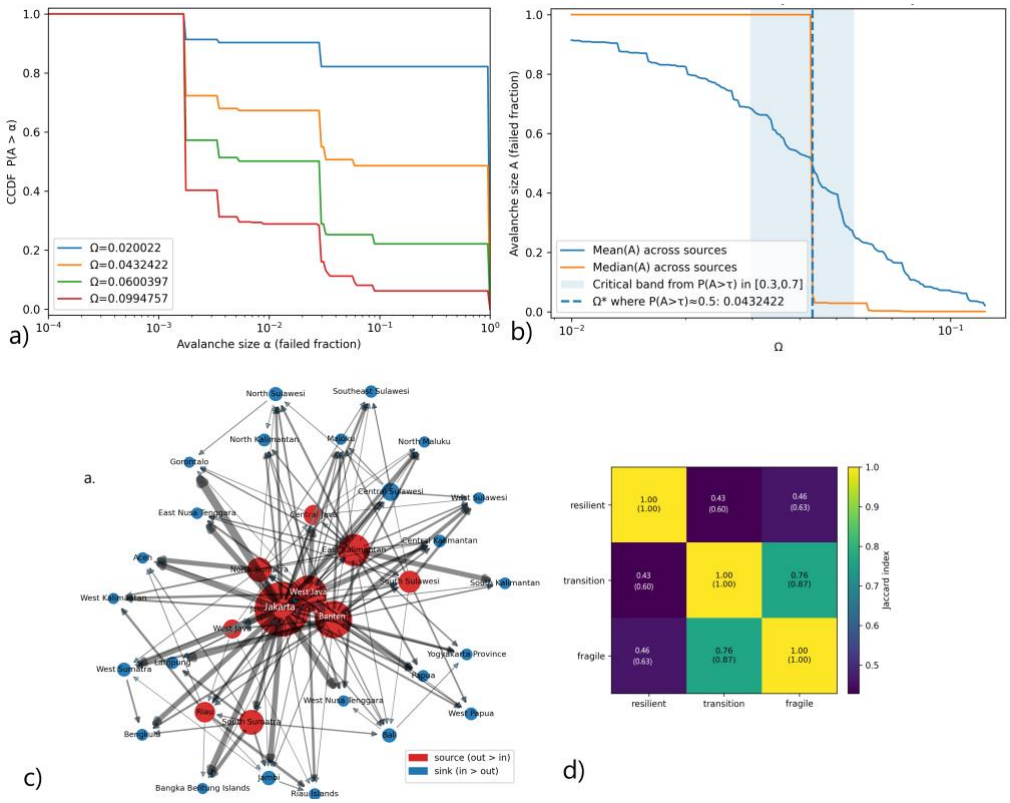

Figure 1 **Cascade regime transition and corridor backbone. (a)** Avalanche-size CCDFs at selected robustness levels. **(b)** Mean and median avalanche size and large-cascade probability, showing the tipping point and near-critical band. **(c)** Transition-regime province corridor network. **(d)** Overlap of top-30 corridor sets across regimes.

Table 1 Selected sector source and sink roles across robustness regimes in the interprovincial corridor network, measured by net corridor balance.

sector	Resilient		Transition		Fragile	
	role	Net strength	role	Net strength	role	Net strength
Processing Industry	source	8.90	source	55.67	source	122.47
Mining	source	0.07	sink	-0.11	sink	-1.11

References

[1] D. Acemoglu, V. M. Carvalho, A. E. Ozdaglar, and A. Tahbaz-Salehi, “The Network Origins of Aggregate Fluctuations”. In: Econometrica 80.5 (2012), pp. 1977–2016.
[2] M. G. Alatriste-Contreras and G. Fagiolo, “Propagation of economic shocks in input-output networks: A cross-country analysis”. In: Physical Review E 90 (2014).
[3] M. Gomez, S. Garcia, S. Rajtmajer, C. Grady, and A. Mejia, “Fragility of a multilayer network of intranational supply chains”. In: Applied Network Science 5.1 (2020).
[4] K.-M. Lee, J.-S. Yang, G. Kim, J. Lee, K.-I. Goh, and I. Kim, “Impact of the Topology of Global Macroeconomic Network on the Spreading of Economic Crises”. In: PLoS ONE 6.3 (2011), e18443.
[5] A. Maulana, P. Pradono, A. F. Aritenang, and H. Situngkir, “Hierarchical Structure of Inter-Regional Input-Output Network: A Multilayer Approach”. In: Complex Networks and Their Applications (2024), pp. 342–350.
[6] Statistics Indonesia (BPS), “Interregional Input–Output Tables of Indonesia 2016”. Statistics Indonesia (Badan Pusat Statistik), 2021.