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# Connected Trade Flows: A Spatial Econometric Approach

## How Trade Networks Endogenize Trade Costs and Amplify Pair-Specific Heterogeneity

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### Abstract

This paper proposes a microfoundation-based econometric specification and estimation framework for a gravity equation of *connected* trade flows, grounded in the network-leveraging behavior of cross-sectional units. Focusing on how countries utilize trade networks as a resource, we endogenize trade costs as a function of network structure, where the conventional iceberg cost emerges as a special case when countries do not leverage their network connections. The network-leveraging behavior induces interdependence among trade flows and amplifies pair-specific heterogeneity. We show that this interdependence can be effectively modeled using a spatial autoregressive framework. For estimation, we extend the Poisson Pseudo Maximum Likelihood Estimator to account for network dependence and propose robust inference procedures that allow for heteroskedasticity and arbitrary correlation structures in the errors. Monte Carlo simulations demonstrate the consistency and reasonable nominal coverage of our proposed estimator.

In the empirical application, we identify significant and evolving network effects across four key phases of global trade: Phase 1 (1986, trade liberalization), Phase 2 (1997, active NAFTA implementation), Phase 3 (2007, emergence of the China trade shock), and Phase 4 (2016, expansion of global supply chains). Across all phases, trade between third-country pairs exhibits persistent positive spillovers, highlighting the reinforcing role of multilateral linkages and the growing interconnectedness of global trade networks. Yet, the pattern of interdependence evolves over time. During early liberalization (Phase 1), trade flows among shared exporters or importers behaved as substitutes, reflecting heightened competition as markets opened. With NAFTA's implementation (Phase 2), these relationships shifted toward complementarity, as regional integration deepened value-chain linkages. The rise of China (Phase 3) reintroduced competitive dynamics, generating renewed substitution and crowding-out effects. By 2016 (Phase 4), these interactions had stabilized, suggesting a balance between competition and complementarity under mature global supply chains.

**Keywords:** Origin-destination flows, international trade, gravity equation, network leveraging behavior, endogenous trade costs, pair-specific heterogeneity, spatial autoregressive model, Poisson pseudo-maximum likelihood estimation.

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