Research Statement

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My research interests are in time series econometrics and (international) macroeconomics. In particular, I am interested in the relation between economic dynamics and networks. Networks summarize bilateral connections among cross-sectional units and, as a result, embody some notion of distance between them. They are omnipresent in (macro)economics. For example, countries are linked through global supply chains, capital flows, geopolitical and cultural ties, cities and regions are tied together by infrastructure and migration, industries connect via input-output linkages and R&D transferability, and individuals are linked by acquaintance and attachment to social identity groups. Networks have interesting implications for the evolution of variables at the cross-sectional level, even more so when they interact with heterogeneity in units' characteristics. In turn, they are themselves shaped by past behavior of the cross-section.

In my Job Market Paper (JMP), **"Cross-Sectional Dynamics Under Network Structure: Theory and Macroeconomic Applications"**, I develop an econometric framework to study the dynamics of a cross-section linked by a network of bilateral ties. It consists of a vector autoregression (VAR) in which innovations transmit cross-sectionally via bilateral links and which can accommodate general patterns on how innovations travel through the network over time, i.e. how network-connections of higher order accumulate as time progresses. In contrast to existing literature,[1] I consider lagged rather than contemporaneous network interactions and I am interested in studying dynamic, contagion-like innovation transmission through the network.[2] To do so, I generalize the time profile of network effects and analyze how it shapes the time series properties of the model. The Network-VAR (NVAR) is applicable whether or not network data is available. I discuss and illustrate each case with a respective application.

In the first application, I take the supply chain network of the US economy as given and document how it shapes the monthly dynamics of Producer Price Indices (PPI) across sectors. I show that the proposed NVAR indeed approximates the process of sectoral prices in an input-output economy with time lags in converting inputs to outputs. Existing macroeconomic literature uses contemporaneous input usage to document that the supply chain network amplifies firm- or sector-level shocks. In contrast, I use the NVAR to estimate the time profile of network interactions, which allows me to go beyond steady state comparisons and study transition dynamics induced by granular shocks. With network data given, inference on the timing of network effects boils down to a pooled-OLS-like regression with covariates that summarize lagged observations using network connections of different order.

The results suggest that sectors differ not only in the strength of their impact on aggregate prices, but also in its timing, with no clear relationship between the two. How quickly a shock in a sector

[1] For all references in this document, see my papers on my website: https://markomlikota.github.io.

[2] Under contemporaneous dependencies, network connections of all order play out simultaneously. As I discuss in the paper, this framework is useful for steady state comparsions, i.e. analyzing long-term effects of permanent shocks, but it is silent on how networks drive dynamics.

affects aggregate PPI is determined by the sector's importance as an immediate – as opposed to further upstream – supplier to relevant sectors in the economy. Owing to their position at the top of supply chains, the response to price increases in energy-related sectors is estimated as particularly slow (persistent).

In the second application, rather than taking the network as given, I use the NVAR to model industrial production growth across 44 countries by assuming and in turn estimating an underlying network as relevant for dynamics. This provides a novel perspective on global business cycles as it assumes that the dynamic comovement in economic activity across countries is the result of bilateral connections. The model yields a sparse, yet flexible way of approximating cross-sectional time series even in high dimensions. Sparsity is owed to networks' ability to summarize complex relations among units by relatively few non-zero bilateral links. Flexibility is obtained because the network is estimated and because, given a network, the model can accommodate different time profiles of network effects. Estimation is conducted by Least Squares with a Lasso penalty on network links.

My theoretical analysis reveals that the NVAR is expected to better capture cross-sectional dynamics than a factor model whenever they are composed of many micro links rather than driven by a few influential units. And indeed, in my application, the NVAR leads to reductions in out-of-sample mean squared errors of up to 20% relative to a principal components factor model, in particular for horizons up to six months. Furthermore, the model returns an estimate for the network as relevant for industrial production dynamics which is roughly in line with expectations and features the US as the most influential country. By explicitly modeling the dependence for any pair of countries, it estimates the whole set of spillover and spillback effects. Differences in these across country pairs are attributed to differences in network-connectedness of different order.

In **"Why Does a Dominant Currency Replace Another?"**, joint with A. Mehl and I. Van Robays, we are interested in explaining the marked increases in the use of the Euro at the expense of the US Dollar in European countries' invoicing of exports. Theory points to the importance of cross-country effects. Besides bilateral trade, these also include strategic complementarities in price setting between exporters from different countries, as well as a relation between a country's Euro-share of export invoicing and the Euro exchange rate volatilities in its destination markets. This defines a network between units characterized by geography as well as variable-type. Therefore, to test the theory and determine the drivers of the observed pheonomenon, we build a panel-VAR with 13 (non-Eurozone) European countries and three variables for each: the Euro-share of export invoicing, exports to the Euro area, and Euro exchange rate volatility. The insights from my JMP on the relation between dynamics and network connections carry over, although in this project we use lagged as well as contemporaneous interactions.[3] The analysis is in the same spirit as the first application in my JMP, since we are interested in the effect of bilateral ties on cross-sectional dynamics rather than generally modeling (and forecasting) the latter. Yet, we only take bilateral trade links as given. The remaining two types of connections are obtained by interacting the relevant bilateral trade statistic with parameters that capture the strength of each type of connection for the whole cross-section.[4] Estimating the latter is challenging because of spurious correlation issues

[3]Theory, as usual, uses contemporaneous network interactions. Because we are using low-frequency (annual) data, abstracting from contemporaneous interactions is not plausible.

[4]The stategic complementarity parameter is interacted with a measure of overlap in export destination markets,

due to trending variables. Our preliminary results suggest that the observed increases in Euro invoicing are primarily the result of reduced Euro exchange rate volatilities rather than increased trade with the Euro Area. Thereby, cross-country effects play an important role in moving the countries jointly away from US Dollar invoicing towards Euro invoicing.

In further projects, I worked on extending econometric methods to enable the analysis of pertinent questions in macroeconomics. In **"Sequential Monte Carlo with Model Tempering"**, joint with F. Schorfheide, we propose a method to substantially speed up Bayesian estimation of models with slow likelihood evaluations. This notably includes nonlinear Dynamic Stochastic General Equilibrium (DSGE) models, which are indispensable for many pressing questions in empirical macroeconomics and whose estimation is often considered practically infeasible. In **"SVARs with Occasionally-Binding Constraints"**, joint with S.B. Aruoba, F. Schorfheide and S. Villalvazo, we build a VAR which can accommodate the effective lower bound (ELB) on interest rates and use it to document a differing inflation response to monetary stimulus at and away from the ELB.

weighted by the respective market shares, while the impact of destination countries' Euro exchange rate volatilities on a country's Euro share of invoicing is scaled by their respective share in that country's exports.