Shock propagation channels behind the global economic contagion network The role of economic sectors and the direction of trade

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## Agenda

### Introduction

#### Materials and methods

The shock contagion network Trade openness network The basic model Model variants: upstream and downstream channels, sectors

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#### Results

Models with aggregate trade Models with sector-level trade Discussion

### **Motivation**

- With globalization, trade connections became increasingly important in channeling economic shocks between countries
- Hot topic: The economic consequences of the 2008 financial crises and the Covid-19 pandemic shed new light on the role of trade relations in spreading shocks between countries
- There is no general consensus in the literature whether trade relations are either significant (Haile and Pozo, 2018) or exclusive (Lee et al., 2011) channels for the spread of macroeconomic shocks
  - Some studies find that trade relations play an important role in spreading crises (Khan, 2018)
  - Others point to financial links as primary drivers of contagion (Grant, 2016; HernándezValdés, 2001)
  - Different channels can affect shock contagion in different ways (Leila, 2011)

### Literature

- A popular approach to capture shock-propagation between countries is analyzing the synchronization of their business cycles (Kose et al., 2003; Doyle and Faust, 2005)
- From a network perspective the business cycle synchronization gained special interest recently (Matesanz and Ortega, 2016; Antonakakis et al., 2016, Sebestyén and Iloskics, 2020)
  - Results show that synchronization across countries does not occur randomly, observed links develop systematically and reflect deeper economic mechanisms
  - One possible reason behind increased synchronization is globalization and the parallel increase in trade openness

### The aim of the research

- Several empirical studies have examined the effect of trade openness on business cycle synchronization (Canova and Dellas, 1993; Frankel and Rose, 1998, Kose and Yi, 2006; Inklaar et al., 2008; Baxter and Kouparitsas, 2006; Di Giovanni and Levchenko, 2010)
- The aim of the study to re-examine this issue between trade openness and synchronization
- We extend the analysis in three ways:
  - 1. Granger-causality approach to identify synchronization
  - A directed approach distinguishing between upstream (import) and downstream (export) contagion
  - 3. Sector-level decomposition of the shock propagation (trade) channels

# The shock contagion network



- Directed binary causal relationships between the business cycles of national economies (Sebestyén and Iloskics, 2020)
- Quarterly GDP data from the OECD countries except Turkey plus Bulgaria and Romania (1996-2019)
- Rolling time windows (52 quarters)
- Pairwise Granger causality estimation between the cyclical components (HP-filter) of country-level GDP series
- Nodes: 42 countries
- Links: if the GDP-cycle of a country affects (Granger-causes) another country

### Trade openness network



- Research question: whether the existence of the shock contagion links can be explained by bilateral trade volumes
- Trade volume of goods by sectors from UN Comtrade database (1996-2019)
- Averaged trade data over the periods (time windows)
- Nodes: 42 countries
- Links: trade volumes

Relationship between the degree centrality of the relative trade openness network and the shock contagion network



### The basic model

- The dataset on shock contagion and trade gains a time dimension (rolling time window)
- The units of observation are directed country-pairs for different time periods
- Panel-econometric framework to estimate the effect of trade links on shock contagion
- Binary dependent variable: fixed effect logit model

$$Pr(\boldsymbol{a}_{c,t}=1|\boldsymbol{x}_{c,t})=P(\alpha_{c}+\boldsymbol{x}_{c,t}^{\prime}\boldsymbol{\beta}), \quad (1)$$

where  $a_{c,t}$  is the binary dependent variable,  $\mathbf{x}_{c,t}$  is the vector of independent variables,  $\beta$  is the estimated coefficient vector,  $\alpha_c$  is the time-independent fixed effect and P(z) express the logistic distribution:  $P(z) = \{1 + exp(-z)\}^{-1}$ 

# Model variants: upstream and downstream channels, sectors

		How does trade enter on the right-hand side?						
		Aggregate trade			Sector-level trade			
		Two-way average (T <sub>c,t</sub> )	Upstream (U <sub>c,t</sub> )	Downstream (D <sub>c,t</sub> )	Two-way average (T <sub>c,t</sub> )	Upstream (U <sub>c,t</sub> )	Downstream (D <sub>c,t</sub> )	
In what combination	Only the key variable M plus controls	Model 1	Model 2B-u	Model 2B-d	Model 3B	Model 4B-u	Model 4B-d	
do variables enter on the right-hand side?	Key variable plus opposite direction plus controls	-	Mod	lel 2A	-	Model 5B		
	Key variable plus all other sectors in the same direction plus controls	-	-	Model 3A	Model 4A-u	Model 4A-d		
	All sectors in all directions plus controls	-	-	-	-	Мос	el 5A	

$$T_{c,t} = \frac{X_{jj,t} + X_{jj,t}}{2Y_{j,t}}, \qquad (2) \qquad \qquad U_{c,t} = \frac{X_{jj,t}}{Y_{j,t}}, \qquad (3) \qquad \qquad D_{c,t} = \frac{X_{ij,t}}{Y_{j,t}}, \qquad (4)$$

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# The share of the 10 sectors in total trade among the sample countries



ID	Name	ID	Name
0	Food and live animals	5	Chemicals and related products, n.e.s.
1	Beverages and tobacco	6	Manufactured goods classified chiefly by material
2	Crude materials, inedible, except fuels	7	Machinery and transport equipment
3	Mineral fuels, lubricants and related materials	8	Miscellaneous manufactured articles
4	Animal and vegetable oils, fats and waxes	9	Commodities and transactions, n.e.s

## Models with aggregate trade

y <sub>c,t</sub>	Model 1	Model 2A	Model 2B-u	Model 2B-d
T <sub>c,t</sub>	1.010309** (0.0052051)	-	-	-
U <sub>c,t</sub>	-	0.9990693 (0.0071911)	1.006458 (0.0051588)	-
$D_{c,t}$	-	1.010078 (0.0086875)	-	1.009577 (0.0062053)
GDPCap <sub>i</sub>	0.8874647*** (0.0226883)	0.8876793*** (0.0227075)	0.8907022*** (0.0227005)	0.8874509*** (0.0225769)
GDPCap <sub>j</sub>	1.152534*** (0.0325587)	1.15319*** (0.0327404)	1.147854*** (0.0321268)	1.153347*** (0.0325802)
Popi	0.9848761*** (0.0056498)	0.9852538** (0.0056001)	0.9851711** (0.0056486)	0.9851722** (0.0055745)
Pop <sub>j</sub>	1.06074*** (0.0107065)	1.060491*** (0.0106602)	1.060582*** (0.010671)	1.060542*** (0.0106651)
Observations	38388	38388	38388	38388
Pseudo R <sup>2</sup>	0.0308	0.0312	0.0298	0.0312

Robust standard errors in parentheses, \* \* \* < 0.001, \* \* < 0.05, \* < 0.1

- Aggregate two-way trade has a positive significant effect on shock contagion
- Significance is lost if we divide aggregate trade into upstream and downstream directions

### Models with sector-level trade (two-way trade)



- When two-way trade is disaggregated into broad sectors, the overall positive effect can be traced back to some sectors
- Food and live animals (0), machinery and transport equipment (7) and miscellaneous manufactured articles (8) are significant channels for shock-transmission
- Chemicals and related products (5) have a negative effect, thus contributing more to the diversification of risks

## Models with sector-level trade (upstream)



- When we disaggregate sectoral trade into upstream and downstream directions, these results are further shaded to some extent
- Food and live animals (0) prove to be a significant and the most robust upstream shock transmission channel
- Machinery and transport equipment (7) and miscellaneous manufactured articles (8) seem to transmit shocks upstream

### Models with sector-level trade (downstream)



 Machinery and transport equipment (7) and miscellaneous manufactured articles (8) also transmit shocks downstream

- The most robust results are obtained for machinery and transport equipment (7)
- The negative effect of chemicals and related products (5) on shock-propagation is visible in both channels, but these results are not very robust

# Discussion (1)

The results contribute to the literature in two interconnected ways

- First, by revealing that the overall positive effect found in aggregate two-way trade hides diverse behavior in specific trading sectors as well as upstream and downstream channels
- Second, by pointing out important and less important channels in this background
  - Some sectors are not significant channels of shock-transmission in either directions
  - Upstream channels seem to be important in agriculture
  - Downstream channels dominate machinery and other manufactures
  - There are sectors (chemicals and related products) trade in which negatively affects shock-transmission

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# Discussion (2)

Apart from the results, the approach has clear limitations as well

- The analysis only takes into account trade in goods as channels of shock-transmission (excludes services)
- Financial linkages may play an equally important role in shock-propagation
- More accurate results would be available if quarterly trade data were used—but in this case the time coverage has to be shortened
- Using rolling time windows it comes at the risk of merging otherwise heterogeneous time-periods into the same time window
- The estimation procedure builds on the assumption that trade relationships are exogenous to shock transmission, so the latter do not affect the former, however, we can not rule this option out (reverse causality)
- A considerable portion of the observations are dropped from the estimations due to the lack of variation in the dependent variable

### Thank you for your attention!

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Iloskics Z, Sebestyén T, Braun E (2021) Shock propagation channels behind the global economic contagion network. The role of economic sectors and the direction of trade. PLoS ONE 16(10): e0258309.



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Sebestyén T, Iloskics Z (2020) Do economic shocks spread randomly?: A topological study of the global contagion network. PLoS ONE 15(9): e0238626.