ASIA AND PACIFIC DEPARTMENT

China Spillovers:
Aggregate- and Firm-Level Evidence

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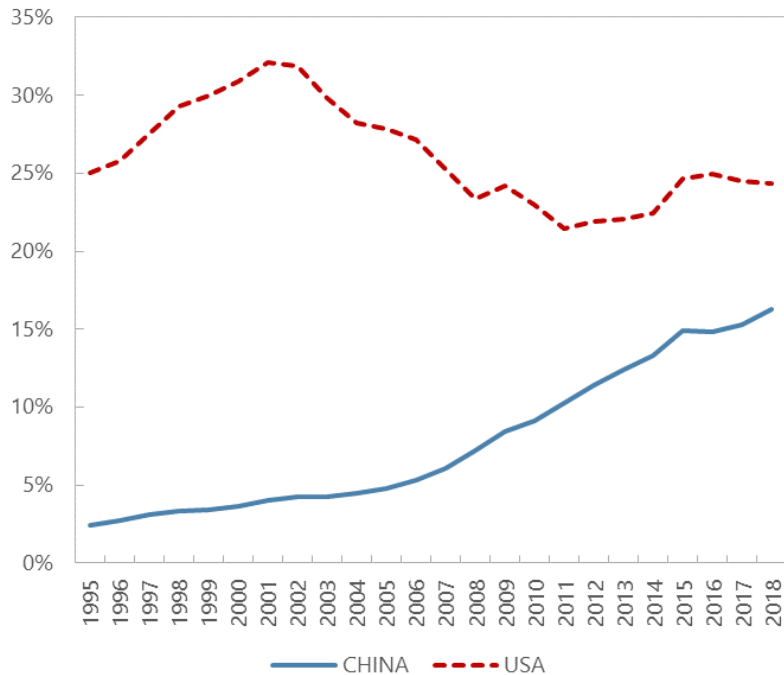

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China's Integration to the World Economy

China's share of global production has risen from 2 percent in 1995 to 16 percent in 2018
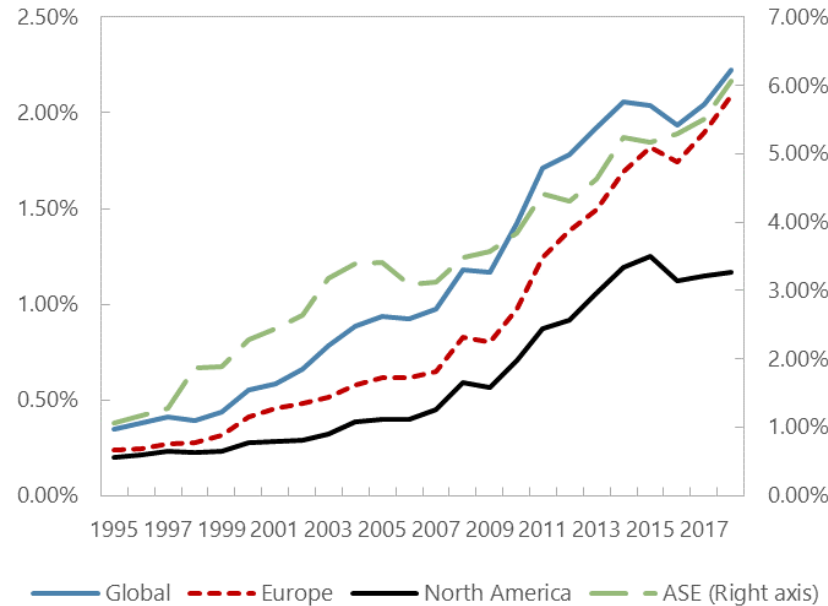
…while demand for manufacturing inputs, creating important linkages with the world

…and its economy has been growing faster than the rest of the world.

Share of global demand met by production in USA and China

Sources: OECD TiVA, IMF Staff calculations.

Share of output absorbed by Chinese domestic demand

Sources: OECD TiVA, IMF Staff calculations.

China and global growth 2001-2027
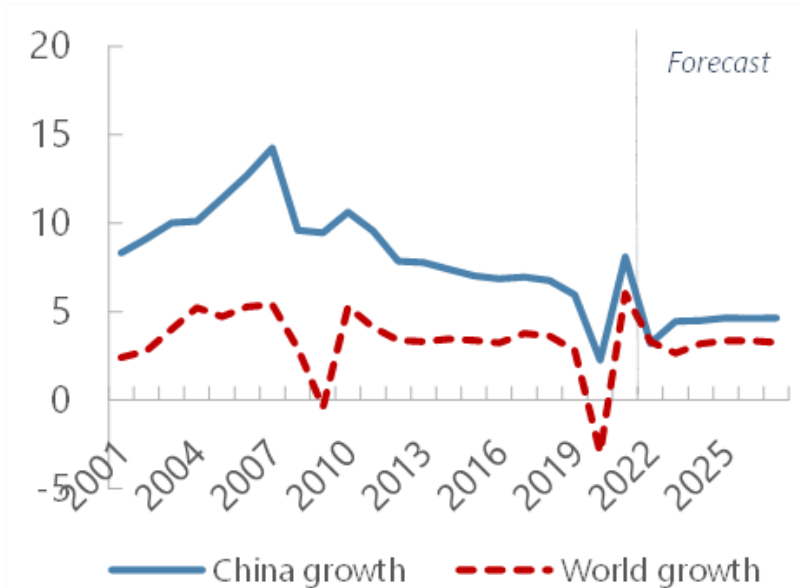
Sources: IMF WEO October 2022, IMF Staff calculations.

- Understanding the China spillovers and the role of trade exposure to China

- Growing literature on China spillovers at the aggregate level (e.g., Cashin and others (2016); Dizioli and other (2016); Duval and others (2014); Furceri and others (2017)), and very limited research on firm level (Ahuja and Nabar (2012); Iacavone, Rauch and Winters (2012)).

Contributing to this literature by providing new China demand/supply shocks and showing their aggregate and firm-level effects

- Documenting the China spillovers on countries and firms:
  1) Decomposing demand and supply shocks in China,
  2) How do China supply and demand shocks affect other **countries** differently?
  3) And how do **firms** respond to these shocks in other countries?

- Structural Vector Autoregression model:

$$A_0 y_t = b + \sum_{j=1}^{p} A_j y_{t-j} + e_t$$

  - y_t contains four variables: China Cyclical Activity of Economic Tracker, China inflation, global GDP growth, global inflation

  - A_0: Capturing the relationship between shocks and endogenous variables

  - b and e_t: Intercept and structural shocks

- The reduced form model:

$$y_t = c + \sum_{j=1}^{p} B_j y_{t-j} + u_t$$

- Using sign-restrictions on the relationship between e_t and y_t to identify $A_0 = Q \times \text{chol}(\Sigma_u)$

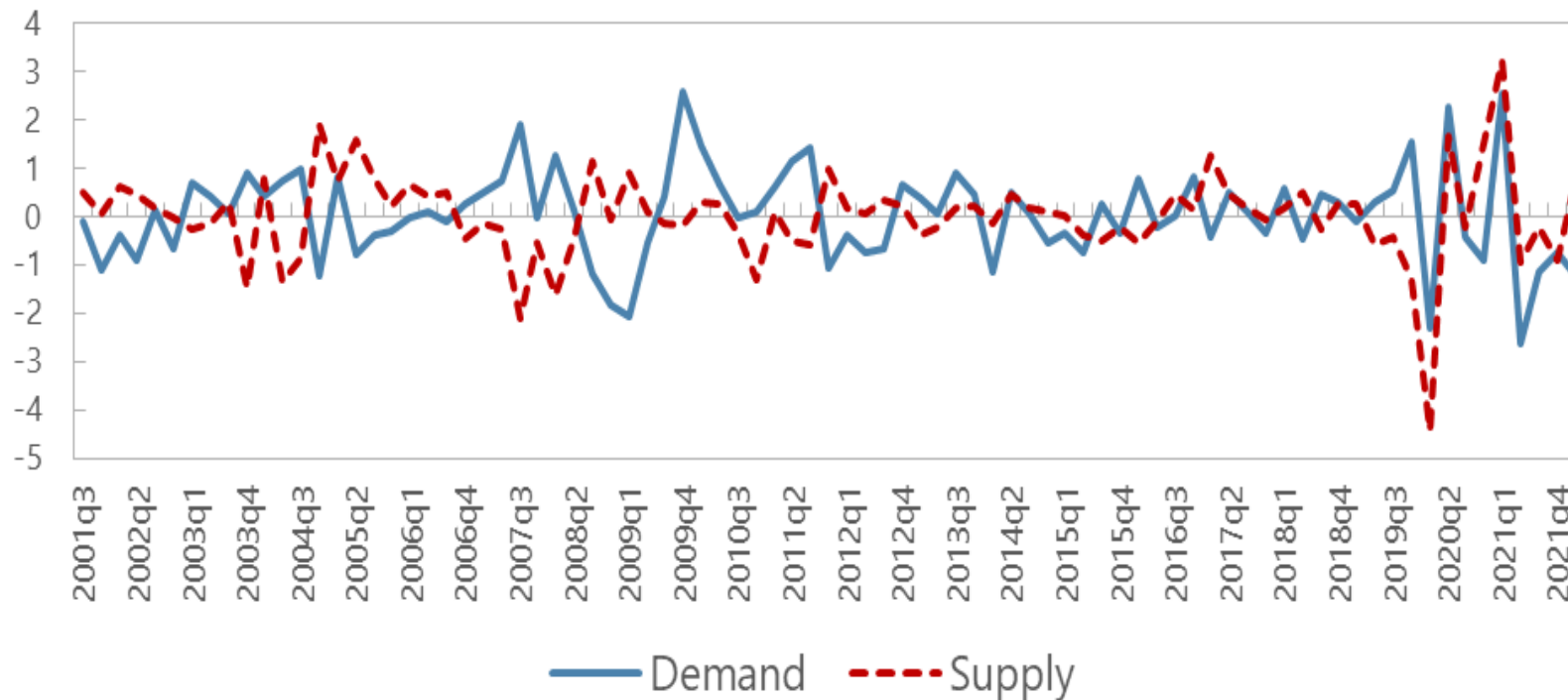# Identification of Demand and Supply Shocks

- The sign restrictions

Shocks: Variables:	Global Supply	Global Demand	Domestic Supply	Domestic Demand
Global GDP	+	+	0*	0
Global CPI	-	+	0	0
China Activity			+	+
China CPI			-	+
* Short-run zero restriction that applies to the first period of the shock.				

- Assuming that

  - **Demand** shocks move prices and quantities in the **same** direction

  - **Supply** shocks move prices and quantities in the **opposite** directions

  - Domestic shocks have **no impact** on global variables

    - To separate domestic and global demand/supply shocks

- **Demand shocks:** Primary driver of activity until recently

- **Supply shocks:** Playing a more prominent role since the pandemic

- Using a panel local projections model to estimate spillovers from China

$$y_{c,t+h} - y_{c,t-1} = \alpha_c + \rho t + \textcolor{red}{\beta_D^h} e_t^D + \textcolor{red}{\beta_S^h} e_t^S + \Gamma' X_{c,t} + \epsilon_{c,t+h}$$

  - ➢ $y_{c,t}$: Log GDP (and investment) in country c

  - ➢ e_t^D and e_t^S: Demand and supply shocks

  - ➢ α_c and t: Country fixed effects and time trend

  - ➢ $X_{c,t}$: Set of controls

- 50 advanced and emerging market economies

  - For 2001Q3-2019Q4

# Significant Spillovers from China

- **Shocks are scaled:** Corresponding to a decrease in China GDP by 1 percent
- **Demand shocks**
  - Moderate spillovers in the short-term
  - Stronger longer-term effects: 0.5 percent drop in GDP and 1.2 percent decline in investment
- **Supply shocks**
  - Effects are larger and more instant
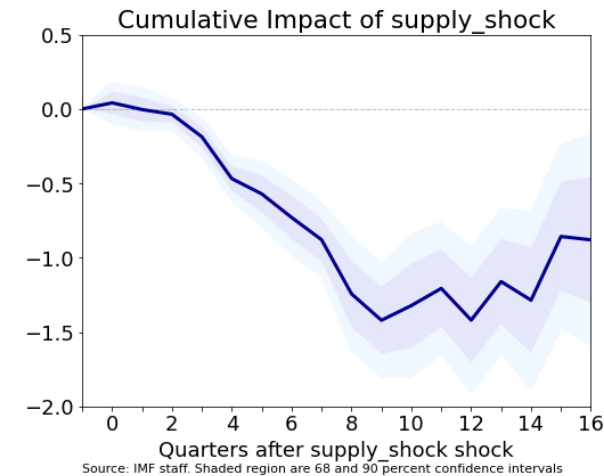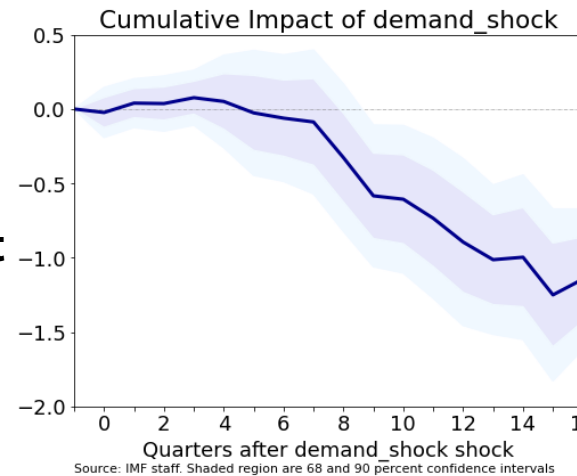 - 0.6 percent decline in GDP and 1.5 percent drop in investment
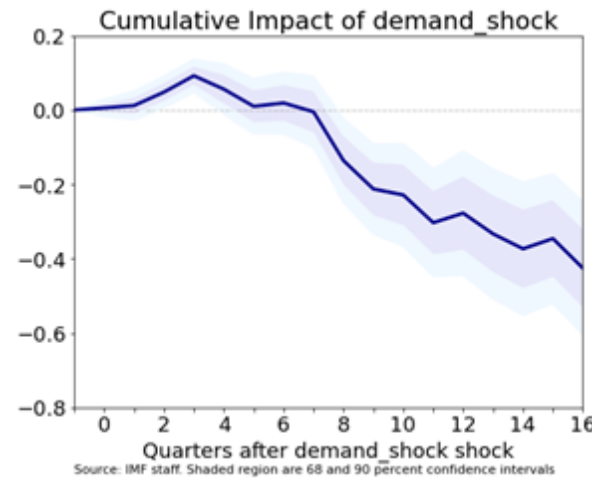
Demand Shocks

Supply Shocks

GDP
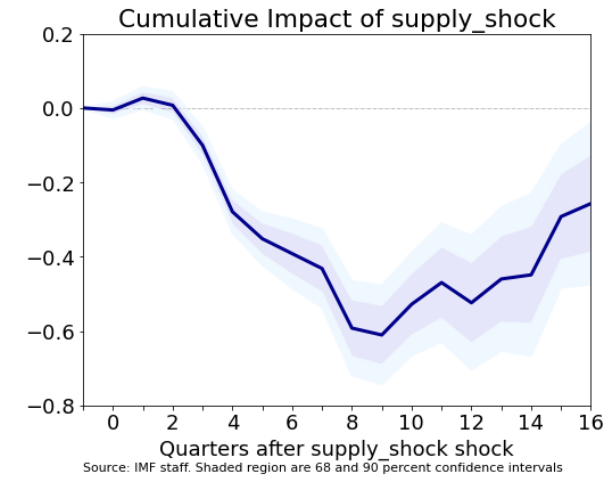
Investment

- Do spillovers **vary across countries** with export dependence on China?

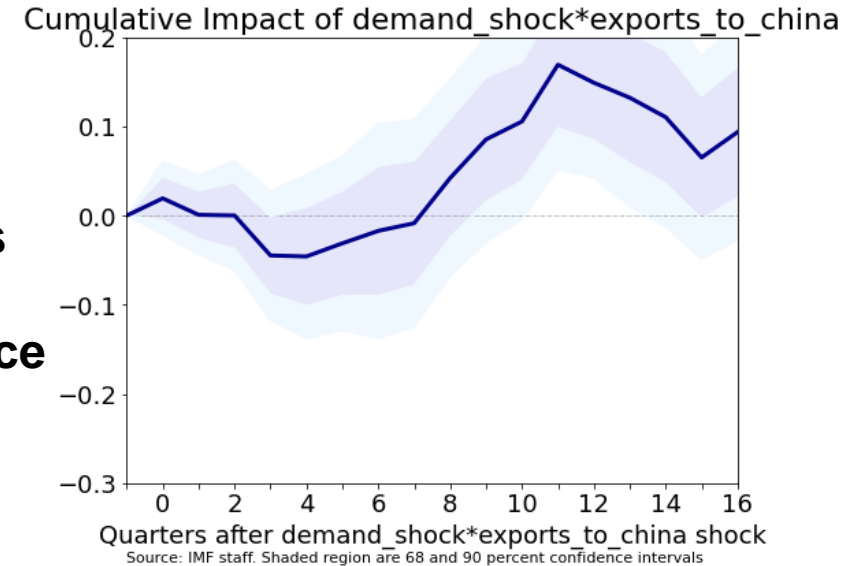- Examining using the following equation:

$$y_{c,t+h} - y_{c,t-1} = \alpha_c + \lambda_t + \beta_{DX}^h e_t^D EX_{c,t} + \beta_{SX}^h e_t^S EX_{c,t} + \mu^h EX_{c,t} + \Gamma' X_{c,t} + \epsilon_{c,t+h}$$

  ➢ $EX_{c,t}$: Exports to China from country c as a share of country's GDP

  ➢ α_c and λ_t: Country and time fixed effects

  ➢ $X_{c,t}$: Set of controls
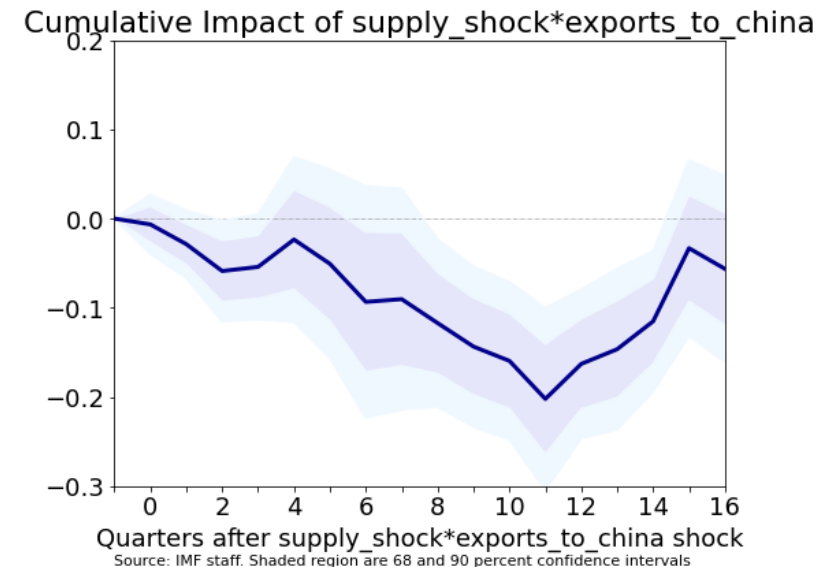
- Additional impacts from exposure to China

- **Demand shocks**
  - Limited role for export dependence to China

- **Supply shocks**
  - Strong and significant interaction with export dependence
  - 0.2 percent additional decline of GDP with higher export dependence

Demand Shocks
×
Export Dependence

Supply Shocks
×
Export Dependence

Cumulative Impact of demand_shock*exports_to_china

Quarters after demand_shock*exports_to_china shock

Source: IMF staff. Shaded region are 68 and 90 percent confidence intervals

Cumulative Impact of supply_shock*exports_to_china

Quarters after supply_shock*exports_to_china shock

Source: IMF staff. Shaded region are 68 and 90 percent confidence intervals

Firm-Level Spillovers

- Investigating the impact of China demand and supply shocks on **firm revenue** across **different countries and industries**

- Firm-level data source: S&P Capital IQ

  - Data availability at **quarterly** frequency

  - From 2001Q3 to 2019Q4 for 20,000+ firms

  - 62 countries (29 advanced, 33 emerging market and developing economies)

  - 20 different industries

  - **Variables of interest:** Firm revenue and capital expenditure

- First, estimating average effect of China shocks on firms

$$y_{cif,t+h} - y_{cif,t-1} = \alpha_{f,q} + \boldsymbol{\beta_D^h} e_t^D + \boldsymbol{\beta_S^h} e_t^S + \Gamma' X_{c,t} + \epsilon_{cif,t+h}$$

➢ $\boldsymbol{y_{cif,t}}$: Log revenue of firm *f* in industry *i,* and country *c*

➢ $\boldsymbol{\beta_D^h}$ and $\boldsymbol{\beta_S^h}$: Firm revenue response against demand and supply shocks

➢ $\boldsymbol{X_{c,t}}$: Controls of various aggregate variables
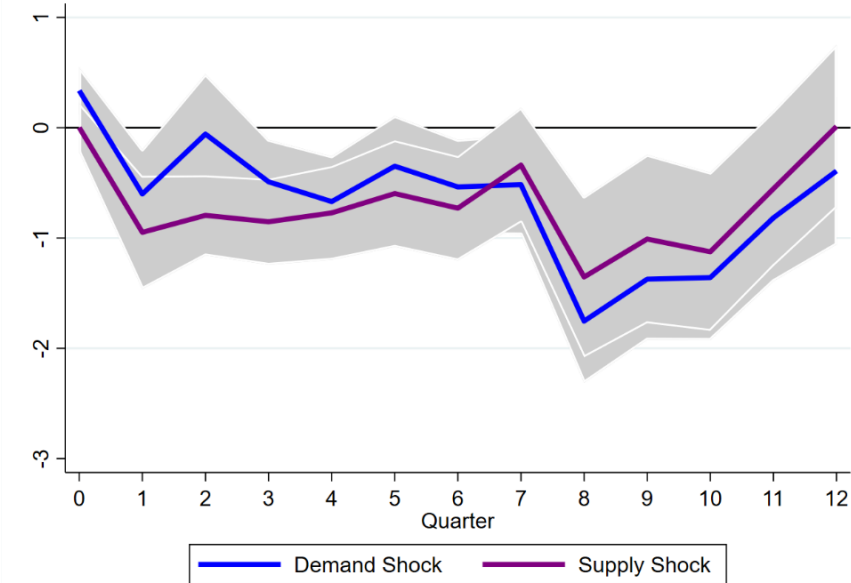
- **Revenue**

  - Significant and negative impacts of both demand and supply shocks
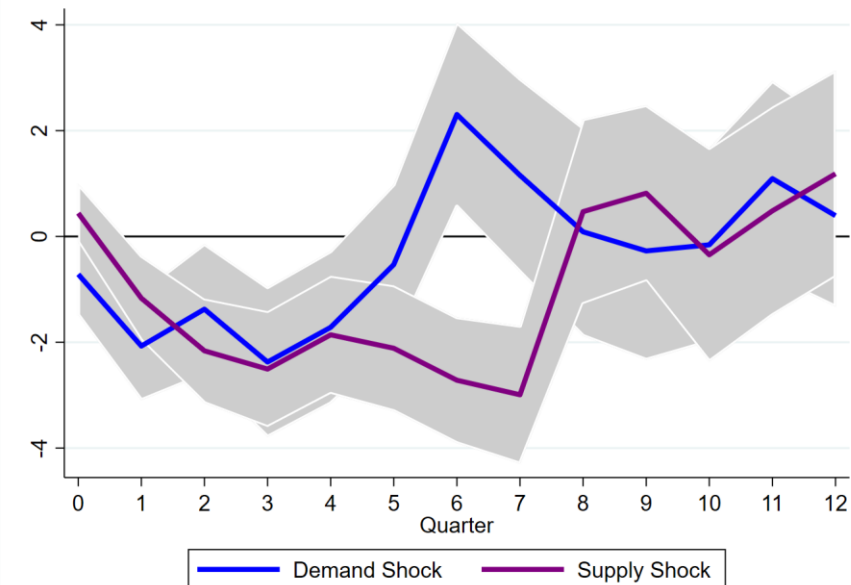
  - Persistent through 3 years

- **Investment**

  - More persistent effects from supply shocks

  - Less persistent impact on investment than revenue

Revenue

Investment

Multi Region Input Output Tables

- How does the impact of shocks vary with China dependence?

  - Using **MRIO tables** to analyze this question

  - Input-output linkages across **62 countries** in **35 sectors** between 2000 and 2019

- **Share of exports to China in total production in each country-industry**

$$EX_{ci,China,t} = \frac{\sum_j Sales_{ci \to China,j,t} + FinalDemand_{ci \to China,t}}{Production_{ci,t}}$$

- Detailed input and output exposure to China:

Share of total inputs to country-industry ci supplied by China

Share of total global demand for country-industry ci's products coming from China

$$Input_{ci,China,t} = \frac{\sum_j Sales_{China,j \to ci,t}}{\sum_d \sum_j Sales_{dj \to ci,t}}$$

$$Output_{ci,China,t} = \frac{\sum_j Sales_{ci \to China,j,t} + FinalDemand_{ci \to China,t}}{\sum_d \sum_j Sales_{ci \to dj,t} + \sum_d FinalDemand_{ci \to d,t}}$$

- Estimating variation in firm revenue responses with export dependence to China

$$y_{cif,t+h} - y_{cif,t-1} = \textcolor{red}{\beta_{DX}^h} e_t^D \boldsymbol{EX_{ci,China}} + \textcolor{red}{\beta_{SX}^h} e_t^S \boldsymbol{EX_{ci,China}} + \alpha_{f,q} + \alpha_{c,t} + \Gamma' X_{i,t} + \epsilon_{cif,t+h}$$

  ➢ $\boldsymbol{EX_{ci,China}}$: Median (across time) export dependence to China in country *c* and industry *i*
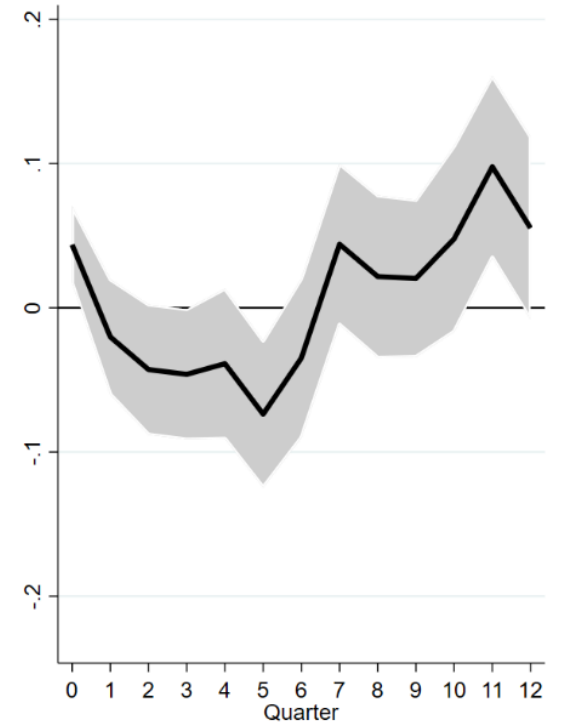
- **Following a negative demand shock:**
  - Firms operate in industries with higher export dependence to China, experienced a larger decline in revenue

- **Role of export exposure for supply shocks:**
  - Relatively less significant
  - Coefficient of interaction term is significant only through the 5th quarter and at a smaller size
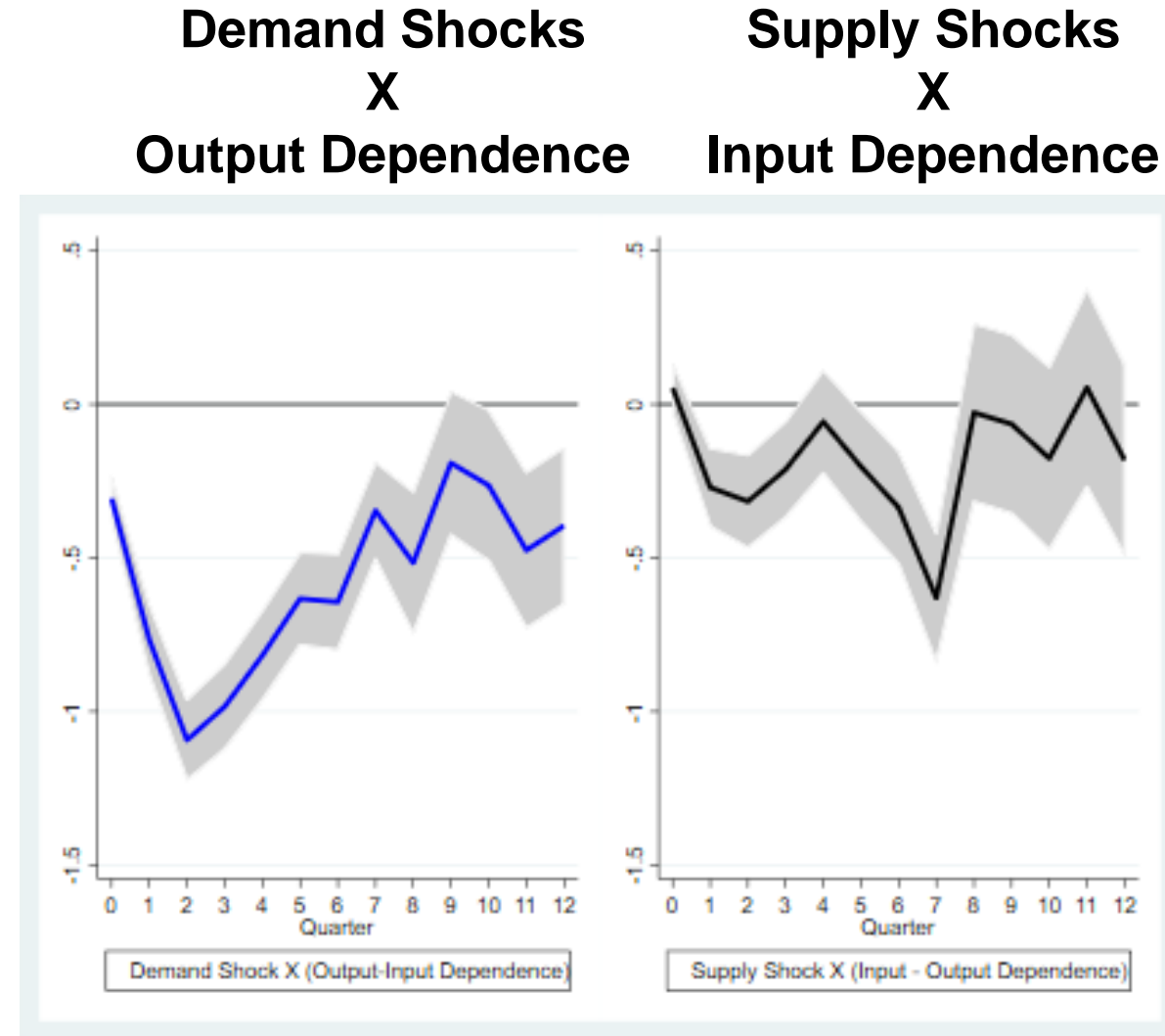
Demand Shocks
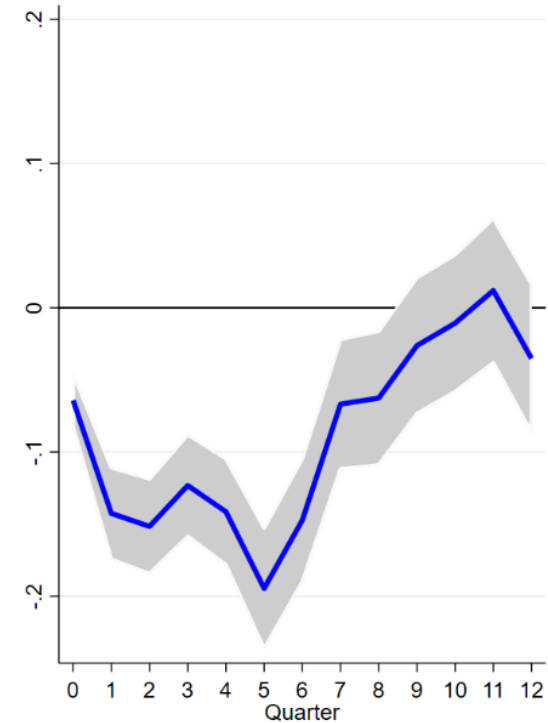
Supply Shocks

- Estimating variation in firm revenue responses with input-output linkages

$$y_{cif,t+h} - y_{cif,t-1} = \textcolor{red}{\beta^h_{D,Output}} e^D_t \boldsymbol{Output}_{ci,China} + \textcolor{red}{\beta^h_{S,Input}} e^S_t \boldsymbol{Input}_{ci,China} + \alpha_{f,q} + \alpha_{c,t} + \Gamma' X_{i,t} + \epsilon_{cif,t+h}$$

➢ $\boldsymbol{Output}_{ci,China}$: Median (across time) output dependence to China in country *c* and industry *i*

➢ $\boldsymbol{Input}_{ci,China}$: Median (across time) input dependence to China in country *c* and industry *i*

- **Following a negative China demand shock**
  - Higher output dependence > stronger adverse effects
- **Supply shocks** operate through input dependence

**Demand Shocks
X
Output Dependence**

**Supply Shocks
X
Input Dependence**

Summing Up

- Strong spillovers from China

  - Both through demand (more effective before the pandemic) and supply (increased importance of supply shocks since then) shocks

- Supply shocks are stronger and more persistent at macro level

  - Similar results for firm revenue

- Demand shocks operate through export exposure and output dependence to China

  - Documented with input-output tables

- Supply shocks are more effective for country-industry pairs with higher input dependence