



**ASIA AND PACIFIC  
DEPARTMENT**

# **CHINA SPILLOVERS: AGGREGATE- AND FIRM-LEVEL EVIDENCE**

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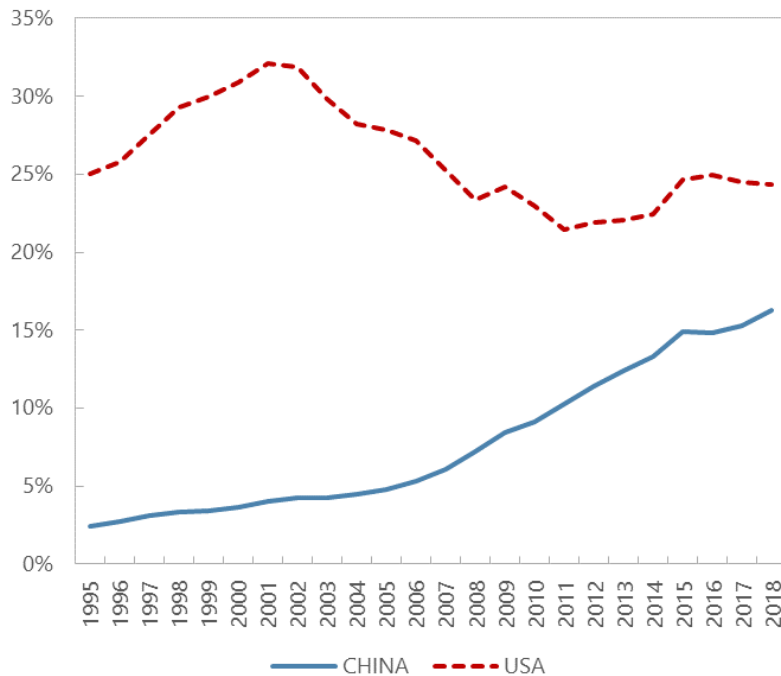
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**MAY 2023**

# China's Integration into the World Economy

China's share of global production has risen from 2 percent in 1995 to 16 percent in 2018

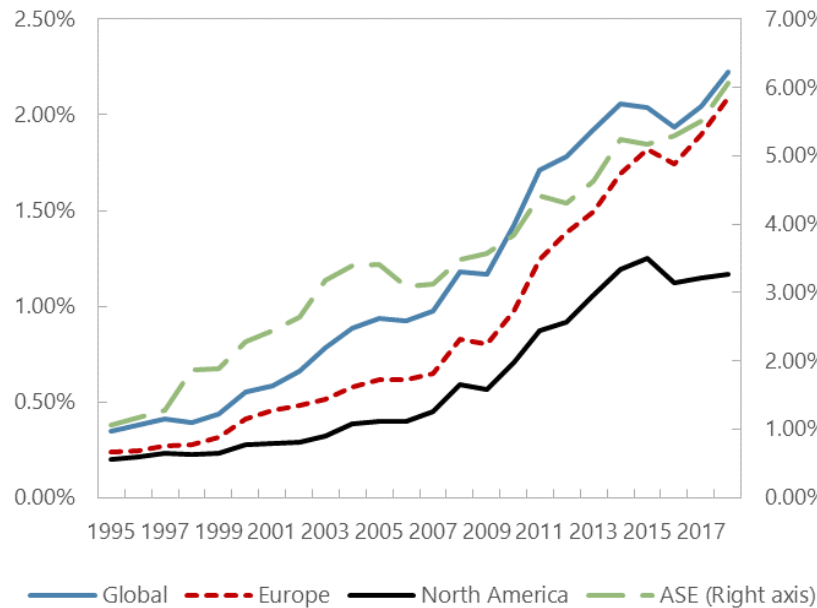
Share of global demand met by production in USA and China



Sources: OECD TiVA, IMF Staff calculations.

...while demand for manufacturing inputs, creating important linkages with the world

Share of output absorbed by Chinese domestic demand



Sources: OECD TiVA, IMF Staff calculations.

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

China and global growth 2001-2027



Sources: IMF WEO October 2022, IMF Staff calculations.

# Motivation & Research Questions

- 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?

# Identification of Demand and Supply Shocks

- Structural Vector Autoregression model:

$$\mathbf{A}_0 \mathbf{y}_t = \mathbf{b} + \sum_{j=1}^p \mathbf{A}_j \mathbf{y}_{t-j} + \mathbf{e}_t$$

- $\mathbf{y}_t$  contains four variables: China Cyclical Activity of Economic Tracker, China inflation, global GDP growth, global inflation
- $\mathbf{A}_0$ : Capturing the relationship between shocks and endogenous variables
- $\mathbf{b}$  and  $\mathbf{e}_t$ : Intercept and structural shocks

- The reduced form model:

$$\mathbf{y}_t = \mathbf{c} + \sum_{j=1}^p \mathbf{B}_j \mathbf{y}_{t-j} + \mathbf{u}_t$$

- Using sign-restrictions on the relationship between  $\mathbf{e}_t$  and  $\mathbf{y}_t$  to identify  $\mathbf{A}_0 = \mathbf{Q} \times \text{chol}(\Sigma_u)$

# Identification of Demand and Supply Shocks

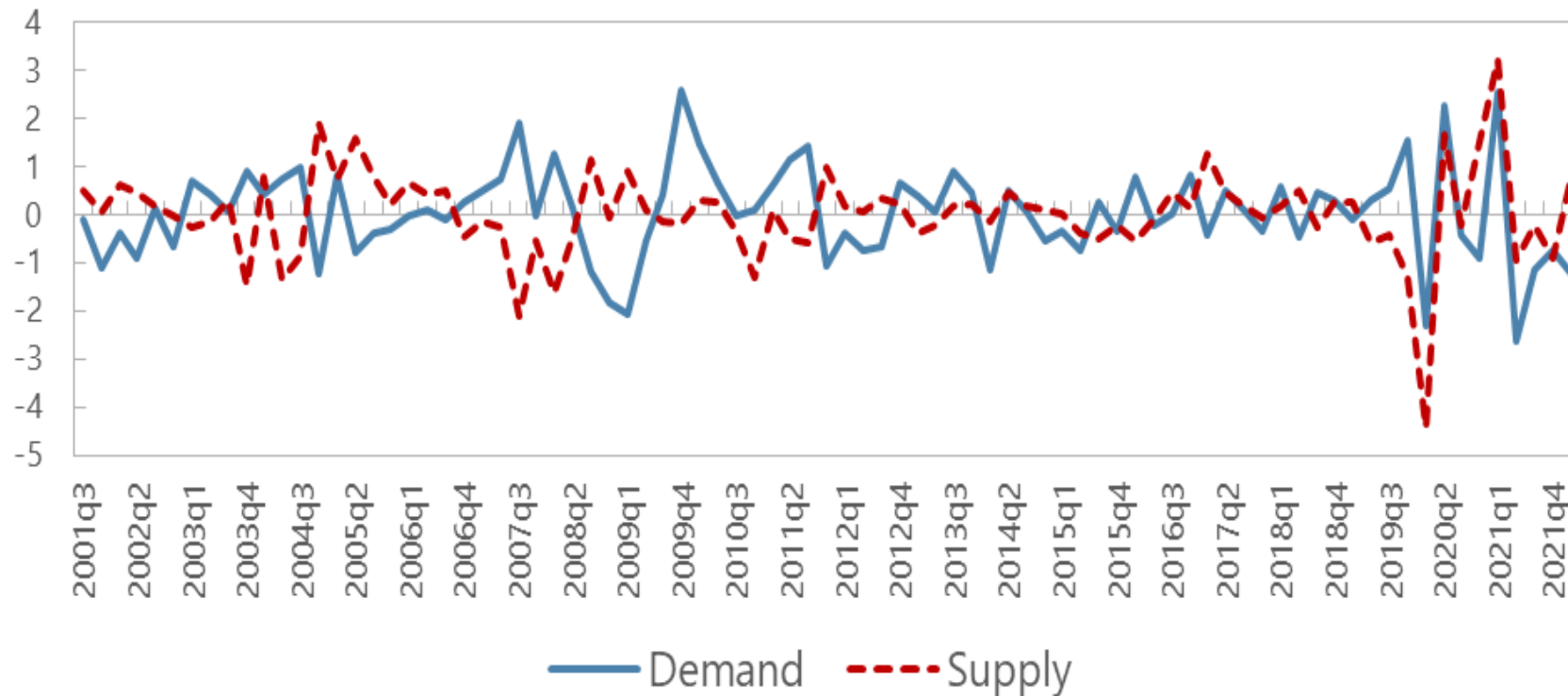
- The sign restrictions

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

# Structural Shocks from SVAR: Demand vs Supply

- **Demand shocks:** Primary driver of activity until recently
- **Supply shocks:** Playing a more prominent role since the pandemic



# Macro Spillovers: Specification

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

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

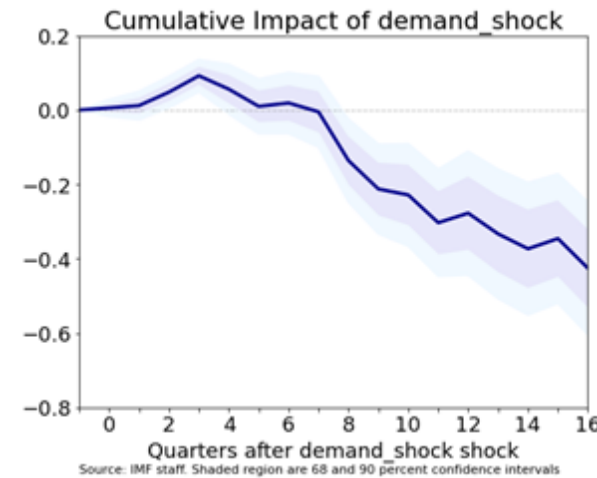
- $y_{c,t}$ : Log GDP (and investment) in country  $c$
  - $e_t^D$  and  $e_t^S$ : Demand and supply shocks
  - $\alpha_c$  and  $t$ : Country fixed effects and time trend
  - $X_{c,t}$ : Set of controls
- 50 advanced and emerging market economies
  - For 2001Q3-2019Q4

# Significant Spillovers from China

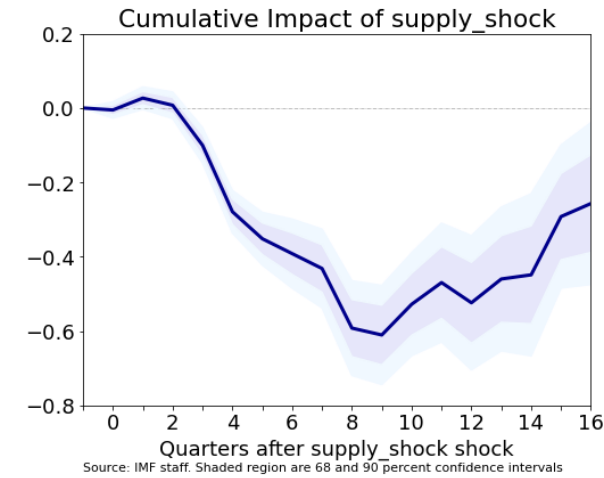
- **Shocks are scaled:** Corresponding to a **decrease** in China GDP by 1 percent
- **Demand shocks**
  - Moderate spillovers in the short-term
  - Stronger longer-term effects: 0.5 percent drop in GDP and 1.2 percent decline in investment
- **Supply shocks**
  - Effects are larger and more instant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

GDP

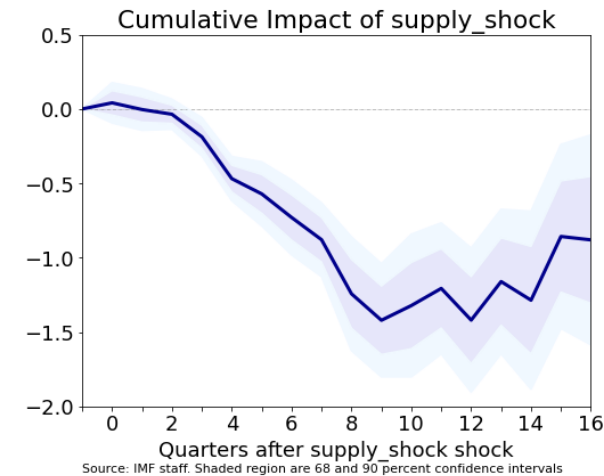
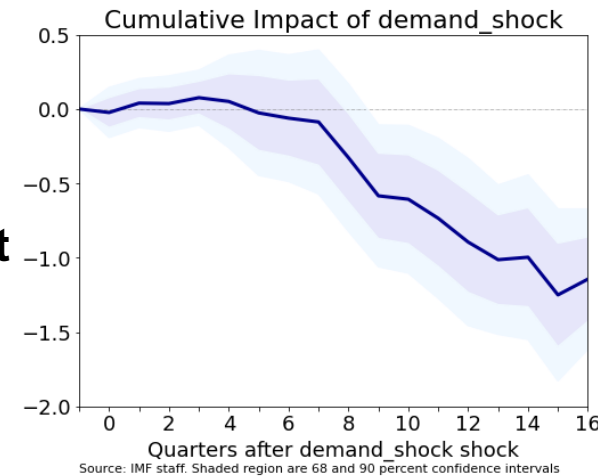
## Demand Shocks



## Supply Shocks



Investment





# Macro Spillovers Heterogeneity: Specification

- Do spillovers **vary across countries** with export dependence on China?
- Examining using the following equation:

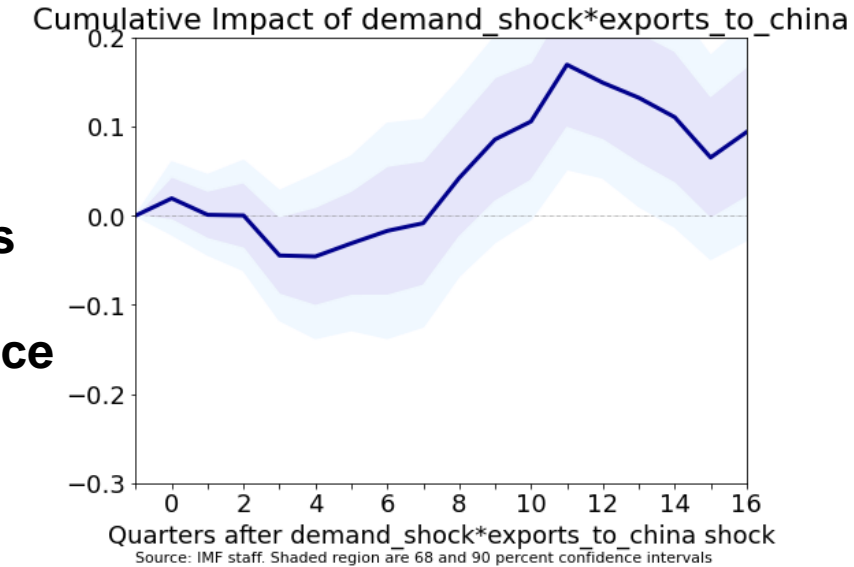
$$y_{c,t+h} - y_{c,t-1} = \alpha_c + \lambda_t + \beta_{DX}^h e_t^D EX_{c,t} + \beta_{SX}^h e_t^S EX_{c,t} + \mu^h EX_{c,t} + \Gamma' X_{c,t} + \epsilon_{c,t+h}$$

- $EX_{c,t}$ : Exports to China from country  $c$  as a share of country's GDP
- $\alpha_c$  and  $\lambda_t$ : Country and **time** fixed effects
- $X_{c,t}$ : Set of controls

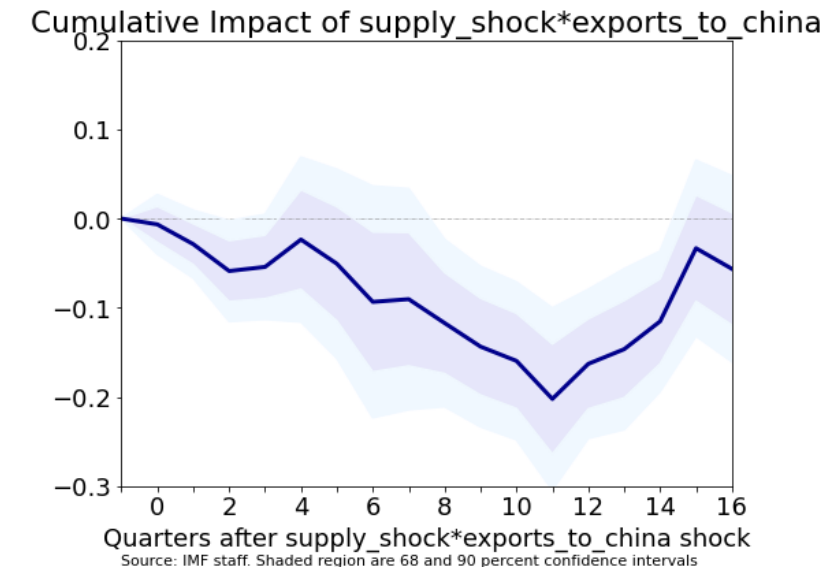
# Macro Spillovers Heterogeneity : Results

- 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**



# 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+ listed (public) firms
  - 62 countries (29 advanced, 33 emerging market and developing economies)
  - 20 different industries
  - **Variables of interest:** Firm revenue and capital expenditure

# Firm-Level Spillovers - Specification

- First, estimating average effect of China shocks on firms

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

- $y_{cif,t}$ : Log revenue of firm  $f$  in industry  $i$ , and country  $c$
- $\beta_D^h$  and  $\beta_S^h$ : Firm revenue response against demand and supply shocks
- $X_{c,t}$ : Controls of various aggregate variables

# Firm-Level Spillovers – Average Results

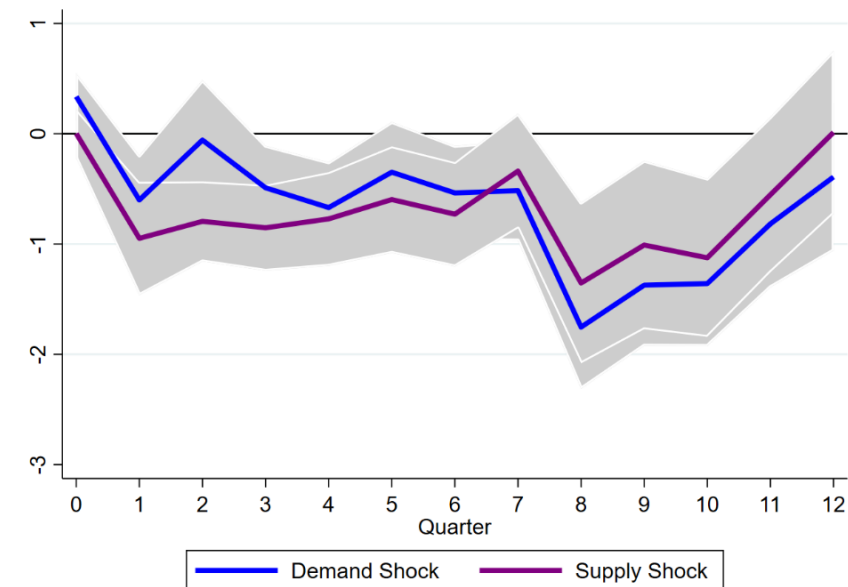
- **Revenue**

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

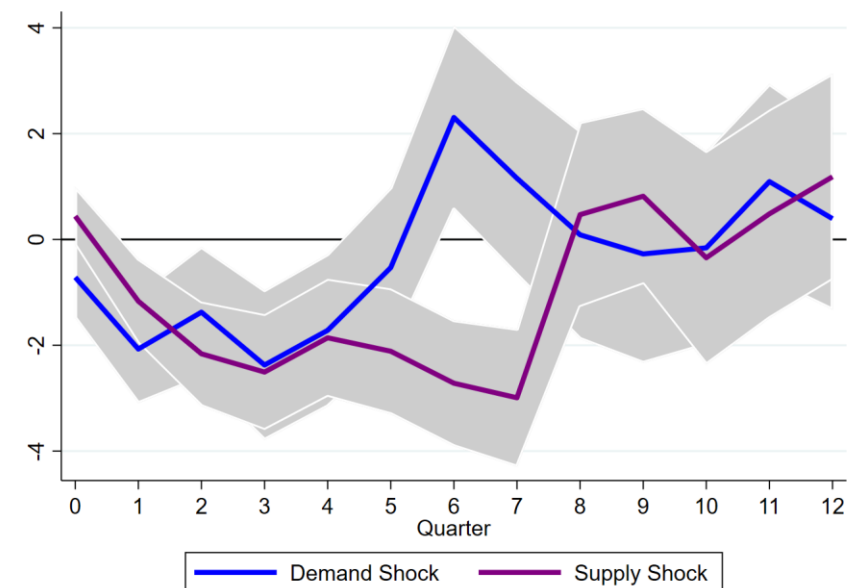
- **Investment**

- 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 industries** between 2000 and 2019

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

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

- Detailed input and output exposure to China:

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

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

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

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

# Role of Export Dependence on Firm Revenue

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

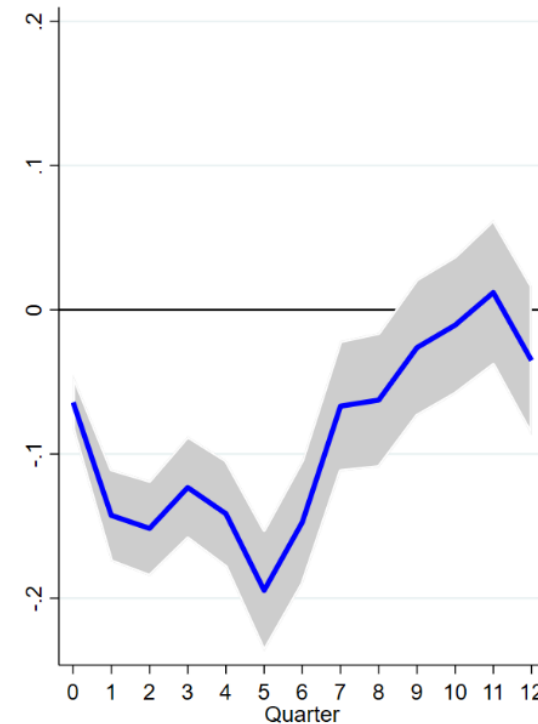
$$y_{cif,t+h} - y_{cif,t-1} = \beta_{DX}^h e_t^D EX_{ci,China} + \beta_{SX}^h e_t^S EX_{ci,China} + \alpha_{f,q} + \alpha_{c,t} + \Gamma' X_{i,t} + \epsilon_{cif,t+h}$$

- $EX_{ci,China}$ : Median (across time) export dependence to China in country  $c$  and industry  $i$

# Firm-Level Spillovers – Export Exposure

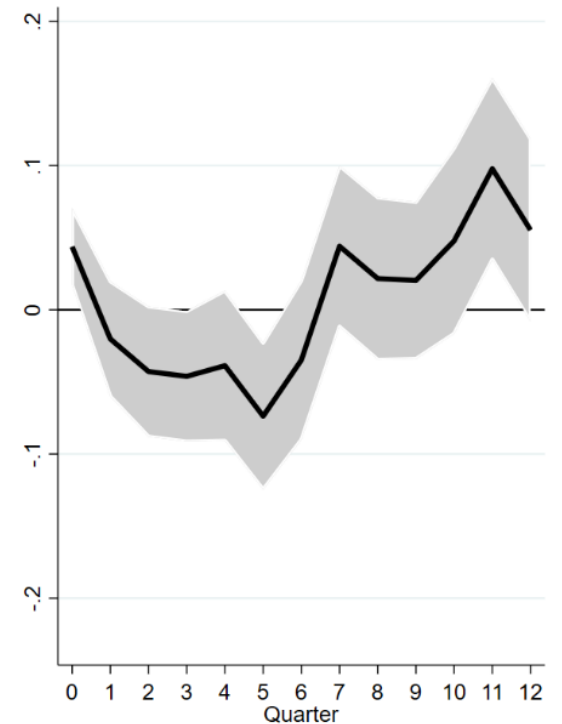
- **Following a negative demand shock:**
  - Firms operate in industries with higher export dependence to China, experienced a larger decline in revenue
- **Role of export exposure for supply shocks:**
  - Relatively less significant
  - Coefficient of interaction term is significant only through the 5<sup>th</sup> quarter and at a smaller size

**Demand Shocks**



Demand Shock X Export Exposure

**Supply Shocks**



Supply Shock X Export Exposure



# Role of Input-Output Linkages on Firm Revenue

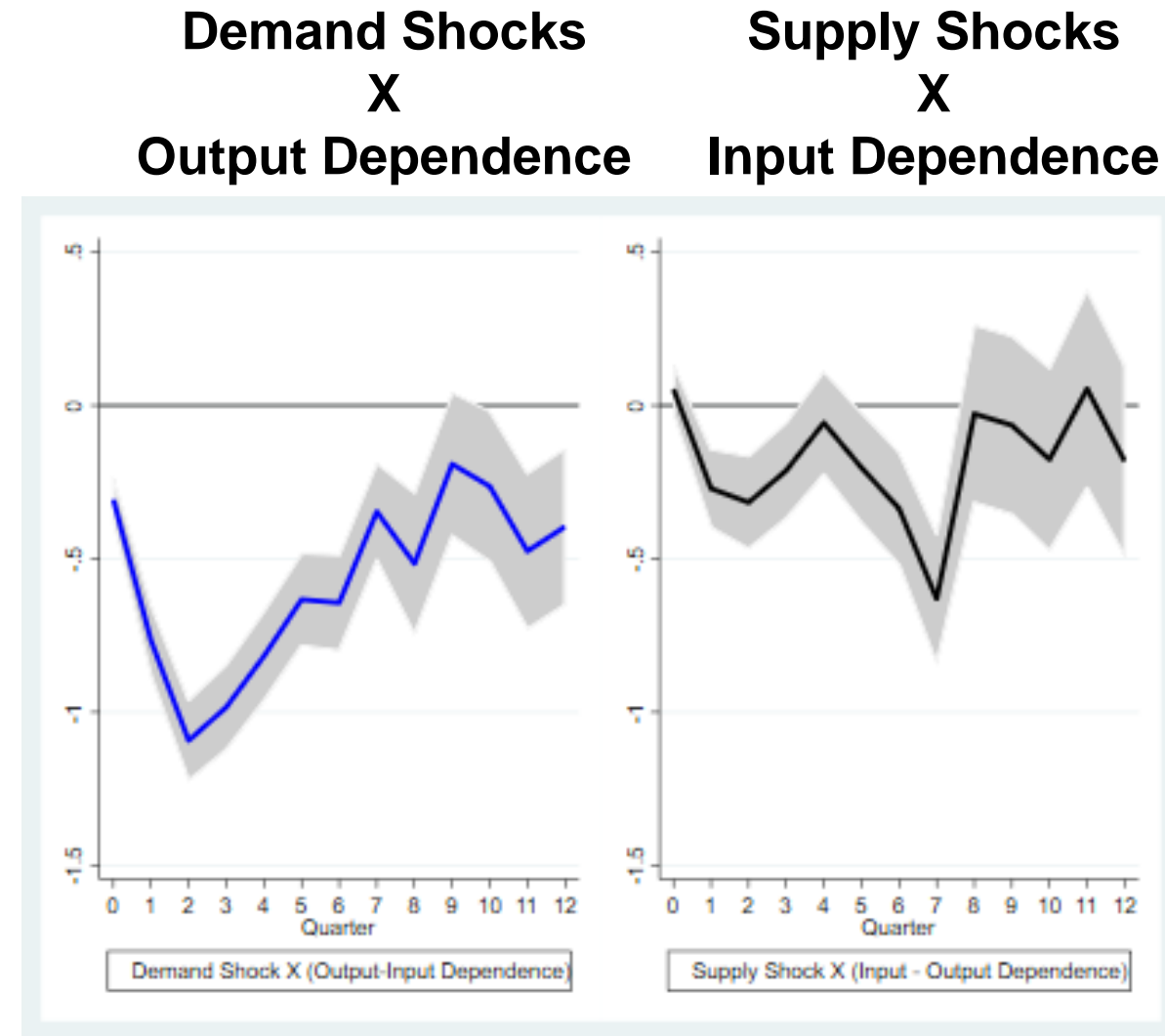
- Estimating variation in firm revenue responses with input-output linkages

$$y_{cif,t+h} - y_{cif,t-1} = \beta_{D,output}^h e_t^D \mathbf{Output}_{ci,China} + \beta_{S,input}^h e_t^S \mathbf{Input}_{ci,China} + \alpha_{f,q} + \alpha_{c,t} + \Gamma' X_{i,t} + \epsilon_{cif,t+h}$$

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

# Firm-Level Spillovers – Input vs Output Dependence

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



# Summing Up

- Strong spillovers from China
  - Both through demand (more important before the pandemic) and supply (increasingly important 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