Trade Shocks and Job Market Volatility: A Network Model Perspective

Jiawen Liu[1] Michael Olabisi[2] Saera Oh[1]

[1] Department of Agricultural, Food and Resource Economics (AFRE)
Michigan State University

[2]
Department of Community Sustainability (CSUS), and Department of Agricultural, Food and Resource Economics (AFRE)
Michigan State University

ASSA, 1/7/2024

This material is based upon work supported by the National Science Foundation under Grant No. 2018267.

Motivation

- Understanding Global Economic Interdependencies.
- The Rising Impact of Emerging Countries on Global Economies.
  - 'China shock' : rising service, declining manufacturing [2, 3, 6, 8]
  - Import, Export and employment. [1, 9, 10, 13]
  - Evidence from other than U.S. [7]
- Addressing the Volatility of Employment Markets.
  - Employment volatility is a significant indicator for both economic and social reasons [4, 5].
  - Firm's involvement in international trade affects employment volatility, categorized by trade frequency, product types, and trading partner characteristics [11].

Our work

- Use a network model of trade to analyze the impact of trading with emerging markets on U.S. employment stability.
- Use WIOD and US labor data to analyze the model prediction.

Framework : Setup

The output for sector $k \in K$, in country $i \in N$, at time $t \in T$, Y_{ikt}, is given by :

$$Y_{ikt} = \underbrace{F_{it}^{DOM} + \sum_{j \in N_1} F_{ijt}^{HIC} + \sum_{j \in N_2} F_{ijt}^{EC}}_{\text{Final Demand Use}} + \underbrace{\sum_{l \in K} \theta_{ilt}^{DOM} Y_{lt}^{DOM} + \sum_{j \in N_1} \sum_{l \in K} \theta_{ijlt}^{HIC} Y_{jlt}^{HIC} + \sum_{j \in N_2} \sum_{l \in K} \theta_{ijlt}^{EC} Y_{jlt}^{EC}}_{\text{Intermediate Use}} \quad (1)$$

In matrix form :

$$\mathbf{Y} = (\mathbf{F}^{DOM} + \mathbf{F}^{HIC} + \mathbf{F}^{EC}) + \mathbf{WY} \quad (2)$$

so,

$$\mathbf{Y} = \underbrace{[\mathbf{I} - \mathbf{W}]^{-1}}_{H}(\mathbf{F}^{DOM} + \mathbf{F}^{HIC} + \mathbf{F}^{EC}) \quad (3)$$

Let the labor-output ratio in sector k in country i at time t be denoted by λ_{ikt}, which represents the amount of labor required to produce one unit of output. The labor demand for that sector can then be expressed as :

$$L_{ikt} = \lambda_{ikt} \cdot Y_{ikt} \tag{4}$$

In matrix form, the labor demand equation becomes :

$$\mathbf{L} = \Lambda \cdot \mathbf{Y} = \Lambda \cdot H(\mathbf{F}^{DOM} + \mathbf{F}^{HIC} + \mathbf{F}^{EC}) \tag{5}$$

We model the change in labor demand in response to changes in demand shocks :

$$d\mathbf{L} = \Lambda\mathbf{H}(d\mathbf{F}^{DOM} + d\mathbf{F}^{HIC} + d\mathbf{F}^{EC}) \tag{6}$$

Drawing from the framework proposed by (Olabisi 2020) [12], we decompose the final use in each country group $X \in (DOM, HIC, EC)$ into two components : a common constant μ^X shared by all sectors within the group, and an idiosyncratic vector $\tilde{\mathbf{F}}^X$ unique to each sector.

$$\mathbf{F}^X = \mu^X \mathbb{1} + \tilde{\mathbf{F}}^X \tag{7}$$

We introduce the concept of 'upstreamness' for each sector, which reflects the position of the sector in the production chain as :

$$\mathbf{U} = \mathbf{H}\mathbb{1} \tag{8}$$

We introduce the notion of scaled labor demand, represented as $d\hat{\mathbf{L}}$.
Combining equations (6) (7) (8), we have

$$d\hat{\mathbf{L}} = \Lambda\mathbf{H}(\hat{\mu}^{DOM} + \hat{\mathbf{F}}^{DOM})d\hat{\mathbf{F}}^{DOM} + \Lambda\mathbf{H}(\hat{\mu}^{HIC} + \hat{\mathbf{F}}^{HIC})d\hat{\mathbf{F}}^{HIC} + \Lambda\mathbf{H}(\hat{\mu}^{EC} + \hat{\mathbf{F}}^{EC})d\hat{\mathbf{F}}^{EC} \tag{9}$$

Write equation (9) for the change in scaled labor demand in country i, sector k.

$$\begin{aligned} d\hat{L}_{ik} = {} & [\Lambda_{ik} U_{ik} \hat{\mu}^{DOM} + \Lambda_{ik} \sum_{jl} (a_{jlik} \hat{F}_{jl}^{DOM})] d\hat{F}_{ik}^{DOM} \\ & + [\Lambda_{ik} U_{ik} \hat{\mu}^{HIC} + \Lambda_{ik} \sum_{jl} (a_{jlik} \hat{F}_{jl}^{HIC})] d\hat{F}_{ik}^{HIC} \\ & + [\Lambda_{ik} U_{ik} \hat{\mu}^{EC} + \Lambda_{ik} \sum_{jl} (a_{jlik} \hat{F}_{jl}^{EC})] d\hat{F}_{ik}^{EC} \end{aligned} \tag{10}$$

Defining volatility σ_L^2 as the variance of the change of labor demand in equation (11), var($d\hat{\mathbf{L}}$)

$$
\begin{aligned}
LVolatility = \sigma^2_{\hat{L}_{ik}} = & [\tilde{U}_{ik}\hat{\mu}^{DOM} + RiskExposure^{DOM}_{ik}]^2 \sigma^2_{\hat{F}^{DOM}_{ik}} \\
& + [\tilde{U}_{ik}\hat{\mu}^{HIC} + RiskExposure^{HIC}_{ik}]^2 \sigma^2_{\hat{F}^{HIC}_{ik}} \\
& + [\tilde{U}_{ik}\hat{\mu}^{EC} + RiskExposure^{EC}_{ik}]^2 \sigma^2_{\hat{F}^{EC}_{ik}}
\end{aligned}
\tag{11}
$$

Where

- $RiskExposure^{DOM}_{ik} := \Lambda_{ik} \sum_{jl}(a_{jlik}\hat{F}^{DOM}_{jl})$. Similarly, for those terms for High income countries and emerging country groups.
- $\tilde{U}_{ik} := \Lambda_{ik} U_{ik}$ as the adjusted upstreamness after multiply the labor per output coefficient.

Lemma 1 : If volatility of final demand is the highest among emerging country groups ($\sigma^2_{\hat{F}^{EC}_{ik}} > \sigma^2_{\hat{F}^{HIC}_{ik}}, \sigma^2_{\hat{F}^{EC}_{ik}} > \sigma^2_{\hat{F}^{DOM}_{ik}}$), then higher risk exposure to emerging country ($RiskExposure^{EC}_{ik}$) would increase the volatility of employment.

Lemma 2 : The risk exposure ($RiskExposure^{X}_{ik}$) for country group X would have a heterogenous effect on its source country i sector k' employment volatility based on its adjusted upstreamness $\tilde{U}_{ik}$.

Data

- World Input - Output Database
  - Leontief inverse Matrix
  - Upstreamness
  - Socio Economic Accounts - Labor output coefficient
- US Bureau of Labor Statistics : Industry level
  - Employment volatility
  - Average wage, employment level

Empirical Model for Lemma 1

$$\begin{aligned} log(\text{LVolatility}_i) = \alpha &+ \beta_1 log(\text{Risk}_i^{EC}) + \beta_2 log(\text{Risk}_i^{EC}) \times FDVolatility_i^{EC/DOM} \\ &+ \beta_3 log(\text{Risk}_i^{EC}) \times FDVolatility_i^{EC/HIC} \\ &+ \beta_4 log(\text{Risk})_i^{EC} \times FDVolatility_i^{EC/DOM} \times FDVolatility_i^{EC/HIC} \\ &+ \mathbf{X}_i'\gamma + \epsilon_i \end{aligned} \quad (12)$$

- $Risk_i^{EC}$ is the risk exposure on Emerging countries.
- $FDVolatility_i^{EC/DOM}$ represents the ratio of final demand volatility between emerging countries (EC) and domestic countries (DOM). Similarly for $FDVolatility_i^{EC/DOM}$.
- $\mathbf{X}_i$ contains all the control variables, including employment level, average salary, Risk exposure on other region groups,etc.

We are intereseted in the coefficient of $log(Risk_i^{EC})$, when $FDVolatility_i^{EC/DOM} > 1$ and $FDVolatility_i^{EC/HIC} > 1$.
$(\beta_1 + \beta_2 FDVolatility_i^{EC/DOM} + \beta_3 FDVolatility_i^{EC/HIC} + \beta_4 FDVolatility_i^{EC/DOM} FDVolatility_i^{EC/HIC})$

Regression Results 1

Table – 1

	Dep. var. :		
	log(Lvolat)		
	All sec.	Manuf.	Serv.
	(1)	(2)	(3)
$\log(\text{Risk}^{EM})$	-1.943^{***}	-9.716^{**}	-1.714^{***}
	(0.344)	(4.519)	(0.415)
$\log(\text{Risk}^{EM})$:FDVolatility$^{EC/DOM}$	0.447^{***}	3.394^{*}	0.187
	(0.109)	(1.787)	(0.149)
$\log(\text{Risk}^{EM})$:FDVolatility$^{EC/HIC}$	1.823^{***}	8.328^{**}	1.941^{***}
	(0.339)	(3.947)	(0.405)
$\log(\text{Risk}^{EM})$:FDVolatility$^{EC/DOM}$:*FDVolatility*$^{EC/HIC}$	-0.399^{***}	-3.101^{**}	-0.168
	(0.100)	(1.560)	(0.133)
Observations	565	100	441
R^2	0.612	0.618	0.695
Adjusted R^2	0.603	0.560	0.686
Residual Std. Error	0.387 (df = 551)	0.310 (df = 86)	0.361 (df = 427)
Note :	$^{*}p<0.1$; $^{**}p<0.05$; $^{***}p<0.01$		

Hypothesis test

Hypothesis test result of $(\beta_1 + \beta_2 FDVolatility_i^{EC/DOM} + \beta_3 FDVolatility_i^{EC/HIC} + \beta_4 FDVolatility_i^{EC/DOM} FDVolatility_i^{EC/HIC})$, taking different value of $FDVolatility_i^{EC/DOM}$ and $FDVolatility_i^{EC/HIC}$.

Estimate	Chisq	Pr($>$Chisq)	$FDVolatility^{EC/DOM}$	$FDVolatility^{EC/HIC}$
-0.07	0.49	0.48	1	1
0.64	13.82	0.00	1	1.5
1.35	23.15	0.00	1	2
0.49	11.70	0.00	2	1
1.00	23.25	0.00	2	2
3.05	35.23	0.00	2	4
0.30	3.80	0.05	4	2
0.76	3.71	0.05	4	4
1.67	3.29	0.07	4	8

Lemma 2 - Heterogeneous Effect by upstreamness

To analyze lemma 2, we use the following model for each country group :
For example, for emerging country group (EM) :

$$
\begin{aligned}
log(\text{LVolatility}_i) = \alpha &+ \beta_1 log(\text{Risk}_i^{EC}) + \beta_2 log(\text{Risk}_i^{EC}) \times \tilde{U}_i + \beta_3 \tilde{U}_i \\
&+ \beta_4 log(\text{Risk}_i^{HIC}) + \beta_5 log(\text{Risk}_i^{DOM}) \\
&+ \beta_6 FDVolatility_i^{EC} + \beta_7 FDVolatility_i^{HIC} + \beta_8 FDVolatility_i^{DOM} \\
&+ \mathbf{X}_i' \gamma + \epsilon_i
\end{aligned}
\tag{13}
$$

Regression Results 2

Table – 2

	Dependent variable :		
	log(Lvolat)		
	(1)	(2)	(3)
$\log(\text{Risk}^{EM})$: *adjupstream*	5.988***		
	(2.187)		
$\log(\text{Risk}^{HIC})$: *adjupstream*		7.416***	
		(1.827)	
$\log(\text{Risk}^{DOM})$: *adjupstream*			9.056***
			(1.898)
$\log(\text{Risk}^{EM})$	−0.141	−0.079	−0.076
	(0.094)	(0.084)	(0.083)
$\log(\text{Risk}^{DOM})$	0.134***	0.170***	0.016
	(0.035)	(0.035)	(0.028)
$\log(\text{Risk}^{HIC})$	0.273***	0.249***	0.304***
	(0.104)	(0.095)	(0.097)
log(fdvEM)	−0.046	−0.029	−0.099
	(0.161)	(0.160)	(0.160)
log(fdvHIC)	0.225**	0.220**	0.216**
	(0.104)	(0.103)	(0.103)
log(fdvDOM)	0.139***	0.156***	0.169***
	(0.038)	(0.037)	(0.038)
adjupstream	−35.938***	−54.584***	−87.742***
	(12.531)	(13.058)	(18.051)
Observations	565	565	565
R^2	0.558	0.565	0.570
Adjusted R^2	0.550	0.558	0.562
Note :		*p<0.1; **p<0.05; ***p<0.01	

Conclusion

- Emerging markets and employment volatility
  - sectors with higher exposure to emerging markets face increased employment volatility. This is particularly noticeable when demand in these emerging countries is more unpredictable compared to high-income and domestic markets.
- Sector - specific effect
  - The impact differs across sectors. It largely depends on the sector's position in the supply chain, or its 'upstreamness'.

Thank You !

References I

[1] Daron Acemoglu, David Autor, David Dorn, Gordon H Hanson, and Brendan Price. Import competition and the great us employment sag of the 2000s. *Journal of Labor Economics*, 34(S1) :S141–S198, 2016.

[2] David Autor, David Dorn, and Gordon H. Hanson. On the Persistence of the China Shock, October 2021.

[3] David H Autor, David Dorn, and Gordon H Hanson. The china syndrome : Local labor market effects of import competition in the united states. *American economic review*, 103(6) :2121–2168, 2013.

[4] John R Baldwin and W Mark Brown. Regional manufacturing employment volatility in canada : The effects of specialisation and trade. *Papers in Regional Science*, 83 :519–541, 2004.

[5] Kent Bausman and W Richard Goe. An examination of the link between employment volatility and the spatial distribution of property crime rates. *American Journal of Economics and Sociology*, 63(3) :665–696, 2004.

[6] Lorenzo Caliendo, Maximiliano Dvorkin, and Fernando Parro. Trade and labor market dynamics : General equilibrium analysis of the china trade shock. *Econometrica*, 87(3) :741–835, 2019.

[7] Wolfgang Dauth, Sebastian Findeisen, and Jens Suedekum. Trade and Manufacturing Jobs in Germany. *American Economic Review*, 107(5) :337–342, May 2017.

References II

[8] Katherine Eriksson, Katheryn N. Russ, Jay C. Shambaugh, and Minfei Xu. Reprint : Trade shocks and the shifting landscape of U.S. manufacturing. *Journal of International Money and Finance*, 114 :102407, June 2021.

[9] Robert C. Feenstra and Akira Sasahara. The 'China shock,' exports and U.S. employment : A global input–output analysis. *Review of International Economics*, 26(5) :1053–1083, 2018.

[10] Lisa M. Grobar. Export-Linked Employment in Southern California. *Contemporary Economic Policy*, 17(1) :97–108, 1999.

[11] Christopher Kurz and Mine Z Senses. Importing, exporting, and firm-level employment volatility. *Journal of International Economics*, 98 :160–175, 2016.

[12] Michael Olabisi. Input–output linkages and sectoral volatility. *Economica*, 87(347) :713–746, 2020.

[13] Mauricio Ulate, Jose P. Vasquez, and Roman D. Zarate. Labor Market Effects of Global Supply Chain Disruptions. *Federal Reserve Bank of San Francisco, Working Paper Series*, 2023(08) :01–46, February 2023.