The Economic Case for Global Vaccinations:
An Epidemiological Model with International Production Networks

Cem Çakmaklı

Koç University

Selva Demiralp

Koç University

Şebnem Kalemli-Özcan

University of Maryland, NBER, CEPR

Sevcan Yeşiltaş

Koç University

Muhammed A. Yıldırım

Koç and Harvard University

February 2021

COVID-19 is a Global Crisis

- COVID-19 pandemic has caused loss of lives and livelihoods across the globe, no country is spared.

- Vaccines are a game changer and can stop the pandemic in a given country/economy.

- Given the global interconnections between countries, even if a country achieves universal vaccination of its citizens, that country may still suffer economic costs if rest of the world is not vaccinated.

COVID-19 is a Global Crisis

- COVID-19 pandemic has caused loss of lives and livelihoods across the globe, no country is spared.

- Vaccines are a game changer and can stop the pandemic in a given country/economy.

- Given the global interconnections between countries, even if a country achieves universal vaccination of its citizens, that country may still suffer economic costs if rest of the world is not vaccinated.

Our work estimates these economic costs:

1. What is the economic impact of not vaccinating poorer nations, on richer nations?

2. How much of the global costs the rich nations bear even if they achieve universal vaccinations in their own economies?

3. Which sectors in rich economies are especially vulnerable?

A Data-Driven Framework, Rich in Country-Sector Heterogeneity

- **Supply**
  - Domestic labor supply is a function of infections —SIR Model
    - Worker/Sector Heterogeneity $\Rightarrow$ Teleworkable & Physical Proximity
  - Domestic + Imported Intermediate Inputs

    Assume Leontief production function (e.g, Baqaee and Farhi (2020))
    $\Rightarrow$ based on evidence of strong complementarity in the short run (e.g., Boehm et al. (2019))

- **Demand** (Foreign and Domestic)
  - Changes in preferences & expenditure is a function of infections —SIR Model

A Data-Driven Framework, Rich in Country-Sector Heterogeneity

- **Supply**
  - Domestic labor supply is a function of infections —SIR Model
    - Worker/Sector Heterogeneity $\Rightarrow$ Teleworkable & Physical Proximity
  - Domestic + Imported Intermediate Inputs

    Assume Leontief production function (e.g, Baqaee and Farhi (2020))
    $\Rightarrow$ based on evidence of strong complementarity in the short run (e.g., Boehm et al. (2019))

- **Demand** (Foreign and Domestic)
  - Changes in preferences & expenditure is a function of infections —SIR Model

- **Infection Dynamics—SIR Model**
  - Country specific R_t numbers.
  - Severe cases > ICU capacity: Endogenous Lockdowns
  - Demand normalizes when active cases < Population/20, 000

A Data-Driven Framework, Rich in Country-Sector Heterogeneity

- **Supply**
  - Domestic labor supply is a function of infections —SIR Model
    - Worker/Sector Heterogeneity $\Rightarrow$ Teleworkable & Physical Proximity
  - Domestic + Imported Intermediate Inputs

    Assume Leontief production function (e.g, Baqaee and Farhi (2020))
    $\Rightarrow$ based on evidence of strong complementarity in the short run (e.g., Boehm et al. (2019))

- **Demand** (Foreign and Domestic)
  - Changes in preferences & expenditure is a function of infections —SIR Model
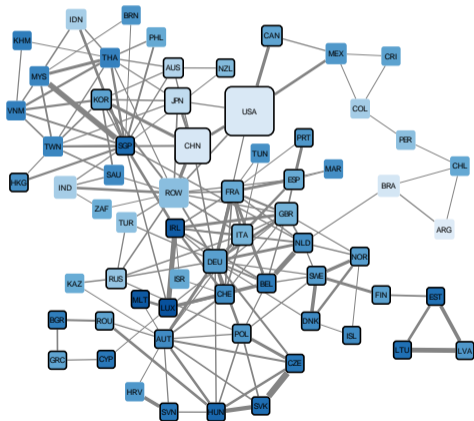
- **Infection Dynamics—SIR Model**
  - Country specific R_t numbers.
  - Severe cases > ICU capacity: Endogenous Lockdowns
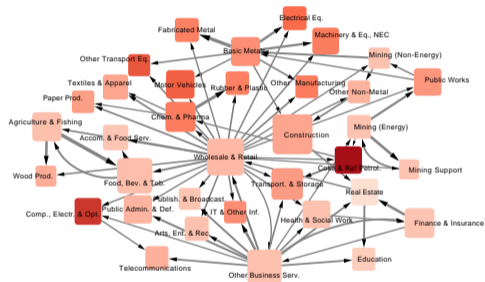 - Demand normalizes when active cases < Population/20,000

- **Open Economy**
  - Infection dynamics of each country affect its supply and demand
    $\Rightarrow$ exports and imports (final and intermediate goods).

Global Trade and Production Network: OECD ICIO Tables

(a) Countries

(b) Industries

35 industries in 65 countries, giving us a matrix of 2275 × 2275 entries

Health Shock is amplified via I-O Linkages

How much global and local amplification can we get from the health shock, affecting demand and labor supply in a given country through I-O links?

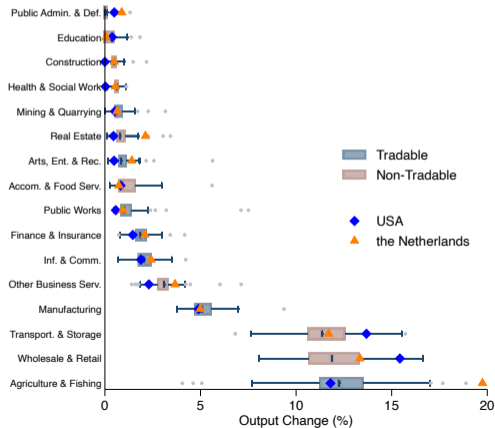| Specification	Demand ↓ Domestic and Foreign	Intermediate Inputs ↓ Domestic and Foreign	Health Shock Amplification
NO IPN	Yes	No	Labor
IPN	Yes	Yes	Amplification via Inter-country / Inter-industry I-O

Vaccination eliminates the labor supply shock and normalizes demand

Total Cost for the World, AEs and EMDEs in terms of 2019 USD (billions)

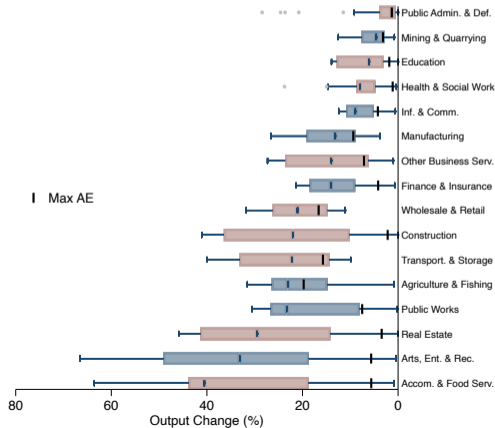|	Immediate Full Vaccination		Immediate Full Vaccination		Full Vaccination by mid-2021	
AEs:						
EMDEs:	No Vaccination		No Vaccination		Half Vaccination by end-2021	
Lockdowns:	No Lockdowns		Endogenous Lockdowns		Endogenous Lockdowns	
	No IPN	**IPN**	**No IPN**	**IPN**	**No IPN**	**IPN**
	(a)	(b)	(a)	(b)	(a)	(b)
(1) World	2,946	4,273	1,479	6,144	1,844	3,763
(2) AEs	509	1,589	204	2,584	399	1,855
(3) EMDEs	2,437	2,685	1,275	3,561	1,445	1,908
(4) Share of AEs (%)	17.3	37.2	13.8	42.0	21.7	49.3
			Relative Declines			
(5) World	3.81	5.53	1.91	7.94	2.38	4.87
(6) AEs	0.75	2.33	0.30	3.79	0.59	2.72
(7) EMDEs	12.06	13.29	6.31	17.62	7.15	9.44

Country-Sector Heterogeneity in Economic Costs under Inequitable Vaccinations: The Amplification Role of Global Trade/Production Network

(a) Vaccinated AEs

(b) Unvaccinated EMDEs

Potential 2021 Supply Chain Disruptions

(a) Feb. 22, 2021

THE WALL STREET JOURNAL.

BUSINESS

Consumer Demand Snaps Back. Factories Can't Keep Up.

Snarled supply chains, labor shortage thwart full reopening; 'everyone was caught flat-footed'

(b) Jan. 9, 2021

THE WALL STREET JOURNAL.

Home   World   U.S.   Politics   Economy   **Business**   Tech   Markets   Opinion   Life & Arts   Real Estate   WSJ. Magazine

BUSINESS

Low on Workers, Manufacturers Recruit Their Executives for the Factory Floor

Covid, child care and competition from e-commerce warehouses contribute to labor shortages at many factories

(c) Jan. 28, 2021

FINANCIAL TIMES

Carmakers braced for prolonged chip shortage

Executives warn supply is unlikely to meet demand in the first half of the year

(d) Mar. 1, 2021

REUTERS

HEALTH   JANUARY 28, 2021 / 12:19 PM / UPDATED A MONTH AGO

Taiwan asks Germany to help obtain coronavirus vaccines

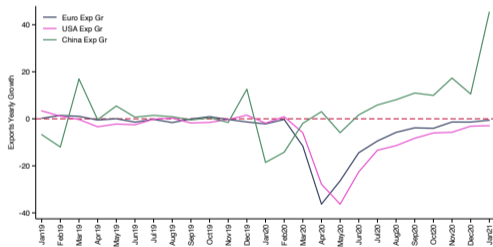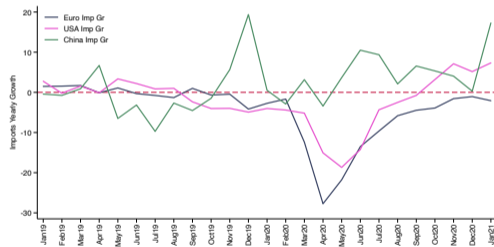## Observed Changes in Aggregate Trade (Source: CPB)
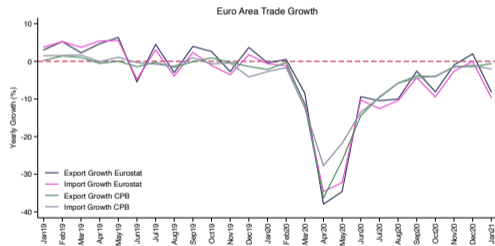

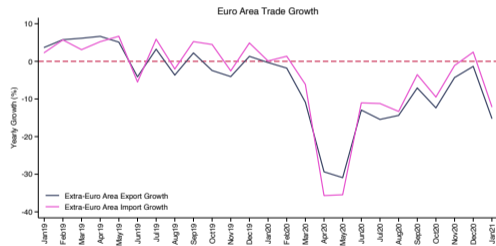**(a)** Growths in Exports

(b) Growths in Imports

Euro Area Trade: CPB vs. Eurostat

(a) All Euro Area Trade

(b) Euro Area Trade with External Countries

Inventories during Pandemic

- During normal times (no supply shock), inventory investment is procyclical:

$$\text{Strong Demand} \quad \Rightarrow \text{Inventories} \quad \Uparrow$$
$$\text{Weak Demand} \quad \Rightarrow \text{Inventories} \quad \Downarrow$$
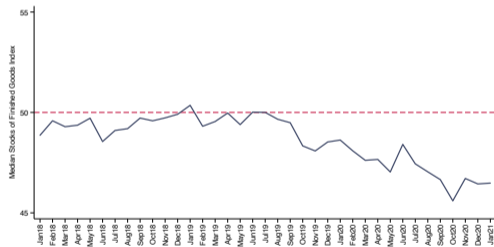
- During the pandemic (supply is constrained), inventory investment is counter-cylical (demand - supply matters):
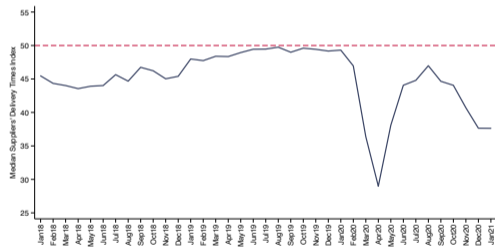
$$\text{Strong Demand} \quad \Rightarrow \text{Inventories} \quad \Downarrow$$
$$\text{Weak Demand} \quad \Rightarrow \text{Inventories} \quad \Uparrow$$

Inventories decline during pandemic: PMI Data

(a) Stocks of Finished Goods Index

(b) Suppliers' Delivery Times Index

Conclusion

- We demonstrated the economic case for global vaccinations on top of the moral case.

- Global costs can vary from 1 to 6 trillion, where AEs bear from 13 to 49 percent: hope for the best, prepare for the worst.

- Our results rely on the fact that no economy is an island and connected to global trade and finance through complex international linkages.

- The potential loss to advanced economies GDP (even-if they achieve universal inoculation) can be larger than the investment needed in global vaccination initiatives such as COVAX. Such investments now is in the best interest of the advanced economies.

- Given the extent of globalization, no economy fully recovers until every economy recovers, and hence a multilateral approach is a "must" to solve the pandemic.