Beyond the Aggregates: Unpacking Inflation in Small Open Economies

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May 19, 2023

Mini Conference, University of Maryland

Motivation

1. Inflation rose everywhere in the past 2-3 years plot
2. Most Central banks increased policy rates in response plot
3. Relevance of production network for macroeconomic outcomes plot

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  - Contribution: Theory and Empirics

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    - resources are not **consumed** internally
      $\rightarrow$ do not enter the consumer price index (CPI)
      $\rightarrow$ good contribute less to inflation

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    - sector can export *indirectly* through its buyers
    - sector can import *indirectly* through its sellers
    - In both cases there is amplification: make sectors to export and import more!

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- **Takeaway**: **Openness** + **production network** alter what the domestic consumer ended up consuming

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    - with adjustment: 0.4 percent increase in CPI
    - decrease impact by around 1/3!

Model

Model Outline

- Static environment
  - N domestic goods, M imported goods, F factors of production.
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  - Representative consumer consumes domestic and imported goods and own factors of production.
  - Factors supplied inelastically, $\bar{L}_f$.
- Supply side
  - Representative firm in each sector, Z_i productivity.
  - Use factors, domestic intermediate and imported intermediate goods (P_m)

Notation and Shocks

- Key objects: Domar weights (λ_i), factor shares (Λ_f), and nominal GDP ($nGDP$)

$$\lambda_i = \frac{\text{Sales}_i}{nGDP}; \quad \Lambda_f = \frac{\text{Payments to Factor}_f}{nGDP}$$
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- "Shocks" as deviations from initial equilibrium: $\hat{X} = \log X - \log X^{init}$
  - Supply: $\{\hat{\bar{L}}_f\}_{f \in F}, \{\hat{Z}_i\}_{i \in N}, \{\hat{P}_m\}_{m \in M}$
  - Demand: $\hat{\mathcal{M}}, \hat{T}$

Inflation in the model

- To a first-order

$$\hat{CPI} = \underbrace{\left(1 - \sum_{f \in F} \tilde{\Lambda}_f\right)\left(\hat{\mathcal{M}} + \frac{T}{\mathcal{M}}\hat{T}\right)}_{\text{Aggregate demand}}$$

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  - $\sum_{f \in F} \tilde{\Lambda}_f$: how much of factors is exported directly and indirectly; Dampens aggregate demand effect.

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$$\hat{CPI} = \underbrace{\left(1 - \sum_{f \in F} \tilde{\Lambda}_f\right)\left(\hat{\mathcal{M}} + \frac{T}{\mathcal{M}}\hat{T}\right)}_{\text{Aggregate demand}} + \frac{nGDP}{\mathcal{M}}\left(\underbrace{-\sum_{f \in F}(\Lambda_f - \tilde{\Lambda}_f)\hat{\tilde{L}}_f}_{\text{Factor Supply}} \underbrace{- \sum_{i \in N}(\lambda_i - \tilde{\lambda}_i)\hat{\tilde{Z}}_i}_{\text{Sectoral Productivity}} \underbrace{- \sum_{f \in F}\tilde{\Lambda}_f\hat{\Lambda}_f}_{\text{Factor share}}\right)$$

  - $\mathcal{M} + T = nGDP$: international trade and finance breaks relationship between what it produced and consumed: $nGDP \neq \mathcal{M}$.

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  - $(\Lambda_f - \tilde{\Lambda}_f)$: how much of factor f is embedded in domestic consumer basket (directly and indirectly). Dampens factor supply effect.

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  - $(\lambda_i - \tilde{\lambda}_i)$ how much of good i is consumed by domestic consumer (directly and indirectly). Dampens sectoral productivity effect.

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  - Factor payment reallocation. Dampens factor prices effect.

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$$+ \frac{nGDP}{\mathcal{M}} \underbrace{\sum_{m \in M}(b_m + \tilde{b}_m)\hat{P}_m}_{\text{Import price changes}}$$

* b_m: direct import consumption share good m, $\tilde{b}_m$: indirect import share m. Amplify imported inflation.

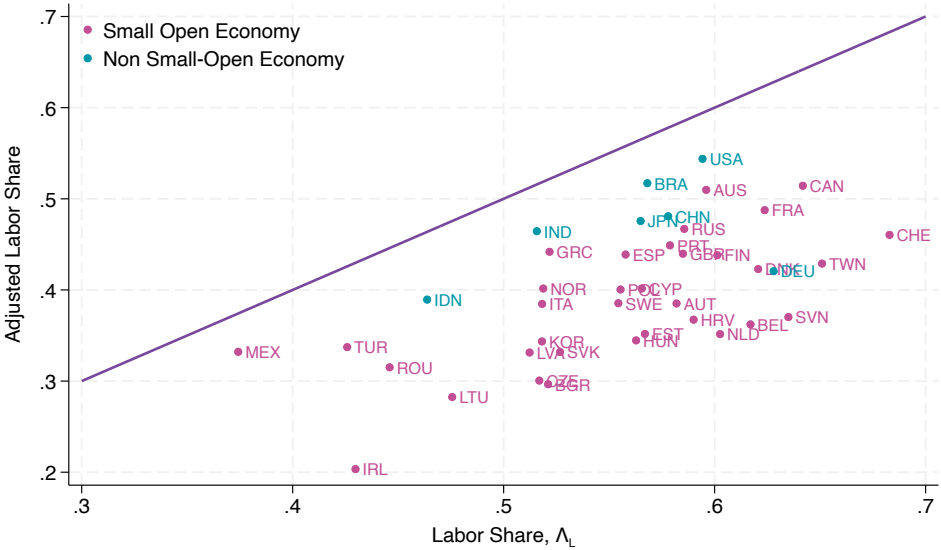
Empirics

Data

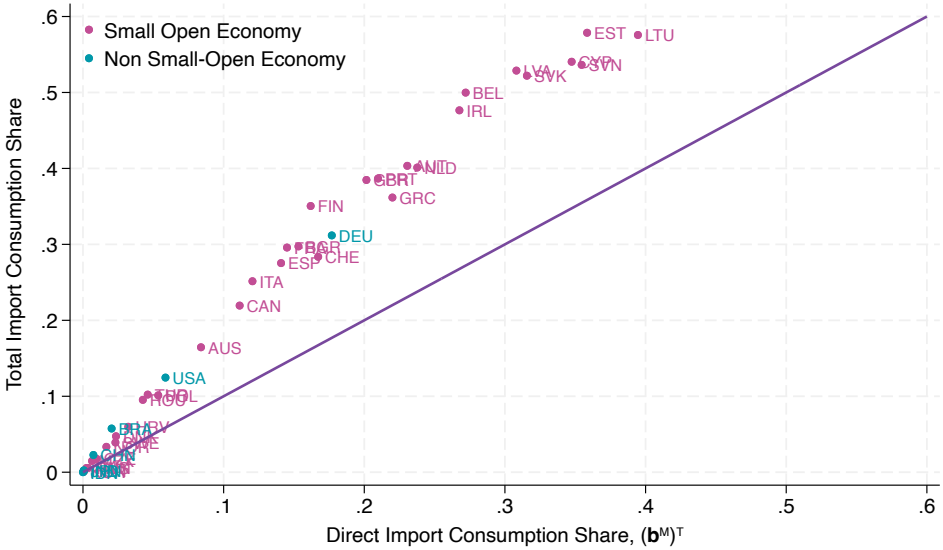
- World Input-Output Tables Release 2016
  - 56 sectors and 43 countries
  - Information on intermediate input usage, exports, imports, sales, wages, etc
  - Figures focus on year 2014.
- Penn-World Table 9.0. Small Open Economy meet this criteria
  - Share of World GDP $\leq 5\%$
  - Openness (Exports + Imports/nGDP) $\geq 30\%$

Domar weights decline by around half

Labor shares decline by $\approx 1/3$



Relevant import shares are ≈ 1.5 direct consumption shares



Conclusion

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- Theory of inflation' sources in small open economies with production networks
- Small open economy and production networks changes pass-through of supply and demand shocks to inflation
- Distinction is quantitatively important in the data

Thank you!

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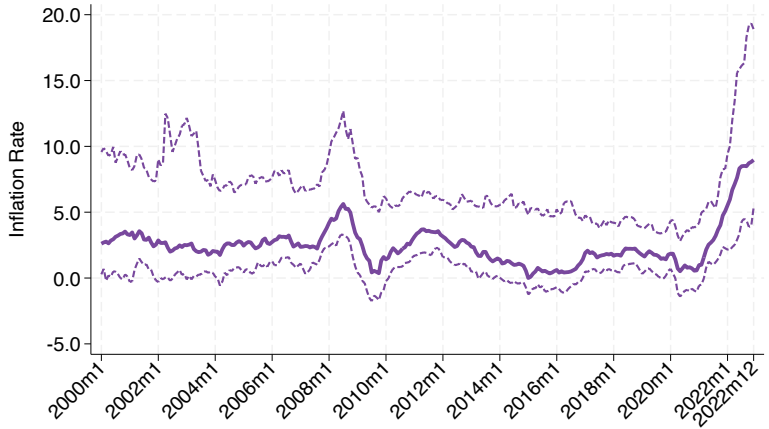
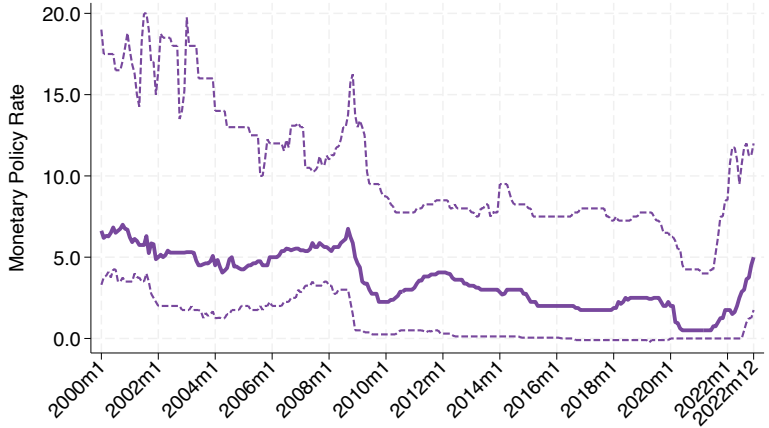
Fact 1: Inflation strikes back

Back



Note: Consumer Price Index year-on-year change. Dashed Lines: 90-10 percentile bands. Source: Bank for International Settlements. 35 AE, 22 Emerging Markets.

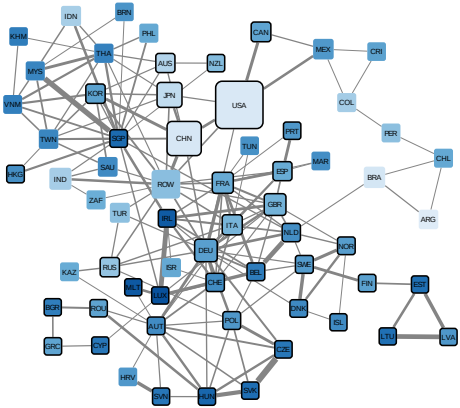
Fact 2: Median Central Bank hiked Back



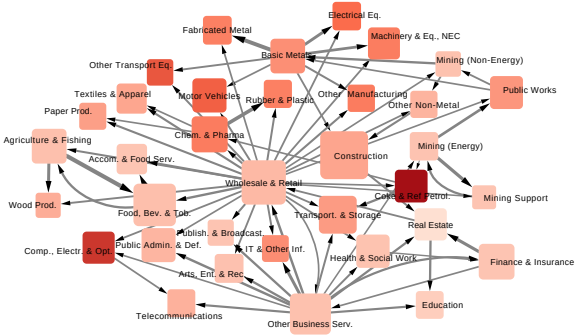
Note: Monetary policy rates. Dashed Lines: 90-10 percentile bands. Source: Bank for International Settlements.

Fact 3: Economies are networks! Back

(a) International Production Network



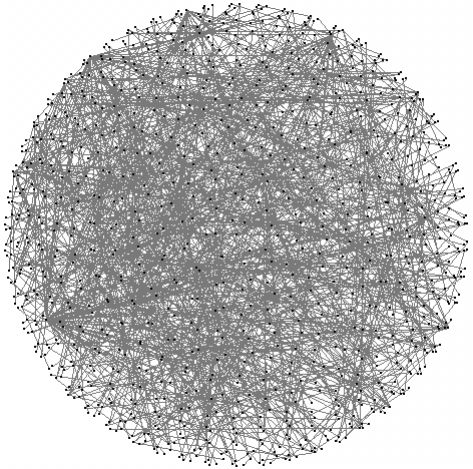
(b) Sectoral Production Network



Source: Cakmakli, Demiralp, Kalemli-Özcan, Yeşiltaş, and Yıldırım (2022) based on OECD Input-Output Tables 2018.

Fact 3: Economies are networks! Back

(c) Chile's Firm-to-Firm Level Production Network



Note: Chilean firm-to-firm level network 2019Q4: 2000 firms random sample, intermediate input sales represents at least 10% of client's total intermediate input purchases.

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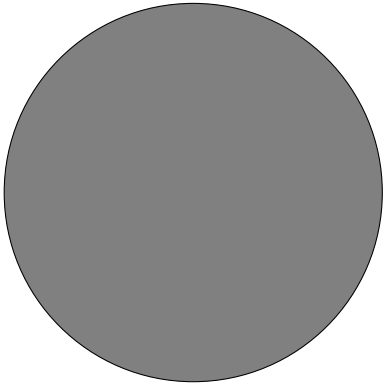

Note: Chilean firm-to-firm level network 2019Q4.

Related Literature Back

1. Inflation in *closed economies* with production networks, sectoral and/or aggregate shocks

   Pasten, Schoenle, and Webber (2020), Guerrieri, Lorenzoni, Straub, and Werning (2021, 2022), Baqaee and Farhi (2022), La'O and Tahbaz-Salehi (2022), Rubbo (2022), Afrouzi and Bhattarai (2022), di Giovanni, Kalemli-Özcan, Silva, and Yıldırım (2022, 2023), Ferrante, Graves, and Iacovello (2023), Luo and Villar (2023),...

   $\Longrightarrow$ I provide a inflation decomposition in a small open economy setup.

2. Inflation in *open economies* with sectoral and/or aggregate shocks

   Gali and Monacelli (2005), Comin and Johnson (2020), Comin, Johnson, and Jones (2023), Fornaro and Romei (2022), Ho, Sarte, and Schwartzmann (2022), di Giovanni, Kalemli-Özcan, Silva, and Yıldırım (2022)

   $\Longrightarrow$ Embed arbitrary production network.

WIOT Classification I

Back

Code	Sector Name
A01	Crop and animal production, hunting and related service activities
A02	Forestry and logging
A03	Fishing and aquaculture
B	Mining and quarrying
C10-C12	Manufacture of food products, beverages and tobacco products
C13-C15	Manufacture of textiles, wearing apparel and leather products
C16	Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials
C17	Manufacture of paper and paper products
C18	Printing and reproduction of recorded media
C19	Manufacture of coke and refined petroleum products
C20	Manufacture of chemicals and chemical products
C21	Manufacture of basic pharmaceutical products and pharmaceutical preparations
C22	Manufacture of rubber and plastic products
C23	Manufacture of other non-metallic mineral products
C24	Manufacture of basic metals
C25	Manufacture of fabricated metal products, except machinery and equipment
C26	Manufacture of computer, electronic and optical products
C27	Manufacture of electrical equipment
C28	Manufacture of machinery and equipment n.e.c.
C29	Manufacture of motor vehicles, trailers and semi-trailers
C30	Manufacture of other transport equipment
C31_C32	Manufacture of furniture; other manufacturing
C33	Repair and installation of machinery and equipment
D35	Electricity, gas, steam and air conditioning supply
E36	Water collection, treatment and supply

WIOT Classification II

Back

Code	Sector Name
G47	Retail trade, except of motor vehicles and motorcycles
H49	Land transport and transport via pipelines
H50	Water transport
H51	Air transport
H52	Warehousing and support activities for transportation
H53	Postal and courier activities
I	Accommodation and food service activities
J58	Publishing activities
J59_J60	Motion picture, video and television programme production, sound recording and music publishing activities; programming and broadcasting activitie
J61	Telecommunications
J62_J63	Computer programming, consultancy and related activities; information service activities
K64	Financial service activities, except insurance and pension funding
K65	Insurance, reinsurance and pension funding, except compulsory social security
K66	Activities auxiliary to financial services and insurance activities
L68	Real estate activities
M69_M70	Legal and accounting activities; activities of head offices; management consultancy activities
M71	Architectural and engineering activities; technical testing and analysis
M72	Scientific research and development
M73	Advertising and market research
M74_M75	Other professional, scientific and technical activities; veterinary activities
N	Administrative and support service activities
O84	Public administration and defence; compulsory social security
P85	Education
Q	Human health and social work activities
R_S	Other service activities