

Global Supply Chain Pressures, International Trade, and Inflation*

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* The views expressed herein are those of the authors and not necessarily those of the Federal Reserve Banks of New York or any other person affiliated with the Federal Reserve System.

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First: We must understand and quantify the relative importance of forces driving inflation

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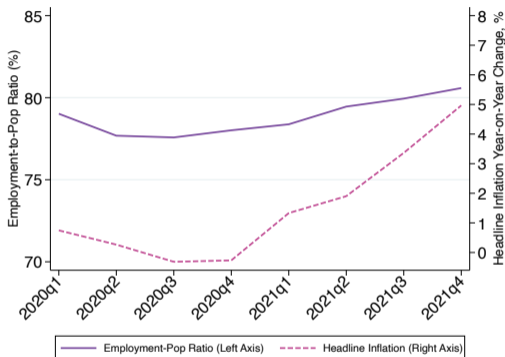
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- Why did we observe an increase in trade together with supply chain bottlenecks?
 - ⇒ Compositional changes in demand played a key role
 - ⇒ Trade **did not** change as strongly w.r.t. GDP as it did during 2008–2009, with dynamics that were consistent with long-lasting supply chain disruptions

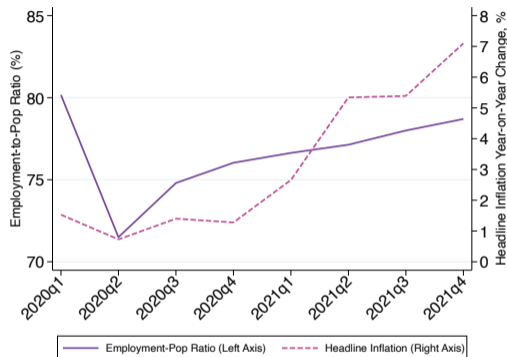
Stylized Facts

Inflation and Employment

Inflation started to increase before employment fully recovered



(a) Euro Area

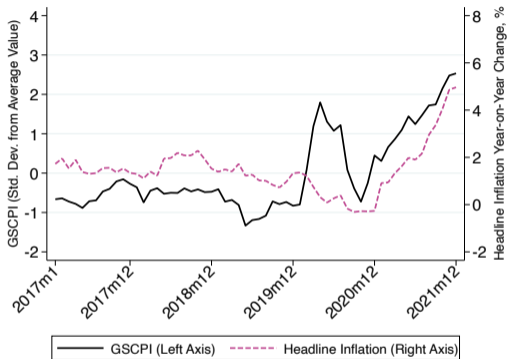


(b) United States

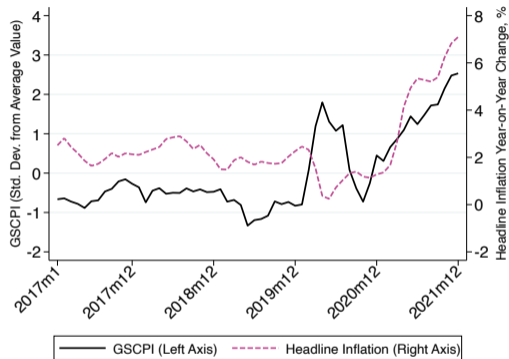
Notes: Both figures plot headline inflation rates on the left axis and the employment to population rate (25-54 years, total) on the right axis. Data sourced from the FRED system maintained by the Federal Reserve of St. Louis.

Inflation and Global Supply Chain Pressures

Simultaneous increase in inflation and supply chain pressures



(a) Euro Area

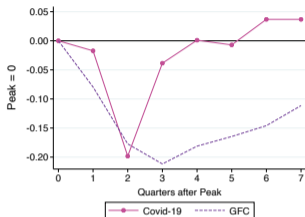


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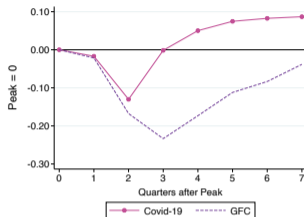
Notes: Both figures plot the Federal Reserve Bank of New York's Global Supply Chain Pressure Index (GSPCI) on the left axis and headline inflation on the right axis. Data sourced from the FRBNY and the FRED system maintained by the Federal Reserve of St. Louis.

Import and Export Quantities: GFC vs Covid-19

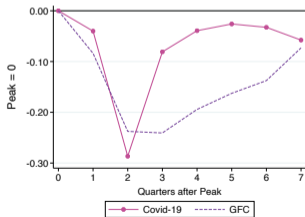
Significant country heterogeneity in trade collapse and recovery relative to 2008–2009



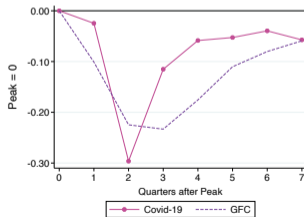
(a) Euro Area Imports



(b) United States Imports



(c) Germany Exports

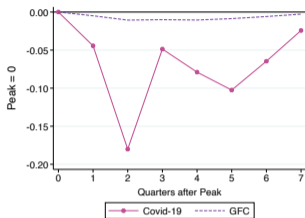


(d) United States Exports

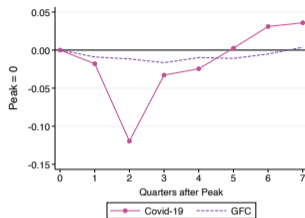
Notes: Figures based on merchandise trade (goods trade) sourced from from the World Trade Organization .

Private Consumption Composition: GFC vs Covid-19 and Composition

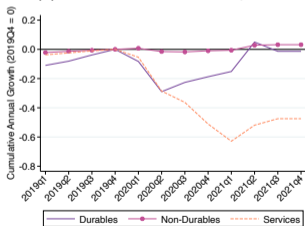
Much larger declines in consumption, faster recovery in durables with differential timing



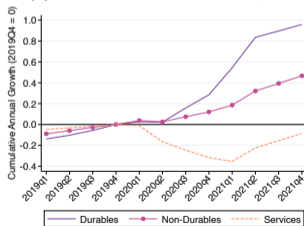
(a) Euro Area: Real Consumption



(b) United States: Real Consumption



(c) Euro Area: Decomposition

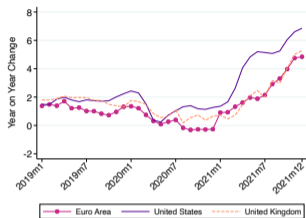


(d) United States: Decomposition

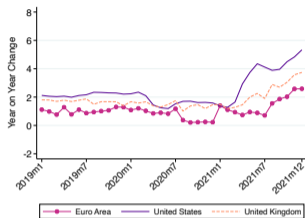
Notes: Figures based on seasonally-adjusted real consumption sourced from the OECD's Quarterly National Accounts.

Inflation in Selected Countries

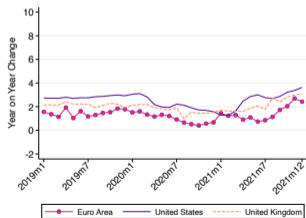
Inflation in goods picked up earlier than inflation in services



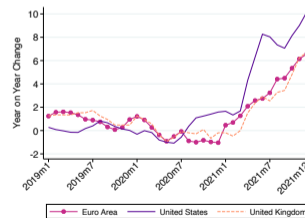
(a) Headline



(b) Core



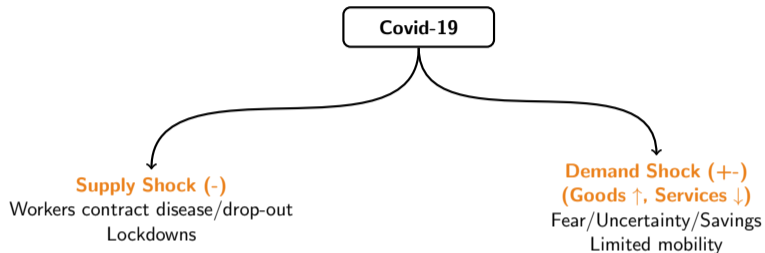
(c) Services



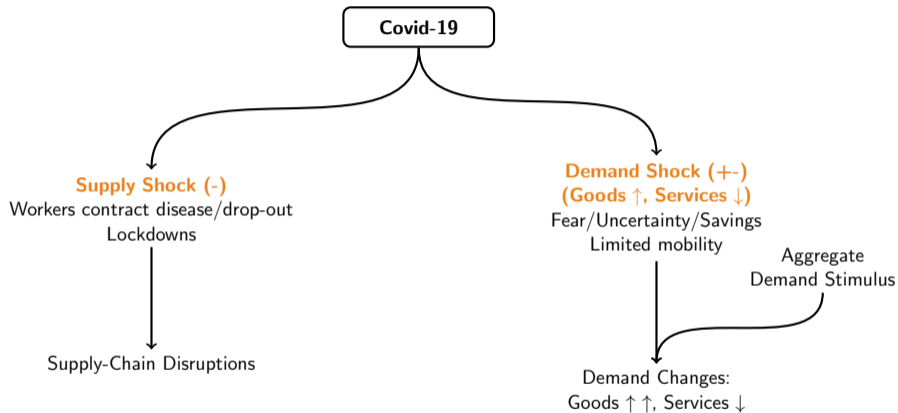
(d) Goods

Notes: Figures plot headline, core, and services and goods annual inflation. Data sourced from the FRED system.

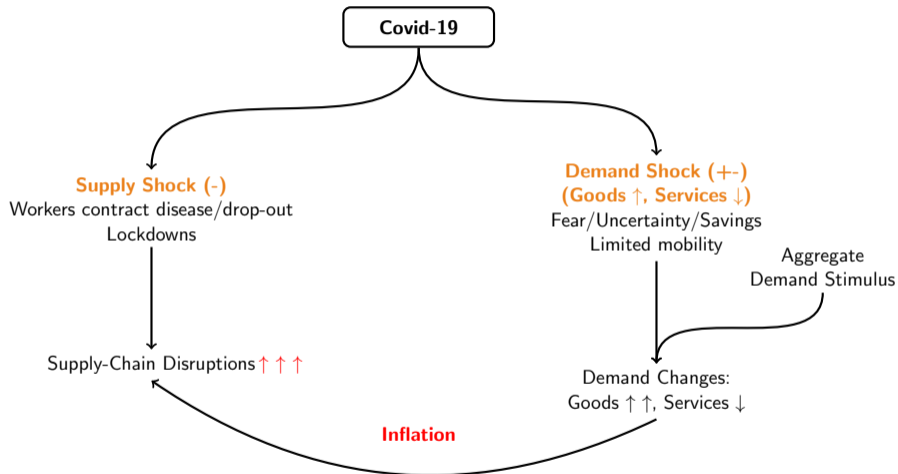
Supply-Demand Imbalances ↑ on a Global Scale During 2020–2021



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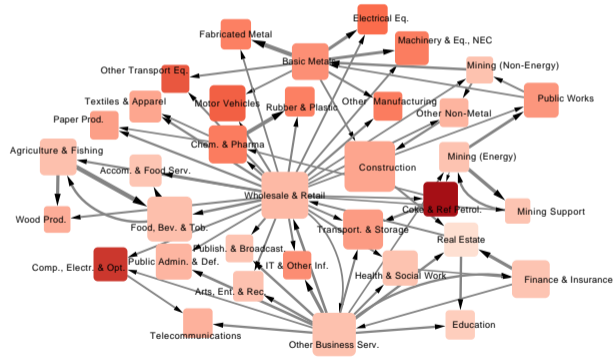
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Drivers of Inflation: Closed Economy

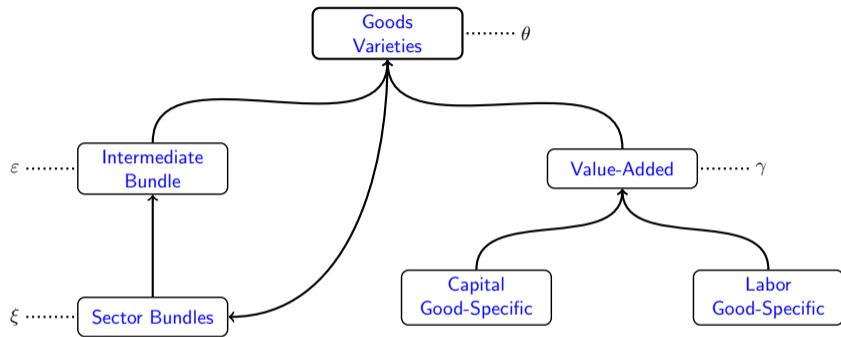
Inflation in a Network-Macro Model

- Multi-sector network economy based on Baqaee and Farhi (2022)
 - Two period model
 - Allow for realistic complementarities in production and intersectoral I-O linkages



45 Industries

Complementarities in production \Rightarrow supply chain bottlenecks



- Barrot and Sauvagnat (2016): Cobb-Douglas production unrealistic in the short run; cannot capture difficulty in substituting among inputs/suppliers
- Estimated short-run elasticities: Atalay (2017); Boehm et al. (2019, 2020)

Decomposing OBSERVED Inflation

Focus on period 2019Q4-2021Q4: captures both collapse and recovery

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Allow a rich set of shocks

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2. Sectoral demand and supply \implies Data: Sectoral consumption and sectoral hours worked

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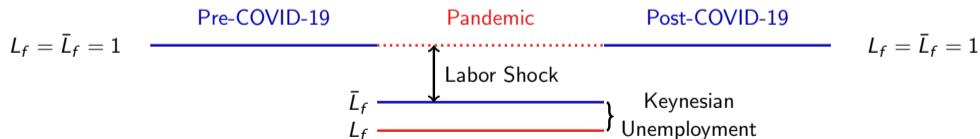
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Key Intuition:

Inflation \approx Aggregate Demand Shocks – $\underbrace{\text{Weighted Observed Employment Changes}}_{\text{Determined by Sectoral Demand, Supply, and Aggregate Shocks}}$

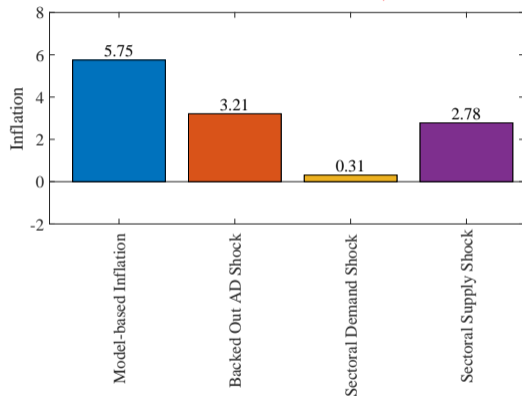
Employment Behavior

- \bar{L}_f : Potential level for factor f
 - Potential employment decreases due to workers getting sick, shutdowns, etc.
- L_f : Employment level for factor f
 - Demand effects/downward wage rigidity \Rightarrow number of workers employed might be lower
- Difference between \bar{L}_f and L_f : Keynesian unemployment

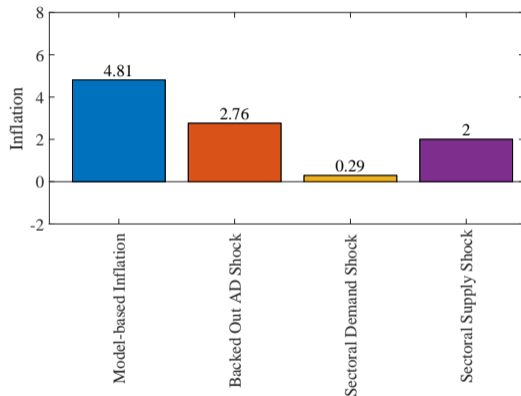


Inflation Decomposition: EA—Observed headline inflation: 4.69

Sectoral supply shocks explain 1/2 of observed EA inflation



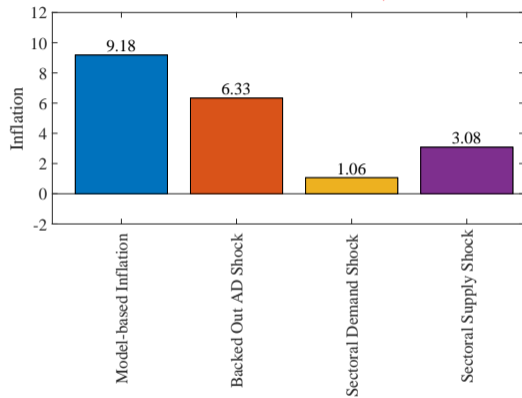
(a) Euro Area: 45 Sectors



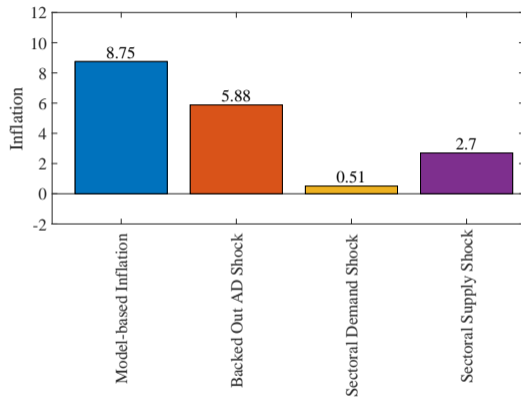
(b) Euro Area: 3 Sectors

Inflation Decomposition: US—Observed headline inflation: 8.47

Sectoral supply shocks explain 1/3 of observed US inflation



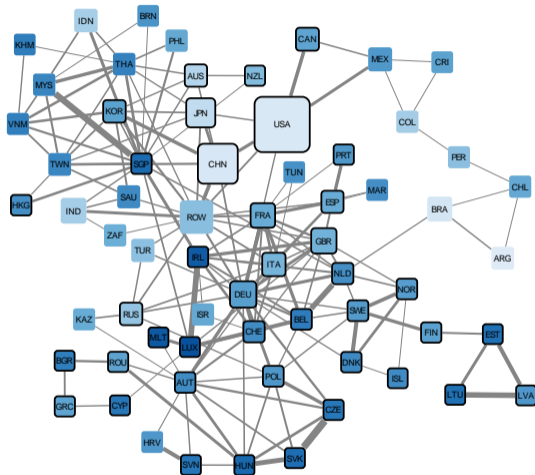
(a) United States: 66 Sectors



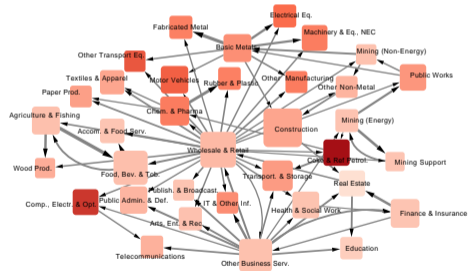
(b) United States: 3 Sectors

Drivers of Inflation: Open Economy

Production Network is Global



(a) 65 Countries



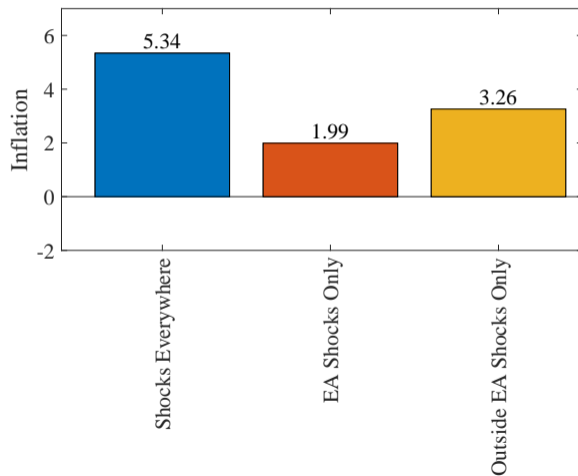
(b) 45 Industries

Decomposing Inflation: Multi-Country Economy

- We follow Çakmaklı, Demiralp, Kalemli-Özcan, Yeşiltaş, Yıldırım (2021, 2022) in extending Baqaee and Farhi (2022) to a multi-country setup.
 - Consider three countries: Euro Area, United States, and the Rest of the World
- Three scenarios:
 - All country shocks
 - Shocks in the Euro Area only
 - Shocks outside the Euro Area only (United States and Rest of the World)

Effects of Global Bottlenecks on Euro Area Inflation

Foreign shocks explain 2/3 of observed EA inflation



Trade and supply chain bottlenecks

The increase in trade and supply chain bottlenecks happened simultaneously

⇒ Led to erroneous thinking that supply chain issues will be transitory

- Given pre-pandemic global input-output linkages, what are the expected international trade flows that follows from changes in final demand? (Bems, Johnson, and Yi, 2010)

- Key intuition:

Output Changes = Global IO Matrix \times Final Demand Shares \times Changes in Final Demand

- We report the elasticity of exports/imports to changes in nominal GDP for:
 - Collapse: 2008Q2-2009Q2 (GFC), 2019Q2-2020Q2 (Covid-19)
 - Recovery: 2009Q2-2010Q2 (GFC), 2020Q2-2021Q2 (Covid-19)

Trade Elasticities with respect to GDP

	Panel I. Data				Panel II. Model			
	Panel A. Great Financial Crisis							
	Collapse		Recovery		Collapse		Recovery	
	Imports	Exports	Imports	Exports	Imports	Exports	Imports	Exports
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
United States	4.35	3.31	5.90	4.99	2.65	1.74	1.67	2.09
Euro Area	2.74	3.11	5.39	5.65	1.34	2.05	0.86	2.39
	Panel B. Covid-19 Pandemic							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
United States	2.43	2.63	2.50	1.52	0.60	1.09	1.31	1.20
Euro Area	1.42	1.45	1.49	1.82	0.87	0.74	1.04	1.16

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- Trade responded much less to changes in GDP during Covid-19 relative to GFC
- Intermediate goods trade played a larger role than final goods trade during Covid-19 than in GFC

Policy Implications

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- Philips curve based on one-sector model cannot separate a series of sectoral supply shocks from a one-time permanent aggregate supply shock
 - $\pi = \pi^e + \beta(y - y^*) + \epsilon$
- Need a network model with asymmetric sectoral supply, relative and aggregate demand shocks
- Nominal wage rigidity, supply shocks and labor rationing in a network model
 - ⇒ cost-push shocks ⇒ inflation
 - **Theory:** La'O and Tahbaz-Salehi (2022), Baqaee and Farhi (2022), Guerrieri et al. (2021)
 - **Quantification for EA and US:** This paper.

Concluding Remarks

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- Monetary policy can tame inflation in a given country by contracting aggregate demand, however, there will remain an upward pressure on price growth as long as global supply bottlenecks persist

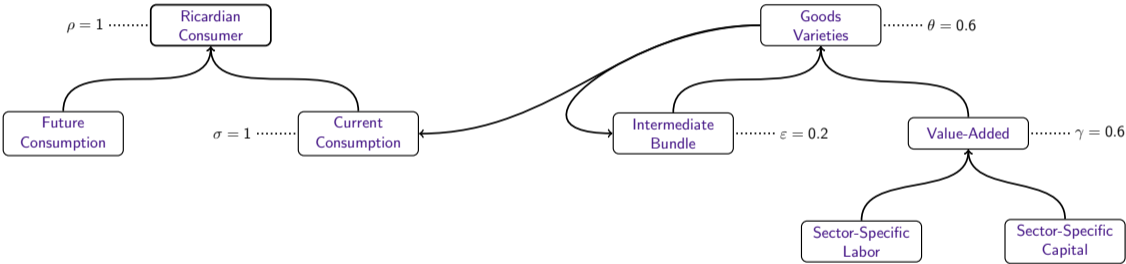
Additional Slides

Observed Data: 2019Q4 – 2021Q4

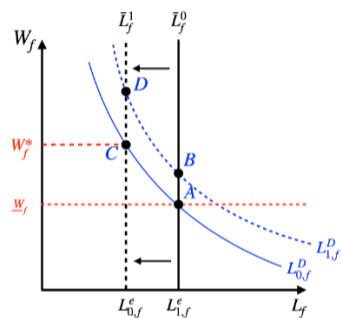
	All Sectors - Percent changes					
	Nominal GDP	Consumption	Hours	Headline CPI	Core CPI	Nominal Wages
Euro Area	4.42	-7.54	-1.48	4.69	2.86	5.01
United States	10.64	-0.72	-2.14	8.47	7.16	7.85

Notes: GDP growth and inflation rates computed based on end-of-period data. Consumption and total hours worked growth rates calculated as cumulative changes between the baseline and end of period. US consumption and total hours worked based on 66 sectors. Euro Area total hours worked based 45 sectors, while consumption based on three sectors. Aggregate consumption and hour worked based on aggregation by consumption shares and labor shares, respectively. Data sourced from FRED and Eurostat.

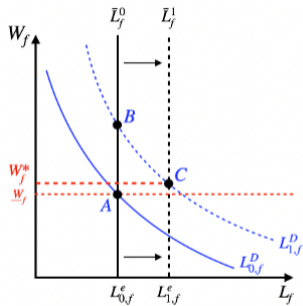
Model Structure



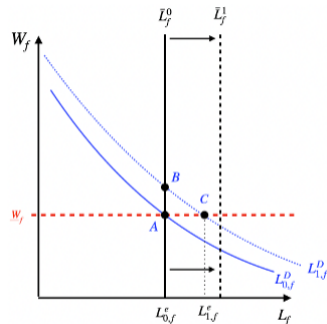
Identifying Labor Shocks



(a) Decrease in Labor

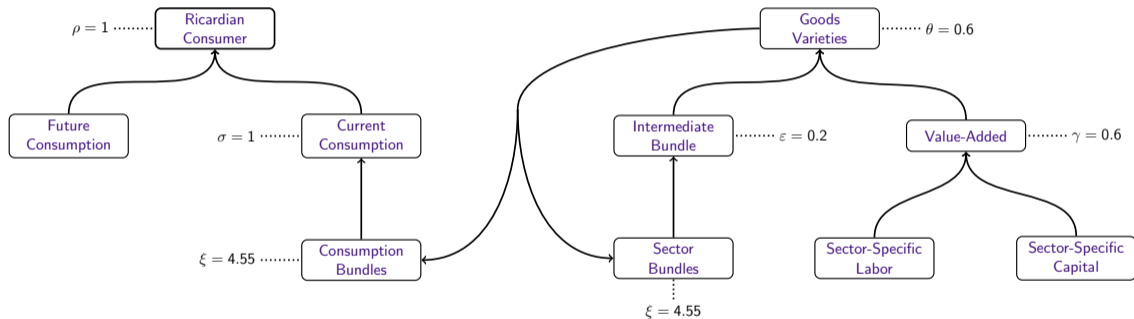


(b) Increase in Labor I

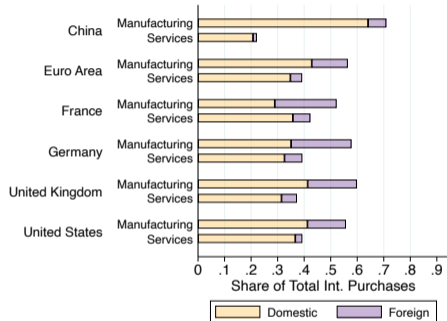


(b) Increase in Labor II

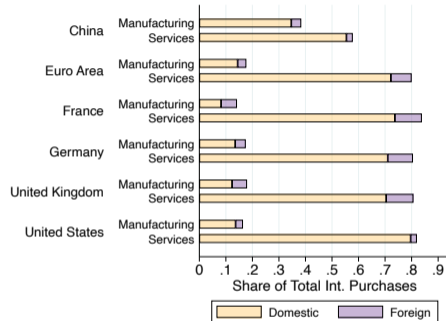
Model Overview Open Economy from Çakmaklı et al. 2021, 2022



Domestic and Foreign Content of Intersectoral Trade



(a) Manufacturing



(b) Services

The Role of Complementarities on Inflation

Panel A. United States			
<i>Calibration Model</i>			
Shocks	Cobb-Douglas (1)	Baseline (2)	Leontief (3)
All	8.93	9.18	9.68
Aggregate Demand	6.33	6.33	6.33
Sectoral Demand	1.01	1.06	0.77
Sectoral Supply	2.70	3.08	3.56

Panel B. Euro Area			
<i>Calibration Model</i>			
Shocks	Cobb-Douglas (1)	Baseline (2)	Leontief (3)
All	5.40	5.75	6.16
Aggregate Demand	3.21	3.21	3.21
Sectoral Demand	0.28	0.31	0.22
Sectoral Supply	2.56	2.78	3.04

Sectoral Shares IO Tables

	Output	VA	Final Demand	Imports	Exports
United States					
Durables	0.06	0.05	0.08	0.31	0.22
Non-Durables	0.13	0.08	0.08	0.29	0.25
Services	0.81	0.87	0.83	0.40	0.52
Euro Area					
Durables	0.11	0.07	0.12	0.20	0.22
Non-Durables	0.16	0.10	0.10	0.32	0.35
Services	0.73	0.83	0.78	0.48	0.43
United Kingdom					
Durables	0.06	0.04	0.07	0.20	0.16
Non-Durables	0.10	0.07	0.09	0.24	0.20
Services	0.84	0.89	0.85	0.56	0.64
World					
Durables	0.09	0.06	0.10	0.21	0.21
Non-Durables	0.20	0.14	0.12	0.35	0.44
Services	0.71	0.79	0.78	0.45	0.35