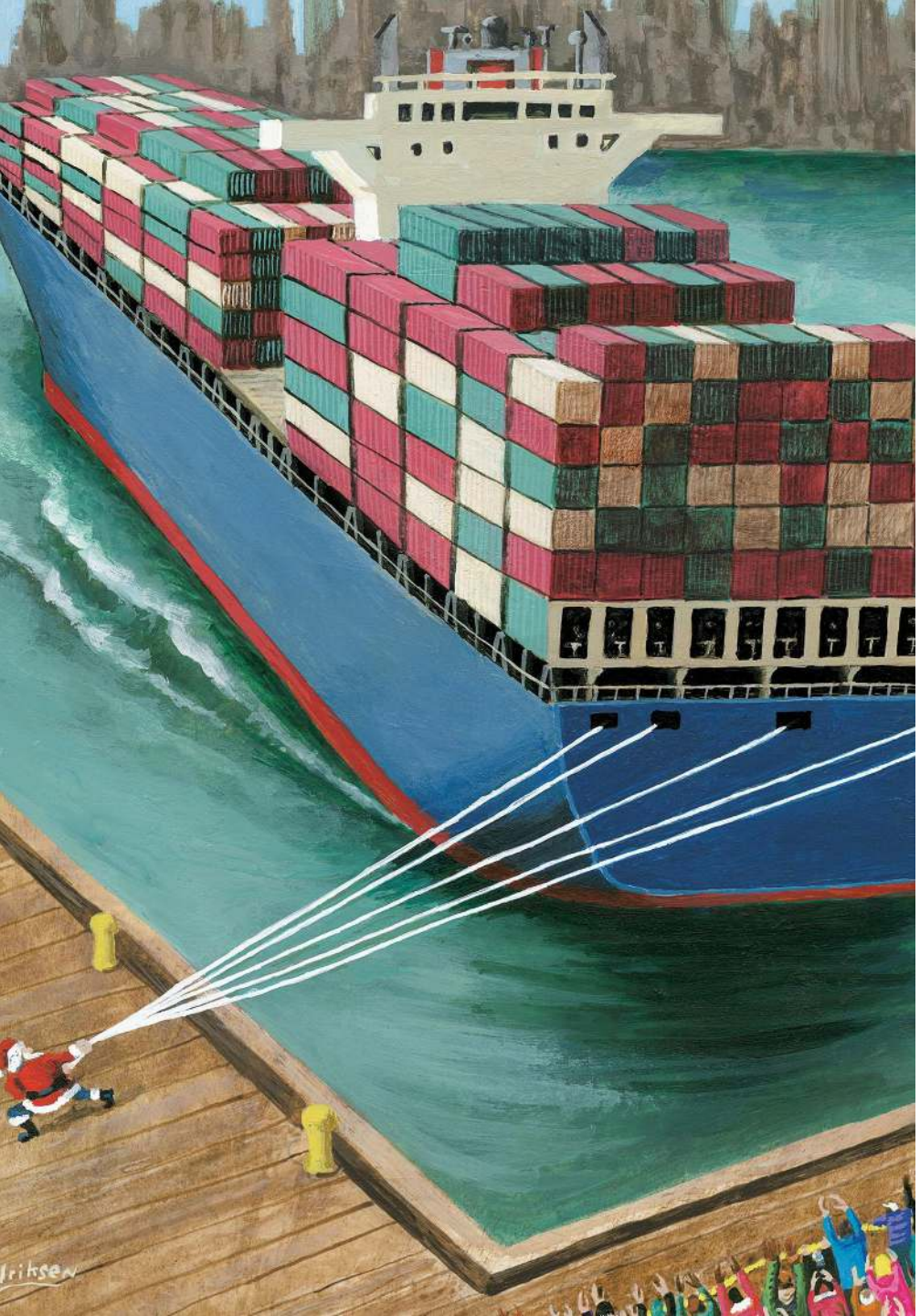

Shipping costs and Inflation

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BCC ANNUAL CONFERENCE, GENEVA

SEPTEMBER 23, 2022

This presentation draws on joint work with Yan Carriere-Swallow, Pragyan Deb, Davide Furceri and Daniel Jimenez.
Views expressed are those of the presenter and should not be attributed to any other institution..

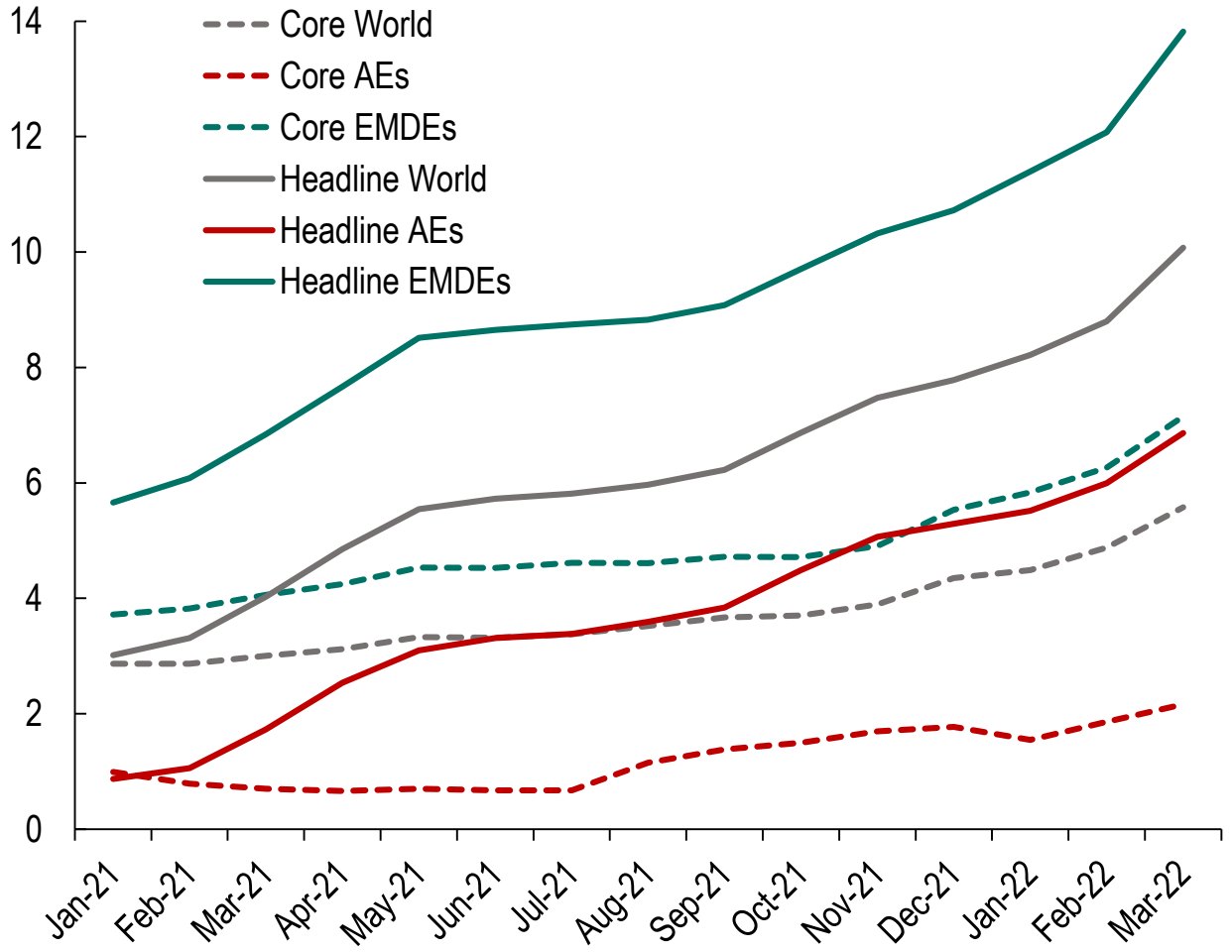
Motivation and Roadmap

- Inflation surge this year took people by surprise
  - Massive revisions to forecasts over the past year for world, AEs, and EMDEs
  - In US, consensus that Fed was behind the curve and is playing catch up
  - Risk of unpleasant spillovers to EMDEs along Fed's tightening path, and deepening debt distress owing to higher borrowing costs and surging dollar
- Drivers of inflation are being scrutinized
  - Too much demand, and too little supply—Econ 101
  - Demand: fiscal stimulus; pandemic savings
  - Supply: pandemic-related supply disruptions; Ukraine war drives commodity price surge
  - Another contributor: global shipping costs—understudied, will focus on this
  - Shipping costs reflect surging demand to transport goods as well as pandemic-induced supply disruptions (personnel; containers)

Rising Inflationary Pressure Since Early 2021

Core and Headline Inflation Rates in AEs and EMDEs

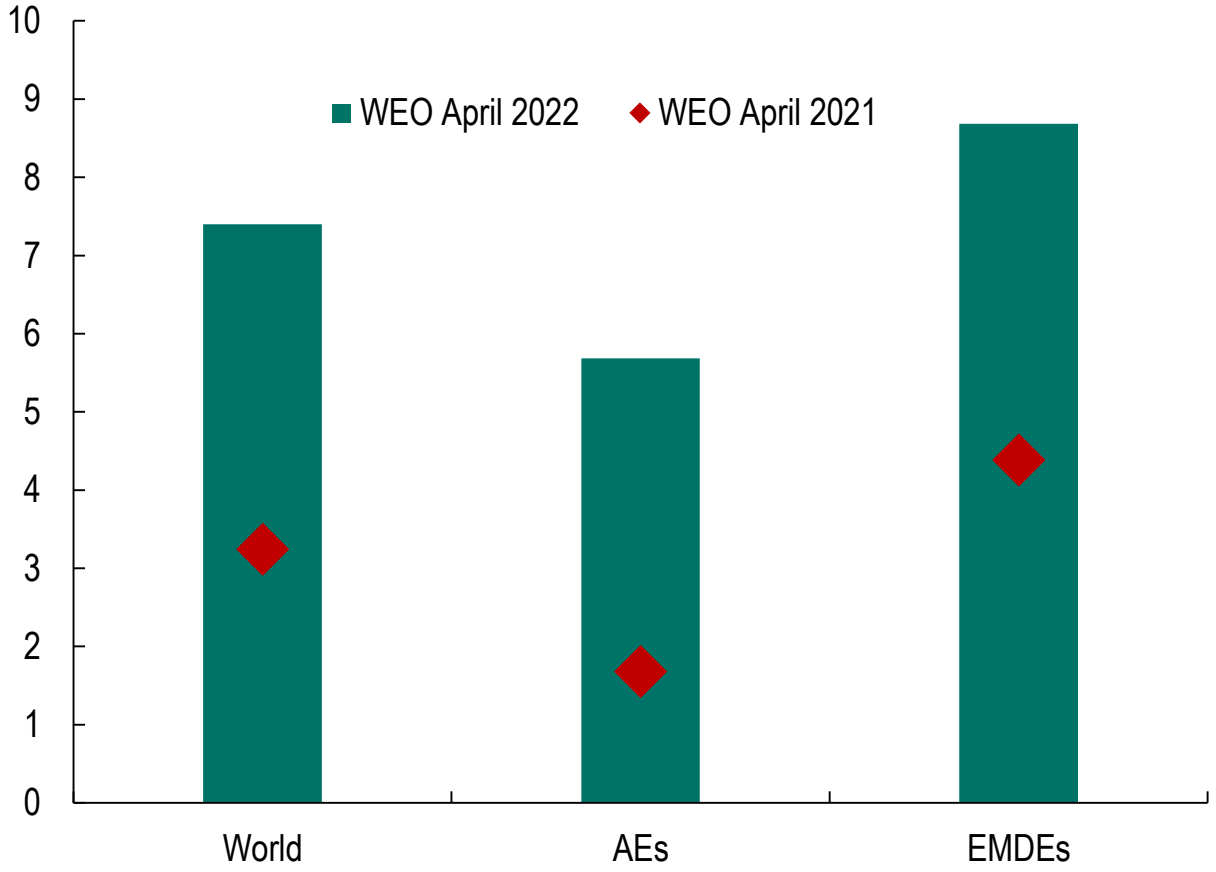
(Percent, CPI Inflation, year-on-year)



Source: Haver Analytics.

Inflation Forecasts for 2022

(Percent)



Source: World Economic Outlook.

Two correlates of inflation surge: freight costs & commodity prices

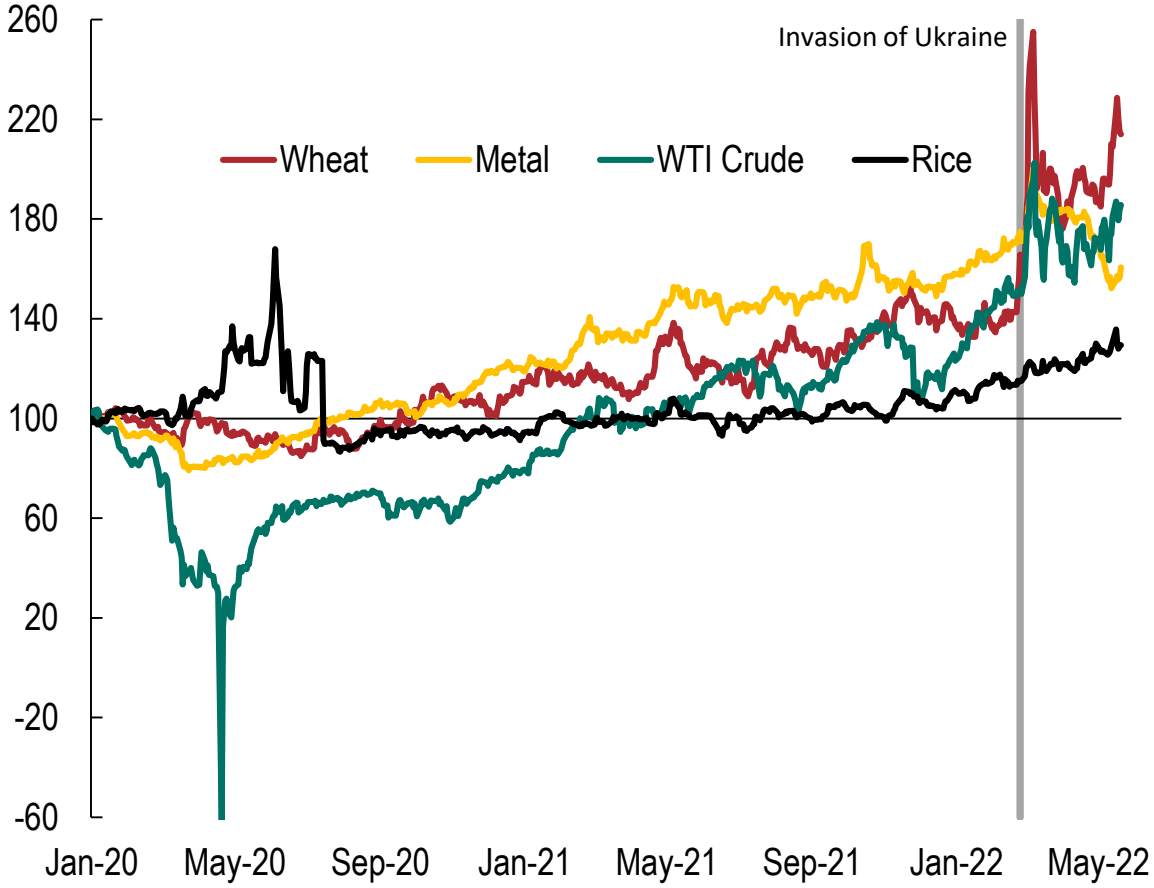
Freight Costs

(Index; 2020=100)

Source: Bloomberg and Haver Analytics.

Commodity Prices

(Index; April 2020=100)



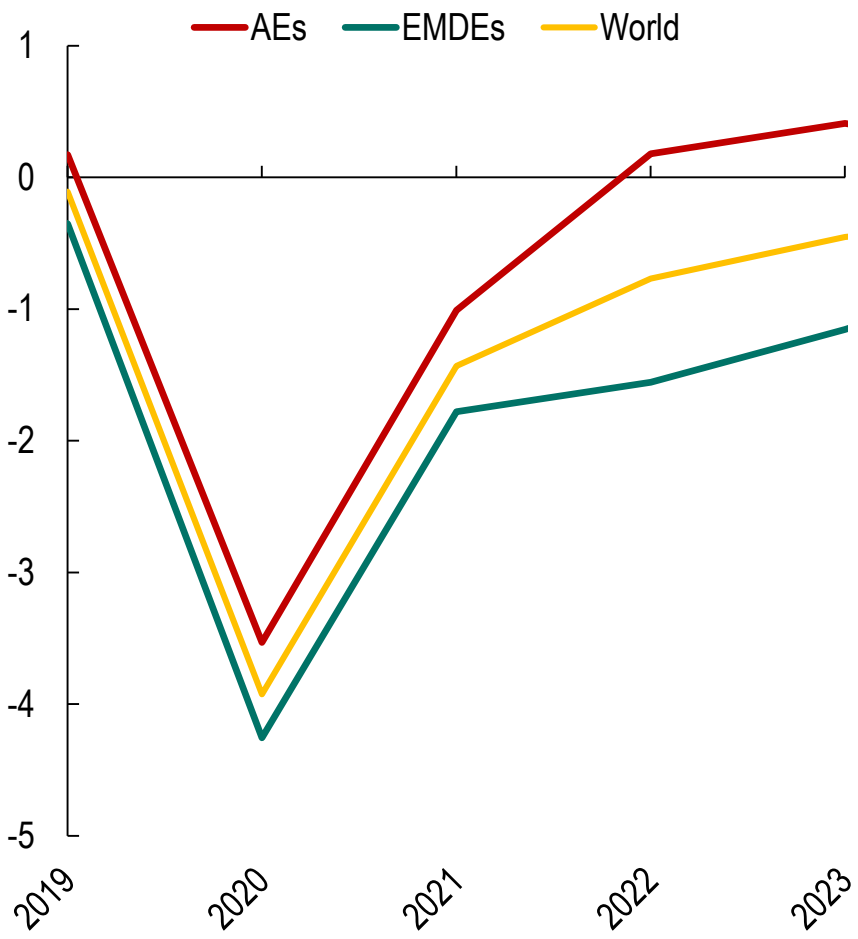
Source: Bloomberg LLP.

Note: Metals index based on Bloomberg Base Metals Spot Price Commodity Index with the following weights: Aluminum (45%), Copper (25%), Nickel (2%), Lead (12%), Zinc (15%), and Tin (1%). Data as of March 31, 2022.

More Difficult Monetary Policy Trade-offs Particularly in EMDEs

Output Gaps

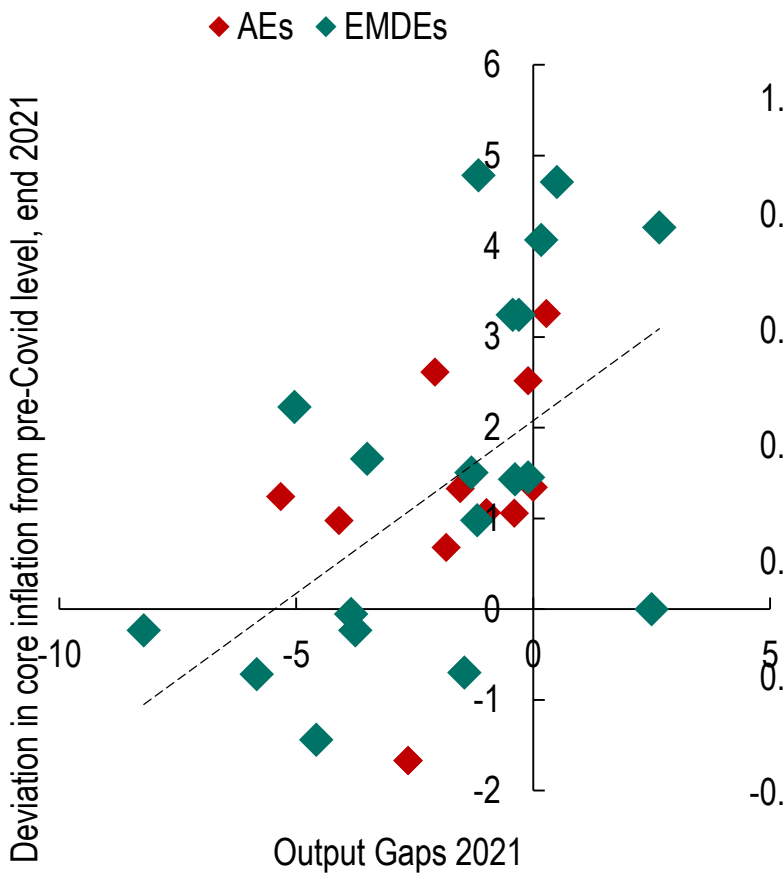
(Percent of GDP; weighted average)



Sources: IMF World Economic Outlook.

Core Inflation vs Output Gaps

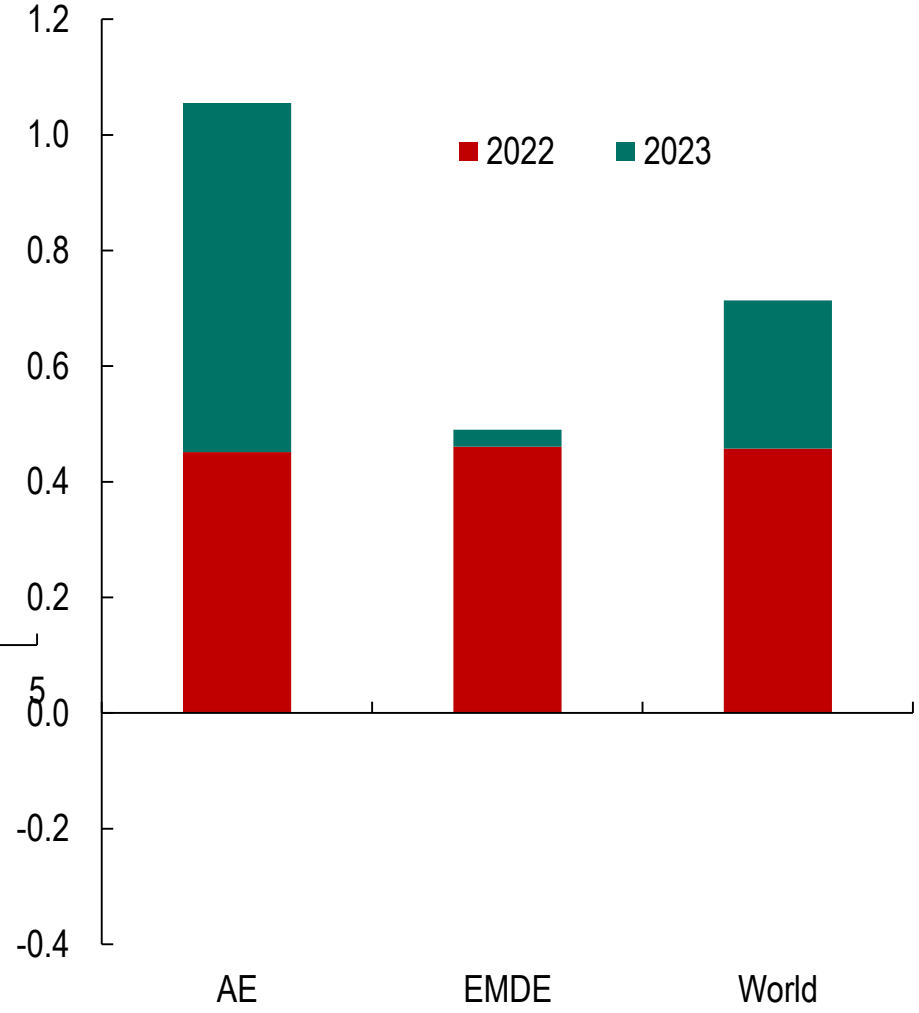
(Percent)



Source: IMF World Economic Outlook.
Notes: Core inflation is Headline CPI excluding food and energy.

Projected Changes in Policy Rates

(Change relative to previous year; simple-average)

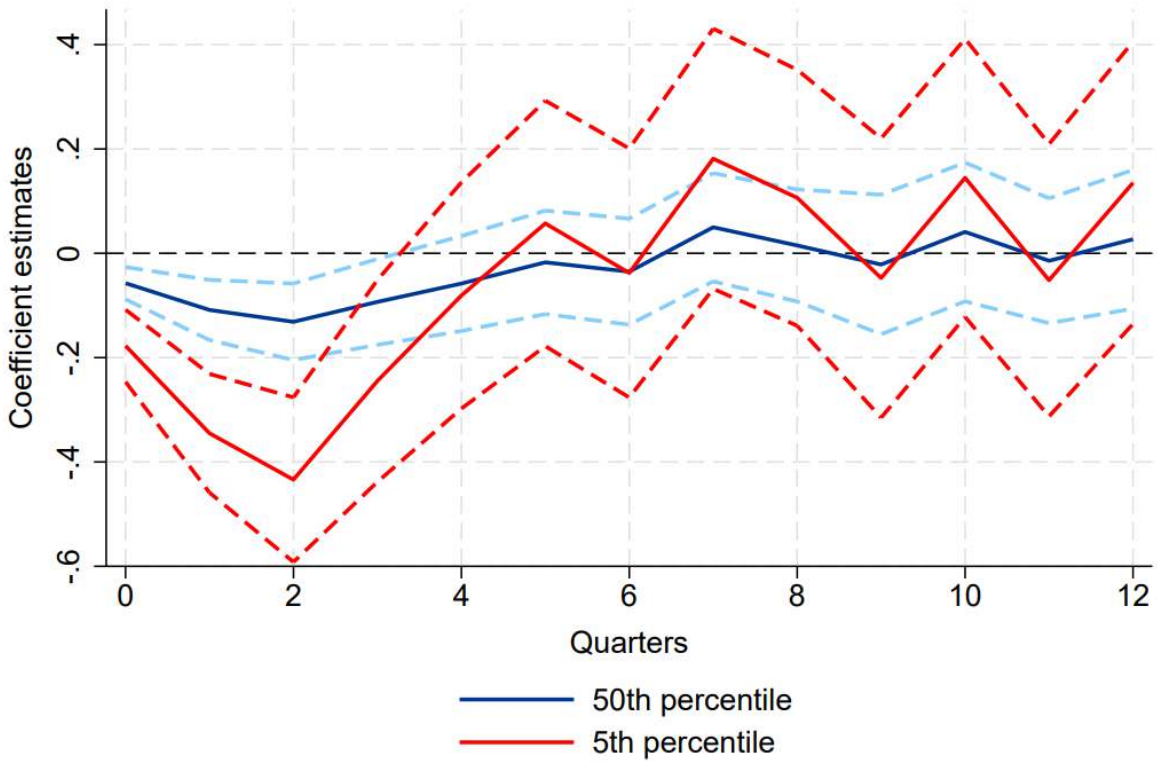


Source: World Economic Outlook and Bloomberg.

Growth Spillovers from US Tightening Amplify Left-tail Outcomes…

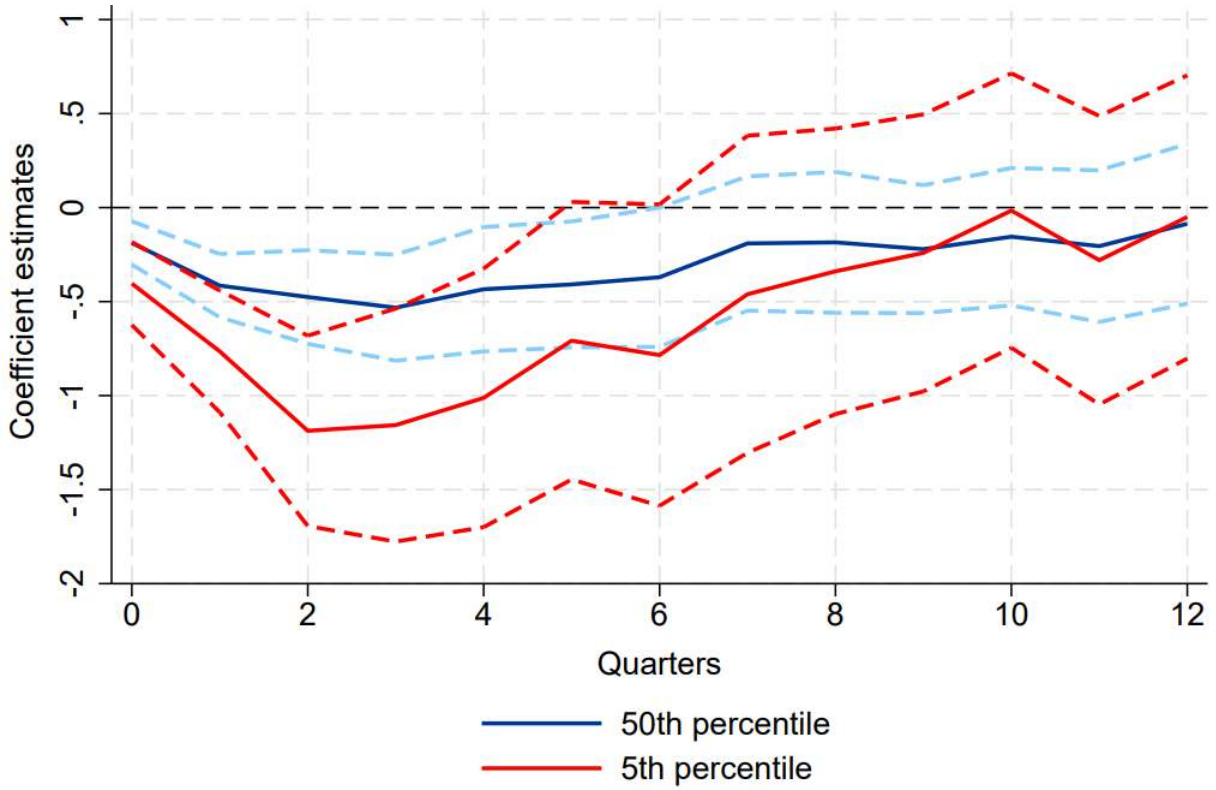
Real GDP: Cumulative Response to a One-Standard-Deviation US Monetary Policy Shock

(Percent)



Real Investment: Cumulative Response to a One-Standard-Deviation US Monetary Policy Shock

(Percent)



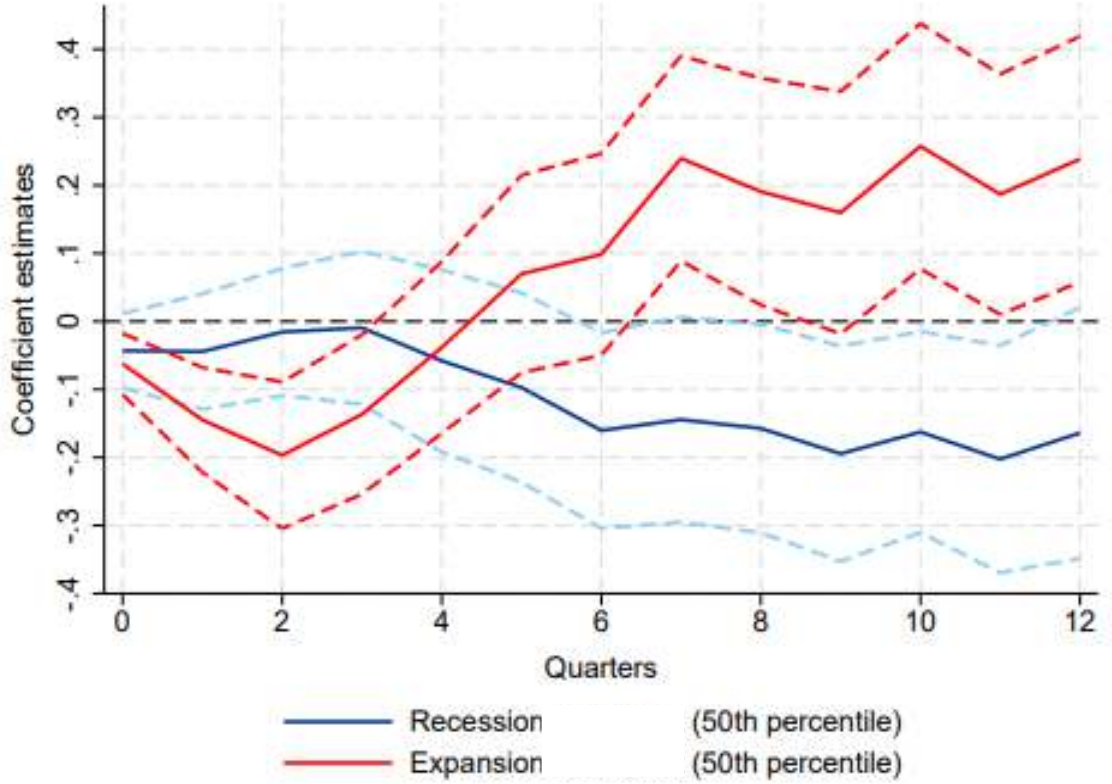
Source: Arbatli-Saxegaard, Firat, Furceri, Gonzalez Dominguez, Ostry, Peiris and Verrier (2021).

Notes: Figures show the estimated response of real GDP and investment in other countries to a one-standard deviation positive monetary policy shock (25 basis points) in the US using panel quantile regressions and local projections. In particular, the blue(red) lines show estimates of $\beta_{h,q}$ in the following equation: $y_{t+\mathrm{h},i} - y_{t-1,i} = \alpha_{i,h,q} + \beta_{h,q} s_t + \theta_{h,q} Z_{t,i} + \varepsilon_{t+h,i}$ for different horizons $h = 0 \ldots 12$ and for q=50th (5th) percentile. $Z_{t,i}$ include lags of the dependent variable. Dashed lines show +/- 2 standard deviations. Standard errors are calculated using block bootstrap methods.

...And are More Persistent in Periods of Economic Weakness

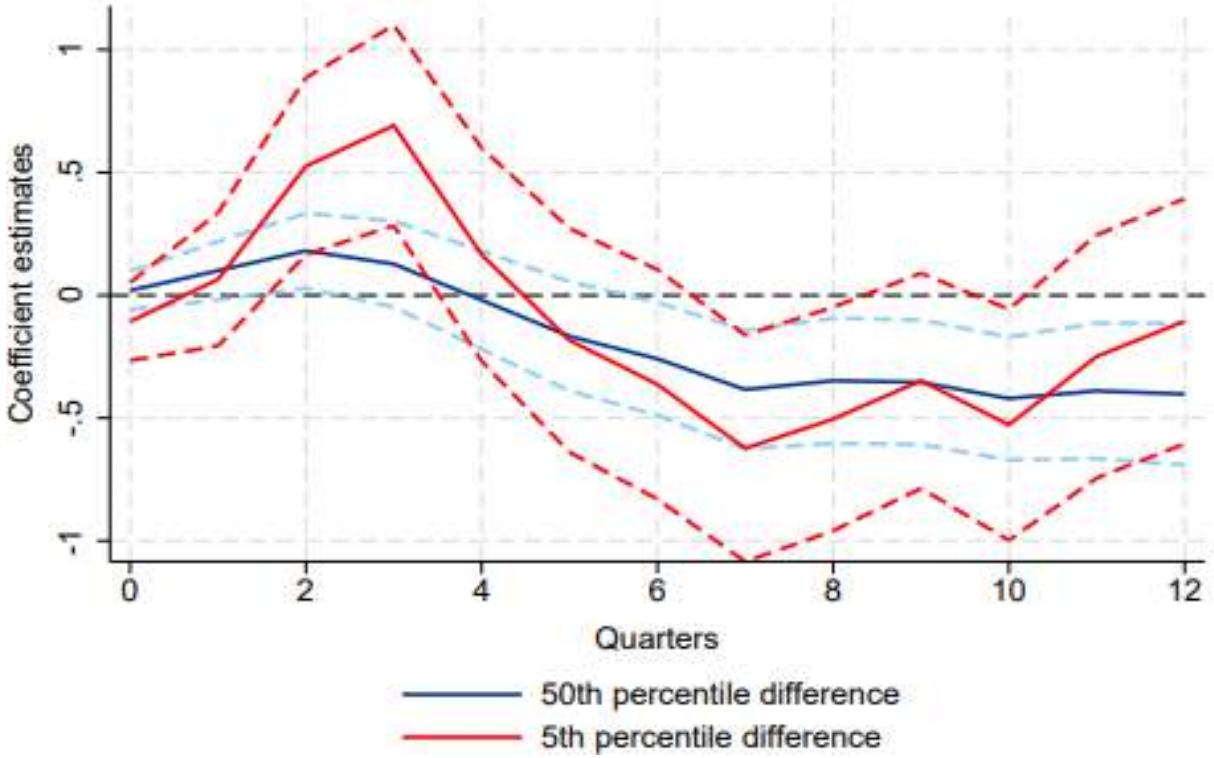
Real GDP: Impulse Responses during Recession vs Expansion

(Percent)



Real GDP: Diff. between Recession and Expansion on 5th and 50th Percentiles

(Percent)

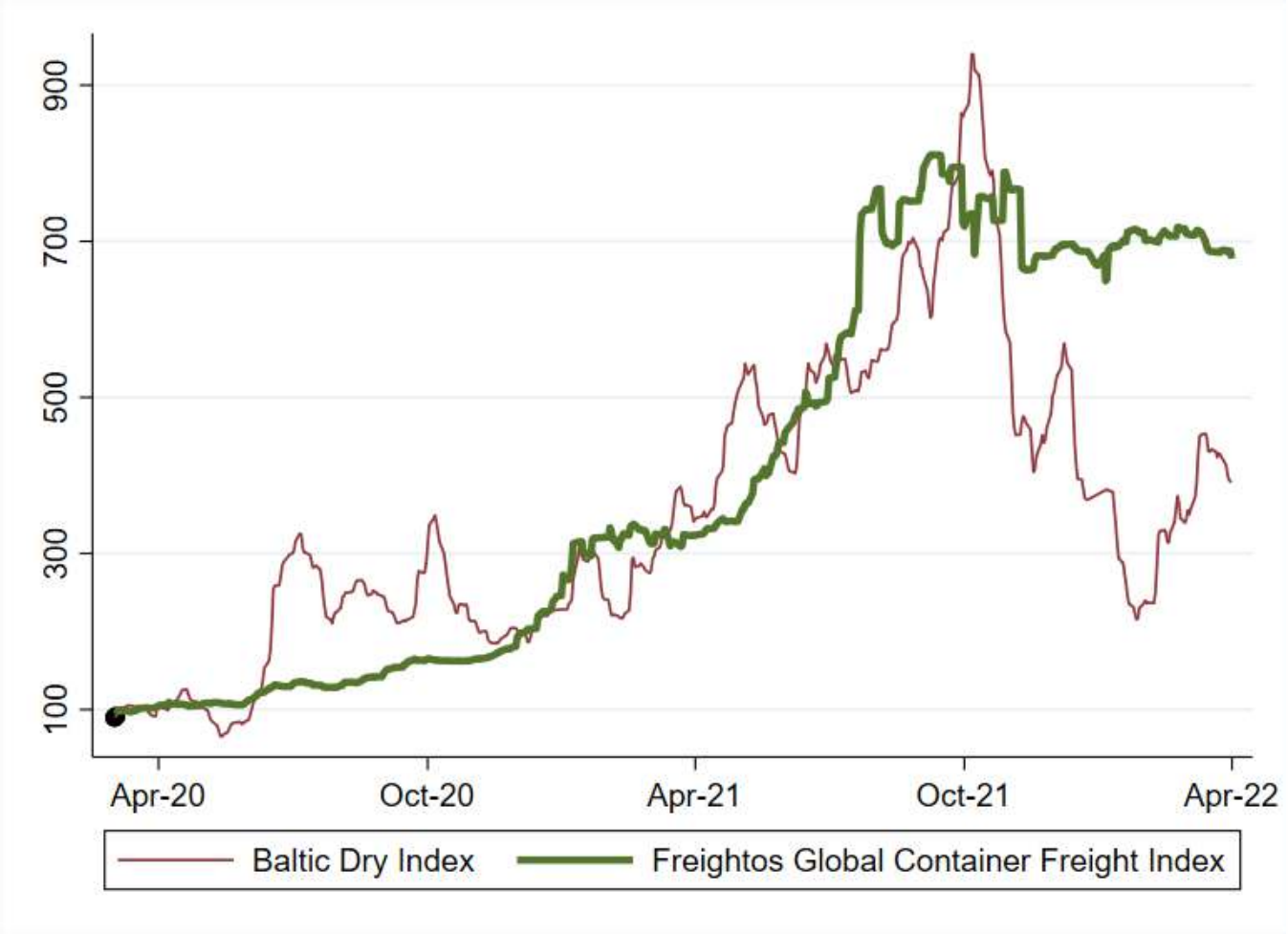


Source: Arbatli-Saxegaard, Firat, Furceri, Gonzalez Dominguez, Ostry, Peiris and Verrier (2021).

Notes: Figures show the estimated response of real GDP in other countries to a one-standard deviation positive US monetary policy shock (25 basis points) using panel quantile regressions and local projections under different states of the business cycle (recession versus expansion) (left figure) and the difference between the impact in recession and expansion states (right figure) for 50th and 5th percentiles. State dependence is modelled using a smooth transition function. In particular, the blue(red) lines show estimates of $\beta_{h,q}^{R}$ ($\beta_{h,q}^{E}$) in the following equation $y_{t+\mathrm{h},i} - y_{t-1,i} = \left(1 - F\left(\Delta y_{i,t}\right)\right)\left(\alpha_{i,h,q}^{E} + \beta_{h,q}^{E} s_t +\right.$

Cost of shipping has surged (300-700 percent) during the pandemic

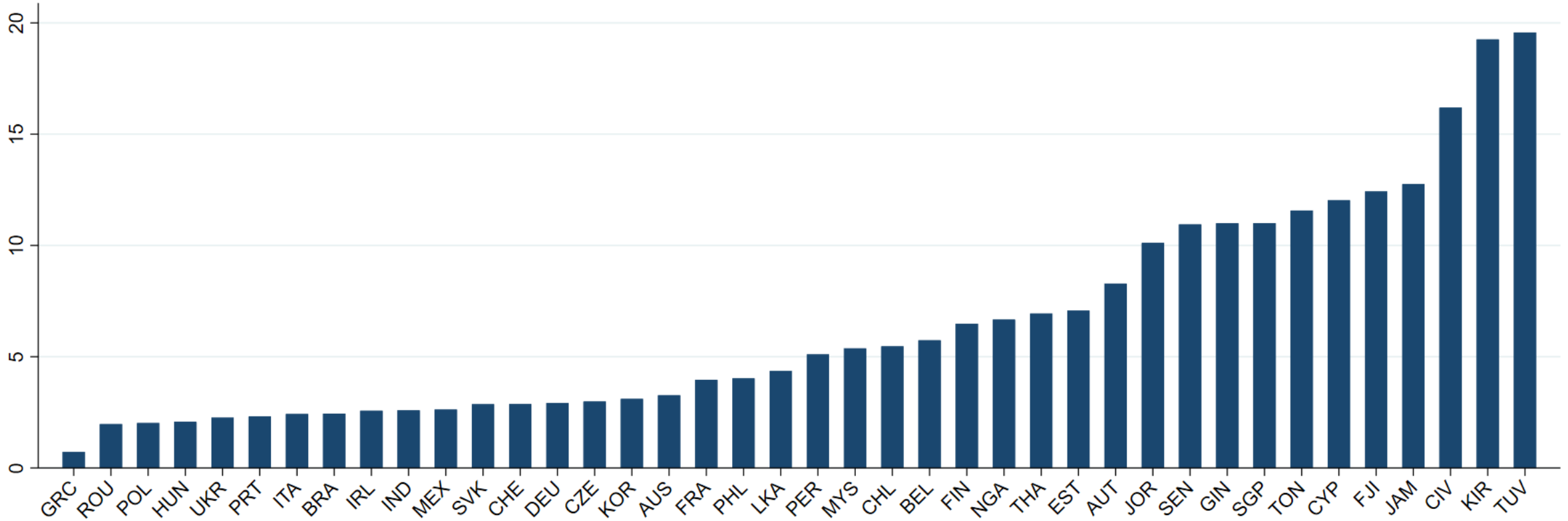
Freight Costs Have Spiked During the Pandemic



Note: Indices rebased to March 2020=100.
Source: Bloomberg, Haver Analytics, and IMF staff calculations.

Freight costs average about 7 percent of import value and up to 15 percent in some cases

Freight costs for imports (percent of value of goods imported; 2015-19)

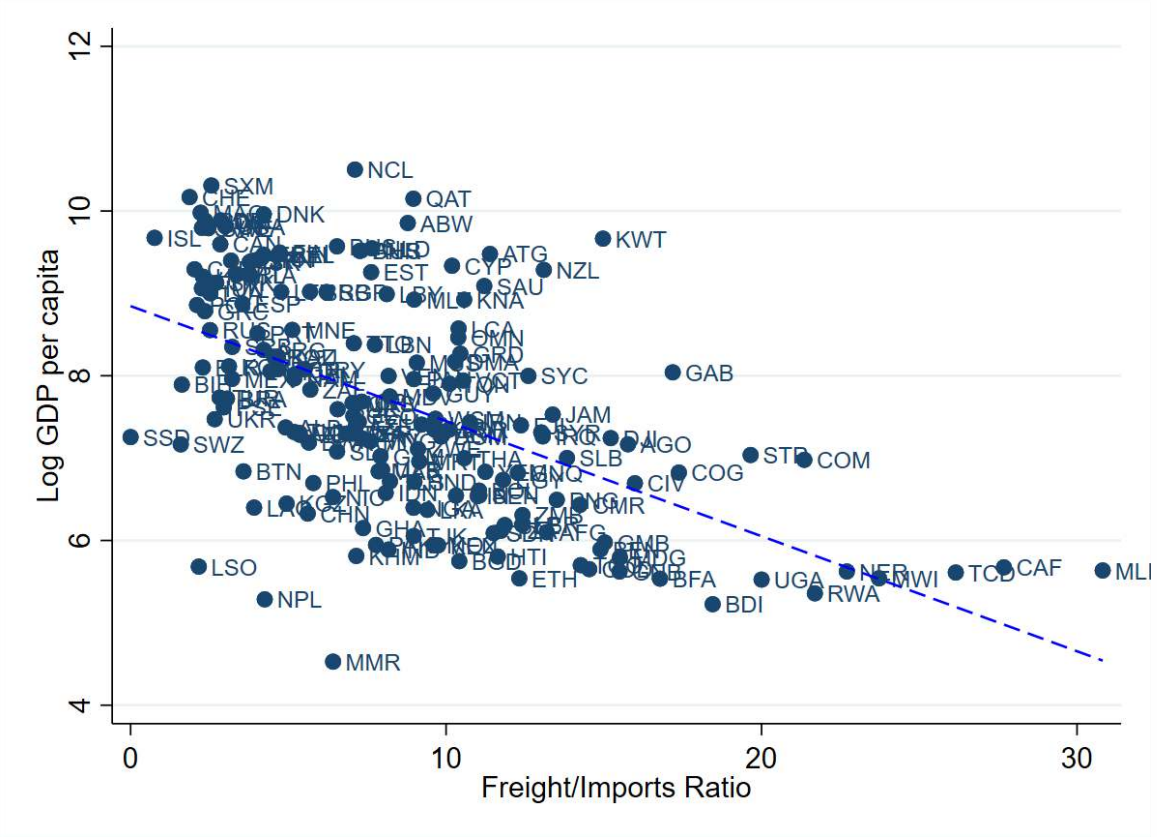


Source: IMF World Economic Outlook and Balance of Payments Statistics.

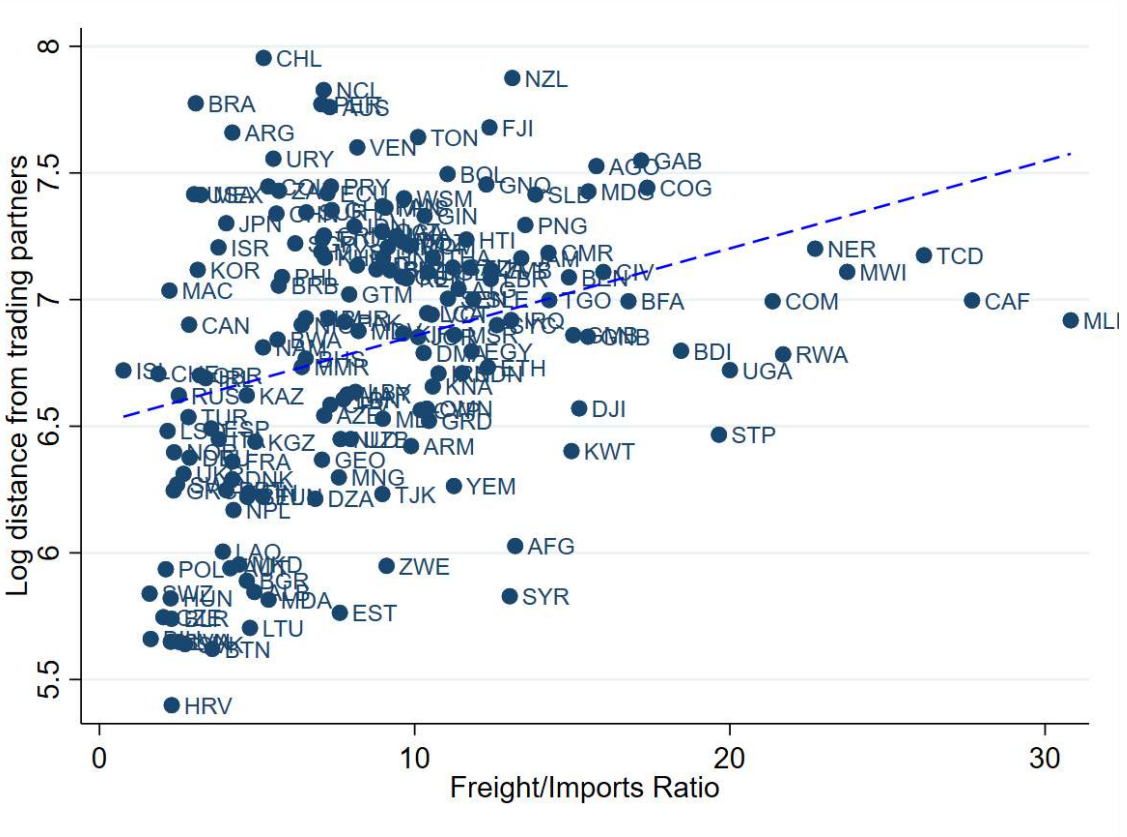
Freight costs are more important for poor & remote countries

Correlates of Freight Costs (2015-19)

GDP per capita



Distance from trading partners



Source: IMF World Economic Outlook and Balance of Payments Statistics.

Areas of inquiry

1. What is the pass-through of shocks to shipping costs to domestic prices—import prices, producer prices, headline consumer prices, core consumer prices, measures of inflationary expectations?

2. How does the transmission of freight costs shocks differ from that of oil and food price shocks?

3. How does the pass-through vary depending on country characteristics and monetary policy frameworks?

4. These questions have not received much attention in the literature—seemed worth studying given the behavior of shipping costs over the past year

Plain Vanilla Empirical Framework: IRFs estimated from LPs

We estimate the following local projections specification in a sample of 46 countries from 1992 to 2021:

$$\pi_{i,t+k} = \alpha_i^k + \sum_{j=1}^{l} \gamma_j^k \, \pi_{i,t-j} + \sum_{j=0}^{l} \beta_j^k w_{t-j} + \sum_{j=0}^{l} \theta_j X_{t-j}^i + \varepsilon_{i,t}^k$$

$\pi_{i,t+k}$ Price inflation in country *i (year-on-year percent change in price index)*

α_i^k Country fixed effects

w_{t-j} Baltic Dry Index *(month-on-month percent change)*

X_{t-j}^i Vector of control variables:

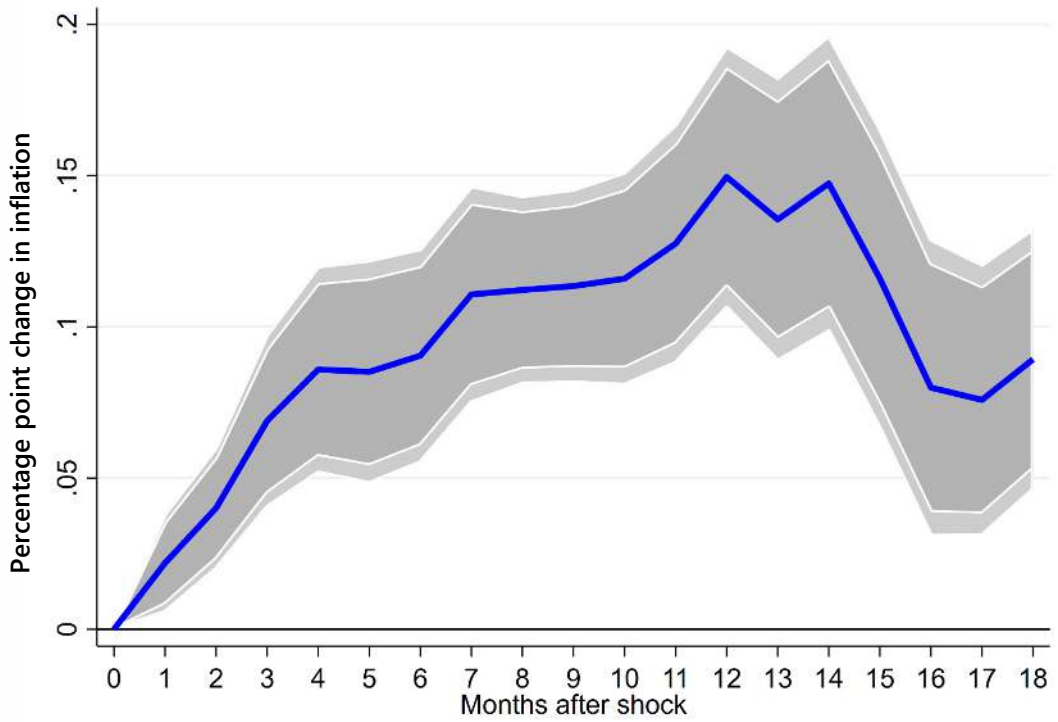
- World oil price *(WTI; month-over-month percent change)*
- World food price index *(GDS; month-over-month percent change)*
- Country *i* output gap *(WEO; annual)* or industrial production *(Haver Analytics; month-over-month percent change)*
- World output gap *(WEO; annual)*

Baseline Results

Response of headline inflation to an increase in shipping costs

	k=1	*k*=3	*k*=6	*k*=12	*k*=18
Shipping costs	0.01705*	0.06409***	0.08632***	0.14667***	0.08627***
	(0.00943)	(0.01646)	(0.01935)	(0.02234)	(0.02218)
Output gap	-0.00133	0.03963	0.17557**	0.19606**	0.11413*
	(0.04282)	(0.07940)	(0.08363)	(0.09711)	(0.06651)
World output gap	-0.00319	0.11551***	0.13096**	0.04840	-0.25255***
	(0.02715)	(0.03472)	(0.04897)	(0.04118)	(0.04761)
World oil price	0.14788***	0.14877***	0.11362***	0.11517***	-0.05282**
	(0.01320)	(0.01883)	(0.02004)	(0.02040)	(0.02138)
World food price	0.04292***	0.10423***	0.18127***	0.15720***	0.08792***
	(0.01276)	(0.02112)	(0.02568)	(0.02169)	(0.01774)
N	10,337	10,275	10,117	9,787	9,460
R^2	0.88	0.75	0.58	0.24	0.17

Note: Coefficients and standard errors have been rescaled to reflect a one-standard-deviation change in each independent variable. Heteroskedasticity-robust standard errors clustered at the country level are reported in parentheses. ***, **, and * denote statistical significance at 99, 95, and 90 percent confidence levels.

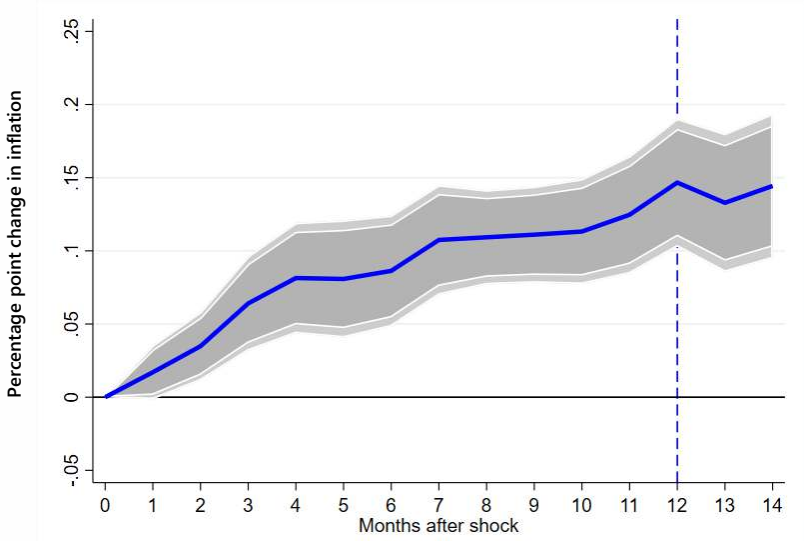


Note: The figure presents the impact of a one standard deviation change in world shipping costs (+22 percentage points) on headline inflation in the baseline sample of 46 economies over period of 1992 to 2021. The solid line is the impulse response function; the dark shaded region indicates the 90 percent confidence band; the light shaded region indicates the 95 percent confidence band. *t*=0 denotes the year of the shock.

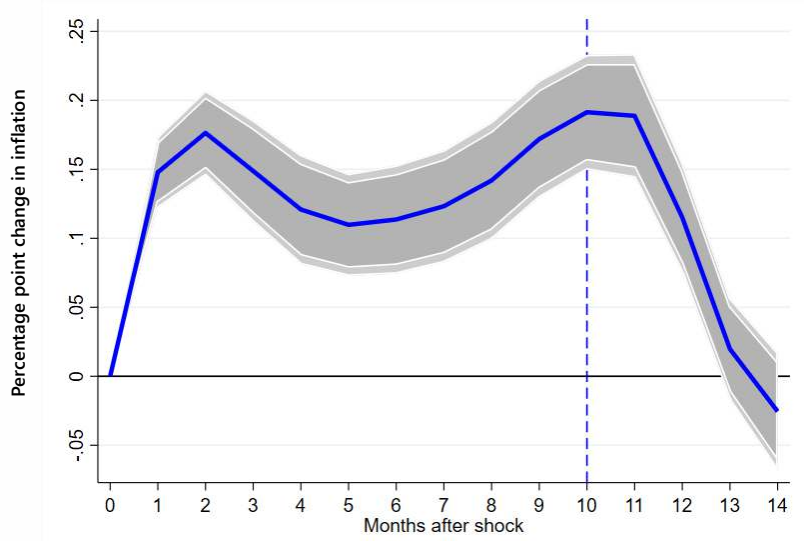
Shocks have similar inflation impact, but different persistence

Response of headline inflation following shock to:

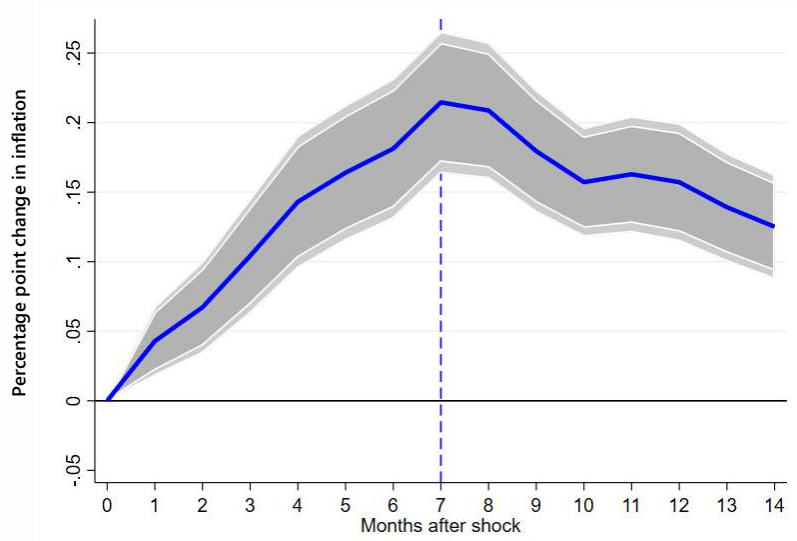
Shipping costs



World oil price



World food price



Note: The figure presents the impact of a one standard deviation increase in each shock variable on domestic headline inflation in the baseline sample of 46 economies over period of 1992 to 2021. The solid line is the impulse response function; the dark shaded region indicates the 90 percent confidence band; the light shaded region indicated the 95 percent confidence band. *t*=0 denotes the year of the shock.

Instrumenting BDI with Suez Canal Closure Yields Similar Results

- We instrument for changes in the Baltic Dry index using closures of the Suez Canal due to accidents that are exogenous to global demand

- Episodes:
  - Tropic Brilliance oil tanker aground
    - November 2004 (3 days)
  - Cargo ship blockage due to sandstorm
    - February 2006 (1 day)
  - Ever Given container ship grounded
    - March 2021 (6 days)

- Construct the instrument based on the number of days in the month that the canal was blocked. Robust to alternatives such as 0/1 dummy for month of blockage or accounting for amount of cargo affected.

- *Exogenous*: Events related to navigational errors and severe weather events—not related to global demand.

- *Relevant*: 30 percent of global container traffic transits through the Suez Canal. Finding alternate routes asks unexpected costs and thousands of miles onto ship itineraries.

IV approach yields similar peak impact, and more persistence

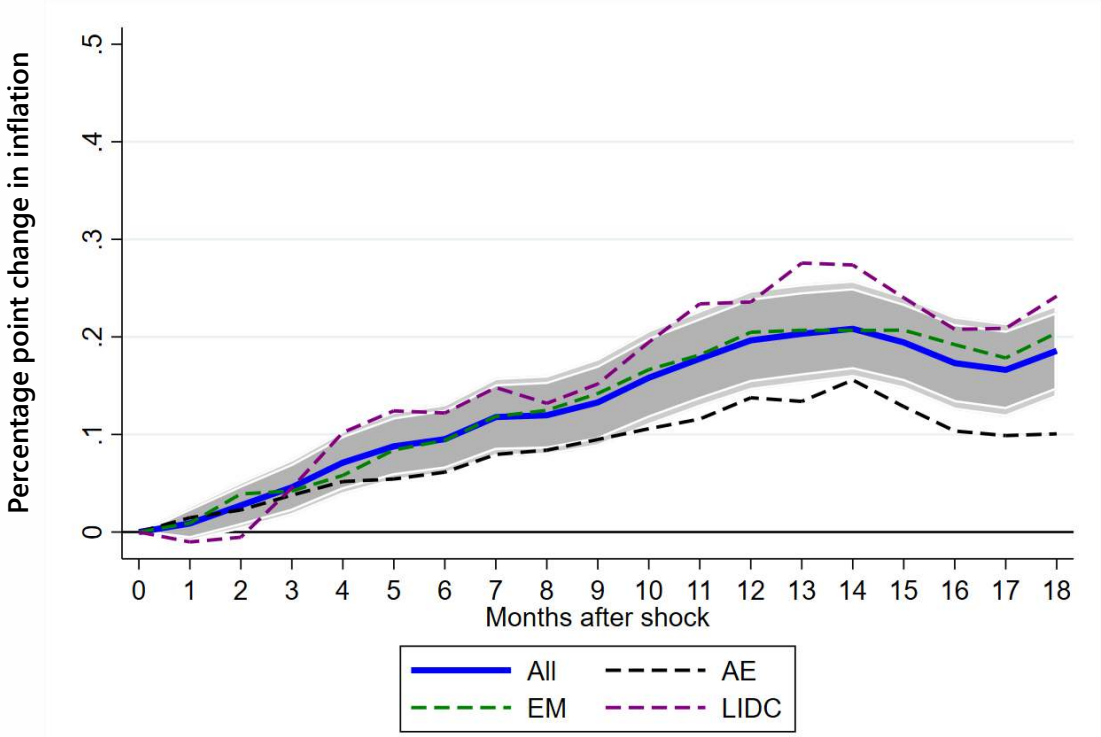
	k=1	*k*=3	*k*=6	*k*=12	*k*=18
Fitted shipping costs	-0.0038	0.0249	0.1072***	0.0991**	0.1315***
	(0.0105)	(0.0173)	(0.0314)	(0.0457)	(0.0366)
Output gap	-0.0138	-0.0165	0.0692	0.0794	0.0503
	(0.0585)	(0.1011)	(0.1610)	(0.1288)	(0.0652)
World output gap	-0.0097	0.0707	-0.1115	-0.2965	-0.7268***
	(0.0356)	(0.0626)	(0.0942)	(0.1934)	(0.1438)
World oil price	0.1393***	0.0837	-0.0523	-0.0771	-0.1602***
	(0.0314)	(0.0839)	(0.1447)	(0.1221)	(0.0362)
World food price	0.0639***	0.1280***	0.1484**	0.1861	-0.0465
	(0.0175)	(0.0371)	(0.0620)	(0.1313)	(0.0482)
N	10,409	10,371	10,247	9,983	9,714
R^2	0.99	0.96	0.85	0.51	0.09
1st stage: F-stat	60.4	63.5	60.5	60.4	32.5

Note: Heteroskedasticity-robust standard errors clustered at the country level are reported in parentheses. ***, **, and * denote statistical significance at 99, 95, and 90 percent confidence levels. Coefficients and standard errors have been rescaled by the standard deviation of each independent variable.

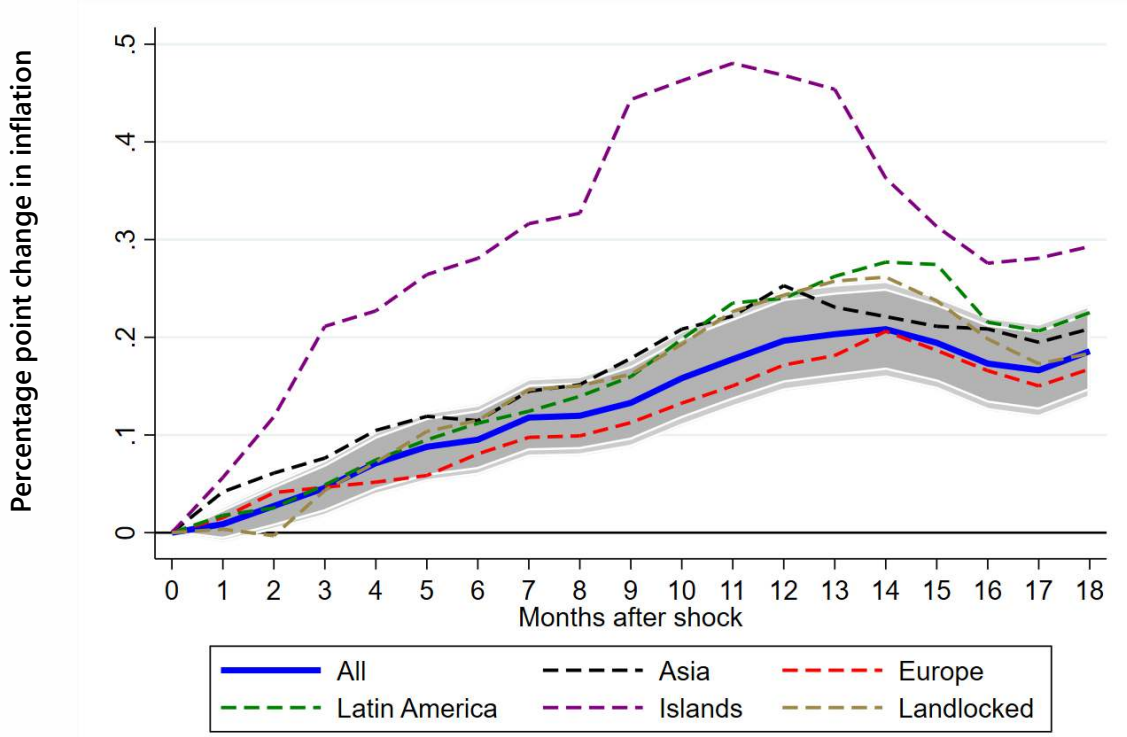
Heterogeneity Across Country Groups, with larger effect on islands

Response of headline inflation

By income classification



By geographic region

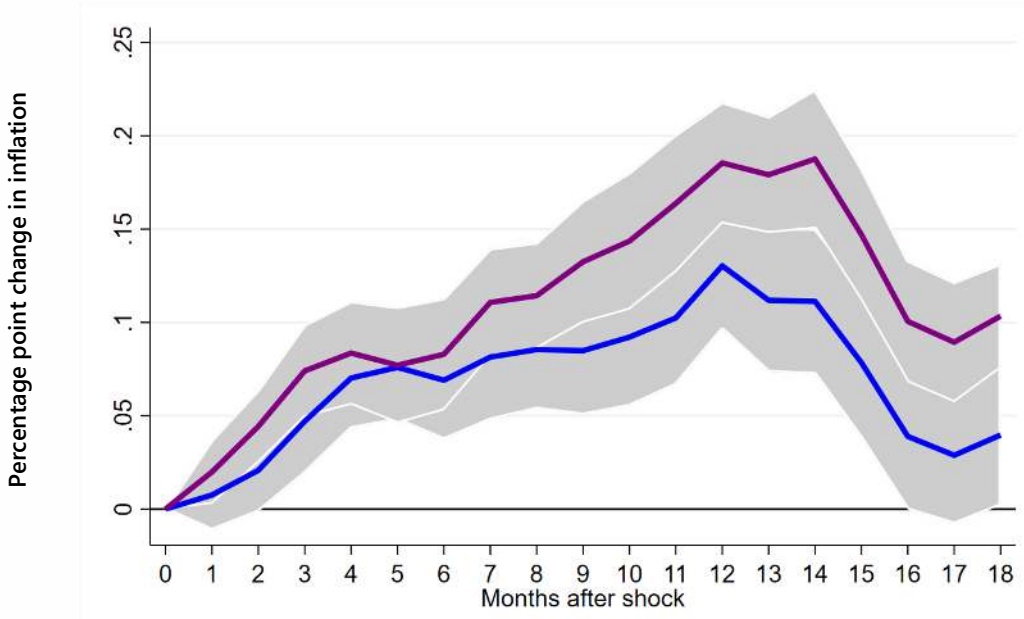


Note: The figure presents the impact of a one standard deviation increase in world shipping costs on domestic headline inflation in the broader sample of 143 economies over period of 1985 to 2021. The solid line is the impulse response function for the full sample; the dark shaded region indicates the 90 percent confidence band; the light shaded region indicates the 95 percent confidence band. t=0 denotes the year of the shock.

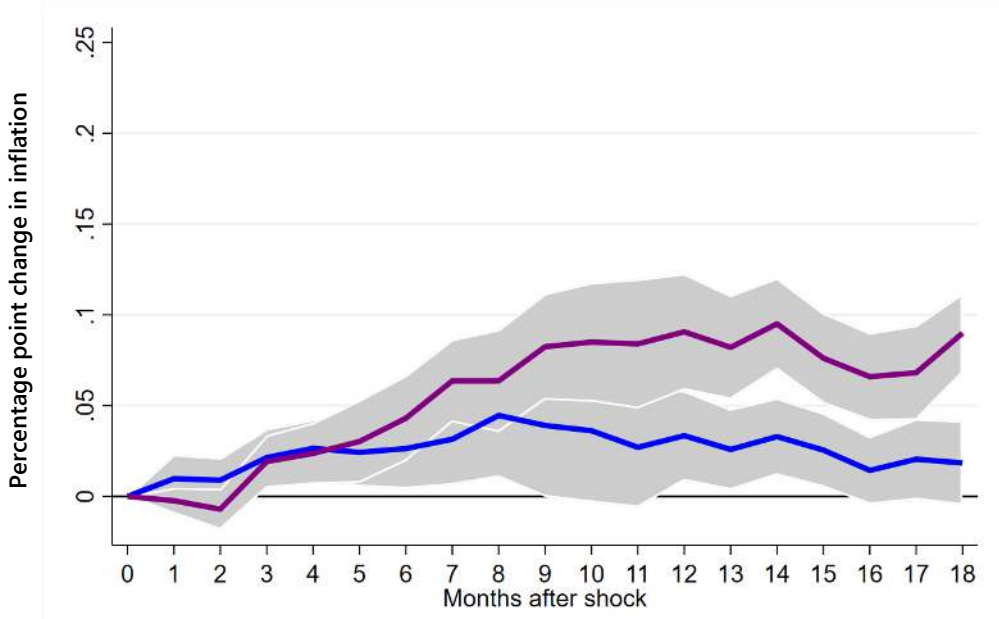
Role of Import Share in Consumption

Responses interacted by import share of domestic consumption

Response of headline inflation



Response of core inflation



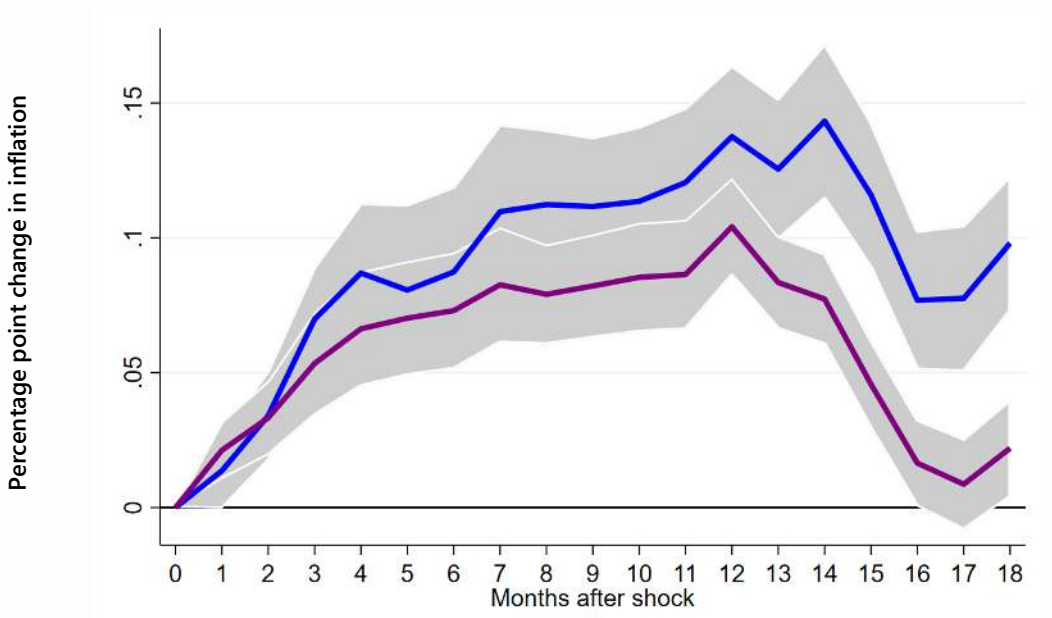
Low import share High import share

Note: The figure presents the impact of a one standard deviation increase in world shipping costs on domestic price indices in the baseline sample of 46 economies over period of 1992 to 2021. We augment the baseline by introducing dummy variables $I_b(Y)$ which denotes bins of data defined over the empirical distribution of each state variable *Y*. The estimated equation is $\pi_{i,t+k} = \alpha_i^k + \vartheta_{i,t}^k + \sum_{j=1}^{l} \gamma_j^k \pi_{i,t-j} + \sum_{j=0}^{l} \sum_b \beta_j^{b,k} I_b(Y) w_{t-j} + \sum_{j=0}^{l} \theta_j X_{t+j}^i + \varepsilon_{i,t}^k$. The solid line is the impulse response function; the dark shaded region denotes +/- 1 standard error. *t*=0 denotes the year of the shock.

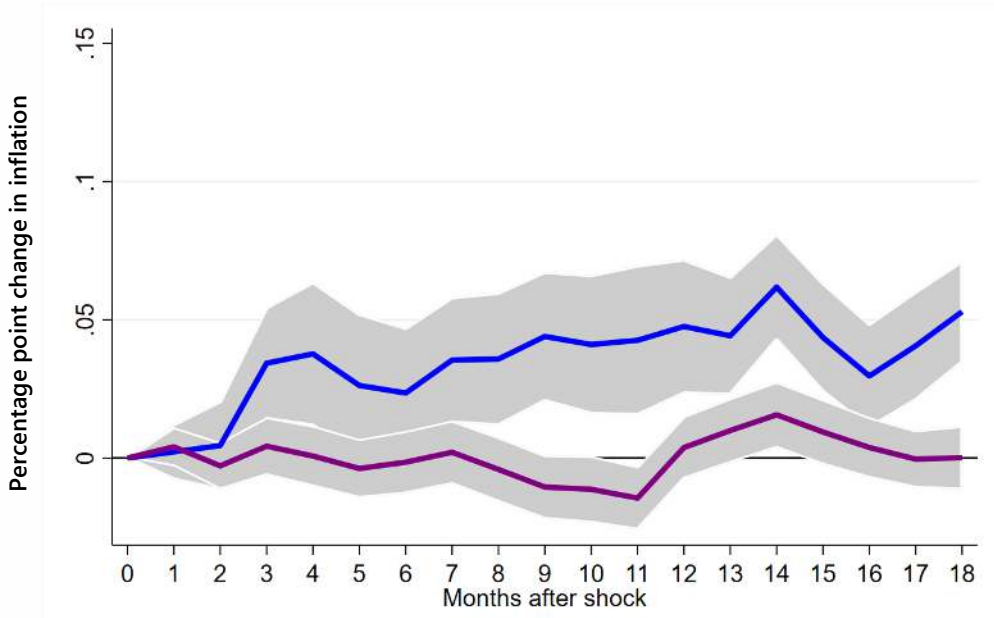
Role of Backward GVC Linkages

Responses interacted with backward GVC linkages

Response of headline inflation



Response of core inflation

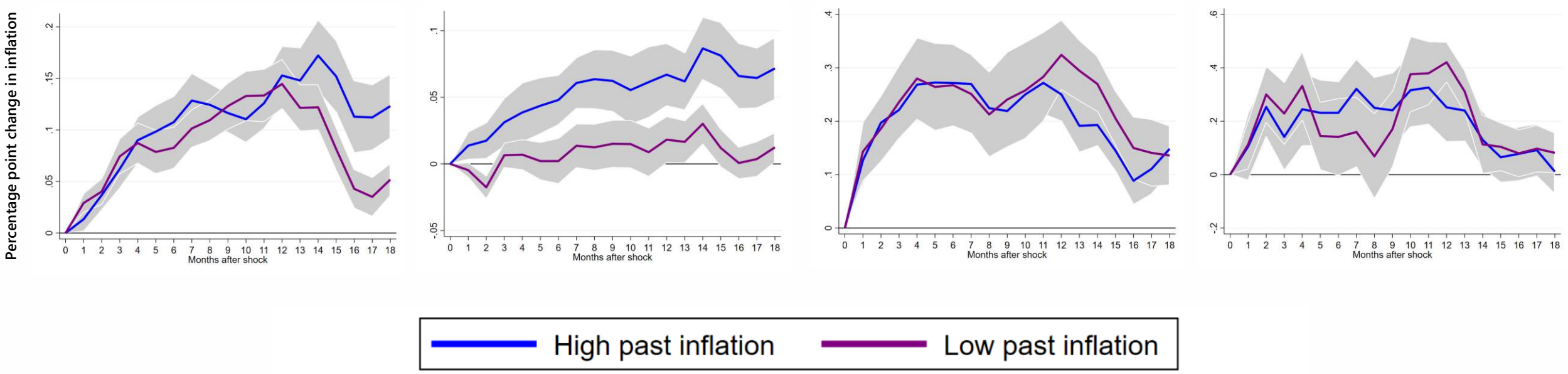


Note: The figure presents the impact of a one standard deviation increase in world shipping costs on domestic price indices in the baseline sample of 46 economies over period of 1992 to 2021. We augment the baseline by introducing dummy variables $I_b(Y)$ which denotes bins of data defined over the empirical distribution of each state variable *Y*. The estimated equation is $\pi_{i,t+k} = \alpha_i^k + \vartheta_{i,t}^k + \sum_{j=1}^{l} \gamma_j^k \pi_{i,t-j} + \sum_{j=0}^{l} \sum_b \beta_j^{b,k} I_b(Y) w_{t-j} + \sum_{j=0}^{l} \theta_j X_{t+j}^i + \varepsilon_{i,t}^k$. The solid line is the impulse response function; the dark shaded region denotes +/- 1 standard error. *t*=0 denotes the year of the shock.

Role of Past Inflation Performance

Responses interacted by average inflation in 1990s

Headline inflation *Core inflation* *Producer price inflation* *Import price inflation*

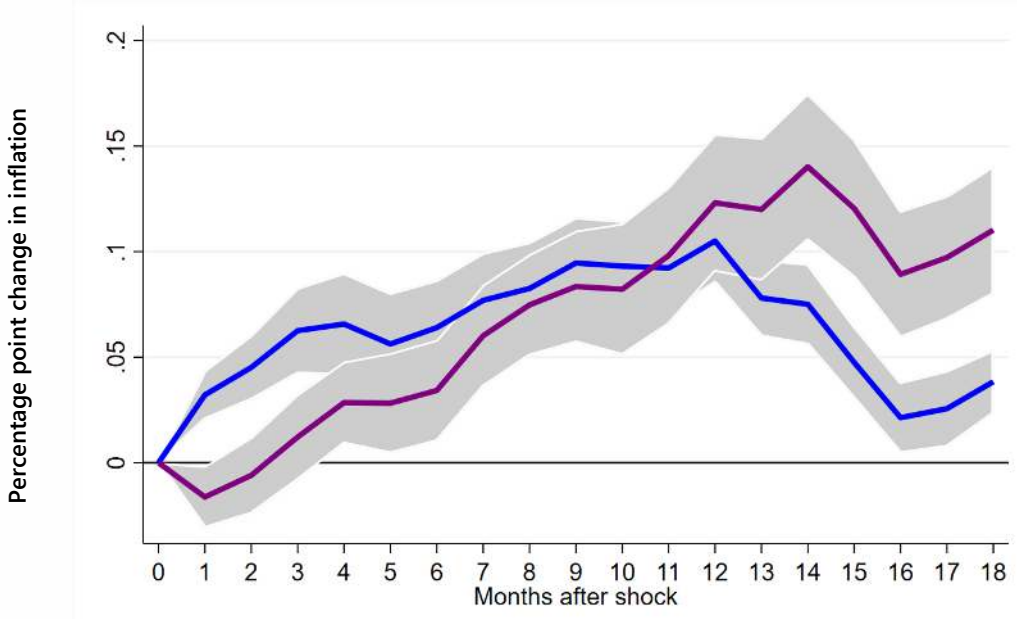


Note: The figures present the impact of one standard deviation increase in shipping costs on measures of domestic price inflation in the baseline sample of 46 economies, where the shipping costs variable has been interacted with a dummy variable indicating bins of data over the average inflation rate in the 1990s. The solid purple lines are the impulse response functions (IRF) for economies with past inflation below the median; the blue lines are the IRFs for economies with past inflation above the median. The shaded regions indicate one standard error bands. *t*=0 denotes the year of the shock..

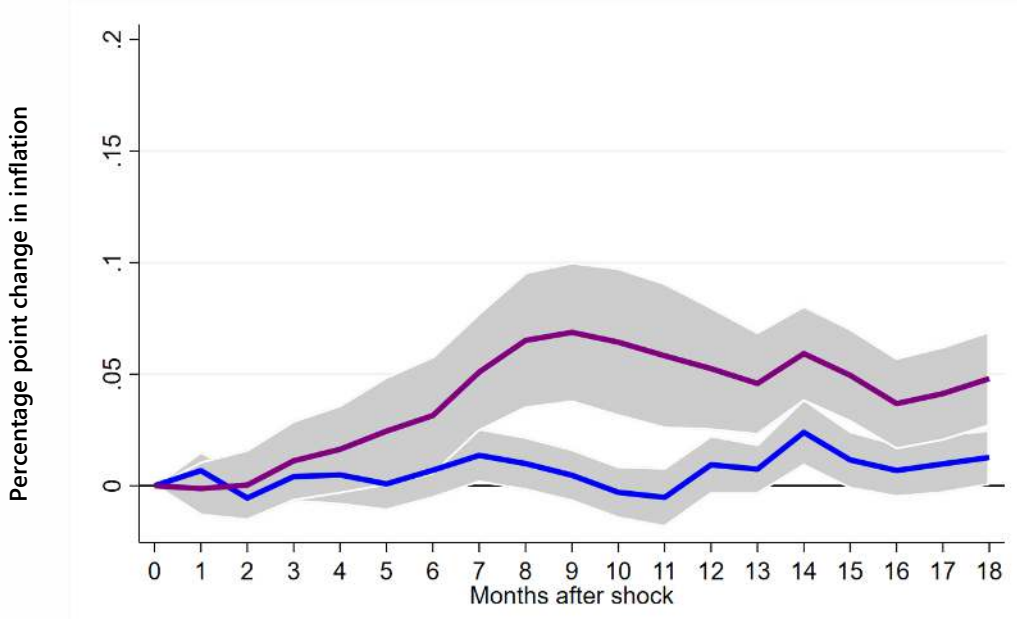
Role of Inflation Anchoring

Responses interacted by estimated anchoring of inflation expectations; similar results across measures

Response of headline inflation



Response of core inflation



High anchoring Low anchoring

Note: The figures present the impact of one standard deviation increase in shipping costs on measures of domestic price inflation in the baseline sample of 46 economies, where the shipping costs variable has been interacted with a dummy variable indicating bins of data over an estimate for the degree of inflation anchoring from Choi and others (2022). The solid purple lines are the impulse response functions (IRF) for countries with anchoring below the median; the blue lines are the IRFs for countries with anchoring above the median. The shaded regions indicate one standard error bands. *t*=0 denotes the year of the shock.

Takeaways

- Increases in global shipping costs lead to significant increases in domestic prices:
    - Rapid and strong impact on import and producer prices
    - Gradual impact on core and headline inflation

- The impact of shipping costs on headline inflation peaks after 12 months, building up more gradually than shocks to world oil or food prices

- Heterogeneous impact across income groups

- Impact larger in countries with a higher share of imports in domestic consumption and weaker monetary policy frameworks.

- Results are robust to using closures of the Suez Canal to instrument for exogenous shocks to shipping costs