

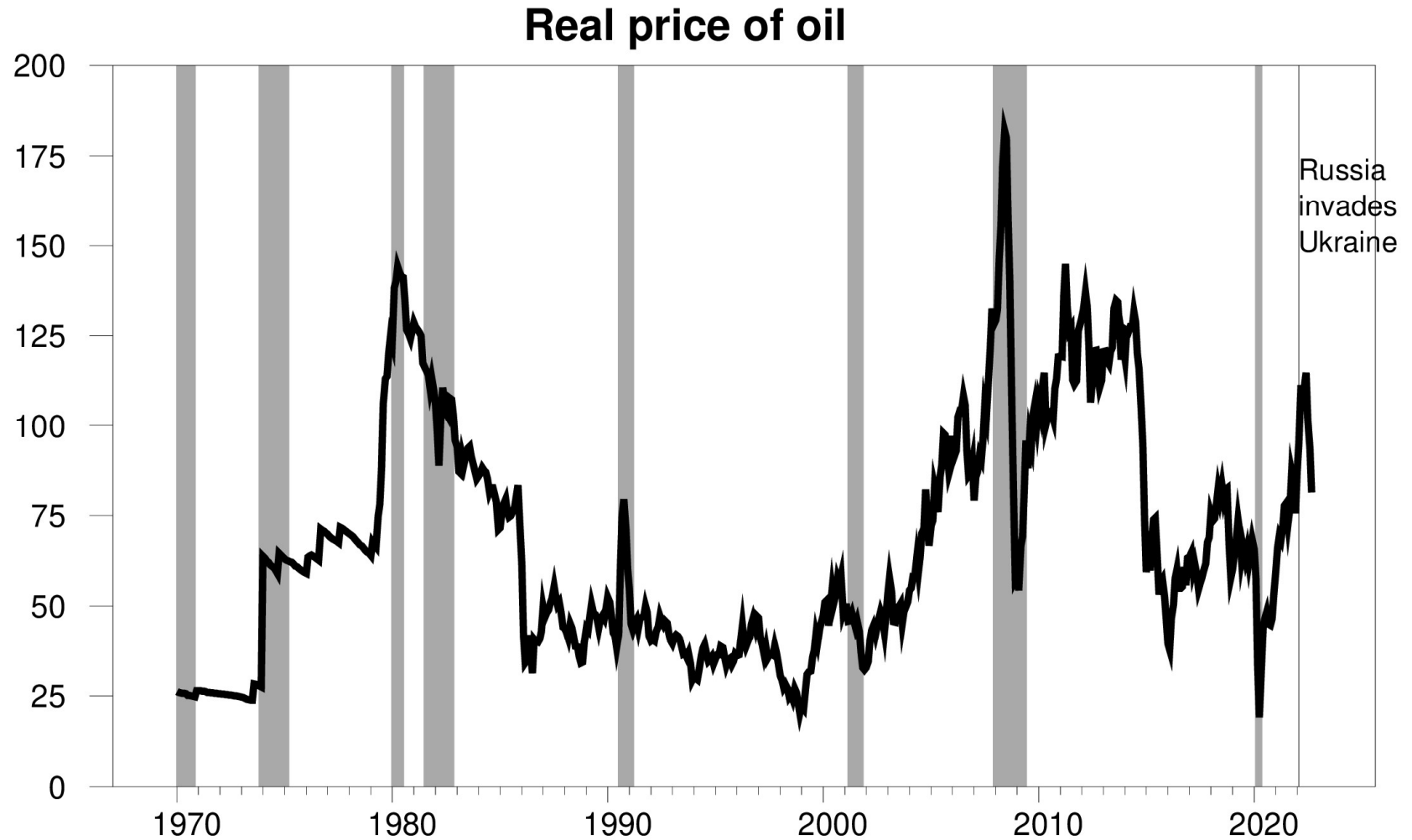
Energy Prices and the World Economy

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- Before the war, Russia produced
 - 13% of world field production of crude oil
 - 17% of world production of natural gas

There was a big run-up in oil prices before Russia invaded Ukraine



- Oil price rose prior to war because demand recovered more quickly than supply
 - U.S. shale oil production still down 5% from Jan 2020
- Oil price lower now than in June because
 - Russia increased oil sales to Asia and Africa
 - Chinese slowdown and monetary contraction will mean lower demand

What would be the consequences if a country or the world suddenly had to decrease energy consumption by 10%?

- Economic theory
- Empirical evidence

Predicted theoretical effects of a 10% decline in oil production

- The dollar value of refined petroleum products consumed in the U.S. represents about 4% of total U.S. GDP
- A quick calculation of the economic cost of losing 10% of world oil production would be $(0.04) \times (0.1) = 0.4\%$ of GDP
- In average recession, the peak-to-trough decline in U.S. real GDP relative to trend is 5% of GDP

Formal justification for quick calculation

If output Y depends on inputs of capital, labor, energy:

$$Y = F(K, N, E)$$

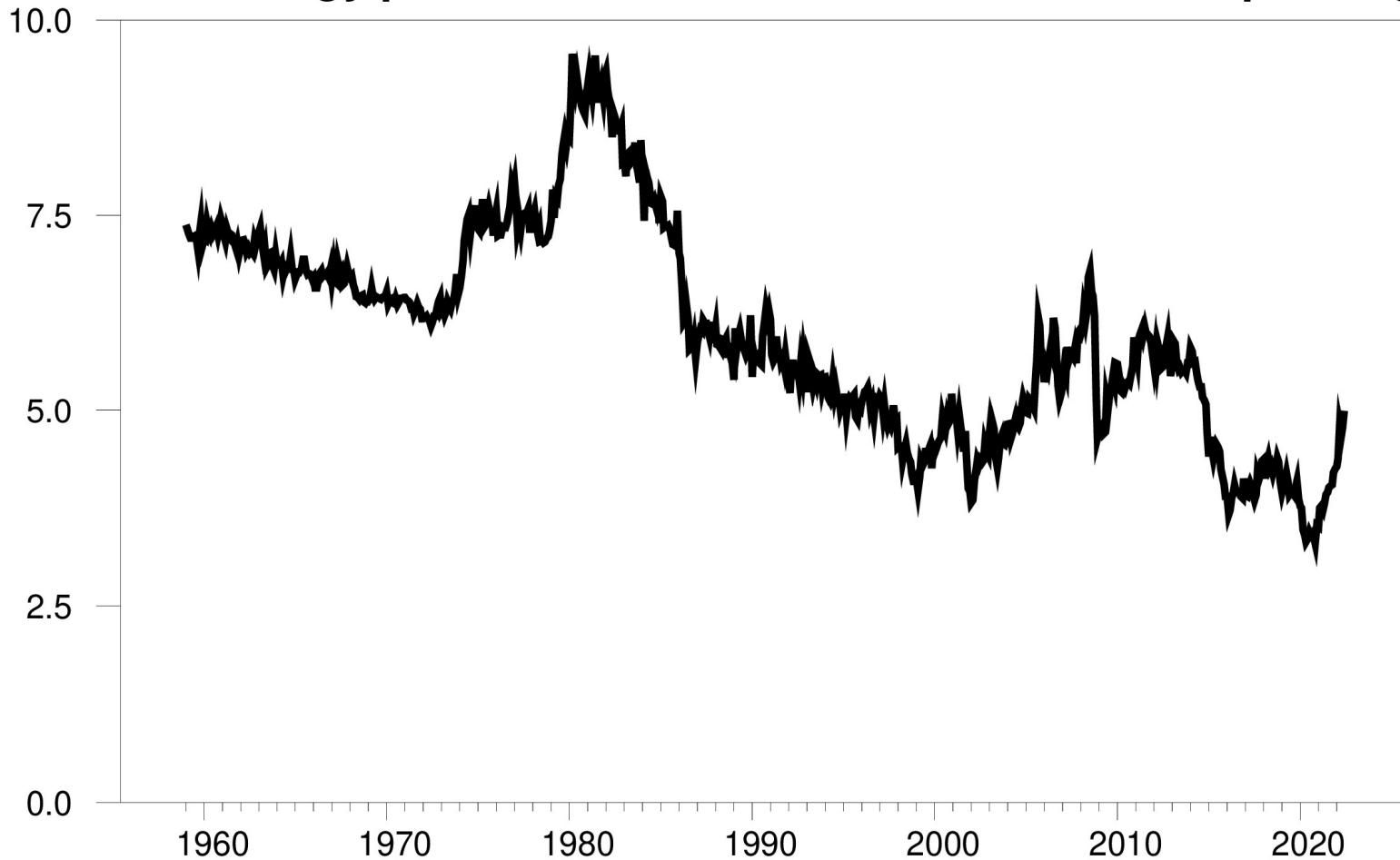
$$\frac{\partial F}{\partial E} = \frac{P_E}{P_Y}$$

$$\frac{\partial F}{\partial E} \frac{E}{Y} = \frac{P_E E}{P_Y Y}$$

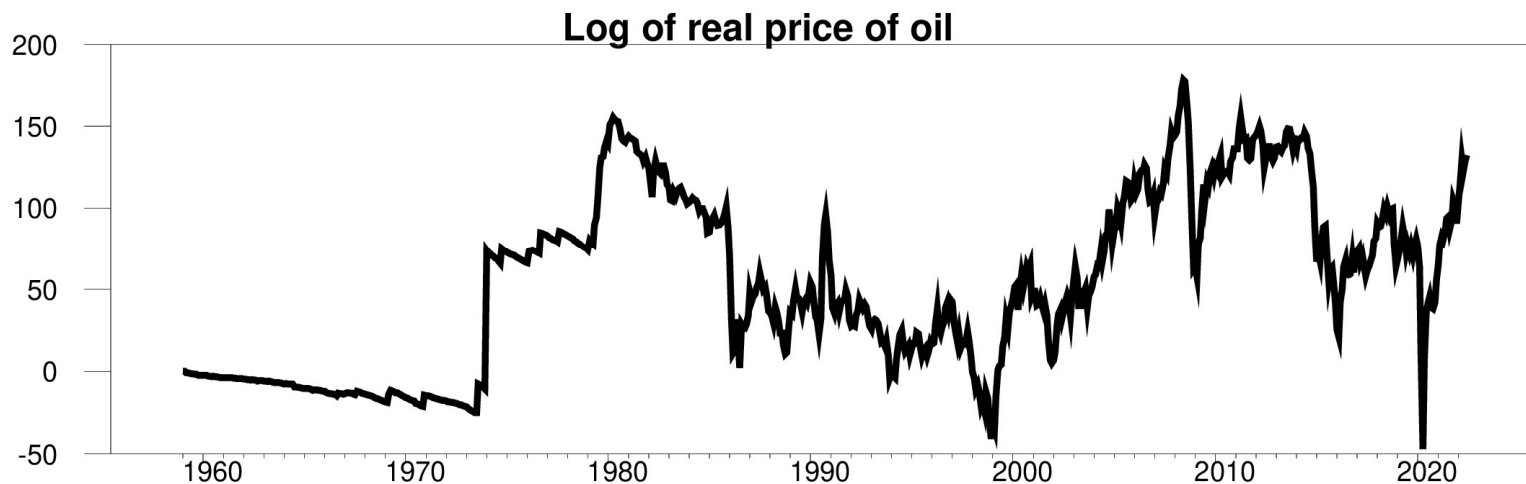
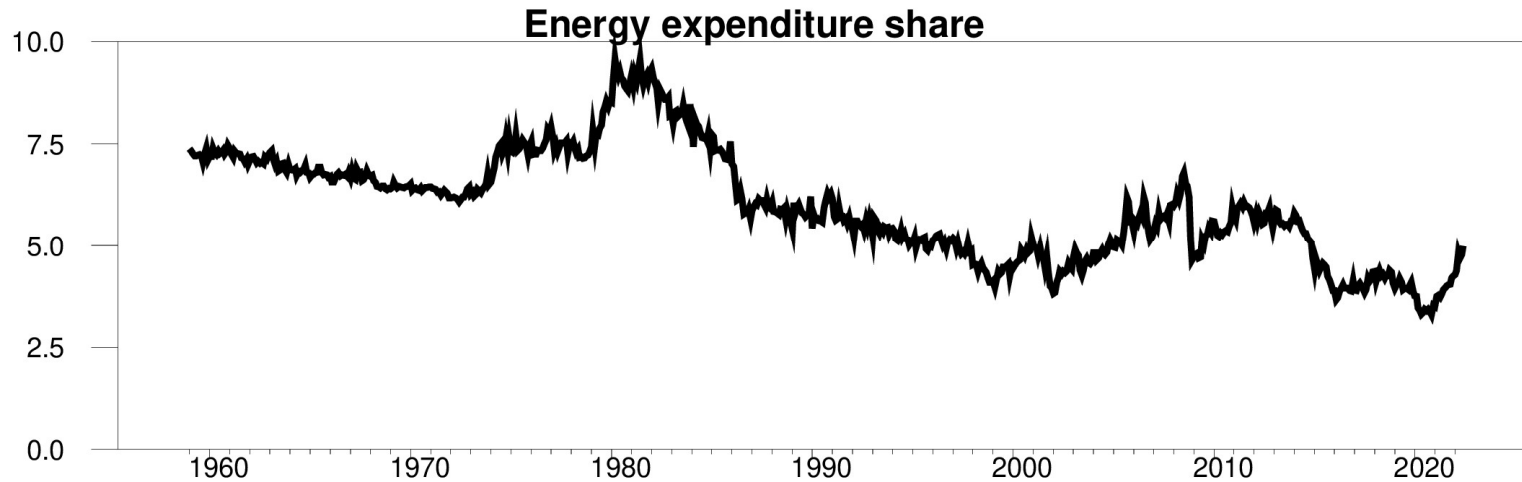
elasticity = expenditure share

Energy's share of GDP has been declining over time ...

Consumer energy purchases as share of total consumer spending



... but the share increases when the price goes up

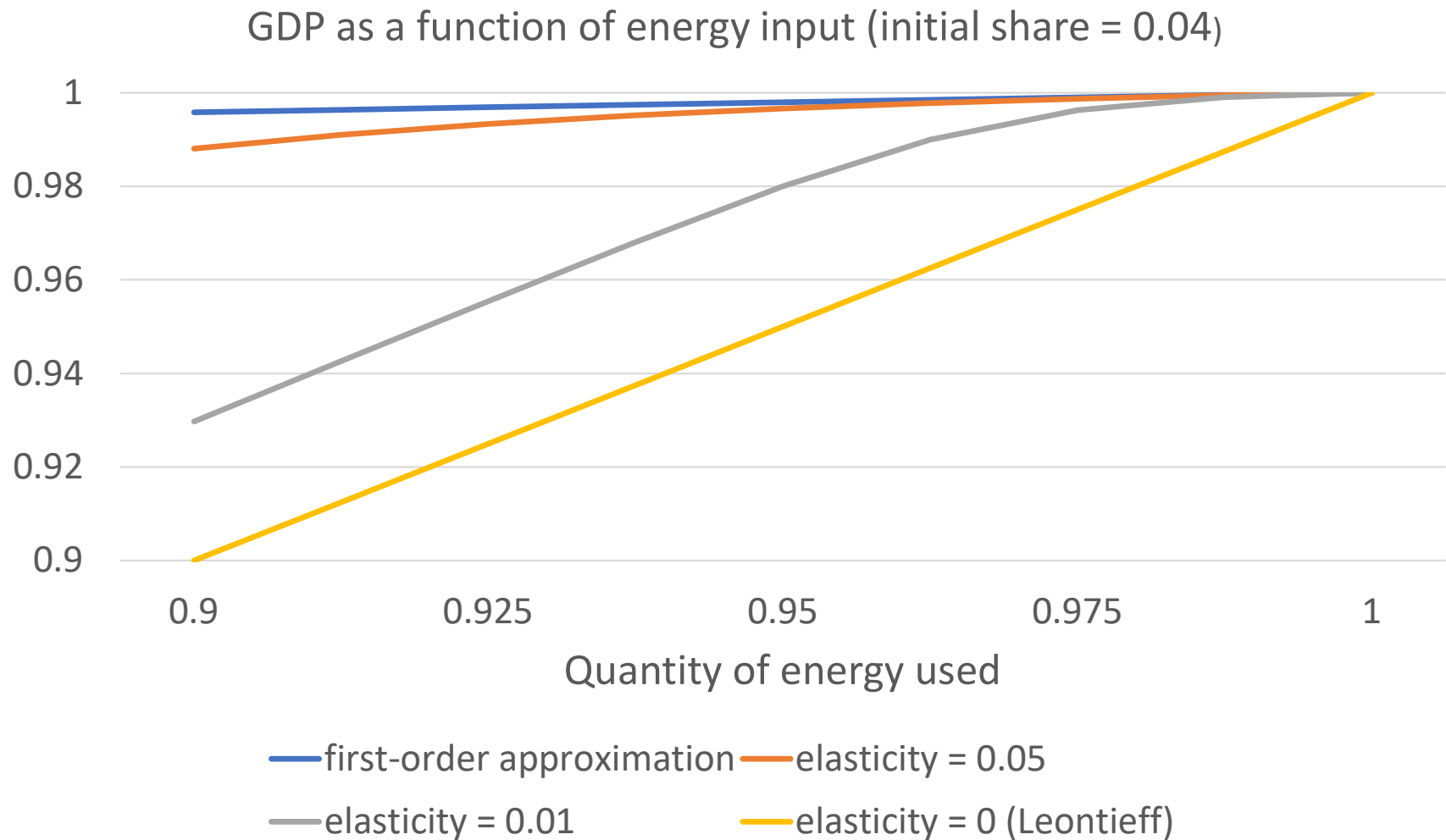


Using production function to calculate discrete changes

CES with initial share α and elasticity of substitution σ :

$$Y = [\alpha^{1/\sigma} E^{(\sigma-1)/\sigma} + (1 - \alpha)^{1/\sigma} (K^\psi N^{1-\psi})^{(\sigma-1)/\sigma}]^{\sigma/(\sigma-1)}$$

Instead of first-order approximation, could calculate actual change in Y as we decrease E holding K and N constant.



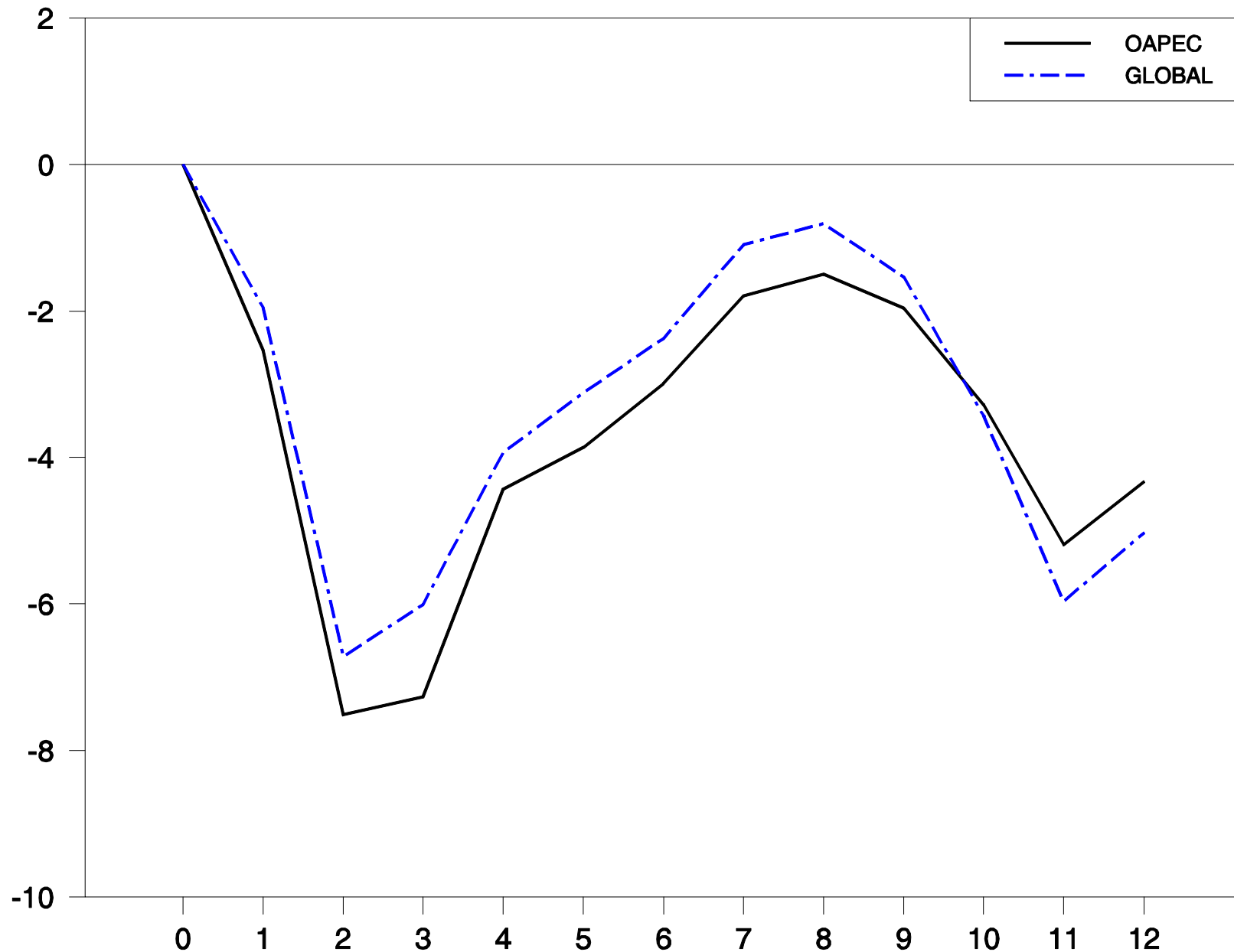
Source: adapted from Bachmann et al. (2022)

- Baqaee and Farhi (Econometrica 2019) developed calculations appropriate for non-epsilon change and multisector detail.
- Bachmann et al. (2022) used their approach to conclude that a cut-off of energy imports from Russia would reduce German GDP by 0.5-3.0% depending on substitutability.

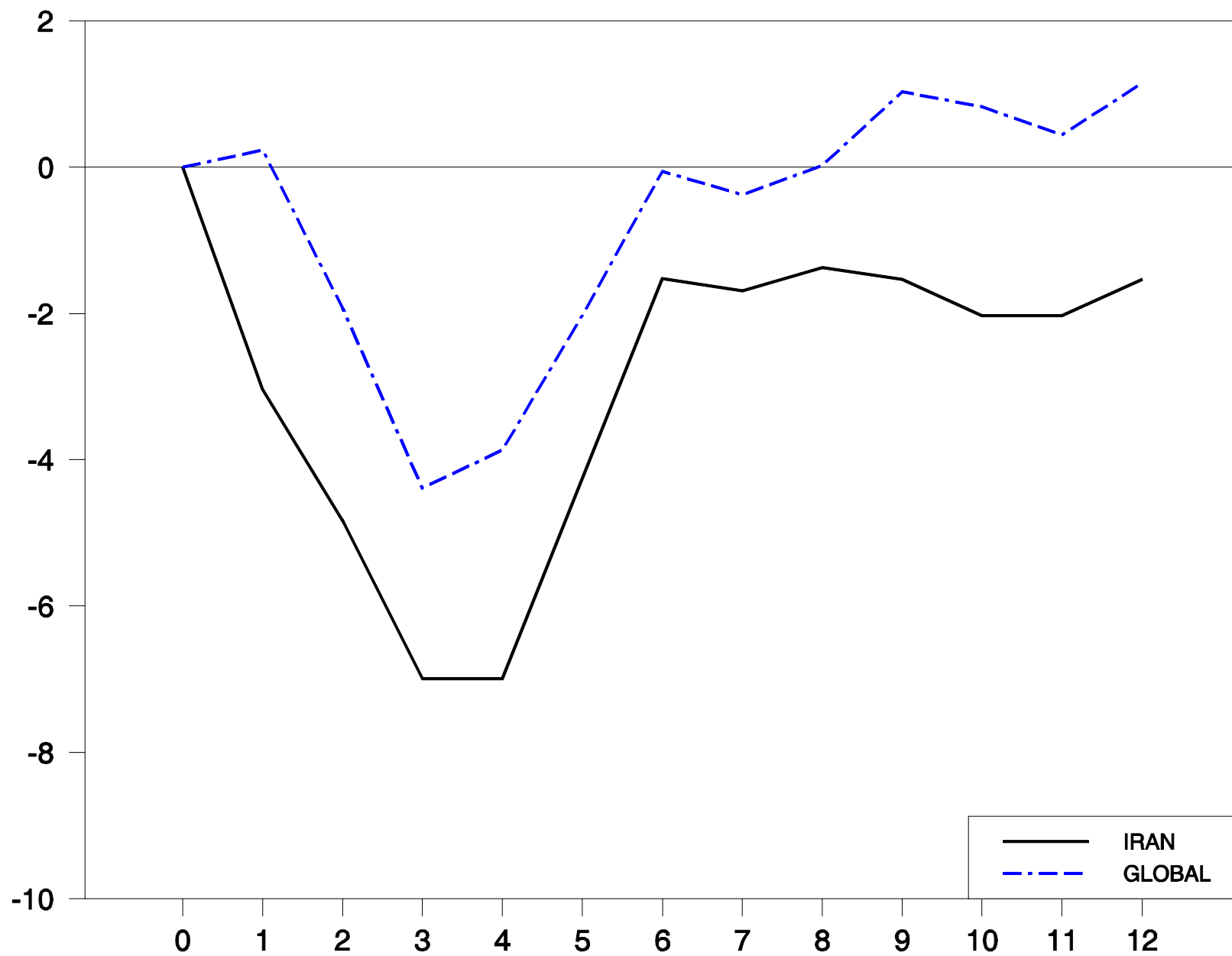
What would be the consequences of a 10% decline in oil production?

- Economic theory
- Empirical evidence

Percent change in crude oil production from members of OAPEC (in black) and world total (in blue) months following Sep 1973



OAPEC embargo: Oil production in months following Sept 1973 Arab-Israeli War.



Iranian revolution: production after Oct 1978

Major historical oil supply disruptions were followed by recessions

Date	Event	Supply cut (local)	Supply cut (global)	Price Change	Recession Start
Nov 73	OAPEC embargo	7%	7%	51%	Dec 73
Nov 78	Iran revolution	7%	4%	57%	Feb 80
Oct 80	Iran-Iraq War	6%	4%	45%	Aug 81
Aug 90	Gulf War I	9%	6%	93%	Aug 90

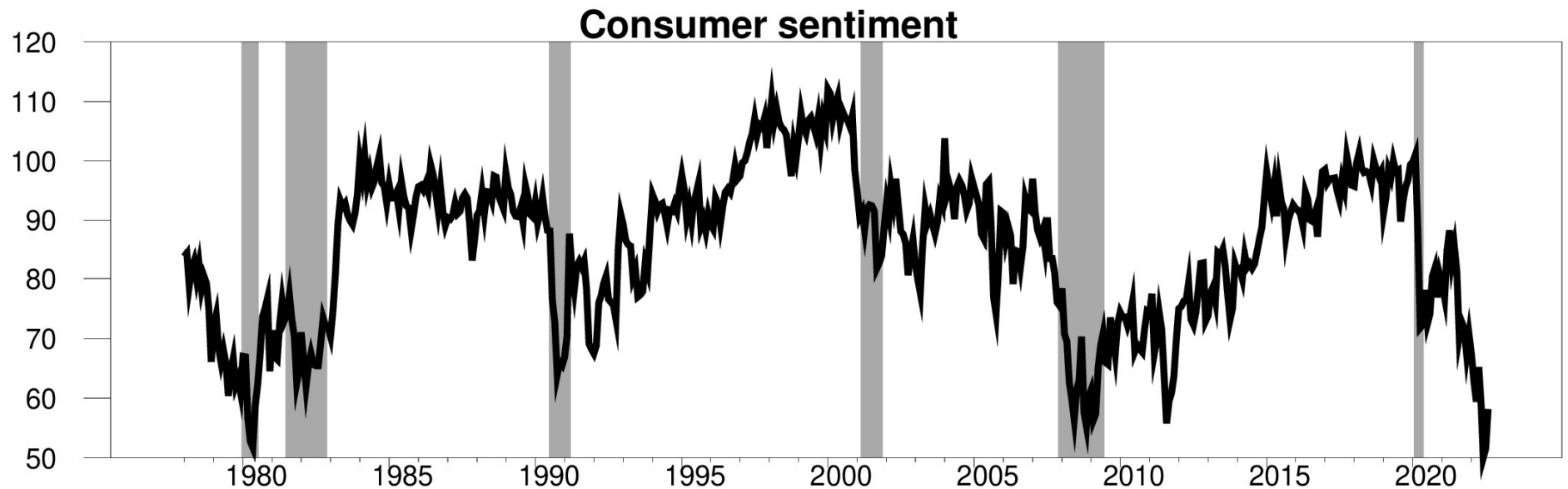
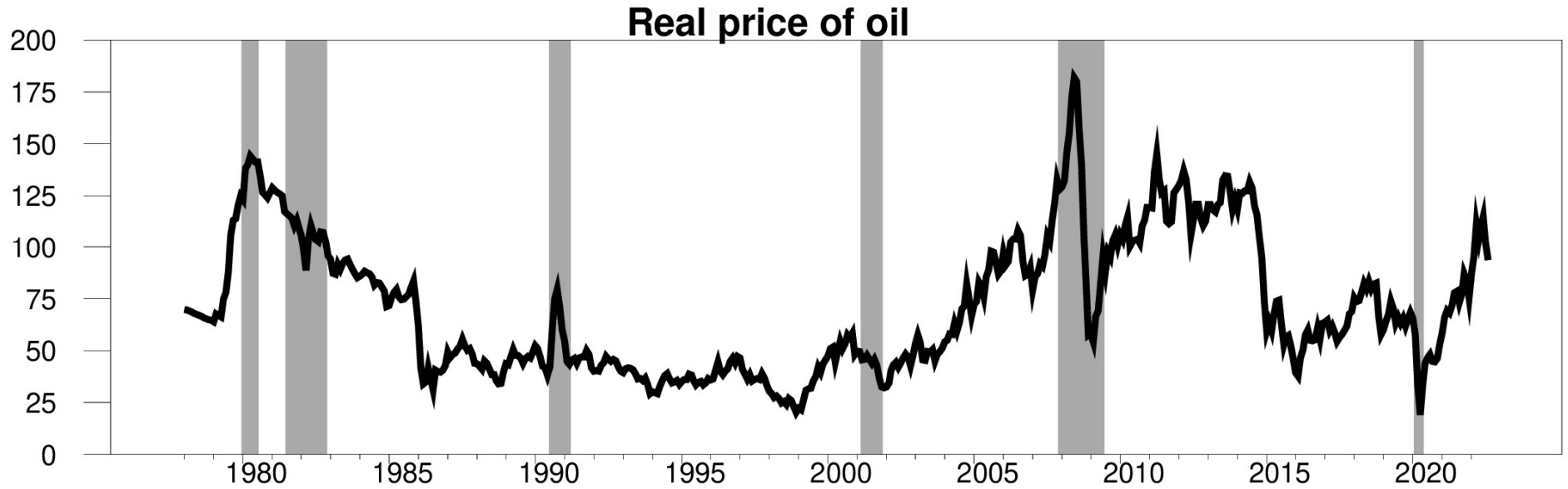
- Economic recessions are characterized by underutilized resources.
- Unemployment rate spikes up and capacity utilization declines.
- N and utilization of K change along with E .
- Is there reason to believe that previous oil shocks contributed to this?

Decline in auto production made significant contribution to downturns

Period	Contribution of autos
1974:Q1-1975:Q1	-0.5%
1979:Q2-1980:Q2	-0.8%
1981:Q2-1982:Q2	-0.2%
1990:Q3-1991:Q3	-0.3%
2007:Q4-2008:Q4	-0.7%

Source: Hamilton, "Major Historical Oil Shocks," 2013

Consumers become more pessimistic when oil prices rise



Take-away: An energy price spike has potential to significantly disrupt spending on other goods

- In the presence of nominal rigidities, this could contribute to drop in real GDP.
 - If this is the mechanism, expansionary monetary and fiscal policy could help.
- Alternatively, may cause drop in real GDP if it is technologically costly to reallocate productive resources -- Hamilton (JPE 1988), “Supply, Demand and Specialized Production” (2022).
 - If this is the mechanism, potential for monetary or fiscal stimulus may be limited.

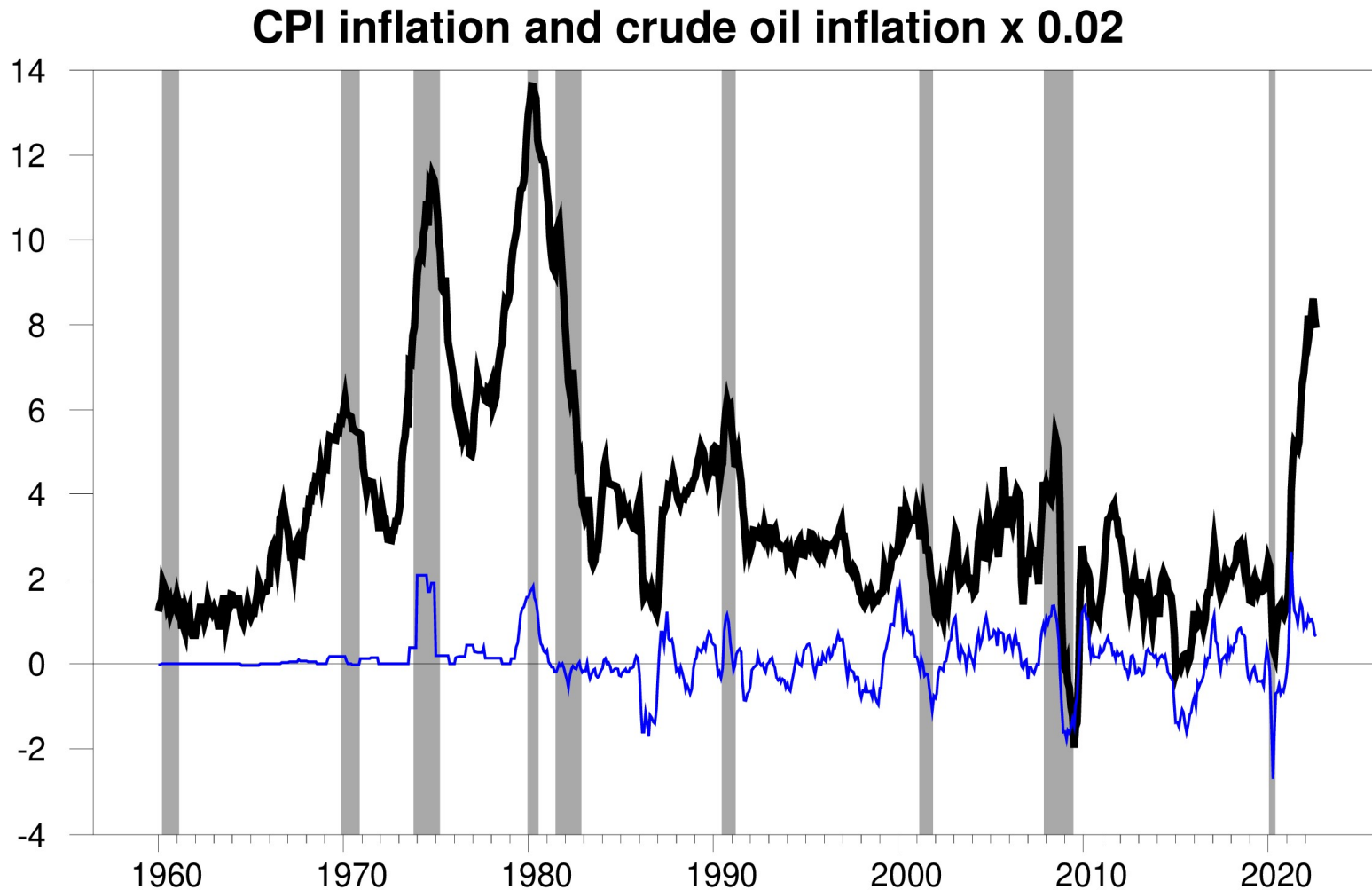
Effects on inflation

- An increase in relative price of energy need not cause increase in overall price level if other prices decline.
- However, if other prices are rigid downwards, relative price increase will be inflationary.
- Mechanical consequences of this are similar to earlier calculations

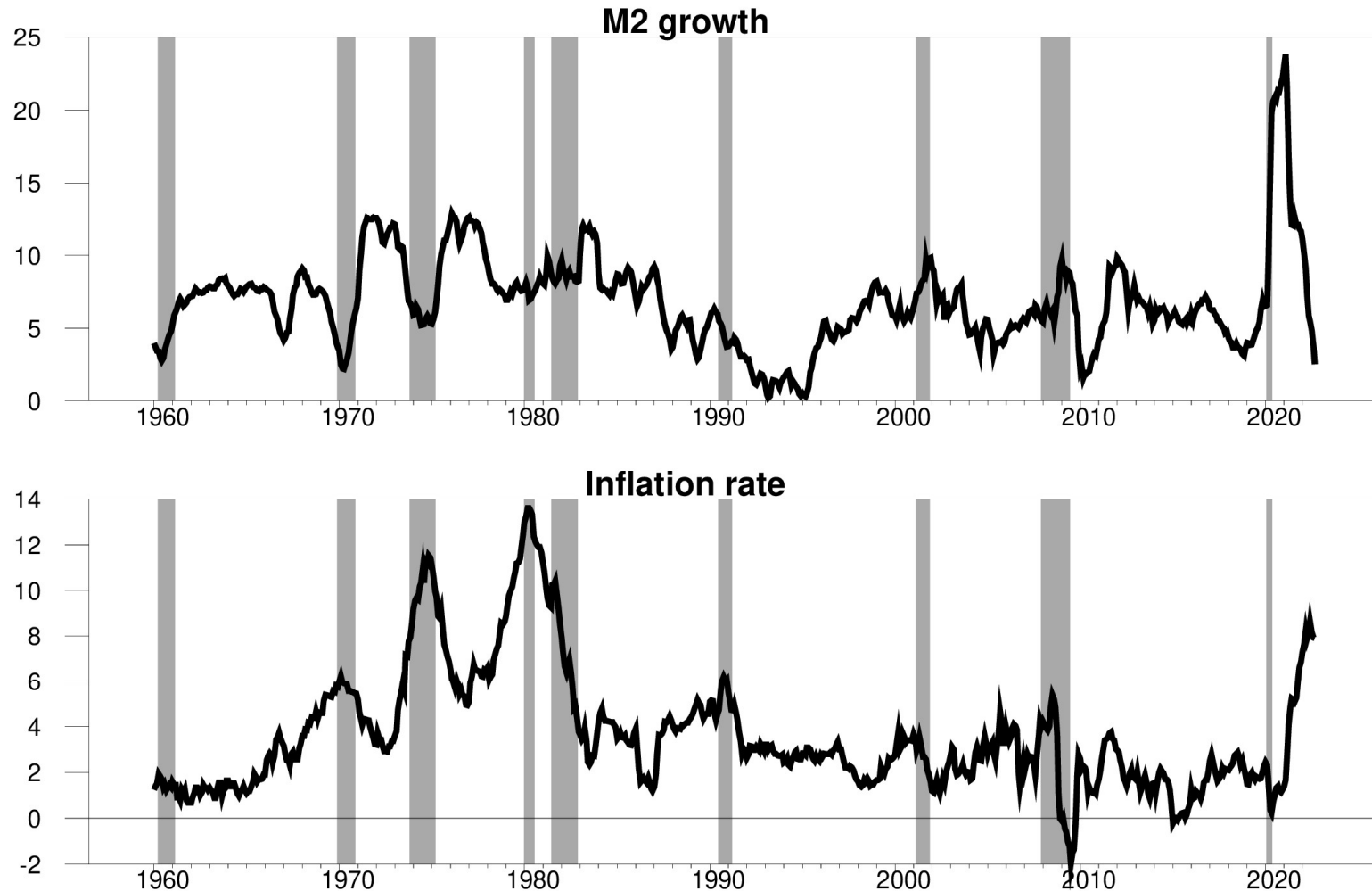
- If crude oil represents half the retail after-tax cost of refined product and these other costs are fixed, when price of oil goes up 10% the price of refined product goes up 5%.
- If no other prices change, we get the direct mechanical contribution to inflation by multiplying percentage change in nominal crude oil price by 0.02.

- Consistent with Fed Chair Powell rule of thumb: if oil price goes up \$10 (about 10% at current prices), headline inflation goes up 0.2 percentage points

Price of oil boosted U.S. inflation by 2% in 1974, 1979, 2021



This can translate into sustained inflation from inflationary expectations and monetary policy

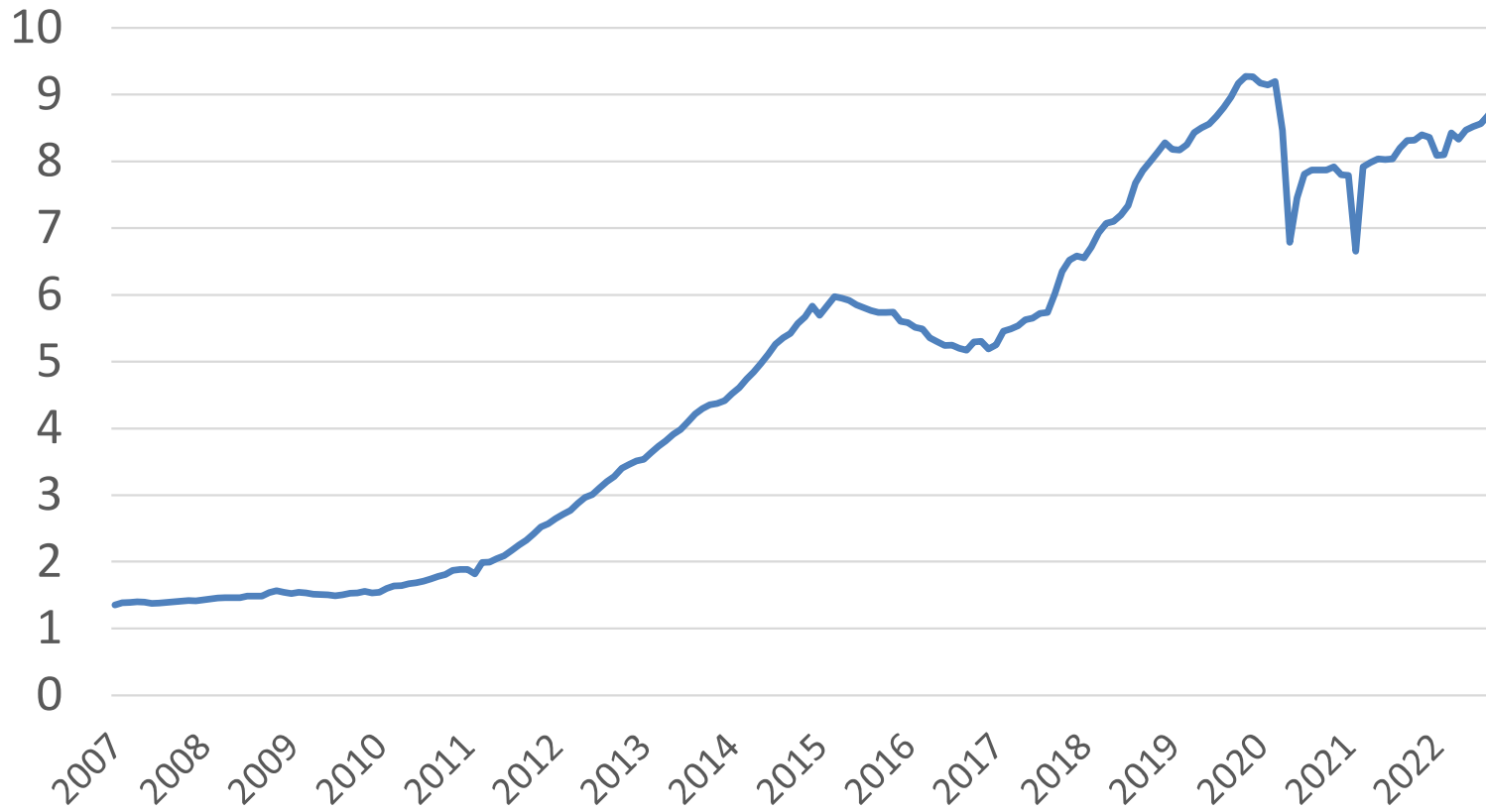


Summary

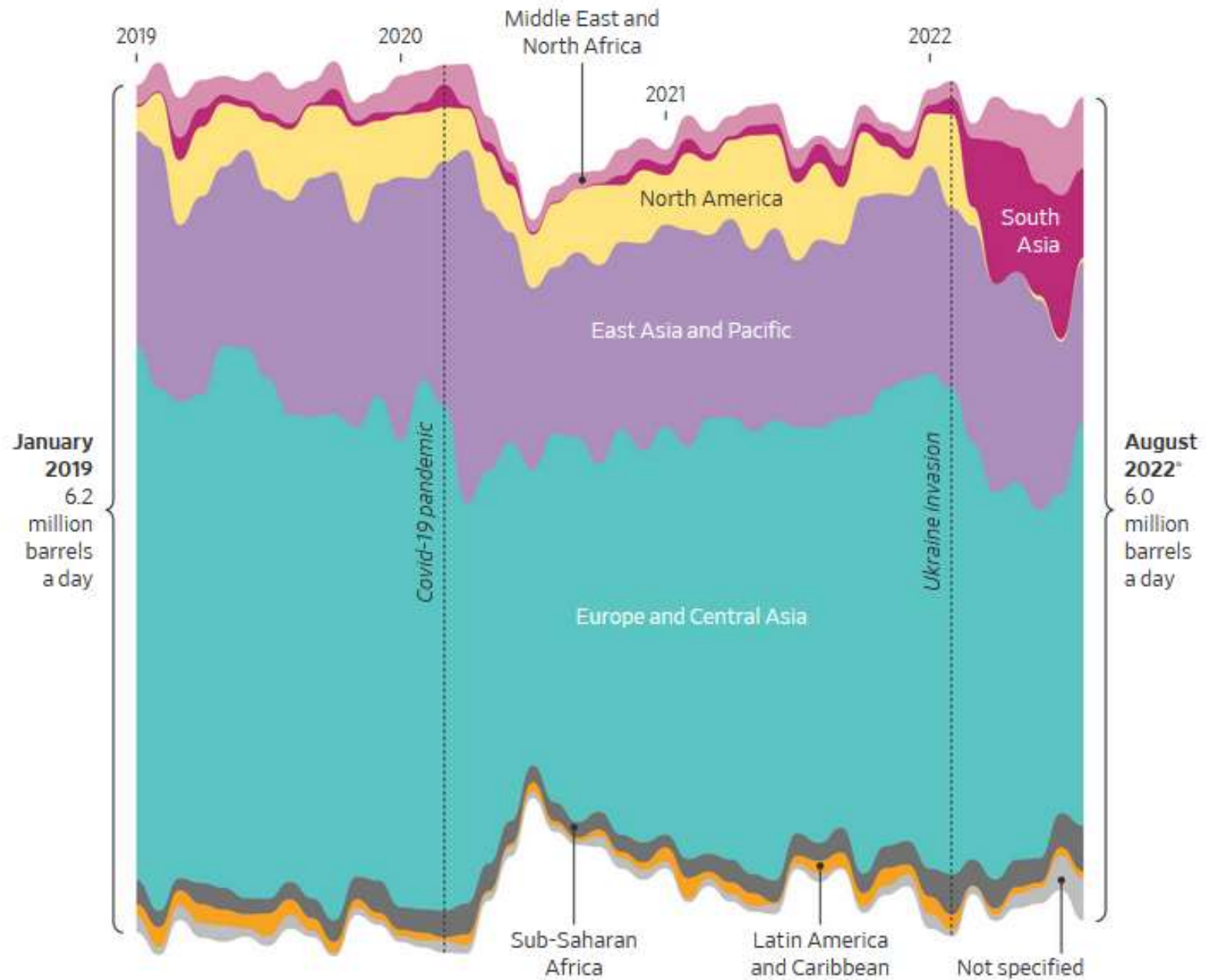
- The immediate direct effects on GDP or inflation of a sharp increase in energy prices should be moderate.
- The indirect spill-over effects on both can be large.

Supplementary slides

U.S. shale oil production (mb/d)



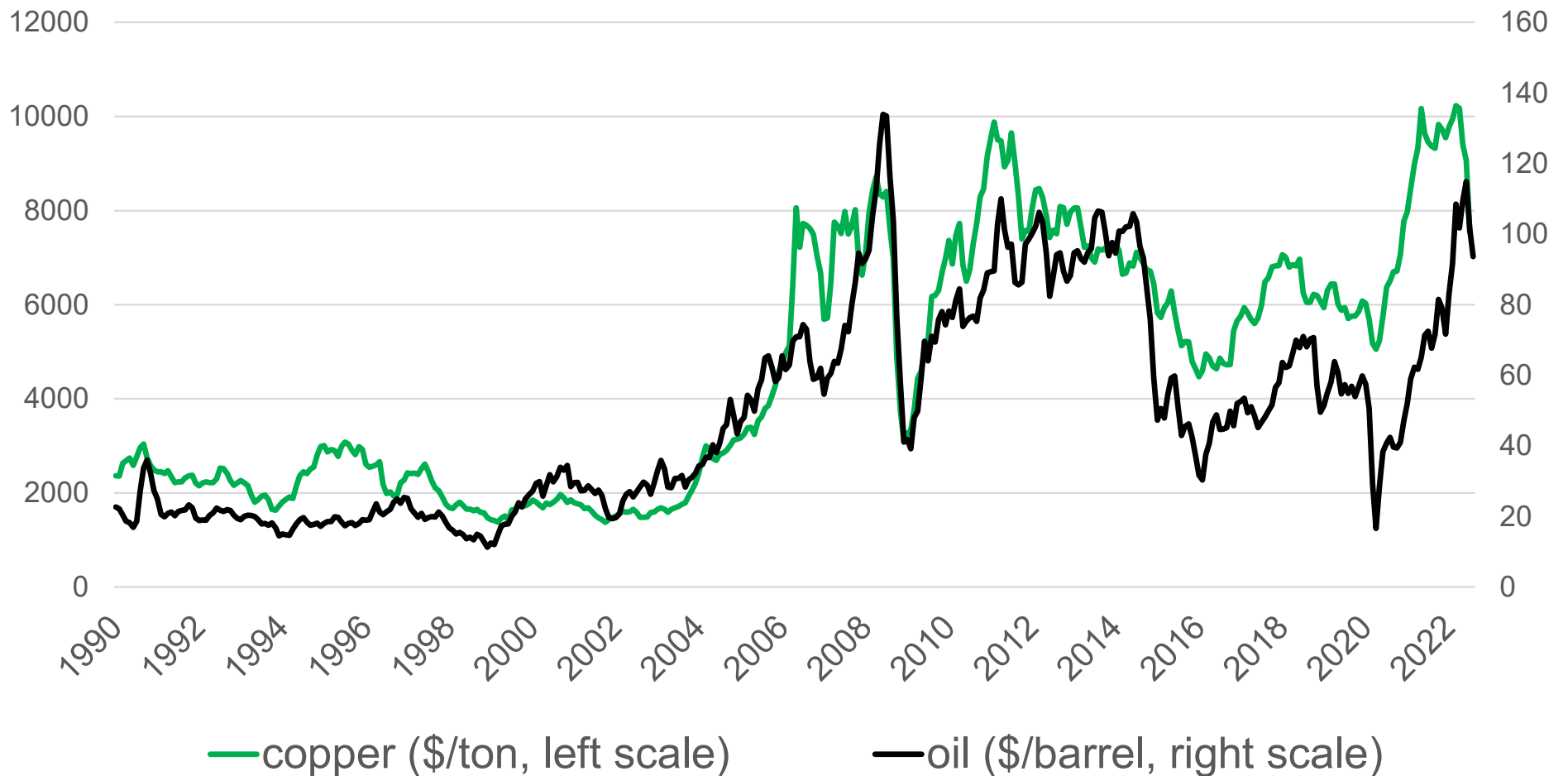
Russian shipments of crude oil and products



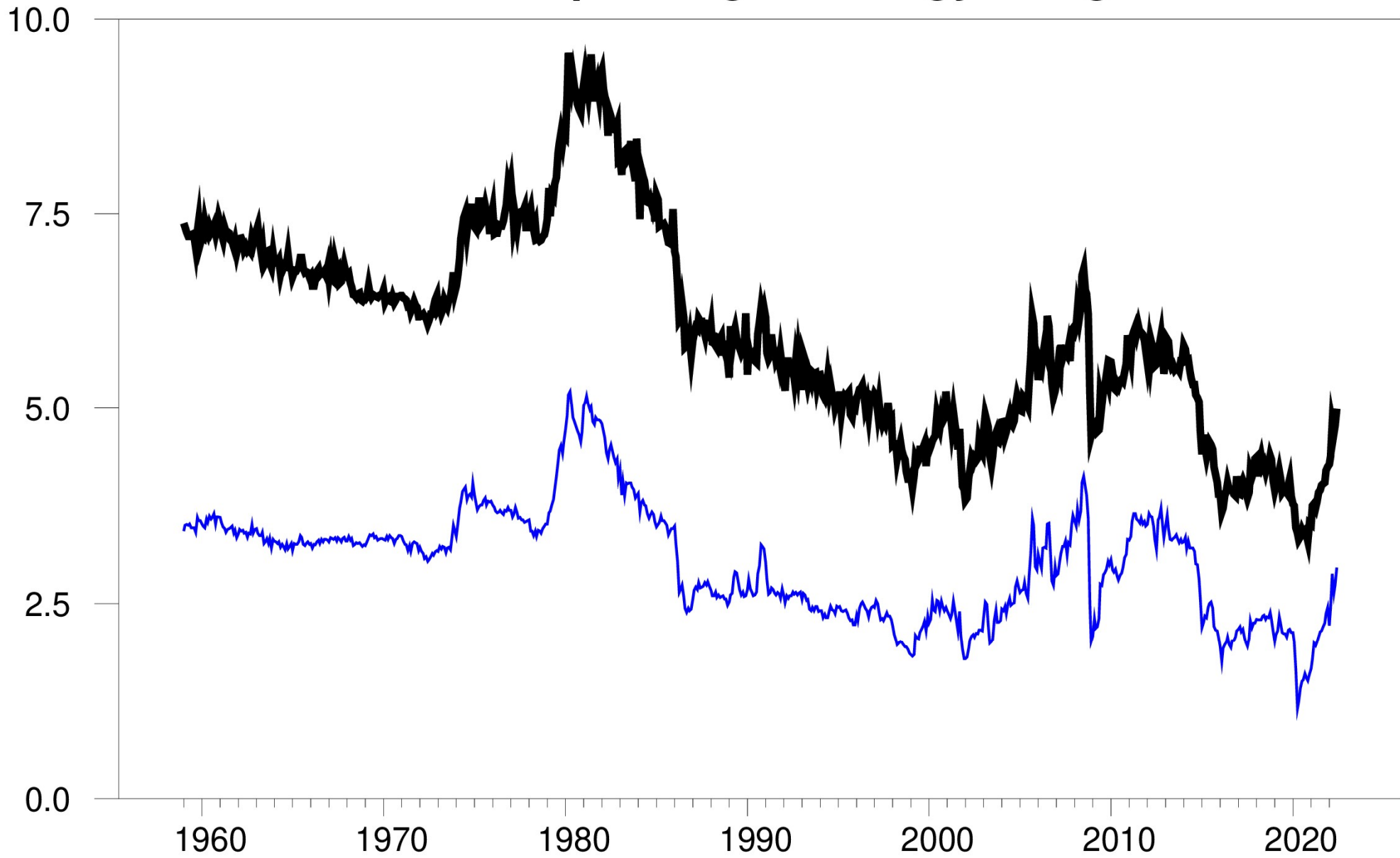
Soure: WSJ, Aug 29, 2022

Recent price drop showed up in commodities broadly

Oil and copper prices



Share of consumer spending on energy and gasoline



s_t^G = purchases of gasoline as a share of total spending in month t .

P_t^{CPI} = overall CPI in month t .

P_t^G = gasoline CPI in month t .

Suppose short-run price elasticity of gasoline demand = 0, i.e., when price goes up, people buy same number of gallons and cut back elsewhere.

In this case, we'd predict

$$s_t^G = \left(\frac{P_t^G / P_t^{CPI}}{P_{t-12}^G / P_{t-12}^{CPI}} \right) s_{t-12}^G$$

Actual and predicted gasoline share if elasticity = 0

