# 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
- Crude oil is easily transported
  - sells for essentially the same price around the world
- Natural gas is much more localized
  - Russia provides 55% of natural gas used by Germany

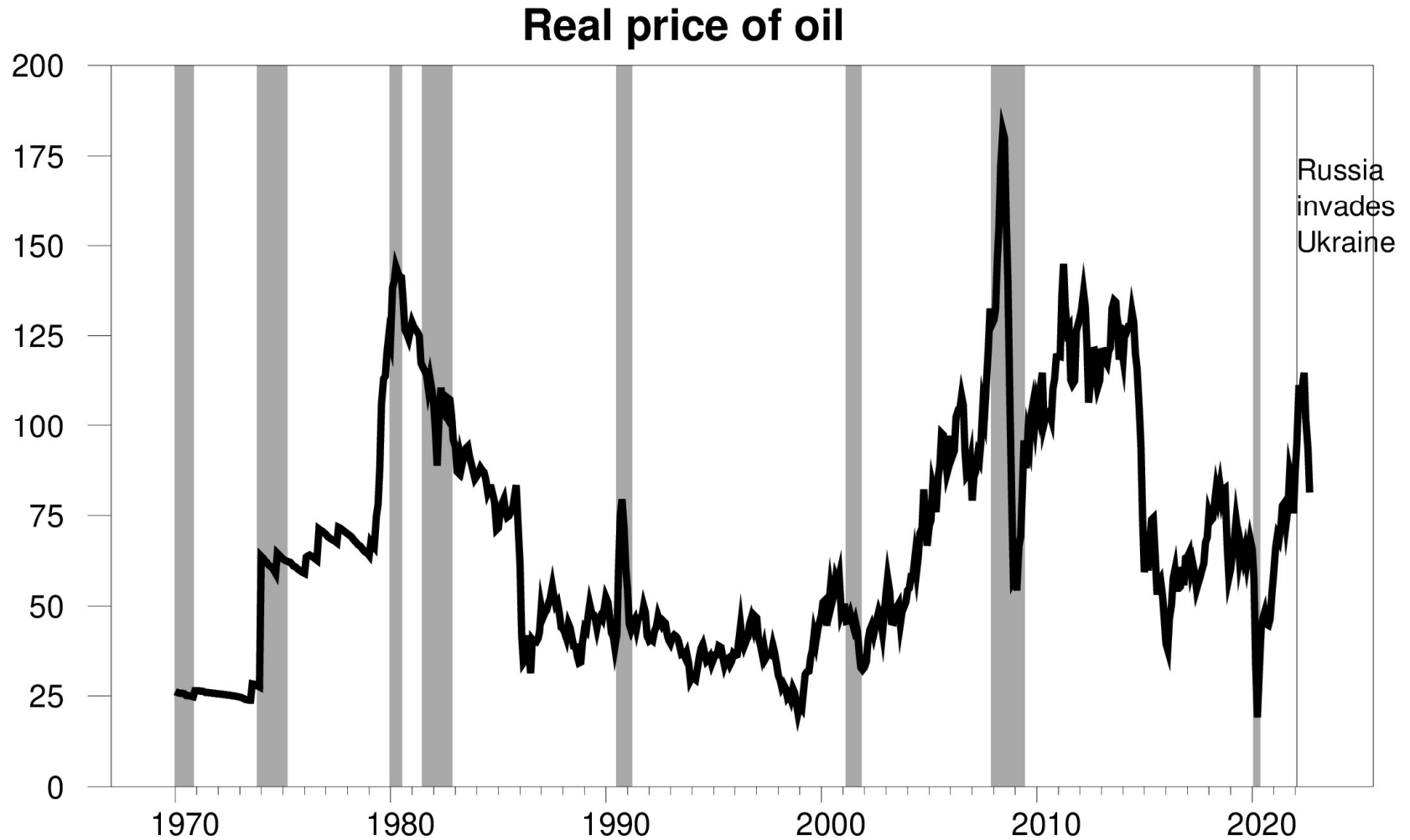# Crude oil prices in U.S. and Europe, Jan 1990 to Aug 2022
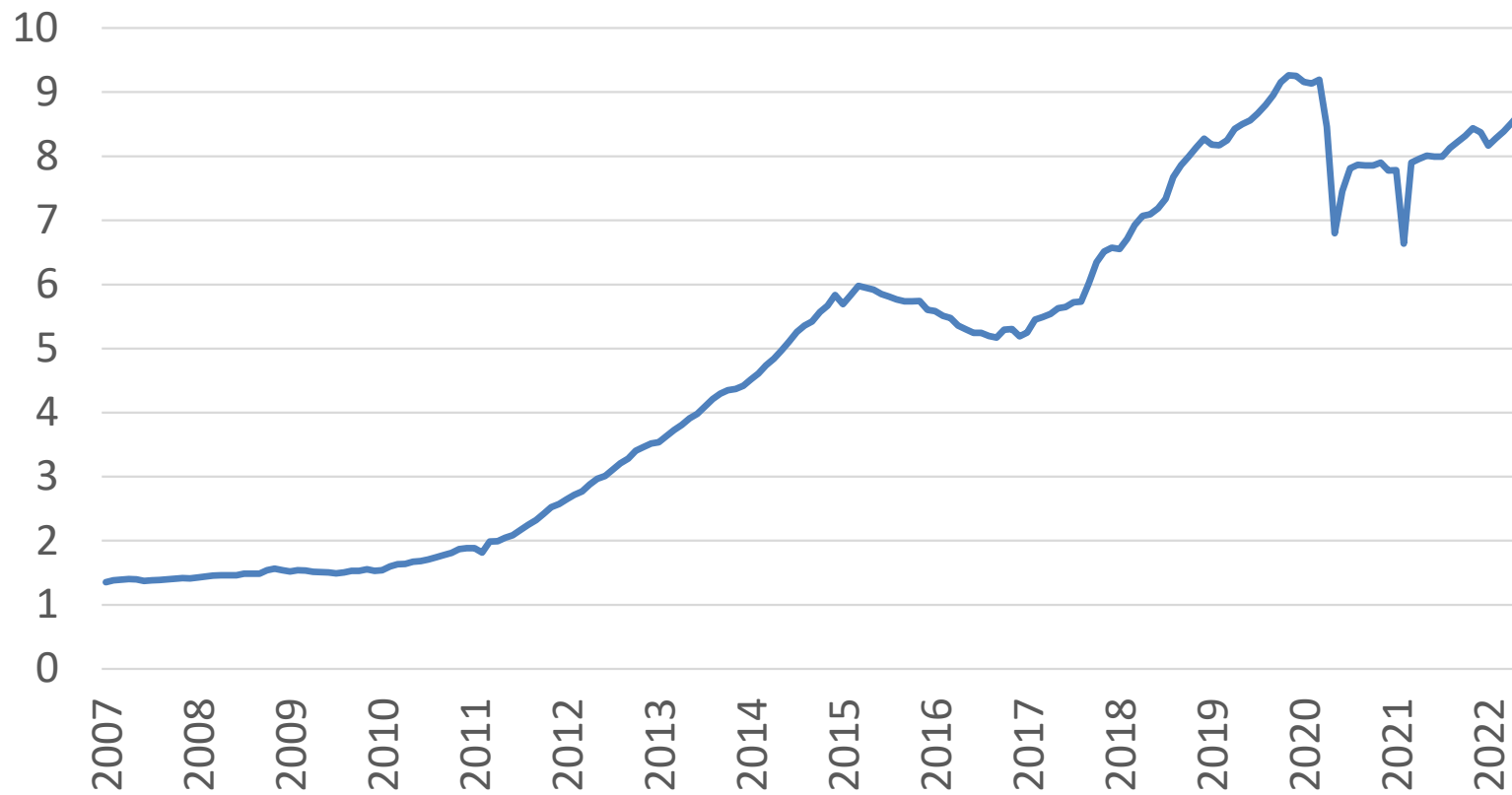
WTI ($/barrel)

Brent ($/barrel)
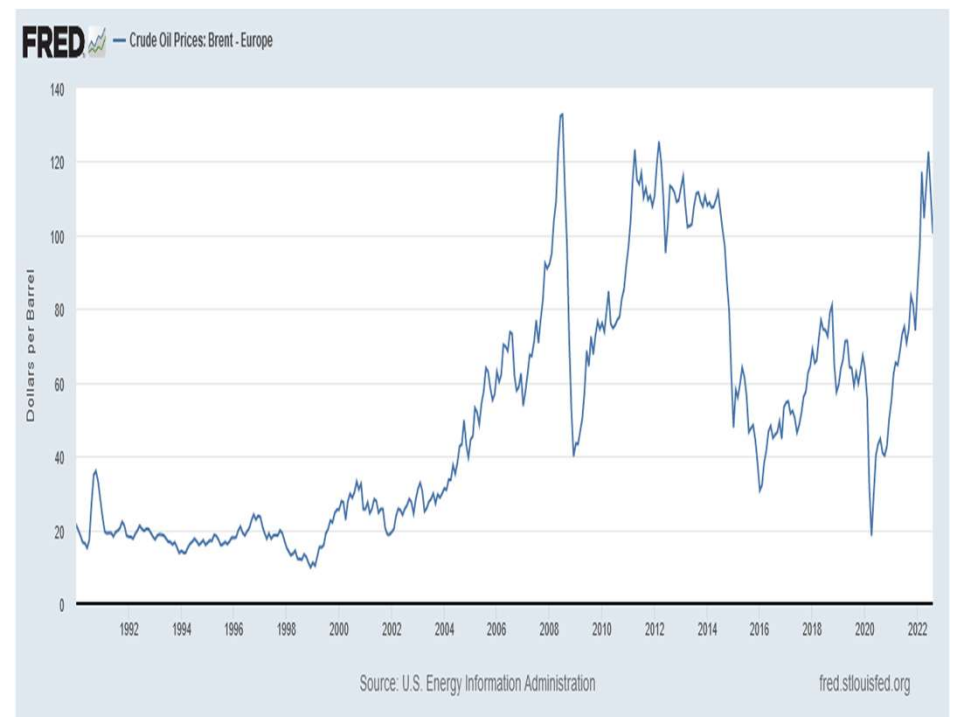
# There was a big run-up in oil prices before Russia invaded Ukraine

**Real price of oil**
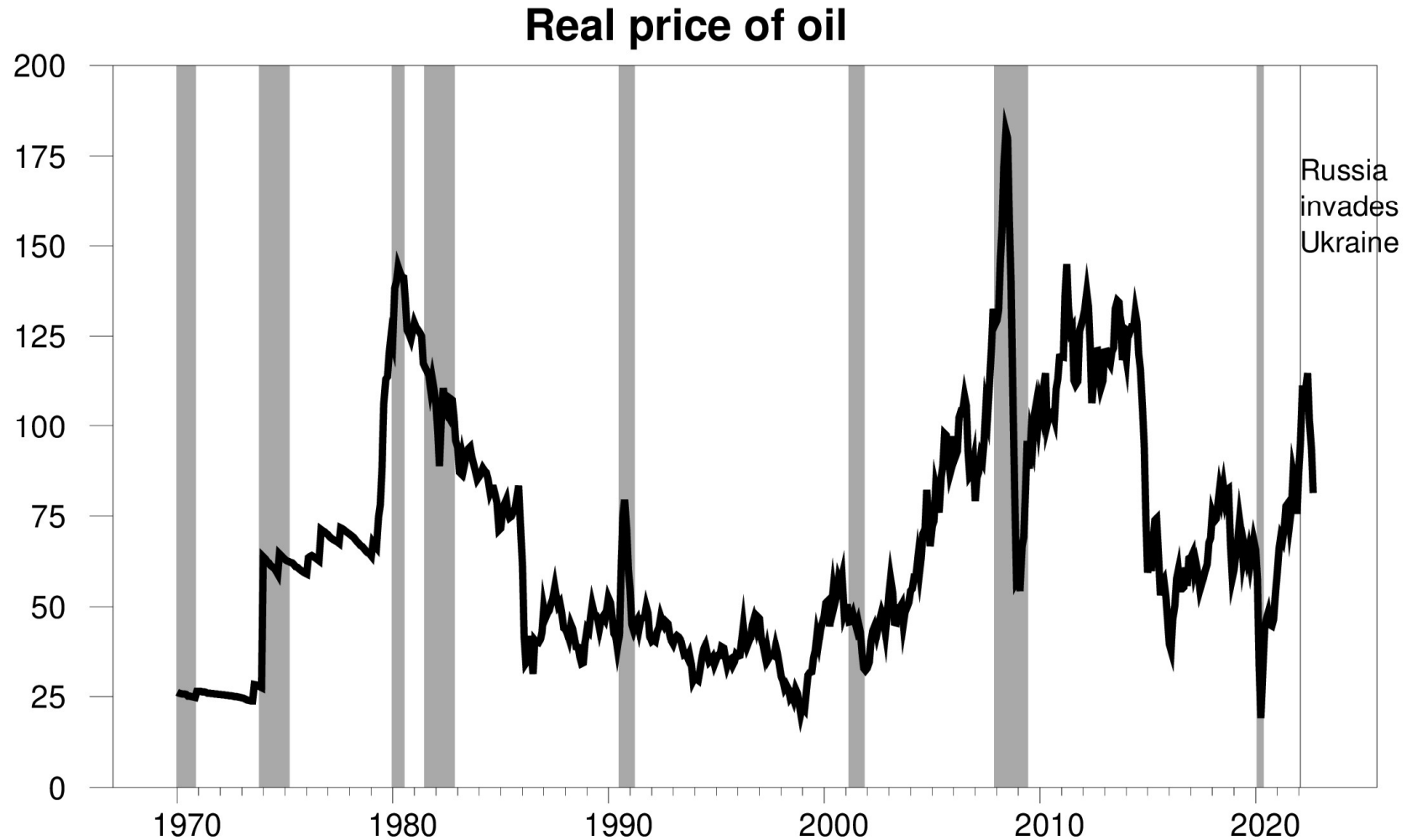


Russia invades Ukraine

4

- Why did oil price go up so much before Russia invaded Ukraine?

- Answer: demand recovered more quickly than supply

- U.S. shale oil production still down 5% from Jan 2020
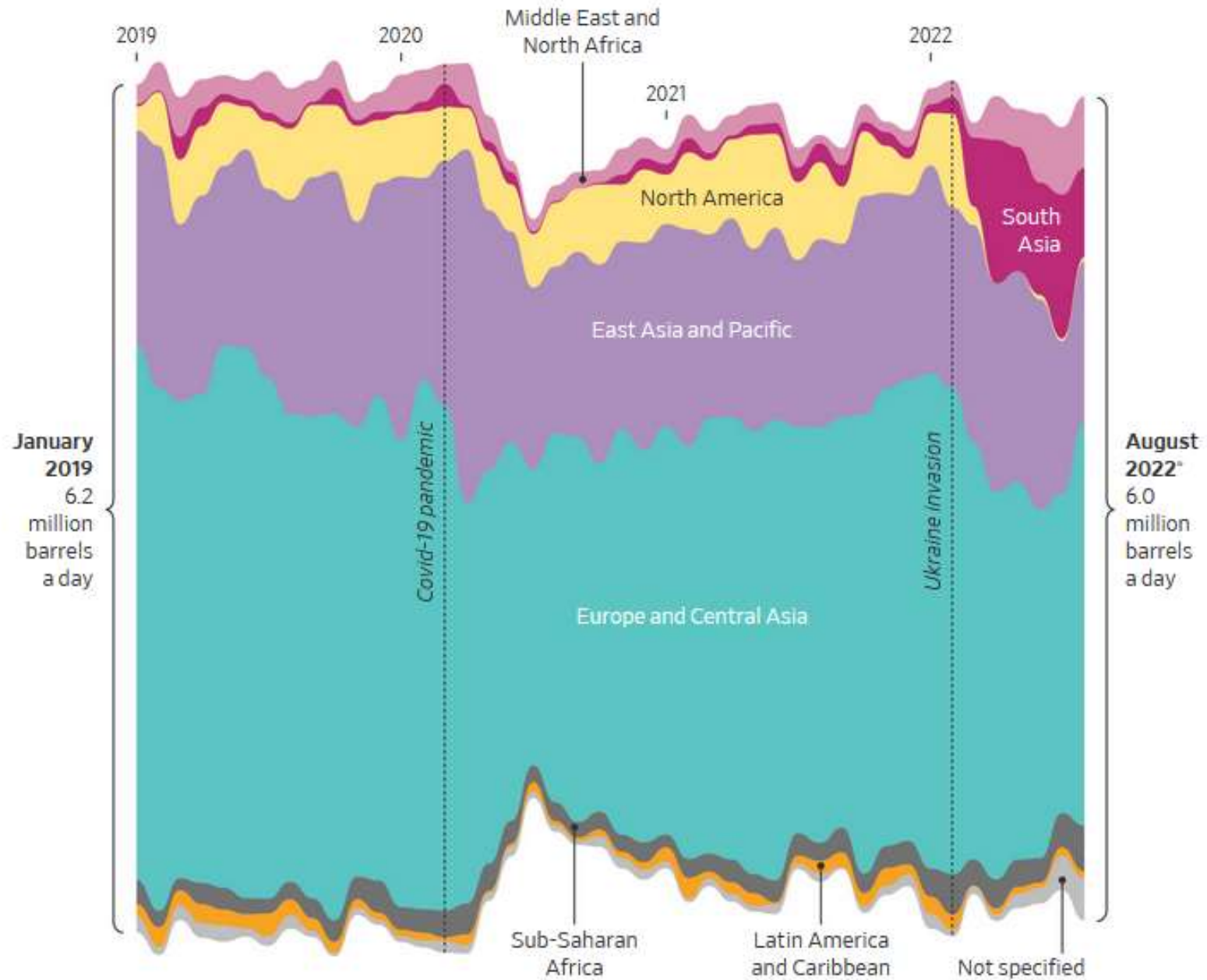
U.S. shale oil production (mb/d)

# Oil price is now lower than it was before Russia invaded Ukraine

**Real price of oil**



Russia invades Ukraine

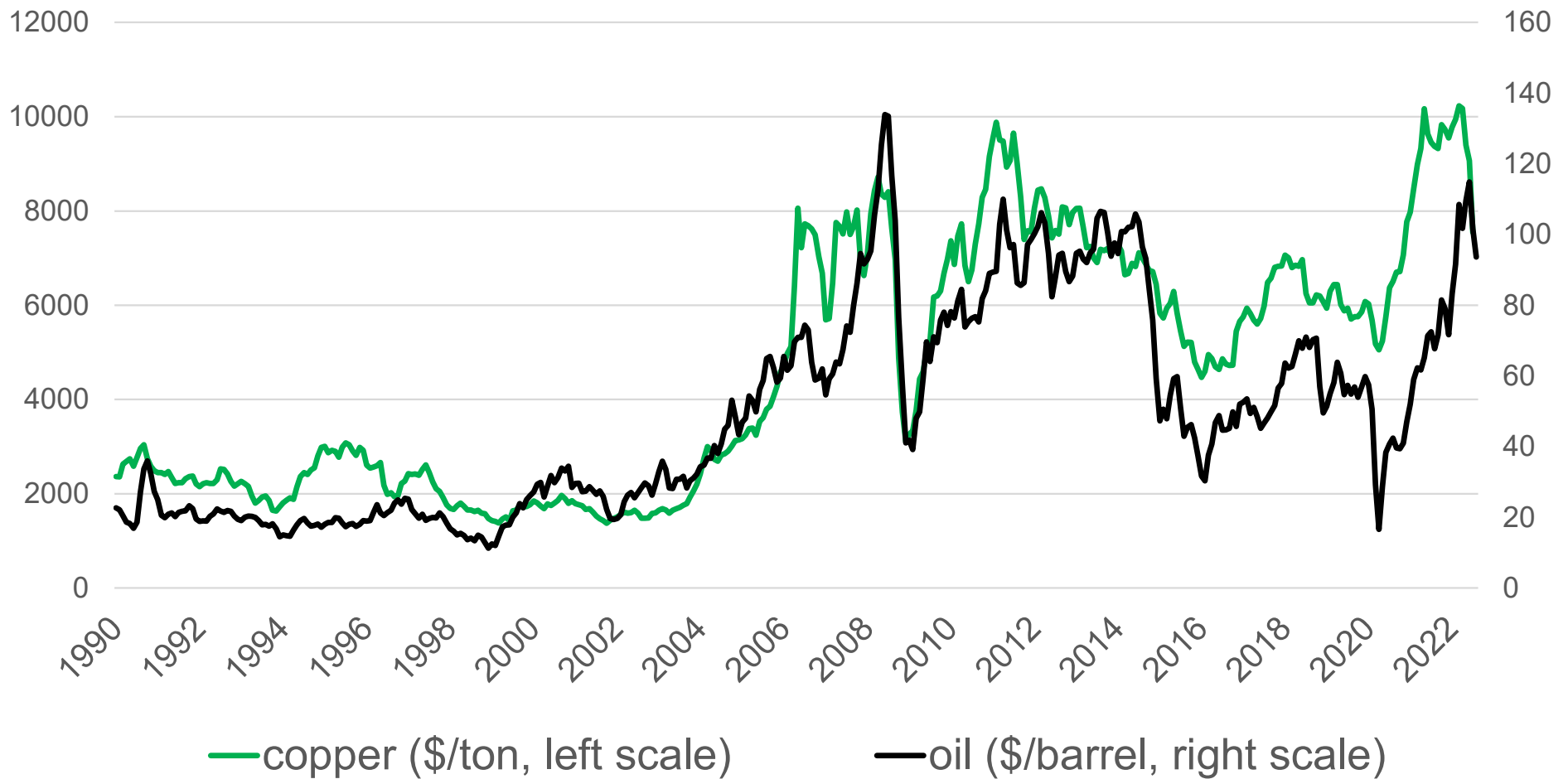# Russian shipments of crude oil and products



Soure: WSJ, Aug 29, 2022

# Recent price drop showed up in commodities broadly

## Oil and copper prices



copper ($/ton, left scale) — oil ($/barrel, right scale)

9

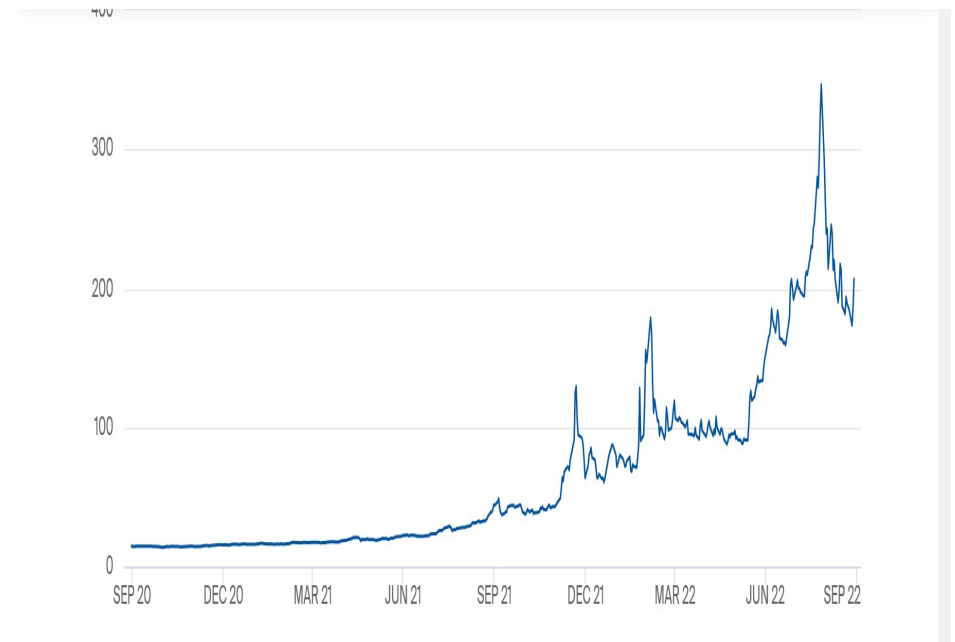# Natural gas prices in U.S. and Europe, Aug 2020 to Sep 2022

U.S. Henry Hub ($/MMBtu)
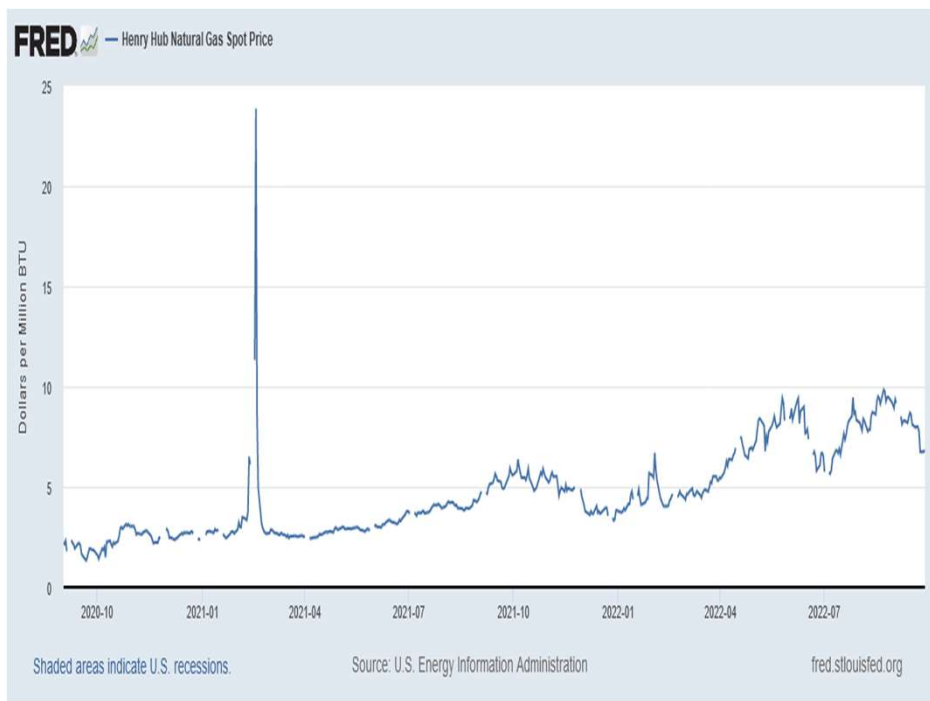
Dutch TTF (€/Mwh)
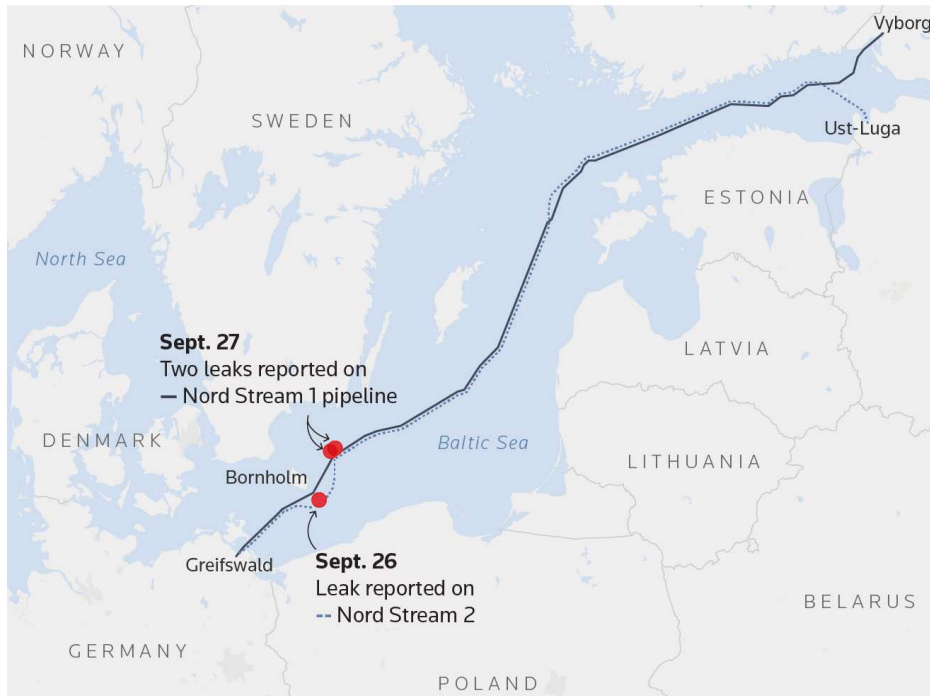




up 70% since Aug 2021

up 400% since Aug 2021 [10]

# Sabotage of Nord Stream pipelines in Baltic Sea



**Mystery leaks reported from Nord Stream gas pipelines**

# Europe's natural gas pipelines



Source: Volker Wieland, 2022

# What would be the consequences if a country or the world had to decrease energy consumption immediately 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) x (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:

$$Y = F(K, N, E)$$
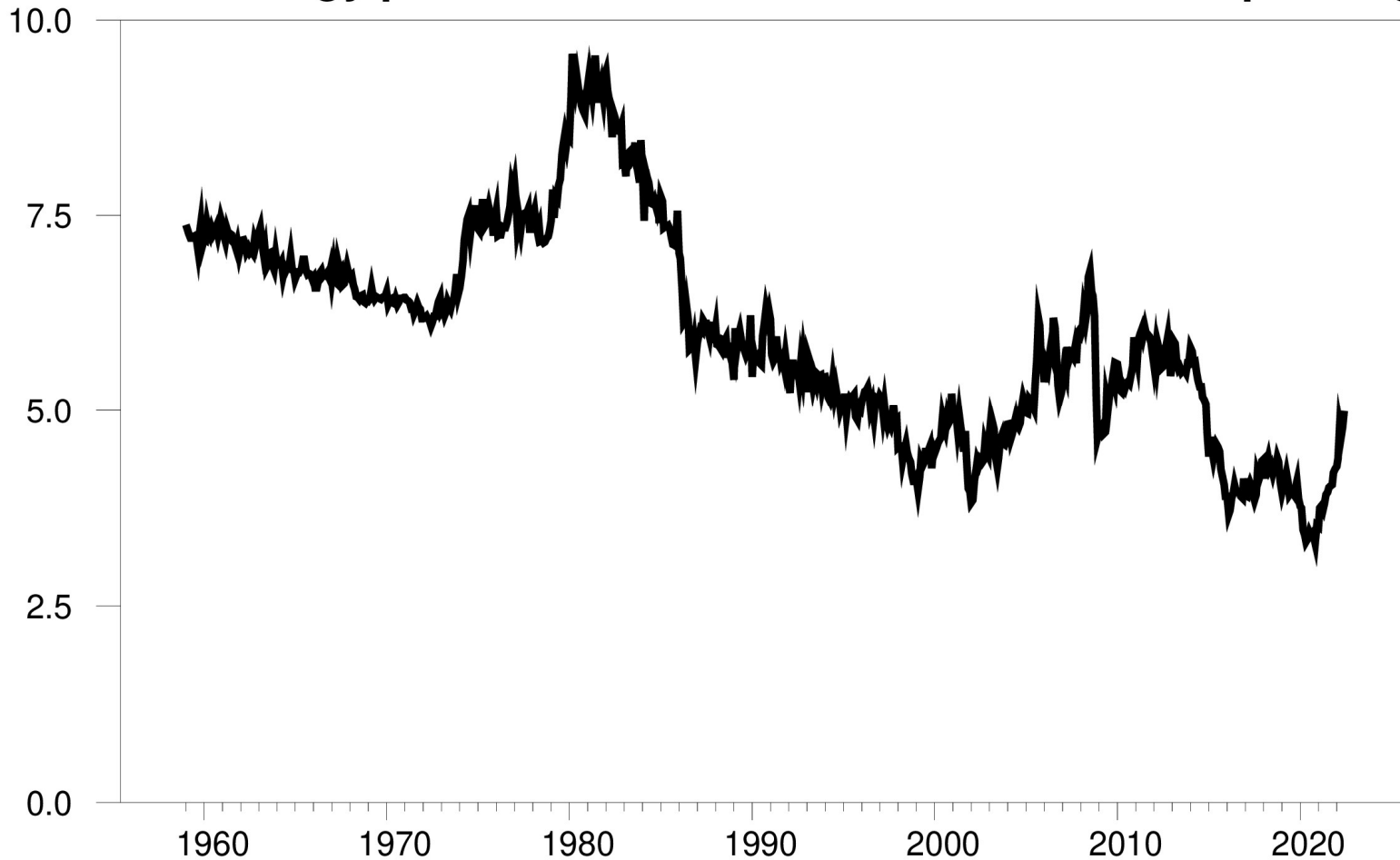
$$\frac{\partial F}{\partial E} = \frac{P_E}{P_Y}$$

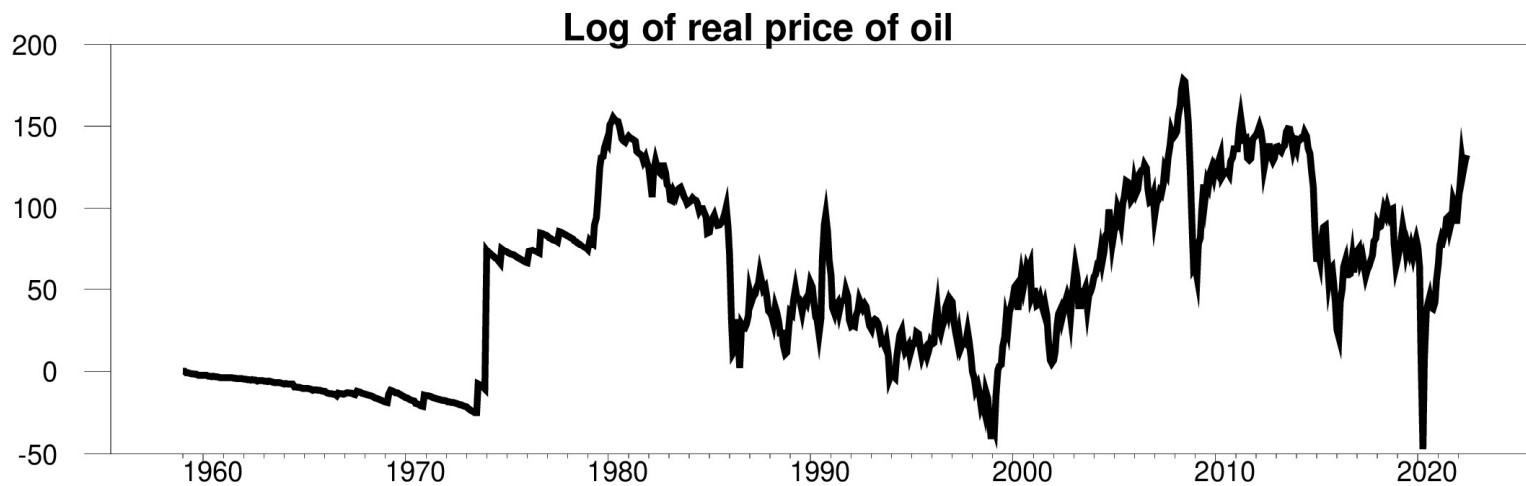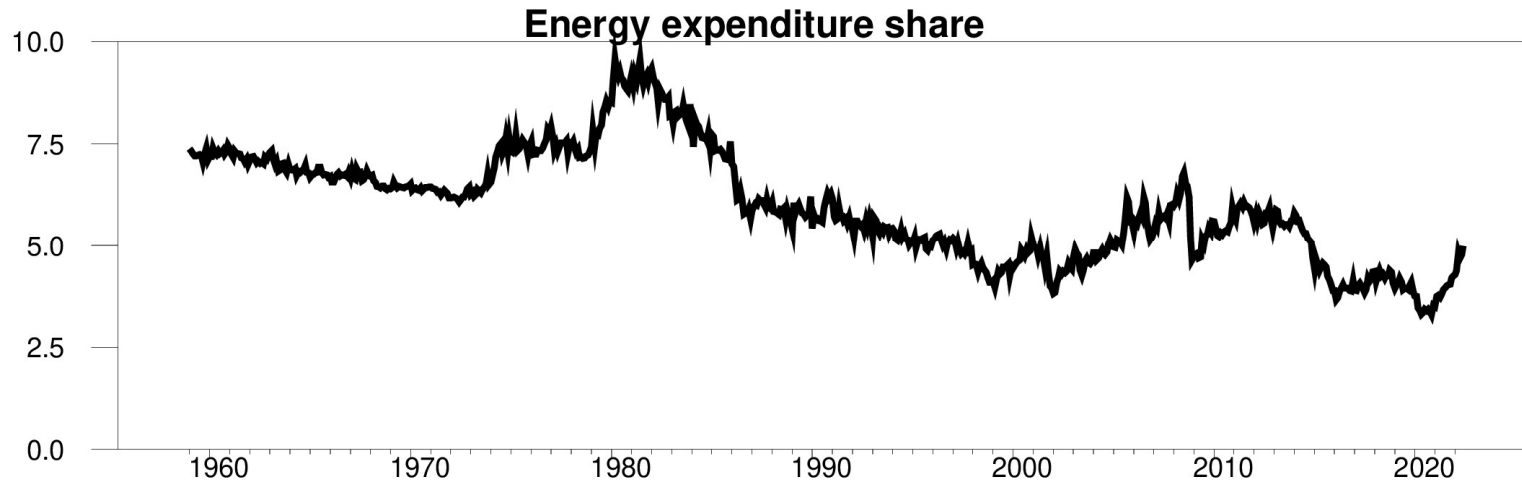$$\frac{\partial F}{\partial E} \frac{E}{Y} = \frac{P_E E}{P_Y Y}$$

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



**Energy expenditure share**

**Log of real price of oil**

# Share of consumer spending on energy and gasoline
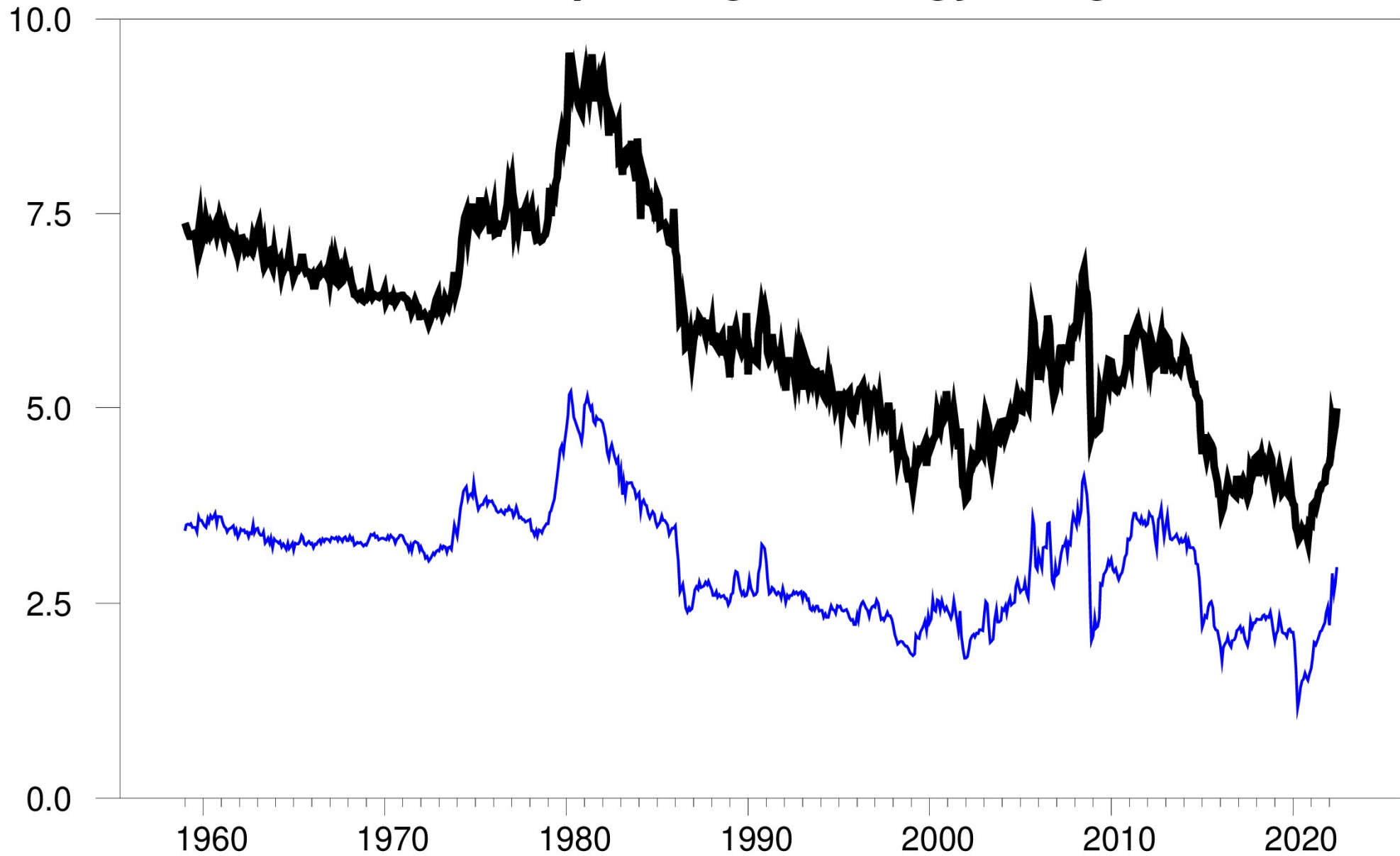
$s_t^G$ = purchases of gasoline as a share of total spending in month $t$.

$P_t^{CPI}$ = 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

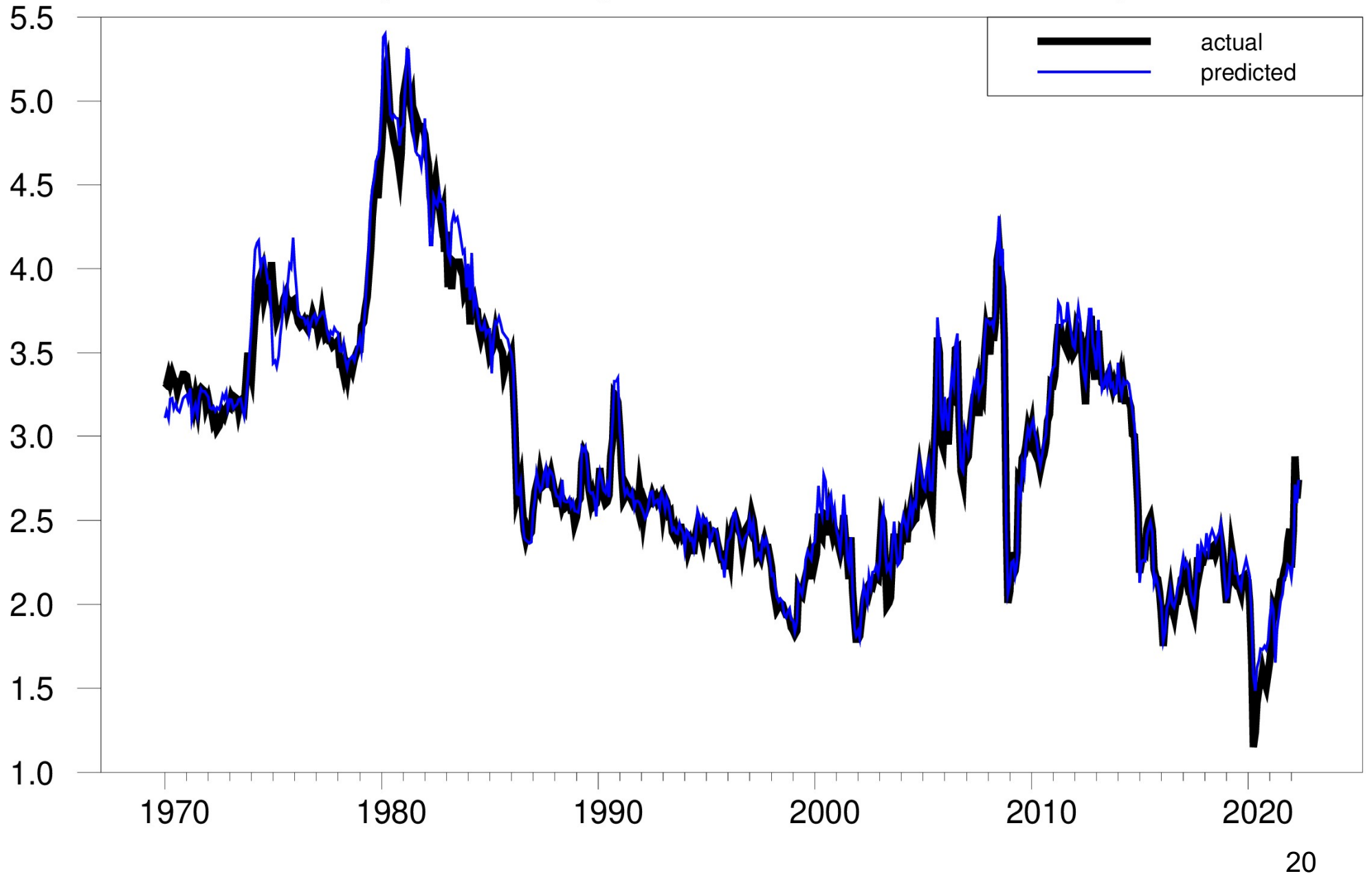# Using production function to calculate discrete changes

CES with initial share $\alpha$ and elasticity of substitution $\sigma$:

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

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

GDP as a function of energy input (initial share = 0.04)

Quantity of energy used

first-order approximation — elasticity = 0.05
elasticity = 0.01 — elasticity = 0 (Leontieff)
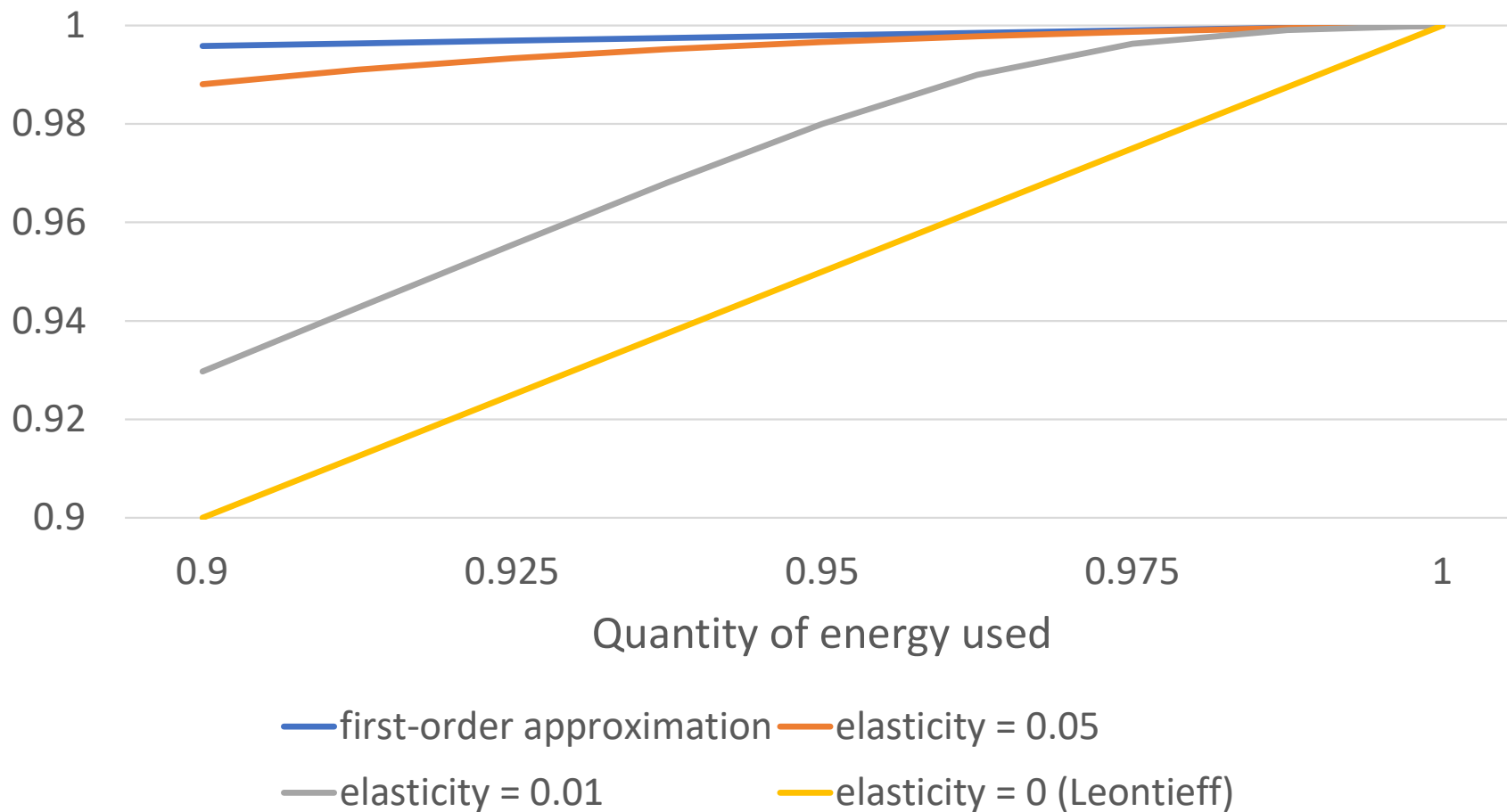
Source: adapted from Bachmann et al. (2022)

22

- Baqaee and Farhi (Econometrica 2019) develop calculations appropriate for non-epsilon change and multisector detail.

- Bachmann et al. (2022) use 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.
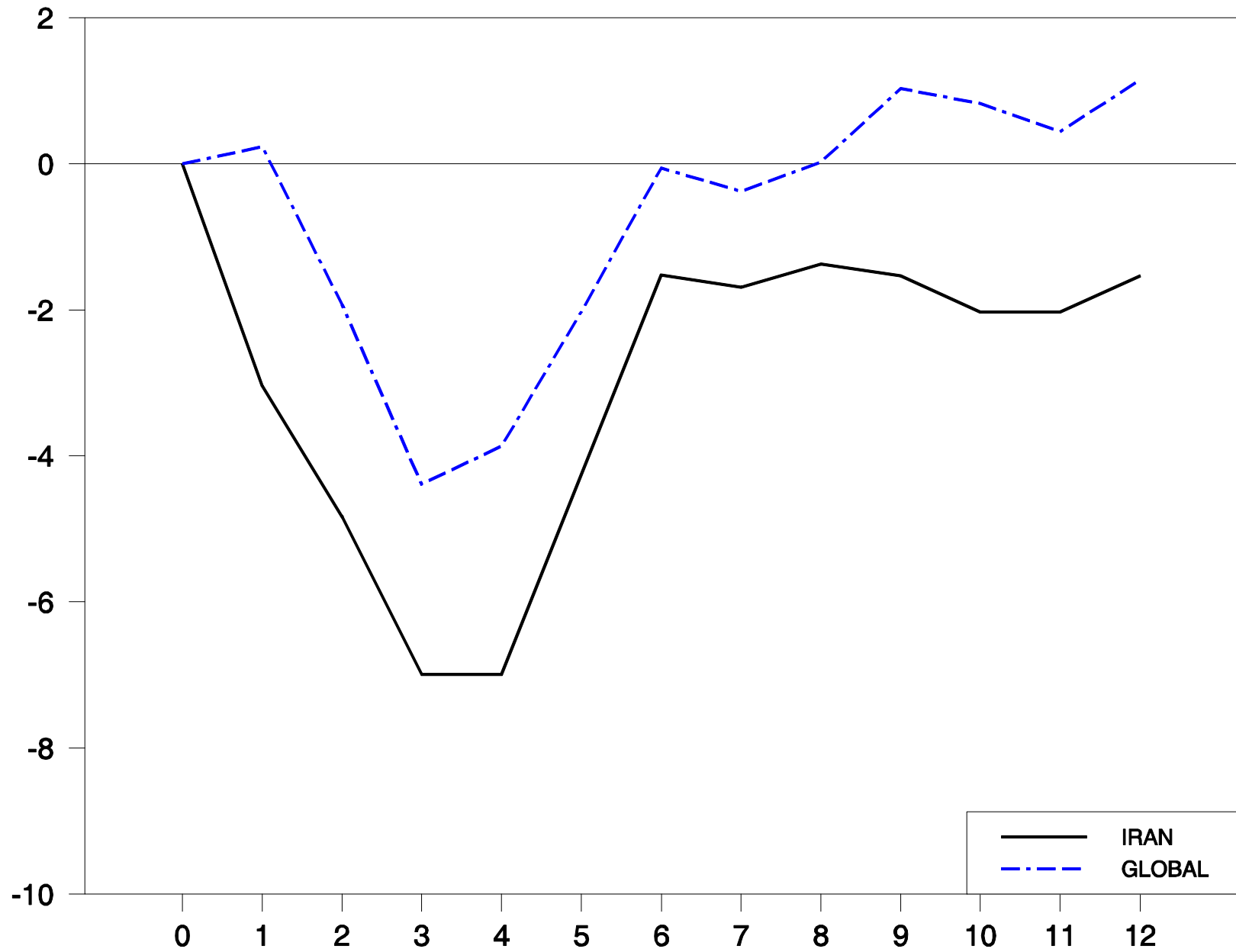
# What would be the consequences of a 10% decline in oil production?

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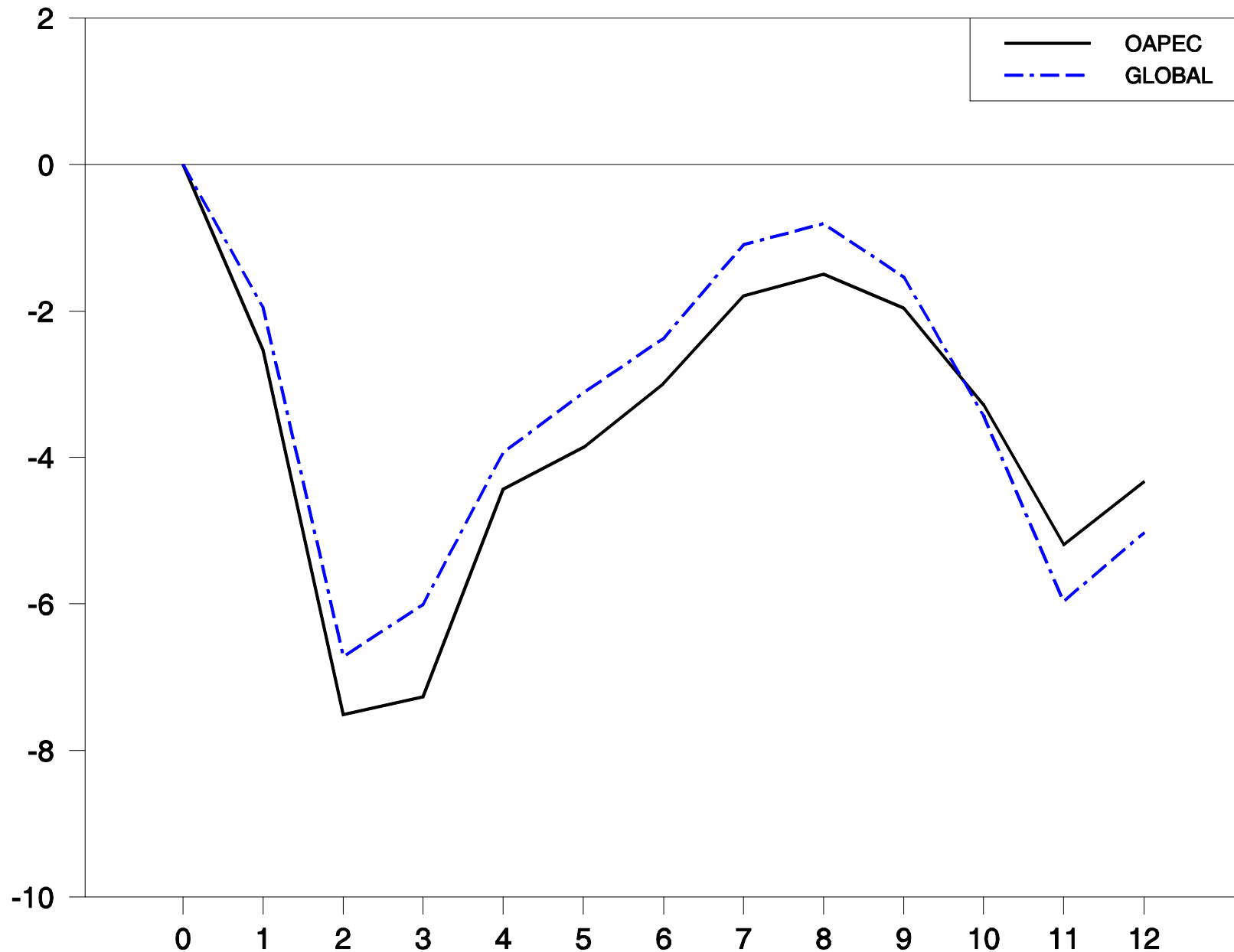
OAPEC embargo: Oil production in months following Sept 1973 Arab-Israeli War.

Iranian revolution: production after Oct 1978

26

# 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



**Real price of oil**

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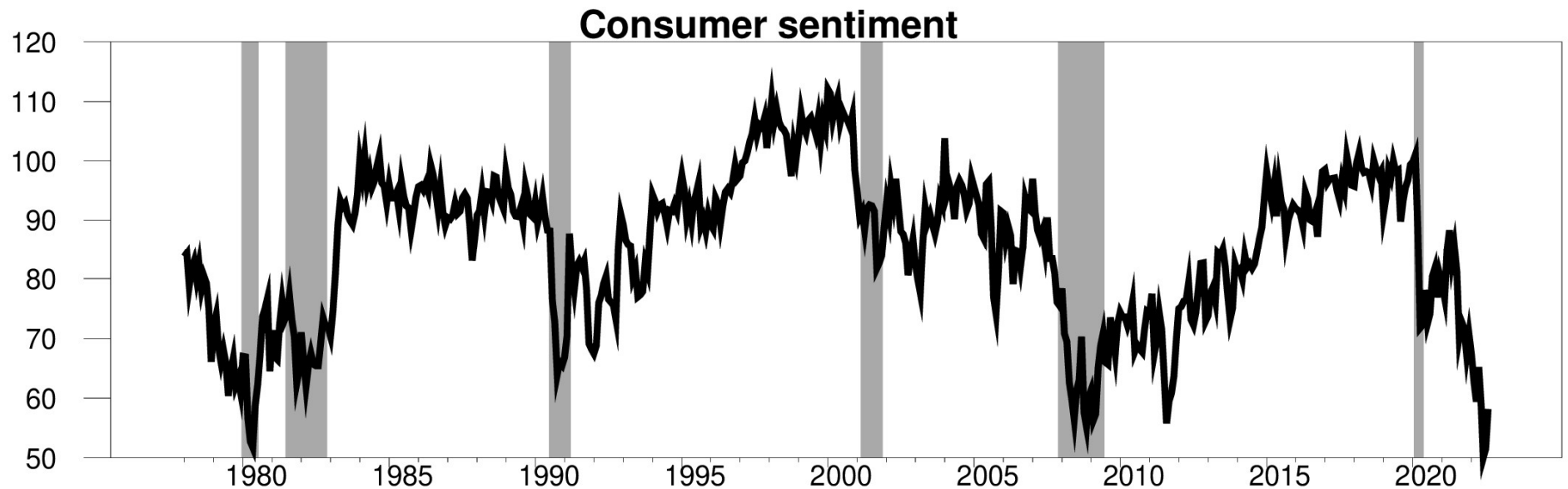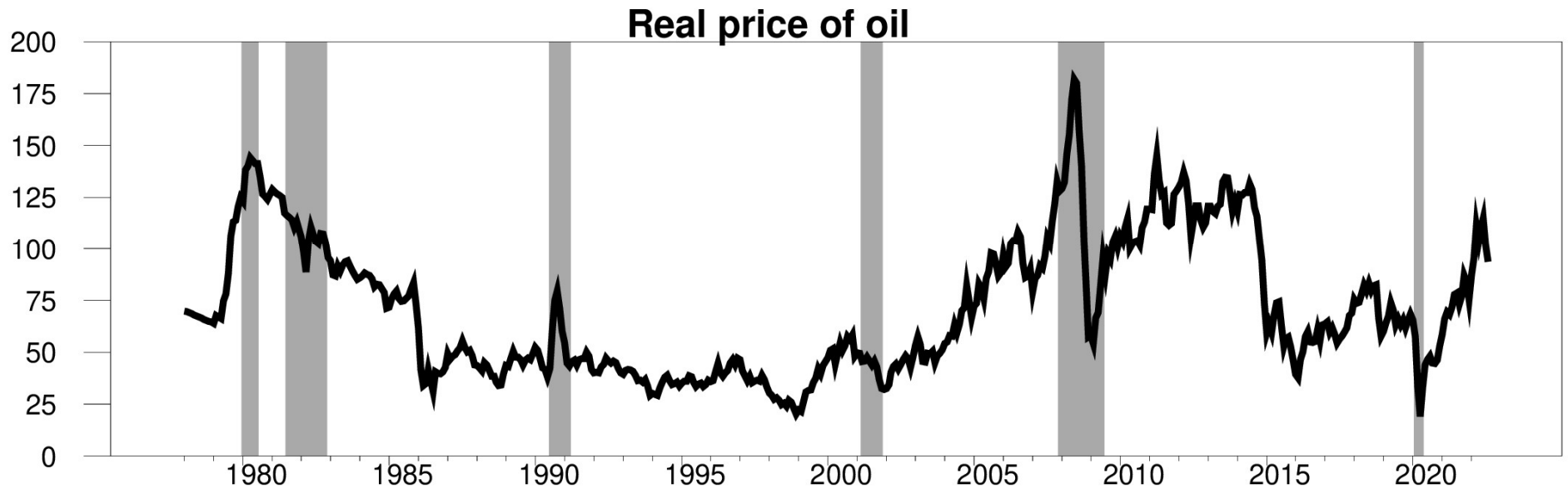
# Take-away: An energy price spike has potential to significantly disrupt spending on other goods

- 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.

# Perspective on current episode

- Energy price increases so far caused slowdown in economic growth, but not enough to cause recession in the U.S.

- Challenges facing Europe likely will mean a recession there.

- Coupled with other shocks (Chinese COVID lockdowns, monetary contraction) a global recession is quite possible.

# 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

**CPI inflation and crude oil inflation x 0.02**
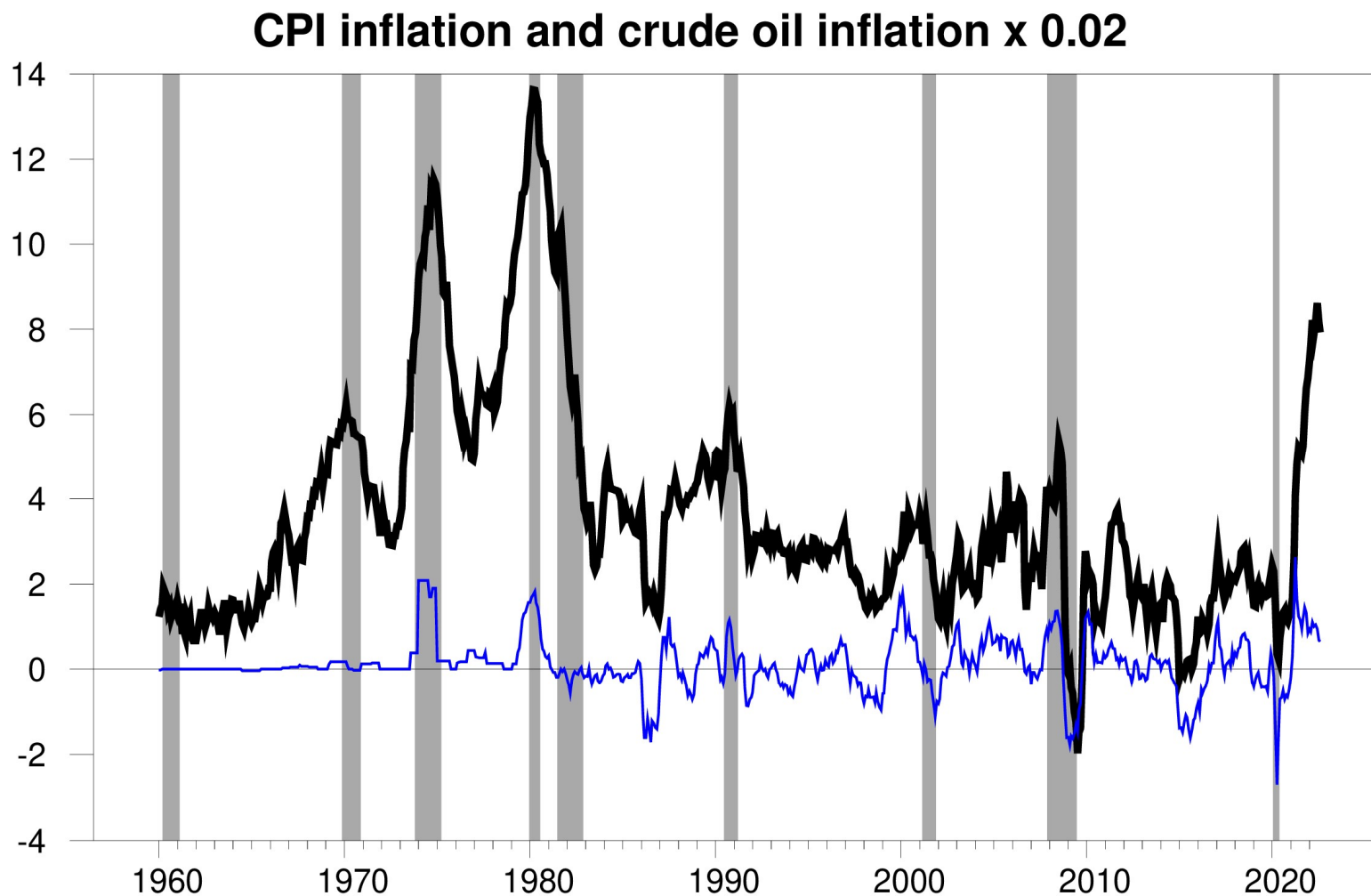
# Changes in Contributions to 12-month CPI Inflation
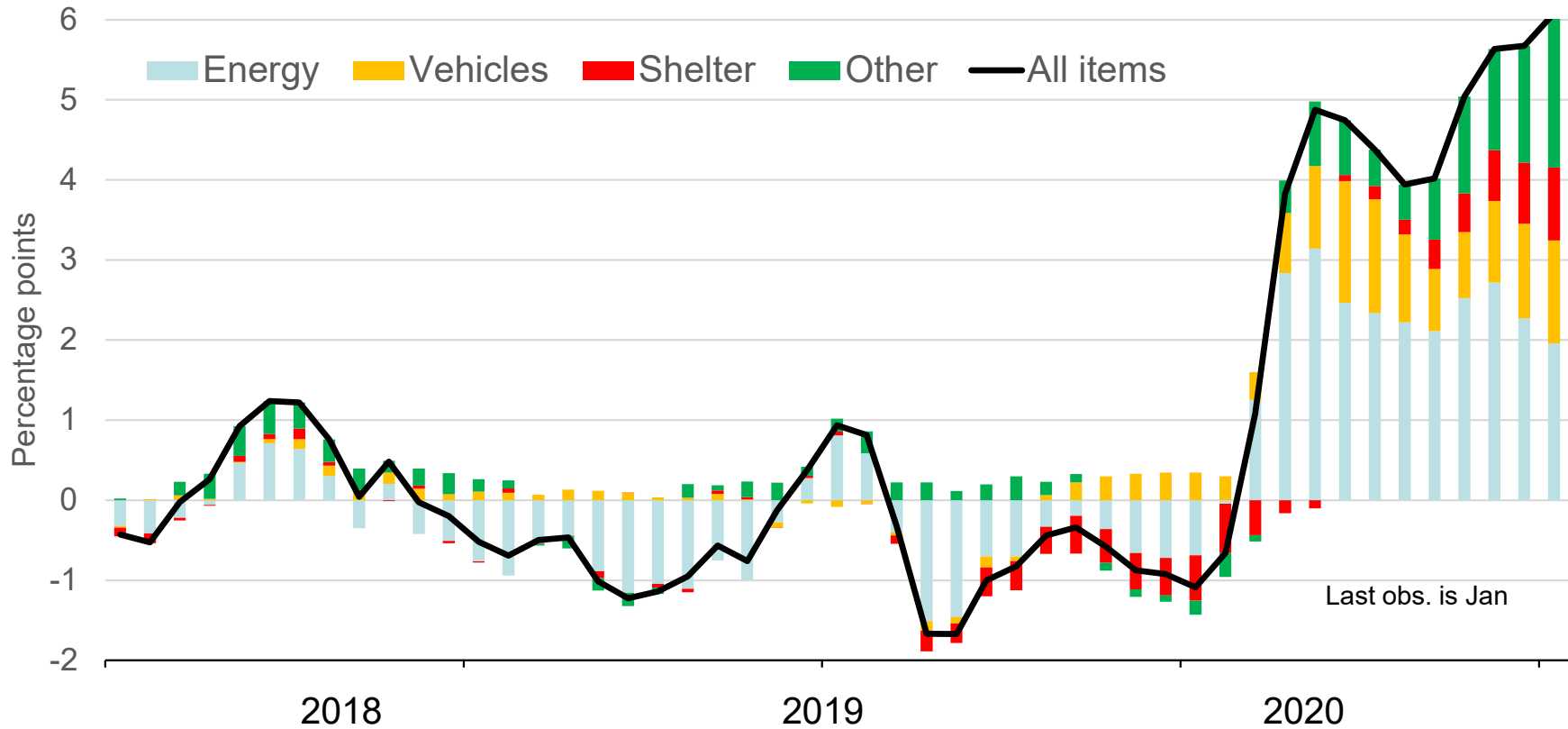
Note: "Vehicles" includes "new vehicles," "used cars and trucks," and "car and truck rental."  "Shelter" includes "Owners Equivalent Rent", "Rent of Primary Residence," "Lodging Away From Home," and "Tenants and Household Insurance."

Source: "The Inflation Situation in the United States," David Reifschneider and David Wilcox, 2022

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



Real interest rate



M2 growth
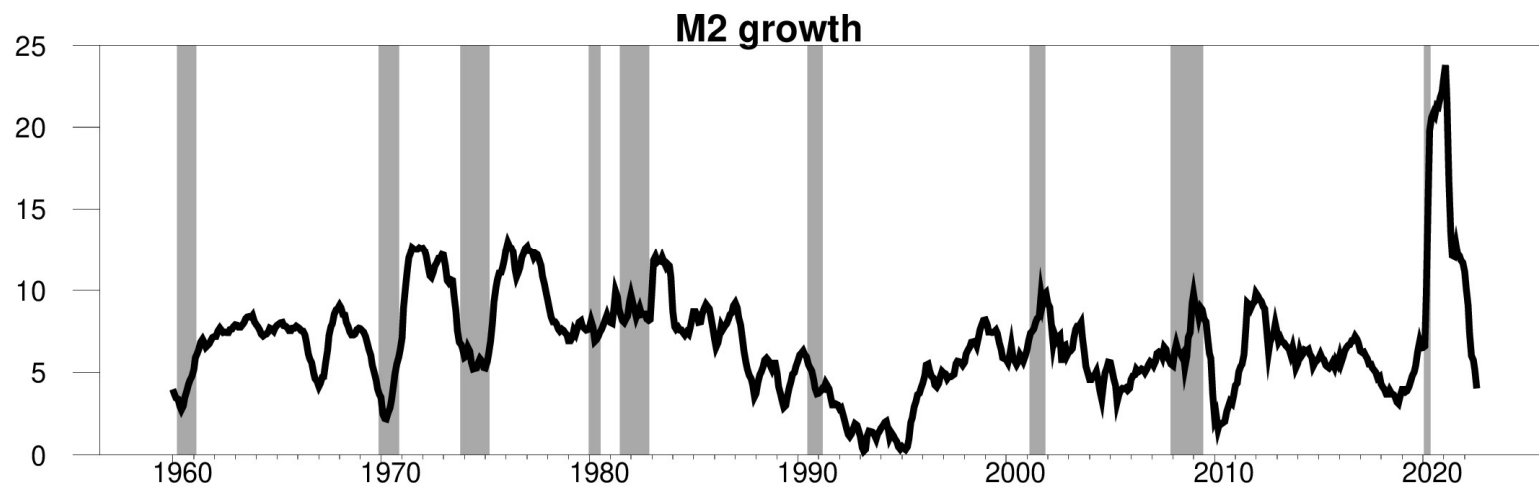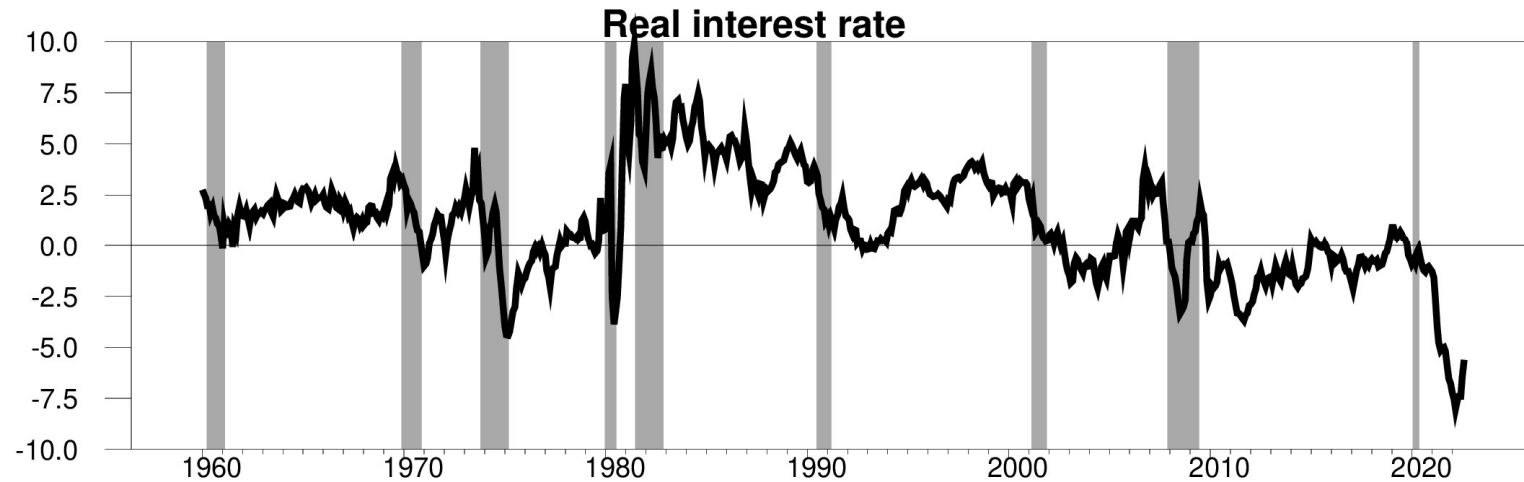
# Policy recommendations for Europe

(1) Nuclear energy

– 25% of German electricity in 2011 from nuclear

– Plan last month was to completely phase out German nuclear by end of 2022

(2) Don't try to shield users from effects of price increases

– Price controls in 1970s made loss in U.S. real GDP greater (Ramey and Vine, NBER Macro Annual)

# Policy recommendations for Europe

(3) Strict conservation for government activities

– Thermostat regulation, 4-day work week for public workers

(4) Fracking for natural gas

(5) Accelerate investments in LNG and renewables