

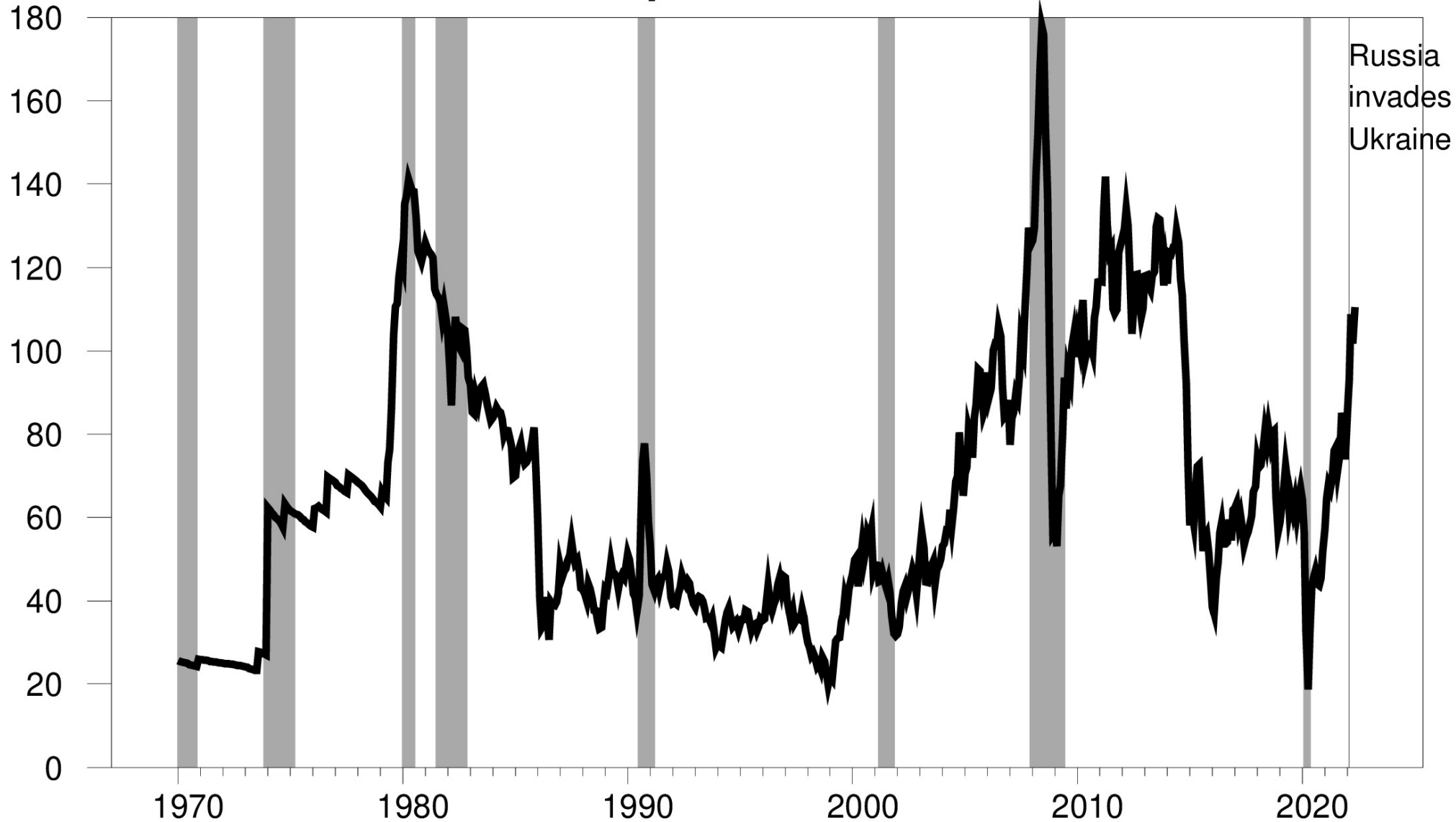
Sanctions, Oil Prices, and Recession

James D. Hamilton

University of California at San Diego

Recent oil price increase is comparable to biggest historical shocks

Real price of oil

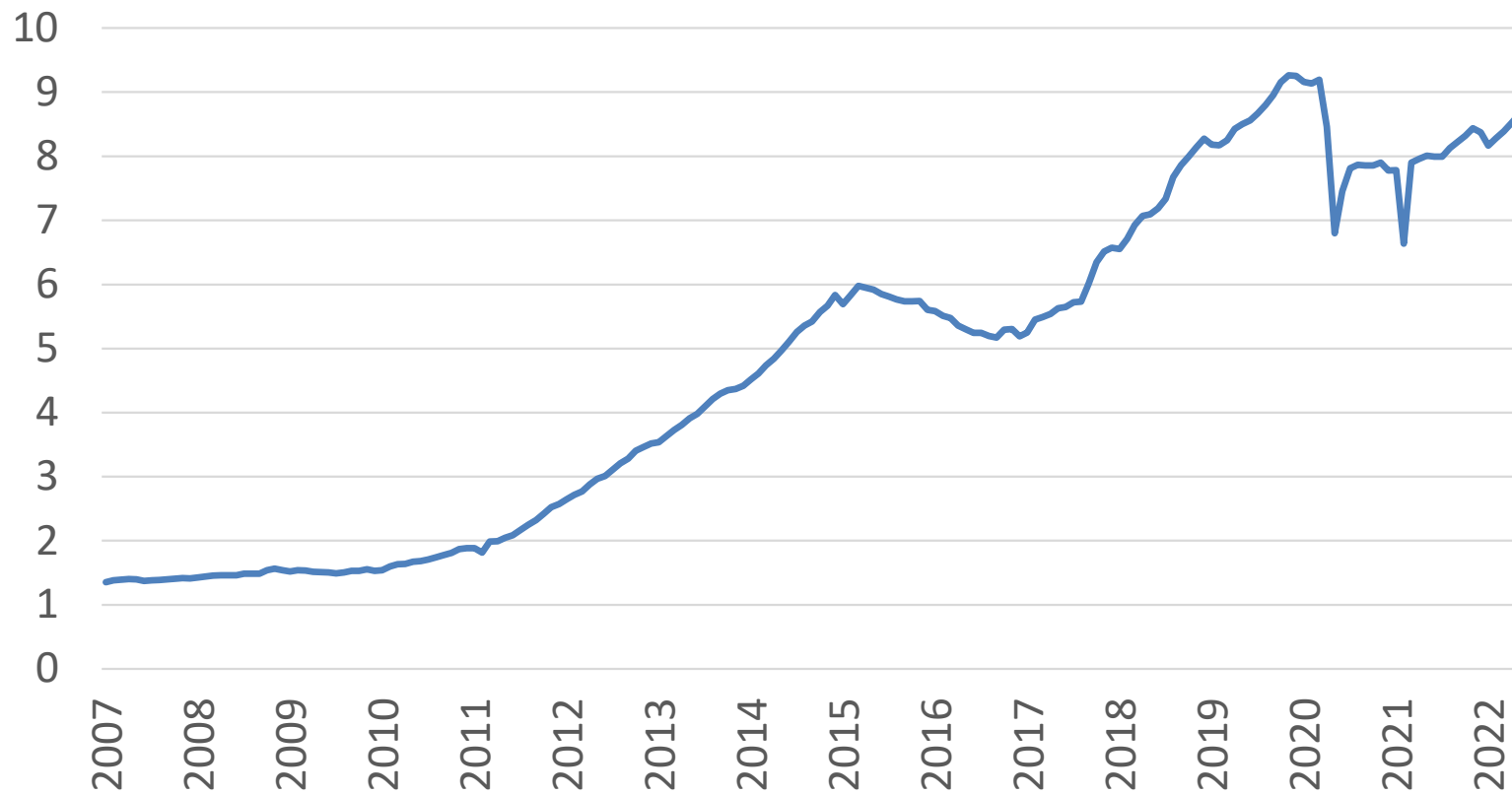


Most of the price run-up came before war in Ukraine

- West Texas Intermediate up \$75/barrel since June 1, 2020
- Russia invaded Ukraine Feb 24, 2022
- WTI up \$18 since Feb 23 and up \$34 since Jan 1, 2022

- Why did oil price go up so much before Russia invaded?
- Answer: demand recovered more quickly than supply
- U.S. shale oil production still down 7% from Jan 2020
- U.S. accounts for about 1/6 of global field production of crude but 1/3 of the decline in world production since Jan 2020

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



Russian oil production

- Russia produces 10 mb/d of crude oil
 - 13% of global field production
- Sanctions have brought Russian production down 0.9 mb/d so far
 - 1.2% of global field production
- Oil is readily transported and essentially sells on a world market
 - View 1.2% or 13% decrease in oil production as world event

Russian natural gas production

- Russia accounts for 17% of world production of natural gas
- Natural gas is much more localized
- Russia provides 55% of natural gas used by Germany

What would be the consequences of a 13% decline in oil production?

- Economic theory
- Empirical evidence

Predicted theoretical effects of a 13% 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 all of Russia oil production would be $(0.04) \times (0.13) = 0.5\%$ of GDP
- Average 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:

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

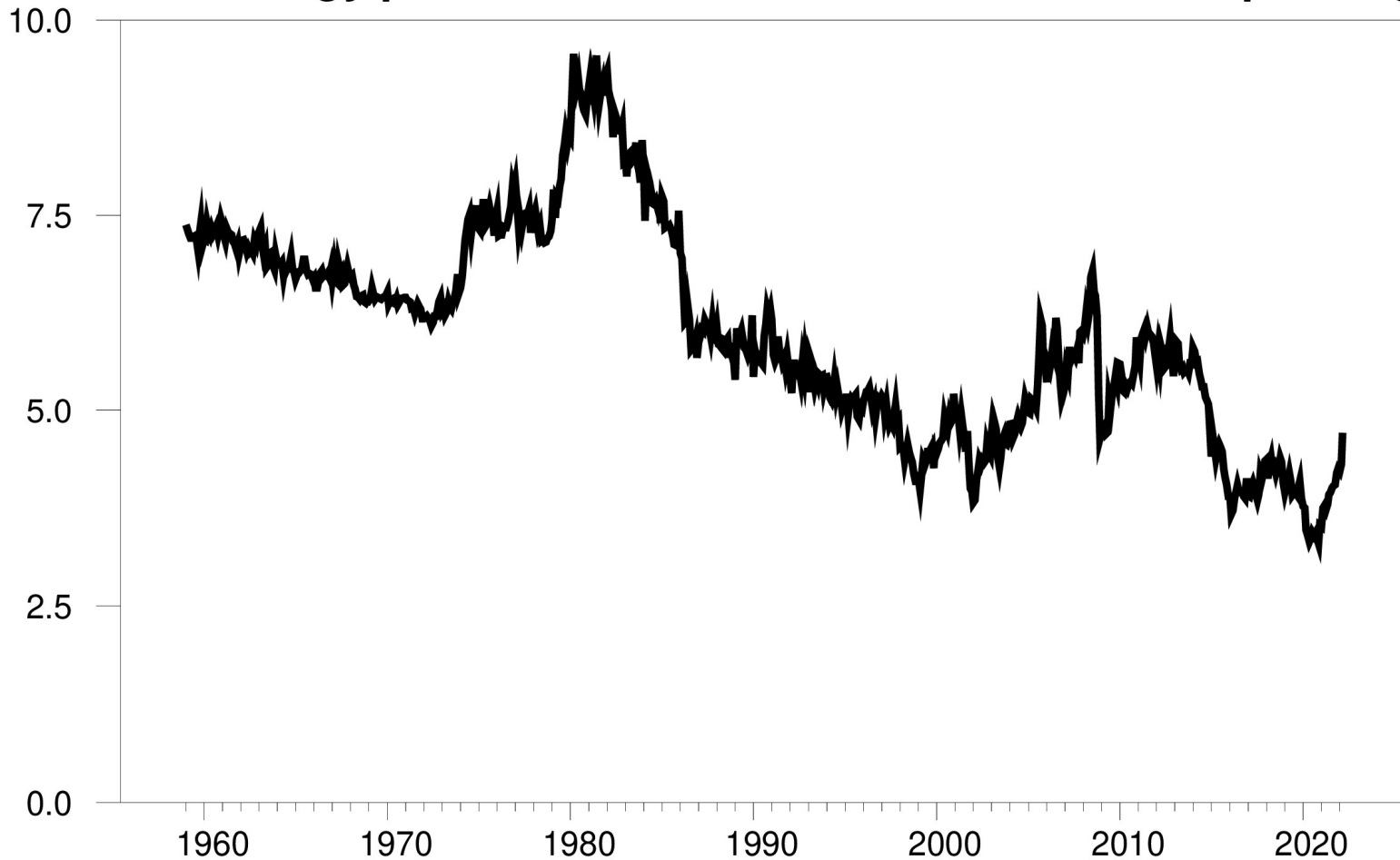
$$\frac{\partial F}{\partial E} = \frac{P_E}{P_Y}$$

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

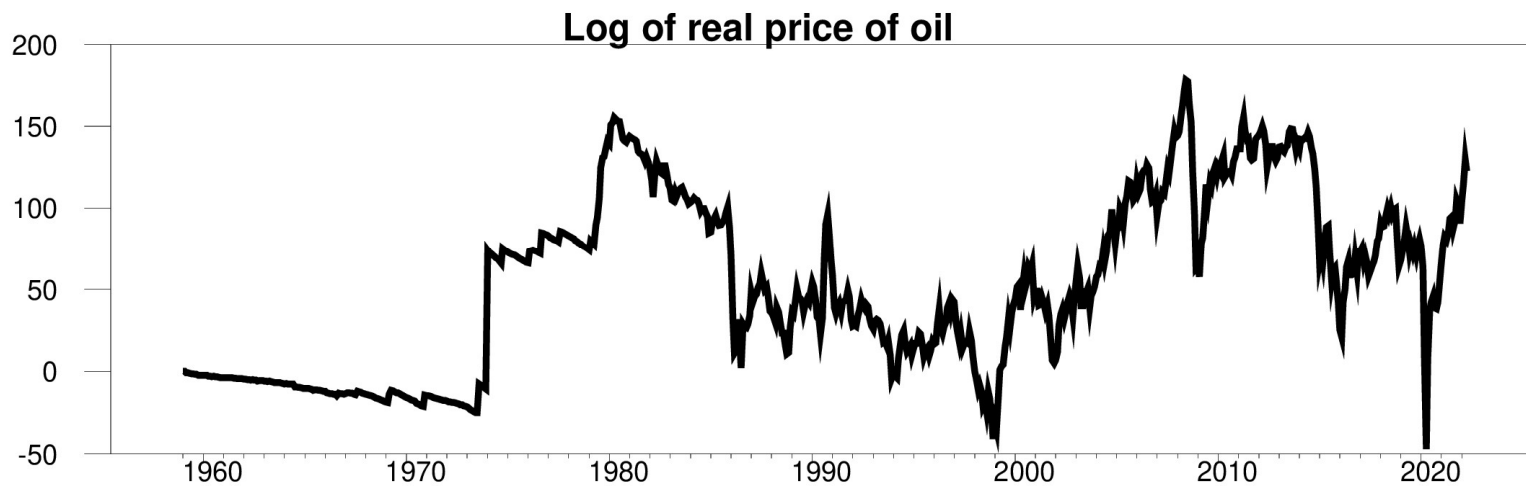
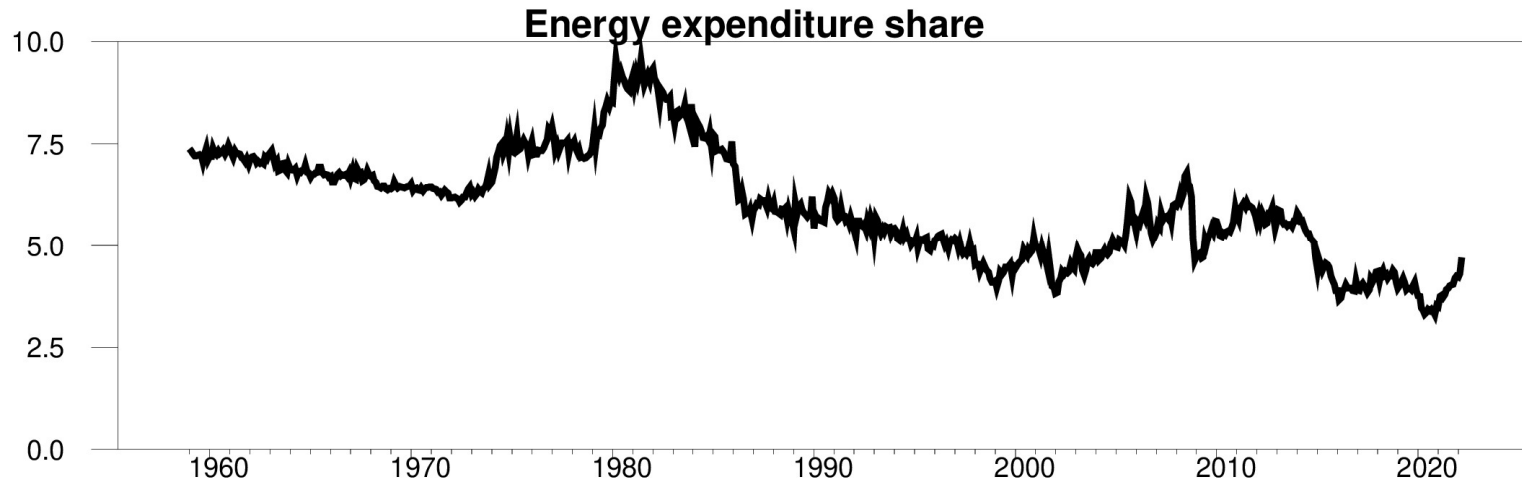
elasticity = expenditure share

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

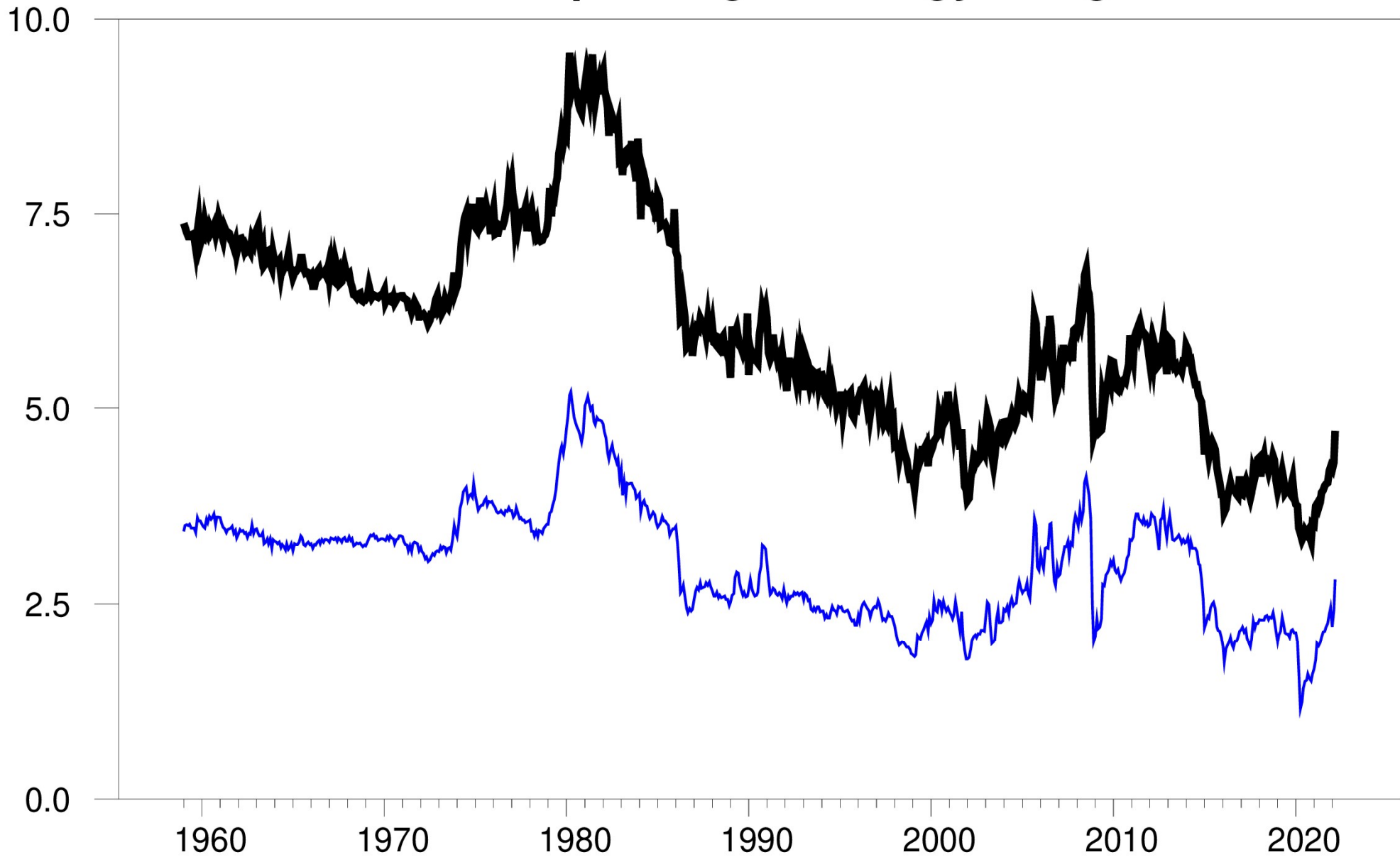
Consumer energy purchases as share of total consumer spending



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



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 .

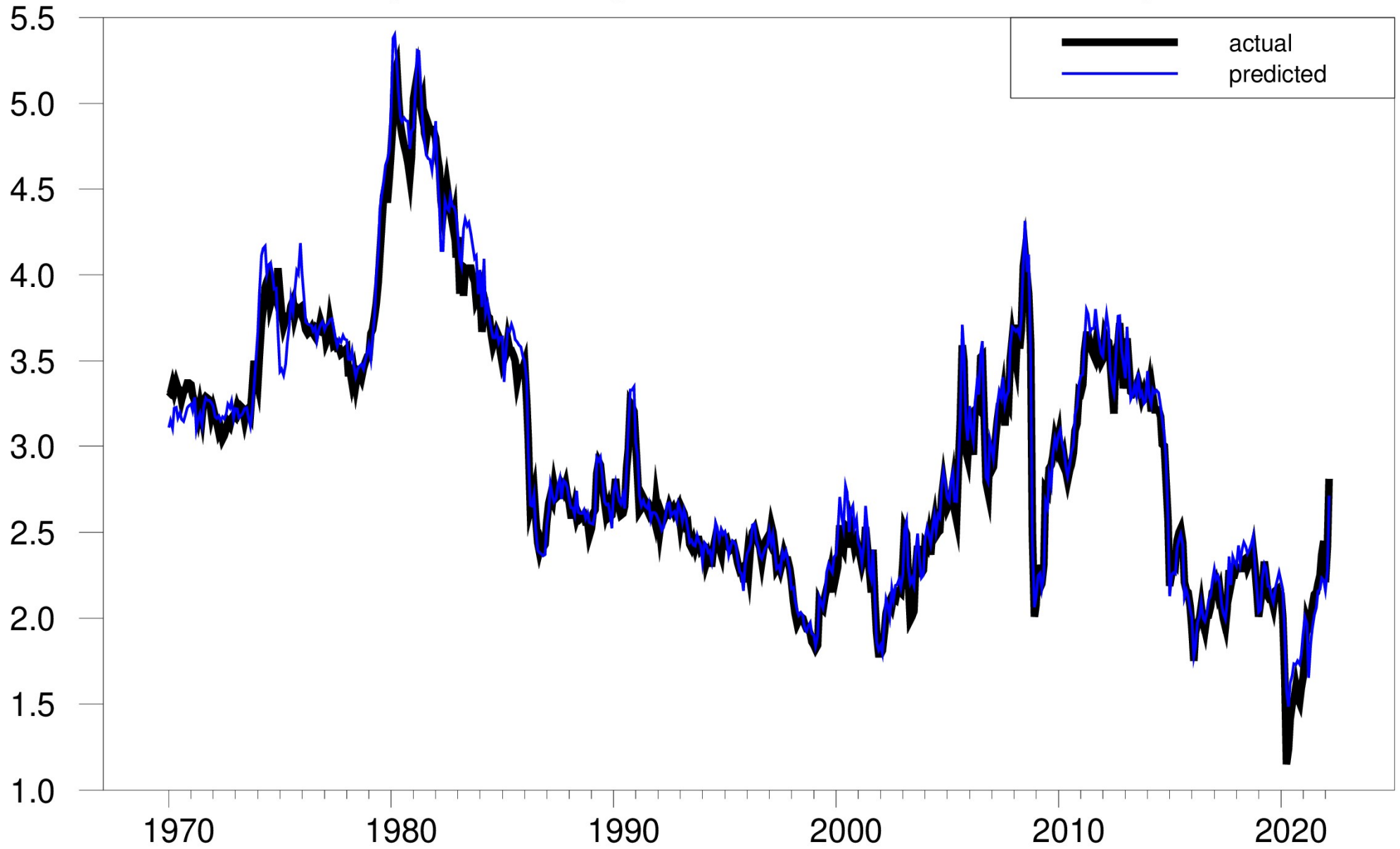
P_t^G = gasoline CPI in month t .

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

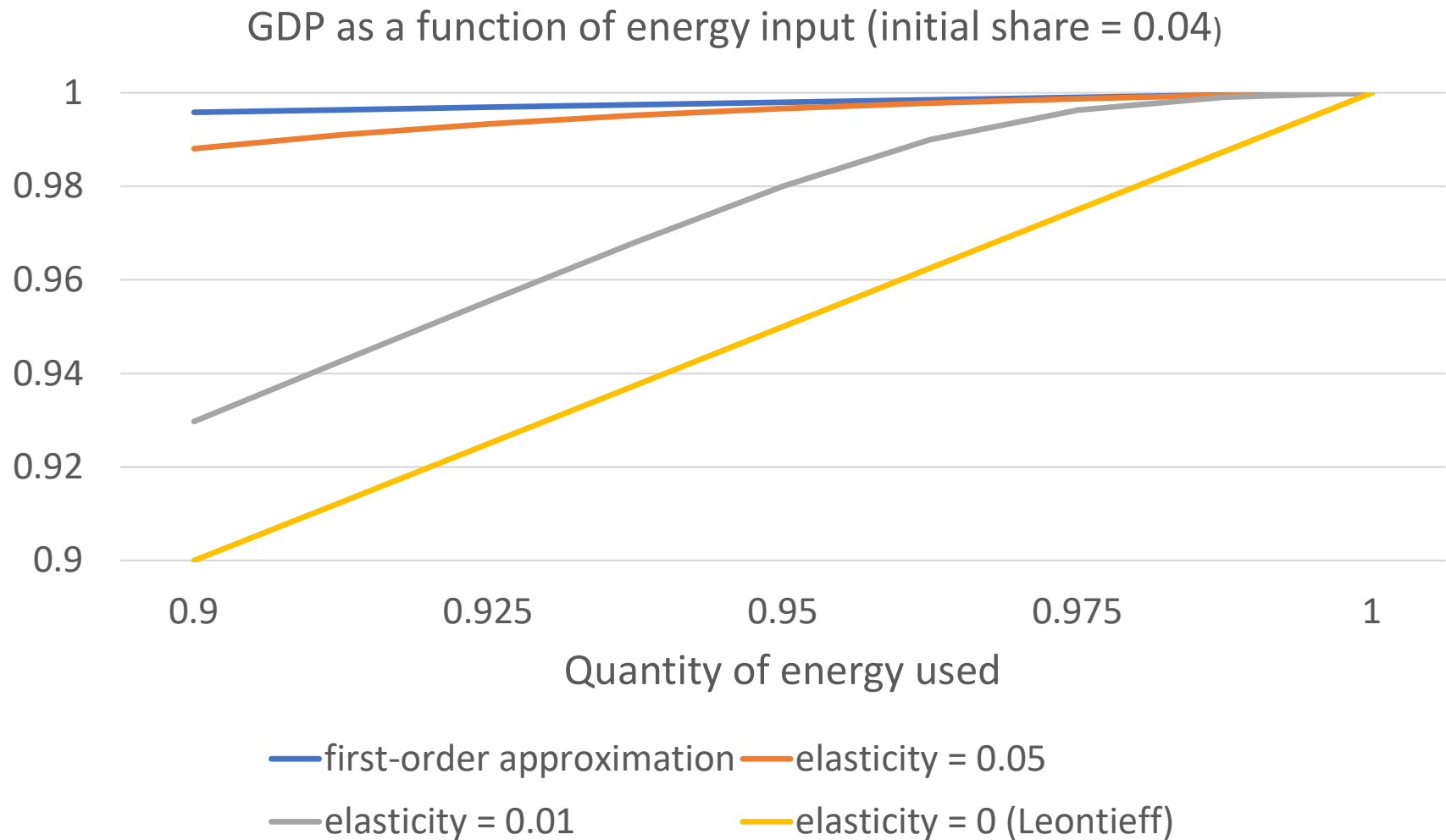


Using production function to calculate discrete changes

CES with initial share 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.



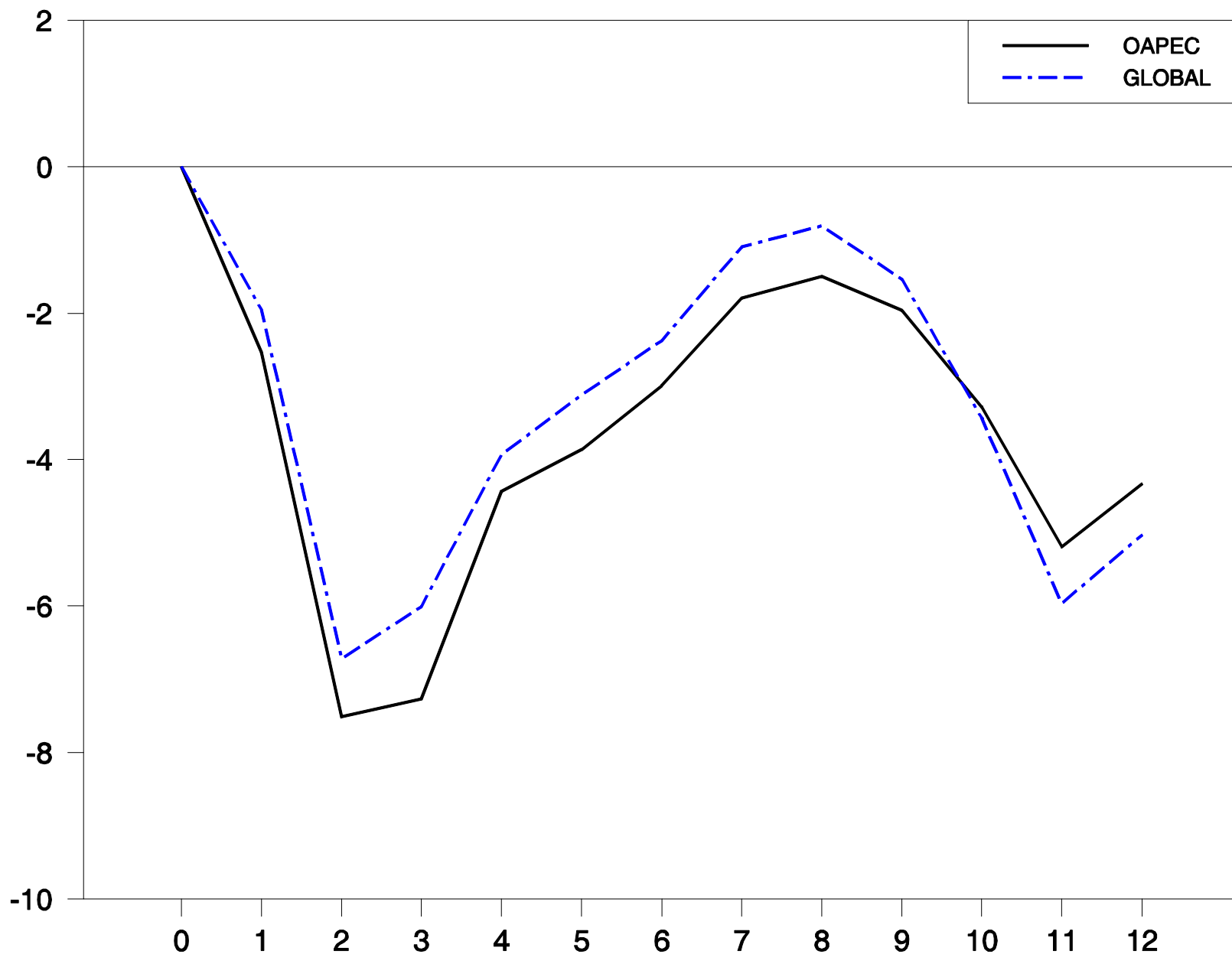
Source: adapted from Bachmann et al. (2022)

- Baqaee and Farhi (Econometrica 2019) 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.

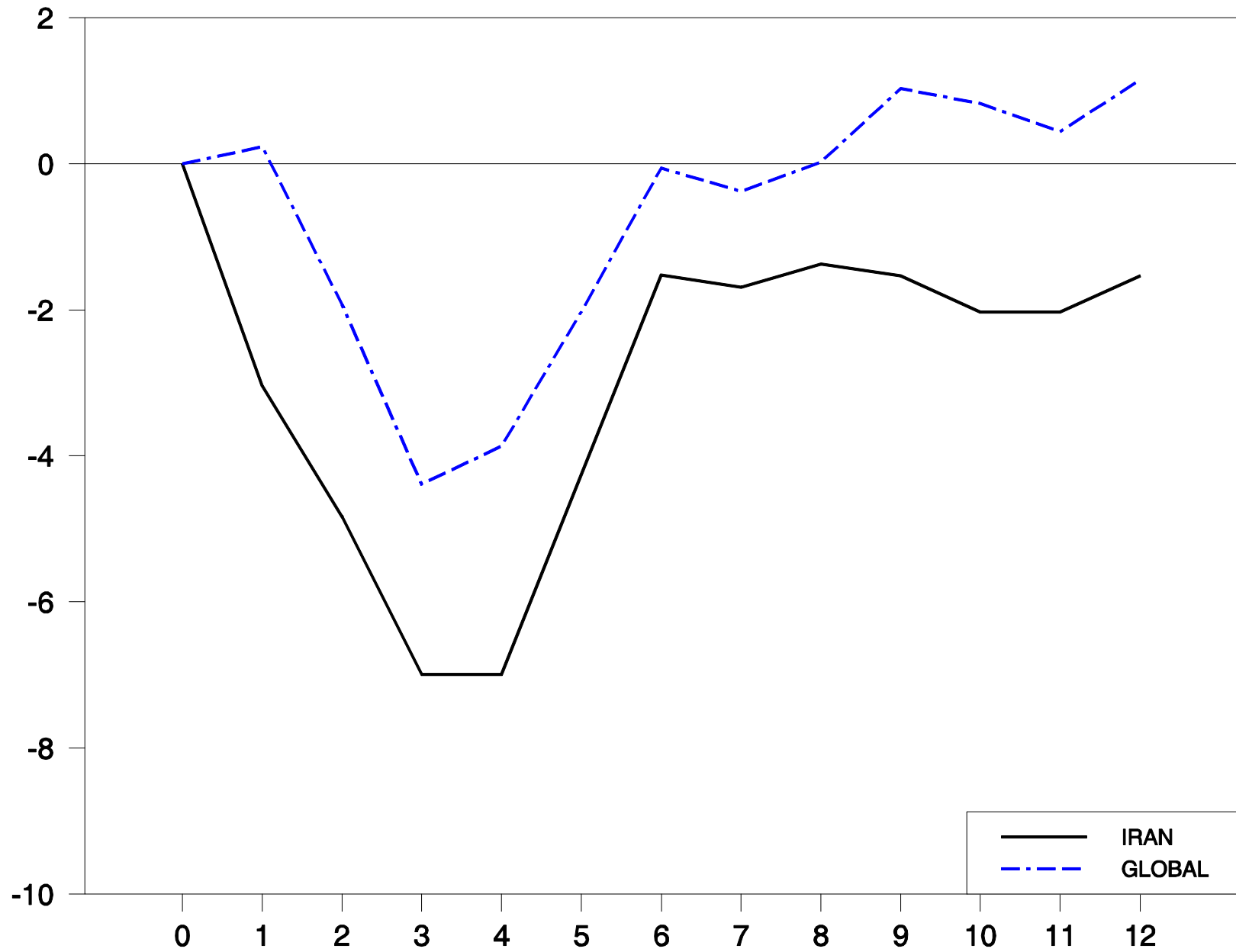
What would be the consequences of a 13% decline in oil production?

- Economic theory
- Empirical evidence

Percent change in crude oil production from members of OAPEC (in black) and world total (in blue) after Sept. 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

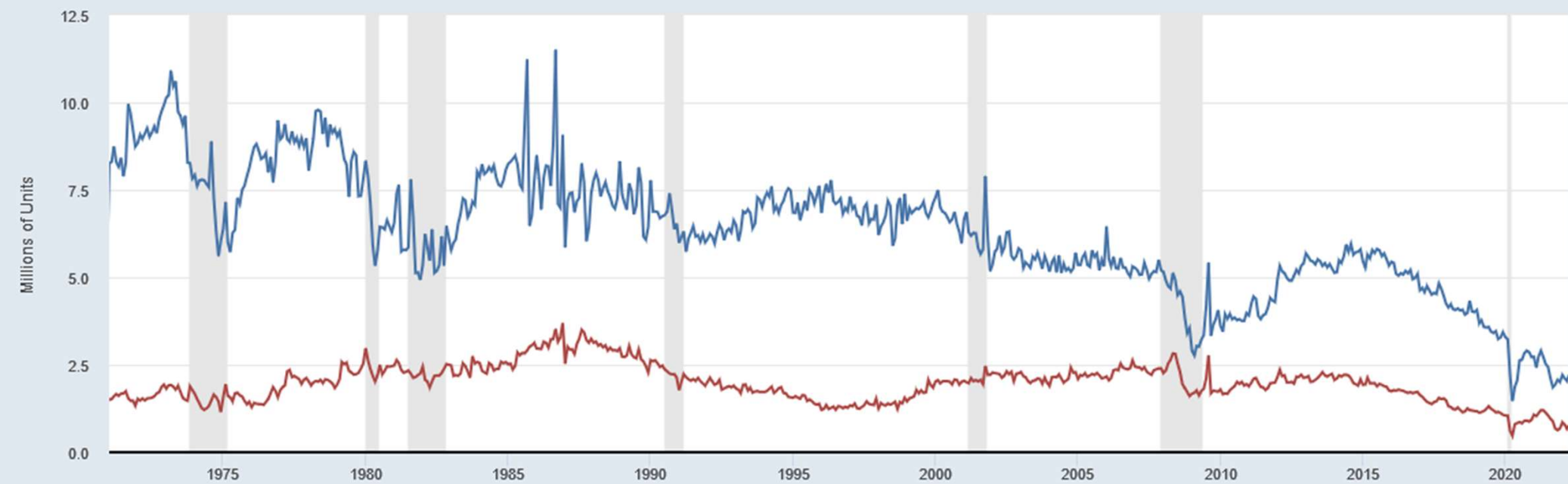
- Economic recessions are characterized by underutilized resources.
- Unemployment rate spikes up and capacity utilization decline.
- N and utilization of K change along with E .
- Is there reason to believe that previous oil shocks contributed to this?

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

- Decline in auto sales coincides with gasoline price increases and often precedes the recession.
- Often see sales of more fuel-efficient vehicles rise at same time that sales of less fuel-efficient vehicles decline.



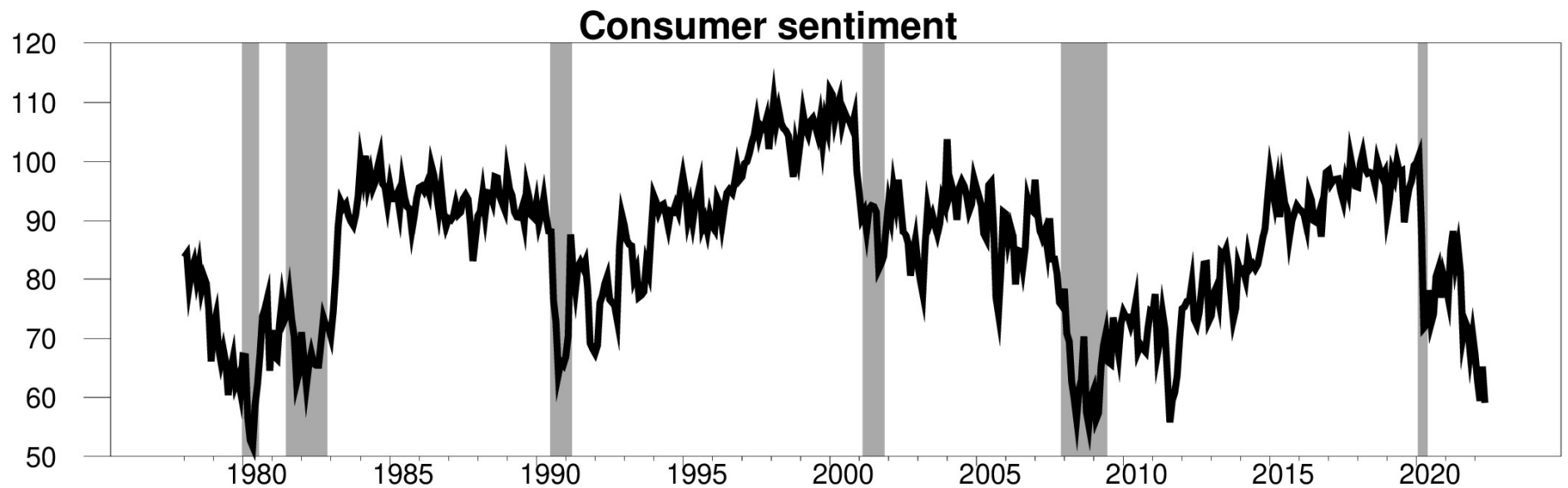
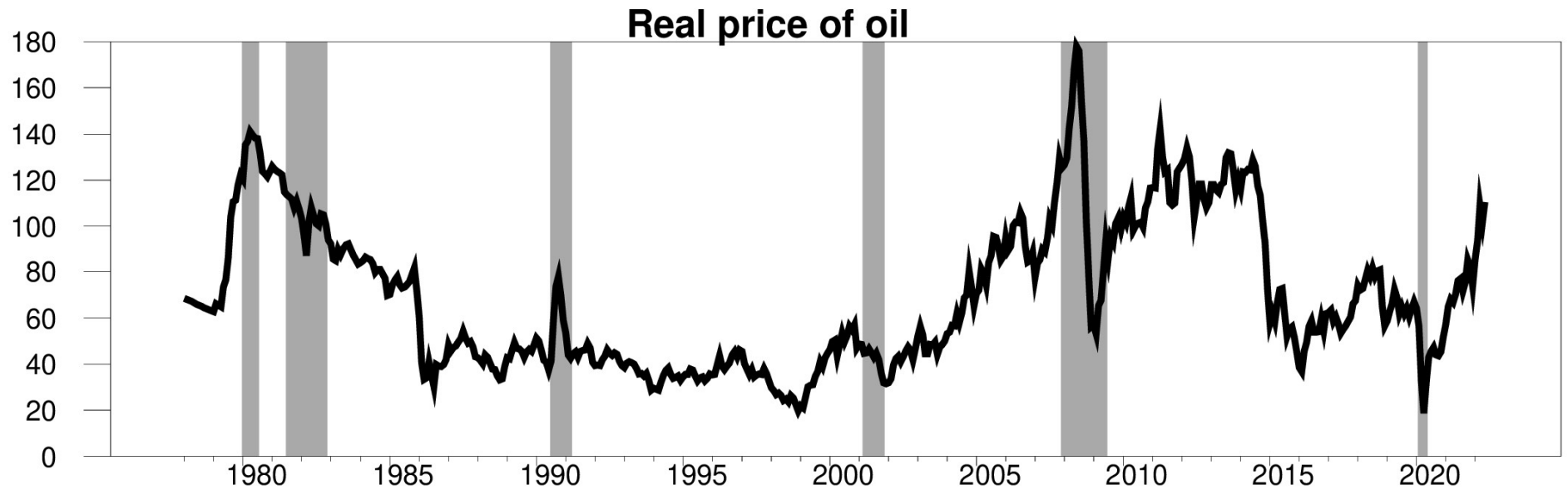
Shaded areas indicate U.S. recessions.

Source: U.S. Bureau of Economic Analysis

fred.stlouisfed.org

- Kuhn, Kehrig, and Ziebarth (2021) document considerable heterogeneity across U.S. consumers.
- 10% of U.S. households never buy gasoline.
- For a different 10% of households, gasoline accounts for more than 10% of total spending
- If median household does not reduce number of gallons purchased, it must cut back on purchases of other goods and services by 4% when gasoline price doubles

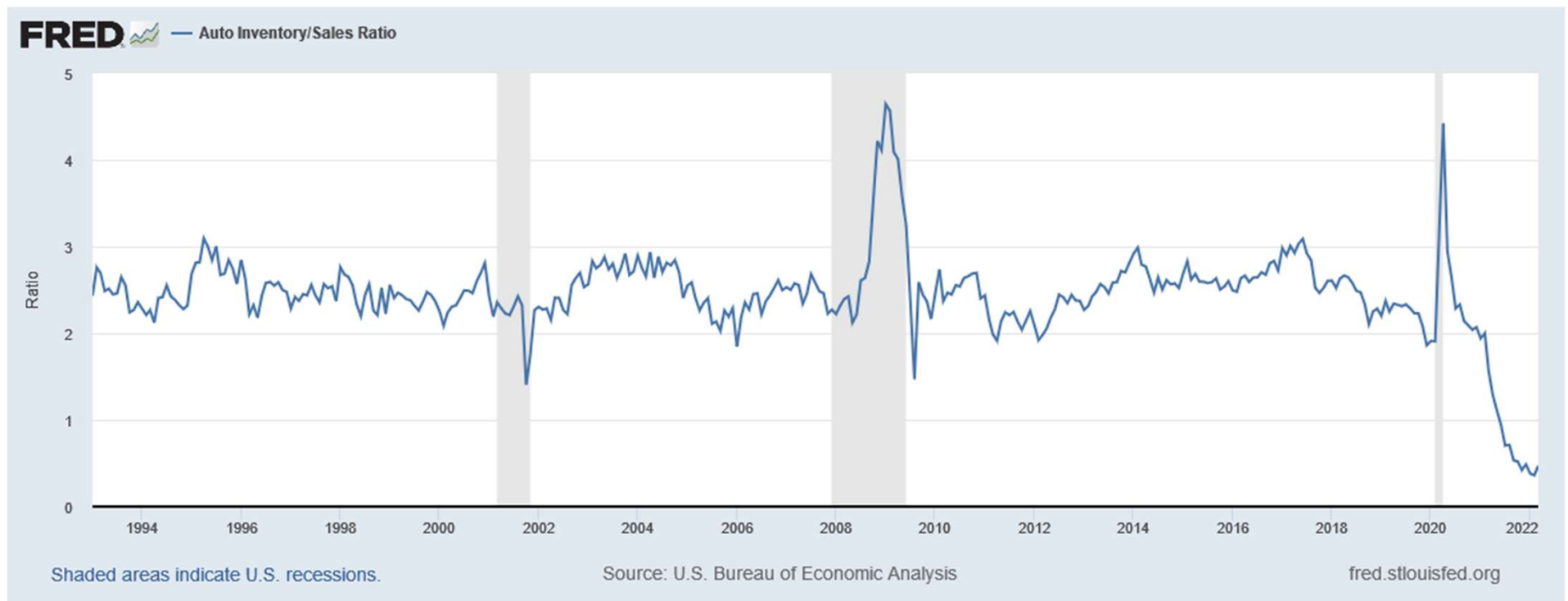
Consumers become more pessimistic when oil prices rise



Conclusion: 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.

Current situation: auto production limited by supply, not demand



- Conclusion: oil price increase so far not enough to cause a recession.
- But what about inflation?

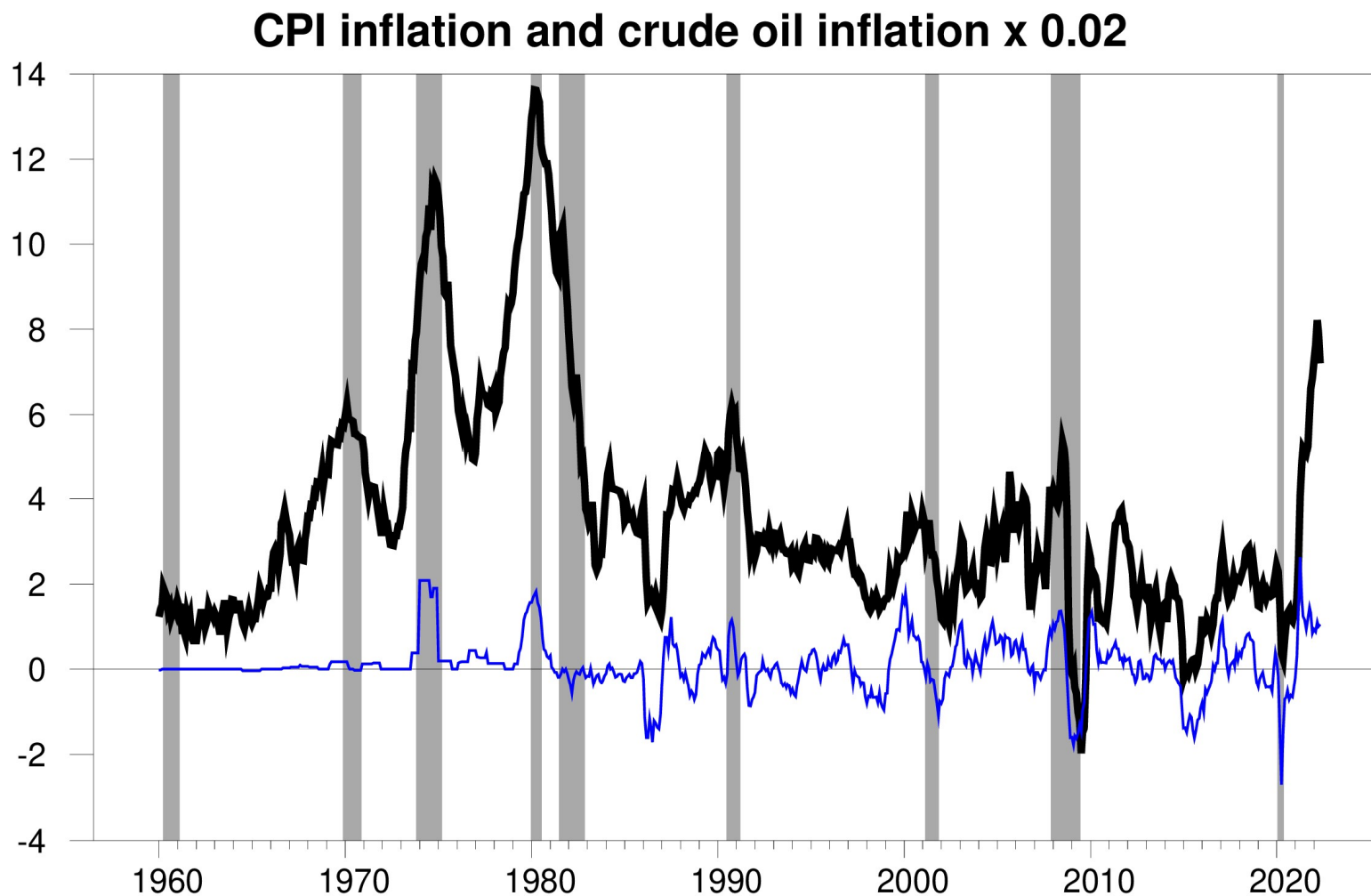
Effects on inflation

- 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

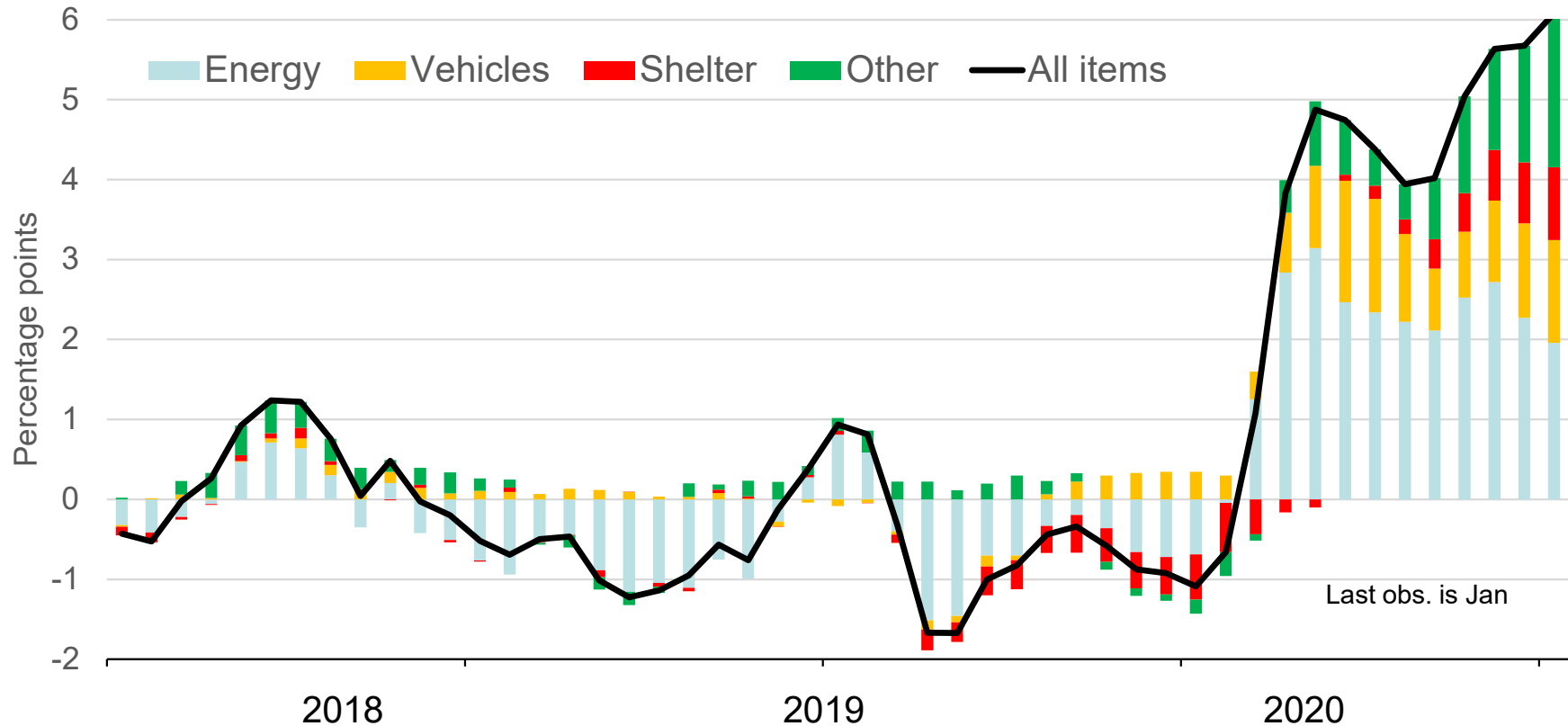
- If crude oil represents half the retail after-tax cost of refined product and these other costs are fixed, when price of oil goes up 10% the price of refined product goes up 5%.
- If no other prices change, we get the direct mechanical contribution to inflation by multiplying percentage change in nominal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



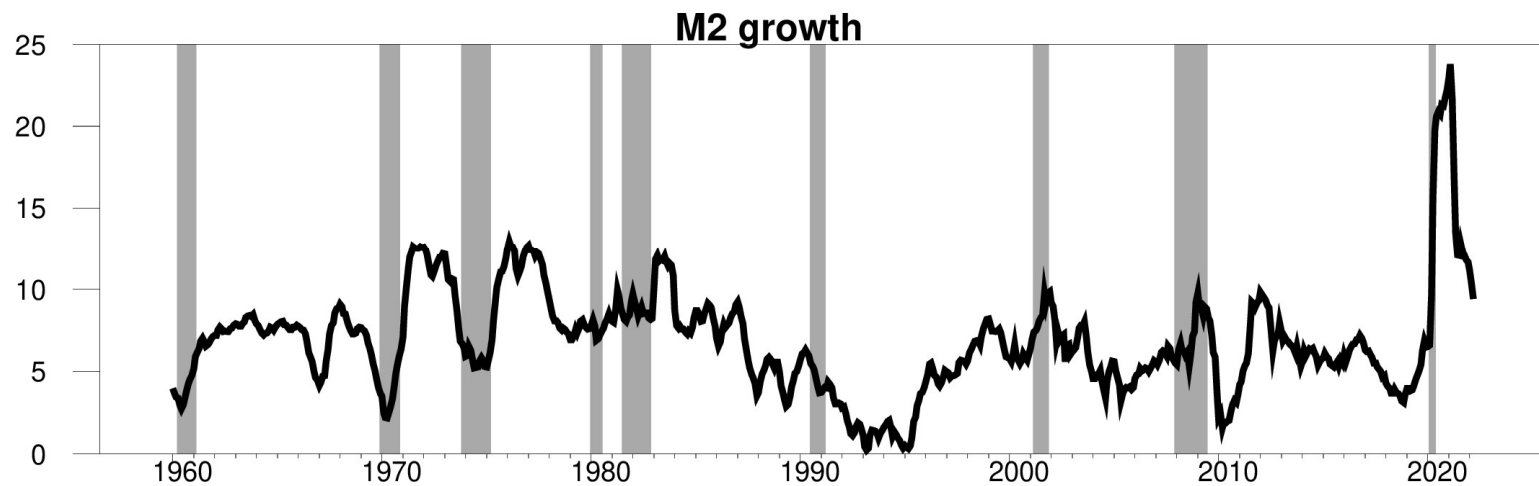
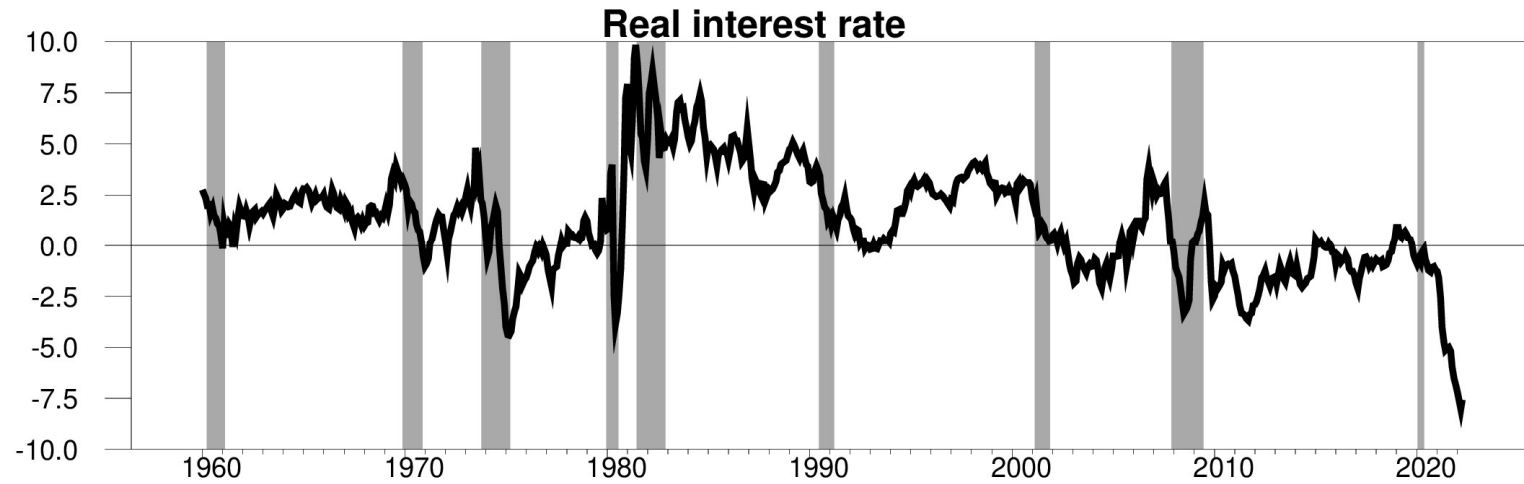
Changes in Contributions to 12-month CPI Inflation



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

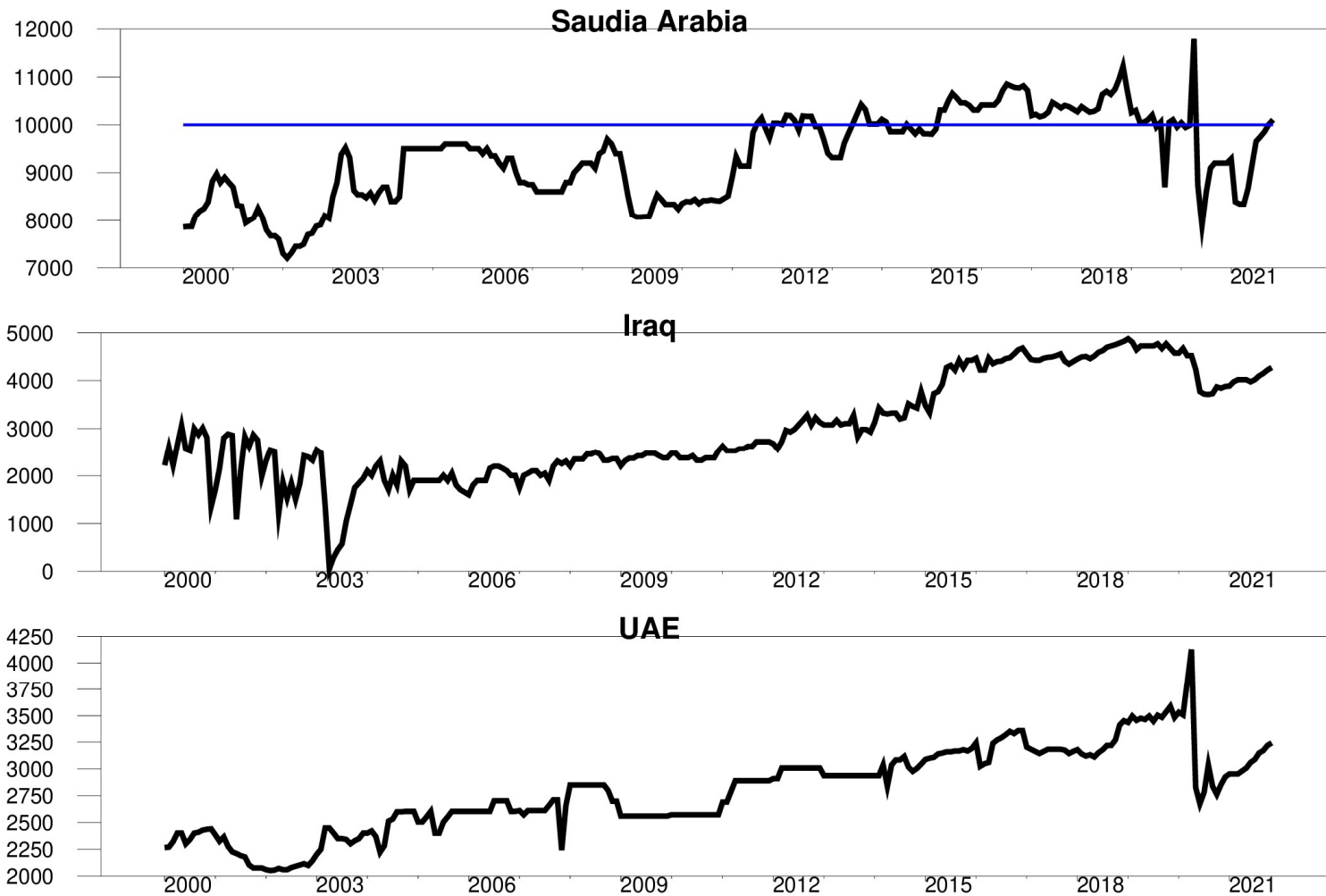
This can translate into sustained inflation from inflationary expectations and monetary policy



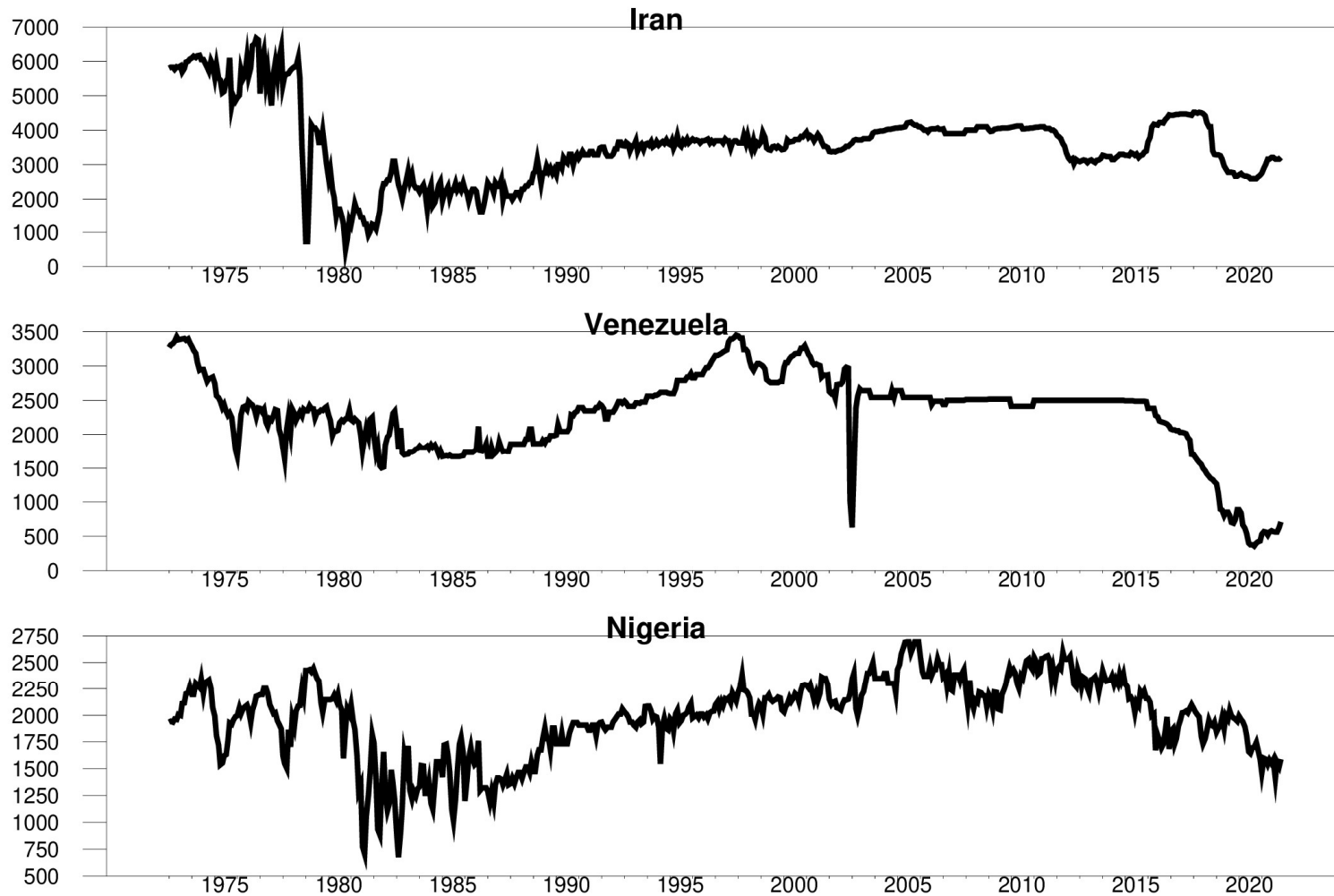
- Conclusion: continued monetary tightening likely necessary to bring inflation down.
- This is likely eventually to lead to recession.

Additional slides

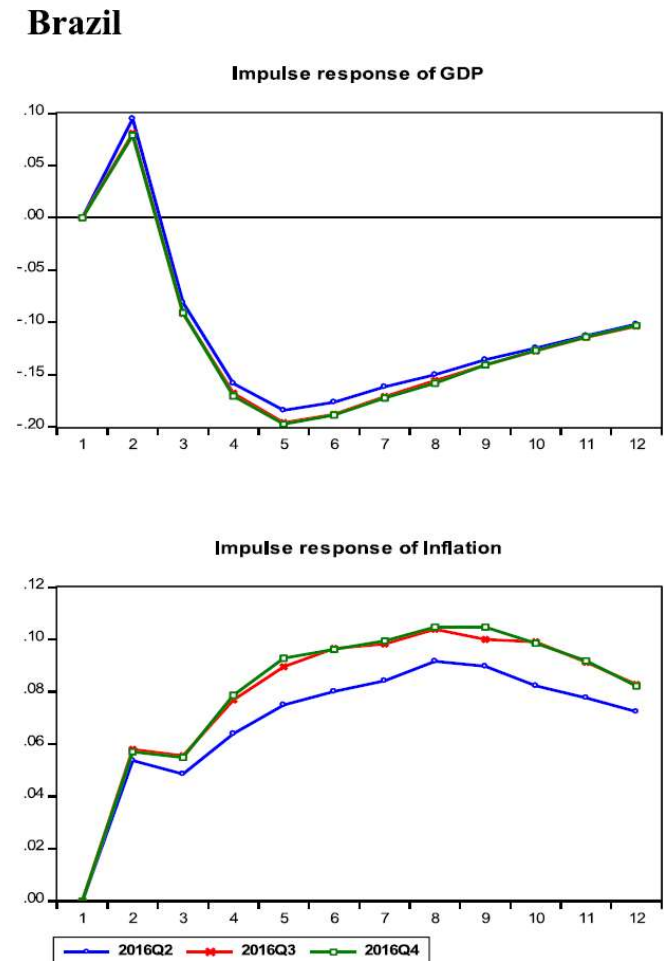
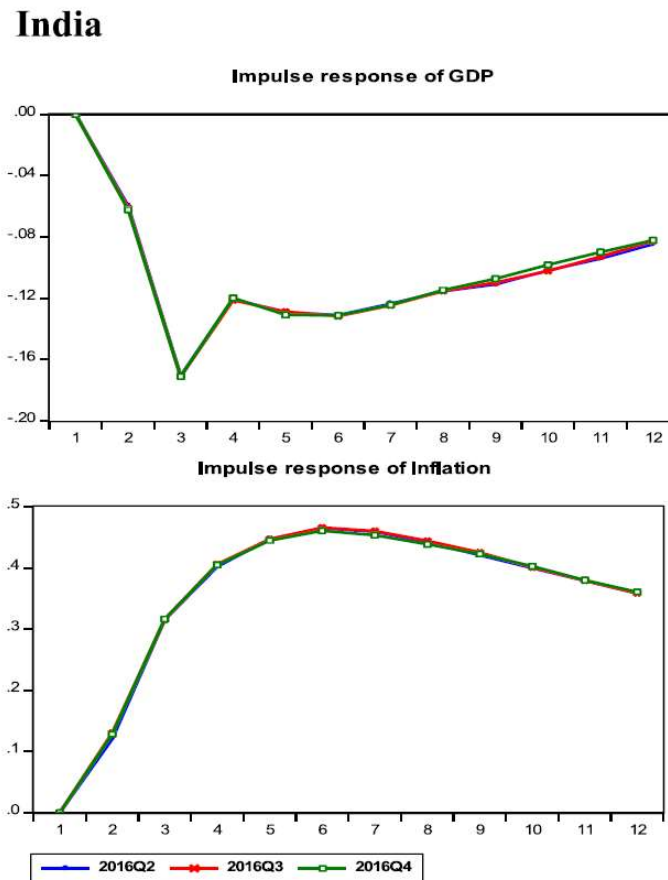
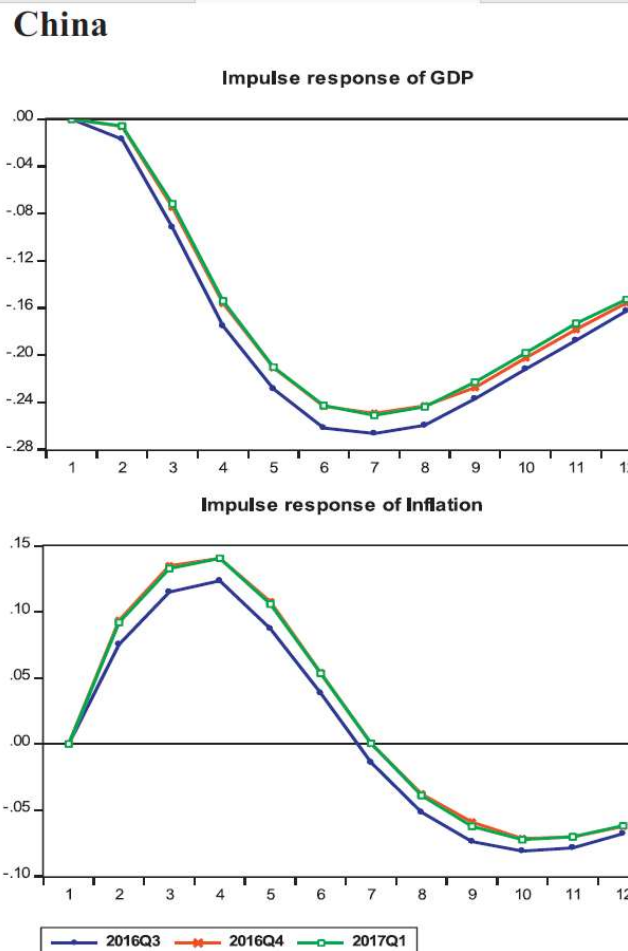
OPEC production is also 1 mb/d below its level at start of 2020



Other possibilities for increased production



Response of real GDP and inflation to oil price shock for China, India, and Brazil from Nasir et al. (En Econ 2018)



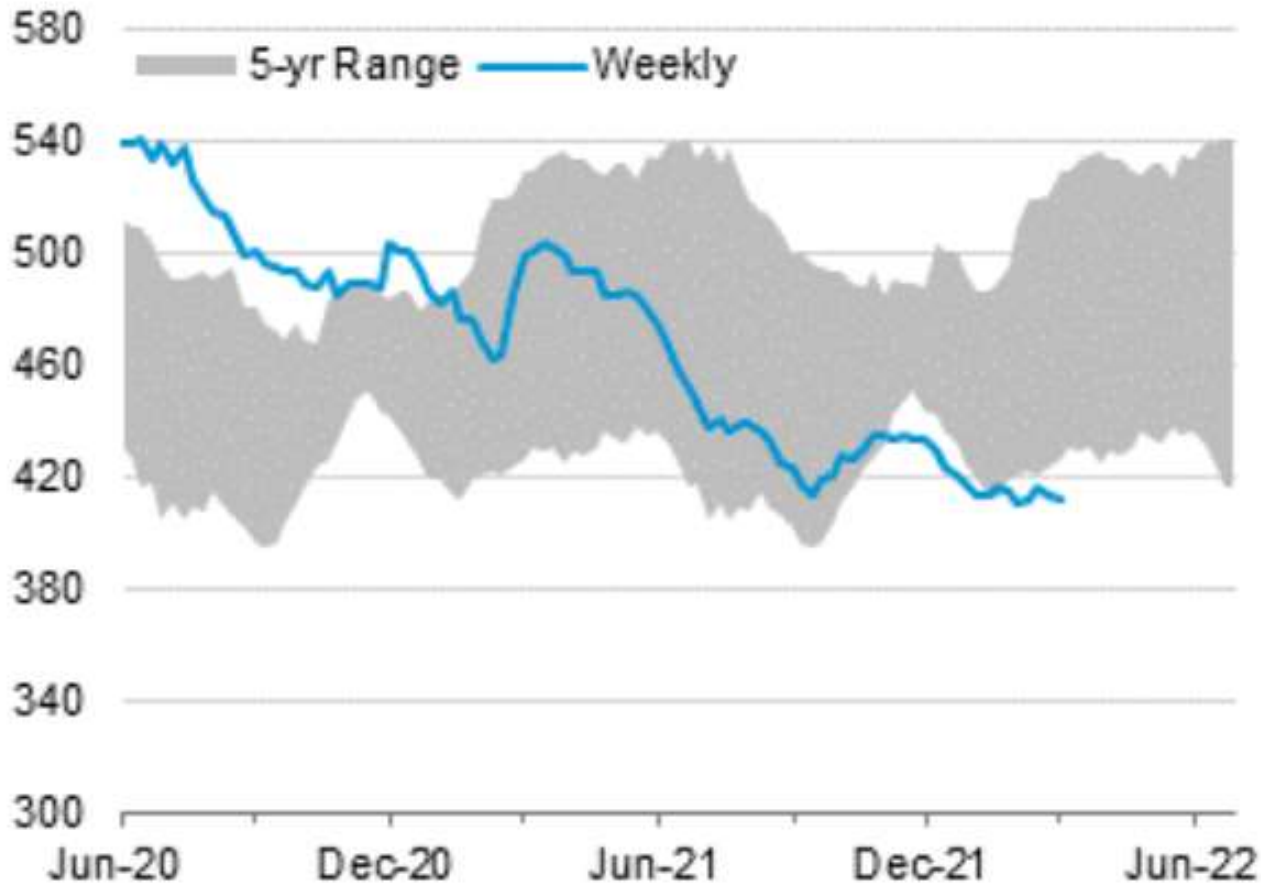
- Biofuels are another alternative to conventional gasoline from crude oil.
- Roberts and Schlenker (AER, 2013) estimated that U.S. ethanol mandate increased world cost of meeting minimum daily calorie requirement by 20%.
- Increased cost of running agricultural equipment and creating fertilizer also increase food costs.

Consequences of non-energy sanctions for Russia

- Visa, Mastercard, American Express, Discover suspended operations in Russia and blocked Russian banks
- Many Russian banks blocked from using SWIFT (system for making international payments)
- Can't use Federal Reserve or ECB clearing either
- Default and nationalization will block access to credit and rest of world for years

Stocks (*million barrels*)

U.S. crude oil stocks
million barrels



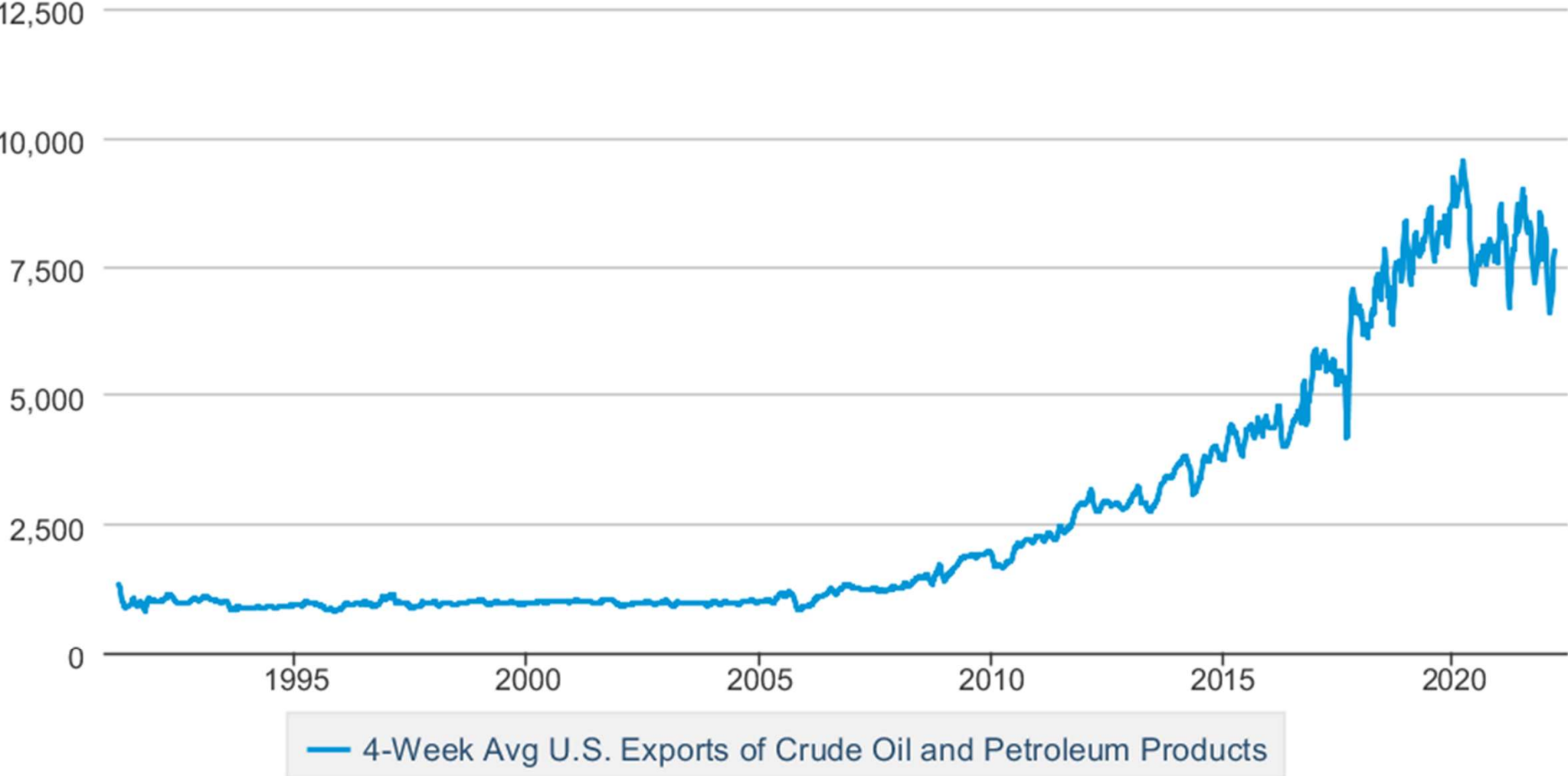
Source: U.S. Energy Information Administration

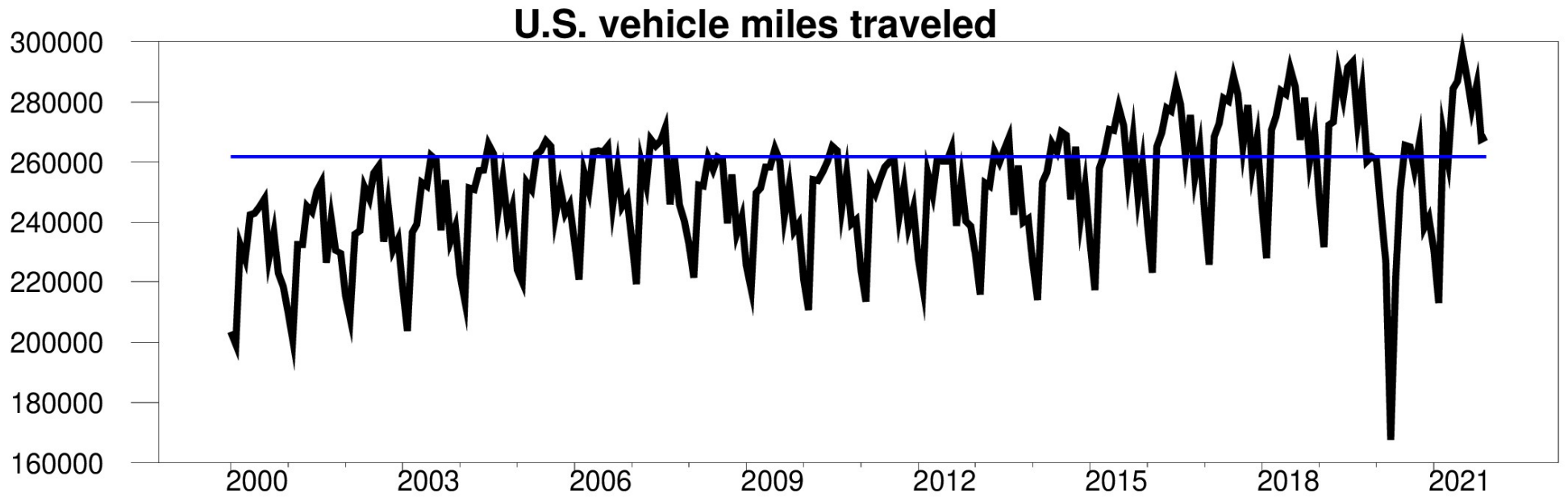
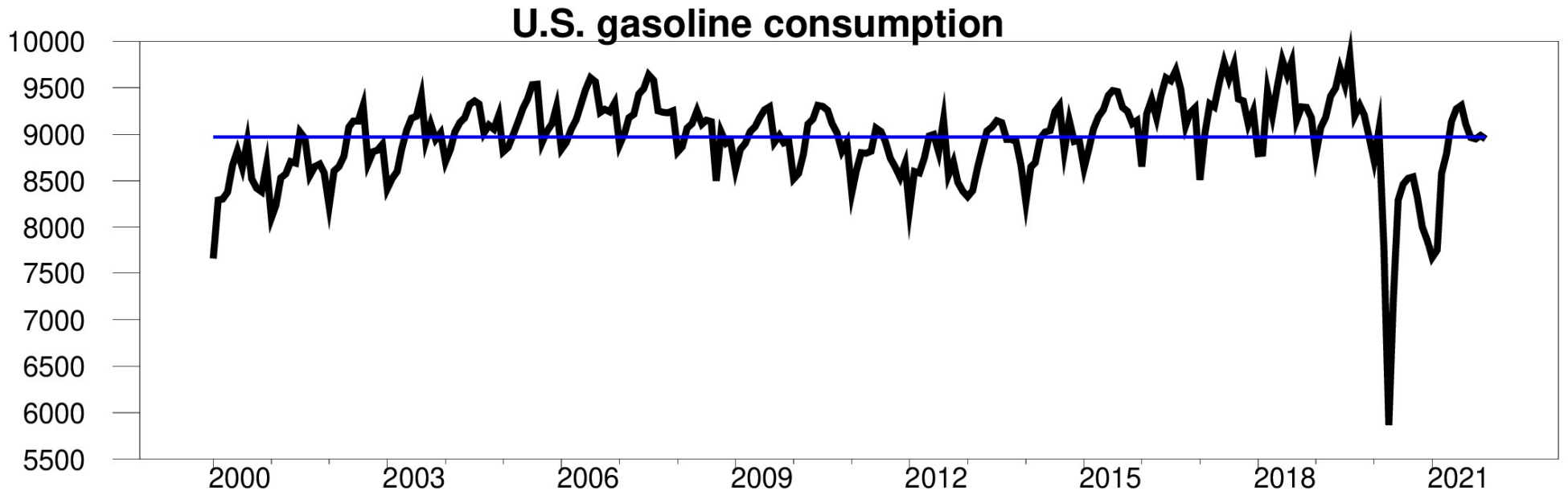
Stocks

Change from last

4-Week Avg U.S. Exports of Crude Oil and Petroleum Products

Thousand Barrels per Day

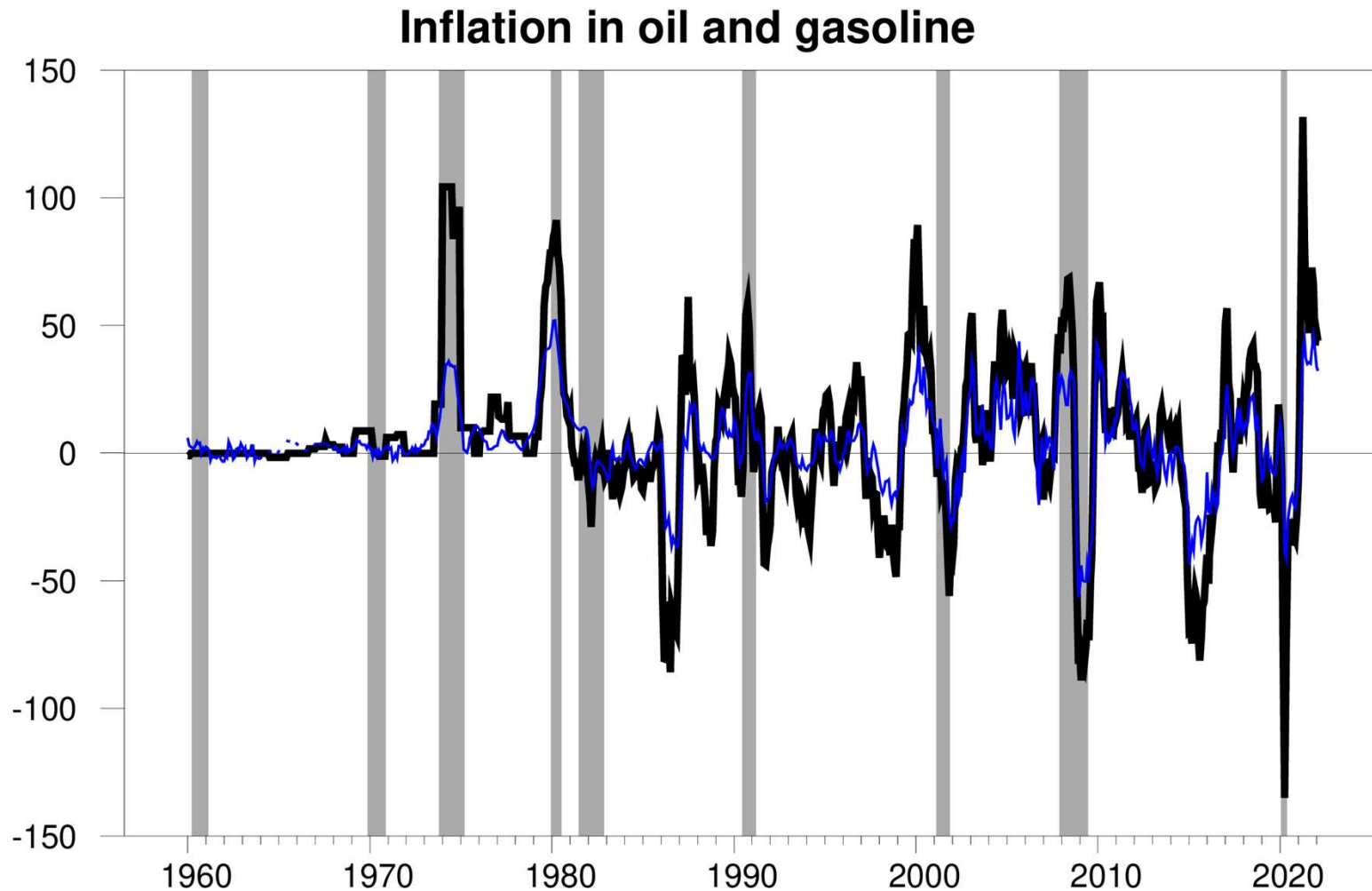




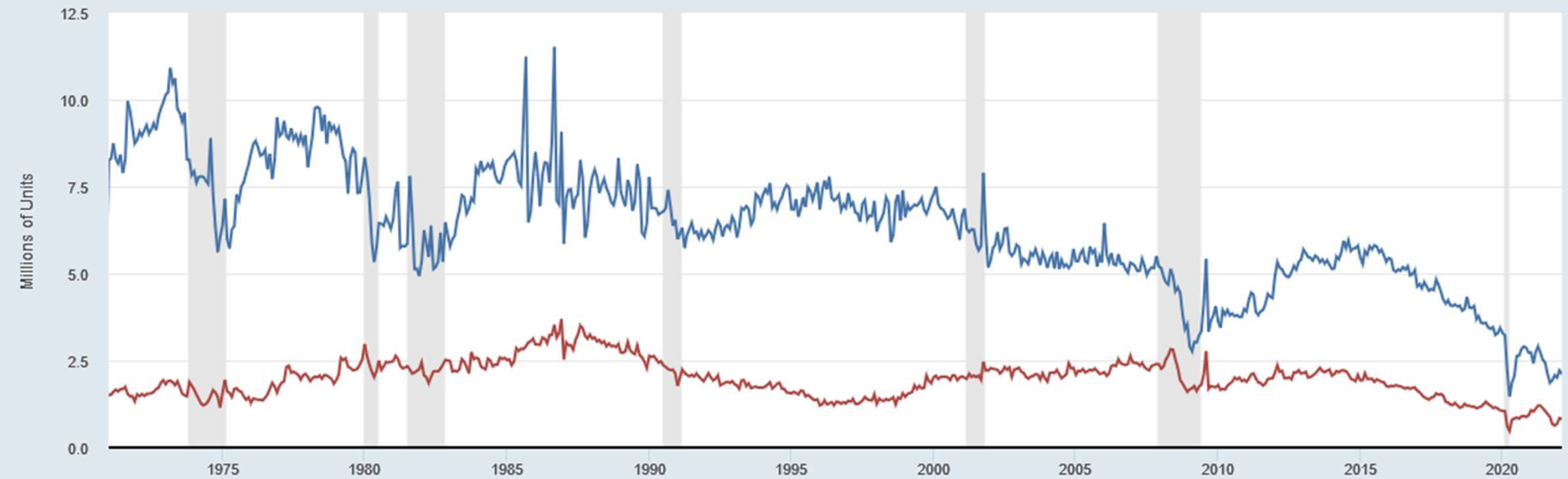
Weights in U.S. consumer price index (from <https://www.bls.gov/cpi/tables/relative-importance/2020.htm>)

- Motor fuel, fuel oil, and propane
 - CPI-U 3.020 CPI-W 3.796
- Electricity and natural gas
 - CPI-U 3.155 CPI-W 3.568
- Energy
 - CPI-U 6.155 CPI-W 7.364

A regression of year-over-year log change in gasoline CPI on y-o-y log change in WTI has coefficient 0.45 and $R^2 = 77\%$



FRED  Motor Vehicle Retail Sales: Domestic Autos
Motor Vehicle Retail Sales: Foreign Autos



Shaded areas indicate U.S. recessions.

Source: U.S. Bureau of Economic Analysis

fred.stlouisfed.org

GDP-based Recession indicator index

