Geopolitical oil price risk and economic fluctuations

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Motivation

- There has been heightened interest in the economic effects of geopolitical risk in recent years.
- Oil supply risks have been widely considered among the top risks (e.g., uncertainty about OPEC quotas, access to Russian oil, widening conflict in the Middle East and disruptions of oil shipments).
- As widely acknowledged in the academic literature, the mere possibility of geopolitical events disrupting oil production may raise oil price uncertainty and cause a recession.
- There is a deep-rooted belief in the macro literature that increases in oil price uncertainty driven by geopolitical events have large adverse effects:
  - Bernanke 1983, Ready 2018, Gao et al. 2022
  - Ferderer 1996, Elder & Serletis 2010, Jo 2014, Cross et al. 2020, Alfaro et al. 2024

Why do many economists expect oil price uncertainty to slow economic activity?

- The origins of this perception can be traced to the 1980s. After two major oil price increases (in the early and late 1970s) were followed by major U.S. recessions, it was natural to conjecture that oil price increases cause recessions.

- By the same logic one would have expected major oil price declines to cause economic expansions.

- This notion was put to a test in 1986, when efforts by OPEC to stabilize the price of oil collapsed and the oil price dropped as sharply as it had increased after the Iranian Revolution in 1979.

- Yet, the U.S. economy failed to expand in the wake of this oil price decline.

Two possible interpretations of this evidence

1. The relationship between the price of oil and the economy is linear:

   - In this case, the modest response of the economy in 1986 implies that the effects of oil price shocks on the economy were also quite modest in 1979.

   - Thus the major recession in 1982 must have been caused by something other than the price of oil.

   - A natural alternative explanation is the sharp monetary tightening that started in 1979 under Federal Reserve Chairman Paul Volcker.

2. The relationship between the price of oil and the economy is nonlinear:

   - Changes in oil-price uncertainty account for the apparent asymmetry in the response to rising and falling oil prices.

   - The recession following the surge in the price of oil in 1979 was greatly worsened by a simultaneous increase in geopolitically driven oil price uncertainty.

   - In 1986 the stimulus implied by falling oil prices was largely offset by an increase in oil price uncertainty associated with the collapse of OPEC.

The latter view has been supported by seemingly robust evidence from empirical work purporting to show large recessionary effects of higher oil price uncertainty.

Typically, however, increases in oil price uncertainty in this literature have been taken as self-evident or inferred from statistical models under strong assumptions rather than directly observed.

Measuring Oil Price Uncertainty

- It is important to stress that oil price uncertainty cannot be measured by changes in the variability of the growth rate of the price of oil.

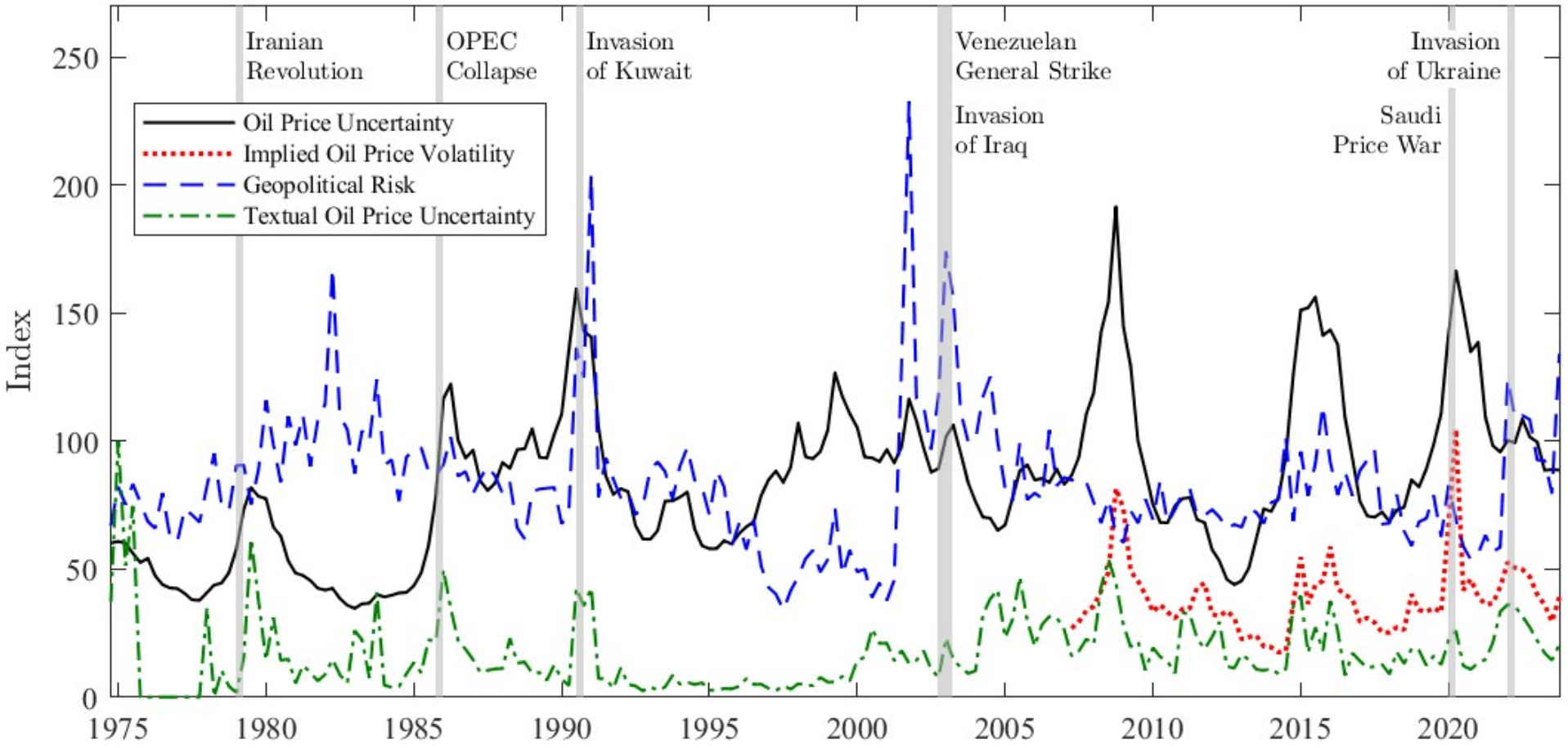
- Nor can it be measured based on the number of times word combinations such as “oil price” and “uncertain” appear in news articles.

- Rather oil price uncertainty arises from lack of predictability (Diebold and Kilian 2001).

  A natural definition of uncertainty is the variability in the future price of oil relative to the price predicted from currently available data (Jurado et al. 2015).

We adopt the latter approach to quantify the one-quarter ahead uncertainty about the real global price of oil since the early 1970s.

Measures of Oil Price Uncertainty



What drives oil price uncertainty?

1. Surges in oil price uncertainty need not be driven by geopolitical events.

   Example:

   - Largest spike in oil price uncertainty occurred in 2008 during the GFC and was clearly not driven by geopolitical events in oil markets.

2. Geopolitical events need not be associated with higher oil price uncertainty.

   Examples:

   - Iraq's invasion of Kuwait in 1990 caused spike in oil price uncertainty
   - The outbreak of the Iran-Iraq War in 1980 did not.

3. In can be difficult to isolate to what extent surges in oil price uncertainty were caused by geopolitical events as opposed to macroeconomic events.

   Examples:

   - Iranian Revolution in 1979 coincided with an unprecedented shift in monetary policy under Volcker.
   - Pandemic in early 2020 coincided with the Saudi price war.

⇨ This evidence highlights importance of jointly modeling the determination of oil price uncertainty, macro uncertainty and economic fluctuations.

Modeling the link from geopolitical risk to economic fluctuations and the price of oil

1. The literature to date has focused on the oil price uncertainty arising from geopolitical events, whereas we explicitly model the downside risk to oil production inherent in these events

2. We develop a nonlinear DSGE model of the global economy:
   - Oil production sector and oil storage
   - Endogenously determined oil price and uncertainty
   - Macro and oil production disasters of stochastic length that occur with time-varying probabilities

3. The model is calibrated to U.S. macroeconomic, financial, and global oil market data.

4. The calibrated model provides a good fit to the data, suggesting that it is a useful laboratory for understanding the role of geopolitical oil price risk.

Why downside risk is what matters

What concerns firms and households is not predictive volatility so much as downside risk.

Example:

- A consumer may be concerned about a geopolitical event disrupting oil production and causing the price of gasoline to reach $5 per gallon.

- That consumer will not be particularly concerned, however, about the possibility of technological innovation increasing oil production to the point that the price of gasoline drops to 50 cents per gallon.

In other words, the relevant risk for consumers is one-sided rather than two-sided.

In our model, uncertainty is driven mainly by downside risk.

Quantifying Risks in the Model

- Downside risks to oil production, or for that matter to the economy, are subjective and hard to measure, but they can be calibrated based on historical data.
- In the model, we consider two forms of downside risk that drive oil price uncertainty and macroeconomic uncertainty:
  - Macroeconomic disasters are modeled after events such as the Great Depression or the Global Financial Crisis. These disasters occur once every half century and on average last 2.5 years.
  - Geopolitically driven oil production disasters are modeled after the historical oil production disasters in 1973-74, 1979 and 1990. They involve a 5 percent drop in global oil production for three quarters on average that is expected to occur every 12.5 years.
- The focus of the study is how the anticipation of these disasters affects the economy rather than their realization.

How changes in the probability of a disaster impact oil markets and the global economy

- The effects of shocks to the downside risk to oil production are very different from those of more traditional stochastic volatility shocks to exogenous oil prices or exogenous oil production.

  It can be shown that the latter shocks have little effect on the economy because the resulting risk is not tilted to one side, but two-sided, highlighting the importance of modeling one-sided risks.

- The effects of anticipated disasters differ qualitatively from the effects of realized disasters.

- There also are important differences between geopolitical oil price risk and macroeconomic risk.

Increase in the probability of an oil production disaster:

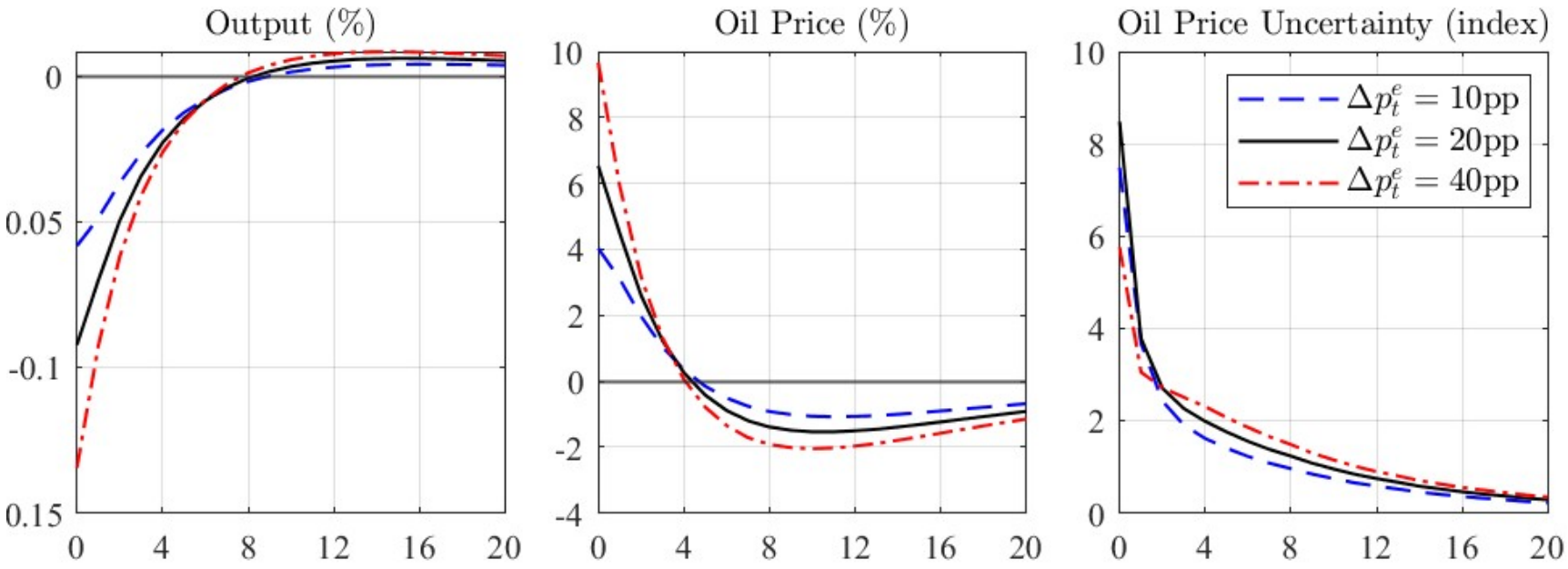
- Causes higher oil price uncertainty and, hence, higher oil storage demand, reflected in a persistent increase in oil inventories and a higher oil price.
- This in turn causes a drop in investment and, hence, output, but little response in output uncertainty or consumption.

Increase in the probability of a growth disaster of the same size:

- Causes a much larger rise in output uncertainty, which is closely mirrored by higher oil price uncertainty.
- As in the case of an oil production disaster probability shock, there is a drop in investment and, hence, output, but the magnitudes are 10 times larger.
- As actual and expected demand for oil drops, there is a sharp drop in the oil price, and oil inventories persistently decline.

Thus, the response of oil inventories and of the price of oil is of opposite sign than in the case of an oil disaster probability shock.

Responses to alternative oil production disaster probability shocks



New insights on role of geopolitical risk in oil market

- Even a large increase in the probability of an oil production disaster similar to disasters that have occurred historically does not have a large macroeconomic impact.

  Example:
  A 20-percentage-point increase in the probability of a major geopolitical oil disaster is only expected to lower output by 0.12 percent.

- It is conceivable, of course, that households and firms at times were anticipating a longer lasting or larger oil production disaster than was ever realized.

Sensitivity analysis

- Following the invasion of Kuwait in 1990, oil price uncertainty rose by more than implied by any of the observed oil production disasters in our model.

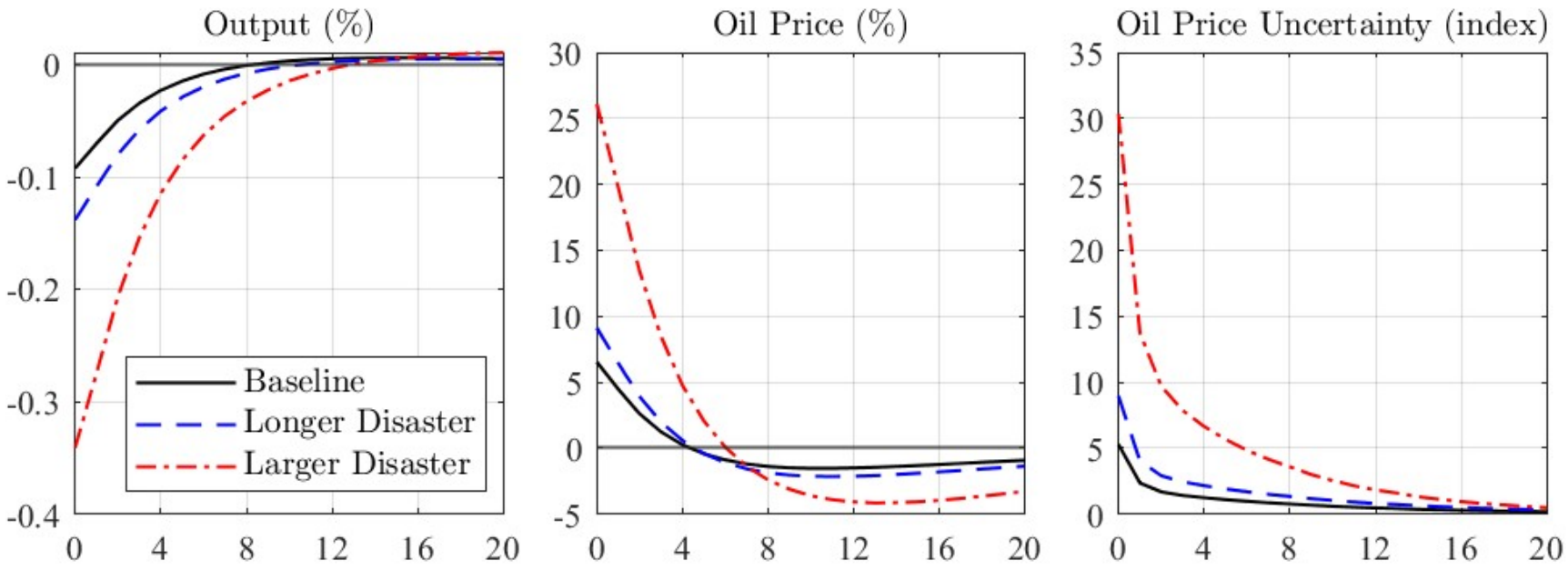
  Such an increase in oil price uncertainty could be explained by anticipation of an oil production shortfall closer to 20 percent of global oil production, corresponding to the oil at risk from a war in the Persian Gulf

  Even when considering an unprecedented 20 percent drop in oil production ("Larger Disaster"), however, it would still take a large increase in the probability of such a disaster (or its realization) to cause a sizable recessionary impact.

  Such an event, if it were realized, would involve a 50 percent increase in the price of oil and a 0.7 percent decline in output.

- A disaster of the same magnitude as in the baseline, but expected to last 10 quarters rather than three quarters, in contrast, would not have much larger effects than in the baseline ("Longer Disaster").

Responses to an oil production disaster probability shock



Take-aways

1. Notwithstanding the attention geopolitical events in oil markets have attracted, geopolitical oil price risk is unlikely to generate sizable global recessionary effects.

2. Geopolitical oil price risk has not been an important driver of global macroeconomic variability to date, intuitively because historically these risks have been rare and the geopolitical events in question are comparatively small.

3. In our model, more than half of the observed oil price uncertainty tends to be macroeconomic uncertainty.

This suggests that previous empirical studies showing large effects of oil price uncertainty likely captured the effects of macroeconomic uncertainty rather than only geopolitical oil price uncertainty.

Implications for econometric models of the effects of oil price uncertainty shocks

1. VAR models with GARCH errors: Uncertainty shocks are squared level shocks (Elder & Serletis 2010)

Our Model: Level and uncertainty shocks are different; oil price changes do not always increase uncertainty

2. VAR models with SV: Oil price uncertainty shocks are independent of oil price level shocks (Jo 2014)

Our Model: Oil price uncertainty is endogenous and may be driven by the same shocks as the price of oil

3. Recursive VAR models: Uncertainty predetermined or macro aggregates predetermined (Gao et al. 2022)

Our Model: All variables simultaneously determined

⇨ Seemingly robust evidence that oil price uncertainty shocks substantially lower real activity must be viewed with caution!