From Importer to Exporter: Oil Shocks and the U.S. Economy*

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Abstract

We study how the shale revolution and the U.S. transition from petroleum importer to net exporter have changed the macroeconomic effects of oil shocks. Using oil supply news shocks identified from OPEC announcements, a time-varying model of the U.S. macroeconomy shows that the contractionary effects have weakened over time and eventually given way to an expansion. State-dependent local projections link this change to the U.S. petroleum trade balance. The improvement does not reflect a mechanical increase in aggregate net exports. Instead, consumption and equity valuations respond more favorably as the United States approaches exporter status, including in energy-intensive sectors. A counterfactual analysis of the 2022 oil-price surge implies sharply different paths for U.S. activity, prices, and monetary policy under the propagation mechanisms prevailing in the early 2000s and early 2020s.

JEL classification: C32, E31, E32, Q43, F41

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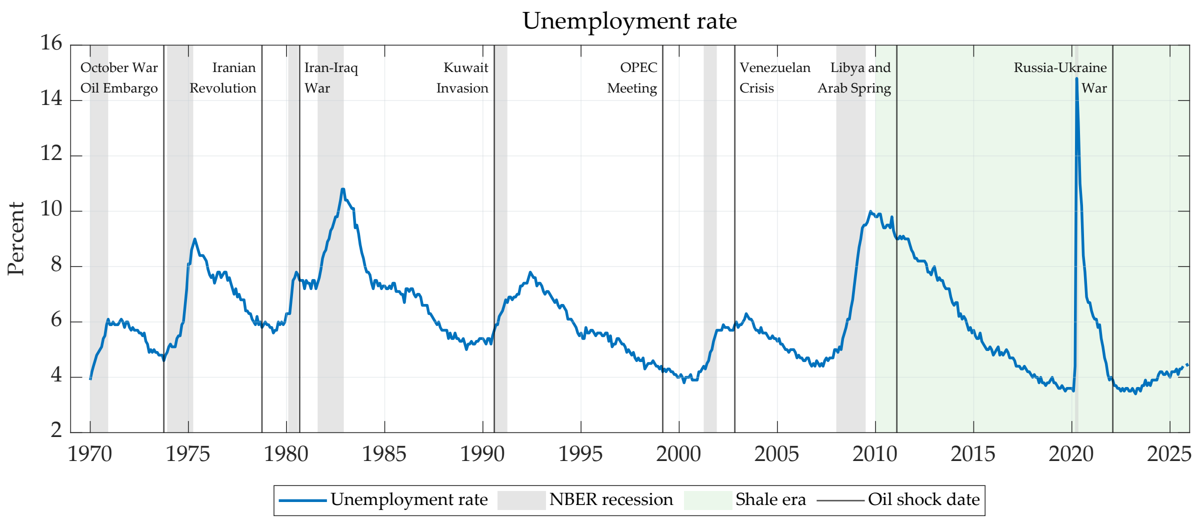
1. Introduction

For much of the postwar period, oil shocks were viewed as a crucial driver of the U.S. business cycle. As Hamilton (1983) famously and presciently observed, from the oil embargo of 1973 through the early 2000s, every U.S. recession was preceded by a sharp increase in the price of oil. Figure 1 illustrates this close historical association: major disruptions in global oil markets were typically followed—with lags that varied across episodes—by a U.S. recession and a rise in unemployment. This striking pattern cemented the view that oil shocks were an important source of U.S. recessions.

Figure 1: Major oil shock dates and the U.S. business cycle

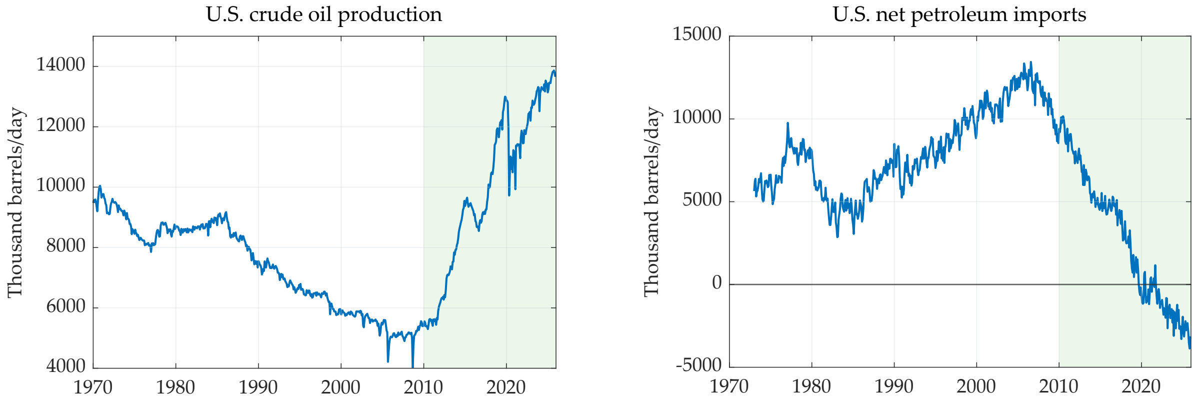


Notes: The blue line shows the monthly U.S. civilian unemployment rate from 1970 to 2025. Gray shading denotes NBER recessions, and light green shading denotes the shale era, defined as the period since 2010. Vertical black lines mark the major oil-market disruptions labeled in the figure.

Around 2010, however, this pattern appears to have changed. The oil-market disruptions associated with the Libyan Civil War and the Arab Spring in 2011 and Russia's invasion of Ukraine in 2022 generated sharp increases in oil prices, yet neither was followed by a U.S. recession. Indeed, the only recession in the post-2010 period was the pandemic recession of 2020, which was caused by the COVID shock, not an oil supply shock (Stock and Watson, 2025). Despite substantial geopolitical disruptions, oil shocks no longer seem to carry the same business-cycle consequences they once did.

A natural candidate for this change is the shale revolution. Advances in hydraulic fracturing and horizontal drilling produced a dramatic expansion in domestic oil production, reversing a decline that had lasted for decades. As Figure 2 shows, U.S. crude oil production rose from roughly 5 million barrels per day in the late 2000s to almost 14

Figure 2: U.S. oil production and net petroleum imports



Notes: The left panel shows monthly U.S. field production of crude oil from 1970 to 2025. The right panel shows monthly U.S. net imports of crude oil and petroleum products from 1973 to 2025. Both series are measured in thousands of barrels per day. Positive net imports indicate that the United States is a net petroleum importer, while negative values indicate that it is a net petroleum exporter. Light green shading denotes the shale era, defined as the period since 2010.

million barrels per day by 2025.[1] Over the same period, net imports of crude oil and petroleum products fell steeply and turned negative in 2019. The United States thereby went from being one of the world's largest petroleum importers to a net petroleum exporter.

This transformation raises the central question of this paper. Does the United States now respond to higher oil prices more like a conventional oil-exporting economy such as Norway, where the income gains from higher oil prices support domestic activity? Or, because it is a large and diversified economy in which households and many industries remain intensive users of oil, is it still vulnerable to adverse oil shocks? We study whether, and through which channels, the shale revolution and the accompanying shift in the U.S. petroleum trade balance have changed the macroeconomic transmission of oil shocks.

Our empirical analysis begins by isolating plausibly exogenous oil-price variation driven by news about global oil supply. Following Känzig (2021), we use high-frequency changes in oil futures prices around announcements of the Organization of the Petroleum Exporting Countries (OPEC). We refine these surprises by purging any component predictable from information available before the announcement, reducing concerns that

[1] Hydraulically fractured horizontally drilled oil wells have been in use since the early 2000s, but with technological improvements, started to increase in earnest in 2009–2010. By October 2011, total footage of fracked oil and gas wells surpassed all other types of well (U.S. Energy Information Administration, 2018). Primarily because of fracking, reserves that had not been economic to extract became so, and U.S. proven reserves of oil grew by 12.8 percent in 2010, the largest increase since 1991 (U.S. Energy Information Administration, 2012). These observations point to the fracking era starting in 2009–2011; for our empirical work, we specify the fracking break date as January 2010.

they reflect information about future demand or anticipated OPEC decisions. We then use the refined surprises as an instrument in a global oil-market vector autoregression (VAR) model. The model yields a monthly oil supply news shock that raises the real oil price, reduces world oil production and industrial activity, and increases consumer prices. The model is deliberately global: it recovers the oil supply news shock from global oil-market dynamics before we turn to its transmission through the U.S. economy.

Over the full sample, the shock produces the familiar stagflationary response in the United States: industrial production declines and consumer prices rise. How has the transmission changed over time? Following Mumtaz and Petrova (2023), we estimate a time-varying VAR of the U.S. macroeconomy, using the extracted oil supply news shock as an instrument. The contractionary response of industrial production weakens steadily over the sample and turns positive during the shale era. The inflation response is largest early in the sample, declines substantially by the late 1980s and 1990s, and rises again around 2020. These estimates reveal substantial time variation without attributing it to a particular structural change.

Can the stark shift in the U.S. petroleum trade balance account for this change in transmission? State-dependent local projections deliver the same qualitative message whether the state is a post-2010 indicator or a continuous measure of net petroleum imports relative to petroleum consumption. At the pre-2010 trade position, an adverse oil supply news shock produces a sizable and persistent contraction. Moving toward exporter status attenuates this contraction and can reverse it, while adding little to the CPI response. The Federal Reserve raises interest rates somewhat more as the trade position improves, consistent with a more favorable output-inflation trade-off.

The mechanism is not a mechanical increase in aggregate net exports. Their response relative to GDP changes little with the petroleum trade position and is imprecisely estimated. Instead, the evidence points to general-equilibrium income and wealth effects. Real consumption and the aggregate stock market respond more favorably as the United States moves toward exporter status. The same is true for the equity valuations of airline and transportation firms, which are directly exposed to higher energy costs. Payroll employment also rises relative to the importer benchmark, while the unemployment rate declines. The gains associated with domestic energy production therefore spill beyond oil producers and support broader demand, employment, and profits.

Finally, we revisit the oil-price surge following Russia's invasion of Ukraine. We recover the sequence of oil supply news shocks required to reproduce the gap between the realized real oil price and a pre-invasion VAR forecast. Feeding this common sequence through propagation mechanisms evaluated at the U.S. trade positions of 2000–05 and

2020–25 yields sharply different outcomes. The earlier configuration implies a persistent decline in industrial production, whereas the recent configuration implies an expansion. It also implies a larger initial increase in consumer prices and a substantially less forceful monetary policy response. The exercise illustrates quantitatively why a large oil shock need not have the same U.S. business-cycle consequences today as it did two decades ago.

Like oil, the United States has shifted from an importer to an exporter of natural gas, raising the question of whether there has been a similar change in the macroeconomic response to natural-gas prices. The gas market is quite different from oil, however, including the episodic nature of the connection between U.S. gas prices and world markets (Stock and Zaragoza-Watkins, 2024) and historical long-term contracting that buffers consumers from price shocks. Recent work applies high-frequency identification techniques to natural-gas markets to identify gas supply shocks (Alessandri and Gazzani, 2025; Colombo and Toni, 2025). It would be interesting to study whether the macroeconomic effects of these shocks have changed over time. We leave this question for future research.

Related literature. The paper contributes to a growing literature studying time variation in the macroeconomic effects of oil shocks. Blanchard and Gali (2007) find that the effects of oil-price increases were more muted in the 2000s than in the 1970s and relate this change to declining oil intensity, greater labor-market flexibility, improved monetary policy, and more favorable accompanying shocks. Baumeister and Peersman (2013) offer a more nuanced picture: although a given oil-price increase has become associated with a smaller output response, the decline in the short-run price elasticity of oil demand implies that a given oil-production shortfall can generate larger oil-price and macroeconomic responses.

We also connect to a literature that studies the role of the shale revolution. Baumeister and Kilian (2016) find that the U.S. response to the 2014–16 oil-price decline was not fundamentally different from its response in 1986: gains to consumption and non-oil investment were largely offset by a contraction in oil-sector investment. By contrast, Bjørnland and Skretting (2024) find that the shale boom altered the transmission of oil-price shocks, generating positive spillovers to investment, income, production, and non-oil employment in parts of the U.S. economy. Our results contribute to this debate by directly linking the changing aggregate response to the U.S. petroleum trade position.

A complementary cross-country and regional literature documents substantial heterogeneity according to economies' exposure to oil production and trade. Peersman and Van

Robays (2012) show that the consequences of oil shocks depend both on the source of the oil-price movement and on whether an economy is a net energy importer or exporter. De Michelis, Ferreira, and Iacoviello (2020) similarly find that oil-price declines support consumption in oil-importing countries and U.S. states but depress it in oil-exporting economies. Related work explores heterogeneity across U.S. states, finding more favorable responses in oil-producing regions (Karaki, 2018; Alsalman and Rangaraju, 2026). We complement this evidence by exploiting the stark transformation of the United States itself—from a major petroleum importer to a net exporter.

Finally, we contribute to the identification of oil supply news. Building on Känzig (2021) and the broader high-frequency identification literature (Nakamura and Steinsson, 2018; Miranda-Agrippino and Ricco, 2021; Bauer and Swanson, 2023b), we extend the OPEC surprise series and purge any component predictable from pre-announcement information. This refinement addresses concerns about information effects surrounding OPEC announcements (Degasperi, 2025; Mori and Peersman, 2026).

Outline. The remainder of the paper is organized as follows. Section 2 identifies the oil supply news shock. Section 3 documents time variation in U.S. transmission. Section 4 relates that variation to the petroleum trade balance. Section 5 studies the underlying channels, and Section 6 applies the estimates to the 2022 oil-price episode. Section 7 concludes.

2. Identification of Oil Supply News Shocks

Oil price changes are endogenous. They reflect not only developments in oil supply, but also changes in global economic activity, oil demand, inventories, risk premia, and expectations about future market conditions. A regression of macroeconomic outcomes on observed oil price changes would therefore conflate shocks with very different origins and effects (Kilian, 2009; Baumeister and Hamilton, 2019). To identify the causal effects of adverse oil supply developments, we need to isolate variation in oil prices that is driven by changes in supply.

High-frequency identification. We follow the high-frequency identification approach from Känzig (2021), extending the sample through December 2025. OPEC production decisions provide a natural source of variation in expected oil supply: they are announced on known dates, are closely watched by market participants, and can shift the expected path of global oil production. We measure the daily changes in WTI crude oil futures prices across maturities up to a year on OPEC announcement days and summarize their common movement by the first principal component. Because the event window is narrow, economic conditions are largely known and priced before the announcement and are unlikely to change within the window. The resulting OPEC surprise thus captures the revision in oil price expectations associated with the announcement.[2]

Recent work has raised concerns about this interpretation. OPEC announcements may reveal information not only about supply decisions but also about OPEC's assessment of future demand. If market participants use this information to revise their demand expectations, the futures-price surprise may combine oil supply news with news about future economic activity (Degasperi, 2025). Relatedly, Mori and Peersman (2026) show that lagged macroeconomic and financial variables can predict high-frequency OPEC surprises. Such predictability may arise precisely because the surprises contain these information effects: OPEC's assessment of future demand may be systematically related to macroeconomic and financial conditions prevailing before the announcement.

Motivated by this evidence, we first examine the predictability of our updated OPEC surprise series. At the level of OPEC announcement days, we estimate the predictive regression

$$z_d = \alpha + \boldsymbol{\beta}'\mathbf{X}_{d-} + \eta_d, \tag{1}$$

where z_d is the raw OPEC surprise and $\mathbf{X}_{d-}$ contains variables observed before announcement day d. The predictors include surprises in the latest U.S. CPI and unemployment releases; three-month changes in the S&P 500, the one-year Treasury yield, the ten-year minus one-year term spread, and a broad commodity price index; three-month changes in the WTI price and U.S. petroleum consumption and production; and heating degree days.

Table 1 provides some evidence of predictability, broadly consistent with the findings of Mori and Peersman (2026). The explanatory power rises from essentially zero when only macroeconomic news is included to about 6 percent once financial variables are added. At the same time, none of the individual predictors is statistically significant at conventional levels. Predictability therefore appears quantitatively limited—and substantially weaker than that documented for high-frequency monetary-policy surprises (Bauer and Swanson, 2023a).

As a conservative step, we follow Bauer and Swanson (2023) and remove from the

[2]Futures prices reflect both expected future spot prices and time-varying risk premia; see Baumeister (2023). We therefore interpret announcement-window changes as revisions to price expectations under the assumption that risk premia do not move systematically with OPEC supply news. Nonsystematic risk-premium movements merely add noise to the surprise measure, while the narrow event window makes substantial systematic movements less likely.

Table 1: Predictability of OPEC oil price surprises

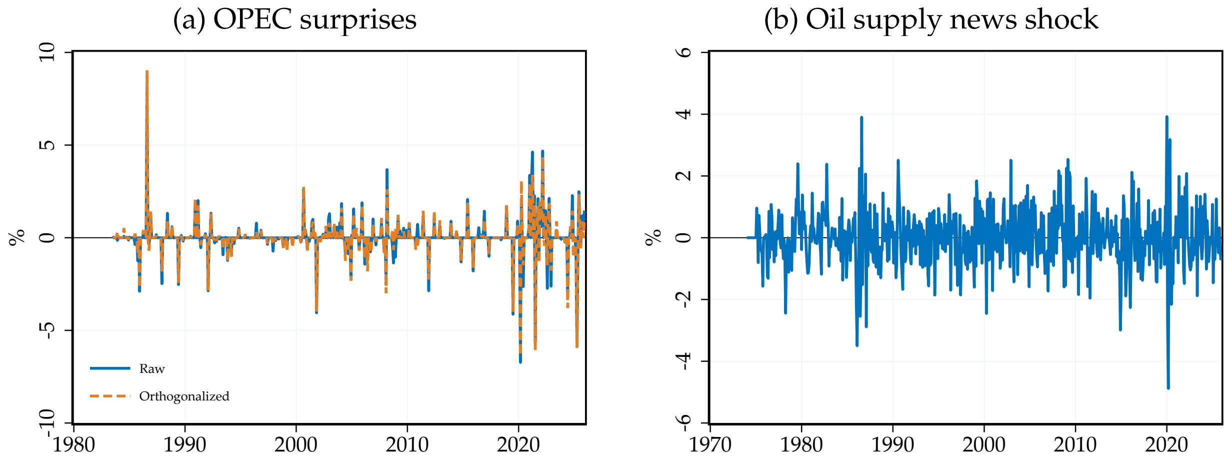
OPEC surprise	(a) Macro news	(b) Financials	(c) Oil market	(d) Full
CPI surprise	-0.227	-0.469	-0.407	-0.414
	(1.904)	(1.955)	(1.898)	(1.901)
Unemployment rate surprise	0.399	0.639	0.347	0.301
	(1.040)	(1.070)	(1.171)	(1.192)
S&P 500 (3M log ch.)		2.697	2.890	2.895
		(2.387)	(2.372)	(2.368)
1-year yield (3M ch.)		0.302	0.350	0.344
		(0.506)	(0.519)	(0.526)
10y-1y slope (3M ch.)		0.959	0.974	0.979
		(0.671)	(0.682)	(0.680)
Commodity spot index (3M log ch.)		4.432	5.397	5.579
		(2.691)	(3.322)	(3.437)
WTI crude (3M log ch.)			-0.958	-1.065
			(1.916)	(1.968)
Petroleum consumption (3M log ch.)			0.484	0.606
			(5.655)	(5.709)
Petroleum production (3M log ch.)			-0.002	-0.027
			(4.962)	(4.967)
Heating degree days (3M ch.)				-0.000
				(0.000)
R-squared	0.001	0.059	0.061	0.061
Adj. R-squared	-0.011	0.024	0.008	0.002

Notes: The table reports coefficients from event-level regressions of the raw OPEC surprise on information available before each announcement, (1). The four columns add macroeconomic news, financial variables, oil-market variables, and heating degree days sequentially. Three-month changes are measured through the day before the announcement. Heteroskedasticity-robust standard errors are reported in parentheses. The sample contains 169 OPEC announcements.

OPEC surprises any component predictable from information available before the announcement. We define the orthogonalized OPEC surprise as the residual $\widehat{\eta}_d$ from the full predictive specification. Removing the predictable component makes relatively little difference in practice. Figure 3a shows that the raw and orthogonalized monthly surprises track each other closely, including during the largest OPEC surprise episodes. Their correlation over the common monthly sample is 0.97.

Because our outcome variables of interest are at the monthly frequency, we aggregate the event-level surprises. To map these event-level residuals into a proxy for the monthly global oil market VAR, we account for the timing of each announcement within the month, as emphasized by Kilian (2024). Specifically, an announcement on calendar day d of a month containing D days receives the linear weight $(D-d+1)/D$. Surprises that occur earlier in the month therefore receive greater weight because they affect a larger share of that month's average. The results are robust to alternative aggregation schemes,

Figure 3: OPEC surprises and the oil supply news shock



Notes: The left panel shows the raw and orthogonalized monthly OPEC surprises. The raw event-level surprise is the first principal component of daily changes in WTI futures prices across maturities up to a year on OPEC announcement days. The orthogonalized surprise is the residual from the full predictive regression (d) in Table 1. Both event-level series are aggregated to monthly frequency using linear weights based on calendar days. The right panel shows the oil supply news shock extracted from the global VAR using the orthogonalized OPEC surprise as an instrument. Positive values denote adverse oil supply news that raises the real oil price.

including an unweighted monthly sum or the MIDAS aggregation method (Lee and Sekhposyan, 2024); Appendix Figure B.4 reports these comparisons.

Global oil market VAR. The orthogonalized OPEC surprise is a useful but noisy measure of oil supply news: it may not capture every relevant change in expected supply and may contain measurement error. We therefore use it as an external instrument rather than treating it as the structural shock itself. Let $\mathbf{y}_t$ denote a vector of monthly variables whose dynamics are described by

$$\mathbf{A}(L)\mathbf{y}_t = \mathbf{S}\boldsymbol{\varepsilon}_t = \mathbf{u}_t, \tag{2}$$

where $\mathbf{u}_t$ contains the reduced-form innovations and $\boldsymbol{\varepsilon}_t$ the mutually uncorrelated structural shocks. Our VAR contains the real oil price, world oil production, world oil inventories, world industrial production, and the world CPI (see Appendix A for details on the data). Unlike Känzig (2021), we do not include any U.S.-specific variables in the identification system. Our goal is to identify a global oil supply news shock and investigate time-varying impacts on the U.S. economy in a second step. The model is estimated on monthly data from January 1974 through December 2025 with 12 lags, a constant, and a dummy for March through May 2020 to account for the COVID period.

Let ε_t^{oil} denote the adverse oil supply news shock, which we assume without loss of generality to be the first shock, and $\mathbf{s}_1$ the corresponding impact vector, given by the first column of $\mathbf{S}$. The monthly orthogonalized OPEC surprise, denoted by z_t, is a valid external instrument if it is correlated with ε_t^{oil} but orthogonal to all other structural shocks. Under these relevance and exogeneity conditions, together with invertibility of the shocks, the covariance between the instrument and the reduced-form innovations identifies $\mathbf{s}_1$ up to sign and scale.

Once the impact vector has been identified, we recover the monthly oil supply news shock as

$$\widehat{\varepsilon}_t^{oil} = \widehat{\mathbf{s}}_1' \widehat{\mathbf{\Sigma}}^{-1} \widehat{\mathbf{u}}_t, \tag{3}$$

where $\widehat{\mathbf{\Sigma}}$ is the covariance matrix of the reduced-form innovations (see Stock and Watson, 2018). Figure 3b plots the resulting shock series. Positive values correspond to adverse news about oil supply that raises the real price of oil.[3]

Figure 4 reports the responses to an adverse oil supply news shock normalized to increase the real oil price by 10 percent on impact. The robust first-stage F-statistic is 11.12, indicating that the orthogonalized OPEC surprise contains meaningful information about the oil supply news shock. The real oil price remains elevated for several years, while world oil production declines persistently and inventories gradually increase. World industrial production contracts by roughly half a percent, and the world CPI rises modestly during the first year before returning toward its pre-shock level. These responses are broadly consistent with Känzig (2021): adverse oil supply news raises oil prices, reduces oil production and global economic activity, and produces a modest increase in consumer prices.

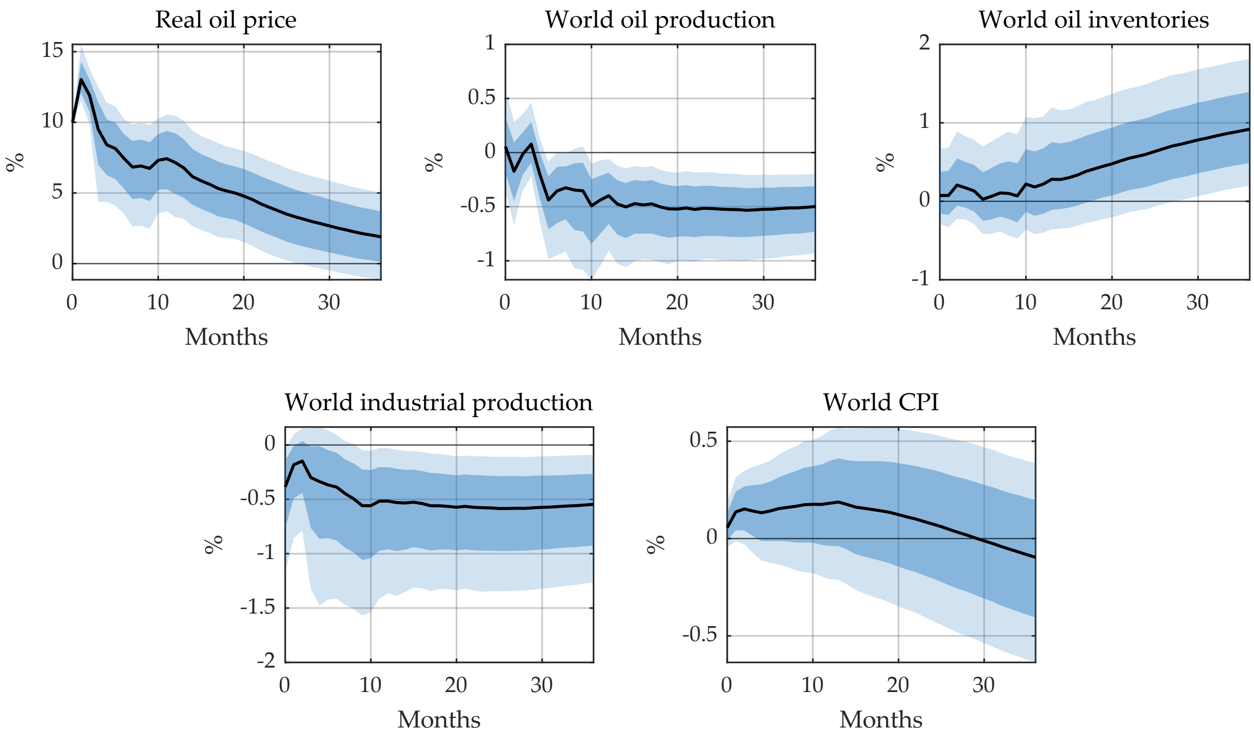
Average effects on the U.S. economy. We now turn to the impact on the U.S. economy. To that end, we estimate simple local projections à la Jordà (2005) of U.S. industrial production and the CPI on the extracted shock over the full sample, recovering their average impact:

$$y_{t+h} = \alpha_h + \beta_h \widehat{\varepsilon}_t^{oil} + \mathbf{\Gamma}_h' \mathbf{W}_{t-1} + u_{t+h}, \tag{4}$$

where y_{t+h} is the outcome variable of interest h periods after the shock. The controls $\mathbf{W}_{t-1}$ contain 12 lags of the outcome and 12 lags of the five variables in the global oil-market VAR, and the COVID dummy covering March–May 2020. The estimation sample is January 1974–December 2025. Throughout the paper, we use the global oil supply news shock recovered from the oil-market VAR as the relevant shock proxy. Using the high-

[3] Because the VAR is estimated over a sample beginning in 1974M1 and includes 12 lags, the identified shock series is unavailable during 1974. To retain the full estimation sample in the subsequent analysis, we censor these missing values to zero. This choice has no material effect on the results.

Figure 4: Global responses to an adverse oil supply news shock



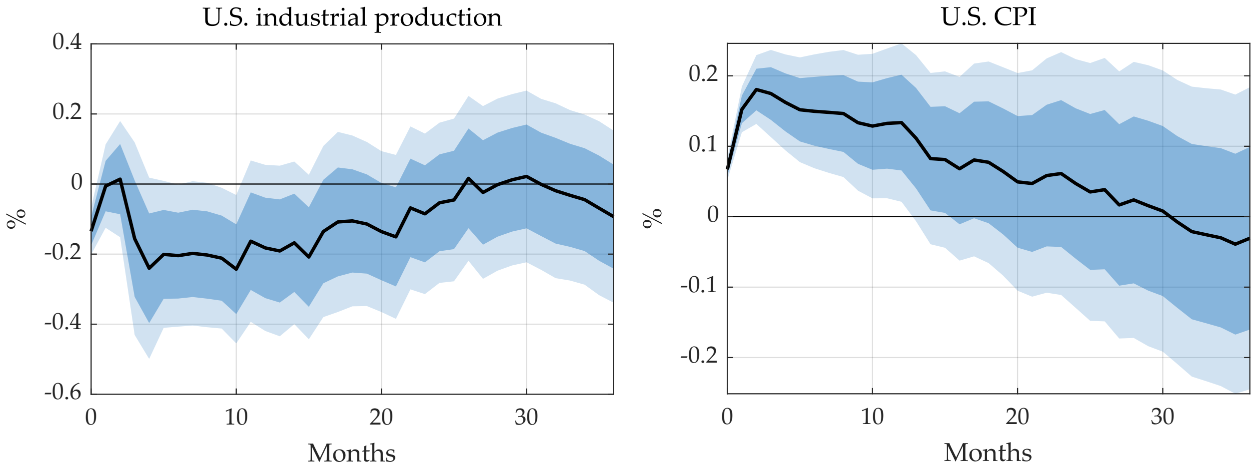
First-stage regression: robust F: 11.12, R^2: 3.89%, Adjusted R^2: 3.73%

Notes: Impulse responses to an adverse oil supply news shock normalized to raise the real oil price by 10 percent on impact, estimated based on the global oil market VAR (2). The model includes the real oil price, world oil production, inventories, industrial production, and the CPI, and is estimated over 1974M1–2025M12 with 12 monthly lags, a constant, and a COVID dummy. Dark and light shaded areas denote 68 and 90 percent confidence intervals, respectively, constructed using a moving-block bootstrap with 10,000 replications.

frequency OPEC surprises directly yields qualitatively similar results, but the estimates are noisier and more sensitive to the choice of controls, reflecting the power problems discussed in Nakamura and Steinsson (2018) and Känzig (2021).

Figure 5 reports the results. On average, industrial production falls by roughly 0.2 percent and remains below baseline over much of the first two years. The CPI rises by approximately 0.1–0.2 percent before gradually returning toward baseline. These effects are somewhat weaker and less persistent than those estimated by Känzig (2021), whose sample ends in 2017. Nevertheless, the full-sample estimates reproduce the conventional stagflationary effects of oil supply shocks, lowering activity and increasing prices. As we show next, however, these average effects mask substantial variation over time.

Figure 5: Average U.S. responses to an adverse oil supply news shock



Notes: Impulse responses of U.S. industrial production and the CPI to an adverse oil supply news shock, estimated using local projections on the oil supply news shock extracted from the global VAR, (4). The sample is 1974M1–2025M12. The controls include 12 lags of the outcome, 12 lags of the five global VAR variables, and a March–May 2020 dummy. Responses are scaled by the VAR normalization that raises the real oil price by 10 percent on impact. Dark and light shaded areas denote 68 and 90 percent confidence intervals based on the lag-augmentation approach.

3. The U.S. Response to Oil Shocks over Time

How has the transmission of oil supply news shocks to the U.S. economy changed over time? We begin with an unrestricted assessment of whether the U.S. response to oil supply news has changed.

Time-varying parameter VAR. We model the U.S. macroeconomy using a VAR that allows both its coefficients and innovation volatilities to evolve over time. Specifically, following Mumtaz and Petrova (2023), we estimate a time-varying parameter VAR with stochastic volatility and identify the oil shock using an external instrument. Let $\mathbf{y}_t$ be an $N \times 1$ vector and let $\mathbf{X}_t = [\mathbf{y}'_{t-1}, \ldots, \mathbf{y}'_{t-p}, 1]'$. The reduced form is

$$\mathbf{y}_t = \mathbf{B}_t \mathbf{X}_t + \mathbf{u}_t, \qquad \mathbf{u}_t = \mathbf{A}_t \mathbf{q} \boldsymbol{\varepsilon}_t, \tag{5}$$

where $\mathbf{q}'\mathbf{q} = \mathbf{I}_N$ and $\boldsymbol{\varepsilon}_t \sim \mathcal{N}(\mathbf{0}, \mathbf{I}_N)$. The autoregressive coefficients evolve as random walks,

$$\mathbf{b}_t = \mathbf{b}_{t-1} + \mathbf{Q}_b^{1/2} \boldsymbol{\eta}_t^b, \qquad \mathbf{b}_t = \mathrm{vec}(\mathbf{B}'_t), \tag{6}$$

and the reduced-form covariance matrix is $\boldsymbol{\Sigma}_t = (\mathbf{A}_t \mathbf{q})(\mathbf{A}_t \mathbf{q})'$. We write $\mathbf{A}_t = \widetilde{\mathbf{A}}_t \mathbf{H}_t^{1/2}$, where $\widetilde{\mathbf{A}}_t$ is lower triangular with ones on the diagonal and $\mathbf{H}_t$ is diagonal. The unrestricted elements of $\widetilde{\mathbf{A}}_t$ and the log diagonal elements of $\mathbf{H}_t$ also follow random walks. Thus the dynamic coefficients, contemporaneous relationships, and shock variances may all change gradually over time.

The external instrument is the global oil supply news shock extracted from the oil market VAR in Section 2. Denoting it by m_t and the oil shock in the U.S. VAR by $\varepsilon_{1,t}$, the measurement equation is

$$m_t = \lambda \varepsilon_{1,t} + \sigma v_t, \qquad v_t \sim \mathcal{N}(0,1), \qquad \mathbb{E}(v_t \boldsymbol{\varepsilon}_t) = \mathbf{0}. \tag{7}$$

Relevance requires $\lambda \neq 0$, while exogeneity requires m_t to be orthogonal to the remaining structural shocks. The instrument selects the first column of the contemporaneous impact matrix, $\mathbf{A}_t\mathbf{q}_1$, within the Bayesian sampler. This joint approach is important because it permits even the impact response to vary over time; a two-step procedure that combines a time-varying reduced form with a fixed impact vector would rule out that possibility by construction.

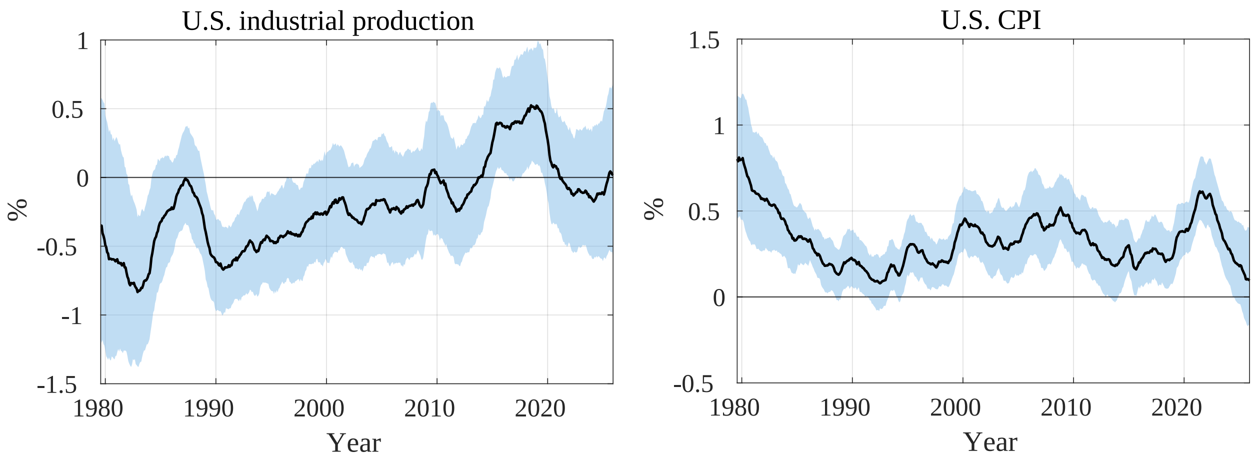
Our monthly VAR contains the real oil price, U.S. industrial production, and the U.S. CPI. All three variables enter in first differences, and the reported impulse responses are cumulated back to levels. The sample runs from January 1974 through December 2025. The first 60 months are used as the training sample for the estimation of the hyperparameters. Our baseline specification includes six monthly lags and a constant. We normalize the shock at each date to raise the real oil price by 10 percent on impact.

We conduct 6,000 MCMC iterations, discarding the first 2,000 as burn-in. To reduce autocorrelation, we retain every fourth draw from the remaining iterations, yielding a final sample of 1,000 draws for inference. In Appendix B.2, we show evidence of the convergence of the algorithm.

Time variation in the response of the U.S. economy. Figure 6 traces the posterior median response of industrial production and the CPI after 12 months at each date following the training sample. The response of industrial production changes dramatically. During the late 1970s and early 1980s, a 10 percent oil-price increase lowers industrial production by roughly one-half to three-quarters of a percent after one year. The contraction becomes smaller over the following decades. By the late 2000s the response is close to zero, and it turns positive through much of the second half of the 2010s. Although posterior uncertainty widens around the pandemic, the central estimate remains far less adverse near the end of the sample than during the historical importer period.

The CPI response also changes, but not monotonically. It is especially large at the be-

Figure 6: Time variation in the U.S. response to oil supply news



Notes: Time-varying 12-month responses of U.S. industrial production and the CPI to an adverse oil supply news shock, estimated using the time-varying parameter VAR (5). The VAR includes the real oil price, U.S. industrial production, and the U.S. CPI in first differences, with six monthly lags and a constant, and is estimated over 1974M1–2025M12. Responses are cumulated to levels and scaled to raise the real oil price by 10 percent on impact. Solid lines denote posterior medians, and shaded areas denote 68 percent posterior credible intervals.

ginning of the sample, falls sharply through the 1980s, and remains comparatively modest during much of the 1990s. It rises again in the early 2000s and around 2020 before declining toward the end of the sample. The key contrast with industrial production is that there is no comparable secular sign reversal. The time-varying VAR therefore points to a pronounced improvement in the activity-inflation trade-off associated with adverse oil shocks.

The time-varying estimates are deliberately unconditional: they show when transmission changed, but not why. We next impose more structure and ask whether the change can be linked directly to the shale revolution and the U.S. petroleum trade balance.

4. The Role of the U.S. Petroleum Trade Balance

Having documented substantial time variation in the effects of oil shocks on the U.S. economy, we next ask whether it can be explained by the transformation of the U.S. petroleum trade balance. To examine this channel, we estimate state-dependent local projections using the oil supply news shock extracted from the global oil market VAR as the shock regressor:

$$y_{t+h} = \alpha_h + \beta_h \widehat{\varepsilon}_t^{oil} + \gamma_h \left(\widehat{\varepsilon}_t^{oil} \times s_t\right) + \delta_h s_t + \mathbf{\Gamma}_h' \mathbf{W}_{t-1} + u_{t+h}, \tag{8}$$

where y_{t+h} is the outcome variable of interest at horizon h, and s_t measures the U.S. petroleum trade position. The controls $\mathbf{W}_{t-1}$ again include 12 lags of the outcome and 12 lags of the five variables in the global oil-market VAR, and the COVID dummy covering March–May 2020. The estimation sample is January 1974–December 2025. Inference follows the lag-augmentation approach of Montiel Olea and Plagborg-Møller (2021).[4] The shock is scaled so that the impact response of the real oil price is 10 percent at $s_t = 0$.

We consider two definitions of the state. The first is a simple indicator for the shale era. We set s_t to zero before January 2010 and to one after, so β_h is the pre-2010 response and $\beta_h + \gamma_h$ is the post-2010 response. This specification permits a transparent comparison without presuming that the precise magnitude of the trade balance is the relevant state.

The second definition uses the continuous petroleum trade position. Let

$$r_t = 100 \times \frac{\text{net petroleum imports}_t}{\text{petroleum consumption}_t}, \qquad s_t = -\frac{r_t - \bar{r}_{pre\text{-}2010}}{\bar{r}_{pre\text{-}2010} - \bar{r}_{2025}}, \tag{9}$$

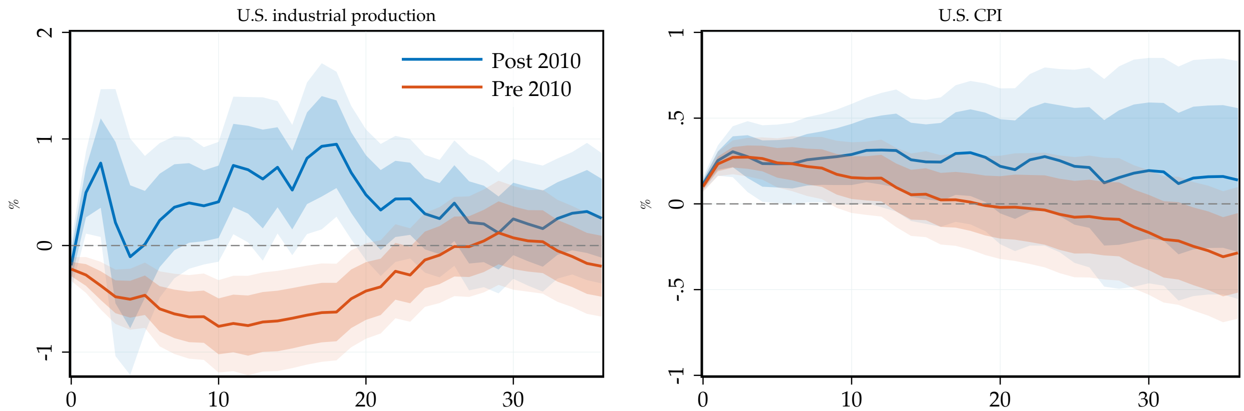
where imports and consumption are seasonally adjusted using the Census X-11 procedure. We center the ratio at its pre-2010 mean and scale it by the difference between the pre-2010 average and the 2025 average. The sign is reversed so that a one-unit increase in s_t represents moving from the average pre-2010 petroleum trade position to the 2025 petroleum trade position, that is, toward exporter status. Under this normalization, β_h is the response at the average pre-2010 trade position and γ_h is the change in that response as the United States moves from its average pre-2010 petroleum trade position to its 2025 average.

A discrete break at the shale revolution. We first examine whether the U.S. response to oil supply news shocks differs in the post-shale period by allowing the impulse responses to change after 2010. Figure 7 reports the results. Before 2010, an adverse oil supply news shock produces a persistent contraction in industrial production, reaching roughly 0.8 percent after a year. After 2010, the point estimate instead becomes positive over most horizons and reaches almost 1 percent at its peak. This contrast closely mirrors the evidence from the time-varying VAR.

The CPI responses differ less on impact. Both periods show an initial increase in prices, but the pre-2010 response subsequently fades, whereas the post-2010 response remains positive and more persistent. The lower persistence of the pre-2010 response is consistent

[4] The baseline confidence bands treat the extracted oil supply news shock as observed and therefore do not incorporate its estimation uncertainty. Appendix Figure B.12 shows that a paired bootstrap that resamples both the extracted shock and the local-projection innovations produces broadly similar bands and leaves the conclusions unchanged.

Figure 7: U.S. responses before and after the shale revolution



Notes: Impulse responses of U.S. industrial production and the CPI to an adverse oil supply news shock before and after January 2010, estimated using the state-dependent local projection specification (8). The sample is 1974M1–2025M12. The controls include 12 lags of the outcome, 12 lags of the five global VAR variables, an indicator for the pre-2010 period, and the COVID dummy. Responses are scaled so that the pre-2010 response of the real oil price is 10 percent on impact. Dark and light shaded areas denote 68 and 90 percent confidence intervals based on the lag-augmentation approach.

with weaker demand pressures as the contraction in real activity takes hold.

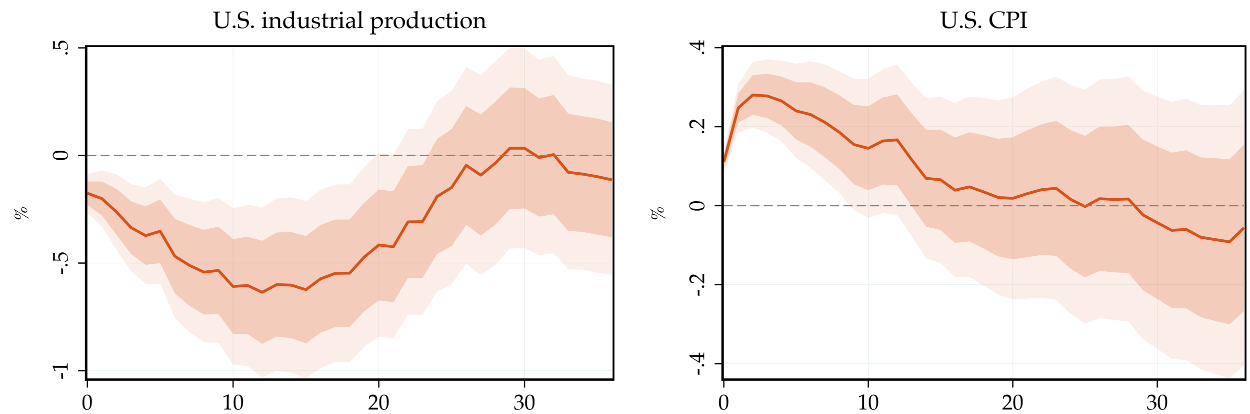
A continuous petroleum-trade channel. The continuous specification ties the change more directly to the economic transformation in Figure 2. Figure 8 reports separately the baseline response, β_h, at the average pre-2010 petroleum trade position and the interaction effect, γ_h, associated with moving from the average pre-2010 U.S. net petroleum imports-to-petroleum-consumption ratio to its 2025 average.

At the average pre-2010 petroleum trade position, industrial production falls by about 0.6 percent after one year. Moving from that position to the 2025 trade position raises the response by roughly 1.5 percentage points, more than offsetting the historical contraction. In contrast, the CPI interaction is small and statistically indistinguishable from zero at nearly all horizons. The change in the energy trade balance can therefore account for much of the improvement in the output response without producing a commensurate increase in inflation. Appendix Figure B.10 shows that this result is insensitive to using import levels instead of the imports-to-consumption ratio and to alternative methods of seasonal adjustment.

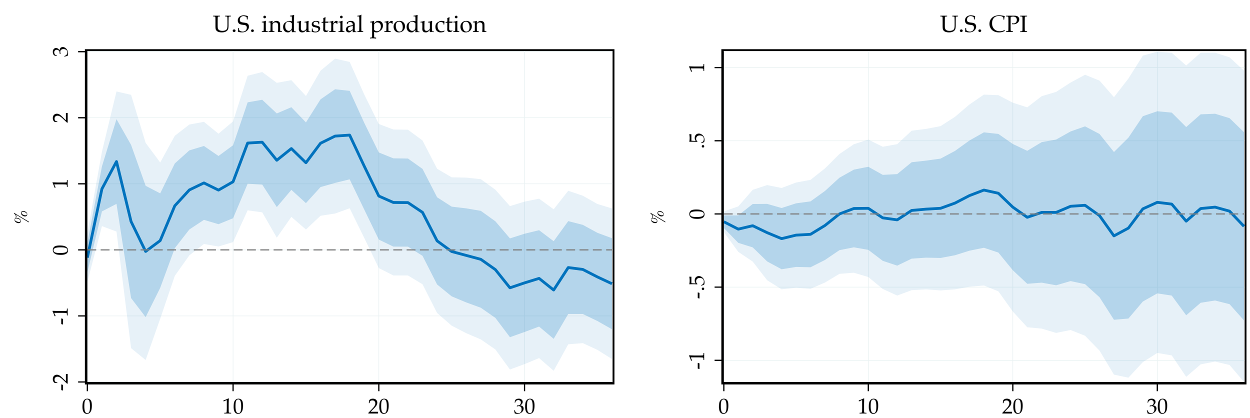
Robustness. One concern with this interpretation is that the petroleum trade position may proxy for other gradual changes in the structure of the U.S. economy. The shale revolution coincided with a decline in energy intensity and manufacturing employment

Figure 8: Responses and the continuous petroleum trade position

(a) Base effect at pre-2010 mean



(b) Interaction effect with exporter status



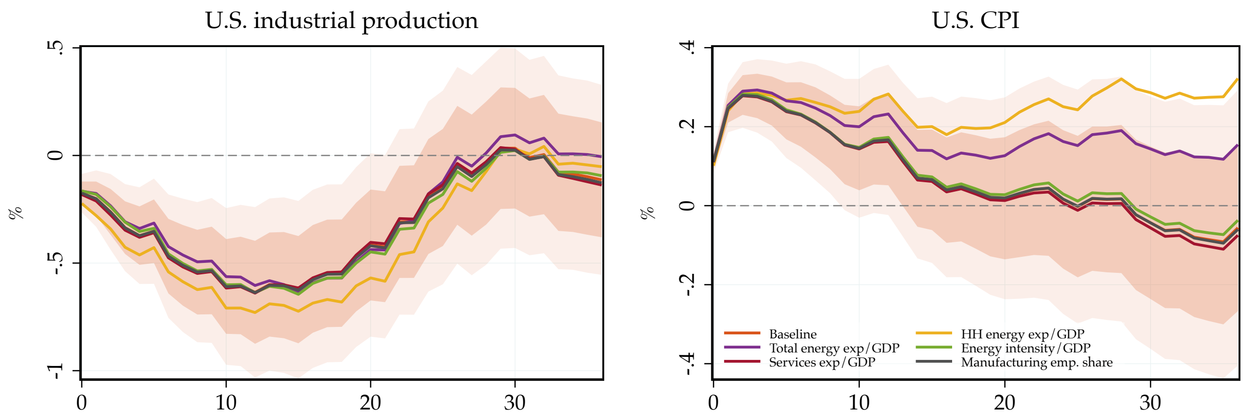
Notes: Impulse responses of U.S. industrial production and the CPI to an adverse oil supply news shock, estimated using the state-dependent local projections in (8). The top row reports the base effect at the average pre-2010 U.S. petroleum trade position; the bottom row reports the change in the response associated with moving from the average pre-2010 net petroleum imports-to-petroleum-consumption ratio to its 2025 average. The sample is 1974M1–2025M12. The controls include 12 lags of the outcome, 12 lags of the five global VAR variables, the net petroleum imports-to-petroleum-consumption ratio, and a March–May 2020 dummy. Responses are scaled such that the real oil price rises by 10 percent on impact at baseline. Dark and light shaded areas denote 68 and 90 percent confidence intervals based on the lag-augmentation approach.

and a continuing shift toward services. These developments were also accompanied by changes in the share of expenditure devoted to energy, which reflects both these structural shifts and movements in energy prices. To address this concern, we re-estimate equation (8) after adding, one at a time, the level of each of these variables and its interaction with the oil supply news shock.

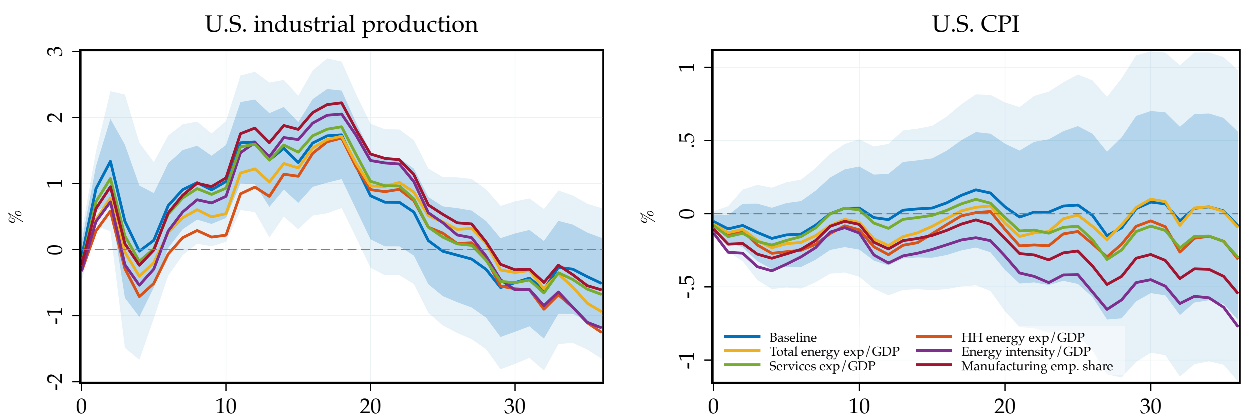
Figure 9 shows that the results are remarkably stable, in the sense that the marginal effect of adding any one of these variables on the impulse responses is small. The industrial-

Figure 9: Petroleum-trade results controlling for other structural changes

(a) Base effect at pre-2010 mean



(b) Interaction effect with exporter status



Notes: Sensitivity of the industrial production and CPI response to controlling for additional interactions in the state-dependent local projections (8). The top row reports the base effect at the average pre-2010 U.S. petroleum trade position; the bottom row reports the change in the response associated with moving from the average pre-2010 net petroleum imports-to-petroleum-consumption ratio to its 2025 average. The baseline solid line and shaded 68 and 90 percent confidence intervals reproduce Figure 8. The additional lines come from separate specifications that further interact the oil supply news shock with household energy expenditures, total energy expenditures, energy intensity, household services expenditures, or the manufacturing employment share, with each variable centered over the estimation sample. All specifications include the baseline controls, as well as the level of the additional variable and its interaction with the oil supply news shock. The sample is 1974M1–2025M12.

production response at the pre-2010 trade position remains contractionary, and the interaction associated with movement toward exporter status remains positive and economically large. The CPI interaction remains close to zero. The estimates therefore do not appear to be driven by the trade position standing in for changes in household energy expenditures, total energy expenditures, energy intensity, the services share, or the manufacturing employment share. Although these exercises cannot rule out every contemporaneous structural change, they indicate that the petroleum-trade channel contains information beyond several leading alternative explanations.

We also examine whether our findings are sensitive to the choice of oil supply shock. Specifically, we use the oil supply shock from Baumeister and Hamilton (2019), identified using a Bayesian structural VAR of the global oil market with informative priors on the short-run elasticities of oil supply and demand. Figure B.11 shows that the overall economic result is unchanged: moving toward exporter status is sufficient to generate an expansion. With this measure, the expansion is quantitatively larger and spills over more into prices, which respond more strongly as the United States moves toward exporter status.

5. Mechanisms

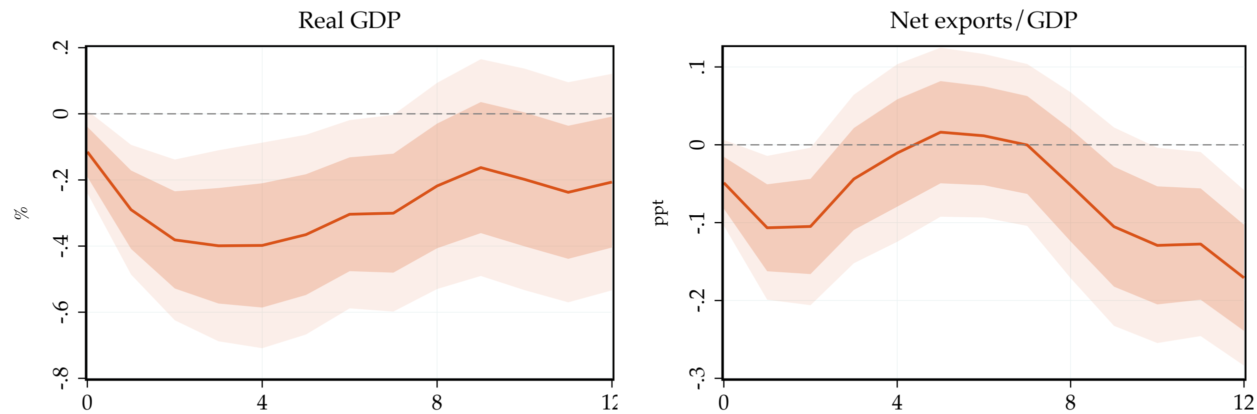
The above estimates establish a close connection between the U.S. petroleum trade balance and the propagation of oil shocks. This section asks how that connection operates. We first show that it is not a mechanical net-export effect, then examine broader income and wealth spillovers and the response of monetary policy.

The mechanical net-export effect is small and short-lived. Becoming a net petroleum exporter improves the terms-of-trade consequences of higher oil prices, but this need not translate one-for-one into a rise in aggregate net exports. Higher domestic income can increase imports of other goods and services, while quantities and production respond gradually. We test the direct accounting channel in quarterly local projections for real GDP and aggregate net exports relative to GDP.

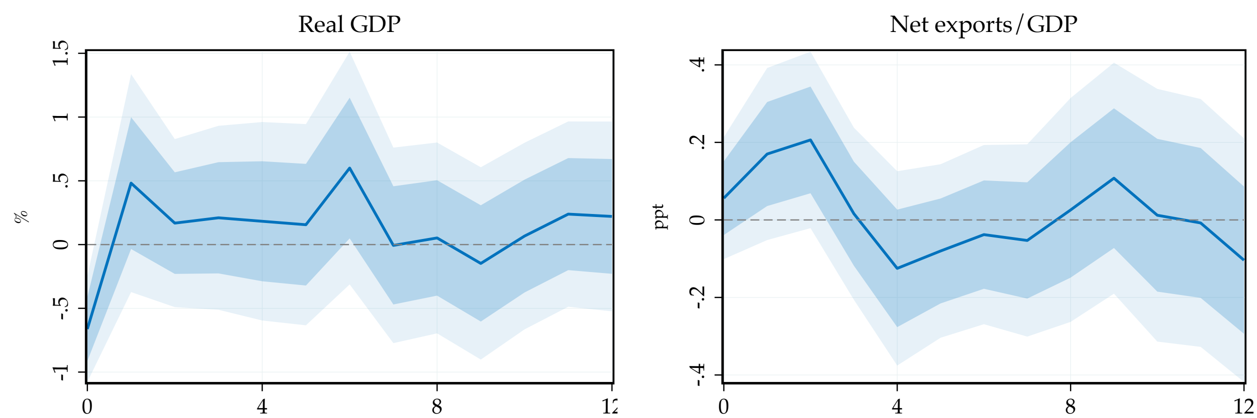
Figure 10 shows that real GDP falls by about 0.4 percent at the average pre-2010 trade position. Moving from this position to the 2025 exporter position raises the GDP response, although the estimate is imprecise. During the first two quarters, net exports decline slightly as a share of GDP at the average pre-2010 trade position, whereas the implied response at the 2025 position—the sum of the base and interaction effects—is slightly positive. At subsequent horizons, both responses are generally small and fluctuate around zero. The more favorable activity response therefore cannot be attributed primarily to a mechanical increase in aggregate net exports. Instead, the petroleum trade balance appears to alter the general-equilibrium distribution of income and demand within the U.S. economy.

Figure 10: Real GDP and aggregate net exports

(a) Base effect at pre-2010 mean



(b) Interaction effect with exporter status

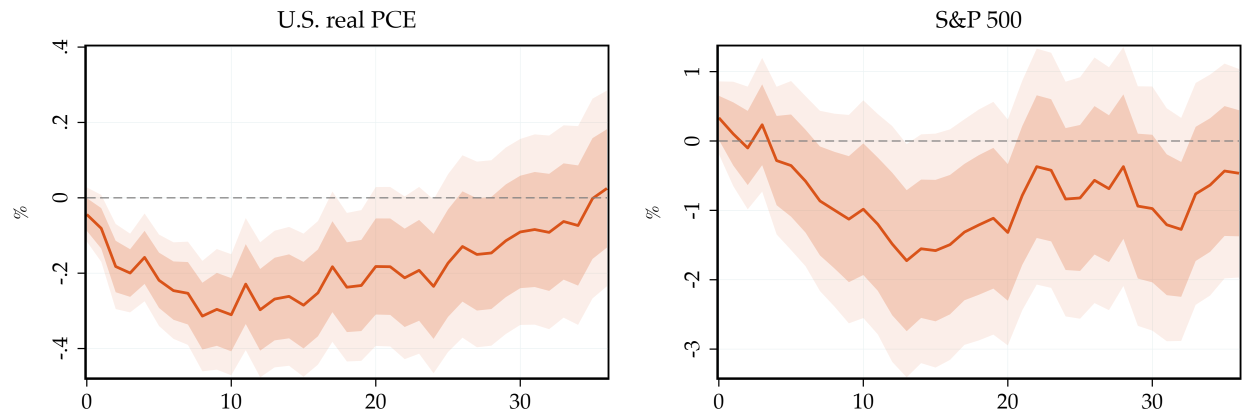


Notes: Impulse responses of real GDP and net exports to an adverse oil supply news shock, estimated using quarterly state-dependent local projections (8), summing the monthly oil supply news shock within each quarter. Net exports relative to GDP are measured as 100 times exports minus imports divided by nominal GDP and are expressed in percentage points. The specification, sample, and normalization follow Figure 8. Dark and light shaded areas denote 68 and 90 percent confidence intervals based on the lag-augmentation approach.

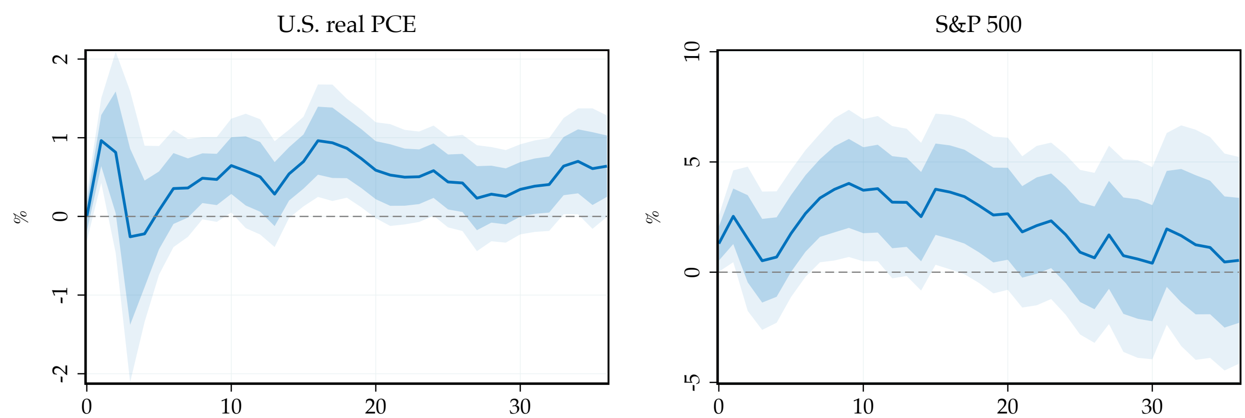
Income, consumption, and equity valuations. Higher oil prices transfer income toward domestic energy producers. When domestic production is small, this transfer largely accrues abroad; when production is large, more of it remains within the United States through profits, wages, investment, tax revenue, and demand for intermediate inputs. Figure 11 is consistent with this channel. At the pre-2010 trade position, an adverse oil supply news shock reduces real personal consumption expenditures and lowers the S&P 500. Moving from the average pre-2010 petroleum trade position to the 2025 exporter position raises both responses substantially. The interaction more than offsets the estimated declines in consumption and aggregate equity values, improving the S&P 500 response by roughly 3–4 percentage points at horizons near one year.

Figure 11: Consumption and aggregate equity valuations

(a) Base effect at pre-2010 mean



(b) Interaction effect with exporter status

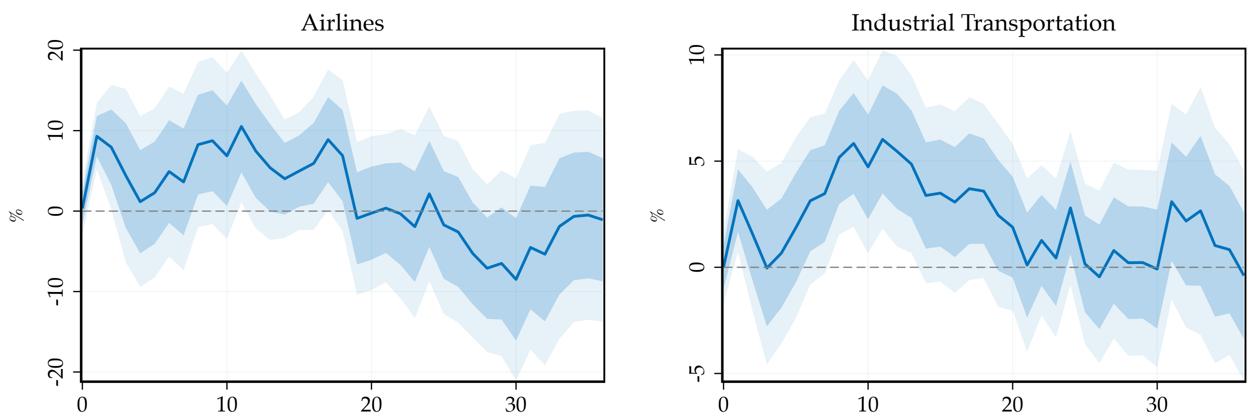


Notes: Impulse responses of real PCE and the S&P 500 to an adverse oil supply news shock, estimated using the state-dependent local projections (8). The top row reports the response at the average pre-2010 petroleum trade position; the bottom row reports the change in the response associated with moving from the average pre-2010 U.S. net petroleum imports-to-petroleum-consumption ratio to its 2025 average. The specification, sample, and normalization follow Figure 8. Dark and light shaded areas denote 68 and 90 percent confidence intervals based on the lag-augmentation approach.

These responses are not a direct measure of oil-sector cash flow, but they summarize the general-equilibrium income and expected-profit effects priced by households and financial markets. The results suggest that the gains to domestic production support demand and valuations broadly enough to offset part of the cost increase faced by oil users.

Figure 12 sharpens this interpretation by considering firms that are directly exposed to higher energy costs. It reports the interaction coefficients for the equity indices of airlines and industrial transportation firms. The two interaction responses are strikingly similar: for both sectors, moving from the average pre-2010 petroleum trade position to the 2025 position makes the equity response more favorable over the first 18 months, even though these sectors are intensive users of energy rather than oil producers. This pattern is difficult to reconcile with a narrowly mechanical export channel and instead points to income and demand spillovers operating in general equilibrium.

Figure 12: Sectoral stock market responses: interaction effect with exporter status

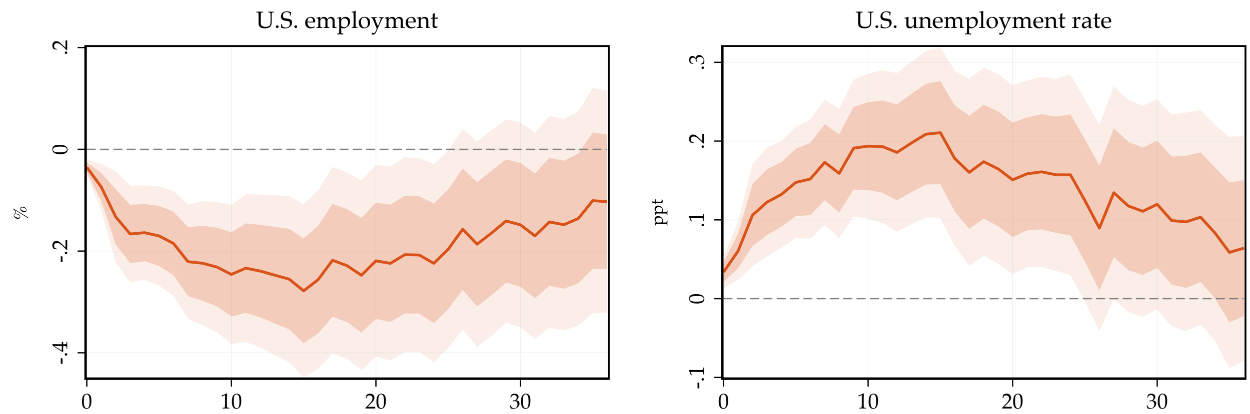


Notes: Impulse responses of sectoral stock market indices to an adverse oil supply news shock, estimated using the state-dependent local projections (8). Depicted is the change in the response associated with moving from the average pre-2010 U.S. net petroleum imports-to-petroleum-consumption ratio to its 2025 average. The specification, sample, and normalization follow Figure 8. Dark and light shaded areas denote 68 and 90 percent confidence intervals based on the lag-augmentation approach.

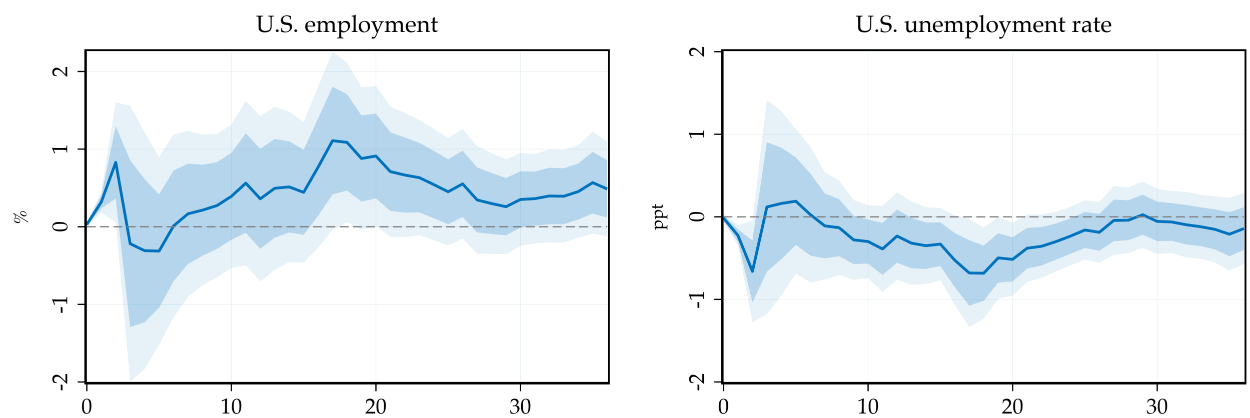
Labor market. The labor-market responses provide complementary evidence that the gains associated with domestic energy production extend beyond the oil sector. Figure 13 shows that, at the average pre-2010 trade position, an adverse oil supply news shock lowers payroll employment by about 0.25 percent and raises the unemployment rate by roughly 0.2 percentage points. Moving from the pre-2010 trade position to the 2025 exporter position makes both responses substantially more favorable: the employment interaction peaks near 1 percent after about 18 months, while the unemployment-rate interaction reaches approximately -0.7 percentage points. Although the estimates are imprecise at some horizons, their medium-run pattern points to stronger labor demand as the United States moves toward exporter status. This shift is consistent with the muted unemployment response to recent oil-market disruptions documented in Figure 1.

Figure 13: Labor market responses

(a) Base effect at pre-2010 mean



(b) Interaction effect with exporter status



Notes: Impulse responses of U.S. payroll employment and the civilian unemployment rate to an adverse oil supply news shock, estimated using the state-dependent local projections (8). The top row reports the response at the average pre-2010 petroleum trade position; the bottom row reports the change in the response associated with moving from the average pre-2010 U.S. net petroleum imports-to-petroleum-consumption ratio to its 2025 average. The specification, sample, and normalization follow Figure 8. To account for the extreme labor-market movements during the pandemic, these specifications additionally control for the Stock and Watson (2025) COVID factor. Dark and light shaded areas denote 68 and 90 percent confidence intervals based on the lag-augmentation approach.

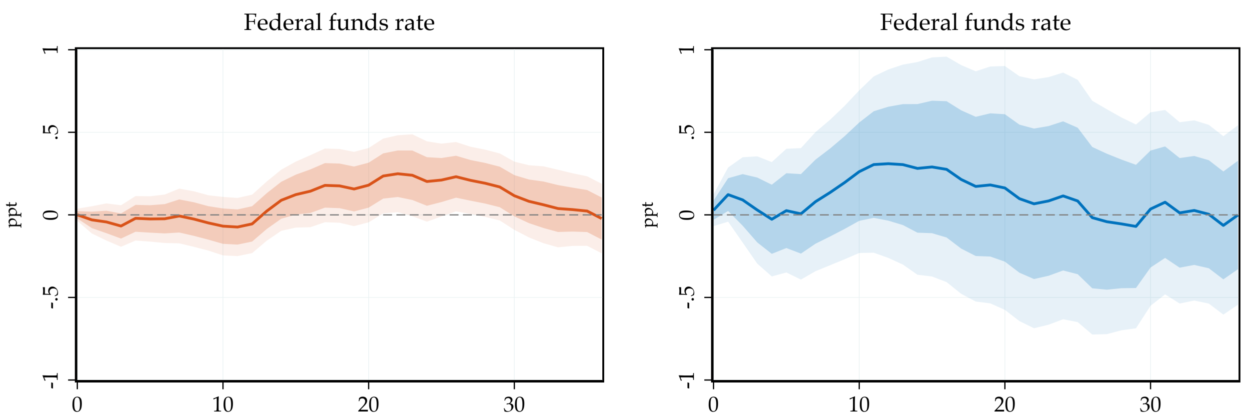
Monetary policy and the output-inflation trade-off. The monetary policy response also shifts with the petroleum trade position. Figure 14 shows that at the pre-2010 mean, the federal funds rate remains unchanged for about a year before rising by about 25 basis points after two years. The interaction is positive over the first two years and peaks near 30 basis points. The Federal Reserve therefore appears to lean somewhat more strongly against the inflationary pressure from oil shocks as the United States moves toward exporter status, although the interaction is imprecisely estimated.

Taken together with Figure 8, the result is consistent with a more favorable stabilization trade-off. The movement toward exporter status improves output while leaving the CPI interaction close to zero, and monetary policy can respond more firmly rather than cushioning a deep contraction. In this limited sense, oil supply shocks move closer to a divine-coincidence configuration in which stabilizing inflation no longer requires accepting as large an output loss.

Figure 14: The monetary policy response

(a) Base effect at pre-2010 mean

(b) Interaction effect with exporter status



Notes: Impulse responses of the federal funds rate to an adverse oil supply news shock, estimated using the state-dependent local projections (8). The left panel reports the response at the average pre-2010 petroleum trade position; the right panel reports the change in the response associated with moving from the average pre-2010 U.S. net petroleum imports-to-petroleum-consumption ratio to its 2025 average. The specification, sample, and normalization follow Figure 8. Dark and light shaded areas denote 68 and 90 percent confidence intervals based on the lag-augmentation approach.

6. Revisiting the 2022 Oil-Price Shock

The preceding results imply that a given oil-price episode can have very different macroeconomic consequences depending on the U.S. petroleum trade position. We illustrate the quantitative importance of this change using the surge in oil prices around Russia's February 2022 invasion of Ukraine.

The counterfactual proceeds in three steps. First, we estimate the five-variable global oil-market VAR through January 2022 and forecast the real oil price from February 2022 onward. The difference between the realized price and this pre-invasion forecast is the oil-price gap **g**. Second, we estimate full-sample local projections of the real oil price on the oil supply news shock and collect the responses $\{\phi_h\}_{h=0}^{H}$ in a lower-triangular Toeplitz matrix $\mathbf{\Phi}$. Following the dynamic inversion logic of Sims (1986), we recover the sequence of oil supply news shocks that reproduces the observed gap:

$$\widehat{\boldsymbol{\epsilon}} = \mathbf{\Phi}^{-1}\mathbf{g}. \tag{10}$$

Using one common shock sequence ensures that the two scenarios match the same oil-price episode and differ only in U.S. propagation.

Third, we evaluate the state-dependent responses of industrial production, the CPI, and the federal funds rate at the average petroleum trade positions observed in 2000–05 and 2020–25. For outcome y and state s, let $\mathbf{\Theta}^y(s)$ denote the Toeplitz matrix formed from the state-specific response $\beta_h^y + s\gamma_h^y$. The implied path is

$$\widehat{\mathbf{y}}(s) = \mathbf{\Theta}^y(s)\widehat{\boldsymbol{\epsilon}}. \tag{11}$$

We conduct the exercise over the first 18 months of the episode. Confidence intervals reflect uncertainty in the state-dependent response paths, while treating the recovered common shock sequence as fixed.[5]

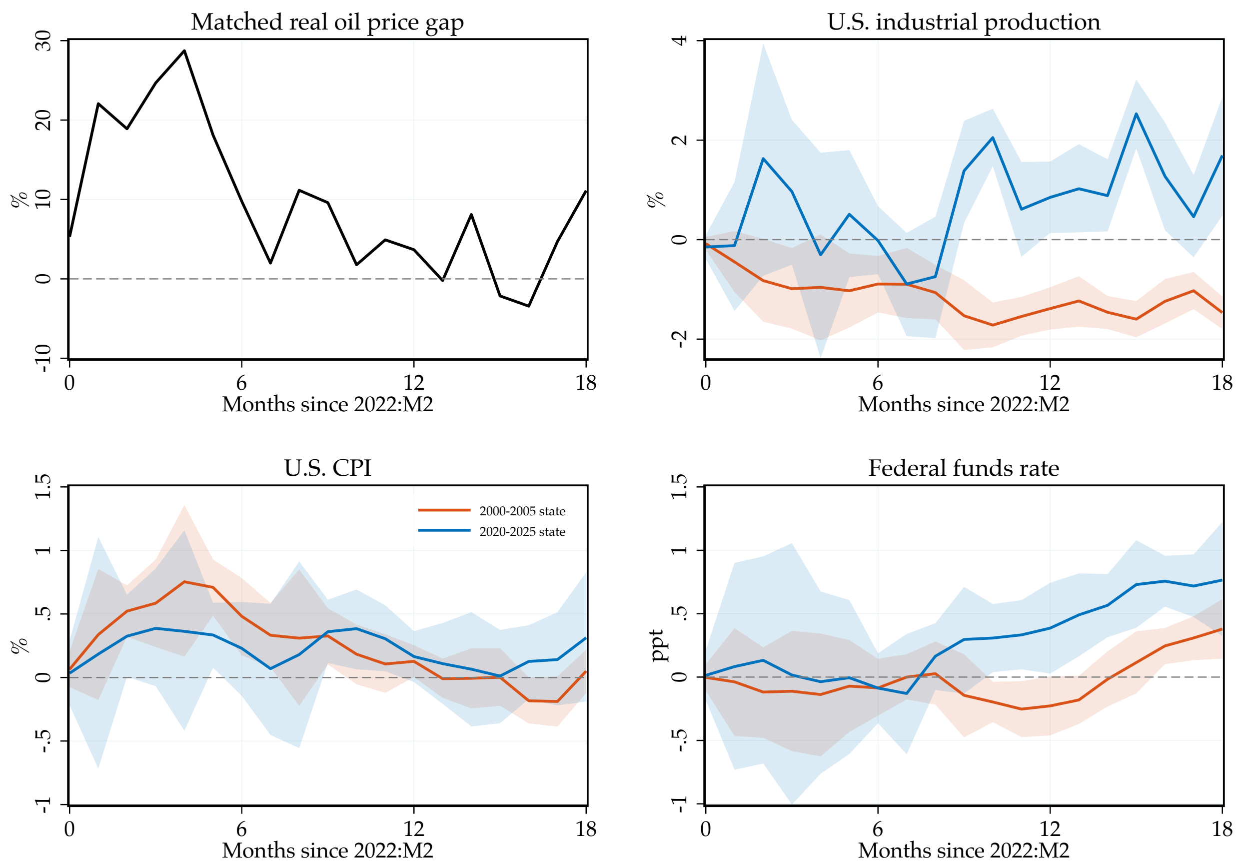
Figure 15 shows the results. The matched real oil-price gap peaks near 30 percent and remains positive through much of the horizon. Under the 2000–05 trade position, the episode would have lowered industrial production by around 1–2 percent. Under the 2020–25 position, the central estimate instead implies an expansion in excess of one percent at longer horizons. The inflation response under the recent state is smaller during the first half of the episode, while the monetary policy response is much more forceful: the federal funds rate rises steadily rather than initially falling. The contrast provides an economically important explanation for why the large 2022 oil shock did not generate the recessionary dynamics that similar disturbances might have produced when the United States was a large petroleum importer.

7. Conclusion

The U.S. economy no longer responds to adverse oil supply news as it did when it was one of the world's largest petroleum importers. A time-varying external-instrument VAR shows that the contraction in industrial production has weakened and, during the shale era, often reversed. State-dependent local projections tie this change to the petroleum trade balance: moving toward exporter status makes the output response substantially

[5] We use a parametric bootstrap for the local-projection coefficients and propagate each draw through the recovered shock sequence to obtain confidence bands for the counterfactual paths.

Figure 15: The 2022 oil-price increase under alternative U.S. petroleum trade positions



Notes: Counterfactual effects of the 2022 oil-price increase under the average U.S. petroleum trade positions in 2000–05 and 2020–25. The top left panel reports the difference between the realized real oil price and a recursive forecast from the global oil-market VAR estimated through January 2022. A common sequence of oil supply news shocks is chosen to match this gap from February 2022 through August 2023. The other panels report the counterfactual paths for industrial production, the CPI, and the federal funds rate obtained by propagating the recovered shock sequence through the state-dependent local-projection responses evaluated at the two petroleum trade positions. Shaded areas denote 68 percent confidence intervals based on 10,000 parametric-bootstrap draws.

more favorable while producing little additional CPI pressure.

The mechanism extends beyond the direct contribution of net exports. Higher oil prices now transfer more income to domestic producers, and the resulting gains propagate through consumption, aggregate equity values, and even the valuations of firms that use energy intensively. Monetary policy also appears to respond somewhat more forcefully. These general-equilibrium effects help explain why the oil-price increase surrounding Russia's invasion of Ukraine had very different implications from comparable episodes in the historical importer period.

The findings do not imply that higher oil prices are unambiguously beneficial for every U.S. household or firm. They continue to raise production costs and reduce purchasing power for energy users. Rather, the shale revolution has changed the balance of aggregate gains and losses sufficiently that an adverse global oil supply shock need no longer generate a large U.S. recession. More broadly, the results show that the domestic production and trade structure of a large economy is central to the propagation of global commodity shocks.

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Online Appendix

From Importer to Exporter: Oil Shocks and the U.S. Economy

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Contents

A. Data

Table A.1 gives details on the data used in the paper, including the data source and the transformation applied.

Table A.1: Data description and sources

Variable	Description	Source	Trans.
Instrument & Orthogonalization			
PC	First principal component from high-frequency oil futures price changes around OPEC announcements	Känzig (2021)	Level
CPISUR	U.S. CPI surprise computed as actual release minus Bloomberg consensus forecast	Bloomberg	Level
UNRATESUR	U.S. unemployment surprise computed as actual release minus Bloomberg consensus forecast	Bloomberg	Level
DGS13M	One-year Treasury rate	FRED	Δ_{3m}
DGS10M13M	10-year minus 1-year Treasury yield term spread	FRED	Δ_{3m}
SP5003M	S&P 500 stock market index	Bloomberg	$100 \times \Delta_{3m}$ log
BGGCOM3M	Bloomberg Commodity Spot Index	Bloomberg	$100 \times \Delta_{3m}$ log
WTI3M	WTI crude oil spot price, extended backward with front-month oil futures prices	EIA and Bloomberg	$100 \times \Delta_{3m}$ log
USPETPR3M	U.S. field production of crude oil and petroleum products (MTTFPUS2)	EIA	$100 \times \Delta_{3m}$ log
USOILCO3M	U.S. oil and petroleum consumption (MTTUPUS2)	EIA	$100 \times \Delta_{3m}$ log
HEATDAY3M	U.S. heating-degree days	EIA	Δ_{3m}
Global VAR			
POIL	Real oil price deflated with world CPI	Känzig (2021)	$100 \times$ log
OILPROD	World oil production	Känzig (2021)	$100 \times$ log
OILSTOCKS	World oil inventories	Känzig (2021)	$100 \times$ log
WORLDIP	World industrial production	Känzig (2021)	$100 \times$ log

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Table A.1 – continued from previous page

Variable	Description	Source	Trans.
WORLDCPI	Chain-linked GDP-weighted world CPI including OECD + 6 (Brazil, China, India, Indonesia, Russia and South Africa) considered in Baumeister and Hamilton (2019)	BIS CPI data & World Bank GDP data	$100 \times \log$
GFC	Global financial factor, extended using VXO (the latter extended following Känzig (2021))	Miranda-Agrippino and Rey (2020)	Level
U.S. Analysis			
UNRATE	U.S. unemployment rate	FRED	Level
USOILIMP	U.S. net imports of crude oil and petroleum products (MTTNTUS2), seasonally adjusted (x11) and divided by (seasonally adjusted-x11) crude oil and petroleum consumption (MTTUPUS2)	EIA	Level
USOILPROD	U.S. crude oil production (MCRFPUS2)	EIA	Level
INDPRO	U.S. industrial production index	FRED	$100 \times \log$
CPIAUCSL	U.S. CPI for all urban consumers: all items	FRED	$100 \times \log$
PCE	Personal consumption expenditures, deflated by headline PCE price index (PCEPI)	FRED	$100 \times \log$
SP500	S&P 500 stock market index	Bloomberg	$100 \times \log$
FEDFUNDS	Federal funds rate	FRED	Level
EMP	U.S. employment (PAYEMS)	FRED	$100 \times \log$
SPAIR	S&P index of airline companies (AIRLNUS)	Datastream	$100 \times \log$
SPTRAN	S&P index of industrial transportation companies (INDTRUS)	Datastream	$100 \times \log$

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Table A.1 – continued from previous page

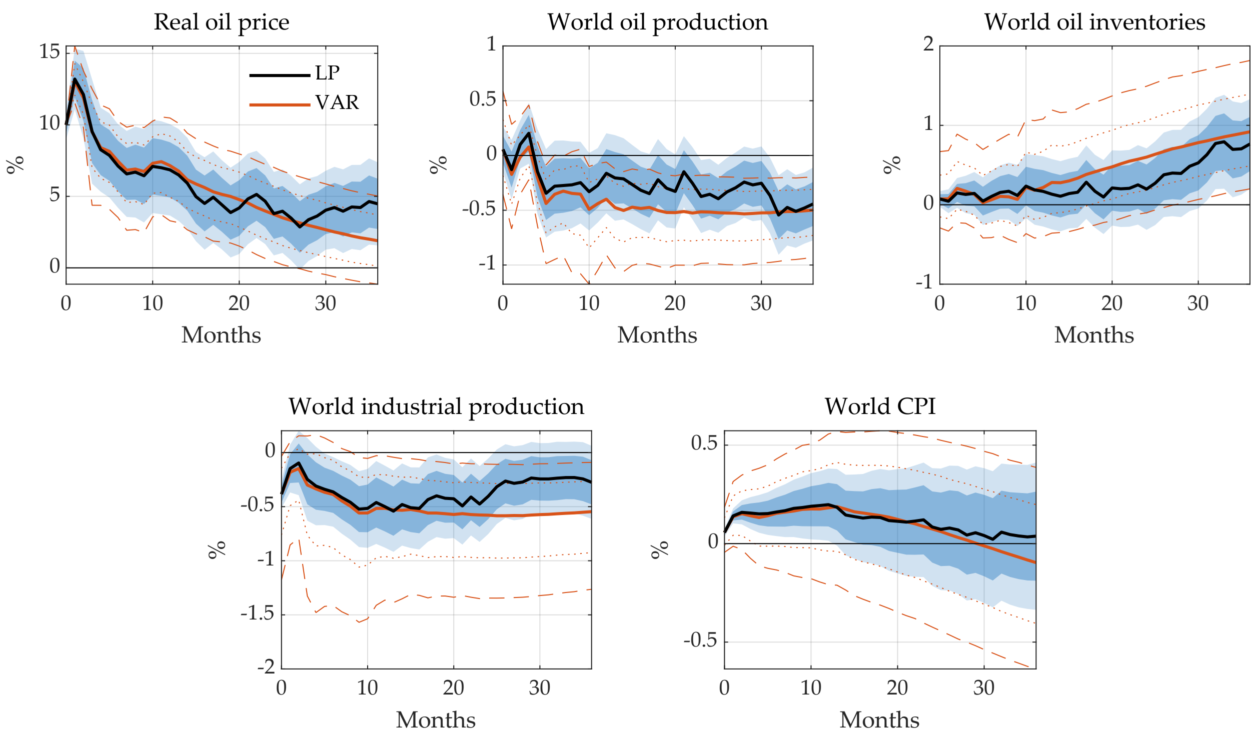
Variable	Description	Source	Trans.
BHSUP	Oil supply shock from Baumeister and Hamilton (2019)	Baumeister's webpage	Level
Quarterly Variables			
GDP	U.S. real gross domestic product (GDPC1)	FRED	$100 \times \log$
NXGDP	U.S. net exports (EXPGS-IMPGS) divided by GDP (GDP)	FRED	Level

B. Additional Results and Robustness

B.1. Global VAR validation and robustness

Figure B.1 compares the global impulse responses from the external-instrument VAR with direct local projections on the extracted oil supply news shock. The two estimators produce similar dynamics for the real oil price, oil production, inventories, industrial production, and consumer prices. This agreement is useful because the shock extracted from the VAR is subsequently used as the regressor or instrument in the U.S. analysis.

Figure B.1: Global responses: external-instrument VAR and local projections

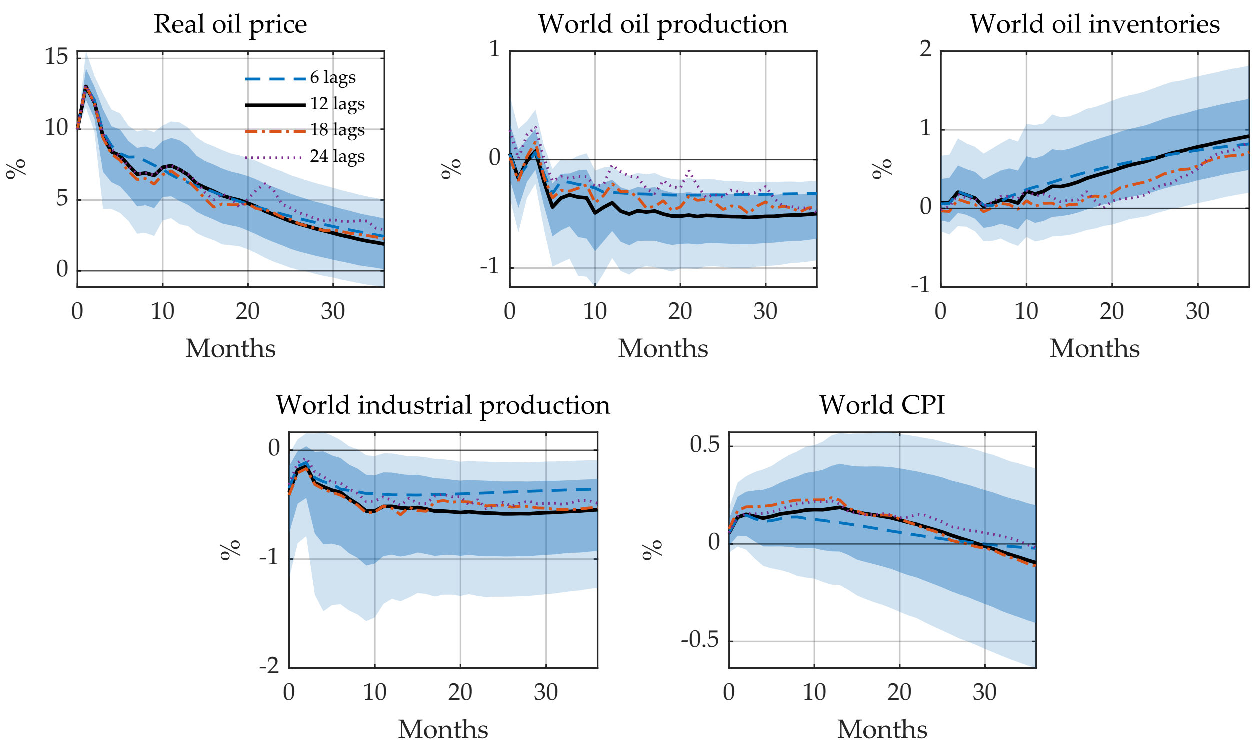


Notes: Impulse responses to an adverse oil supply news shock, comparing the baseline external-instrument VAR with direct local projections. Dark and light shaded areas denote 68 and 90 percent confidence intervals, respectively, for the local projections; dotted and dashed red lines denote the corresponding intervals for the VAR.

Figure B.2 varies the global VAR lag order from 6 to 24 months. The point estimates are very similar across specifications, especially for the real oil price, oil production, and world industrial production. Figure B.3 augments the VAR with a global financial-cycle factor. The main oil-market and real-activity responses remain intact, suggesting that the identified shock is not proxying for contemporaneous global financial conditions.

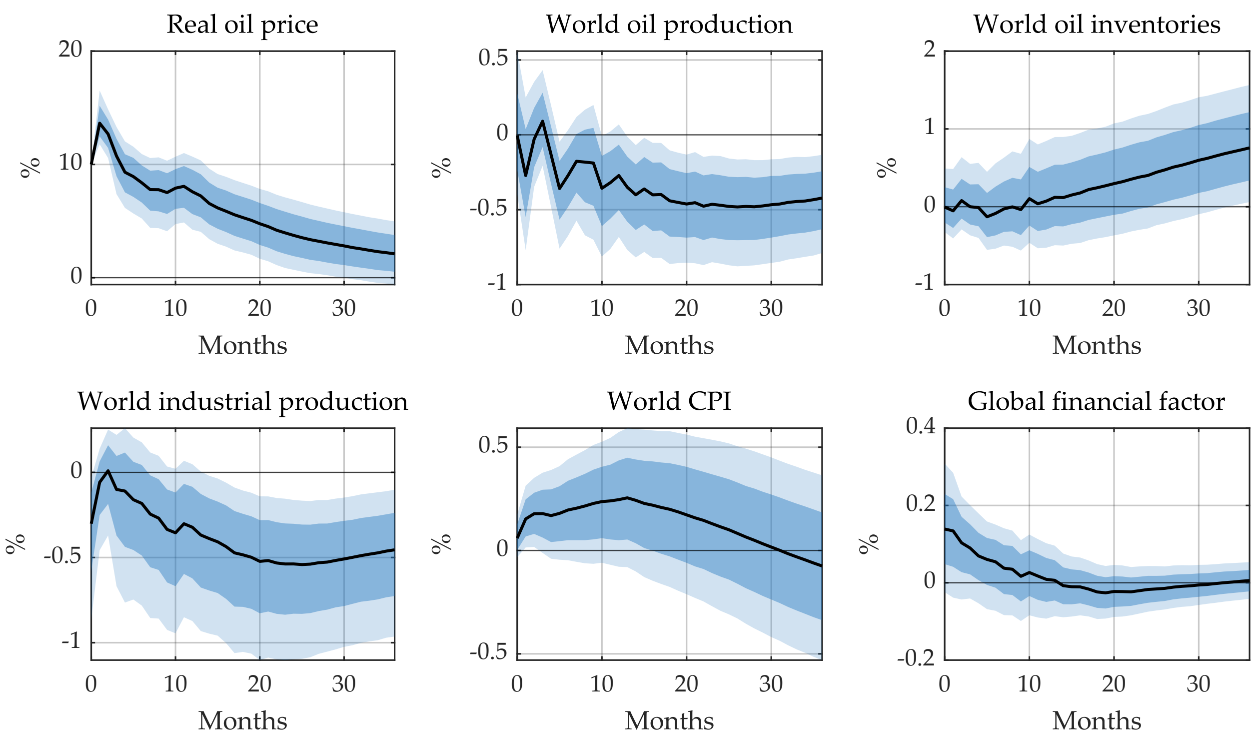
Our baseline aggregation assigns each event-level surprise the calendar-day linear

Figure B.2: Global VAR robustness to the lag order



Notes: Impulse responses from the global external-instrument VAR estimated with 6, 12, 18, and 24 monthly lags. Dark and light shaded areas denote 68 and 90 percent confidence intervals, respectively, for the baseline 12-lag specification.

Figure B.3: Global VAR including a global financial-cycle factor

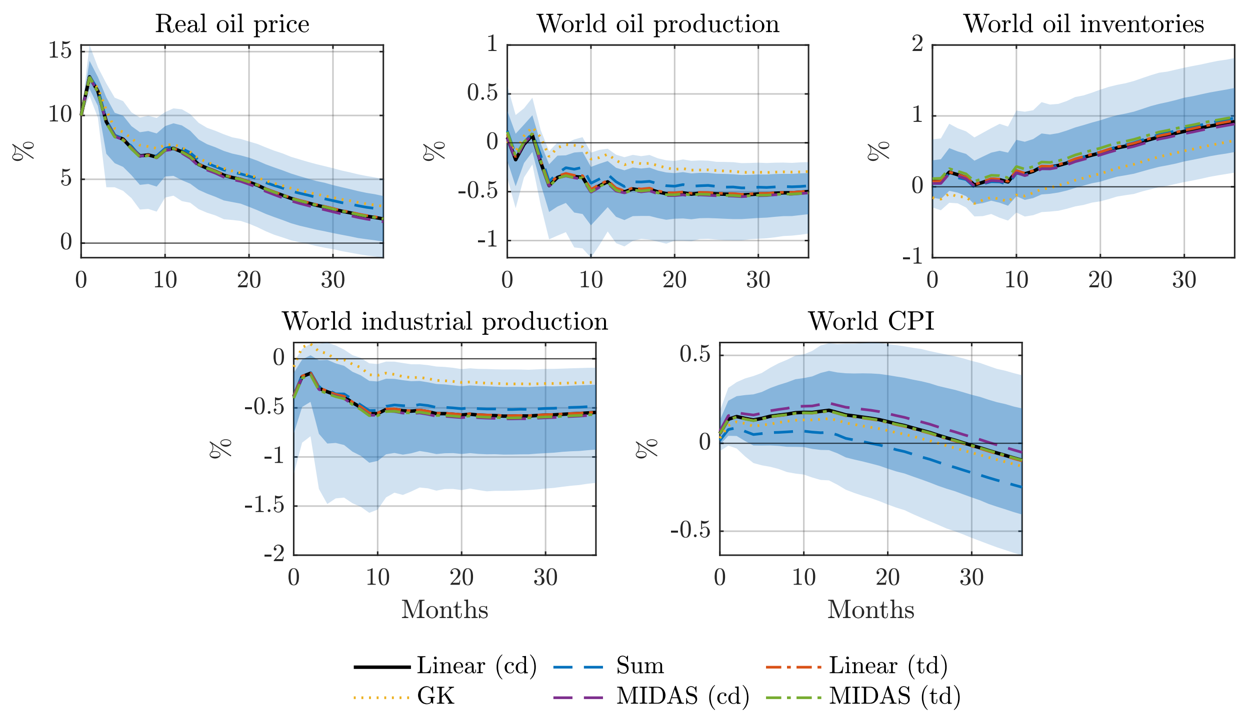


First-stage regression: robust F: 13.01, R^2: 4.76%, Adjusted R^2: 4.61%

Notes: Impulse responses from the global external-instrument VAR augmented with an extended global financial-cycle factor. Dark and light shaded areas denote 68 and 90 percent confidence intervals, respectively.

weight described in Section 2. We assess the sensitivity of the global oil market VAR responses to using an unweighted monthly sum, linear weights based on NYSE trading days, the Gertler–Karadi aggregation, and MIDAS weights based on calendar or trading days. Figure B.4 reports the comparison.

Figure B.4: Robustness to alternative aggregation of OPEC surprises

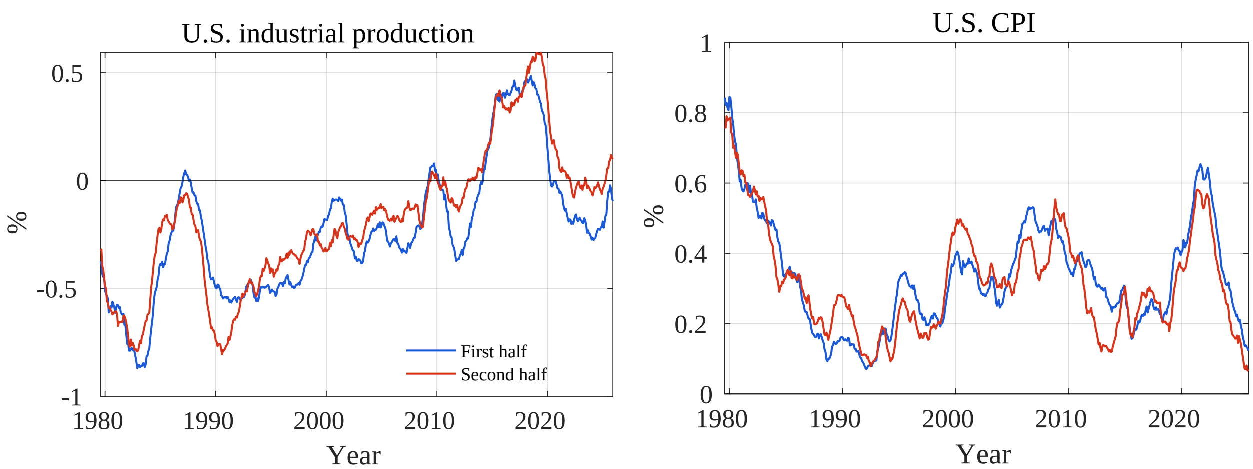


Notes: Impulse responses from the global external-instrument VAR using alternative monthly aggregations of OPEC surprises. The black line denotes the baseline calendar-day aggregation; colored lines denote the alternatives shown in the legend. Dark and light shaded areas denote 68 and 90 percent confidence intervals, respectively, for the baseline.

B.2. TVP-VAR convergence and robustness

Figure B.5 assesses whether the posterior summaries are stable within a given MCMC run. We split the retained draws into two equal halves and recompute the posterior median response using each half separately. If the sampler were still drifting, or if the retained draws were dominated by a particular segment of the chain, the two median paths would differ noticeably. Instead, the first- and second-half medians are very close for both U.S. industrial production and U.S. CPI at the 12-month horizon. This suggests that the reported time variation is not an artifact of where we stop the chain or of one portion of the retained draws.

Figure B.5: First- and second-half posterior medians from the TVP-VAR

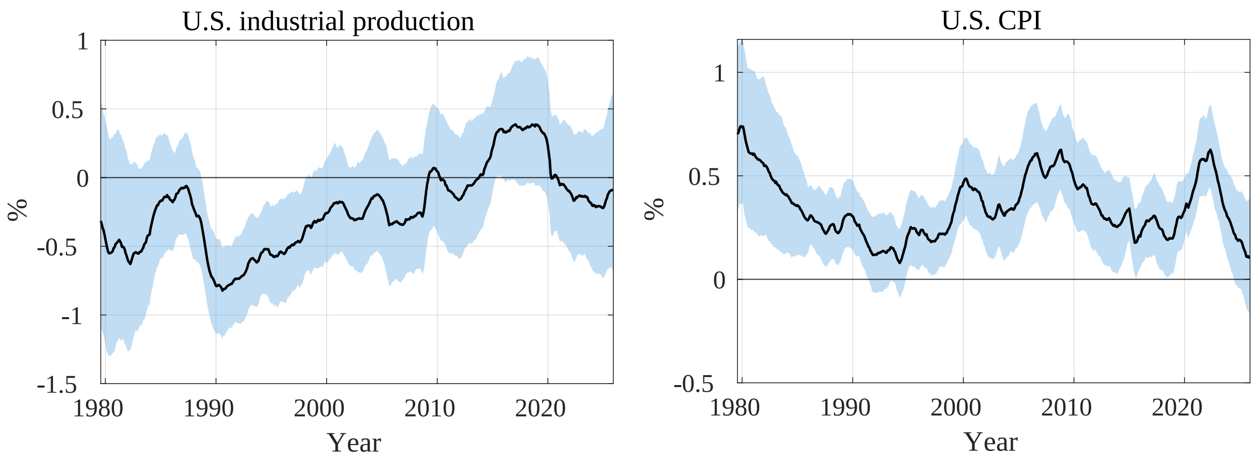


Notes: Posterior median time-varying 12-month responses computed separately from the first and second halves of the retained MCMC draws.

Figures B.6 and B.7 assess sensitivity to the random seed. In Figure B.6, we pool retained draws from four independent runs initialized with different seeds and compute the posterior median and credible intervals from the pooled posterior draws. This provides a direct check that combining independent chains leads to the same substantive pattern as the baseline run. In Figure B.7, we keep the seed-specific runs separate and overlay their posterior medians. This is a stricter visual check: if the sampler were converging to different regions of the posterior under different initializations, the seed-specific median paths would visibly separate. The close alignment of the four paths indicates that the estimated time variation is robust to initialization of the MCMC algorithm.

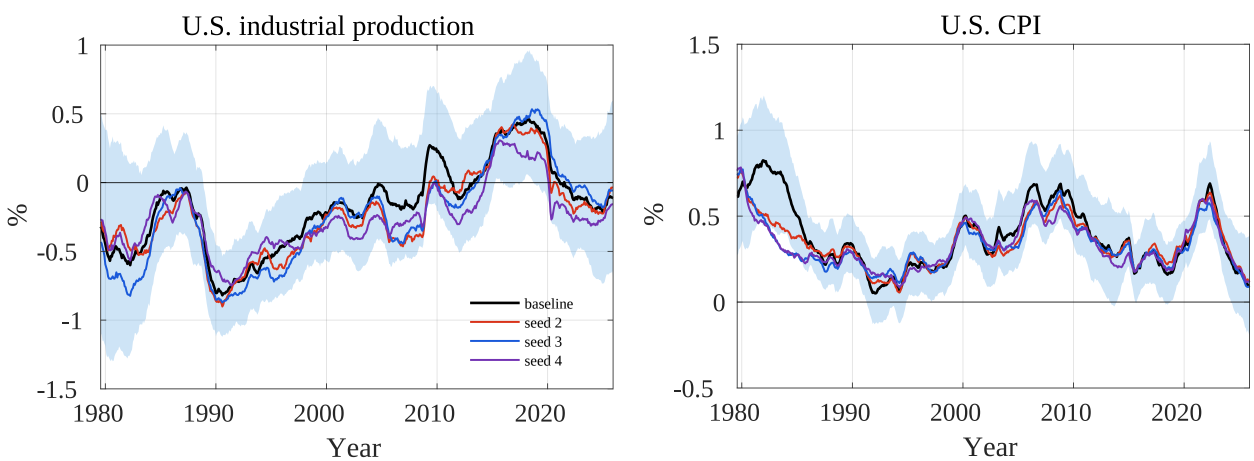
Finally, Figure B.8 reports inefficiency factors for the retained posterior draws of the 12-month impulse responses at each date. Larger values correspond to greater autocorrelation in the retained draws and therefore to a smaller effective number of independent

Figure B.6: TVP-VAR responses using pooled draws from multiple seeds



Notes: Time-varying 12-month responses computed from posterior draws pooled across four MCMC runs initialized with different random seeds. Solid lines denote pooled posterior medians, and shaded areas denote 68 percent credible intervals.

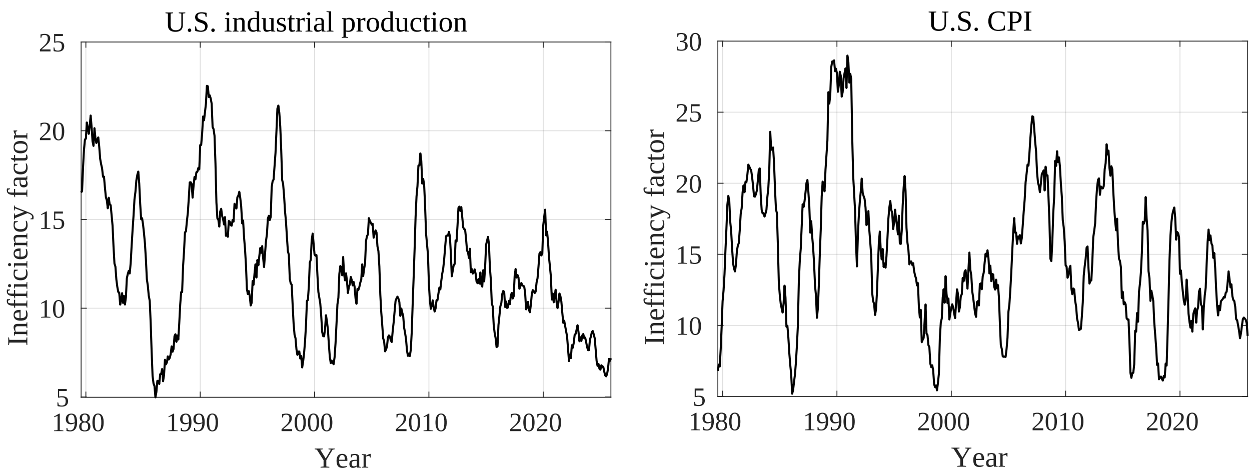
Figure B.7: TVP-VAR responses across MCMC seeds



Notes: Posterior median time-varying 12-month responses across four MCMC runs initialized with different random seeds. The black line denotes the baseline run; colored lines denote the other runs. Shaded areas denote 68 percent credible intervals from the baseline run.

posterior draws. The inefficiency factors are generally moderate for both U.S. industrial production and U.S. CPI, with only limited episodes of higher persistence. This indicates that the posterior medians reported for the 12-month responses are estimated from a reasonably informative set of retained draws.[1]

Figure B.8: Inefficiency factors for TVP-VAR impulse responses



Notes: Inefficiency factors for the retained MCMC draws of the time-varying 12-month responses, reported as a diagnostic of sampling efficiency.

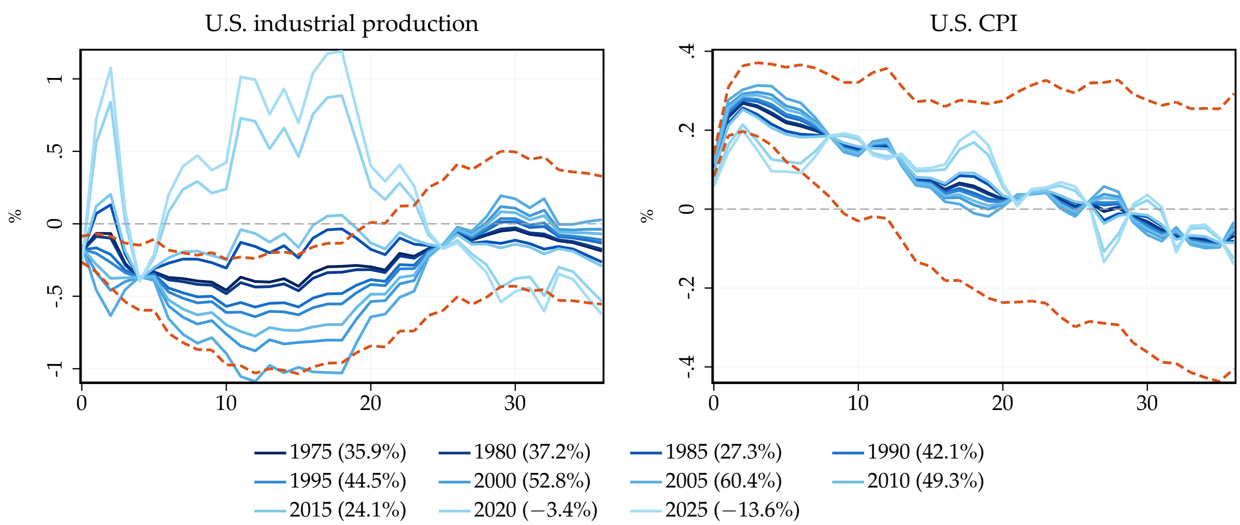
[1] We also repeated the MCMC estimation with a substantially larger number of simulations. Specifically, we used 50,000 iterations with 30,000 burn-in draws, increasing the number of retained draws by a factor of five. The estimated impulse responses are virtually unchanged.

B.3. Mapping the continuous estimates into historical responses

Figure B.9 evaluates the continuous-state estimates at petroleum trade positions observed every five years. The resulting paths provide a transparent summary of the model's implications over time. The industrial-production contraction becomes progressively smaller as net imports fall and turns into an expansion at several horizons under the 2020 and 2025 trade positions. The CPI responses vary much less across historical trade positions, consistent with the small CPI interaction estimates in Figure 8.

Figure B.9: U.S. responses evaluated at historical petroleum trade positions

(a) Industrial production (b) Consumer prices



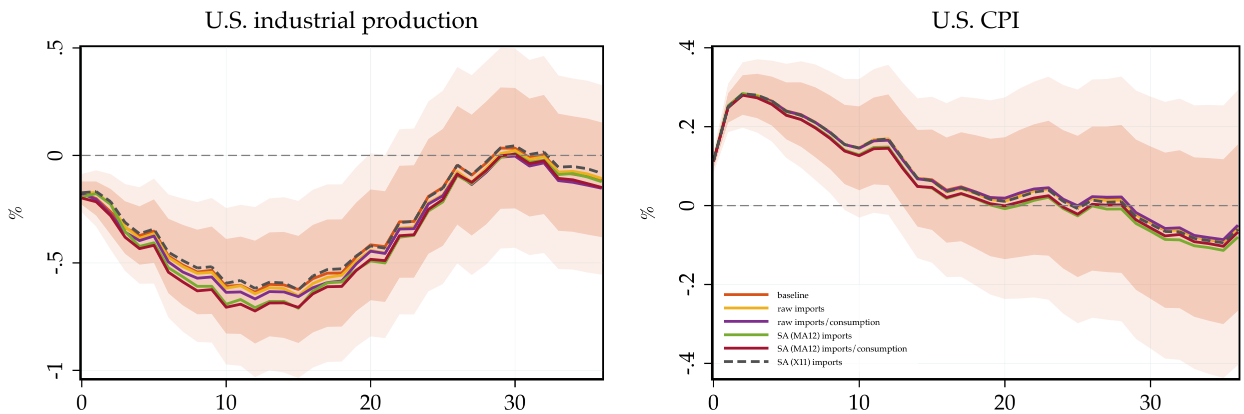
Notes: Impulse responses evaluated at historical annual-average U.S. petroleum trade positions. Each line corresponds to the year shown in the legend; orange dashed lines denote 90 percent confidence intervals for the response at the pre-2010 mean.

B.4. Alternative measures of the petroleum trade position

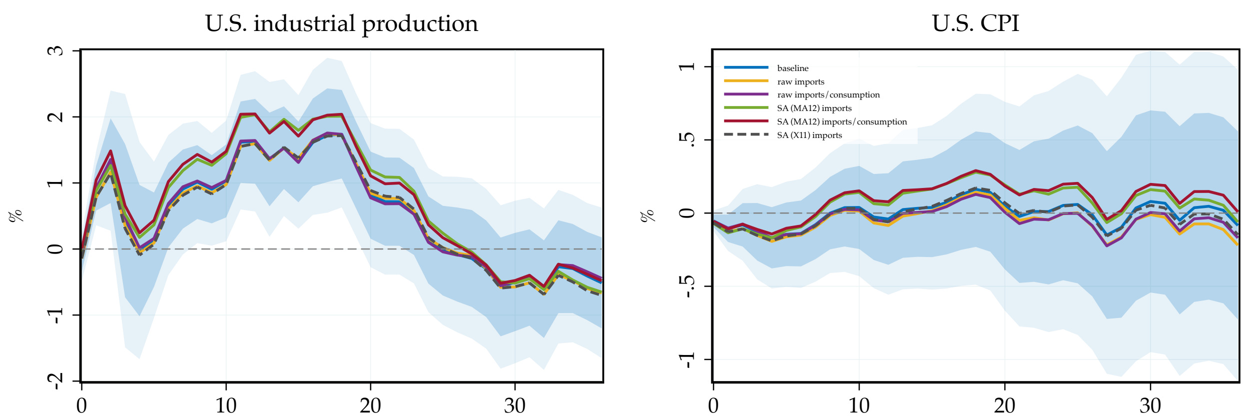
Figure B.10 overlays results using six definitions of the state: raw net petroleum imports, raw imports relative to petroleum consumption, 12-month moving averages of both measures, X-11 seasonally adjusted net imports, and the baseline X-11 imports-to-consumption ratio. Each measure is centered at its own pre-2010 mean, standardized over the full sample, and sign-reversed so that positive values represent movement toward exporter status. The estimates are nearly indistinguishable across definitions.

Figure B.10: Alternative measures of the U.S. petroleum trade position

(a) Base effect at pre-2010 mean



(b) Interaction effect with exporter status



Notes: State-dependent local-projection responses estimated using alternative measures of the U.S. petroleum trade position. Colored lines denote the alternative measures; dark and light shaded areas denote 68 and 90 percent confidence intervals, respectively, for the baseline measure.

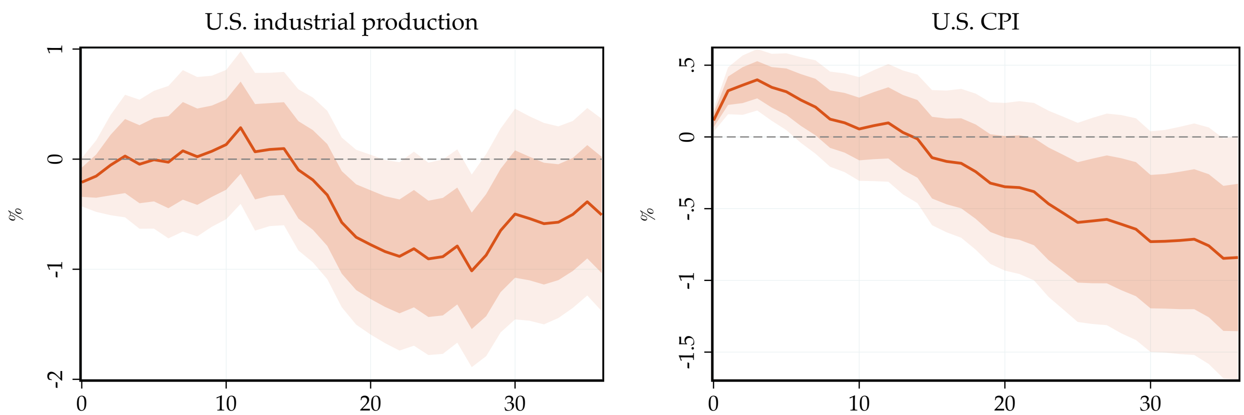
B.5. Alternative measure of the oil supply shock

We examine whether our findings are sensitive to the choice of oil supply shock. While our baseline analysis relies on a high-frequency identification strategy, Baumeister and Hamilton (2019) identify oil supply shocks using a Bayesian structural VAR of the global oil market. Their approach differs from previous work by placing informative priors on the short-run elasticities of oil supply and demand, rather than imposing tight restrictions on the supply elasticity while leaving the demand elasticity unrestricted.

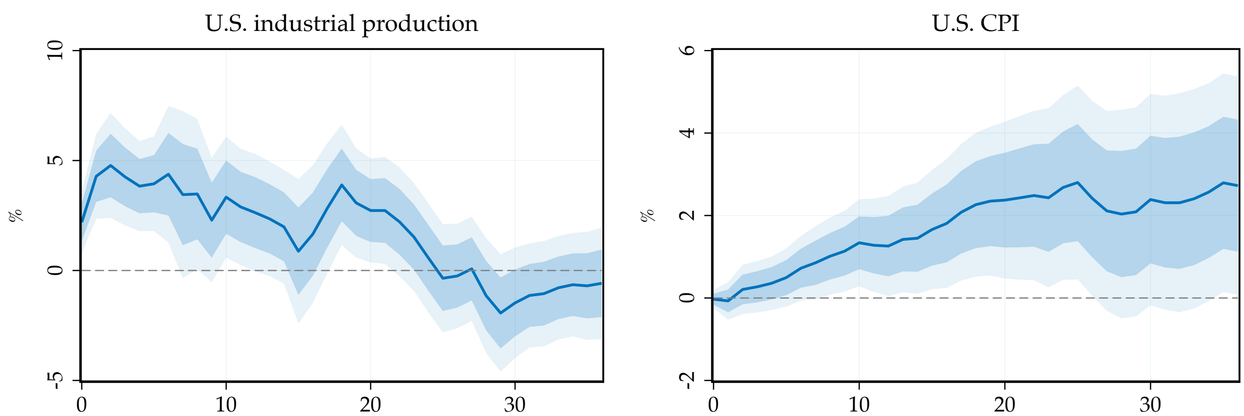
Figure B.11 shows that the pre-2010 responses are broadly consistent with those obtained using our baseline shock, although the timing and persistence of the effects differ somewhat. Such differences are not surprising, as alternative identification strategies need not isolate shocks with the same dynamic properties (Ramey, 2016). As in our baseline specification, transitioning to net exporter status is sufficient to generate an expansion during the first year following the shock, with the response of industrial production being quantitatively larger than in our baseline results. The interaction effect on prices is somewhat stronger, however, resulting in a larger increase in the price level. This may reflect general equilibrium effects associated with the larger expansion in economic activity.

Figure B.11: Alternative measure of the oil supply shock

(a) Base effect at pre-2010 mean



(b) Interaction effect with exporter status



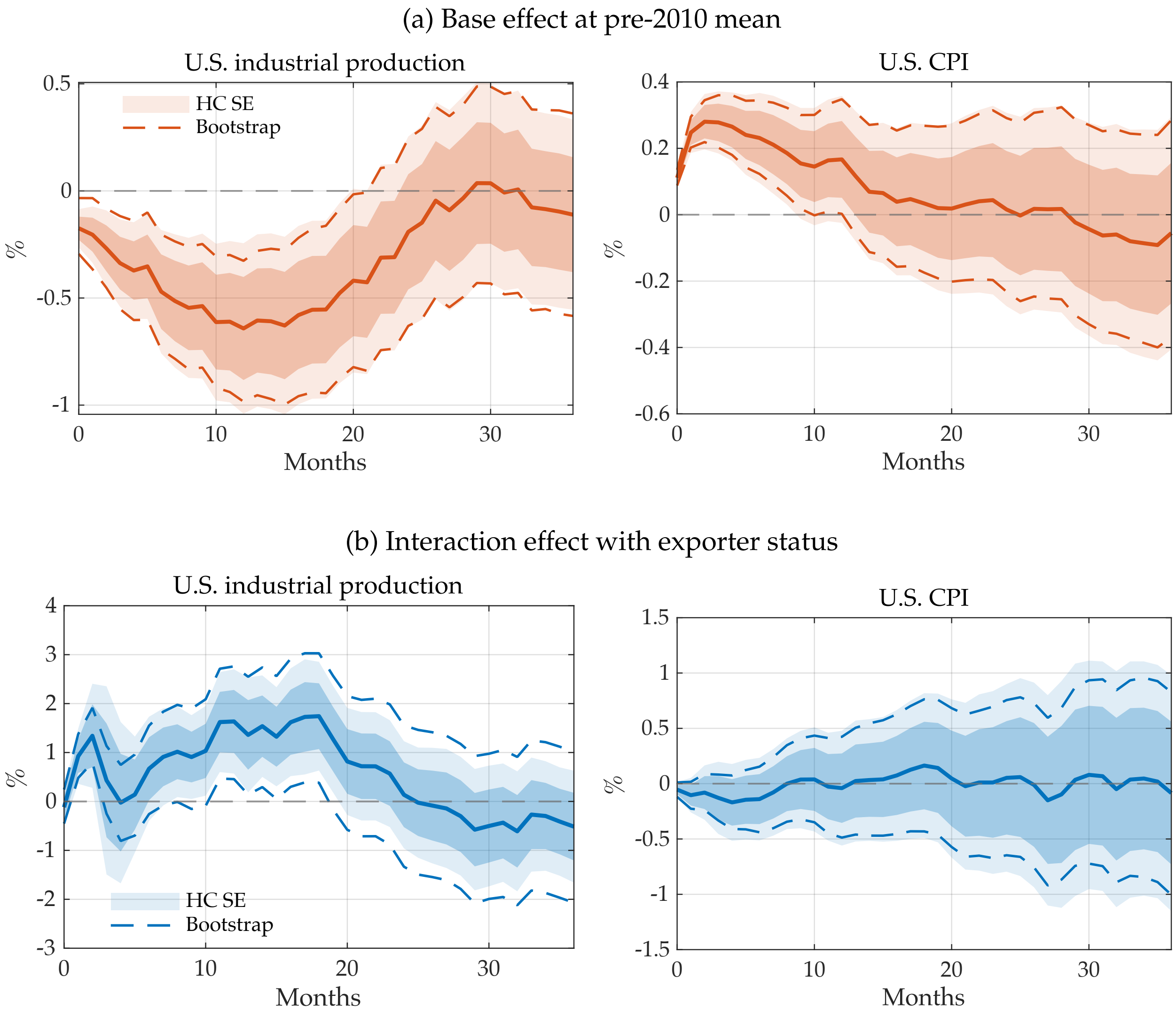
Notes: State-dependent local-projection responses estimated using the oil supply shock from Baumeister and Hamilton (2019) instead of the baseline shock. Both shocks are scaled to raise the real oil price by 10 percent on impact at the average pre-2010 petroleum trade position. Dark and light shaded areas denote 68 and 90 percent confidence intervals, respectively.

B.6. Accounting for uncertainty in the extracted shock

The baseline local-projection inference treats the estimated oil supply news shock as observed. This simplifies inference but omits uncertainty from estimating the shock in the global external-instrument VAR. We assess whether this matters using a paired bootstrap that resamples, with replacement, the extracted shock together with innovations from outcome-specific VAR data-generating processes and re-estimates the state-dependent local projections in each of 4,000 replications.

Figure B.12 compares the resulting 90 percent bootstrap bands with the baseline lag-augmentation bands for industrial production and the CPI. The bootstrap bands follow the baseline bands closely, although they are somewhat wider at some horizons, particularly for the industrial-production interaction. The economic conclusions are unchanged: industrial production contracts at the pre-2010 trade position, movement toward exporter status substantially improves its response, and the CPI interaction remains small and statistically indistinguishable from zero.

Figure B.12: Inference accounting for uncertainty in the extracted shock



Notes: Confidence intervals from the baseline state-dependent local projections compared with intervals from a paired bootstrap that accounts for uncertainty in the extracted shock. Solid lines denote point estimates, shaded areas denote baseline 68 and 90 percent confidence intervals, and dashed lines denote 90 percent bootstrap confidence intervals.