Brookings Papers
ON ECONOMIC ACTIVITY

BPEA Conference Draft, September 24-25, 2026

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

Diego R. Känzig (Northwestern University, CEPR, and NBER)

James H. Stock (Harvard University and NBER)

Luca Zanotti (Northwestern University)

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

Diego R. Känzig
Northwestern

James H. Stock
Harvard

Luca Zanotti
Northwestern

September, 2026

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 weakened over time and eventually became expansionary. State-dependent local projections link this change to the U.S. petroleum trade balance. The improvement goes beyond mechanical net export effects: as the terms-of-trade response turns more favorable, consumption, equity valuations, and activity strengthen broadly across sectors and regions, pointing to general-equilibrium income and wealth effects. 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 before the shale boom vs. the early 2020s.

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

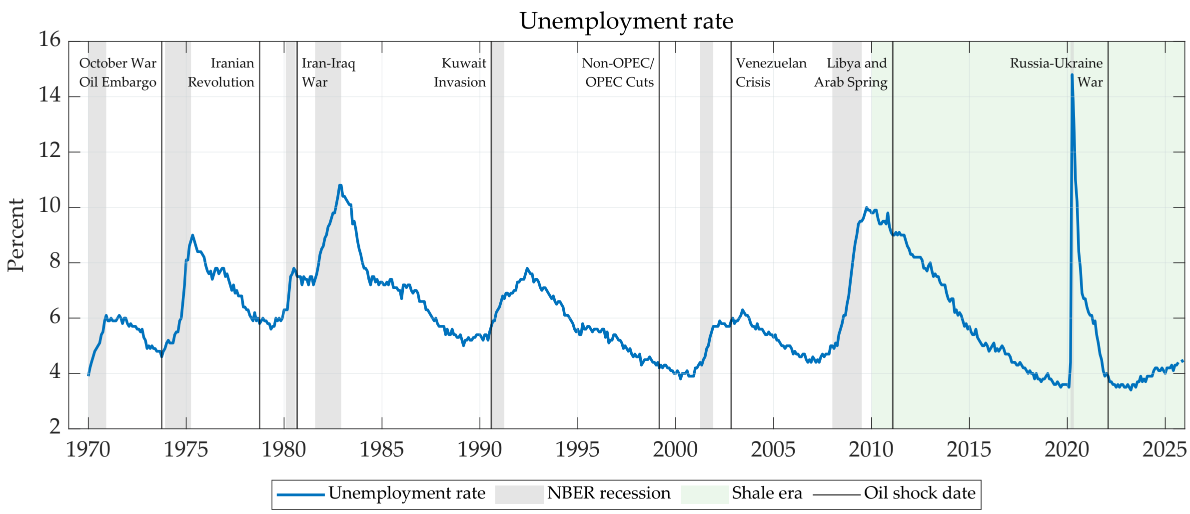
Keywords: Oil shocks, shale revolution, energy trade balance, macroeconomic effects

*Känzig: Northwestern University, CEPR, and NBER (email: dkaenzig@northwestern.edu); Stock: Department of Economics and Harvard Kennedy School, Harvard University and NBER (email: james_stock@harvard.edu); Zanotti: Northwestern University (email: luca.zanotti@u.northwestern.edu).
We thank Christiane Baumeister, Jón Steinsson, and Johannes Wieland for useful comments and suggestions.

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 the unemployment rate. 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



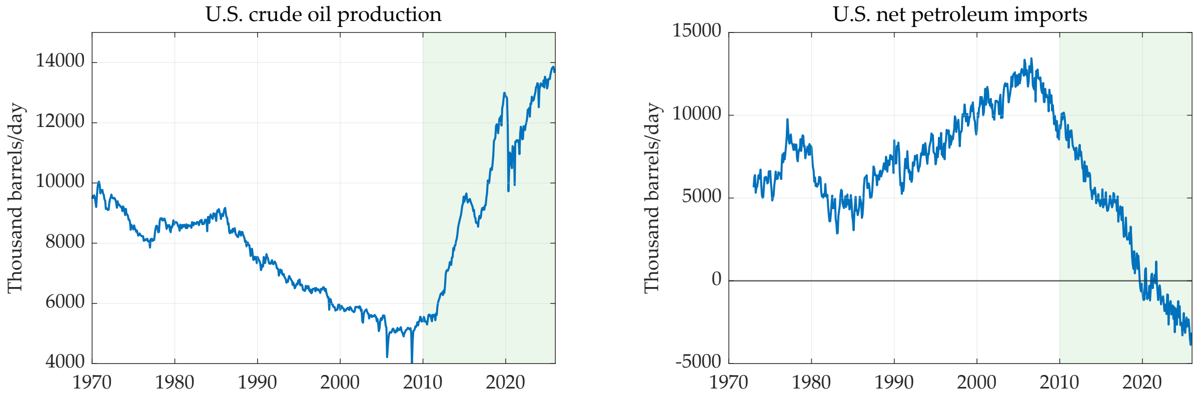
Notes: The blue line shows the monthly U.S. civilian unemployment rate from 1970 to 2025. Gray shading denotes NBER recessions, and light green shading denotes the shale era, defined as the period since 2010. Vertical black lines mark the major oil market disruptions labeled in the figure.

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, which for these purposes we date to 2010.[1] Advances in hydraulic fracturing and horizontal drilling produced a

[1]Hydraulically fractured horizontally drilled oil wells have been in use since the early 2000s, but with technological improvements, began to expand rapidly around 2009–2010. By October 2011, total footage

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.

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 million barrels per day by 2025. 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 assess whether these surprises are predictable from macroeconomic, financial, and oil market information available before the announcement

of fracked oil and gas wells surpassed the total footage of all other well types combined (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.

and find little evidence that they are. We then use the 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. We provide multiple pieces of evidence that indicate, however, that this response has changed substantially 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.

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. This changing effect of an oil supply shock on real economic activity is large, statistically significant, and appears across multiple sectors—not just oil and gas—within the U.S. economy. The Federal Reserve raises interest rates somewhat more as the trade position improves, consistent with a more favorable output-inflation trade-off.

While the primary purpose of this paper is to document these changes, we also consider five possible mechanisms: a mechanical increase in net exports; a regional shift in which gains in oil-producing states increasingly outweigh losses elsewhere; a sectoral shift in which gains to oil-producing sectors increasingly outweigh losses in energy-intensive sectors; changes in monetary policy; and a general-equilibrium response through income and wealth effects. While several of these channels appear to play some role, our reading is that the primary channel operates through wealth and income effects. As the United States moves toward exporter status, the terms-of-trade response flips from deterioration to improvement, while the response of aggregate net exports remains modest. At the same time, production, employment, equity valuations, and consumption all respond more favorably. These gains are broad-based: non-mining employment improves by similar amounts in oil-producing and non-oil-producing states, employment rises across manufacturing, trade, and services, and even the equity valuations of airline and transportation firms become more favorable. Monetary policy, if anything, responds more forcefully. Taken together, these patterns suggest that the gains from higher oil prices increasingly accrue domestically and propagate through broader income and wealth effects that support demand and activity.

Finally, we revisit the recent 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 average pre-shale U.S. petroleum trade position and the 2021 pre-shock position yields sharply different outcomes. Under the pre-shale trade position, the shock sequence implies a persistent decline in industrial production, whereas under the 2021 trade position it implies an expansion. In the pre-shale regime, consumer prices also rise more initially and monetary policy responds substantially less forcefully. The exercise illustrates quantitatively why a large oil shock need not have the same U.S. business-cycle consequences today as it did a few decades ago.

Related literature. The paper contributes to a growing literature studying time variation in the macroeconomic effects of oil market shocks. Blanchard and Galí (2010) study the effects of oil price increases, without distinguishing between supply- and demand-driven movements in oil prices, and find that their effects were more muted in the 2000s than in the 1970s. They relate this change to declining oil intensity, greater labor-market flexibility, improved monetary policy, and more favorable accompanying shocks. More closely related to our empirical analysis, Baumeister and Peersman (2013) study the time-varying impacts of oil supply shocks and 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) study the sharp oil price decline of 2014–16 and find that its effects on the U.S. economy were broadly comparable to those of the 1986 oil price decline, with gains in consumption and non-oil investment largely offset by a contraction in oil sector investment. By contrast, Bjørnland and Skretting (2024) identify oil supply shocks and find that the shale boom altered their transmission, generating positive spillovers beyond the oil sector to investment, income, industrial production, and employment in parts of the U.S. economy. Our results contribute to this literature by directly linking the changing aggregate response to the U.S. petroleum trade position.[2]

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 (Alsalman and Rangaraju, 2026; Karaki, 2018). We complement this evidence by exploiting the stark transformation of the United States itself—from a major petroleum importer to a net exporter.

We also contribute to the identification of oil supply news. Building on Känzig (2021) and the broader high-frequency identification literature (Bauer and Swanson, 2023b; Miranda-Agrippino and Ricco, 2021; Nakamura and Steinsson, 2018), we extend the OPEC surprise series, show that it is largely unpredictable from pre-announcement information, and account explicitly for the timing of announcements when aggregating the surprises to the monthly frequency. The results are robust to both orthogonalizing the surprises and using alternative aggregation schemes.

As with 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 differs from the oil market in several respects, however, including the episodic connection between U.S. gas prices and world markets (Stock and Zaragoza-Watkins, 2024) and its history of long-term contracts that buffer 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 effects of these shocks have changed over time. We leave this question for future research.

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

[2]Related work studies how the U.S. transition to net petroleum exporter status has changed the dollar's response to oil shocks (Degasperi, 2026; Oruc et al., 2026).

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 (Baumeister and Hamilton, 2019; Kilian, 2009). 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.[3]

A potential concern is that OPEC surprises may not reflect purely exogenous supply news. OPEC production decisions can respond systematically to information about expected oil demand, so that announcement surprises may inherit a predictable component from pre-announcement economic conditions. In addition, OPEC announcements may reveal information about OPEC's own assessment of future demand, leading market participants to revise their expectations about future economic activity (Degasperi, 2025). Känzig (2021) addresses these concerns by purging the surprises of information contained in OPEC's own demand forecasts. However, these forecasts are only available from 2001 onward, limiting the sample over which this adjustment can be implemented. We therefore take a broader approach and ask whether the OPEC surprises are predictable from publicly available macroeconomic, financial, and oil market information prior to the announcement, following the logic of Bauer and Swanson (2023a).

[3]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.

To this end, we regress each OPEC surprise on a broad set of macroeconomic, financial, and oil market variables observed before the announcement:

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

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 rate, 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: Predictability of OPEC oil price surprises

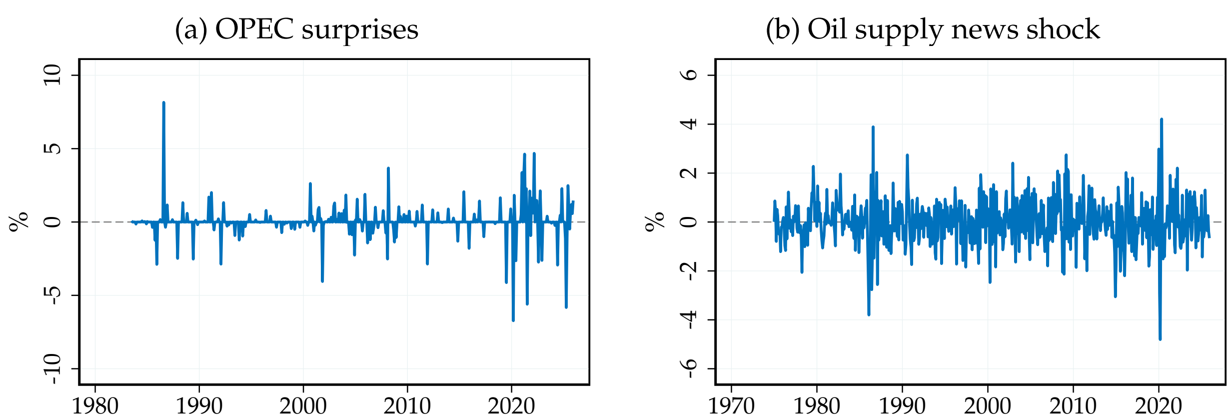
	(1) (a) Macro news	(2) (b) Financials	(3) (c) Oil market	(4) (d) Full
CPI surprise	-0.227	-0.469	-0.407	-0.414
	(1.904)	(1.955)	(1.898)	(1.901)
Unemployment rate surprise	0.399	0.639	0.347	0.301
	(1.040)	(1.070)	(1.171)	(1.192)
S&P 500 (3M log ch.)		2.697	2.890	2.895
		(2.387)	(2.372)	(2.368)
1-year rate (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 change)			-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
Observations	169	169	169	169

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.

As shown in Table 1, there is little evidence of predictability. None of the individual predictors is statistically significant at conventional levels. While the R^2 rises to about 6 percent once financial and oil market variables are included, the adjusted R^2 remains close to zero. Overall, the predictive content of publicly available macroeconomic and financial information appears limited, and substantially weaker than that documented for high-frequency monetary-policy surprises (Bauer and Swanson, 2023a).

Given the limited evidence of predictability, we use the unadjusted OPEC surprises in our baseline analysis. As a robustness check, we follow Bauer and Swanson (2023a) and purge the surprises of any component predictable from information available before the announcement, defining the orthogonalized OPEC surprise as the residual $\widehat{\eta}_d$ from the full predictive specification. As we show in Appendix B.1, this adjustment makes little difference to the results. This is perhaps not surprising as the unadjusted and orthogonalized monthly surprises track each other very closely, with a correlation of 0.97.

Figure 3: OPEC surprises and the oil supply news shock



Notes: The left panel shows the monthly OPEC surprise series, constructed as the first principal component of daily changes in WTI futures prices across maturities up to a year on OPEC announcement days, aggregated to the monthly frequency using linear weights. The right panel shows the oil supply news shock extracted from the global VAR using the OPEC surprise series as an instrument. Positive values denote adverse oil supply news that raises the real oil price.

Because our outcome variables of interest are at the monthly frequency, we aggregate the event-level surprises. To map these event-level surprises into an instrument 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 resulting monthly OPEC surprise series is shown in Figure 3a. The results are robust to alternative aggregation schemes, including an unweighted monthly sum or the mixed-data sampling (MIDAS) aggregation method (Lee and Sekhposyan, 2024); Appendix Figure B.3 reports these comparisons.

Global oil market VAR. The OPEC surprise series 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.

Suppose the dynamics of the global oil market can be characterized by a structural vector autoregression (VAR) model. 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 model 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). We include the world CPI to enrich the information set of the VAR model and better capture global inflationary pressures.[4] Unlike Känzig (2021), we do not include any U.S.-specific variables in the 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 OPEC surprise series, 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.

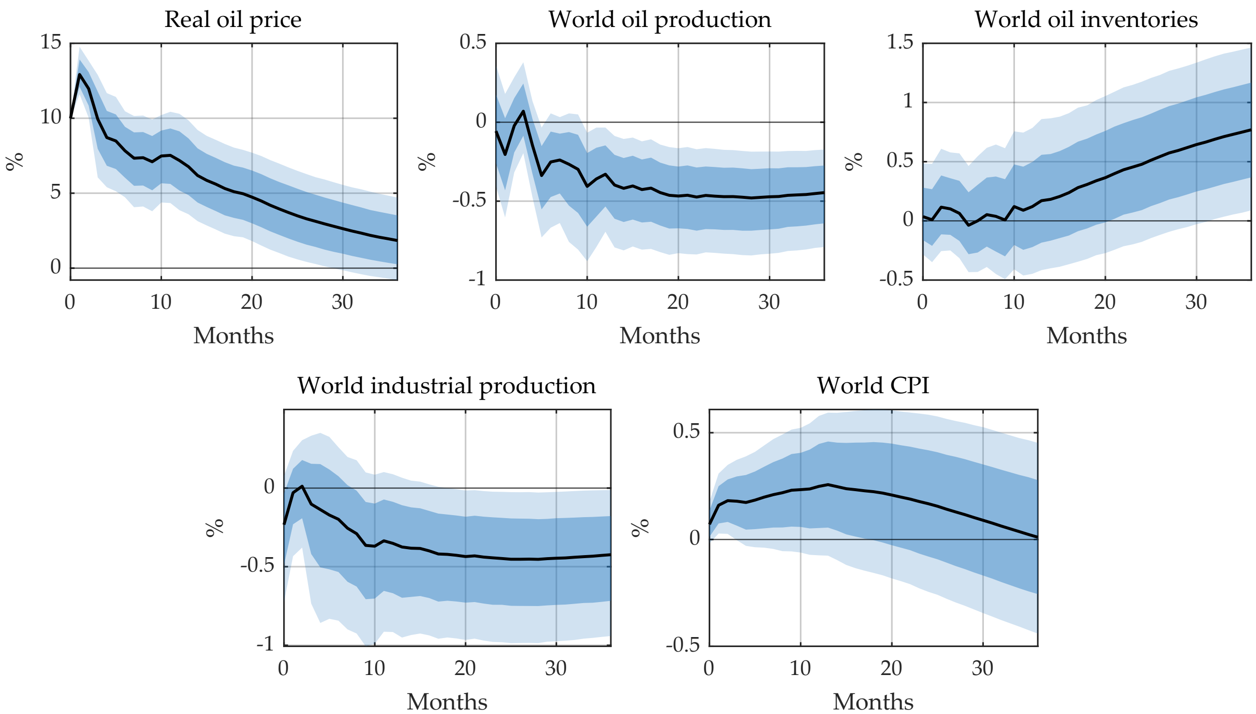
Once the impact vector has been identified, we recover the monthly oil supply news shock as

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

where $\widehat{\boldsymbol{\Sigma}}$ 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

[4] Mori and Peersman (forthcoming) show that conventional oil market VARs can suffer from non-invertibility problems and emphasize the importance of accounting for financial information. In Appendix B.3, we thus augment the model with a measure of the global financial cycle. The results turn out to be very similar.

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



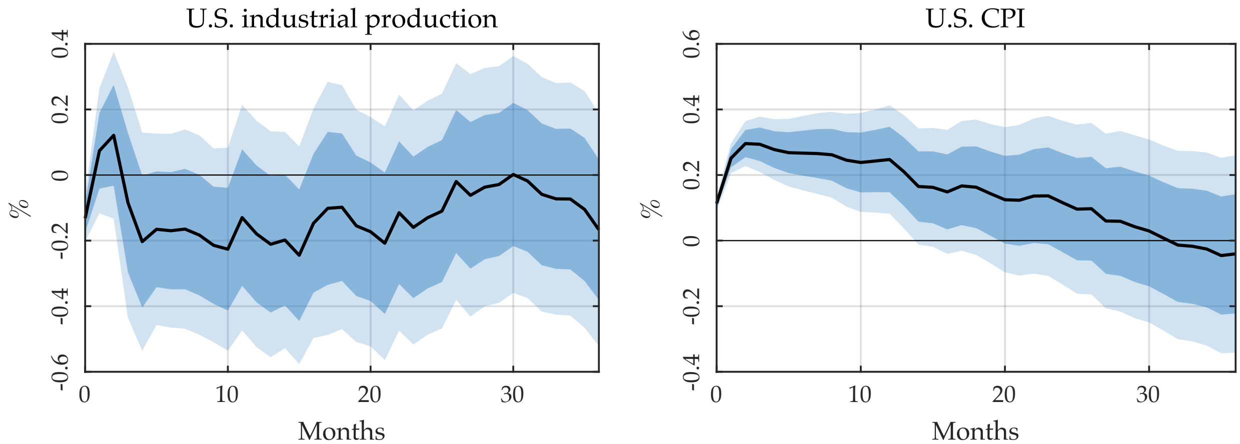
First-stage regression: robust F: 18.39, R^2: 5.31%, Adjusted R^2: 5.16%

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 March-May 2020 dummy. Dark and light shaded areas denote 68 and 90 percent confidence intervals, respectively, constructed using a moving-block bootstrap with 10,000 replications.

news about oil supply that raises the real price of oil. The series captures several prominent oil market episodes, including the collapse of OPEC discipline in the mid-1980s and Saudi Arabia's late-2014 decision to maintain production.

Figure 4 reports the global 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 18.39, exceeding conventional weak-instrument critical values (Montiel Olea and Pflueger, 2013) and indicating that OPEC surprises contain 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 the evidence in Känzig (2021).

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 1975M1–2025M12. The controls include 6 lags of the outcome, 6 lags of the five global VAR variables, a March–May 2020 dummy and the COVID factor from Stock and Watson (2025). Responses are scaled by the LP 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.

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 $\mathbf{W}_{t-1}$ include 6 lags of the outcome, the U.S. COVID factor from Stock and Watson (2025), together with the corresponding controls from the global oil market VAR: 6 lags of the five oil market variables and the March–May 2020 dummy.[5] The estimation sample is January 1975–December 2025, reflecting the availability of the VAR-extracted shock. Throughout the paper, we use the global oil supply news shock recovered from the oil market VAR as the relevant shock proxy. As documented in Appendix D.3.2, using the high-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

[5]To keep the specification parsimonious, we use six monthly lags (Montiel Olea et al., 2026). Appendix Figure D.4 shows that our results are robust to using 12 lags.

around 0.3 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.

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 analysis that allows the U.S. response to evolve flexibly over time.

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,

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

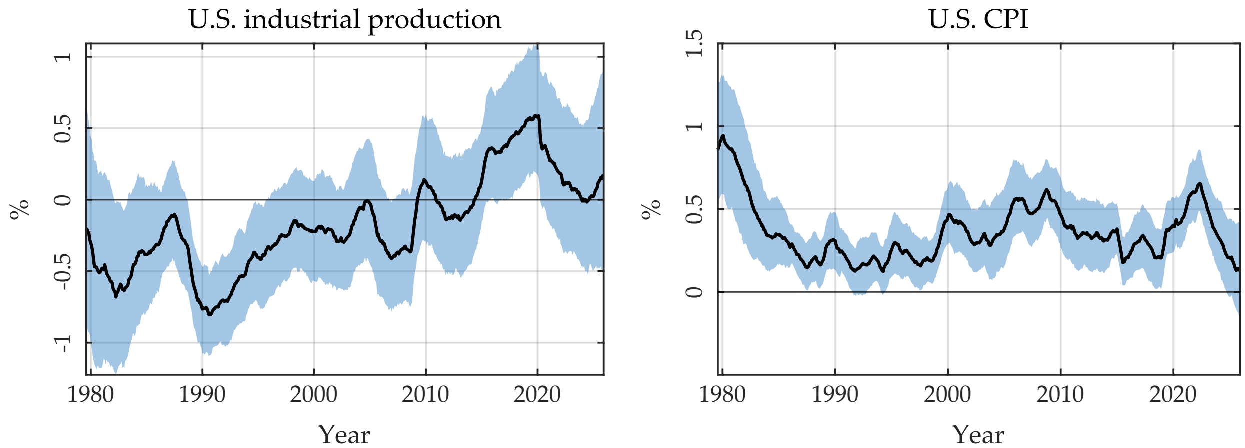
and the reduced-form covariance matrix is $\boldsymbol{\Sigma}_t = (\mathbf{A}_t \mathbf{q})(\mathbf{A}_t \mathbf{q})'$. We write $\mathbf{A}_t = \widetilde{\mathbf{A}}_t \mathbf{H}_t^{1/2}$, where $\widetilde{\mathbf{A}}_t$ is lower triangular with ones on the diagonal and $\mathbf{H}_t$ is diagonal. 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

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.

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 U.S. 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.[6] 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 follow the prior specification and Bayesian sampling algorithm of Mumtaz and Petrova (2023). The priors are centered using the training sample and favor gradual parameter variation, see Mumtaz and Petrova (2023) for details. 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 C.1, we show evidence of the convergence of the algorithm.

[6] In the baseline specification, we do not control separately for the COVID period, allowing the VAR to capture this variation. In Appendix C.2, we show robustness to residualizing the variables prior to estimation with respect to a March–May 2020 dummy and the Stock and Watson (2025) COVID factor.

Time variation in the response of the U.S. economy. For each date after the training sample, Figure 6 plots the posterior median 12-month responses of industrial production and the CPI. 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 beginning 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. Taken together, these results are broadly consistent with earlier evidence that the U.S. response to oil shocks has become more favorable with the shale boom (Bjørnland and Skretting, 2024).

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:

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

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 6 lags of the outcome variable, the Stock and Watson (2025) COVID factor, as well as the controls from the global oil market VAR. The estimation sample is January 1975–December 2025. Inference follows the lag-augmentation approach of Montiel Olea and Plagborg-Møller (2021).[7] 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

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

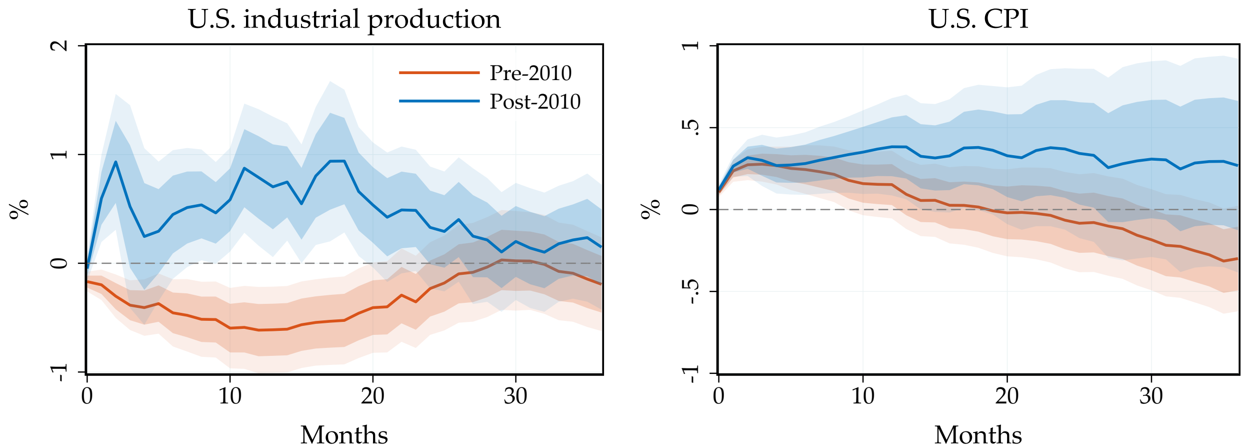
where imports and consumption are seasonally adjusted using the Census X-11 procedure. We center the ratio at its pre-2010 mean and scale it by the difference between the pre-2010 average and the 2025 average. The sign is reversed so that a one-unit increase in s_t represents moving from the average 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 petroleum trade position, $\beta_h + \gamma_h$ is the response at the 2025 trade position, and γ_h is the change in the response associated with moving from the former to the latter.

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 from January 2010 onward. Figure 7 reports the results. Before 2010, an adverse oil supply news shock produces a persistent contraction in industrial production, reaching roughly -0.6 percent after a year. From 2010 onward, the point estimate instead becomes positive over most horizons and reaches almost +1 percent at its peak. Both the pre-2010 contraction and the post-2010 expansion are economically large and statistically significant over a range of horizons. This contrast 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 with weaker demand pressures as the contraction in real activity takes hold.

[7] The baseline confidence bands treat the extracted oil supply news shock as observed and therefore do not incorporate its estimation uncertainty. Appendix Figure D.13 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 1975M1–2025M12. The controls include 6 lags of the outcome, 6 lags of the five global VAR variables, an indicator for the pre-2010 period, a March-May 2020 dummy, and the COVID factor from Stock and Watson (2025). 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.

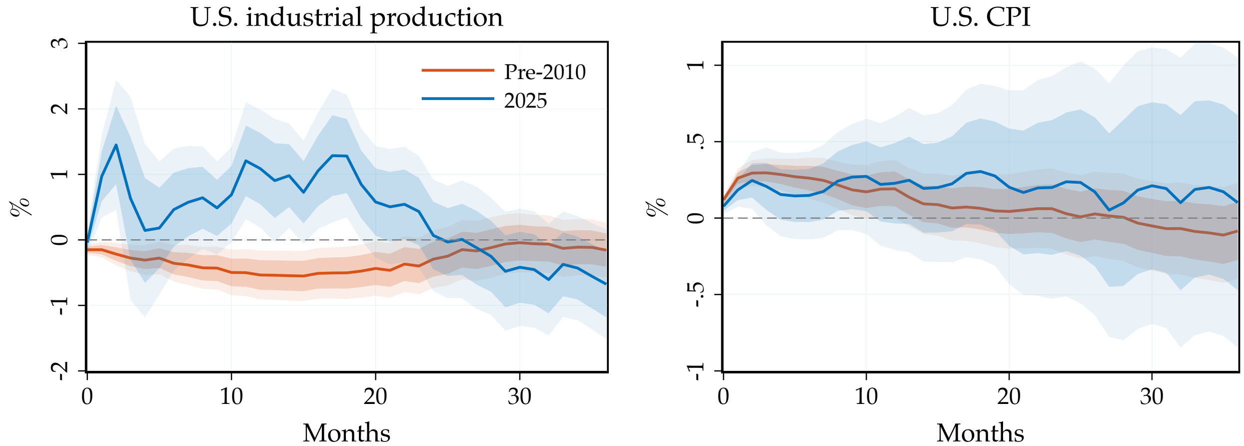
The role of the petroleum-trade position. The continuous specification ties the change more directly to the economic transformation documented in Figure 2. Figure 8 reports the responses at the average pre-2010 and 2025 petroleum trade positions, together with the interaction effect, γ_h, associated with moving from the former to the latter.

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. This change is statistically significant at the 10 percent level for most horizons up to two years. In contrast, the CPI interaction is small and statistically indistinguishable from zero at nearly all horizons. Appendix Figure D.15 traces the implied responses at historical annual-average petroleum trade positions: the contraction in industrial production weakens as net import dependence declines after 2010, and the response turns positive at short and medium horizons toward the end of the sample. 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.

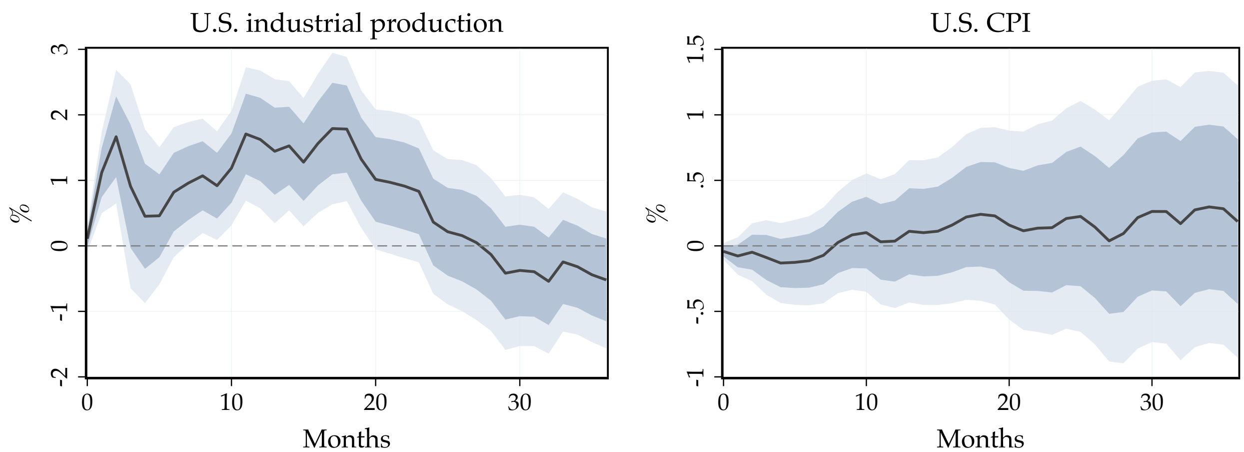
To connect these results to the motivating evidence in Figures 1-2, we study how the labor-market responses vary with the U.S. petroleum trade position. Figure 9 shows that, at the average pre-2010 trade position, an adverse oil supply news shock lowers payroll employment by about 0.25 percent and raises the unemployment rate by roughly 0.2

Figure 8: Responses conditional on petroleum trade position

(a) Effect at pre-2010 and 2025 means



(b) Interaction effect with exporter status

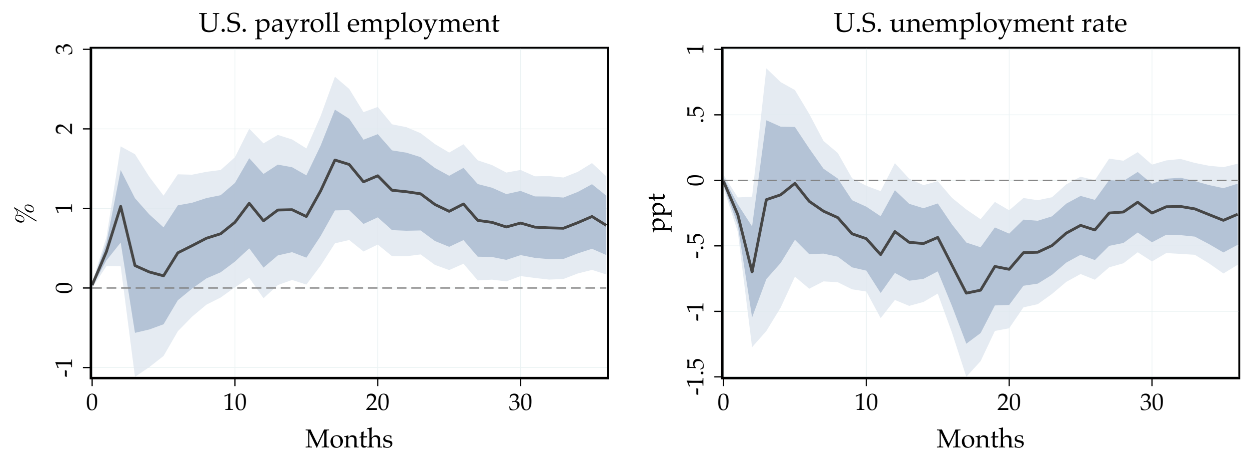


Notes: Impulse responses of U.S. industrial production and the CPI to an adverse oil supply news shock, estimated using the state-dependent local projections (8). The top row reports the effect at the average pre-2010 and at the average 2025 U.S. petroleum trade position; the bottom row reports the change 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 1975M1–2025M12. The controls include 6 lags of the outcome, 6 lags of the five global VAR variables, the net petroleum imports-to-petroleum-consumption ratio, a March–May 2020 dummy, and the COVID factor from Stock and Watson (2025). Responses are scaled such that the real oil price rises by 10 percent on impact in the average pre-2010 state. Dark and light shaded areas denote 68 and 90 percent confidence intervals based on the lag-augmentation approach.

Figure 9: Labor market responses conditional on petroleum trade position

(a) Effect at pre-2010 and 2025 means

(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 effect at the average pre-2010 and at the average 2025 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 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.

percentage points. Moving from the pre-2010 trade position to the 2025 exporter position substantially alters the labor-market effects of the shock: the employment interaction peaks around 1.5 percent after about 18 months, while the unemployment-rate interaction reaches approximately -0.9 percentage points, implying a reversal of both responses at the 2025 trade position. Although the estimates are imprecise at some horizons, the medium-run pattern indicates a substantial improvement in labor-market outcomes as the United States moves toward exporter status. This helps rationalize the motivating observation that recent oil market disruptions have no longer been followed by the sharp increases in unemployment that characterized earlier episodes.

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 and a continuing shift toward services (see e.g. Känzig and Williamson, 2025). The shale era also largely coincided with the zero lower bound period, which has itself been shown to alter the propagation of oil shocks (Miyamoto, Nguyen, and Sergeyev, 2026). To address this concern, we re-estimate equation (8), retaining our baseline interaction with the petroleum trade position while adding, one at a time, each alternative variable and its interaction with the oil supply news shock.

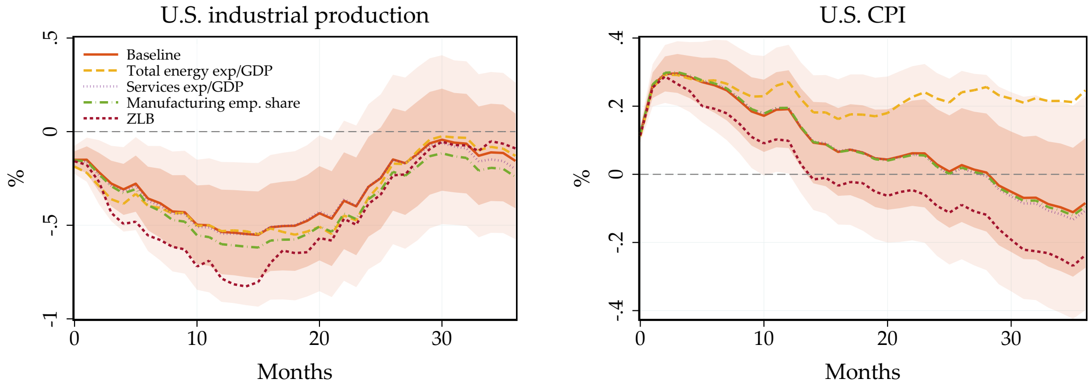
Figure 10 shows that the interaction with the petroleum trade position is essentially unchanged across specifications. In each case, moving toward exporter status continues to produce a large positive interaction for industrial production, while the CPI interaction remains close to zero. The implied responses at the pre-2010 and 2025 trade positions are also generally very similar to the baseline. The main exception is the CPI response when controlling for total energy expenditures, which becomes more persistent. Overall, the results suggest that the changing transmission of oil shocks associated with the petroleum trade position is not driven by these alternative structural changes or the ZLB period. Although these exercises cannot rule out every contemporaneous change in the U.S. economy, they indicate that the petroleum trade position contains information beyond several leading alternative explanations.

The results are also robust to a range of specification and sample choices. Appendix Figure D.6 shows that the results are robust to using net import levels instead of the imports-to-consumption ratio and to measuring the trade position using the crude oil balance rather than the broader petroleum balance. We further show that the main findings are essentially unchanged when we expand the set of U.S. controls in the local projections, include additional lags, or vary the start date of the estimation sample (see Appendix Figures D.3–D.5).

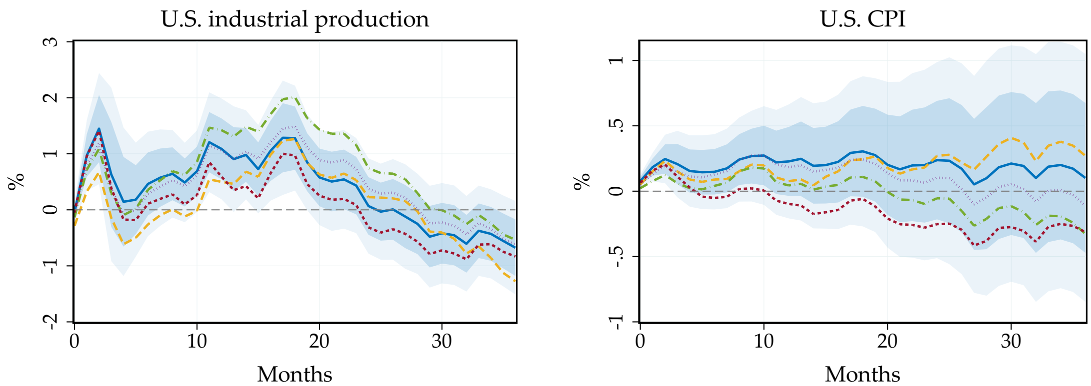
Another concern is that the global propagation of oil shocks may itself have changed over time. Our baseline shock measure is extracted from a constant-parameter global oil market model and imposes a stable mapping from OPEC surprises into the global oil supply news shock. If this mapping evolved over time, part of the apparent change in U.S. transmission could reflect changes in the shock itself rather than in its propagation through the U.S. economy. Reassuringly, Bjørnland and Skretting (2024) find no compa-

Figure 10: Petroleum-trade results controlling for other structural changes

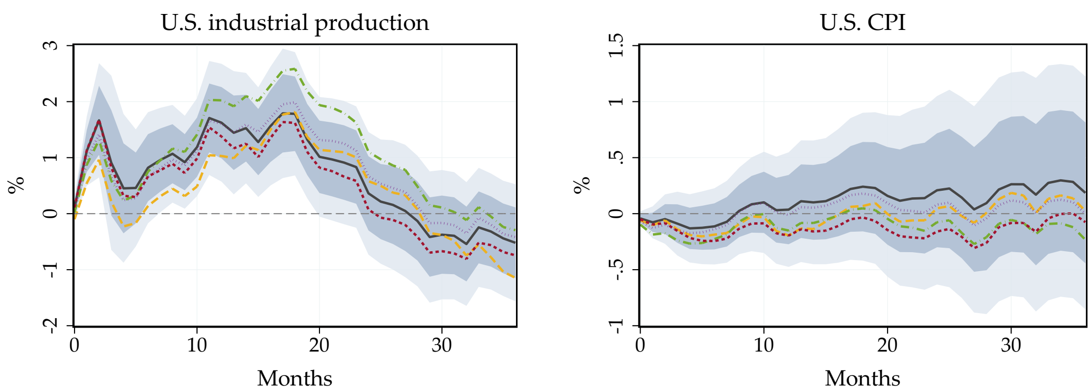
(a) Base effect at pre-2010 mean



(b) Effect at 2025 mean



(c) Interaction effect with exporter status



Notes: Sensitivity of the industrial production and CPI responses to controlling for additional interactions in the state-dependent local projections (8). 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 total energy expenditures, services expenditures, the manufacturing employment share, or the zero lower bound period. The first three variables are centered around the sample mean, while the ZLB indicator equals one when the federal funds rate is at or below 0.5 percent (Miyamoto, Nguyen, and Sergeyev, 2026). 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 1975M1–2025M12.

rable improvement in the response of the U.K. economy over time, where the petroleum trade balance has remained relatively stable.

To address this concern more formally, we re-estimate the state-dependent local projections using the high-frequency OPEC surprises directly rather than the oil supply news shock extracted from the global VAR. This specification bypasses the constant-parameter global oil market model. Appendix D.3.2 shows that the results are qualitatively unchanged: the industrial-production response becomes substantially more favorable as the United States moves toward exporter status, while the CPI results remain broadly similar. The estimates are less precise, reflecting the limited power of the high-frequency surprises, but the central conclusion is unchanged.

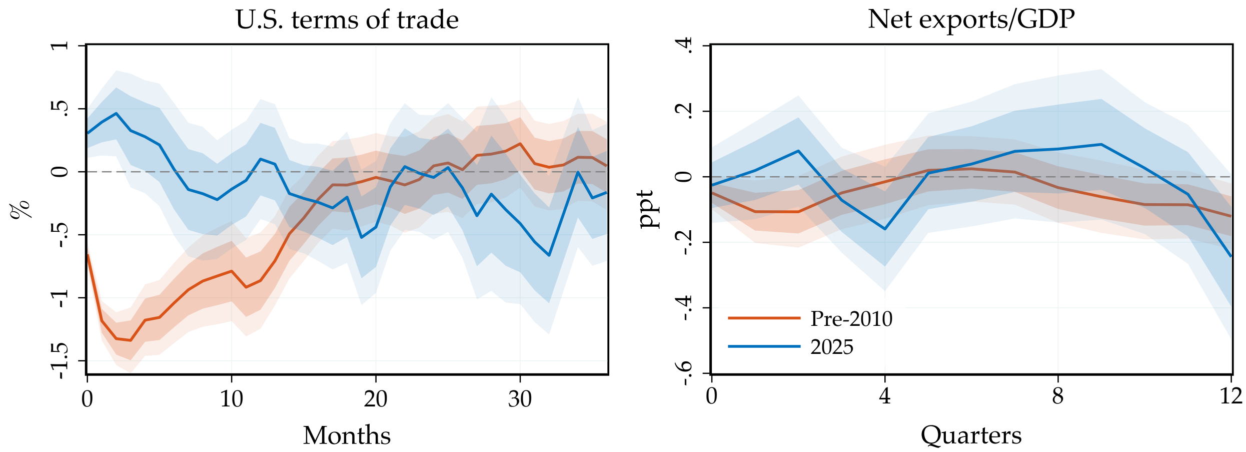
Finally, we examine whether our findings are sensitive to the choice of oil shock measure. We consider two alternatives: the nonlinear oil price shock of Hamilton (1996) and the oil supply shock of Baumeister and Hamilton (2019), identified from a Bayesian structural VAR of the global oil market using informative priors on the short-run elasticities of oil supply and demand. Appendix D.3.3 shows that the qualitative result is robust across both measures: moving toward exporter status substantially improves the activity response and is sufficient to generate an expansion. With the Baumeister and Hamilton (2019) shock, the expansion is quantitatively larger and accompanied by a stronger increase in prices.

5. Mechanisms

The above estimates establish a close connection between the U.S. petroleum trade balance and the propagation of oil shocks. In this section, we consider five potential mechanisms that could explain this change: a direct net export accounting effect, a regional shift in which the benefits to oil producing states increasingly outweigh the disadvantages to other states, a sectoral shift in which benefits to the fossil fuel industry increasingly outweigh disadvantages to other sectors, changes in monetary policy, and a general-equilibrium effect mediated through income and wealth effects. These mechanisms are not mutually exclusive. While several of these channels appear to play some role, the evidence points to the general-equilibrium income and wealth channel as the dominant mechanism.

Before turning to these mechanisms, we show that the real oil price response itself is similar across petroleum trade positions (see Appendix Figure D.14). Thus, the changing macroeconomic effects do not appear to be driven by different oil price dynamics across states.

Figure 11: Terms of trade and aggregate net exports



Notes: Impulse responses of U.S. terms of trade and net exports to an adverse oil supply news shock, estimated using monthly and quarterly state-dependent local projections (8), respectively. For the quarterly LP, we sum 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.

The direct net export effect. Becoming a net petroleum exporter changes the direct trade consequences of higher oil prices. When the United States is a large petroleum importer, an oil price increase worsens its terms of trade; as it moves toward exporter status, this effect should attenuate and eventually reverse. A more favorable terms-of-trade response, however, need not translate one-for-one into higher aggregate net exports, which also depend on trade quantities and the response of non-oil exports and imports. We therefore examine both the U.S. terms of trade and aggregate net exports relative to GDP.[8]

Figure 11 shows a striking reversal in the terms-of-trade response. At the average pre-2010 trade position, an adverse oil supply news shock produces a sizable deterioration in the U.S. terms of trade. At the 2025 exporter position, the response instead becomes positive at short horizons. The direct relative-price consequences of an oil price increase thus flip as the United States moves from importer to exporter status. By contrast, the response of aggregate net exports is small. During the first two quarters, net exports decline slightly as a share of GDP at the pre-2010 trade position, whereas the implied response at the 2025 position is modestly positive. At subsequent horizons, both responses fluctuate around zero. The changing macroeconomic response therefore cannot be attributed

[8] Because the national-accounts measures of exports, imports, and GDP used here are available only at the quarterly frequency, we aggregate the monthly oil supply news shock within each quarter and estimate the local projections at the quarterly frequency.

primarily to a mechanical increase in aggregate net exports, despite the pronounced improvement in the terms of trade.

The regional shift hypothesis. Another potential explanation is a regional shift, in which high oil prices increasingly benefit oil-producing states while continuing to have the same negative effect on non-oil-producing states as in the past. This hypothesis is examined in Figure 12, which shows impulse responses for total and sectoral employment in oil-producing and non-oil-producing states, estimated from a panel of U.S. states using continuous-interaction local projections. It is true that the response of mining employment in oil-producing states now peaks at three times what it did pre-2010. That said, employment in non-mining sectors rises in both producing and non-producing states by nearly the same amount, suggesting that the regional shift hypothesis is not a major component.

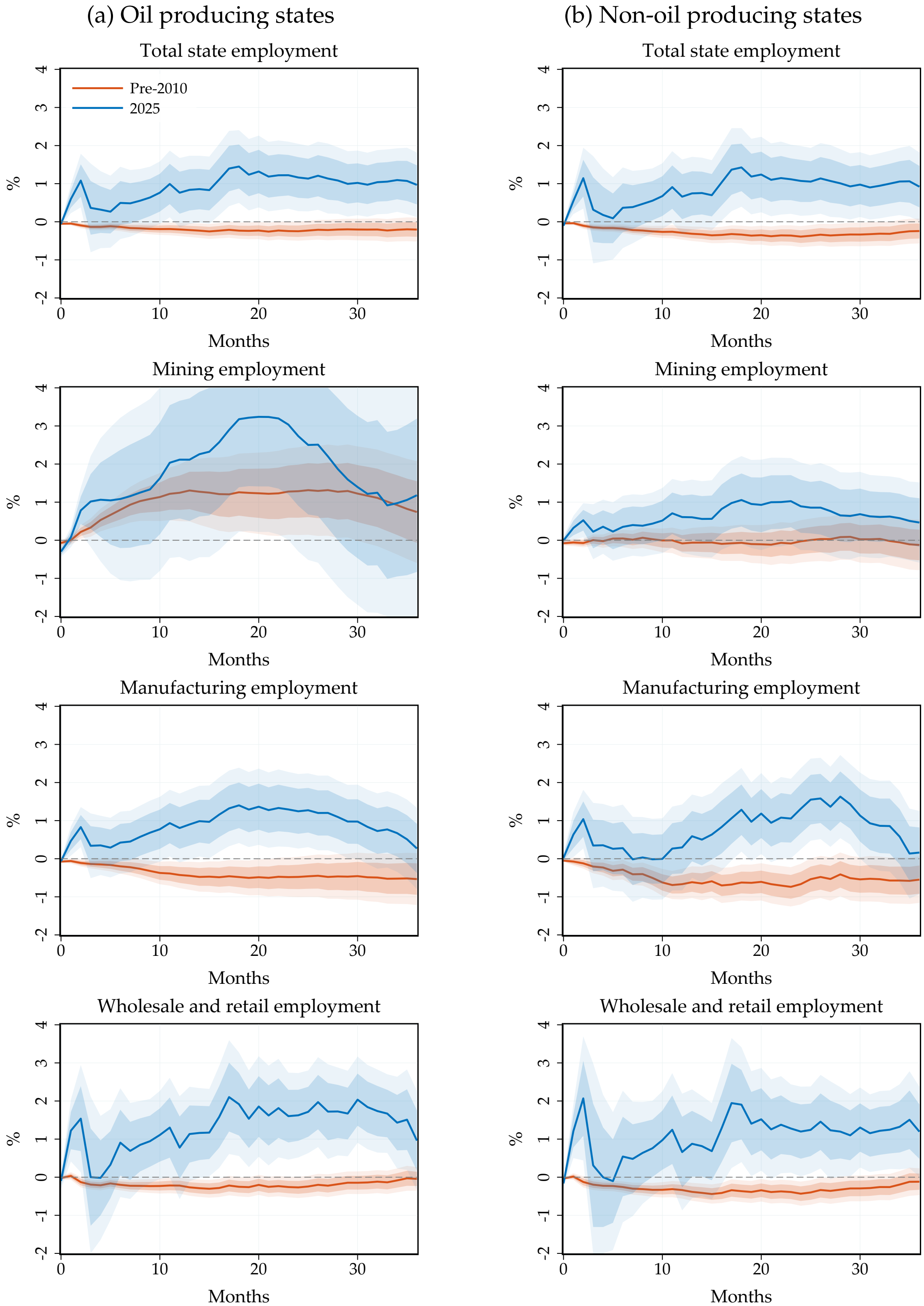
The sectoral shift hypothesis. A related potential explanation is that, at the higher levels of oil production reached during the shale era, the gains to the oil and gas sector from higher oil prices outweigh the negative effect of the shock on other sectors, particularly those dependent on consumer purchases and those most negatively impacted by higher gasoline and diesel prices.

This hypothesis is investigated in Figure 13, which shows sectoral employment responses to the oil shock estimated using continuous-interaction local projections. Three observations emerge. First, employment in oil and gas extraction already responded positively to an oil shock pre-2010, but this response becomes substantially larger at the 2025 exporter position. Second, while the oil shock depressed employment in most other sectors at the pre-2010 trade position, at the 2025 exporter position it generates a broad-based labor-market expansion, raising employment across nearly all sectors, including construction, manufacturing, services, and financial activities. Third, the sectors that exhibit little change—such as education and health care, and government—are those in which one would expect oil shocks to have limited effects.

We find a similar pattern for sectoral industrial production. Figure 14 shows that the response becomes markedly more favorable at the 2025 trade position in manufacturing, business equipment, durable goods, and materials, all of which contract at the pre-2010 position but expand over much of the horizon at the 2025 position. By contrast, non-durable goods and fuels display smaller or less systematic changes.[9] Taken together, these

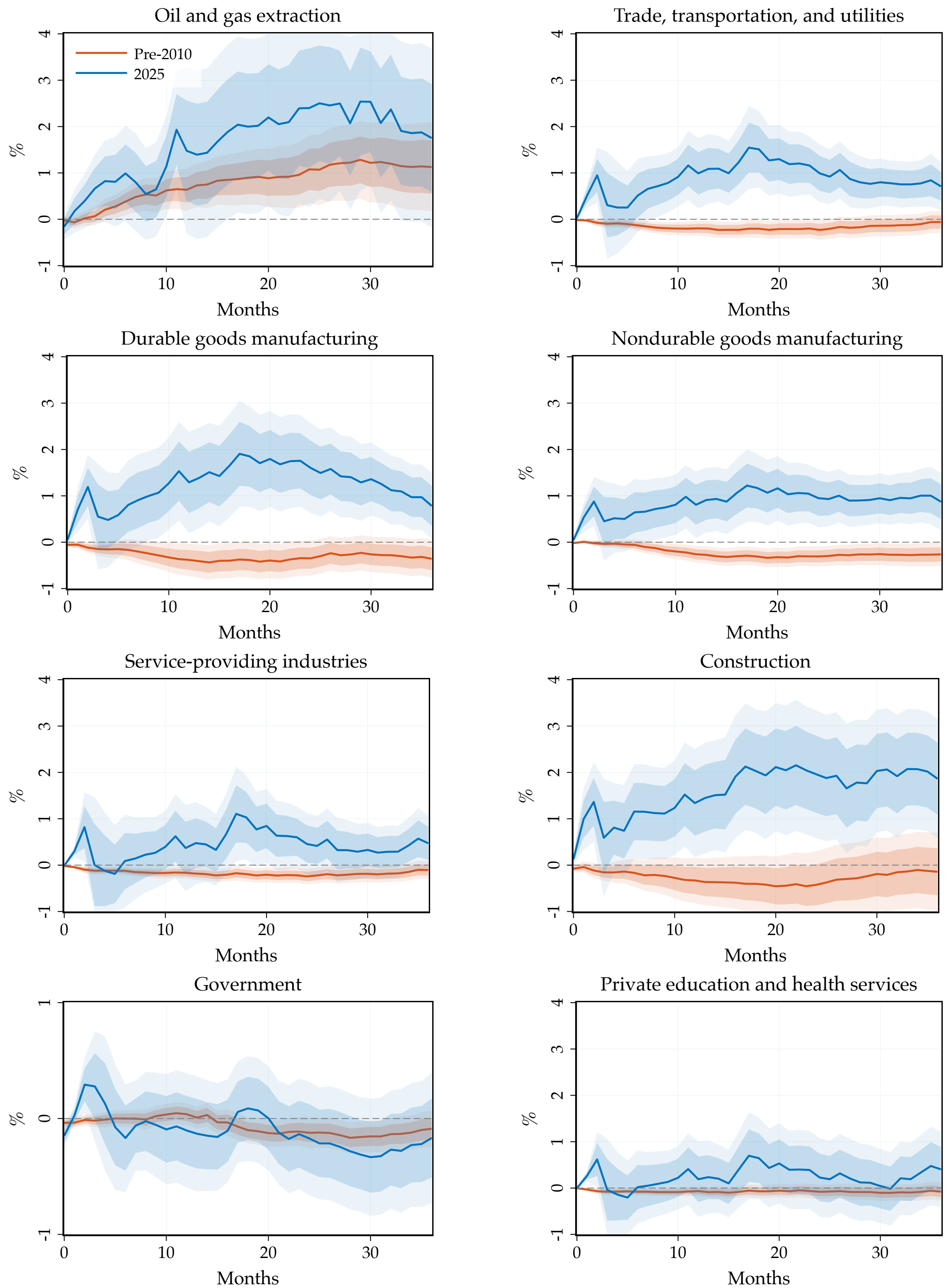
[9] Appendix D.5.3 presents additional sectoral results, including employment responses in retail trade and financial activities, as well as disaggregated consumption responses.

Figure 12: Employment responses by state



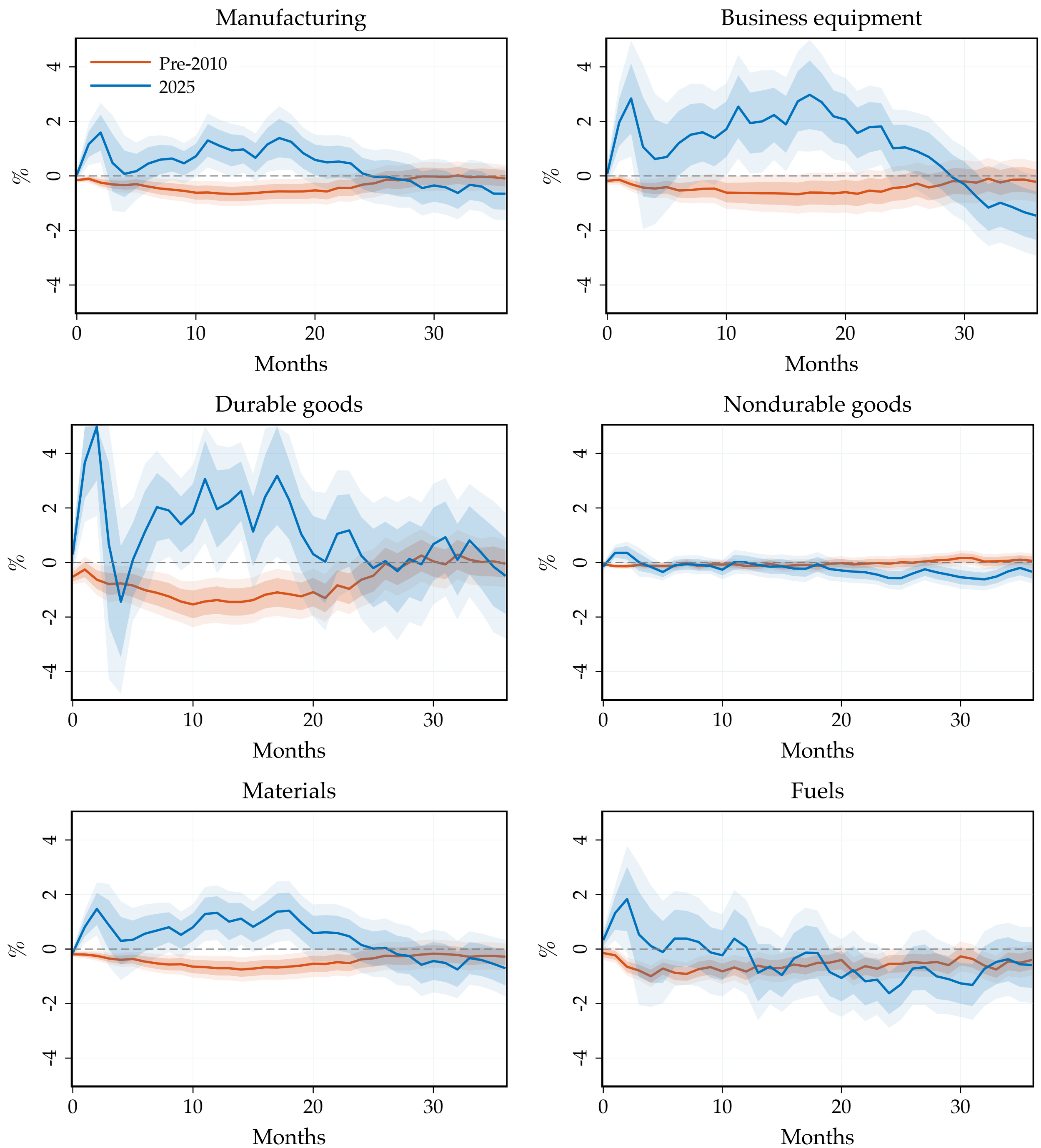
Notes: Impulse responses for employment in oil- and non-oil-producing states, defined as in Bjørnland and Skretting (2024), estimated using state-dependent local projections on a panel of U.S. states. The specification follows Figure 8 and includes state fixed effects. The sample spans 1975M1–2025M6. Dark and light shaded areas denote 68 and 90 percent confidence intervals, respectively, based on standard errors clustered by time.

Figure 13: Employment responses by sector



Notes: Impulse responses of sectoral employment to an adverse oil supply news shock, estimated using (8). Every panel reports the effect at the average pre-2010 and at the average 2025 U.S. petroleum trade position. 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.

Figure 14: Industrial production responses by sector

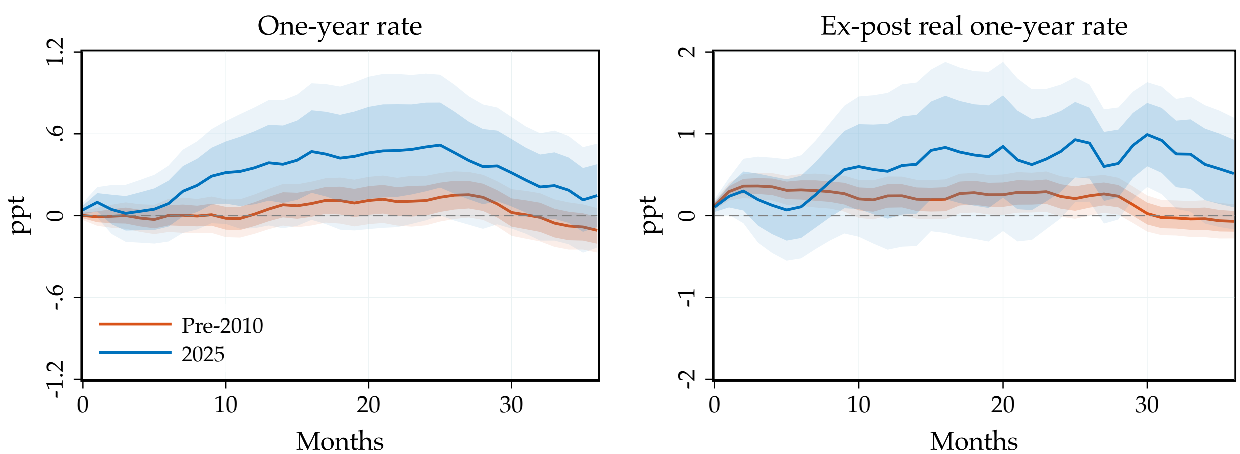


Notes: Impulse responses of sectoral production to an adverse oil supply news shock, estimated using (8). Every panel reports the effect at the average pre-2010 and at the average 2025 U.S. petroleum trade position. The specification, sample, and normalization follow Figure 8. Dark and light shaded areas denote 68 and 90 percent confidence intervals based on the lag-augmentation approach.

results reinforce the conclusion that the changing transmission is broad-based rather than confined to the oil sector.

Monetary policy and the output-inflation trade-off. An influential literature argues that part of the contractionary effect of oil shocks arises from the endogenous monetary policy response to the resulting inflationary pressure (Bernanke et al., 1997; Leduc and Sill, 2004). We therefore ask whether changes in monetary policy can account for the changing U.S. response to oil shocks. Following Gertler and Karadi (2015), we use the one-year Treasury rate as a measure of the monetary policy stance and additionally consider the ex-post real one-year rate.

Figure 15: The monetary policy response



Notes: Impulse responses of the one-year Treasury rate and the ex-post real one-year rate to an adverse oil supply news shock, estimated using (8). Both panels report the response at the average pre-2010 and at the average 2025 U.S. petroleum trade position. 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.

Figure 15 shows that monetary policy, if anything, responds more forcefully as the United States moves toward exporter status. At the pre-2010 trade position, the one-year rate rises only modestly, whereas at the 2025 position it increases substantially more. The same pattern is even more pronounced for the ex-post real rate. Thus, the reversal in the activity response cannot be explained by a more accommodative monetary policy response in the exporter state. Instead, together with Figure 8, the results are consistent with a more favorable stabilization trade-off: output responds more positively while inflation changes relatively little, allowing monetary policy to tighten more rather than cushioning a contraction.

Income and wealth effects. The reversal in the terms-of-trade response documented above provides a natural source of broader income gains. When the United States is a large petroleum importer, higher oil prices reduce domestic purchasing power by raising the cost of imported energy. As the United States moves toward exporter status, this effect attenuates and eventually reverses: higher oil prices improve the terms of trade and more of the associated rents accrue domestically through profits, wages, investment, tax revenues, and demand for intermediate inputs. These gains can support spending and activity well beyond the oil sector (see e.g. Auclert et al., 2024).

Figure 16 provides evidence consistent with this channel. At the pre-2010 trade position, an adverse oil supply news shock reduces real personal consumption expenditures, whereas at the 2025 exporter position the response becomes positive. The improvement in consumption is concentrated in spending on goods and services other than energy. Panel a shows that real PCE excluding food and energy rises persistently at the 2025 trade position, while the response of real consumption of energy goods and services changes much less and remains comparatively muted. Thus, the more favorable aggregate consumption response reflects broader household spending rather than simply greater consumption of energy.

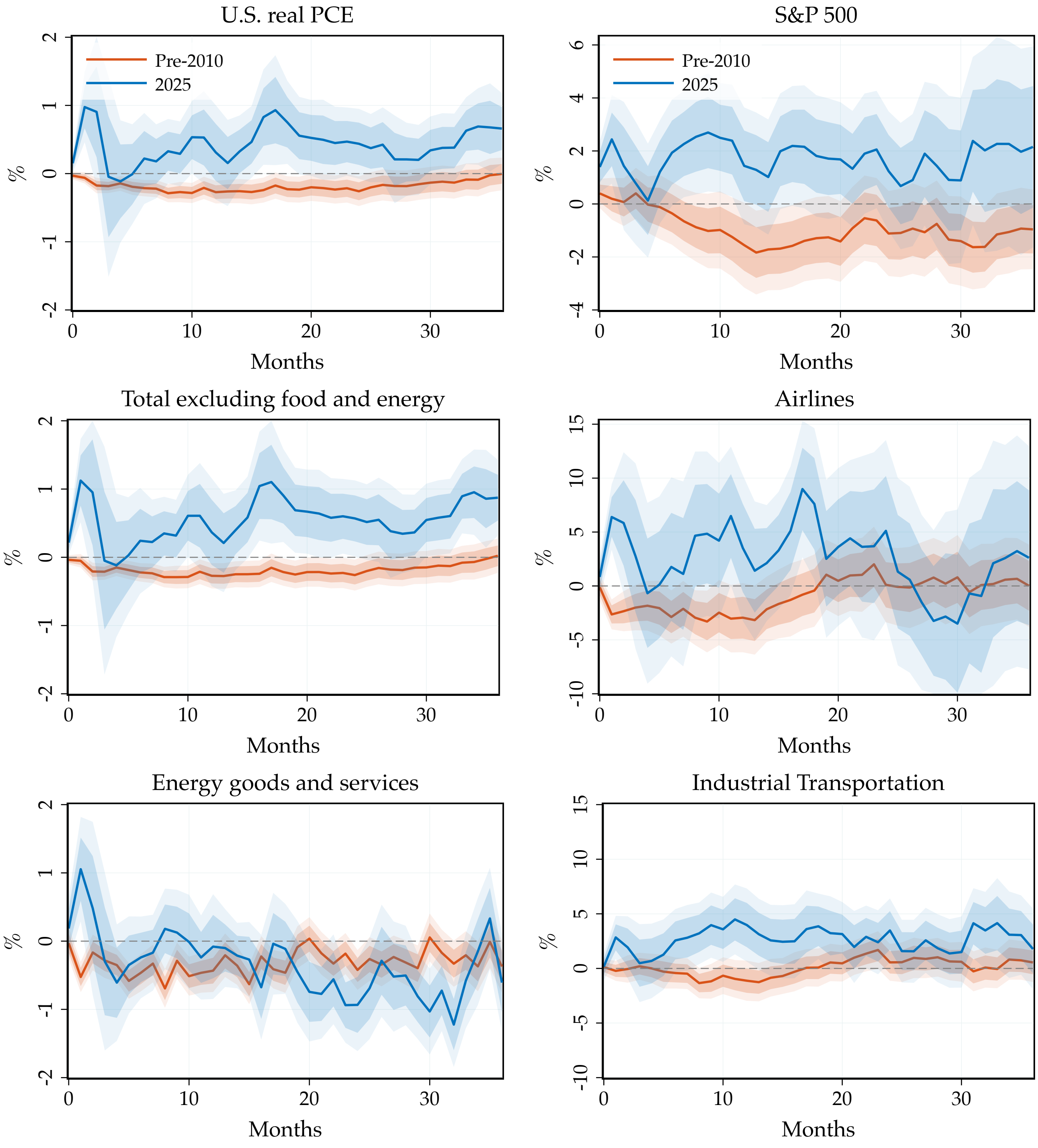
Equity valuations point to an additional wealth channel. At the pre-2010 trade position, the shock lowers the S&P 500, whereas at the 2025 exporter position the equity response becomes positive, peaking at around 2 percent. Moving between the two trade positions improves the S&P 500 response by roughly 3–4 percentage points at horizons near one year. This increase in equity values raises household financial wealth and can itself support consumption.

The magnitude of the equity response is also economically meaningful for consumption. For a simple back-of-the-envelope calculation, we use the annual marginal propensity to consume out of stock-market wealth estimated by Chodorow-Reich, Nenov, and Simsek (2021): 3.2 cents per dollar. In 2025, U.S. household and nonprofit equity and mutual-fund wealth was about 3.2 times annual PCE. A 2 percent increase in equity valuations would therefore imply an increase in consumption of roughly 0.2 percent ($0.032 \times 3.2 \times 0.02$). While this calculation is only illustrative, it suggests that the stock-market wealth effect alone could account for a meaningful part of the more favorable consumption response.

Finally, the improvement in equity valuations is not confined to oil producers. Panel b also reports the responses of airline and industrial transportation stocks—two industries that are directly exposed to higher energy costs. At the pre-2010 trade position, their valuations decline following an adverse oil supply shock. At the 2025 position, both

Figure 16: Consumption and equity valuations

(a) Consumption: aggregate & selected parts (b) Stock prices: aggregate & selected industries



Notes: Impulse responses to an adverse oil supply news shock estimated using (8). Column (a) reports the responses of aggregate real PCE and selected components. Column (b) shows the responses of the S&P 500 and selected sectoral stock price indices. Each panel reports the effect at the average pre-2010 and 2025 U.S. petroleum trade positions. 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.

responses become substantially more favorable over the first 18 months, despite these firms being intensive users rather than producers of energy. This pattern is difficult to reconcile with a narrow sectoral reallocation mechanism and instead points to income, demand, and wealth spillovers operating in general equilibrium.

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 $\mathbf{g}$. 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:

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

The recovered shock sequence is shown in Appendix Figure E.1. 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 one-year rate at the average petroleum trade positions observed in the pre-2010 period and in 2021. 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

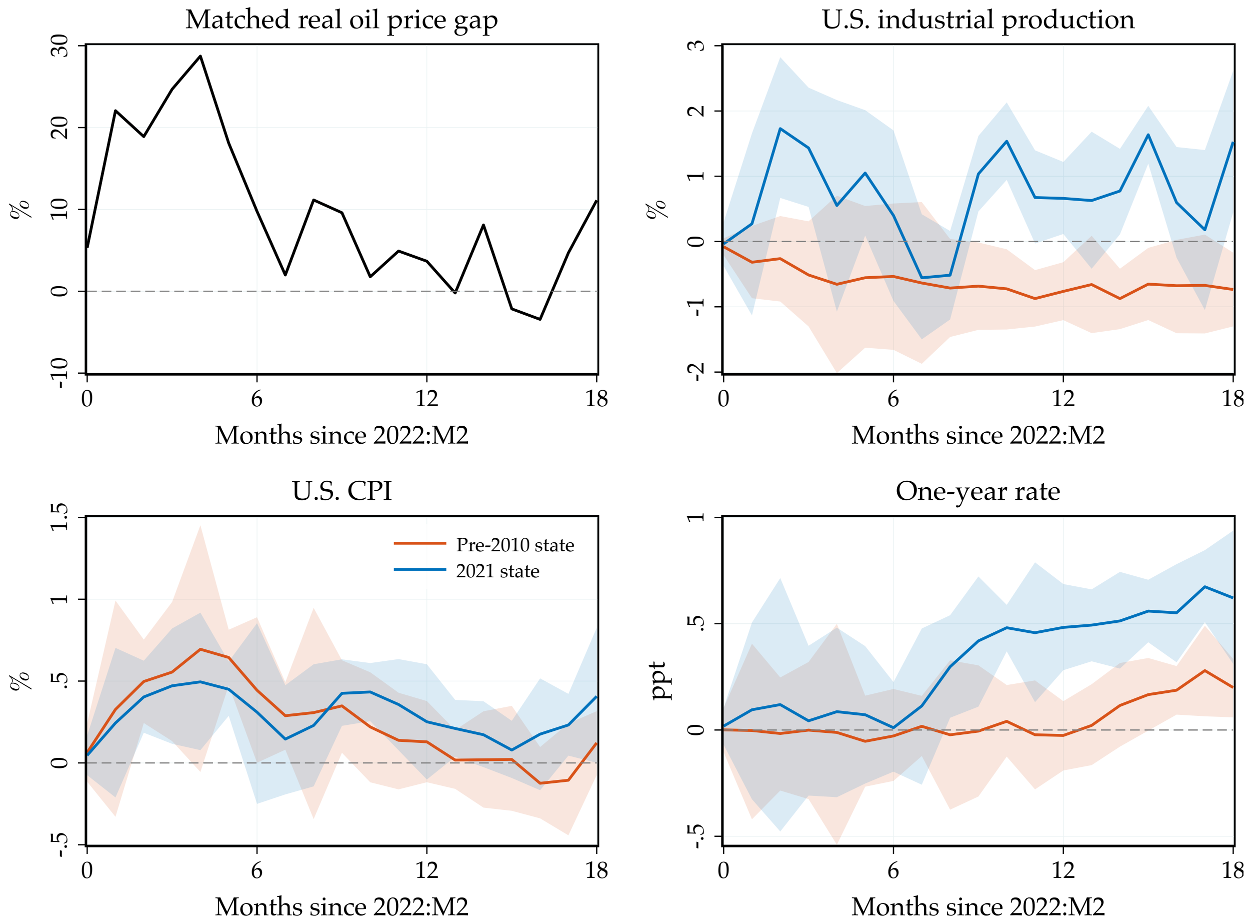
$$\widehat{\mathbf{y}}(s) = \mathbf{\Theta}^y(s)\widehat{\boldsymbol{\epsilon}}. \tag{11}$$

We conduct the exercise through an 18-month horizon, from February 2022 to August 2023. Confidence intervals reflect uncertainty in the state-dependent response paths, while treating the recovered common shock sequence as fixed.[10]

Figure 17 shows the results. The matched real oil price gap peaks near 30 percent and

[10] 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 17: 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 the pre-2010 period and in 2021. 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 one-year 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.

remains positive through much of the horizon. Under the average pre-2010 trade position, the episode would have lowered industrial production by around 1 percent. Under the 2021 trade position, the central estimate instead implies an expansion in excess of one percent at longer horizons. The CPI response is somewhat smaller initially but more persistent under the 2021 trade position. The monetary policy response is also substantially more forceful: the one-year rate rises substantially under the 2021 trade position, whereas it remains close to zero for much of the horizon under the pre-2010 position. The contrast provides an economically coherent 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 more favorable while producing little additional CPI pressure.

The mechanism extends beyond a mechanical effect on net exports or a narrow regional or sectoral shift. Instead, the evidence points to broad-based income and wealth effects. As the U.S. terms of trade improve, more of the gains from higher oil prices accrue domestically, supporting household spending, equity valuations, and activity across regions and sectors. Even the valuations of firms that are intensive users of energy respond more favorably. Monetary policy also appears to respond somewhat more forcefully. Together, these general-equilibrium effects help explain why the oil price increase surrounding Russia's invasion of Ukraine has had very different implications than 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 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.

References

Alessandri, Piergiorgio and Gazzani, Andrea (2025). "Natural Gas and the Macroeconomy: Not All Energy Shocks Are Alike". *Journal of Monetary Economics* 151, p. 103749.

Alsalman, Zeina and Rangaraju, Sandeep K. (2026). "The Macroeconomic Effects of Oil Shocks in the Oil and Non-Oil Producing States". *The Energy Journal* 47.2, pp. 255–288.

Auclert, Adrien, Monnery, Hugo, Rognlie, Matthew, and Straub, Ludwig (2024). "Managing an Energy Shock: Fiscal and Monetary Policy". *Heterogeneity in Macroeconomics: Implications for Monetary Policy*, pp. 39–108.

Bauer, Michael D. and Swanson, Eric T. (2023a). "A Reassessment of Monetary Policy Surprises and High-Frequency Identification". *NBER Macroeconomics Annual* 37.1, pp. 87–155.

— (2023b). "An Alternative Explanation for the "Fed Information Effect"". *American Economic Review* 113.3, pp. 664–700.

Baumeister, Christiane (2023). "Measuring Market Expectations". *Handbook of Economic Expectations*, pp. 413–441.

Baumeister, Christiane and Hamilton, James D. (2019). "Structural Interpretation of Vector Autoregressions with Incomplete Identification: Revisiting the Role of Oil Supply and Demand Shocks". *American Economic Review* 109.5, pp. 1873–1910.

Baumeister, Christiane and Kilian, Lutz (2016). "Lower Oil Prices and the US Economy: Is This Time Different?" *Brookings Papers on Economic Activity* 2016.2, pp. 287–357.

Baumeister, Christiane and Peersman, Gert (2013). "Time-Varying Effects of Oil Supply Shocks on the US Economy". *American Economic Journal: Macroeconomics* 5.4, pp. 1–28.

Bernanke, Ben S., Gertler, Mark, Watson, Mark, Sims, Christopher A., and Friedman, Benjamin M. (1997). "Systematic Monetary Policy and the Effects of Oil Price Shocks". *Brookings Papers on Economic Activity* 1997.1, pp. 91–157.

Bjørnland, Hilde C. and Skretting, Julia (2024). "The Shale Oil Boom and the US Economy: Spillovers and Time-Varying Effects". *Journal of Applied Econometrics* 39.6, pp. 1000–1020.

Blanchard, Olivier J. and Galí, Jordi (2010). "The Macroeconomic Effects of Oil Price Shocks: Why Are the 2000s So Different from the 1970s?" *International Dimensions of Monetary Policy*, pp. 373–428.

Chodorow-Reich, Gabriel, Nenov, Plamen T., and Simsek, Alp (2021). "Stock Market Wealth and the Real Economy: A Local Labor Market Approach". *American Economic Review* 111.5, pp. 1613–1657.

Colombo, Daniele and Toni, Francesco (2025). “Gas Prices and the Macroeconomy”. *Working Paper*.

De Michelis, Andrea, Ferreira, Thiago R. T., and Iacoviello, Matteo (2020). “Oil Prices and Consumption across Countries and US States”. *International Journal of Central Banking* 16.2, pp. 3–43.

Degasperi, Riccardo (2025). “Identification of Expectational Shocks in the Oil Market Using OPEC Announcements”. *Working Paper*.

— (2026). “Barrels of Trouble: The Change in Correlation between Oil and the Dollar”. *Working Paper*.

Gertler, Mark and Karadi, Peter (2015). “Monetary Policy Surprises, Credit Costs, and Economic Activity”. *American Economic Journal: Macroeconomics* 7.1, pp. 44–76.

Hamilton, James D. (1983). “Oil and the Macroeconomy since World War II”. *Journal of Political Economy* 91.2, pp. 228–248.

— (1996). “This Is What Happened to the Oil Price-Macroeconomy Relationship”. *Journal of Monetary Economics* 38.2, pp. 215–220.

Jordà, Òscar (2005). “Estimation and Inference of Impulse Responses by Local Projections”. *American Economic Review* 95.1, pp. 161–182.

Känzig, Diego R. (2021). “The Macroeconomic Effects of Oil Supply News: Evidence from OPEC Announcements”. *American Economic Review* 111.4, pp. 1092–1125.

Känzig, Diego R. and Williamson, Charles T. (2025). “Unraveling the Drivers of Energy-Saving Technical Change”. *NBER Working Paper 34511*.

Karaki, Mohamad B. (2018). “Oil Prices and State Unemployment Rates”. *The Energy Journal* 39.3, pp. 25–50.

Kilian, Lutz (2009). “Not All Oil Price Shocks Are Alike: Disentangling Demand and Supply Shocks in the Crude Oil Market”. *American Economic Review* 99.3, pp. 1053–1069.

— (2024). “How to Construct Monthly VAR Proxies Based on Daily Surprises in Futures Markets”. *Journal of Economic Dynamics and Control* 168, p. 104966.

Leduc, Sylvain and Sill, Keith (2004). “A Quantitative Analysis of Oil-Price Shocks, Systematic Monetary Policy, and Economic Downturns”. *Journal of Monetary Economics* 51.4, pp. 781–808.

Lee, Yeon J. and Sekhposyan, Tatevik (2024). “The Relevance of Temporal Aggregation for the Propagation of Macroeconomic Shocks”. *Working Paper*.

Miranda-Agrippino, Silvia and Ricco, Giovanni (2021). “The Transmission of Monetary Policy Shocks”. *American Economic Journal: Macroeconomics* 13.3, pp. 74–107.

Miyamoto, Wataru, Nguyen, Thuy L., and Sergeyev, Dmitriy (2026). “How Oil Shocks Propagate: Evidence on the Monetary Policy Channel”. *Working Paper*.

Montiel Olea, José L. and Pflueger, Carolin (2013). "A Robust Test for Weak Instruments". *Journal of Business & Economic Statistics* 31.3, pp. 358–369.

Montiel Olea, José L. and Plagborg-Møller, Mikkel (2021). "Local Projection Inference Is Simpler and More Robust Than You Think". *Econometrica* 89.4, pp. 1789–1823.

Montiel Olea, José L., Plagborg-Møller, Mikkel, Qian, Eric, and Wolf, Christian K. (2026). "Local Projections or Vector Autoregressions? A Primer for Macroeconomists". *NBER Macroeconomics Annual* 40.1, pp. 111–152.

Mori, Lorenzo and Peersman, Gert (forthcoming). "Estimating the Macroeconomic Effects of Oil Supply News". *The Review of Economics and Statistics*.

Mumtaz, Haroon and Petrova, Katerina (2023). "Changing Impact of Shocks: A Time-Varying Proxy SVAR Approach". *Journal of Money, Credit and Banking* 55.2–3, pp. 635–654.

Nakamura, Emi and Steinsson, Jón (2018). "High-Frequency Identification of Monetary Non-Neutrality: The Information Effect". *The Quarterly Journal of Economics* 133.3, pp. 1283–1330.

Oruc, Bayram, Rüth, Sebastian K., Van der Veken, Wouter, and Zhang, Ren (2026). "When OPEC Speaks: The Dollar's Evolving Reaction to Oil Supply News in the Age of Shale". *Working Paper*.

Peersman, Gert and Van Robays, Ine (2012). "Cross-Country Differences in the Effects of Oil Shocks". *Energy Economics* 34.5, pp. 1532–1547.

Sims, Christopher A. (1986). "Are Forecasting Models Usable for Policy Analysis?" *Federal Reserve Bank of Minneapolis Quarterly Review* 10.1, pp. 2–16.

Stock, James H. and Watson, Mark W. (2018). "Identification and Estimation of Dynamic Causal Effects in Macroeconomics Using External Instruments". *The Economic Journal* 128.610, pp. 917–948.

— (2025). "Recovering from COVID". *Brookings Papers on Economic Activity* 2025.1, pp. 297–346.

Stock, James H. and Zaragoza-Watkins, Matthew (2024). "The Market and Climate Implications of US LNG Exports". *NBER Working Paper 32228*.

U.S. Energy Information Administration (2012). *U.S. Crude Oil Reserves Increase by 12.8 Percent in 2010*.

— (2018). *Horizontal Drilling Boosts Pennsylvania's Natural Gas Production*.

Online Appendix

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

Diego R. Känzig
James H. Stock
Luca Zanotti

Contents

A. Data

Table A.1 describes the variables, sources, and transformations used in the empirical analysis. Variables used in the instrument analysis are measured at the OPEC-event frequency, with Δ_{3m} denoting a three-month change measured through the day before the announcement. Variables entering the global VAR and the U.S. analysis are monthly, except for net exports and the associated national-accounts variables, which are available at the quarterly frequency. Where necessary, we seasonally adjust variables using the Census X-11 procedure. Unless otherwise noted in the description, variable names correspond to the identifiers used in the source datasets.

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's webpage	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
DGS1	One-year Treasury rate	FRED	Δ_{3m}
DGS10M1	10-year (DGS10) minus 1-year (DGS1) Treasury yield term spread	FRED	Δ_{3m}
SP500	S&P 500 stock market index	Bloomberg	$100 \times \Delta_{3m}$ log
BGGCOM	Bloomberg Commodity Spot Index	Bloomberg	$100 \times \Delta_{3m}$ log
WTI	WTI crude oil spot price, extended backward with front-month oil futures prices	EIA and Bloomberg	$100 \times \Delta_{3m}$ log
USPETPR	U.S. field production of crude oil and petroleum products (MTTFPUS2)	EIA	$100 \times \Delta_{3m}$ log
USOILCO	U.S. oil and petroleum consumption (MTTUPUS2)	EIA	$100 \times \Delta_{3m}$ log

Continued on next page

Table A.1 – continued from previous page

Variable	Description	Source	Trans.
HEATDAY3M	U.S. heating-degree days	EIA	Δ_{3m}
Global VAR			
POIL	Oil price (WTISPLC) deflated with world CPI	FRED & own calcuations	$100 \times \log$
OILPROD	World oil production (EIA1955)	Datastream	$100 \times \log$
OILSTOCKS	World oil inventories, constructed as in Känzig (2021) and extended through 2025	Datastream & own calcuations	$100 \times \log$
WORLDIP	World industrial production, constructed as in Baumeister and Hamilton (2019)	Baumeister's webpage	$100 \times \log$
WORLDCPI	Chain-linked GDP-weighted world CPI including OECD + 6 (Brazil, China, India, Indonesia, Russia and South Africa)	BIS CPI data & World Bank GDP data	$100 \times \log$
GFC	Global financial factor, extended using VXO (the latter extended following the methodology in 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 (X-11) and divided by (seasonally adjusted, X-11) crude oil and petroleum consumption (MTTUPUS2)	EIA	Level
USOILCRIMP	U.S. net imports of crude oil (MCRNTUS2), seasonally adjusted (X-11), and divided by (seasonally adjusted, X-11) crude oil consumption (crude refinery and blender net input–MCRRIUS2)	EIA	Level
USTOTPRCF	U.S. terms of trade	Datastream	$100 \times \log$
NXGDP	U.S. net exports (EXPGS-IMPGS) divided by GDP (GDP)	FRED	Level (quarterly)

Continued on next page

Table A.1 – continued from previous page

Variable	Description	Source	Trans.
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	$100 \times \log$
CFAC	U.S. COVID factor	Stock and Watson (2025)	Level
ENEREXP	Total energy expenditure over GDP, constructed as seasonally adjusted (X-11) total primary energy consumption (TETCBUS) multiplied by the PCE energy price index (DNRGRG3M086SBEA), and divided by GDP (GDP)	FRED and EIA	$100\times$ Level
MANEMPSH	Manufacturing employment share, constructed as U.S. manufacturing employment (MANEMP) over total U.S. employment (PAYEMS)	FRED	$100\times$ Level
SERVEXP	Services expenditure (PCES) over GDP (GDP)	FRED	$100\times$ Level
PCE	Personal consumption expenditures, deflated by headline PCE price index (PCEPI)	FRED	$100 \times \log$
SP500	S&P 500 stock market index	Bloomberg	$100 \times \log$
DGS1	One-year Treasury rate	FRED	Level
RDGS1	Ex-post real one-year Treasury rate, constructed as one-year Treasury rate minus one-year-ahead CPI inflation	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	$100 \times \log$

Continued on next page

Table A.1 – continued from previous page

Variable	Description	Source	Trans.
EMPOILGAS	All employees, oil and gas extraction (CES1021100001)	FRED	$100 \times \log$
EMPCONS	All employees, construction (USCONS)	FRED-MD	$100 \times \log$
EMPTTU	All employees, trade, transportation, and utilities (USTPU)	FRED-MD	$100 \times \log$
EMPDURMF	All employees, durable goods manufacturing (DMANEMP)	FRED-MD	$100 \times \log$
EMPNDURMF	All employees, nondurable goods manufacturing (NDMANEMP)	FRED-MD	$100 \times \log$
EMPSERV	All employees, service-providing industries (SRVPRD)	FRED-MD	$100 \times \log$
EMPRTRADE	All employees, retail trade (USTRADE)	FRED-MD	$100 \times \log$
EMPFIRE	All employees, financial activities (USFIRE)	FRED-MD	$100 \times \log$
EMPGOVT	All employees, government (USGOVT)	FRED-MD	$100 \times \log$
EMPEDHE	All employees, private education and health services (USEHS)	FRED	$100 \times \log$
STEMPTOT	State-level total employment	Guerreiro et al. (2026)	$100 \times \log$
STEMPMIN	State-level mining employment	Guerreiro et al. (2026)	$100 \times \log$
STEMPMAN	State-level manufacturing employment	Guerreiro et al. (2026)	$100 \times \log$
STEMPWH	State-level wholesale and retail employment	Guerreiro et al. (2026)	$100 \times \log$
PCECORE	PCE excluding food and energy (DPCCRC1M027SBEA) deflated by core PCE price index (PCEPILFE)	FRED	$100 \times \log$
PCEENER	Energy PCE (DNRGRC1M027SBEA) deflated by energy PCE price index (DNRGRG3M086SBEA)	FRED	$100 \times \log$

Continued on next page

Table A.1 – continued from previous page

Variable	Description	Source	Trans.
PCEFOOD	Food PCE (DFXARC1M027SBEA) deflated by food PCE price index (DFXARG3M086SBEA)	FRED	$100 \times \log$
PCESERV	Services PCE (PCES) deflated by services PCE price index (DSERRG3M086SBEA)	FRED	$100 \times \log$
PCEDUR	Durable goods PCE (PCEDG) deflated by durable goods PCE price index (DDURRG3M086SBEA)	FRED	$100 \times \log$
PCENDUR	Nondurable goods PCE (PCEND) deflated by nondurable goods PCE price index (DNDGRG3M086SBEA)	FRED	$100 \times \log$
IPCONGD	Industrial production, consumer goods	FRED-MD	$100 \times \log$
IPDCONGD	Industrial production, durable consumer goods	FRED-MD	$100 \times \log$
IPNCONGD	Industrial production, nondurable consumer goods	FRED-MD	$100 \times \log$
IPFINAL	Industrial production, final products	FRED-MD	$100 \times \log$
IPBUSEQ	Industrial production, business equipment	FRED-MD	$100 \times \log$
IPMANSICS	Industrial production, manufacturing, SIC	FRED-MD	$100 \times \log$
IPMAT	Industrial production, materials	FRED-MD	$100 \times \log$
IPFUELS	Industrial production, fuels	FRED-MD	$100 \times \log$
BHSUP	Oil supply shock from Baumeister and Hamilton (2019)	Baumeister's webpage	Level
HAMSHOCK	Monthly oil price shock (maximum between zero and the log difference between the current crude petroleum PPI (WPU0561) and its maximum over the previous 36 months)	Hamilton (1996) & own calculation	$100\times$ Level

Notes: Transformations apply to the series defined in the description column; "Level" denotes no further transformation. Δ_{3m} denotes a three-month change measured through the day before an OPEC announcement. Instrument-analysis variables are measured at the event frequency; other variables are monthly unless listed as quarterly. X-11 denotes Census seasonal adjustment.

B. Additional Global VAR Results

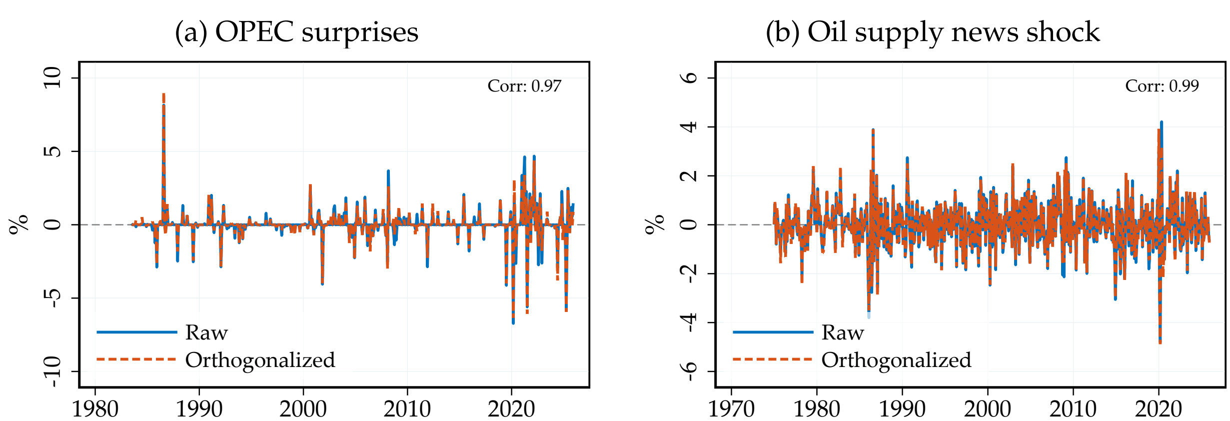
This appendix assesses the sensitivity of the global responses in Section 2 to the construction of the external instrument and the specification of the oil market model.

B.1. External Instrument

We examine robustness to purging the OPEC surprises of the component predictable from pre-announcement information and to using alternative methods to aggregate event-level surprises to the monthly frequency.

Orthogonalization. We first study how purging the OPEC surprises of their predictable component affects the results. To this end, we orthogonalize the OPEC surprises with respect to the full set of macroeconomic, financial, oil market, and weather predictors in Table 1, and then aggregate the residuals using the baseline calendar-day weights. Figure B.1 compares the resulting series with the baseline. Orthogonalization makes little difference: the monthly instruments have a correlation of 0.97, while the corresponding extracted shocks have a correlation of 0.99.

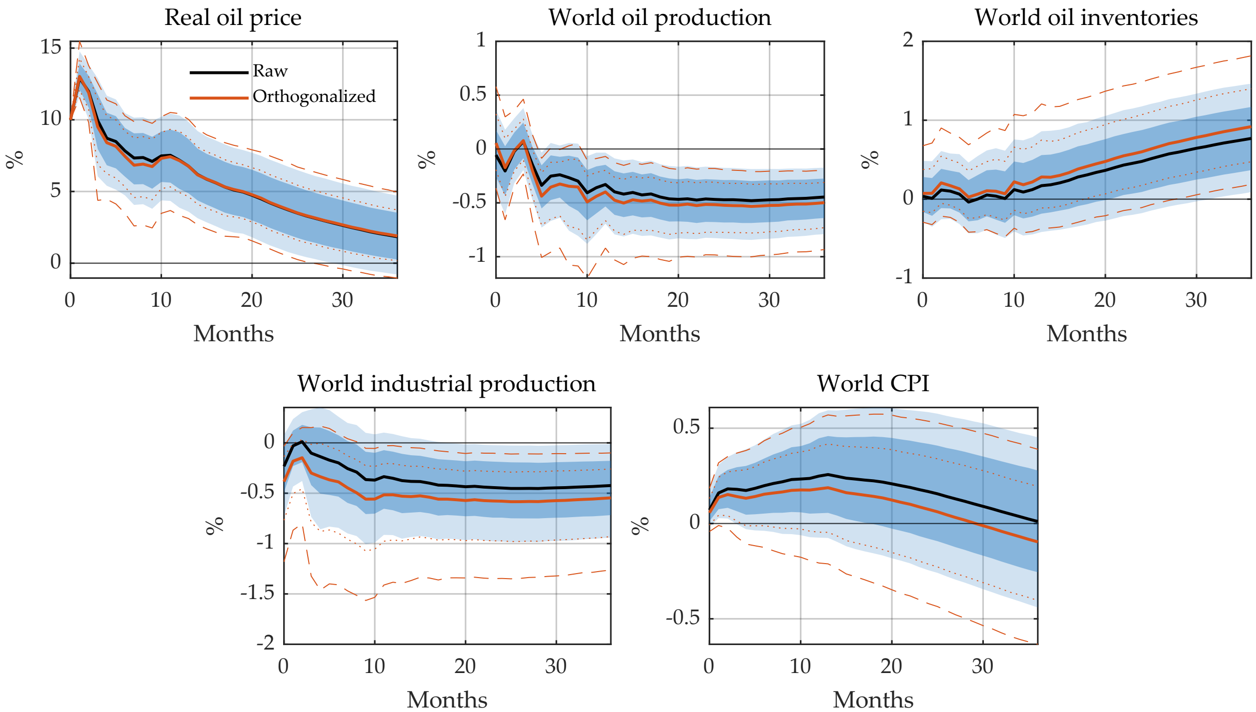
Figure B.1: OPEC surprises and oil supply news shocks, raw and orthogonalized



Notes: The left panel shows the raw and orthogonalized OPEC surprise series, aggregated to the monthly frequency using linear weights. Orthogonalization is performed at the event level, prior to aggregation. The right panel shows the corresponding oil supply news shocks extracted from the global VAR. Each panel reports the correlation between the two series.

Figure B.2 shows that the global responses are also very similar. The orthogonalized instrument implies a somewhat larger contraction in world industrial production, with wider confidence bands, but leaves the oil price, production, and inventory responses largely unchanged.

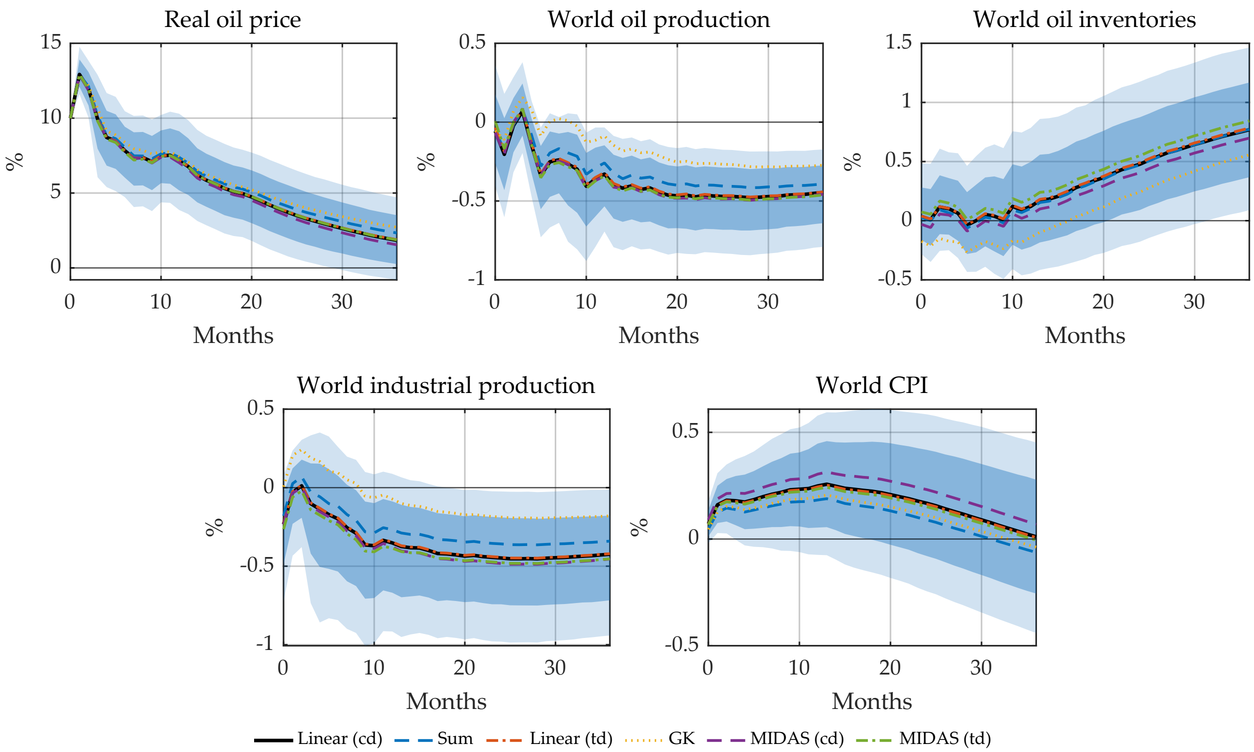
Figure B.2: Robustness to orthogonalization of OPEC surprises



Notes: Impulse responses from the global external-instrument VAR using raw (black line) and orthogonalized OPEC surprises (red line) as instruments. Dark and light shaded areas denote 68 and 90 percent confidence intervals for the baseline VAR; dotted and dashed red lines denote the corresponding intervals for the VAR using the orthogonalized instrument.

Aggregation. Because our outcome variables of interest are only available at the monthly frequency, we have to aggregate the event-level OPEC surprises. In principle, alternative aggregation schemes should not affect the identified responses in population. However, in finite samples, they can matter by affecting instrument strength. An announcement early in the month, for example, affects a larger share of the monthly average than an announcement near the end. Figure B.3 compares our baseline calendar-day linear weights with an unweighted monthly sum, linear weights based on trading days, the Gertler–Karadi aggregation, and MIDAS weights based on calendar or trading days. The responses are virtually unchanged across these alternative aggregation schemes.

Figure B.3: Robustness to alternative aggregation of OPEC surprises

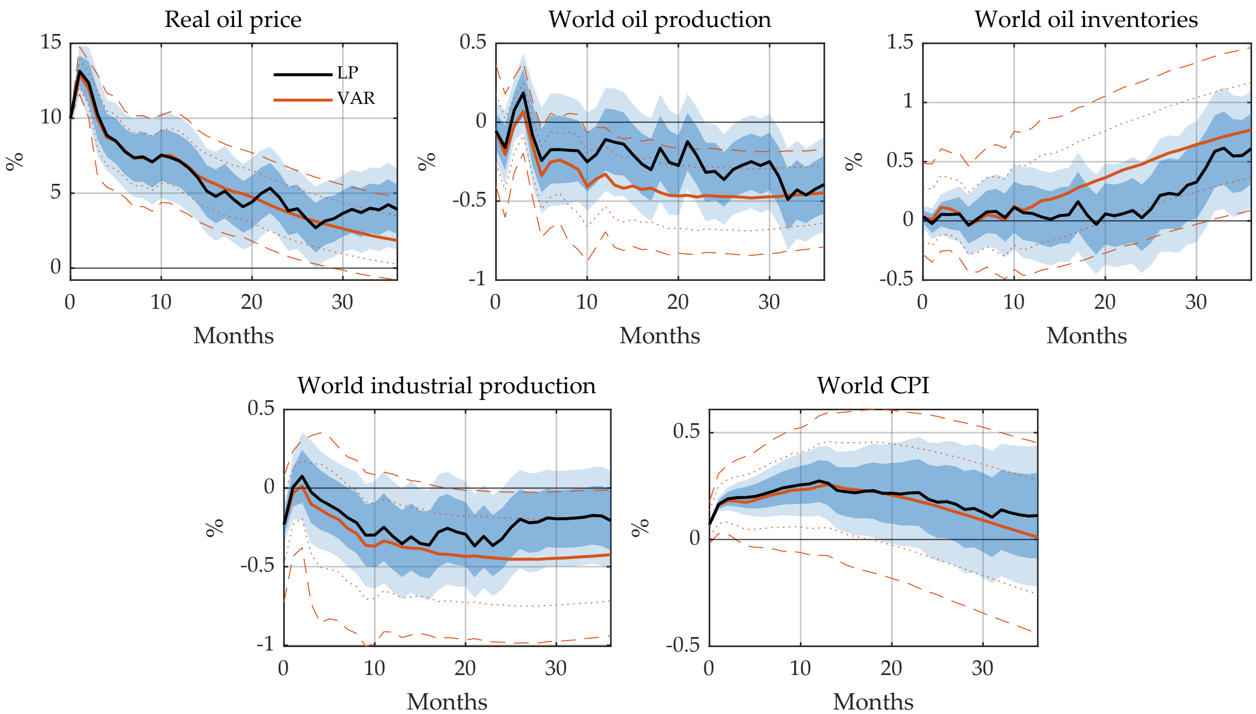


Notes: Impulse responses from the global external-instrument VAR using alternative monthly aggregations of OPEC surprises. The black line denotes the baseline calendar-day linear weights; colored lines denote the alternatives shown in the legend. Dark and light shaded areas denote 68 and 90 percent confidence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

B.2. Relaxing VAR Structure

The VAR approach computes impulse responses iteratively by extrapolating the dynamics contained in the first few autocovariances and therefore relies on the model capturing the global oil market dynamics reasonably well. As an alternative that does not impose this VAR structure, we directly estimate the responses to the extracted oil supply news shock using local projections. Figure B.4 compares the two approaches. Reassuringly, they produce very similar responses for the real oil price, oil production, inventories, industrial production, and consumer prices.

Figure B.4: VAR-based vs. LP-based responses

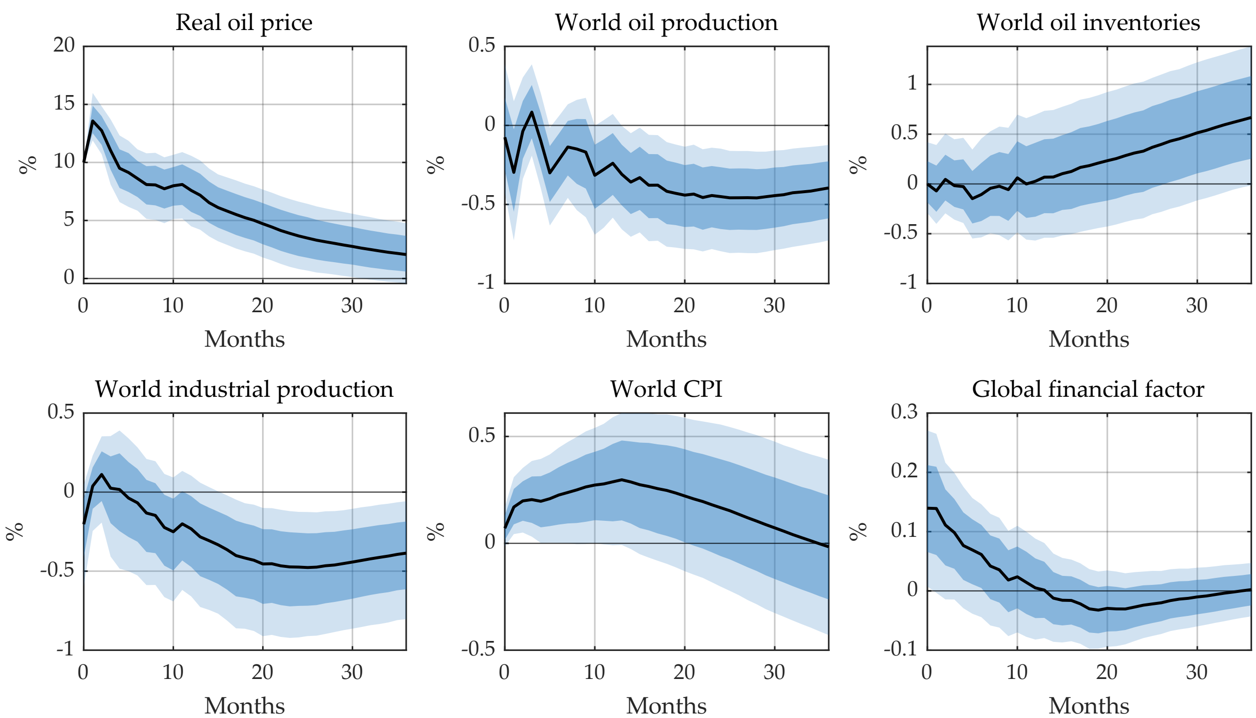


Notes: Impulse responses to an adverse oil supply news shock, comparing the baseline VAR-based responses (red line) with local projections on the extracted shock (black line). Dotted and dashed red lines denote the corresponding intervals for the VAR; dark and light shaded areas denote 68 and 90 percent confidence intervals, respectively, for the local projections.

B.3. Invertibility and Specification Choices

Another assumption underlying the VAR approach is invertibility: the global VAR must contain sufficient information to recover the oil supply news shock from current and past observables. To assess sensitivity to the information set, we augment the baseline model with the global financial-cycle factor of Miranda-Agrippino and Rey (2020), extended as described in Table A.1. This exercise is motivated by Mori and Peersman (forthcoming), who emphasize the importance of financial information in oil market VARs. Figure B.5 shows that the responses from the augmented model are very similar to the baseline.

Figure B.5: Controlling for global financial cycle

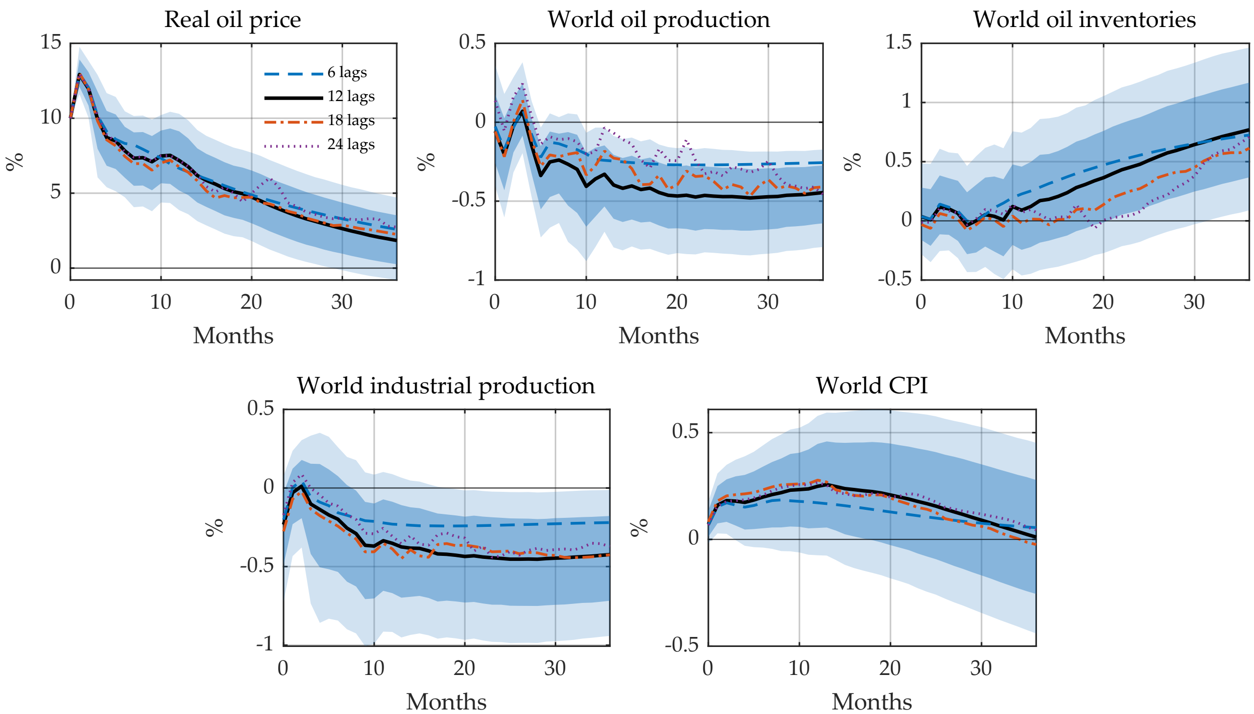


First-stage regression: robust F: 19.09, R^2: 6.00%, Adjusted R^2: 5.85%

Notes: Impulse responses to an adverse oil supply news shock based on the global oil market VAR augmented with an extended global financial-cycle factor. Dark and light shaded areas denote 68 and 90 percent confidence intervals.

Finally, Figure B.6 varies the lag order of the global VAR. The results are robust to increasing the lag length to 18 or even 24 months.

Figure B.6: Robustness to the lag order of the VAR



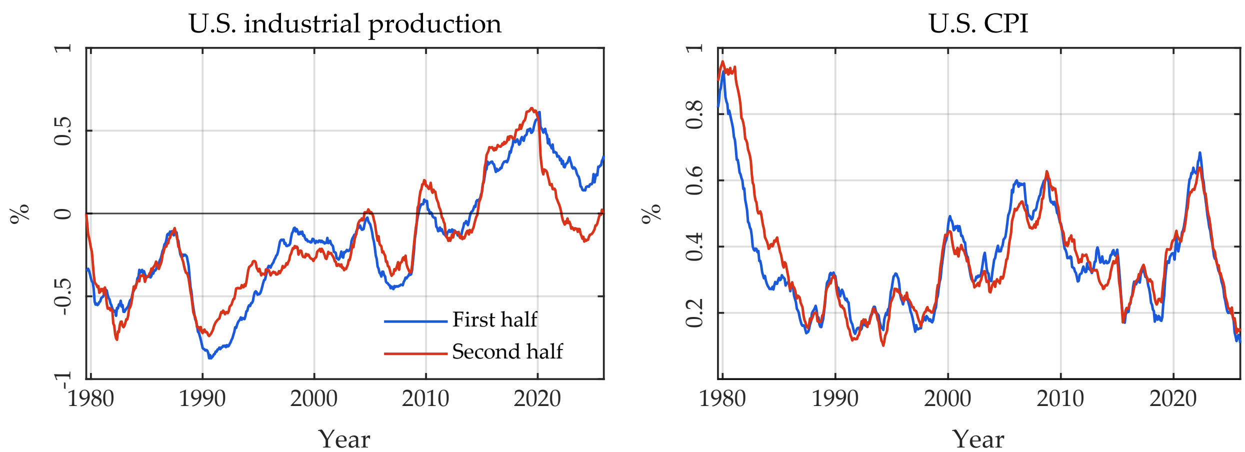
Notes: Impulse responses to an adverse oil supply news shock based on the global oil market VAR estimated with 6, 12, 18, and 24 monthly lags. Dark and light shaded areas denote 68 and 90 percent confidence intervals for the baseline 12-lag specification.

C. Additional TVP-VAR Results

C.1. Convergence

We assess the stability of the posterior responses using split-chain comparisons, independent runs, and inefficiency factors. Figure C.1 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. Reassuringly, the first- and second-half medians are very close for both U.S. industrial production and U.S. CPI at the 12-month horizon. Overall, this split-chain comparison points to no apparent convergence issues.

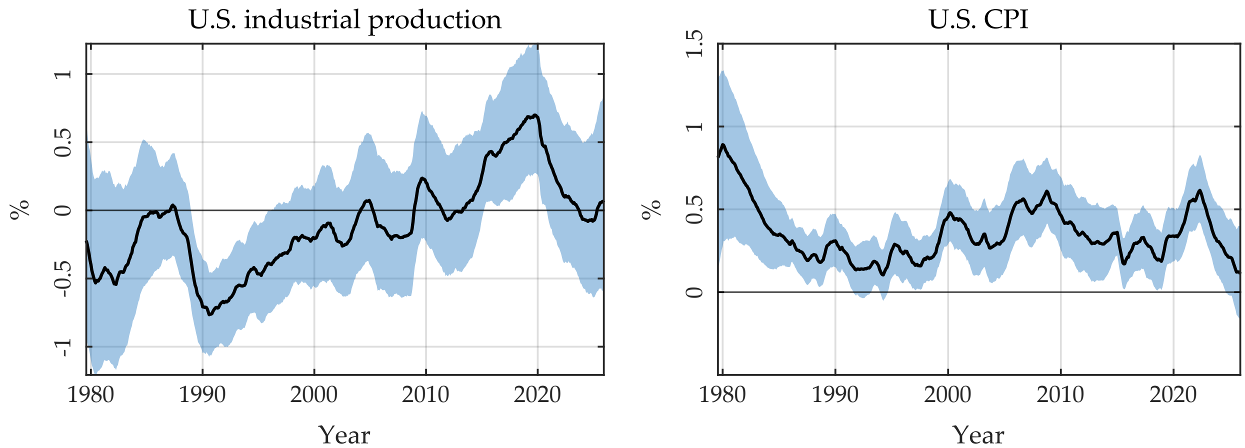
Figure C.1: Split-chain comparison for the TVP-VAR



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

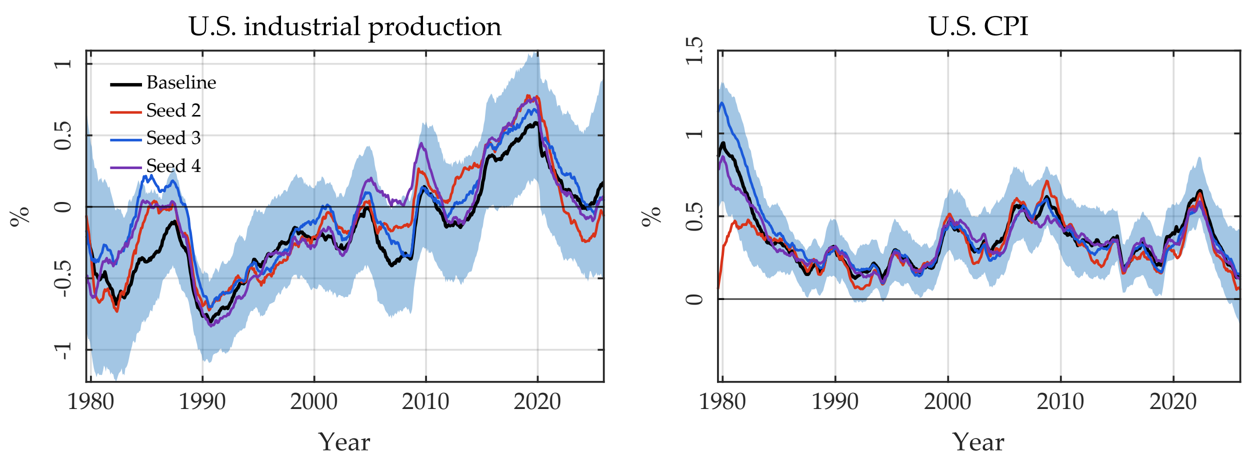
Figures C.2 and C.3 assess sensitivity to the random seed. In Figure C.2, we pool retained draws from four independent runs initialized with different seeds and recompute the posterior median and credible intervals. The pooled estimates closely match the baseline. Figure C.3 instead keeps the runs separate and overlays their posterior medians. If different initializations led the sampler to different regions of the posterior, the seed-specific paths would visibly diverge. Instead, the four paths are closely aligned, providing no evidence that the estimated time variation is sensitive to initialization of the MCMC algorithm.

Figure C.2: 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 posterior credible intervals.

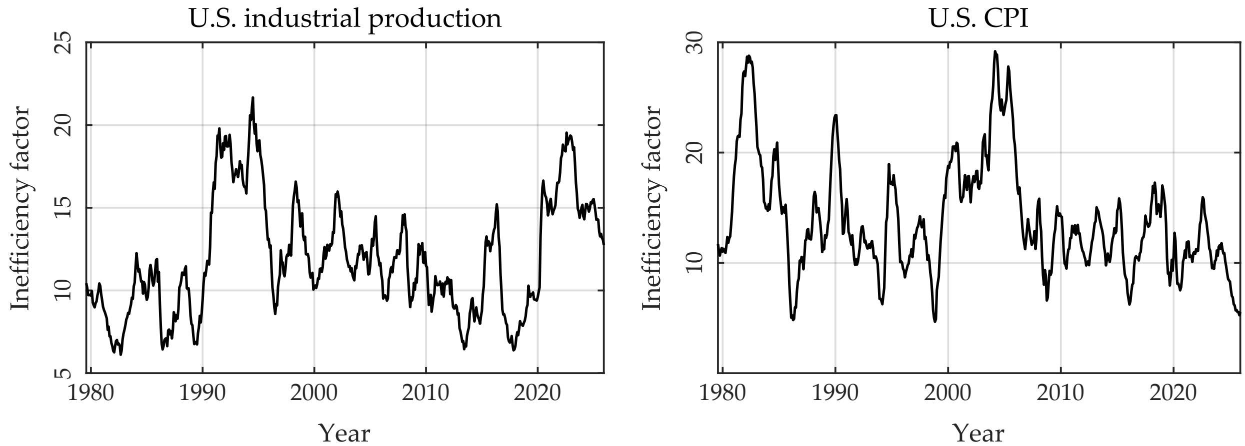
Figure C.3: TVP-VAR responses across MCMC seeds



Notes: Posterior median of the 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 posterior credible intervals from the baseline run.

Finally, Figure C.4 reports inefficiency factors for the retained posterior draws of the 12-month impulse responses at each date. Larger values indicate greater autocorrelation in the retained draws and hence a smaller effective number of independent 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 based on a reasonably informative set of retained draws.[1]

Figure C.4: Inefficiency factors for TVP-VAR responses



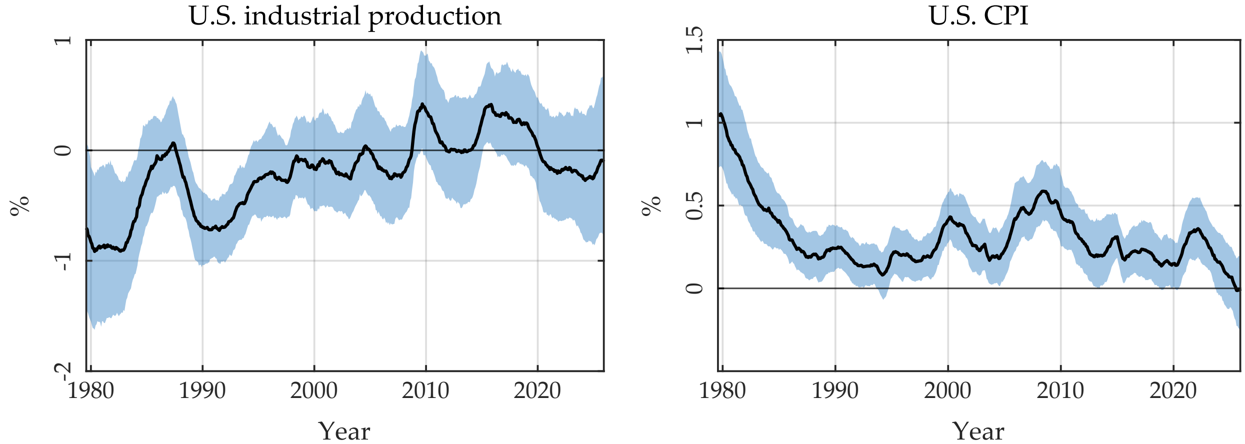
Notes: Inefficiency factors for the retained MCMC draws of the time-varying 12-month responses, reported as a diagnostic of sampling efficiency.

C.2. Robustness

In the baseline specification, we allow the TVP-VAR to capture all sources of time variation, including exceptional episodes such as the COVID-19 pandemic. As a robustness check, Figure C.5 repeats the analysis after residualizing the differenced VAR variables with respect to a March–May 2020 dummy and the COVID factor from Stock and Watson (2025). The industrial-production response still becomes progressively less contractionary and turns positive through much of the 2010s. The response around and after 2020 is more muted than in the baseline, and the temporary rise in the CPI response around that date is attenuated. Overall, the longer-run change in transmission is robust to controlling explicitly for the exceptional pandemic period.

[1] As an additional check, we repeated the estimation with 50,000 MCMC iterations and 30,000 burn-in draws, increasing the number of retained draws by a factor of five. The estimated impulse responses are virtually unchanged.

Figure C.5: TVP-VAR controlling for COVID factors



Notes: Time-varying 12-month responses of U.S. industrial production and the CPI to an adverse oil supply news shock. The specification follows Figure 6, but residualizes the VAR variables with respect to the COVID controls (March–May 2020 dummy and the Stock and Watson (2025) COVID factor). Solid lines denote posterior medians, and shaded areas denote 68 percent posterior credible intervals.

D. Additional LP Results and Sensitivity

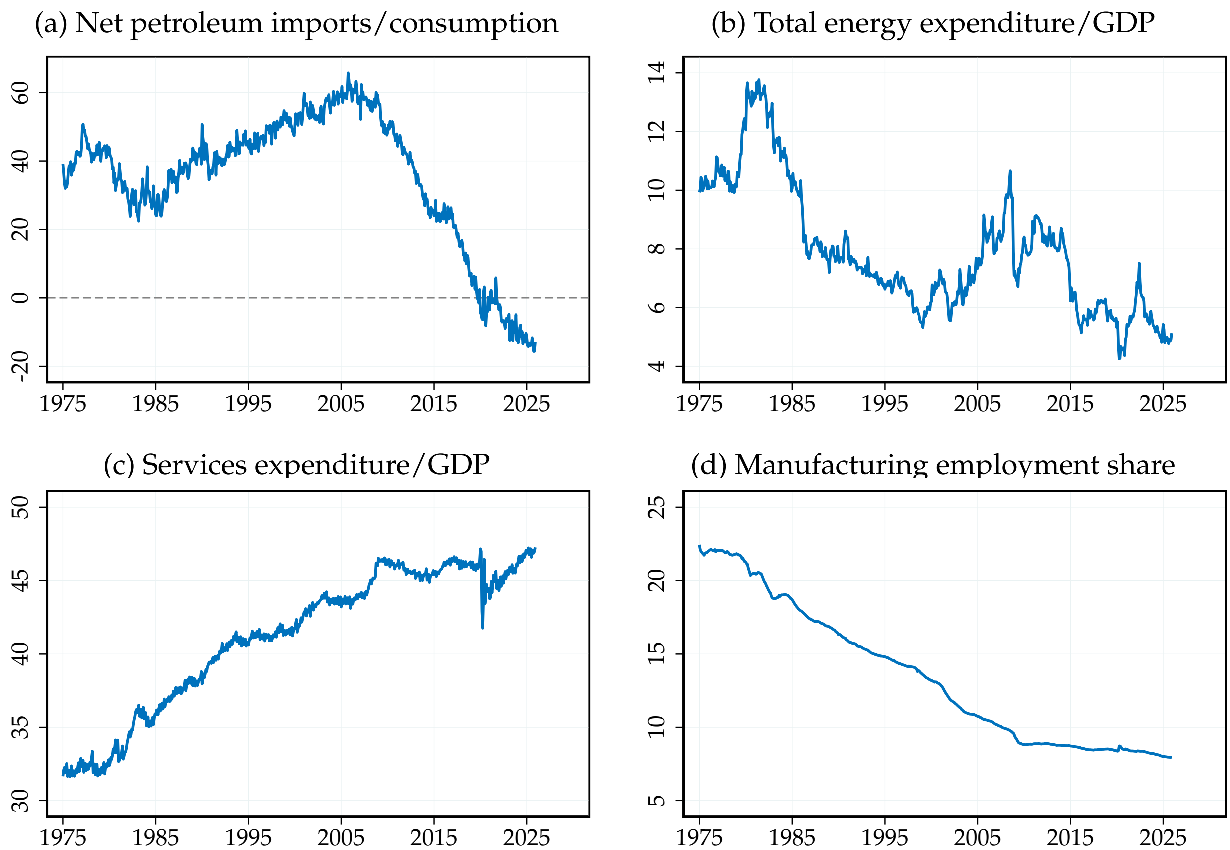
This appendix reports robustness checks and additional results for the state-dependent local projections. Unless stated otherwise, the specification follows Figure 8: six lags of the outcome and global variables, the petroleum trade position, and the pandemic controls, over 1975M1–2025M12. Continuous-state responses are evaluated at the average pre-2010 and 2025 petroleum trade positions. The interaction is the 2025 response minus the pre-2010 response, and the shock is normalized to raise the real oil price by 10 percent on impact at the pre-2010 trade position. Confidence intervals generally use lag-augmentation inference.

D.1. Sensitivity with Respect to Controls and Sample Period

Controls. The petroleum trade balance changed alongside other features of the U.S. economy that could influence oil shock transmission. Figure D.1 plots the trade position together with the energy expenditure measure, services expenditures relative to GDP, and the manufacturing employment share used in the additional-interaction specifications in Figure 10. However, these variables display quite different time-series patterns. Net petroleum imports relative to consumption remained broadly stable, if anything increasing, through the mid-2000s before reversing sharply with the shale boom. By contrast, the rise in the services share and decline in the manufacturing employment share are much more gradual and extend throughout the sample. Energy expenditures relative to GDP similarly exhibit a longer-run downward trend, interrupted by the commodity-price boom of the 2000s. The sharp reversal in the petroleum trade position is therefore distinct from these more gradual structural trends.

As shown in the main text, controlling for these variables leaves the baseline results broadly unchanged. In each case, we add both the level of the alternative variable and its interaction with the oil supply news shock, while retaining the baseline petroleum-trade interaction. The estimated response associated with moving toward exporter status remains large and positive for industrial production and close to zero for the CPI.

Figure D.1: Petroleum trade position and other structural trends

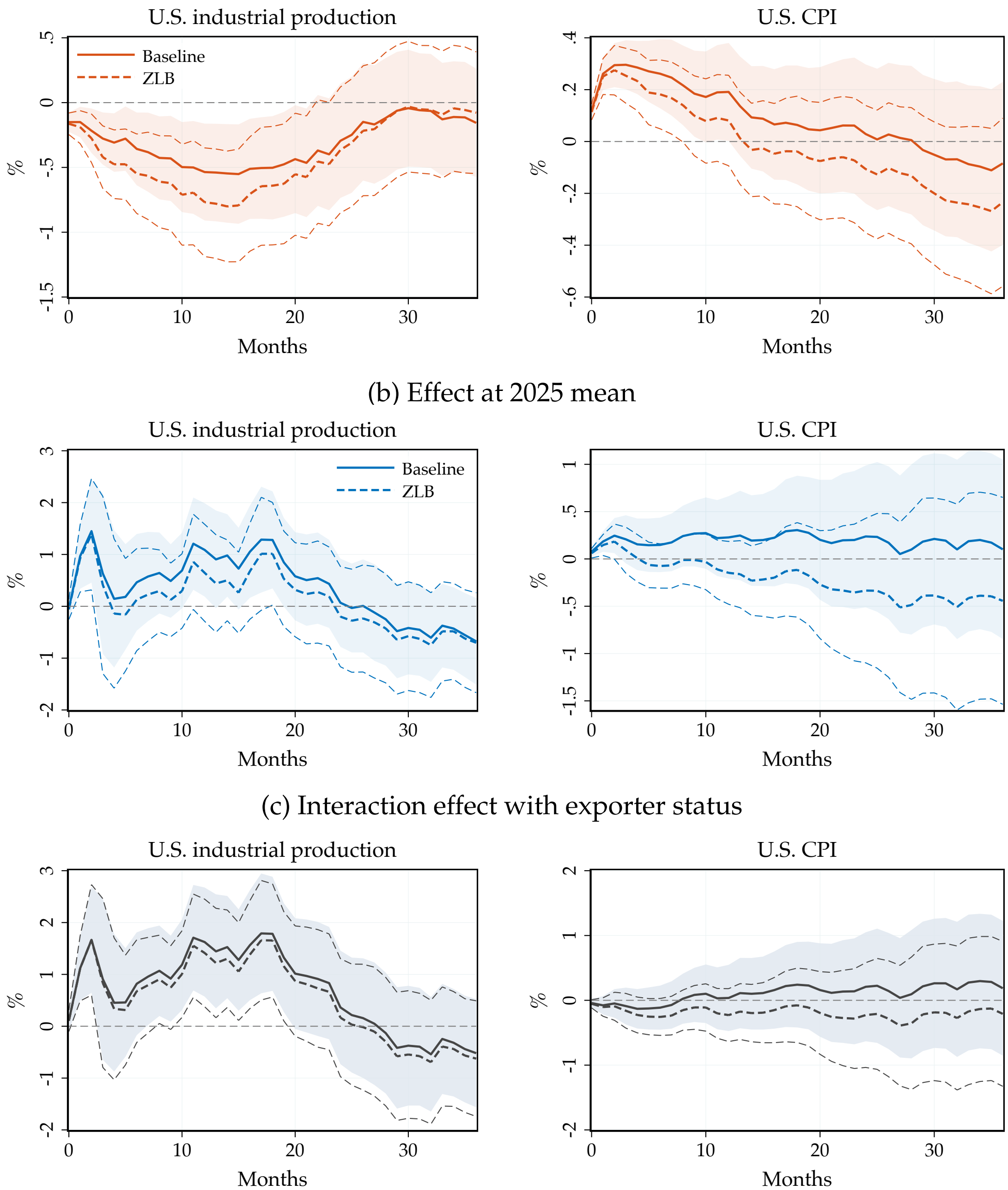


Notes: This figure shows the petroleum trade position and the structural variables used in Figure 10. Net petroleum imports, petroleum consumption, and primary energy consumption are seasonally adjusted using the Census X-11 method before constructing the variables of interest.

Miyamoto, Nguyen, and Sergeyev (2026) find that the zero lower bound (ZLB) plays an important role in the propagation of oil shocks. Since the ZLB period overlaps substantially with the shale era, it could potentially confound our petroleum-trade interaction. In the main text, we already show that adding a ZLB indicator and its interaction with the oil supply news shock leaves the point estimates of our baseline responses largely unchanged. Figure D.2 complements this evidence by showing that the statistical significance of the estimates is also very similar. In particular, the industrial-production response remains significantly more favorable as the United States moves toward exporter status, while the CPI interaction remains small and insignificant.

Figure D.2: Sensitivity to controlling for the zero lower bound

(a) Effect at pre-2010 mean

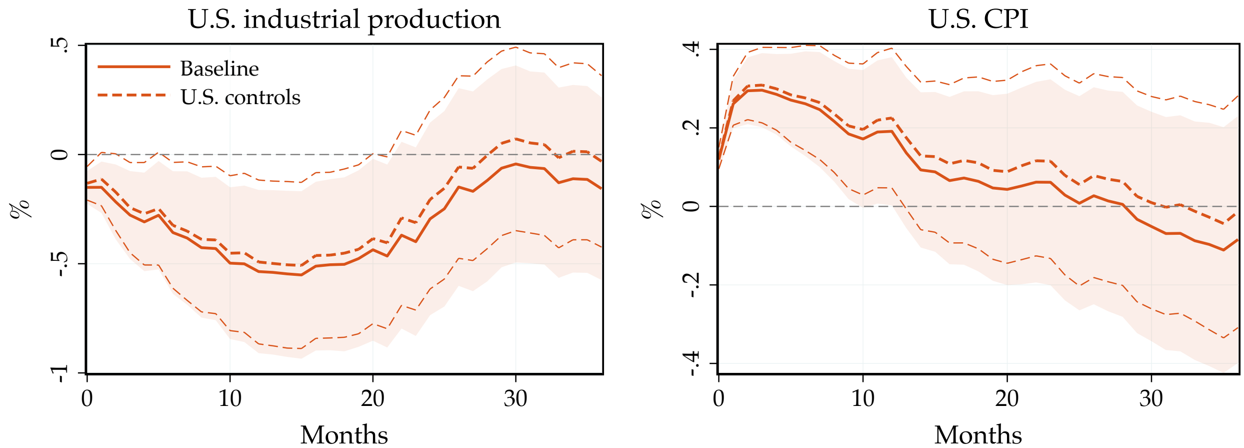


Notes: Sensitivity of the petroleum-trade-dependent local-projection responses to adding a ZLB indicator and its interaction with the oil supply news shock. The indicator equals one when the federal funds rate is at or below 0.5 percent. The remaining specification and normalization follow Figure 8. Solid lines and shaded areas denote baseline estimates and 90 percent confidence intervals; dashed lines denote estimates and 90 percent confidence intervals with the additional controls.

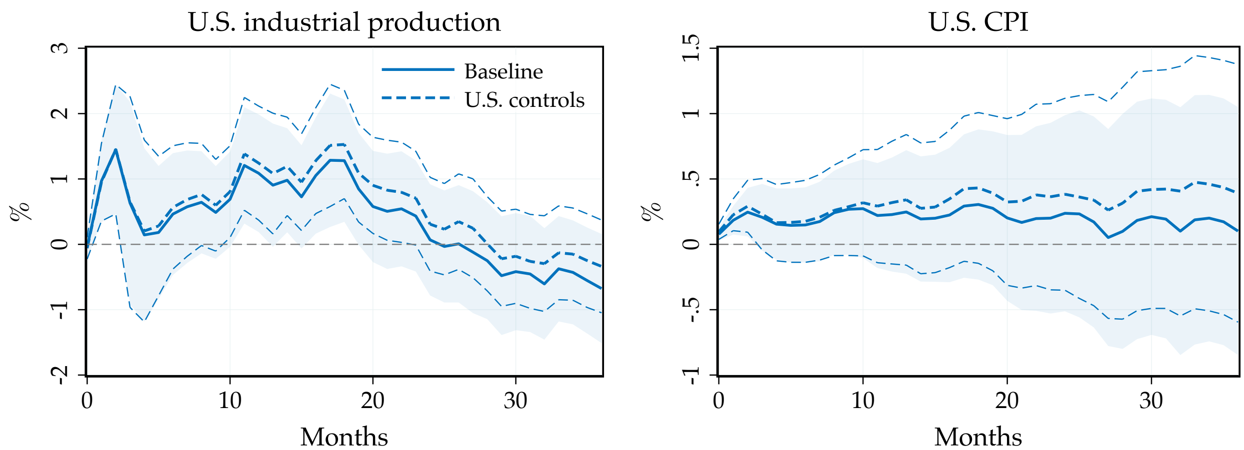
In the baseline specification, the only U.S.-specific controls are lags of the outcome variable and the COVID factor. Figure D.3 expands this information set by adding lags of U.S. industrial production, the CPI, and the one-year Treasury rate. The estimated responses remain virtually unchanged, indicating that the results are robust to conditioning on a richer set of U.S. macroeconomic information.

Figure D.3: Sensitivity to expanding U.S. controls

(a) Effect at pre-2010 mean



(b) Effect at 2025 mean

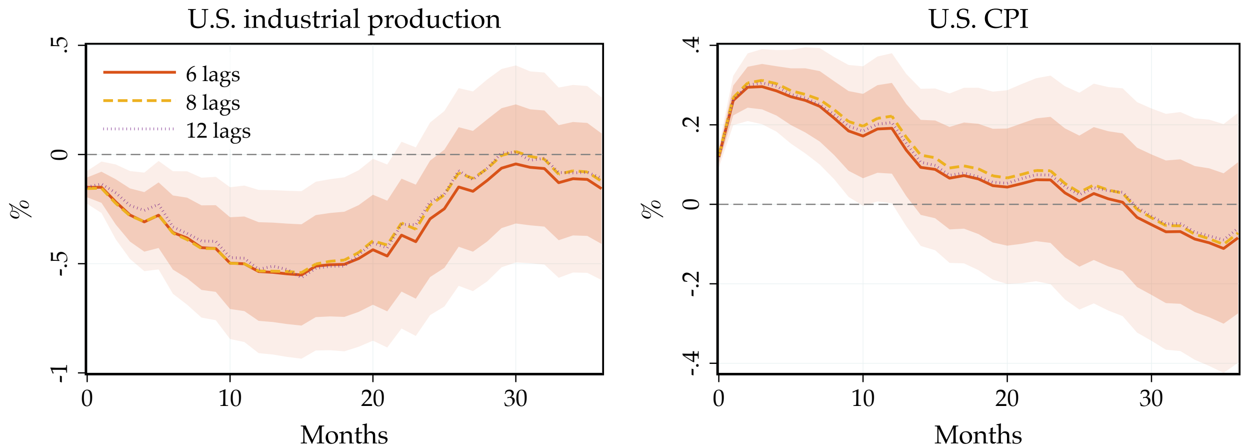


Notes: Sensitivity of the petroleum-trade-dependent local-projection responses to expanding the set of U.S. controls (six lags of U.S. industrial production, the CPI, and the one-year Treasury rate). The remaining specification and normalization follow Figure 8. Solid lines and shaded areas denote baseline estimates and 90 percent confidence intervals; dashed lines denote estimates and 90 percent confidence intervals with the additional controls.

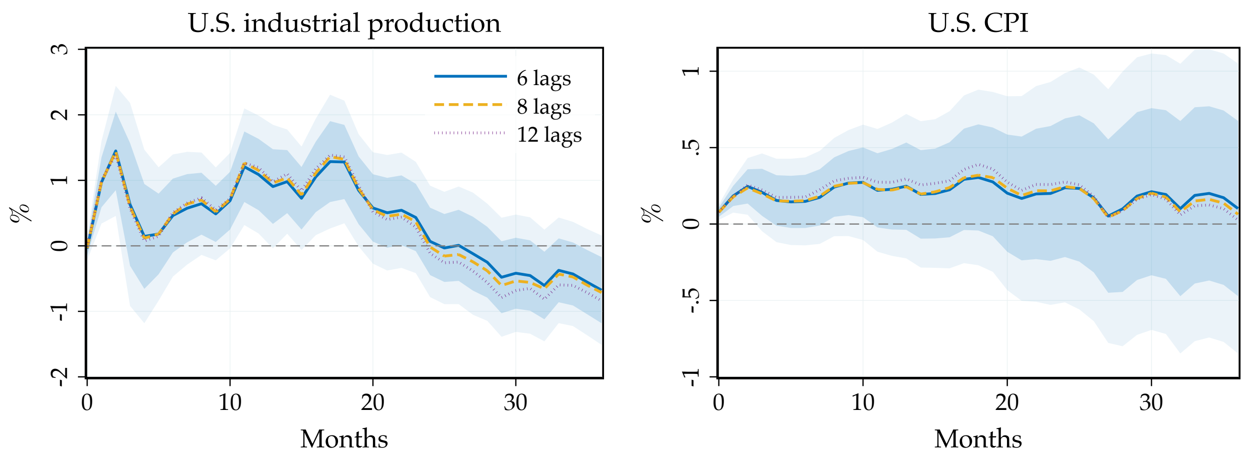
To keep the state-dependent local projections parsimonious, our baseline specification includes 6 monthly lags. Figure D.4 examines robustness to richer dynamics by increasing the lag order to 8 or 12 months. The responses are nearly unchanged at both petroleum trade positions, indicating that the results are not sensitive to the baseline lag choice.

Figure D.4: Sensitivity to lag structure

(a) Effect at pre-2010 mean



(b) Effect at 2025 mean

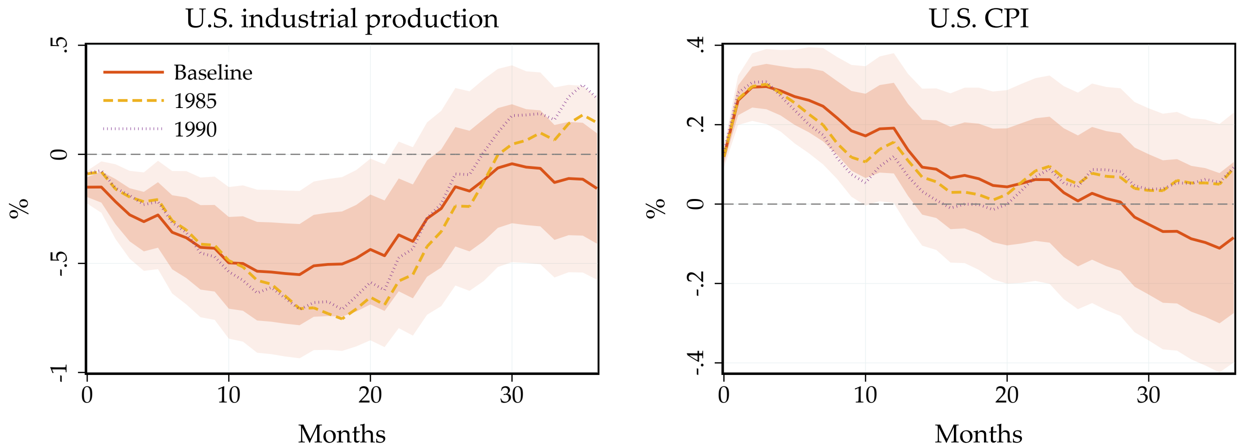


Notes: Sensitivity of the petroleum-trade-dependent local-projection responses to increasing the number of lags. The remaining specification and normalization follow Figure 8. Solid lines and shaded 68 and 90 percent confidence intervals reproduce the baseline six-lag estimates; dashed and dotted lines denote estimates using 8 and 12 lags, respectively.

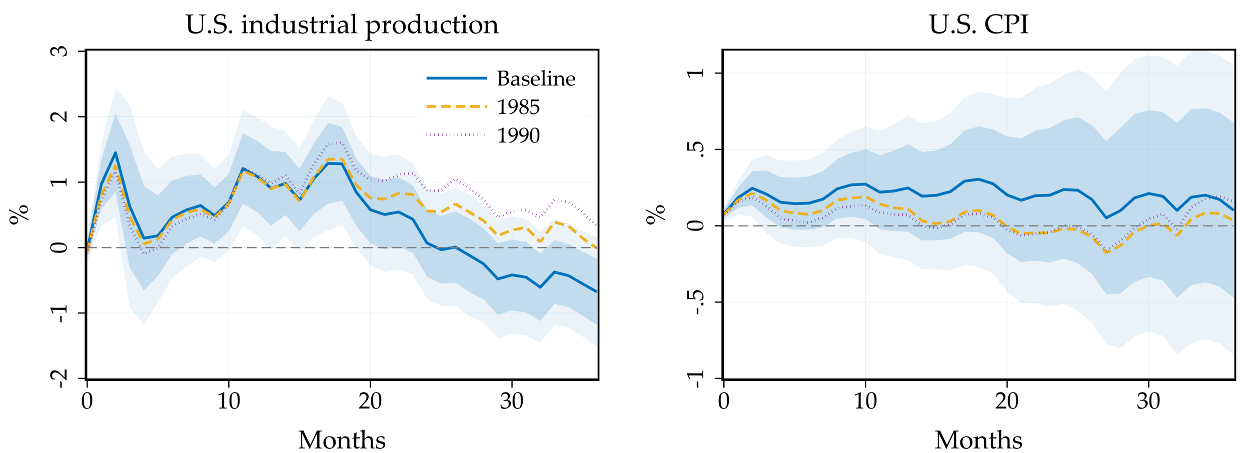
Sample period. The full sample includes the large oil shocks of the 1970s and early 1980s, which could disproportionately influence the estimates. To assess their importance, Figure D.5 re-estimates the model starting the sample in January 1985 or January 1990. The results are broadly similar to the baseline. For industrial production, the contraction at the pre-2010 trade position becomes somewhat more pronounced at medium horizons but less persistent in the shorter samples, while the expansion at the 2025 position remains intact. The CPI responses are also very similar across samples. Thus, the main contrast between the pre-2010 and 2025 trade positions does not depend on the early part of the sample.

Figure D.5: Sensitivity to sample period

(a) Effect at pre-2010 mean



(b) Effect at 2025 mean



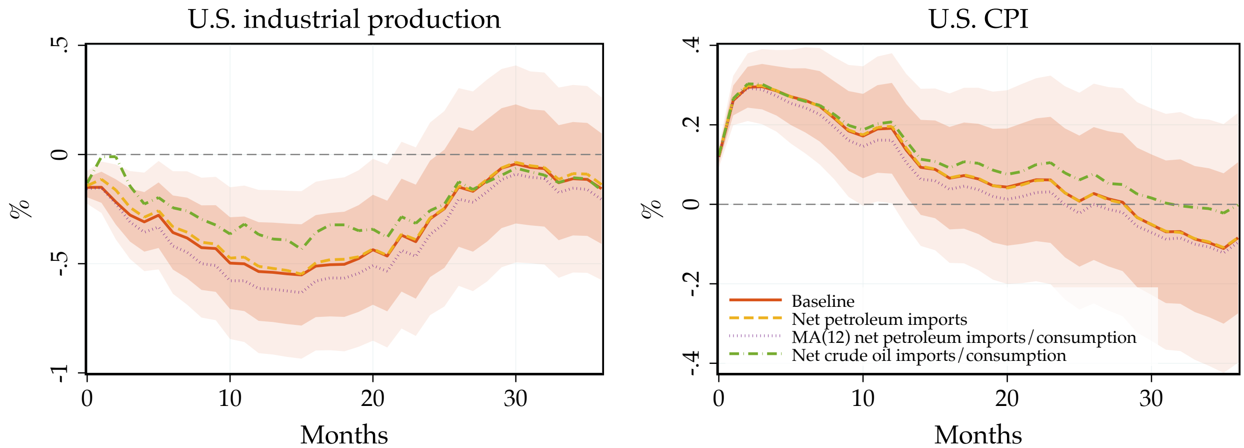
Notes: Sensitivity of the petroleum-trade-dependent local-projection responses to the estimation sample. The remaining specification and normalization follow Figure 8. Solid lines and shaded 68 and 90 percent confidence intervals reproduce the baseline estimates; dashed and dotted lines denote estimates from samples starting in 1985M1 and 1990M1, respectively.

D.2. Alternative Interaction Measures

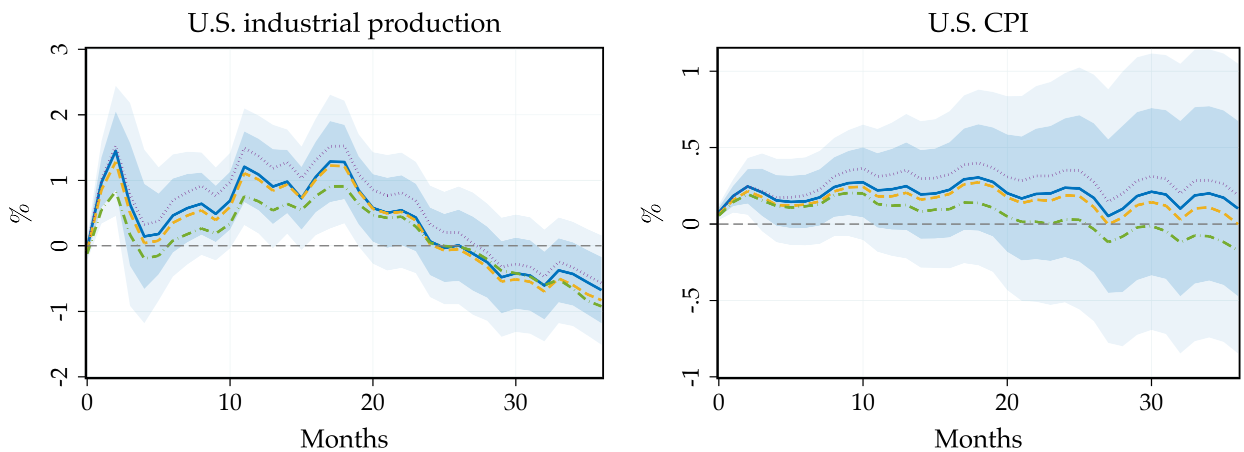
Does our result depend on how we measure the U.S. petroleum trade position? Figure D.6 examines robustness to alternative measures of the petroleum trade position. We compare the baseline seasonally adjusted net petroleum imports-to-consumption ratio with net petroleum imports in levels, the ratio of 12-month moving averages of net petroleum imports and petroleum consumption, and net crude oil imports relative to crude oil consumption. For each measure, we evaluate the responses at its own pre-2010 and 2025 averages.

Figure D.6: Alternative measures of the U.S. petroleum trade position

(a) Effect at pre-2010 mean



(b) Effect at 2025 mean



Notes: Petroleum-trade-dependent local-projection responses estimated using alternative measures of the U.S. petroleum trade position, each evaluated at its pre-2010 and 2025 averages. Colored lines denote estimates using the alternative measures; dark and light shaded areas denote 68 and 90 percent confidence intervals for the baseline measure.

The results are very similar across measures. In all cases, the industrial-production response shifts markedly toward expansion as the U.S. moves toward exporter status, while the CPI responses change little. Thus, the results are not sensitive to scaling the net trade variable by consumption, smoothing short-run fluctuations, or using crude oil rather than the broader petroleum balance.

D.3. Alternative Shock Measures

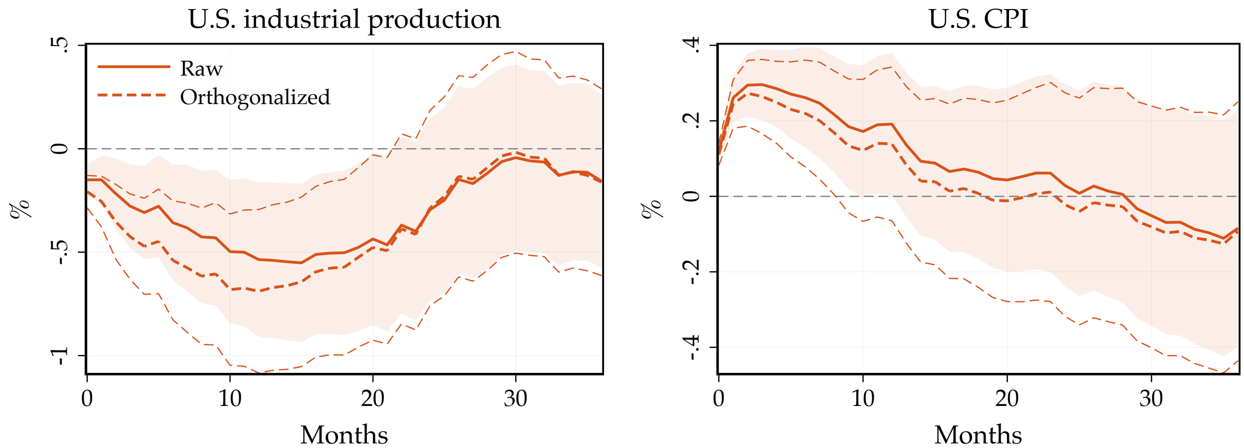
We next assess the sensitivity of the state-dependent local projection results to how the oil shock is measured. We first consider alternative constructions of our baseline oil supply news shock and then re-estimate the specification using alternative oil shock measures from the literature.

D.3.1. Using VAR shock based on the orthogonalized proxy

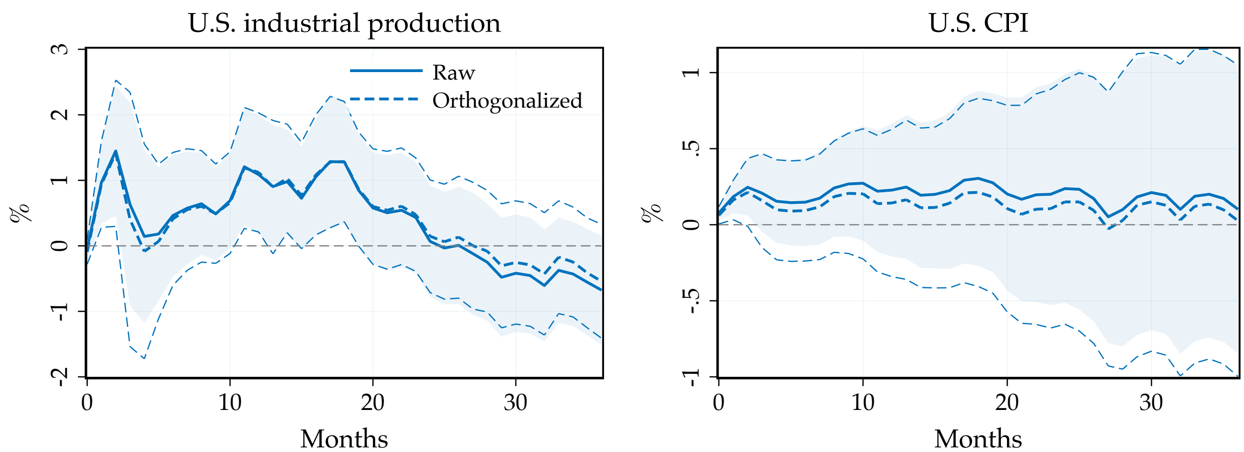
First, we assess whether purging the OPEC surprises of their predictable component before using them to identify the oil supply news shock in the global VAR affects the results. Figure D.7 re-estimates the state-dependent local projections using the shock extracted from a VAR using these orthogonalized surprises. The resulting responses are very similar to the baseline. This is perhaps not surprising given the close correspondence between the baseline and orthogonalized shock series shown in Figure B.1.

Figure D.7: Sensitivity to orthogonalizing OPEC surprises

(a) Effect at pre-2010 mean



(b) Effect at 2025 mean



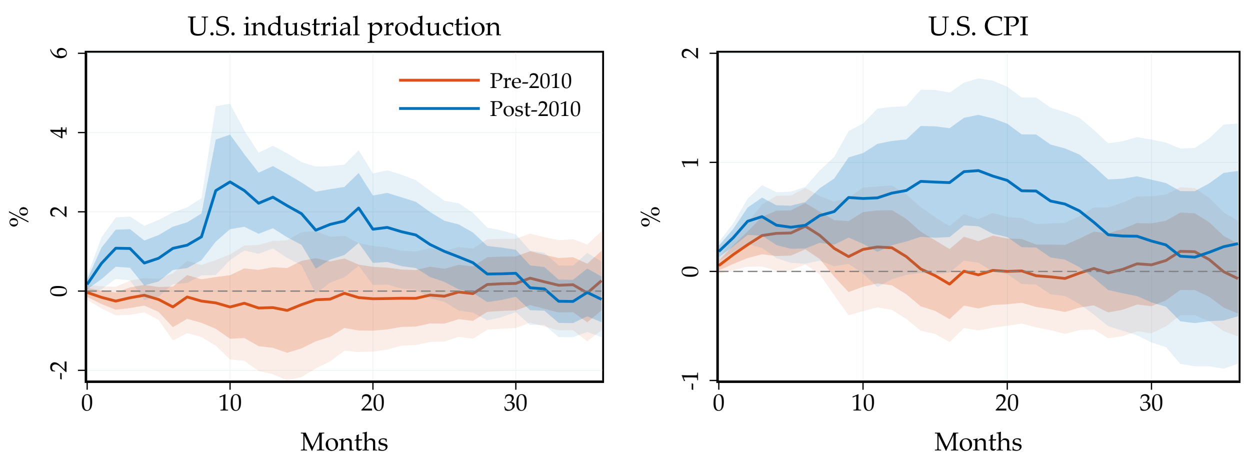
Notes: Petroleum-trade-dependent local-projection responses estimated using oil supply news shocks extracted from the global VAR using, respectively, the raw and orthogonalized OPEC surprises as instruments. The specification, sample, and normalization follow Figure 8. Solid lines and shaded areas denote estimates and 90 percent confidence intervals for the raw instrument; dashed lines denote estimates and 90 percent confidence intervals for the orthogonalized instrument.

D.3.2. Using the OPEC surprises directly as a shock

We next use the monthly OPEC surprises directly in the local projections, replacing the VAR-extracted shock and its interaction with the state. This provides a useful robustness check because it bypasses the global VAR altogether and therefore does not impose a time-invariant mapping from OPEC surprises into global oil market dynamics. The drawback is statistical power. The announcement surprises account for only a relatively small share of monthly oil price variation, which is affected by many other shocks, and this signal-to-noise problem becomes increasingly important at longer horizons. We therefore expect estimates based directly on the surprises to be less precise than those using the VAR-extracted oil supply news shock.

Figures D.8–D.10 present a broader set of results using the surprises directly, covering both state-dependent specifications—the pre-/post-2010 indicator and the continuous petroleum trade position—as well as labor-market outcomes. Across specifications, the main qualitative patterns are preserved. The real-activity response becomes substantially more favorable from 2010 onward and as the U.S. petroleum trade position improves, while the labor-market results similarly show stronger employment and lower unemployment at the exporter position. The CPI responses are also broadly consistent with the baseline, although somewhat more variable across horizons. Overall, the main conclusion is robust to using the high-frequency OPEC surprises directly rather than extracting the oil supply news shock through the global VAR.

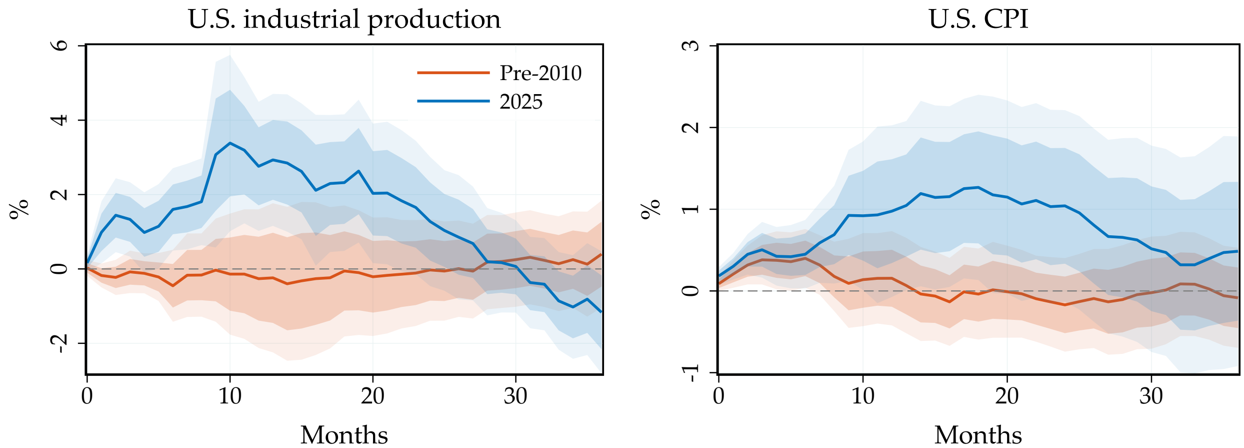
Figure D.8: Pre- and post-2010 responses using OPEC surprises directly



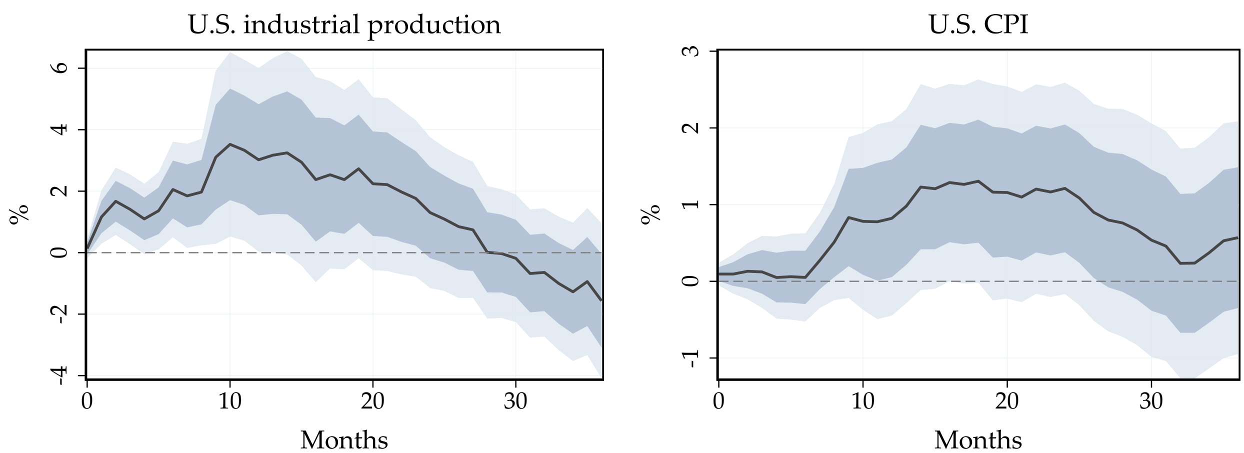
Notes: Local-projection responses before and after January 2010, using the monthly OPEC surprise series directly as the shock. The specification and normalization follow Figure 7. Dark and light shaded areas denote 68 and 90 percent confidence intervals.

Figure D.9: Petroleum-trade results using OPEC surprises directly (I)

(a) Effect at pre-2010 and 2025 means



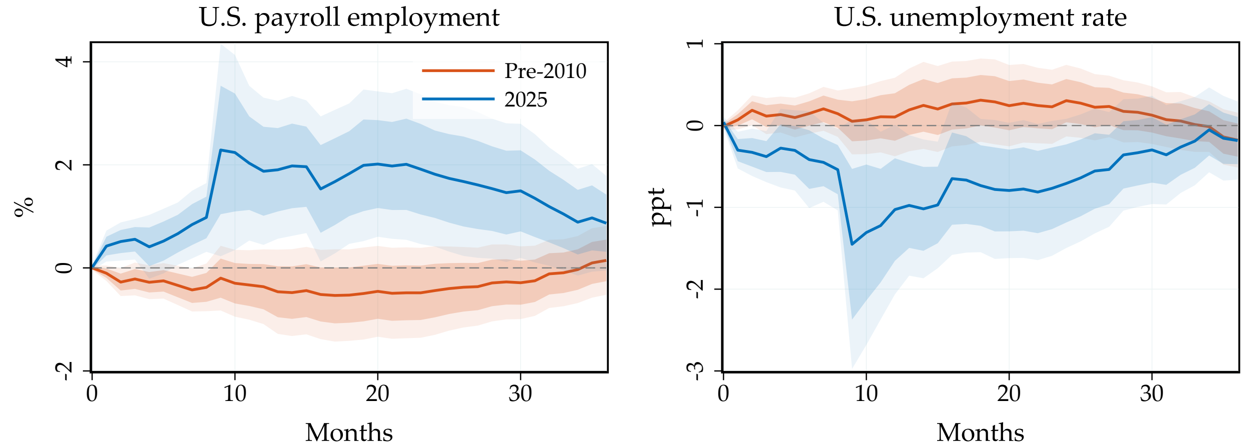
(b) Interaction effect with exporter status



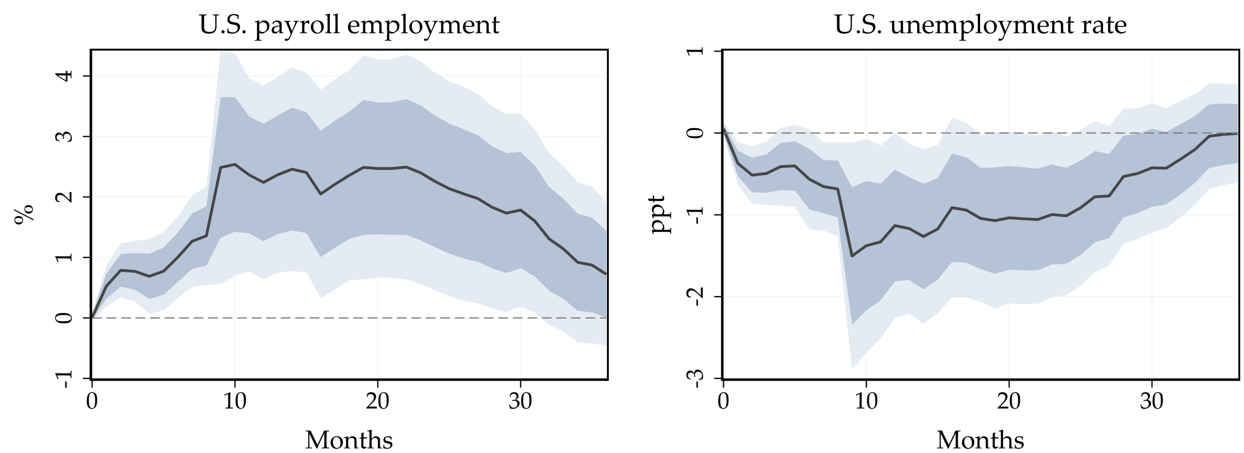
Notes: Petroleum-trade-dependent local-projection responses estimated using the monthly OPEC surprise series directly as the shock. The specification and normalization follow Figure 8. The top row reports responses at the average pre-2010 and 2025 petroleum trade positions; the bottom row reports the change in the response between these positions. Dark and light shaded areas denote 68 and 90 percent confidence intervals.

Figure D.10: Petroleum-trade results using OPEC surprises directly (II)

(a) Effect at pre-2010 and 2025 means



(b) Interaction effect with exporter status



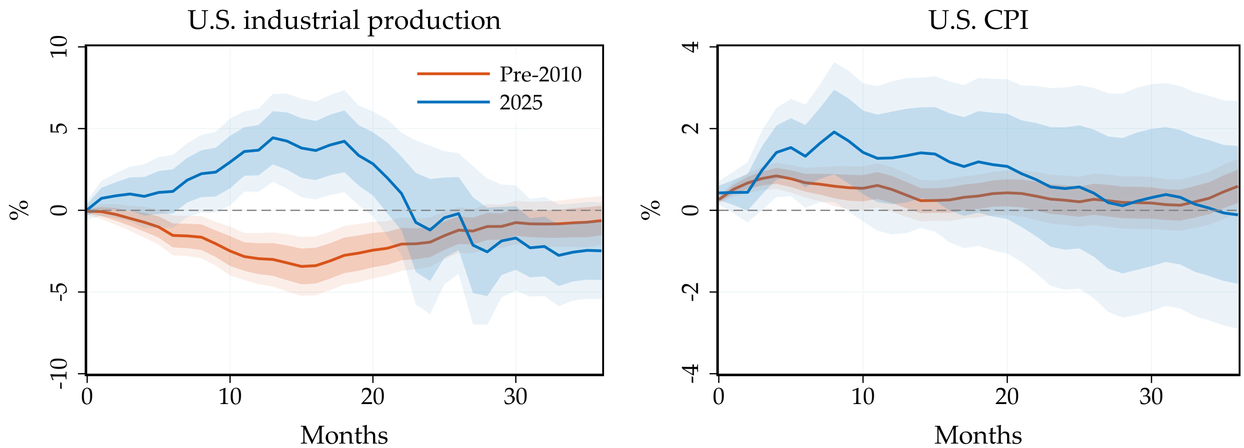
Notes: Petroleum-trade-dependent local-projection responses of the labor market estimated using the monthly OPEC surprise series directly as the shock. The specification and normalization follow Figure 8. The top row reports responses at the average pre-2010 and 2025 petroleum trade positions; the bottom row reports the change in the response between these positions. Dark and light shaded areas denote 68 and 90 percent confidence intervals.

D.3.3. Using alternative oil shock measures from the literature

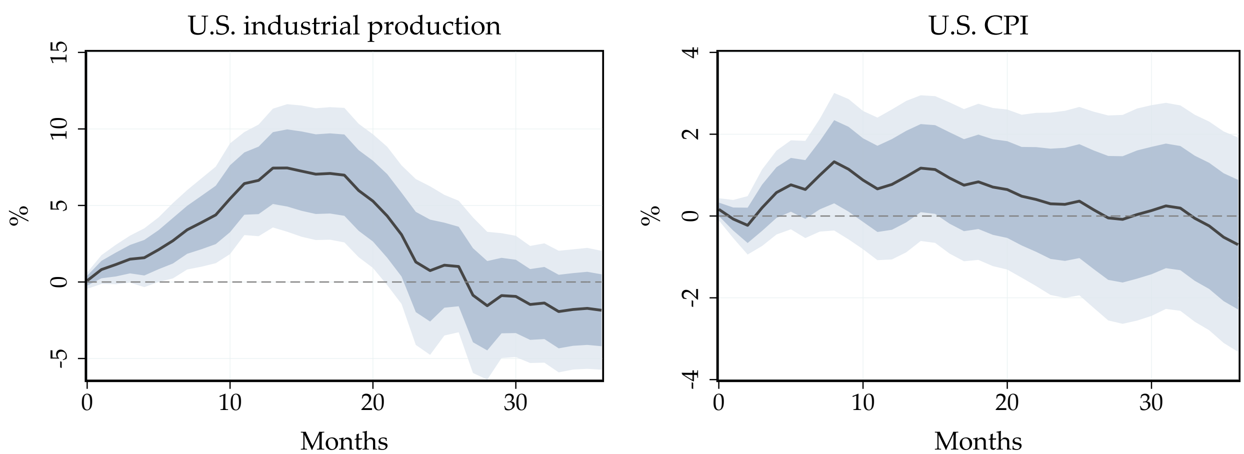
Finally, we consider two alternative oil shock measures from the literature. Figure D.11 uses the monthly net oil price increase measure of Hamilton (1996, 2003), constructed from the positive part of the log difference between the crude petroleum PPI and its maximum over the preceding 36 months. While this measure does not separately identify supply and demand shocks, it provides a useful comparison with a broader measure of oil price increases. Reassuringly, the main pattern is very similar to our baseline: industrial production contracts at the pre-2010 trade position but expands strongly at the 2025 exporter position over the first two years. The CPI responses are also broadly consistent with the baseline, although less precisely estimated.

Figure D.11: Using the Hamilton (1996) oil shock

(a) Effect at pre-2010 and 2025 means



(b) Interaction effect with exporter status

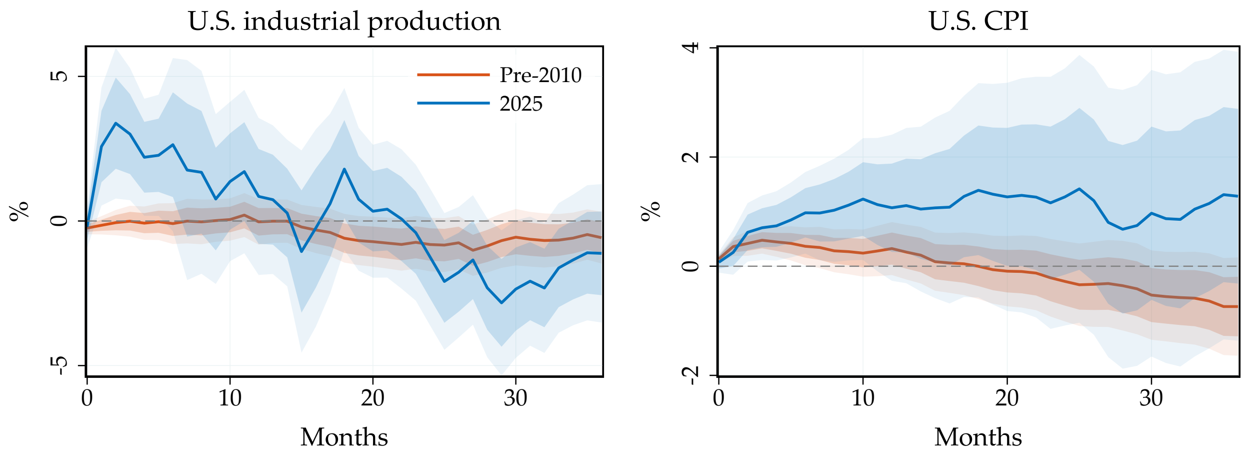


Notes: Petroleum-trade-dependent local-projection responses estimated using the net oil price increase measure constructed following Hamilton (1996). Responses are scaled to raise the real oil price by 10 percent on impact at the average pre-2010 petroleum trade position. Dark and light shaded areas denote 68 and 90 percent confidence intervals.

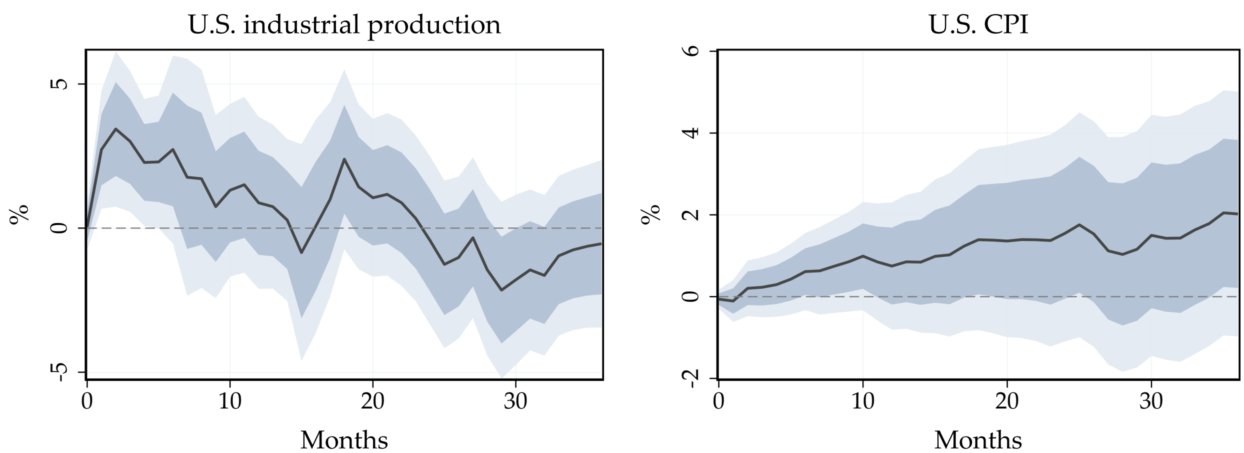
Figure D.12 instead uses the oil supply shock of Baumeister and Hamilton (2019), identified in a Bayesian oil market VAR with informative priors on supply and demand elasticities. Again, the industrial-production response becomes substantially more favorable as the United States moves from the pre-2010 to the 2025 trade position. The precise magnitudes and longer-run dynamics differ somewhat from our baseline, as do the CPI responses, but the central result is preserved. Thus, despite substantial differences in the construction and identification of these alternative shock measures, they consistently point to a markedly more favorable real-activity response to oil price increases at the exporter trade position.

Figure D.12: Using the Baumeister and Hamilton (2019) oil supply shock

(a) Effect at pre-2010 and 2025 means



(b) Interaction effect with exporter status



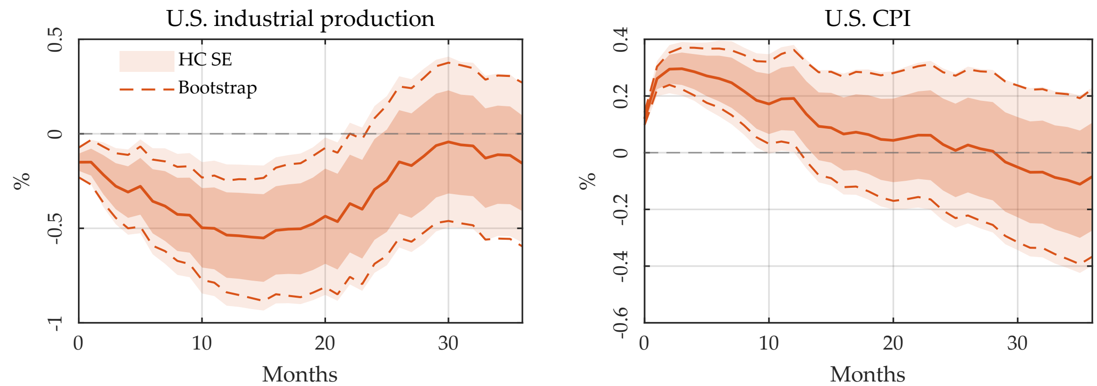
Notes: Petroleum-trade-dependent local-projection responses estimated using the oil supply shock from Baumeister and Hamilton (2019). Responses are scaled to raise the real oil price by 10 percent on impact at the average pre-2010 petroleum trade position. Dark and light shaded areas denote 68 and 90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

D.4. Inference: Accounting for Shock Uncertainty

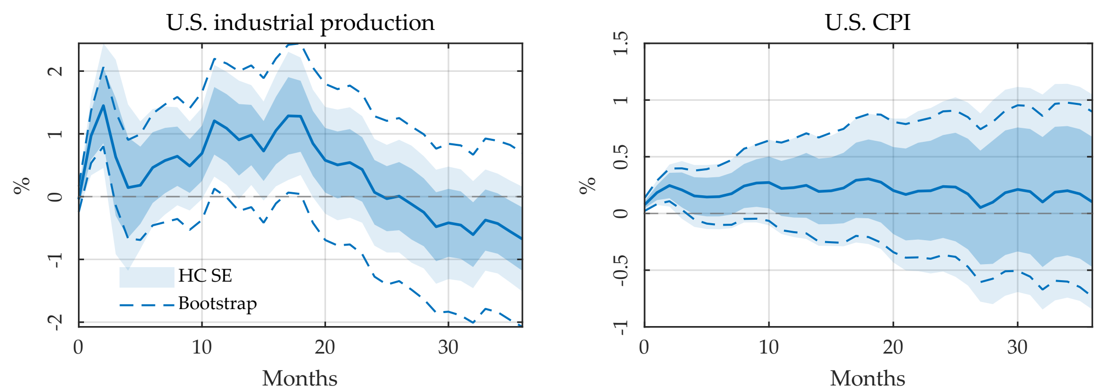
The baseline local-projection inference treats the estimated oil supply news shock as observed. This simplifies inference but omits uncertainty from estimating the shock in the global external-instrument VAR. We assess whether this matters using a paired bootstrap that resamples, with replacement, the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

Figure D.13: Accounting for estimation uncertainty in the oil supply news shock

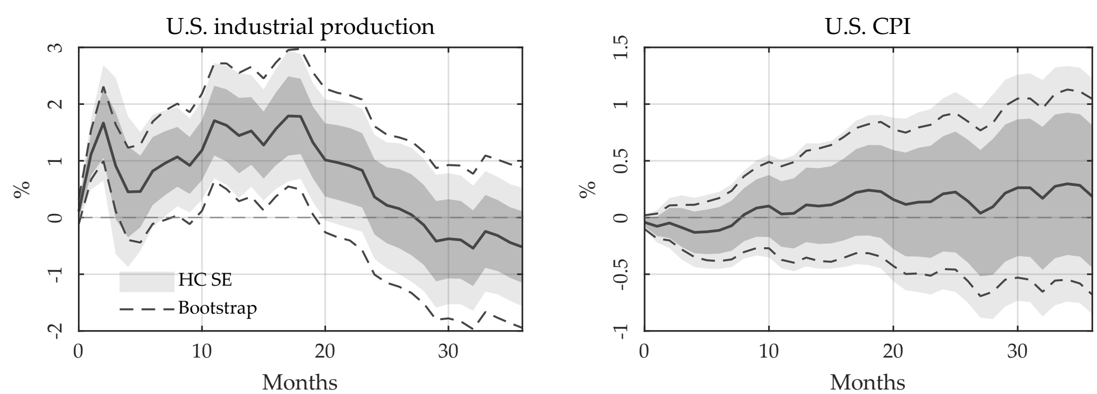
(a) Effect at pre-2010 mean



(b) Effect at 2025 mean



(c) Interaction effect with exporter status



Notes: Confidence intervals from the baseline state-dependent local projections compared with intervals from a paired bootstrap that jointly resamples the extracted shock and innovations from outcome-specific VARs. Solid lines denote point estimates, dark and light shaded areas denote baseline 68 and 90 percent confidence intervals, respectively, and dashed lines denote 90 percent bootstrap confidence intervals.

Figure D.13 compares the resulting 90 percent bootstrap bands with the baseline lag-augmentation bands for industrial production and the CPI. The bootstrapped 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 significantly at the pre-2010 trade position, movement toward exporter status significantly improves its response, and the CPI interaction remains small and statistically indistinguishable from zero.

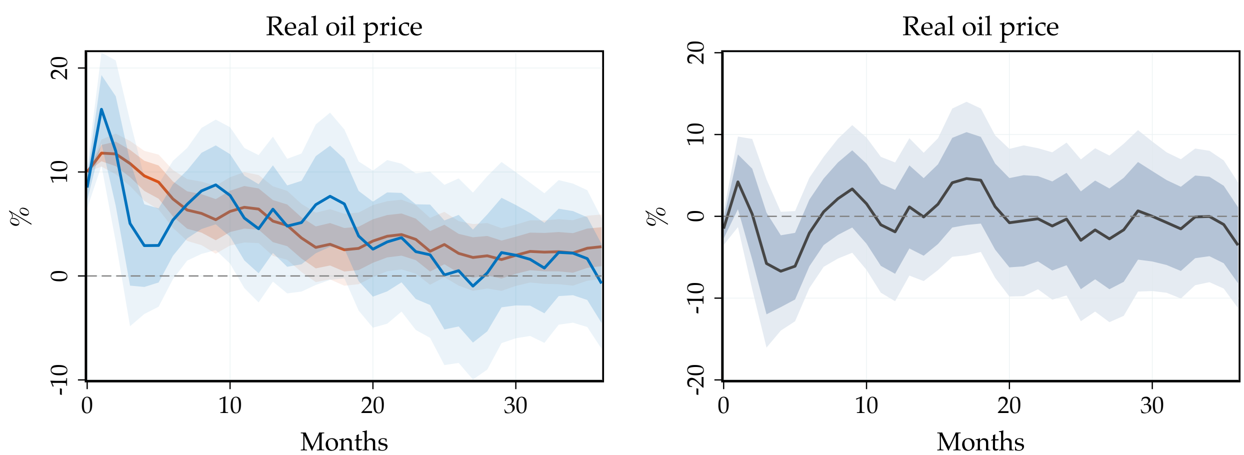
D.5. Additional Results

We next present several additional results from the state-dependent local projections that help characterize the changing transmission of oil shocks across petroleum trade positions.

D.5.1. Oil price response across regimes

One potential explanation for the different macroeconomic responses is that the same oil supply news shock generates different oil price dynamics across petroleum trade positions. Figure D.14 shows that this is not the case. Although the 2025 response fluctuates somewhat more at short horizons, both regimes display a persistent increase in the real oil price followed by a gradual decline. The estimated difference between the two responses is generally small and imprecisely estimated. Thus, the contrasting activity responses do not appear to be driven by a mechanical difference in oil price impacts across regimes.

Figure D.14: Oil price response across regimes

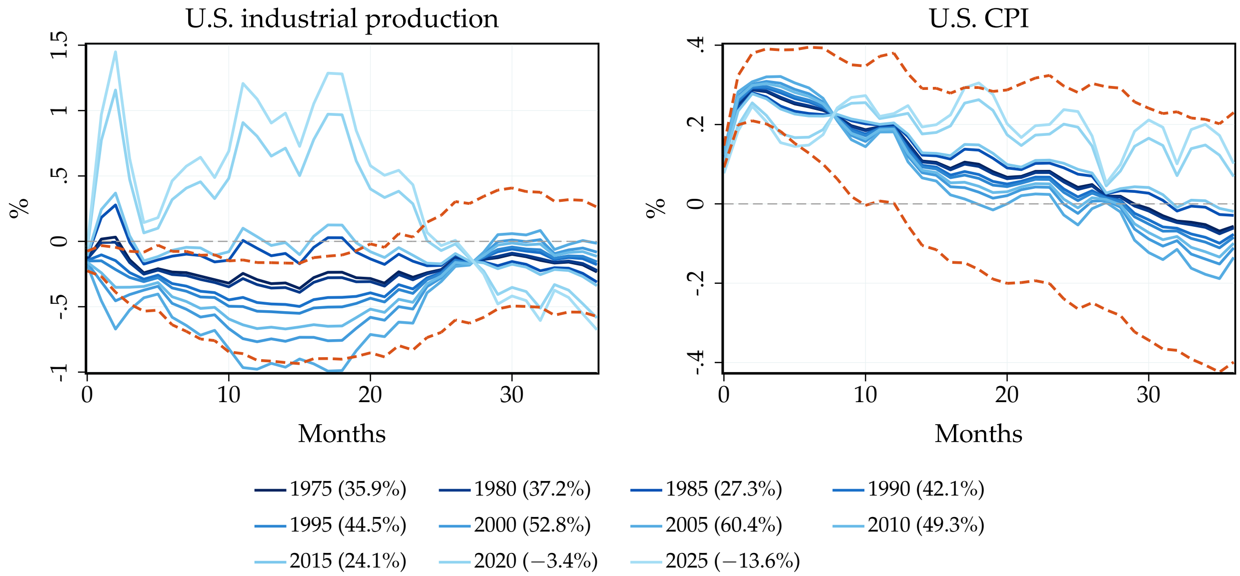


Notes: Petroleum-trade-dependent local-projection responses of the real oil price to an adverse oil supply news shock. The left panel reports responses at the average pre-2010 and 2025 U.S. petroleum trade positions; the right panel reports the change in the response between these positions. The specification, sample, and normalization follow Figure 8. Dark and light shaded areas denote 68 and 90 percent confidence intervals.

D.5.2. Evolution of continuous-state estimates over time

Figure D.15 evaluates the continuous-state estimates at average petroleum trade positions in five-year intervals. 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 D.15: Petroleum-trade-dependent responses over time

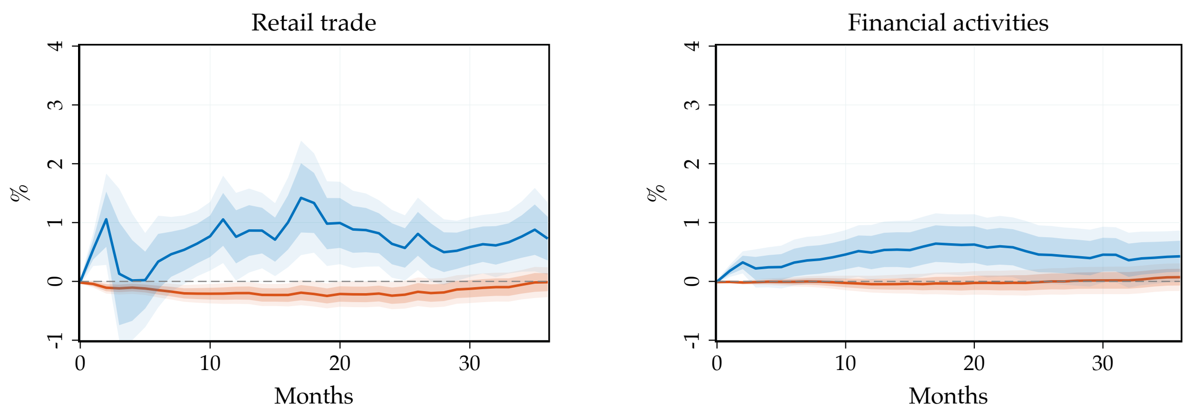


Notes: State-dependent local-projection responses evaluated at historical annual-average U.S. petroleum trade positions. Each line corresponds to the year shown in the legend, with percentages indicating net petroleum imports relative to consumption; orange dashed lines denote 90 percent confidence intervals for the response at the pre-2010 mean.

D.5.3. Additional sectoral responses

In this appendix, we expand on the sectoral responses presented in the main text. Figure D.16 adds retail trade and financial activities to the sectoral employment results. Employment responds more positively at the 2025 petroleum trade position in both sectors. The retail-trade response is particularly pronounced, while financial employment increases more gradually. These results provide further evidence that the improvement extends beyond industries directly involved in oil production.

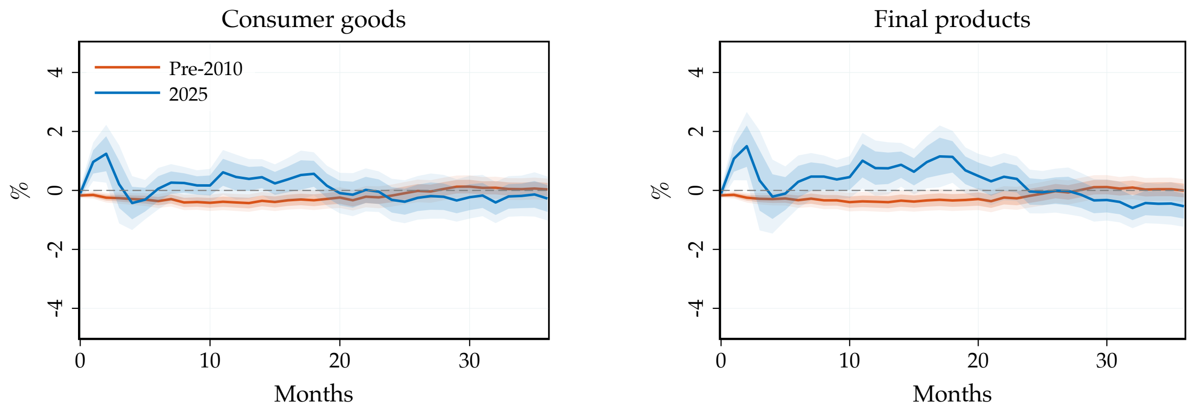
Figure D.16: Additional sectoral employment responses



Notes: Impulse responses of employment in retail trade and financial activities to an adverse oil supply news shock, estimated using (8). Each panel reports responses at the average pre-2010 and 2025 U.S. petroleum trade positions. The specification, sample, and normalization follow Figure 8. Dark and light shaded areas denote 68 and 90 percent confidence intervals.

Figure D.17 reports additional sectoral industrial-production responses for consumer goods and final products. In both cases, the response becomes more favorable at the 2025 petroleum trade position. The difference is particularly persistent for final products, which expand through much of the first two years at the 2025 position while remaining broadly flat at the pre-2010 position. These results further reinforce the broad-based nature of the improvement in real activity.

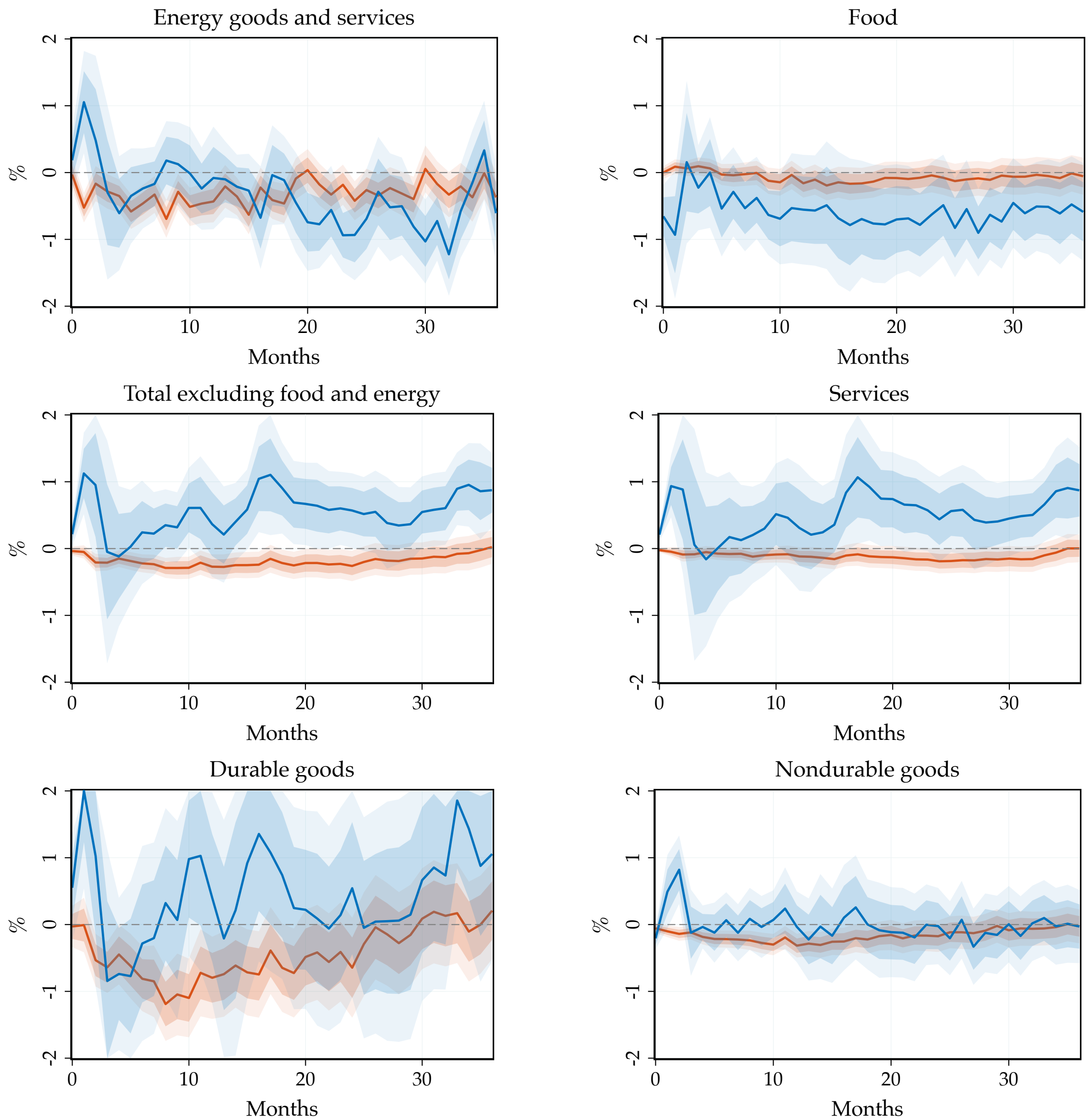
Figure D.17: Additional sectoral production responses



Notes: Impulse responses of industrial production of consumer goods and final products to an adverse oil supply news shock, estimated using (8). Each panel reports responses at the average pre-2010 and 2025 U.S. petroleum trade positions. The specification, sample, and normalization follow Figure 8. Dark and light shaded areas denote 68 and 90 percent confidence intervals.

Figure D.18 further disaggregates real personal consumption expenditures. The more favorable aggregate response at the exporter trade position is particularly evident in consumption excluding food and energy and in services. Durable-goods consumption also generally responds more favorably, although with considerable uncertainty. The pattern is not uniform: food consumption declines more at the 2025 position, and energy and nondurable-goods consumption show little sustained improvement. The aggregate consumption result thus reflects gains in important spending categories rather than a uniformly positive response across all components.

Figure D.18: Consumption responses



Notes: Impulse responses of sectoral real PCE to an adverse oil supply news shock, estimated using (8). Each panel reports responses at the average pre-2010 and 2025 U.S. petroleum trade positions. The specification, sample, and normalization follow Figure 8. Dark and light shaded areas denote 68 and 90 percent confidence intervals.

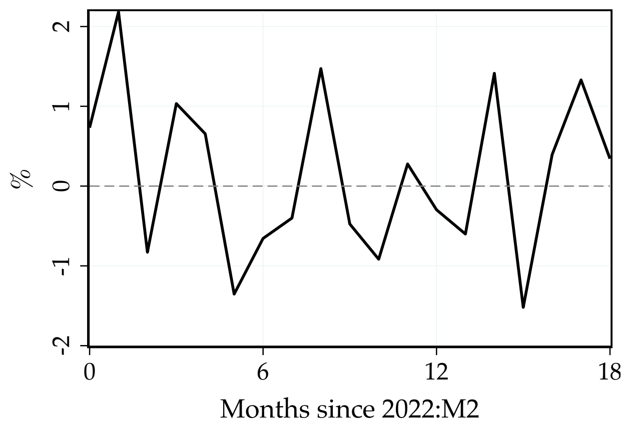
E. Additional Results for Counterfactual Analysis

Figure E.1 reports the shock sequence recovered by the dynamic inversion in (10). Positive shocks raise the oil price and negative shocks lower it. The initial positive innovations account for the sharp rise relative to the pre-invasion forecast, while the subsequent mix of positive and negative innovations matches the evolution of the oil price gap through

August 2023, taking account of the persistence of earlier shocks.

This sequence is chosen to reproduce the observed gap under the estimated oil price responses. The same recovered sequence is used for both petroleum trade positions in Figure 17, so their difference reflects the estimated change in U.S. propagation.

Figure E.1: Implied oil supply news shock sequence



Notes: The figure shows the monthly oil supply news shock sequence recovered using (10) to match the real oil price gap from February 2022 through August 2023. Positive values denote shocks that raise the real oil price. The same shock sequence is used for both petroleum trade positions in Figure 17.

References Appendix

Baumeister, Christiane and Hamilton, James D. (2019). “Structural Interpretation of Vector Autoregressions with Incomplete Identification: Revisiting the Role of Oil Supply and Demand Shocks”. *American Economic Review* 109.5, pp. 1873–1910.

Guerreiro, Joao, Hazell, Jonathon, Känzig, Diego R., and Manuel, Ed (2026). “The Macroeconomic Effect of Stimulus Checks: Evidence from Postwar Veterans’ Payments”. *Working Paper*.

Hamilton, James D. (1996). “This Is What Happened to the Oil Price-Macroeconomy Relationship”. *Journal of Monetary Economics* 38.2, pp. 215–220.

— (2003). “What Is an Oil Shock?” *Journal of Econometrics* 113.2, pp. 363–398.

Känzig, Diego R. (2021). “The Macroeconomic Effects of Oil Supply News: Evidence from OPEC Announcements”. *American Economic Review* 111.4, pp. 1092–1125.

Miranda-Agrippino, Silvia and Rey, Hélene (2020). “US Monetary Policy and the Global Financial Cycle”. *The Review of Economic Studies* 87.6, pp. 2754–2776.

Miyamoto, Wataru, Nguyen, Thuy L., and Sergeyev, Dmitriy (2026). “How Oil Shocks Propagate: Evidence on the Monetary Policy Channel”. *Working Paper*.

Mori, Lorenzo and Peersman, Gert (forthcoming). “Estimating the Macroeconomic Effects of Oil Supply News”. *The Review of Economics and Statistics*.

Stock, James H. and Watson, Mark W. (2025). “Recovering from COVID”. *Brookings Papers on Economic Activity* 2025.1, pp. 297–346.