Online Appendix for
Relative-Price Changes as Aggregate Supply Shocks Revisited: Theory and Evidence*

Hassan Afrouzi†
Columbia University and NBER

Saroj Bhattarai‡
University of Texas at Austin

Edson Wu§
University of Texas at Austin

*We thank Klaus Adam, Larry Ball, Larry Christiano, Ippei Fujiwara, Yuriy Gorodnichenko, Raphael Schoenle, Felipe Schwartzman, and conference and seminar participants at the NBER conference on Inflation in the COVID era and Beyond, Keio University, and Sabanci University for very helpful comments. We thank Raphael Schoenle for generously sharing data on frequency of price adjustment across U.S. sectors. First draft: April 2024. This draft: July 2024.

†Department of Economics, 1105A IAB, 420 West 118th St, New York, NY 10027. hassan.afrouzi@columbia.edu.

‡Department of Economics, 2225 Speedway, Stop C3100, Austin, TX 78712. saroj.bhattarai@austin.utexas.edu.

§Department of Economics, 2225 Speedway, Stop C3100, Austin, TX 78712. edsonwu91@gmail.com.

A Appendix

A.1. Proofs

A.1.1. Proof of Lemma 1.

Proof. Differentiating Equation (16) and combining it with Equation (15) we can eliminate $p^{\#}_{i,t}$ and $\dot{p}^{\#}_{i,t}$ from Equations (15) and (16) and write them as one second-order differential equation in terms of $p_{i,t}$, which in the limit of $\rho \to 0$ reads:

$$\dot{\pi}_{i,t} = \theta_i^2 (p_{i,t} - p^*_{i,t}), \forall i \in \{u, d\} \tag{A.1}$$

where $\pi_{i,t} \equiv \dot{p}_{i,t}$ is the first time derivative of $p_{i,t}$; i.e., the instantaneous rate of inflation in the sectoral price of i. We now note that

$$\begin{aligned}(1-a_{uu})(1-a_{dd})\lambda_d r_t - \alpha_u x_t &= (1-a_{uu})(1-\beta)\left((p_{u,t}-p_{d,t}) - (p_{u,t}-p_{d,t})^f\right) - \alpha_u y_t + \alpha_u y_t^f \\ &= (1-a_{uu})(p_{u,t} - p_t - p^f_{u,t} + p^f_t) - \alpha_u(-p_t + p^f_t) \\ &= (1-a_{uu})(p_{u,t} - p^f_{u,t}) = p_{u,t} - p^*_{u,t}\end{aligned}$$

where we have used the expressions for λ_d and definitions of $p^f_{u,t}$ and $p^*_{u,t}$. Substituting this into Equation (A.1) we obtain the Phillips curve for sector u. Similarly, note that

$$\begin{aligned}-(1-a_{uu})(1-a_{dd})\lambda_u r_t - \alpha_d x_t &= -((1-a_{dd})\beta + (1-\beta)a_{du})((p_{u,t}-p_{d,t}) - (p_{u,t}-p_{d,t})^f) - \alpha_d y_t + \alpha_d y_t^f \\ &= (1-a_{dd})(p_{d,t} - p^f_{d,t}) - a_{du}(p_{u,t} - p^f_{u,t}) \\ &= p_{d,t} - p^*_{d,t}\end{aligned}$$

Substituting this into Equation (A.1) we obtain the Phillips curve for sector d. ■

A.1.2. Proof of Proposition 1.

Proof. Considering the deviations of prices from the new steady state after a shock to relative prices, let $p_{u,0}$ and $p_{d,0}$ denote these log-deviations of prices in sectors u and d at time 0, right after the shock. Assuming that prior to the shock to sector u's productivity or wedge, the economy was in a steady state with zero inflation, the relationship between $p_{u,0}$ and $p_{d,0}$ is given by (comparing these prices across the two steady states under the assumption that monetary policy does not change m):

$$p_{d,0} = \frac{a_{du}}{1-a_{dd}} p_{u,0} \tag{A.2}$$

Given that prices are sticky, we are interested in how prices in sectors u and d start from these values and converge to the steady state. Under the assumption that monetary policy does not respond along the transition path; i.e., $m_t = 0, \forall t \geq 0$ (which also implies that $i_t = 0, \forall t \geq 0$), we note that

$$0 = m_t = \beta p_{u,t} + (1-\beta) p_{d,t} + y_t \tag{A.3}$$

Noting that $(p_{u,t} - p_{d,t})^f = y_t^f = 0$ along the path as well (because there are no shocks after time 0), we have

$$r_t = p_{u,t} - p_{d,t}$$
$$x_t = y_t - y_t^f = y_t = -p_{u,t} + (1-\beta) r_t$$

Plugging these into Equation (17), we have

$$\begin{aligned} \ddot{p}_{u,t} = \dot{\pi}_{u,t} &= (1-a_{uu})(1-\beta)\theta_u^2 r_t - (1-a_{uu})\theta_u^2(-p_{u,t} + (1-\beta) r_t) \\ &= (1-a_{uu})\theta_u^2 p_{u,t} \end{aligned} \tag{A.4}$$

which is second-order differential equation only in terms of $p_{u,t}$ with the initial condition that $p_{u,0}$ is given as well as the boundary condition that $p_{u,t}$ should converge back to its steady state ($\lim_{t\to\infty} p_{u,t} = 0$). It follows that

$$p_{u,t} = p_{u,0} e^{-\xi_u t}, \qquad \xi_u = \theta_u \sqrt{1-a_{uu}} \tag{A.5}$$

Now, plugging the expression for r_t and x_t, as well as the solution to $p_{u,t}$ into Equation (18), we have

$$\ddot{p}_{d,t} = \dot{\pi}_{d,t} = \xi_d^2 p_{d,t} - \frac{a_{du}}{1-a_{dd}} \xi_d^2 p_{u,0} e^{-\xi_u t} \tag{A.6}$$

which is a second-order differential equation in $p_{d,t}$ with the initial condition that $p_{d,0}$ is given as well as the boundary condition that $p_{d,t}$ should converge back to its steady state ($\lim_{t\to\infty} p_{d,t} = 0$). It follows that

$$p_{d,t} = \frac{a_{du}}{1-a_{dd}} \frac{p_{u,0}}{\xi_d^2 - \xi_u^2} \left(\xi_d^2 e^{-\xi_u t} - \xi_u^2 e^{-\xi_d t} \right) \tag{A.7}$$

where $p_{u,0}$ captures the initial distortion in relative prices caused by the shock to sector u. Differentiating the solutions for $p_{u,t}$ and $p_{d,t}$, we have:

$$\left. \frac{\partial \pi_{u,t}}{\partial \pi_{u,0}} \right|_{z_u} = e^{-\xi_u t} \tag{A.8}$$

$$\left. \frac{\partial \pi_{d,t}}{\partial \pi_{u,0}} \right|_{z_u} = \frac{a_{du}}{1-a_{dd}} \frac{\xi_d}{\xi_d + \xi_u} \left(\frac{\xi_d e^{-\xi_u t} - \xi_u e^{-\xi_d t}}{\xi_d - \xi_u} \right) \tag{A.9}$$

Moreover, to see why this spillover inflation is positive along the whole path, note that its sign depends only on the sign of the term within parentheses. Now, first consider the case of $\xi_u > \xi_d$, in which case this term is positive if $e^{-\xi_u t}/\xi_u > e^{-\xi_d t}/\xi_d$, which is true given $\xi_d > \xi_u$ because the function $f(x) = e^{-xt}/x$ is positive strictly decreasing in $x > 0$ for any positive $t > 0$. Now, consider $\xi_u > \xi_d$ and note that now the term inside parentheses is positive if $e^{-\xi_u t}/\xi_u < e^{-\xi_d t}/\xi_d$ which is true for same reason as before. Finally, the case of $\xi_u = \xi_d$ can be obtained by taking the limit of $\xi_u \to \xi \equiv \xi_d$ (or vice versa) which yields

$$\lim_{\xi_u \to \xi \equiv \xi_d} \left. \frac{\partial \pi_{d,t}}{\partial \pi_{u,0}} \right|_{z_u} = \frac{1}{2} \frac{a_{du}}{1-a_{dd}} (1+\xi t) e^{-\xi t} > 0 \tag{A.10}$$

■

A.1.3. Proof of Corollary 1.

Proof. From Equations (A.8) and (A.9) note that

$$\frac{\partial \pi_{u,t}}{\partial \pi_{u,0}}\Big|_{z_u} = e^{-\xi_u t} \tag{A.11}$$

$$\frac{\partial \pi_{d,t}}{\partial \pi_{d,0}}\Big|_{z_u} = \frac{\xi_d e^{-\xi_u t} - \xi_u e^{-\xi_d t}}{\xi_d - \xi_u} \tag{A.12}$$

Given that $\xi_d > \xi_u > 0$ by assumption we see that $\frac{\partial \pi_{d,t}}{\partial \pi_{d,0}}\Big|_{z_u} > \frac{\partial \pi_{u,t}}{\partial \pi_{u,0}}\Big|_{z_u}$ if and only if:

$$\xi_d e^{-\xi_u t} - \xi_u e^{-\xi_d t} > (\xi_d - \xi_u) e^{-\xi_u t} \iff e^{-\xi_d t} < e^{-\xi_u t} \iff \xi_d t > \xi_u t \tag{A.13}$$

where the last statement is true as long as $t > 0$. ■

A.1.4. Proof of Proposition 2.

Proof. **Part 1.** On a path where monetary policy engineers $x_t = 0, \forall t \geq 0$, we can add and subtract the sectoral Phillips curves in Equations (17) and (18) to re-write them as:

$$\ddot{r}_t = (1 - a_{uu})(1 - a_{dd})(\lambda_d \theta_u^2 + \lambda_u \theta_d^2) r_t$$

$$\frac{\dot{\pi}_{u,t}}{\lambda_d \theta_u^2} + \frac{\dot{\pi}_{d,t}}{\lambda_u \theta_d^2} = 0$$

These are both second-order differential equations, which, subject to the boundary conditions r_0 given and stability of prices uniquely characterize the path of both price indices over time. To see this note that, subject to these boundary conditions, the first equation implies:

$$r_t = r_0 e^{-\bar{\xi} t}, \quad \bar{\xi} \equiv \sqrt{(1 - a_{uu})(1 - a_{dd})(\lambda_d \theta_u^2 + \lambda_u \theta_d^2)}$$

while integrating the second one twice implies:

$$\frac{p_{u,t}}{\lambda_d \theta_u^2} + \frac{p_{d,t}}{\lambda_u \theta_d^2} = K_0 + K_1 t$$

for some constants K_0 and K_1 that should be chosen to satisfy the boundary conditions implied by the equilibrium prices. First, since we are working with a log-linearized approximation around a zero-inflation steady state, there could be no-trends in prices implying $K_1 = 0$. Second, we must have prices converging back to their steady-state levels as $t \to \infty$, which gives:

$$\lim_{t \to \infty} \left(\frac{p_{u,t}}{\lambda_d \theta_u^2} + \frac{p_{d,t}}{\lambda_u \theta_d^2} \right) = 0$$

implying that $K_0 = 0$ (because $p_{d,t}$ and $p_{u,t}$ are defined as deviations from the steady-state as $t \to \infty$). Therefore,

$$\lambda_u \theta_d^2 p_{u,t} + \lambda_d \theta_u^2 p_{d,t} = 0$$

Dividing by $(\lambda_u \theta_d^2 + \lambda_d \theta_u^2)$ we get

$$\frac{\lambda_u \theta_d^2}{\lambda_u \theta_d^2 + \lambda_d \theta_u^2} p_{u,t} + \frac{\lambda_d \theta_u^2}{\lambda_u \theta_d^2 + \lambda_d \theta_u^2} p_{d,t} = 0, \forall t \geq 0 \tag{A.14}$$

$$\implies p_{u,t} = \frac{\lambda_d \theta_u^2}{\lambda_u \theta_d^2 + \lambda_d \theta_u^2} r_0 e^{-\bar{\xi} t}, \quad p_{d,t} = -\frac{\lambda_u \theta_d^2}{\lambda_u \theta_d^2 + \lambda_d \theta_u^2} r_0 e^{-\bar{\xi} t}$$

where we have used the fact that $r_t = p_{u,t} - p_{d,t} = r_0 e^{-\bar{\xi} t}$.

Part 2. Having specified the path of sectoral prices, we can now calculate the aggregate price level and inflation rate as

$$p_t = \beta p_{u,t} + (1-\beta) p_{d,t} = \left(\beta - \frac{\lambda_u \theta_d^2}{\lambda_u \theta_d^2 + \lambda_d \theta_d^2}\right) r_t$$

$$\implies \pi_t = -\bar{\xi} \left(\beta - \frac{\lambda_u \theta_d^2}{\lambda_u \theta_d^2 + \lambda_d \theta_d^2}\right) r_t$$

■

A.2. Proof of Proposition 3

Proof. Follows from definition of ζ and the expression for the the Domar weights λ_u and λ_d. ■

A.3. Data and sources

Variable	Source	Series Code
PCE Price Index	St. Louis FRED	PCEPI
PCE Core Price Index	St. Louis FRED	PCEPILFE
Unemployment Rate	St. Louis FRED	UNRATE
Real PCE Quantity Index	St. Louis FRED	DPCERA3M086SBEA
PPI	St. Louis FRED	PPIACO
PPI Oil and gas extraction	St. Louis FRED	PCU21112111
PPI Petroleum and Coal Products Mfg	St. Louis FRED	PCU32413241
PCE Price Indices by Type of Product	Table 2.4.4U.	
Real PCE by Type of Product, Quantity Indices	Table 2.4.3U.	
IO Use Table Before Redefinitions PRO	BEA	
PCE Bridge at Summary level	BEA	
Frequency of price adjustment	Pastel et al. (2020)	
Import Matrices Before Redefinitions SUM	BEA	
PCE Energy Price Index	St. Louis FRED	DNRGRG3M086SBEA
Import Price Index	St. Louis FRED	IR
Import Price Ex-Petroleum Index	St. Louis FRED	IREXPET
Average hourly earnings	St. Louis FRED	AHETPI
PCE Durable Goods Price Index	St. Louis FRED	DDURRG3M086SBEA
PCE Non-Durable Goods Price Index	St. Louis FRED	DNDGRG3M086SBEA
PCE Goods Price Index	BEA: Table 2.4.4U.	
PCE Services Price Index	BEA: Table 2.4.4U.	
Real PCE Goods Quantity Index	BEA: Table 2.8.3.	
Real PCE Services Quantity Index	BEA: Table 2.8.3.	
Oli Supply News Shock	https://github.com/dkaenzig/oilsupplynews	
Global Supply Chain Pressure Index	https://www.newyorkfed.org/research/policy/gscpi	

Table A.1: Variables and data used in the regressions.

PPI energy. We construct a measure of PPI energy by calculating the simple geometric mean between the PPI oil and gas extraction and the PPI petroleum and coal products mfg. That is,

$$\text{PPI energy}_t \equiv \left(\text{PPI oil and gas extraction}_t^{1/2}\right)\left(\text{PPI petroleum and coal products mfg}_t^{1/2}\right)$$

Input-Output table (A) and Personal consumption expenditures ($\boldsymbol{\beta}$). We use the 1997 IO use table before redefinition in producers' value at the Summary level disaggregation. We disregard the distinction between commodities and industries and assume that each industry produces only one commodity. Furthermore, we exclude the government sectors (GFGD, GFGN, GFE, GSLG, GSLE), Scrap, used and secondhand goods (Used), Noncomparable imports and rest-of-the-world adjustment (Other)[1]. After this, we end up with 66 sectors. For the empirics, we also perform the following: (1) we collapse the retail summary sectors into a single retail sector. That is, we collapse Motor vehicles and parts dealers (441), Food and beverage stores (445), General merchandise stores (452), and Other retail (4A0) into a single retail sector; (2) we collapse Oil and gas extraction (211) and Petroleum and coal products (324) into a single Total oil sector. We end up with 62 sectors.

Frequency of price adjustment. We use data from Pasten, Schoenle, and Weber (2020). The data comes at a more disaggregated level than the disaggregation we use (Summary level). We aggregate it into our disaggregation level by taking the simple average of frequency of price adjustment among industries within our disaggregation level for which we have data.

Sufficient Statistics for PCE categories. An important component of our analysis is the NIPA PCE bridge table. We use the 1997 PCE bridge table. For each PCE category, the rows of the bridge table shows the commodities included in it, the producers' value of the commodity, and the transportation costs and trade margins required to move the commodity from producer to consumer.

We are interested in $\left[\frac{a_{ji}}{1-a_{jj}}\frac{\theta_j\sqrt{1-a_{jj}}}{\theta_j\sqrt{1-a_{jj}}+\theta_i\sqrt{1-a_{ii}}}\right]_{j \text{ is PCE category}}$ where j is a PCE category. We do not directly observe the cost shares in terms of PCE categories, a_{ji}, their frequency of price adjustment θ_j, or their own category input share a_{jj}. However, we do observe the IO commodities that compose this PCE category, along with its producers' value, transportation costs, and trade margins.

To overcome this limitation, to calculate the sufficient statistic, we take a weighted average of the sufficient statistic for each IO sector that is included in j's PCE category. The weights are given by the share of PCE purchasers' value ex-transportation cost accounted for the respective IO sector. We include wholesale margins and retail margins as rows in the bridge. These would correspond to the Wholesale Trade (42) and the consolidated Retail Sector (441, 445, 452, 4A0). The reason why we exclude transportation cost is because at the Summary level, we cannot assign to which one of the transportation sectors (481, 482, 483, 484, 486, 487) this cost refers to. Similarly, the reason why we collapse the retail sectors into one retail sector is because we cannot assign the margin to the corresponding IO retail sector.

[1] Baqaee and Farhi (2020) adopts a similar procedure.

Two-sector parameterization. In the theory section, we use a two-sector model with upstream and downstream sectors. We define the flexible upstream sector as the Oil and gas extraction (211), Petroleum and coal products (324), Utilities (22), Primary metals (331), Wholesale trade (42), Farms (111CA), Other real estate (ORE), and Federal Reserve banks, credit intermediation, and related activities (521CI) sectors. All other sectors are defined as sticky downstream sectors. For the frequency of price adjustment, we first calculate the continuous-time FPA, then we calculate the sectoral duration $1/\theta_i$. Then, we take the simple average of the sectoral duration among sectors that belong to the upstream and downstream sectors. Finally, we recover the upstream and downstream FPA by calculating $\theta_j = 1/\text{duration}_j$, $j \in \{\text{upstream}, \text{downstream}\}$. To construct $\mathbf{A}$ and $\boldsymbol{\beta}$ we use the IO use table, collapsing the IO sectors that belong to upstream and downstream sectors. We end up with the following objects:

$$\boldsymbol{\beta} = \begin{pmatrix} \beta_{\text{upstream}} \\ \beta_{\text{downstream}} \end{pmatrix} = \begin{pmatrix} 0.1003 \\ 0.8996 \end{pmatrix}$$

$$\mathbf{A} = \begin{bmatrix} a_{uu} & a_{ud} \\ a_{du} & a_{dd} \end{bmatrix} = \begin{bmatrix} 0.3102 & 0.3668 \\ 0.1346 & 0.4703 \end{bmatrix}$$

where the sector u is the upstream sector, and sector d is the downstream sector. Finally,

$$\Theta = \begin{bmatrix} \theta_{\text{upstream}} & 0 \\ 0 & \theta_{\text{downstream}} \end{bmatrix} = \begin{bmatrix} 0.2899 & 0 \\ 0 & 0.0920 \end{bmatrix}$$

A.4. Additional results for aggregate effects

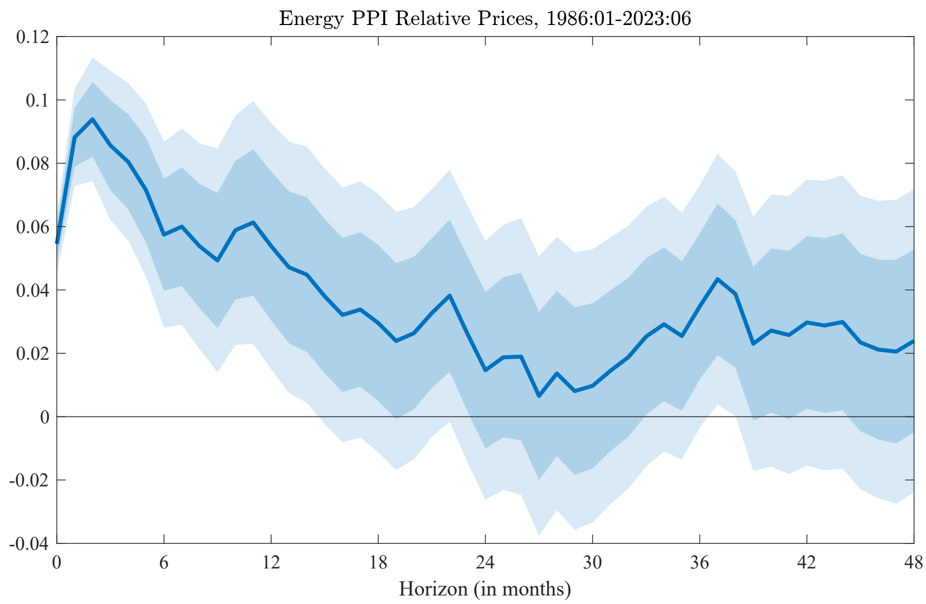

Figure A.1: Relative PPI energy prices impulse responses to an oil supply news shock

Notes: This figure plots impulse responses of relative energy PPI. The measure is relative to the aggregate PPI. This measure is defined as the simple geometric average of relative Oil and gas extraction PPI and relative Petroleum and gas extraction PPI. The shock is the oil supply news shock from Kanzig (2021). The dependent variable is measured in log and the independent variable is in units of the shock. The shock is such that a unit shock leads to a 10.88% increase in the Brent oil prices on impact. Sample period: 1986:01 - 2023:06. Standard errors are robust to heteroskedasticity and autocorrelation. The shaded area corresponds to 68% and 90% confidence intervals.

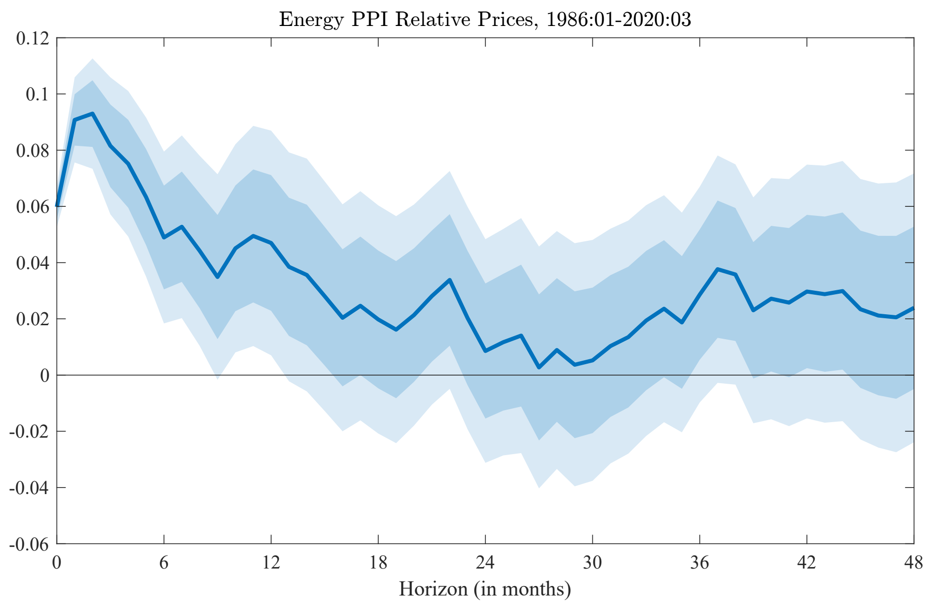

Figure A.2: Relative PPI energy prices impulse responses to an oil supply news shock

Notes: This figure plots impulse responses of relative energy PPI. The measure is relative to the aggregate PPI. This measure is defined as the simple geometric average of relative Oil and gas extraction PPI and relative Petroleum and gas extraction PPI. The shock is the oil supply news shock from Kanzig (2021). The dependent variable is measured in log and the independent variable is in units of the shock. The shock is such that a unit shock leads to a 10.88% increase in the Brent oil prices on impact. Sample period: 1986:01 - 2020:03. Standard errors are robust to heteroskedasticity and autocorrelation. The shaded area corresponds to 68% and 90% confidence intervals.

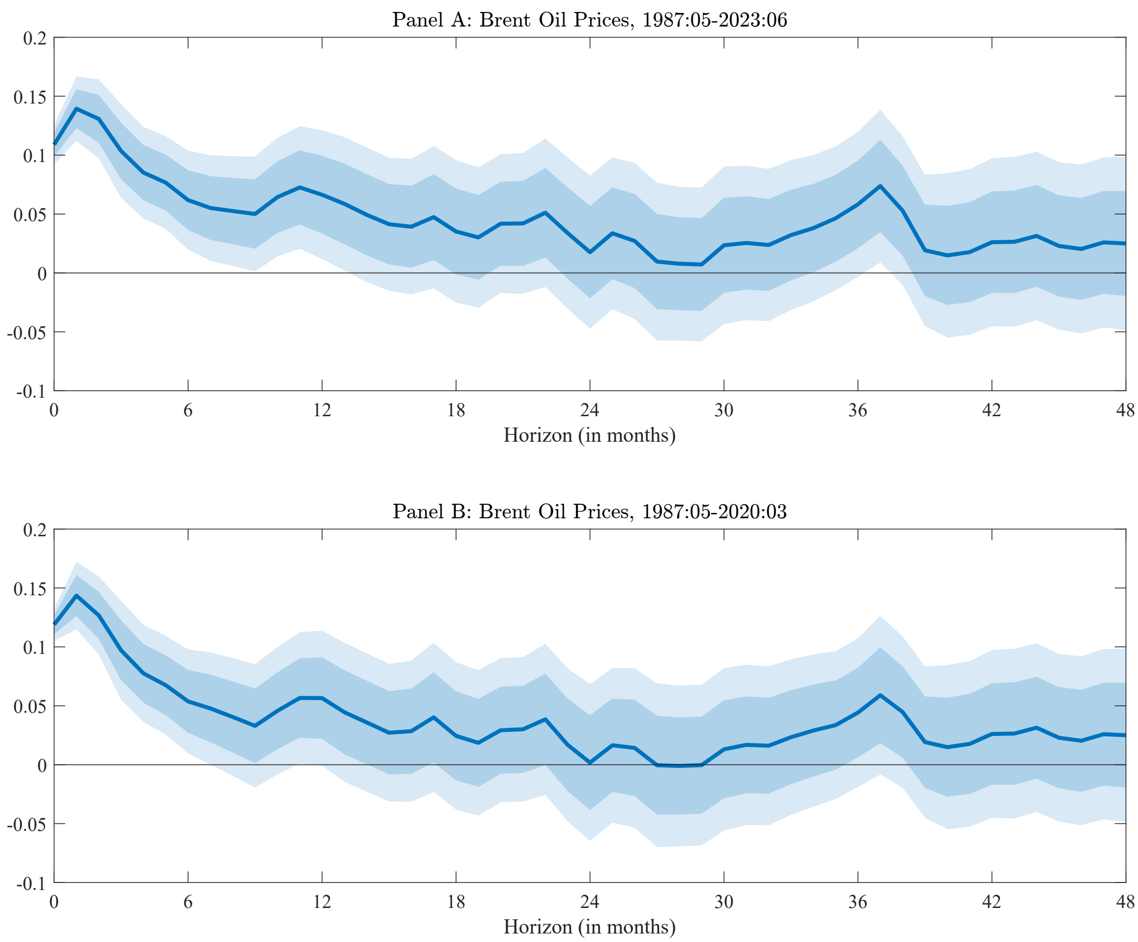

Figure A.3: Impulse responses to a Kanzig shock

Notes: This figure plots impulse responses of Brent oil prices. The shock is the oil supply news shock from Kanzig (2021). The dependent variable is measured in log and the independent variable is in units of the shock. In panel A, a one unit shock leads to a 10.88% increase in oil prices on impact. Standard errors are robust to heteroskedasticity and autocorrelation. The shaded area corresponds to 68% and 90% confidence intervals.

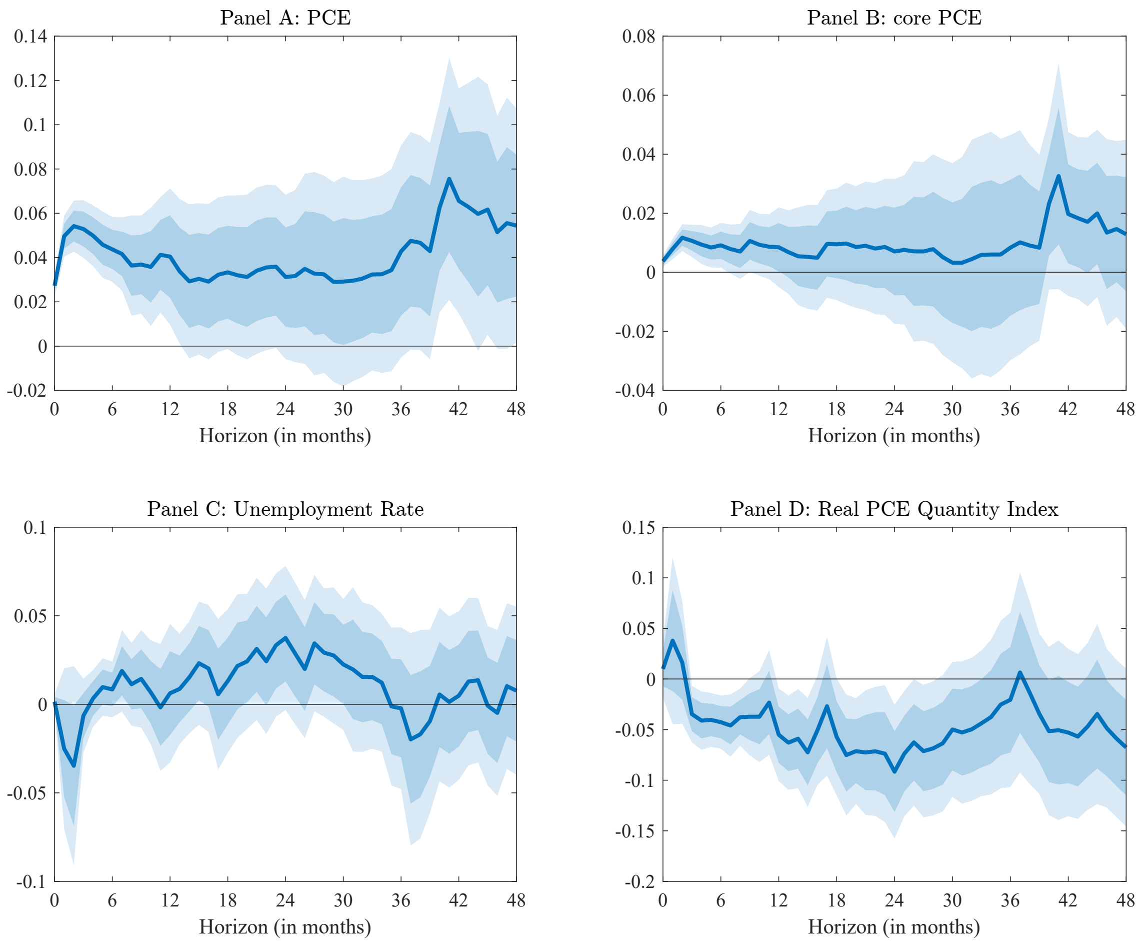

Figure A.4: Impulse responses to a shock to the relative price of energy

Notes: This figure plots impulse responses of PCE headline inflation, PCE core inflation, the unemployment rate, and the real PCE quantity index. The shock is to the relative price of energy. The relative price of energy is measured as a simple geometric mean of relative Oil and gas extraction PPI and relative Petroleum and coal products PPI (relative to the aggregate PPI) and is instrumented by the oil supply news shock by Kanzig (2021). The dependent variable and the independent variable are expressed in log. Hence, the coefficients represent elasticities. Sample period: 1986:01 - 2020:03. Standard errors are robust to heteroskedasticity and autocorrelation. The shaded area corresponds to 68% and 90% confidence intervals.

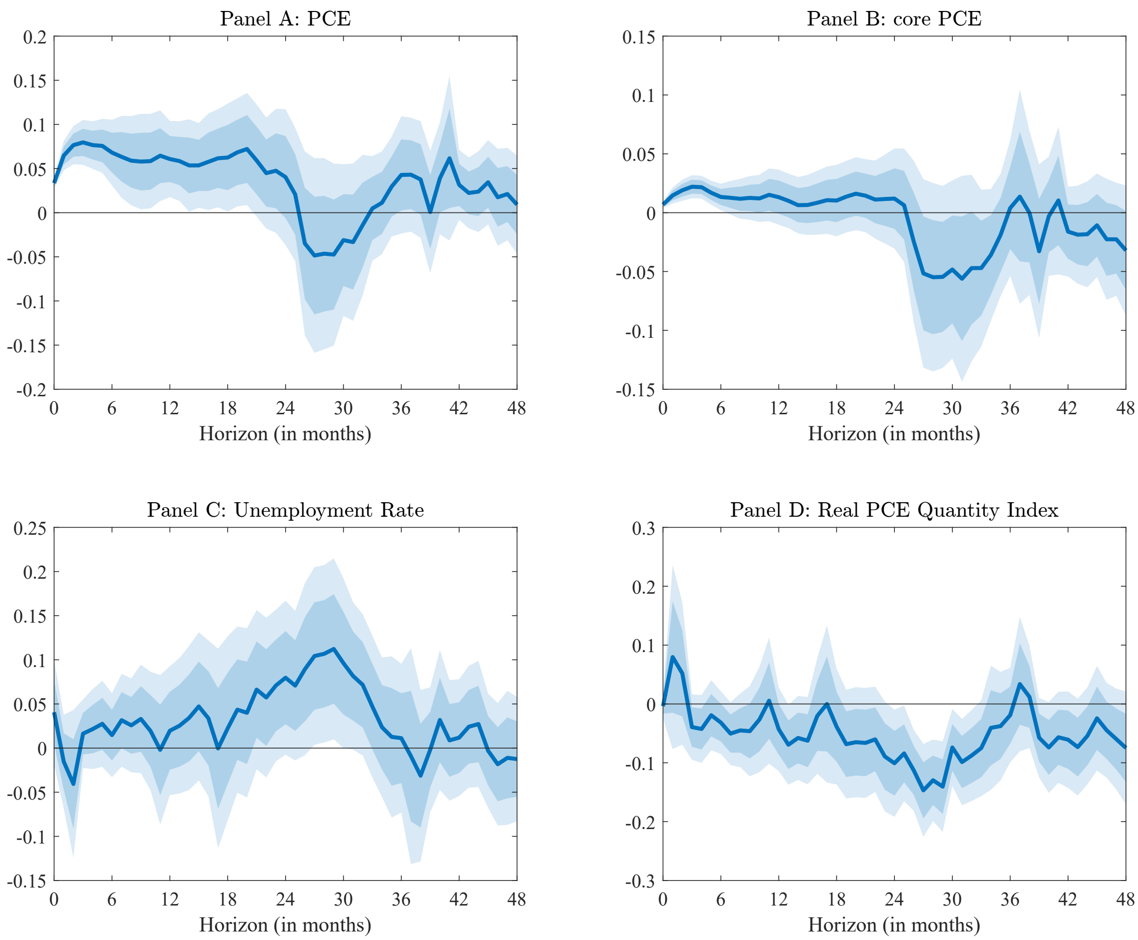

Figure A.5: Impulse responses to a shock to the relative price of energy

Notes: This figure plots impulse responses of PCE headline inflation, PCE core inflation, the unemployment rate, and the real PCE quantity index. The shock is to the relative price of energy. The relative price of energy is measured as a simple geometric mean of relative Oil and gas extraction PPI and relative Petroleum and coal products PPI (relative to the aggregate PPI). Sample period: 2008:01 - 2023:06. Both the dependent variable and the independent variable are expressed in log. Hence, the coefficients represent elasticities. Standard errors are robust to heteroskedasticity and autocorrelation. The shaded area corresponds to 68% and 90% confidence intervals.

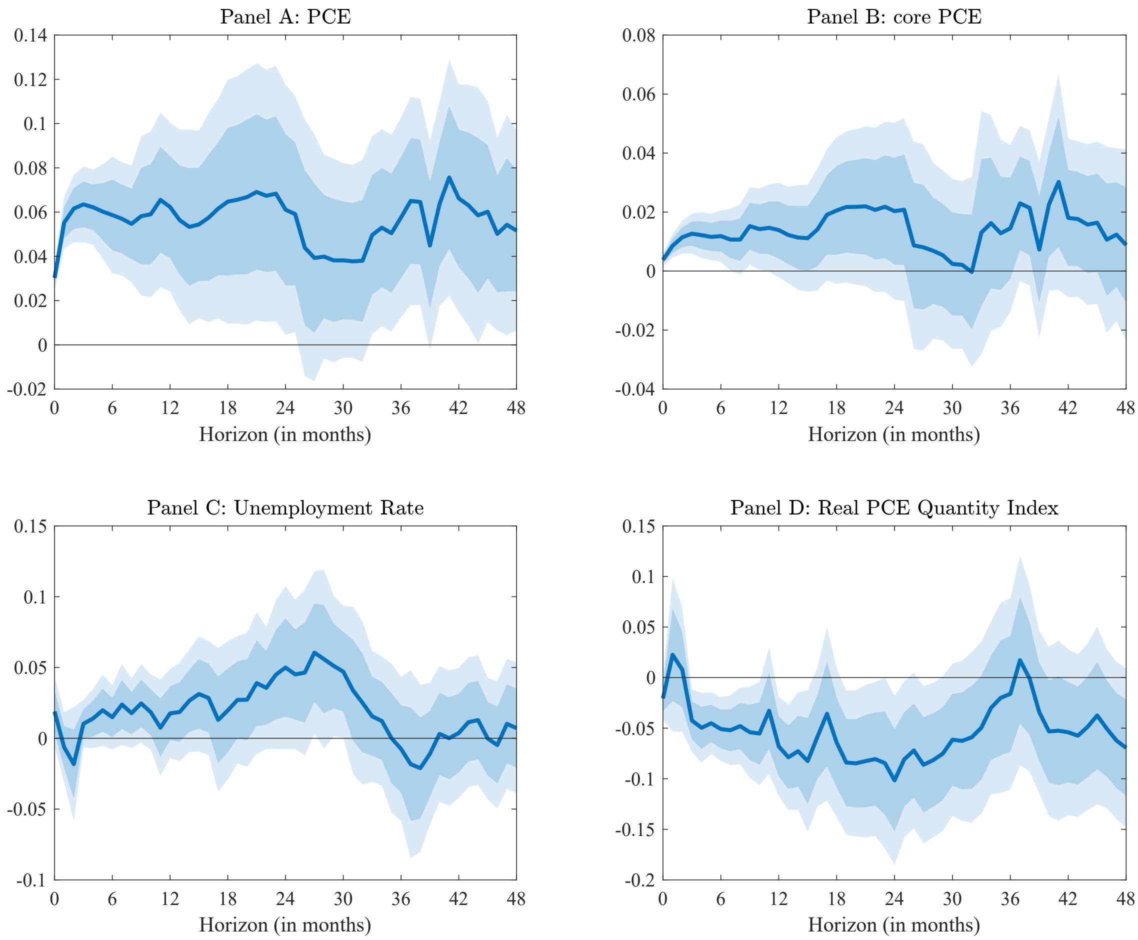

Figure A.6: Impulse responses to a shock to the relative price of energy

Notes: This figure plots impulse responses of PCE headline inflation, PCE core inflation, the unemployment rate, and the real PCE quantity index. The shock is to the relative price of energy. The relative price of energy is measured as a simple geometric mean of relative Oil and gas extraction PPI and relative Petroleum and coal products PPI (relative to the aggregate PPI). The specification uses lagged real wages as controls. Both the dependent variable and the independent variable are expressed in log. Hence, the coefficients represent elasticities. Sample period: 1986:01 - 2023:06. Standard errors are robust to heteroskedasticity and autocorrelation. The shaded area corresponds to 68% and 90% confidence intervals. First stage F-stat: Panel A: 84.77. Panel B: 78.55. Panel C: 113.10. Panel D: 116.99.

A.5. Additional results for heterogeneous effects

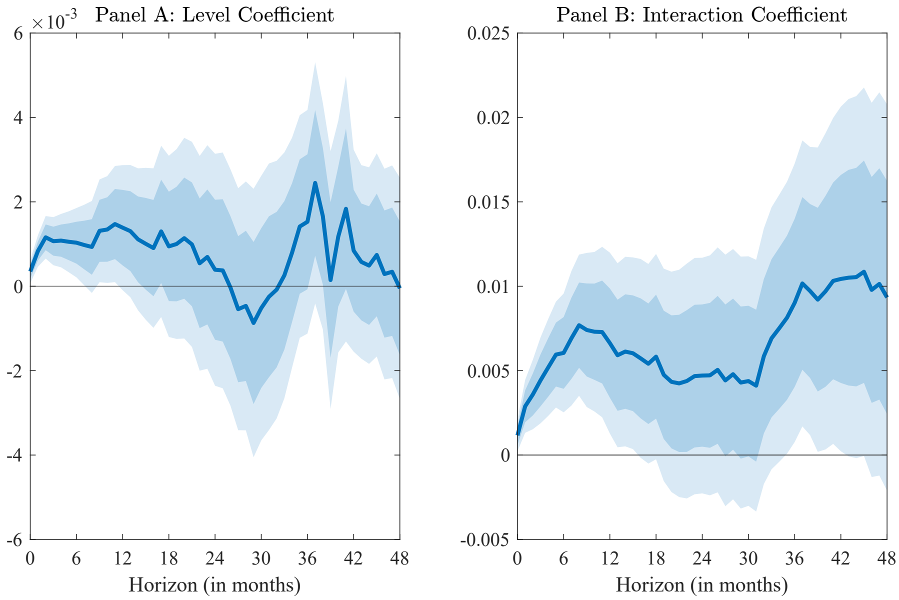

Figure A.7: Estimated panel Local Projections coefficients to a Kanzig (2021) shock

Notes: This figure plots the estimated panel Local Projections coefficients to an oil supply news shock, where the dependent variable is the sectoral PCE price index. Reduced form specification. The dependent variable is measured in log and the independent variable is in units of the shock. The shock is such that a unit shock leads to a 10.88% increase in the Brent oil prices on impact. Sample period: 1998:01 - 2023:06. Standard errors are Driscoll-Kraay. The shaded area corresponds to 68% and 90% confidence intervals.

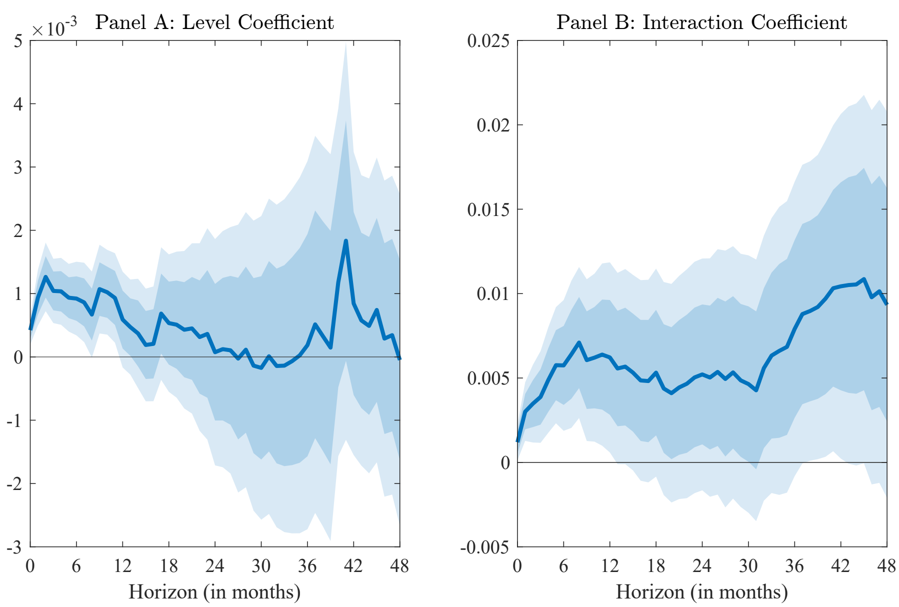

Figure A.8: Estimated panel Local Projections coefficients to a Kanzig (2021) shock

Notes: This figure plots the estimated panel Local Projections coefficients to an oil supply news shock, where the dependent variable is the sectoral PCE price index. Reduced form specification. The dependent variable is measured in log and the independent variable is in units of the shock. The shock is such that a unit shock leads to a 10.88% increase in the Brent oil prices on impact. Sample period: 1998:01-2020:03. Standard errors are Driscoll-Kraay. The shaded area corresponds to 68% and 90% confidence intervals.

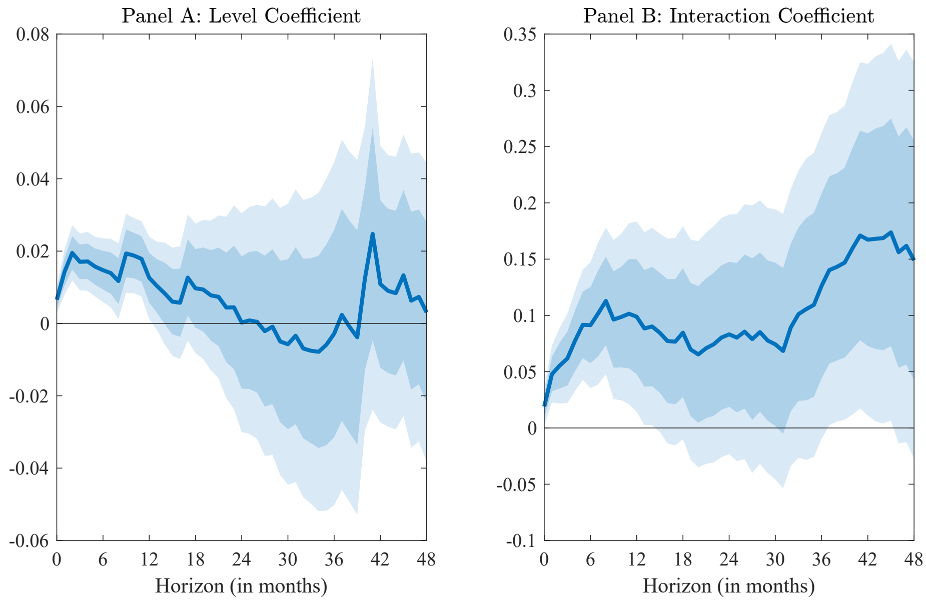

Figure A.9: Estimated panel Local Projections coefficients to a shock to the relative price of energy

Notes: This figure plots the estimated panel Local Projections coefficients to a shock to the relative price of energy, where the dependent variable is the sectoral PCE price index. The relative price of energy is instrumented by the oil supply news shock from Kanzig (2021). The dependent variable and the independent variable are expressed in log. Hence, the coefficients represent elasticities. Sample period: 1998:01 - 2020:03. Standard errors are Driscoll-Kraay. The shaded area corresponds to 68% and 90% confidence intervals. F-stat: 49.9697.

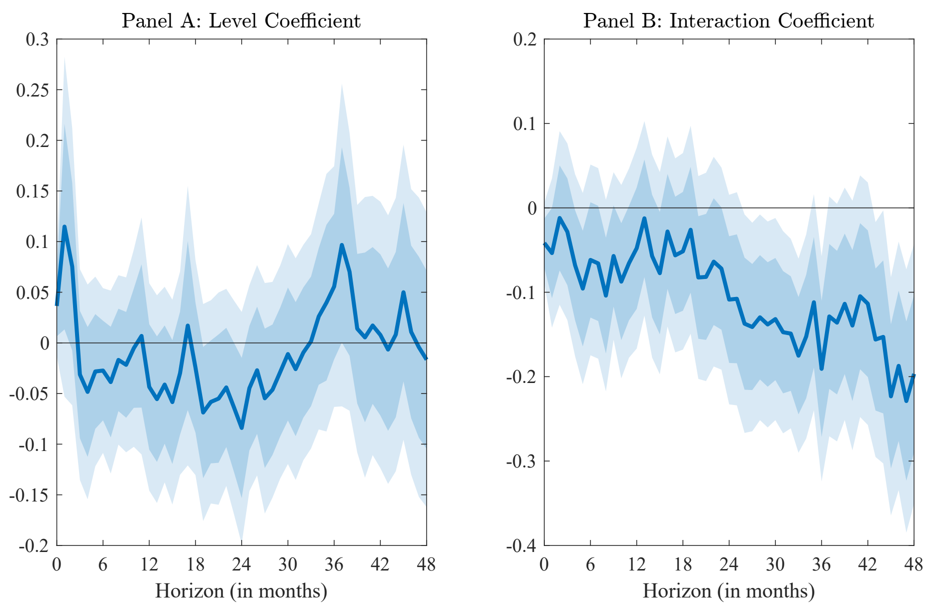

Figure A.10: Estimated panel Local Projections coefficients to a shock to the relative price of energy

Notes: This figure plots the estimated panel Local Projections coefficients to a shock to the relative price of energy, where the dependent variable is the sectoral PCE quantity index. The relative price of energy is instrumented by the oil supply news shock from Kanzig (2021). The dependent variable and the independent variable are expressed in log. Hence, the coefficients represent elasticities. Sample period: 1998:01 - 2020:03. Standard errors are Driscoll-Kraay. The shaded area corresponds to 68% and 90% confidence intervals.

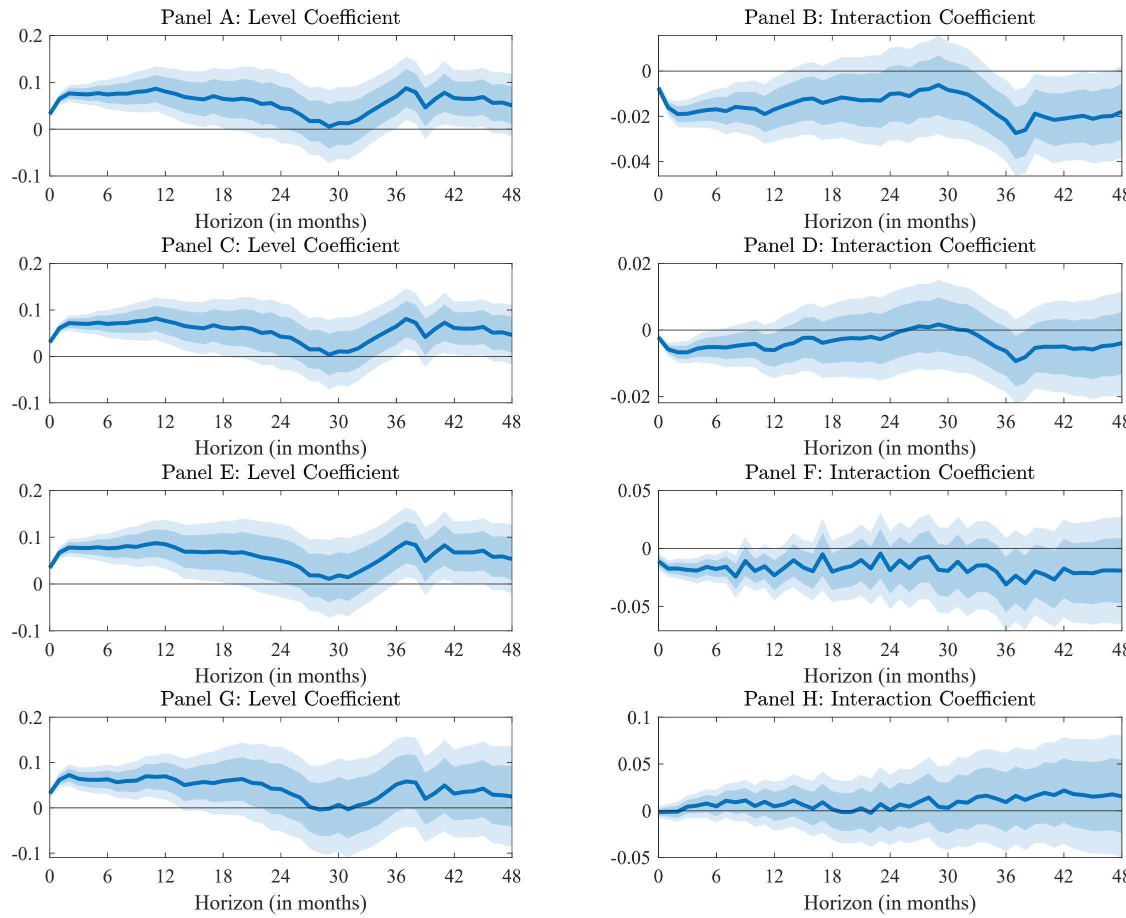

Figure A.11: Estimated panel Local Projections coefficients to a shock to the relative price of energy

Notes: This figure plots the estimated panel Local Projections coefficients to a shock to the relative price of energy, where the dependent variable is the sectoral PCE price index. The relative price of energy is instrumented by the oil supply news shock from Kanzig (2021). The dependent variable and the independent variable are expressed in log. Hence, the coefficients represent elasticities. Sample period: 1998:01 - 2023:06. Panel A, B: Ambulatory health care services. F-stat: 50.3411. Panel C, D: Hospitals. F-stat: 50.3452. Panel E, F: Insurance carriers and related activities. F-stat: 51.46013. Panel G, H: Legal services. F-stat: 50.496. Standard errors are Driscoll-Kraay. The shaded area corresponds to 68% and 90% confidence intervals.

A.6. Robustness and extensions on sectoral effects

A.6.1. Time Fixed Effects Regressions. In this subsection we run an alternative specification including time fixed effects which should account for common shocks that affect all PCE categories. Figure A.12 shows that our sufficient statistics do predict the response of sectoral inflation to oil supply shocks correctly even after taking into account time fixed effects. More specifically, we run

$$\log P_{jt+h} - \log P_{jt-1} = \beta_1^{(h)} \times \left(\frac{a_{ji}}{1-a_{jj}} \frac{\theta_j \sqrt{1-a_{jj}}}{\theta_j \sqrt{1-a_{jj}} + \theta_i \sqrt{1-a_{ii}}} \right) \times \left(\log(\frac{\text{PPI energy}_t}{\text{PPI}_t}) - \log(\frac{\text{PPI energy}_{t-1}}{\text{PPI}_{t-1}}) \right)$$
$$+ \sum_{k=1}^{12} \gamma_k^{(h)} (\log P_{jt-k} - \log P_{jt-k-1}) + FE_t + \epsilon_{jt}$$

instrumenting the change in the relative prices of energy with the oil supply news shock from Kanzig (2021). FE_t is the time fixed effect.

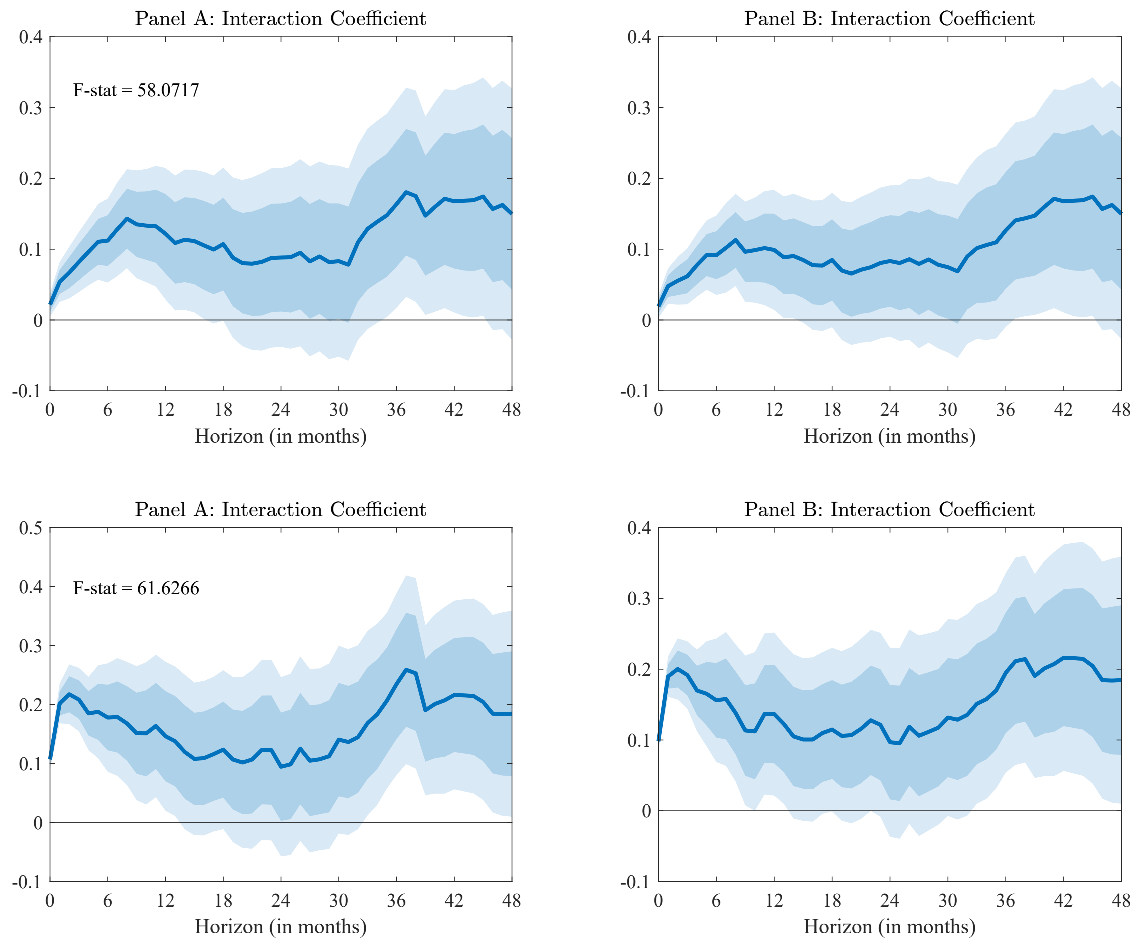

Figure A.12: Estimated panel Local Projections coefficients to a shock to the relative price of energy

Notes: This figure plots the estimated panel Local Projections coefficients to a shock to the relative price of energy, where the dependent variable is the sectoral PCE price index. The relative price of energy is instrumented by the oil supply news shock from Kanzig (2021). The dependent variable and the independent variable are expressed in log. Hence, the coefficients represent elasticities. Specification with time fixed effects. Panel A: Ex-PCE categories with positive Petroleum and coal products or Oil and gas extraction producers' value. 1998:01-2023:06. F-stat: 58.0717. Panel B: Ex-PCE categories with positive Petroleum and coal products or Oil and gas extraction producers' value. 1998:01-2020:03. Panel C: All PCE categories. 1998:01-2023:06. F-stat: 61.6266. Panel D: All PCE categories. 1998:01-2020:03. Standard errors are Driscoll-Kraay. The shaded area corresponds to 68% and 90% confidence intervals.

A.6.2. Sector Fixed Effects Regressions. In this subsection we run an alternative specification including sector fixed effects which should account for time invariant sectoral heterogeneity. Figure A.13 shows the result. For the sector fixed effects specification, we run

$$\begin{aligned}
\log P_{jt+h} - \log P_{jt-1} = \beta_0^{(h)}\Big(\log(\frac{\text{PPI energy}_t}{\text{PPI}_t}) - \log(\frac{\text{PPI energy}_{t-1}}{\text{PPI}_{t-1}})\Big) \\
+ \beta_1^{(h)} \times \Big(\frac{a_{ji}}{1-a_{jj}}\frac{\theta_j\sqrt{1-a_{jj}}}{\theta_j\sqrt{1-a_{jj}}+\theta_i\sqrt{1-a_{ii}}}\Big) \times \Big(\log(\frac{\text{PPI energy}_t}{\text{PPI}_t}) - \log(\frac{\text{PPI energy}_{t-1}}{\text{PPI}_{t-1}})\Big) \\
+ \sum_{k=1}^{K}\zeta_k^{(h)}\Big(\log(\frac{\text{PPI energy}_{t-k}}{\text{PPI}_{t-k}}) - \log(\frac{\text{PPI energy}_{t-k-1}}{\text{PPI}_{t-k-1}})\Big) \\
+ \sum_{k=1}^{12}\gamma_k^{(h)}(\log P_{jt-k} - \log P_{jt-k-1}) + FE_j + \epsilon_{jt}
\end{aligned}$$

where FE_j is the sector fixed effect.

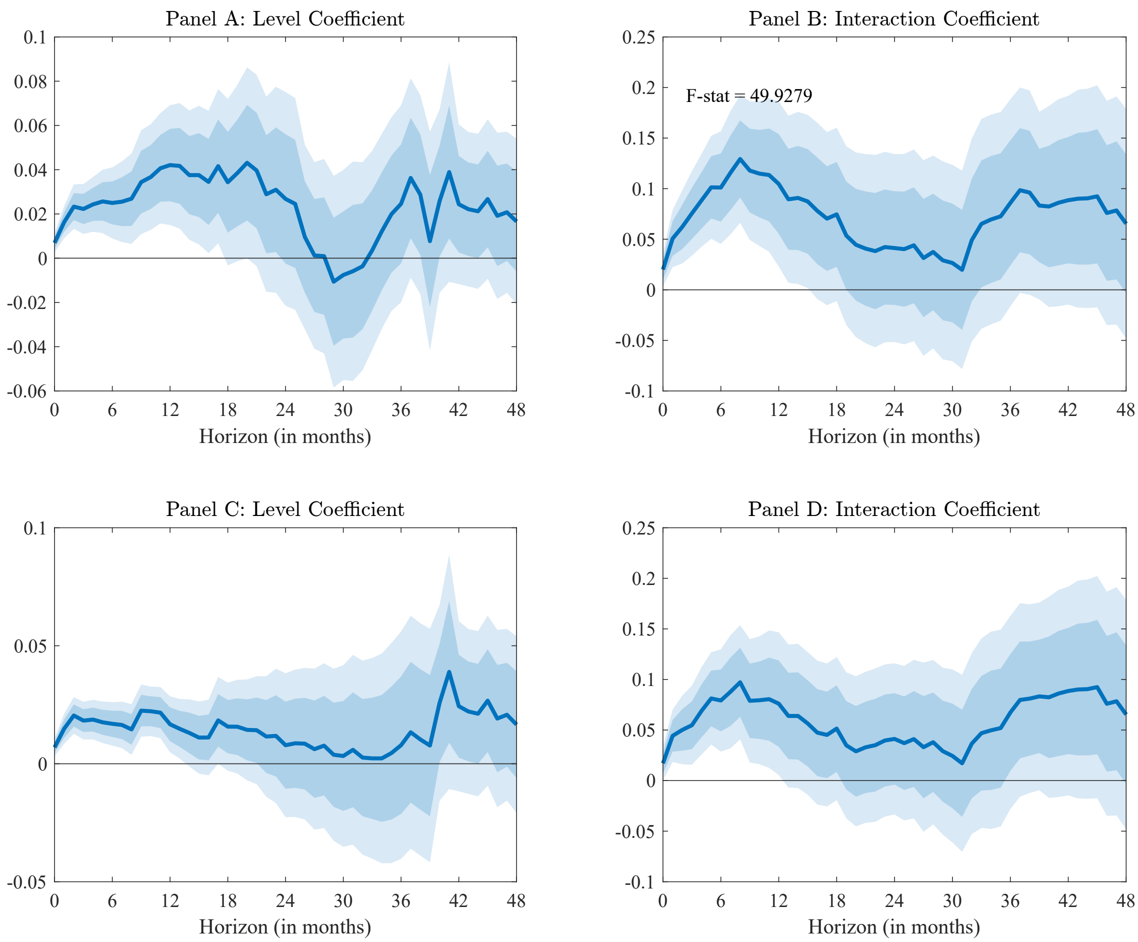

Figure A.13: Estimated panel Local Projections coefficients to a shock to the relative price of energy

Notes: This figure plots the estimated panel Local Projections coefficients to a shock to the relative price of energy, where the dependent variable is the sectoral PCE price index. The relative price of energy is instrumented by the oil supply news shock from Kanzig (2021). The dependent variable and the independent variable are expressed in log. Hence, the coefficients represent elasticities. Specification with sector fixed effects. Panel A and B: 1998:01-2023:06. Panel C and D: 1998:01-2020:03. Standard errors are Driscoll-Kraay. The shaded area corresponds to 68% and 90% confidence intervals. F-stat: 49.92

A.6.3. Oil and gas extraction as the oil sector. Throughout our analysis, we assumed that the total oil sector was represented by both oil and gas extraction and petroleum and coal products. In this subsection, we show that our results are robust to considering oil and gas extraction as the oil sector. For this analysis, we don't exclude any PCE category. The reason why we do this is because the oil and gas extraction sector is not consumed as a final consumption for any category. That is, the personal consumption expenditures for the oil and gas extraction sector is zero. Therefore, there is no mechanical effect on sectoral PCE prices. Figure A.14 shows the results for prices and Figure A.15 for quantities.

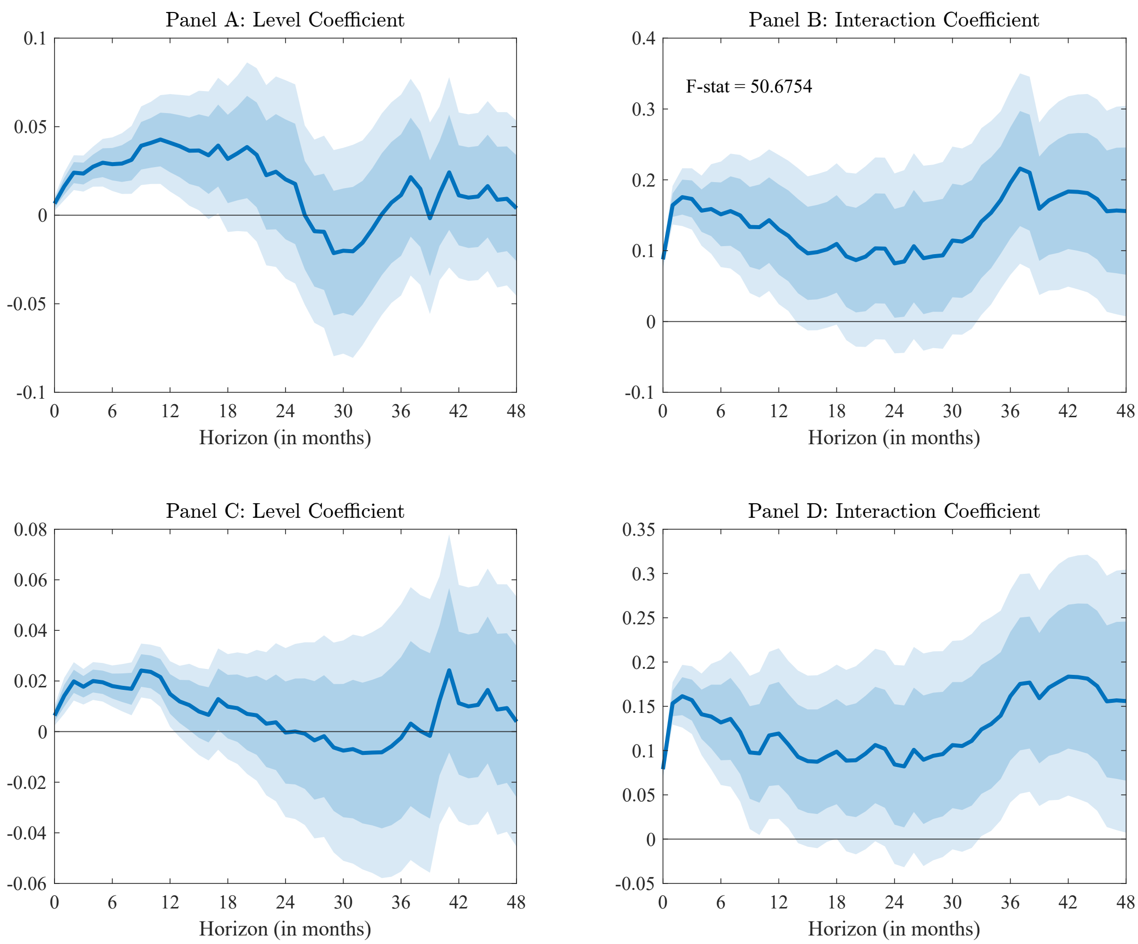

Figure A.14: Estimated panel Local Projections coefficients to a shock to the relative price of energy

Notes: This figure plots the estimated panel Local Projections coefficients to a shock to the relative price of energy, where the dependent variable is the sectoral PCE price index. The relative price of energy is instrumented by the oil supply news shock from Kanzig (2021). The dependent variable and the independent variable are expressed in log. Hence, the coefficients represent elasticities. The sufficient statistic is created with relation to Oil and gas extraction sector. Sample: All PCE categories. Panel A, B: 1998:01 - 2023:06. Panel C, D: 1998:01 - 2020:03. Standard errors are Driscoll-Kraay. The shaded area corresponds to 68% and 90% confidence intervals. F-stat: 50.6754

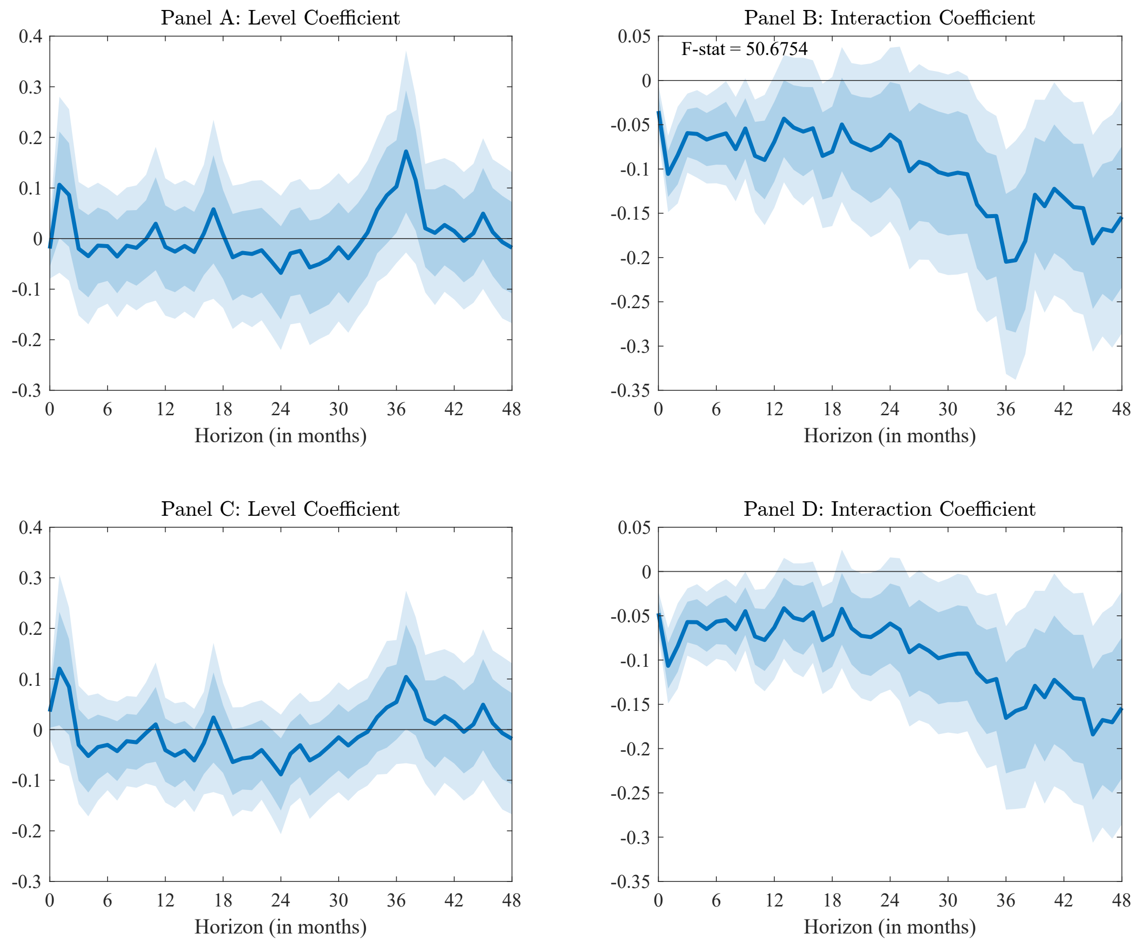

Figure A.15: Estimated panel Local Projections coefficients to a shock to the relative price of energy

Notes: This figure plots the estimated panel Local Projections coefficients to a shock to the relative price of energy, where the dependent variable is the sectoral PCE quantity index. The relative price of energy is instrumented by the oil supply news shock from Kanzig (2021). The dependent variable and the independent variable are expressed in log. Hence, the coefficients represent elasticities. The sufficient statistic is created with relation to Oil and gas extraction sector. Sample: All PCE categories. Panel A, B: 1998:01 - 2023:06. Panel C, D: 1998:01 - 2020:03. Standard errors are Driscoll-Kraay. The shaded area corresponds to 68% and 90% confidence intervals. F-stat: 50.6754

A.7. Additional Evidence

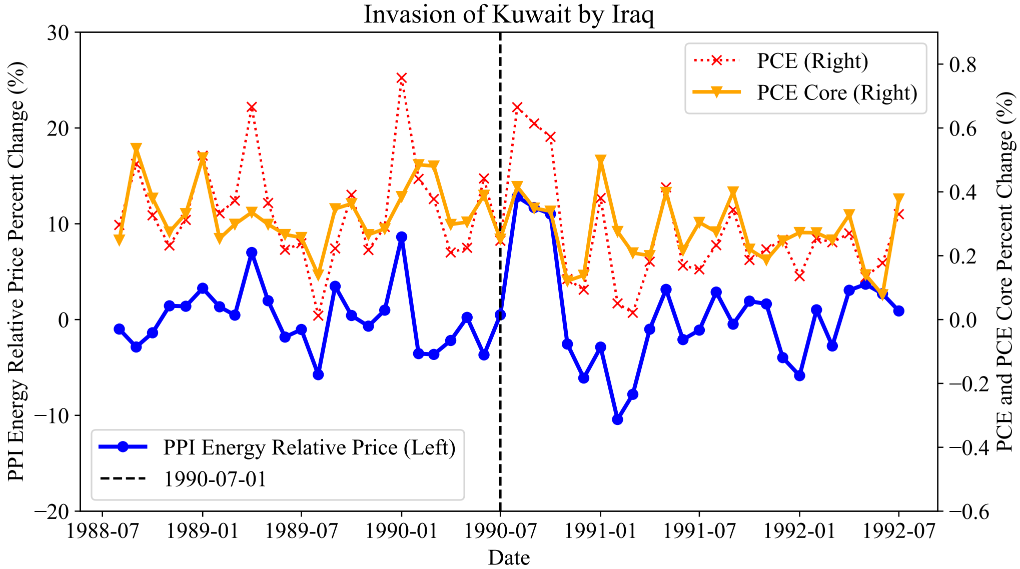

Figure A.16: Event Study Invasion of Kuwait

Notes: The figure plots the monthly percentage change of PPI energy relative price, PCE, and PCE core price indices during the Gulf War.

	(1)	(2)
Suff. Stat. × PPI Change	0.524**	0.285*
	(0.250)	(0.149)
Constant	2.187***	2.215***
	(0.381)	(0.382)
N. of obs.	73	70
Time period	1990:07 - 1991:03	1990:07 - 1991:03
Sample	Full	Ex-Energy

Table A.2: Event Study Gulf War.

Notes: Regression specification: $100\times(\log P_{i,1991:03} - \log P_{i,1990:07}) = \beta_0 + \beta_1 \times \text{Suff. Stat.}_i \times 100\left(\log\left(\frac{\text{PPI energy}}{\text{PPI}}\right)_{1991:03} - \log\left(\frac{\text{PPI energy}}{\text{PPI}}\right)_{1990:07}\right) + \varepsilon_i$. Dependent Variable: $\log P_{i,1991:03} - \log P_{i,1990:07}$, where i is a PCE category. Sample Ex-Energy excludes the categories with positive Oil and Gas Extraction or Petroleum and Coal Products in it.

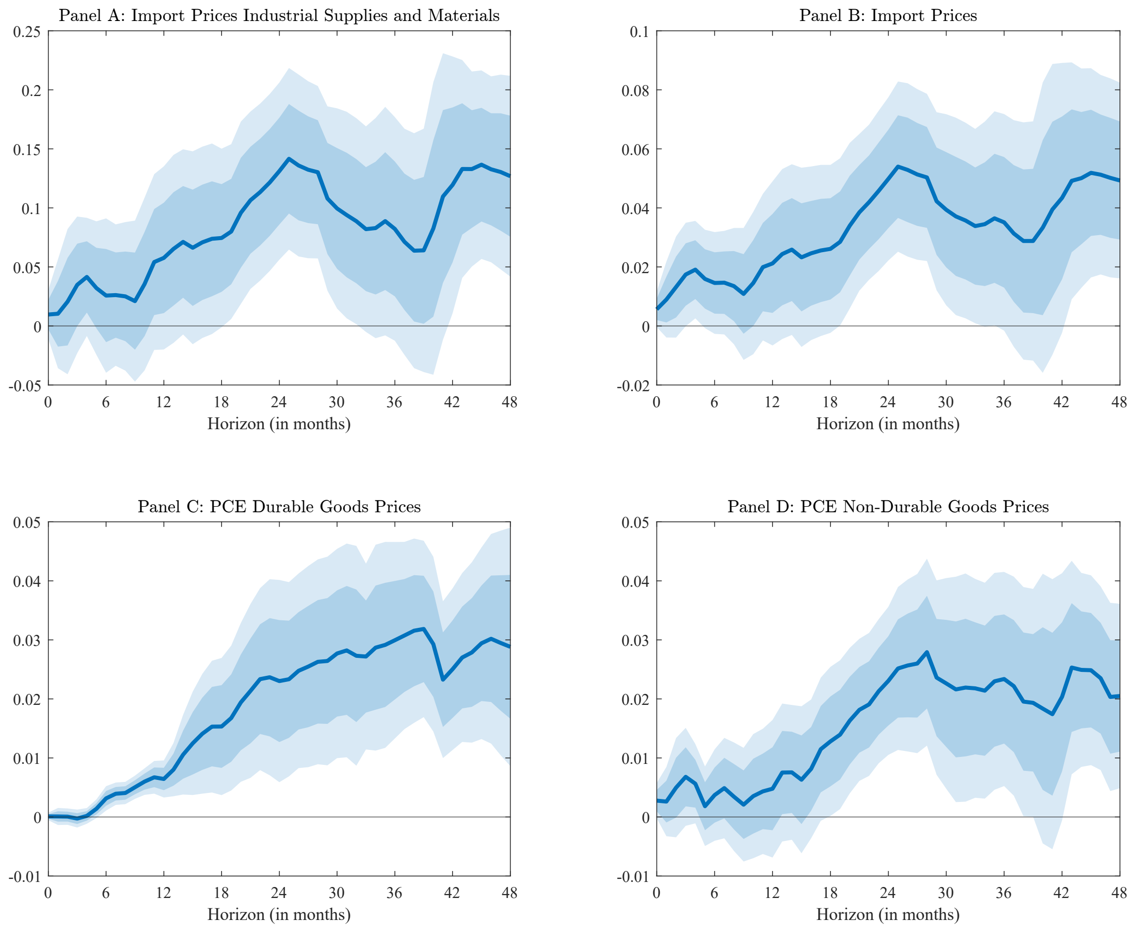

Figure A.17: Impulse responses to a global supply chain pressure innovation

Notes: This figure plots impulse responses of import price inflation, import price industrial supplies and materials inflation, PCE durable goods price inflation, and PCE non-durable goods price inflation. The independent variable is the NY Fed Global Supply Chain Pressure Index. The dependent variable is expressed in log, while the independent variable is expressed in units of the index. Controls for 12 lags of log industrial production change, log real wage changes, log PCE changes, log PCE core changes, unemployment changes, and log real personal consumption expenditures. Sample period: 1998:01 - 2020:03. Standard errors are robust to heteroskedasticity and autocorrelation. The shaded area corresponds to 68% and 90% confidence intervals.

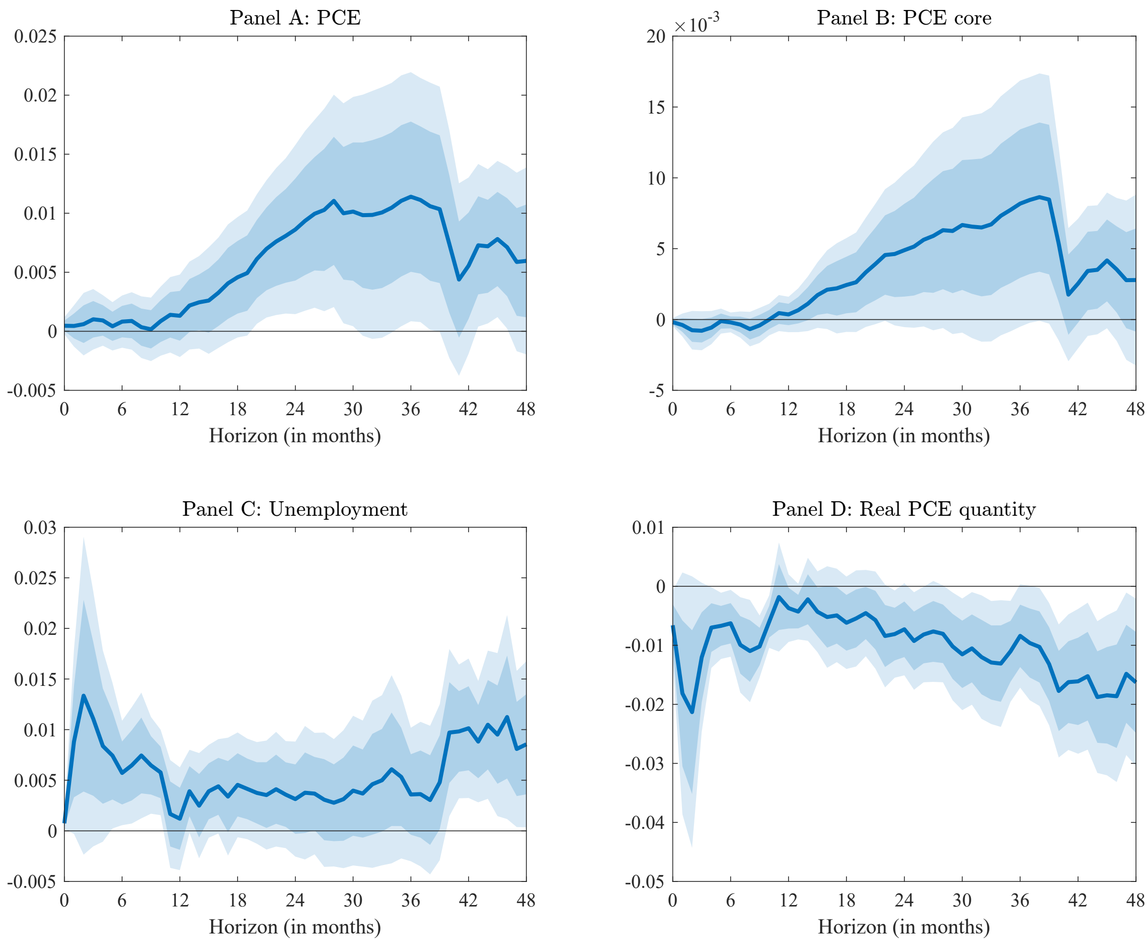

Figure A.18: Impulse responses to a global supply chain pressure innovation

Notes: This figure plots impulse responses of PCE headline inflation, PCE core inflation, the unemployment rate, and the real PCE quantity index. The independent variable is the NY Fed Global Supply Chain Pressure Index. The dependent variable is expressed in log, while the independent variable is expressed in units of the index. Controls for 12 lags of log industrial production change, log real wage changes, log PCE changes, log PCE core changes, unemployment changes, and log real personal consumption expenditures. Sample period: 1998:01 - 2020:03. Standard errors are robust to heteroskedasticity and autocorrelation. The shaded area corresponds to 68% and 90% confidence intervals.

References

BAQAEE, D. R., AND E. FARHI (2020): "Productivity and Misallocation in General Equilibrium," *The Quarterly Journal of Economics*, 135(1), 105–163.

KANZIG, D. R. (2021): "The Macroeconomic Effects of Oil Supply News: Evidence from OPEC Announcements," *American Economic Review*, 111(4), 1092–1125.

PASTEN, E., R. SCHOENLE, AND M. WEBER (2020): "The Propagation of Monetary Policy Shocks in a Heterogeneous Production Economy," *Journal of Monetary Economics*, 116, 1–22.