The Effects of News Shocks and Supply-Side Beliefs

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Motivation

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- Fundamental relationship between economic decisions and agents' expectations
- Workhorse approach: full-information rational expectations (FIRE)
- Survey-based measures of beliefs systematically deviate from FIRE
- For example, households tend to overweight supply-side narratives

This paper investigates the causes and consequences of supply-side reasoning in an NK model featuring news shocks

Supply-Side Perspectives

Households use supply-side narratives in explaining the macroeconomy

- Households often report “greed” and “big business and corporate profits” as drivers of inflation (Shiller 1997)
- Relative to experts, households consistently use supply-side reasoning more and demand-side reasoning less (Andre et al 2022a, 2022b)
    - Example: households are more likely to think in terms of a “cost channel” for monetary policy transmission
- The correlation between households’ expected inflation and expected unemployment is positive (Kamdar 2019)

Preview: Model

Develop a NK model featuring agents that receive news about future structural shocks:

- Agents overweight the likelihood that news is informative about supply shocks
- Microfoundation: robustness or behavioral
- Intuition: supply shocks are particularly damaging to welfare

Implications:

- Simple FIRE-based estimations of the Phillips curve are biased; however, estimations with survey-based expectations are unbiased
- News shocks (which $\uparrow$ inflation expectations)
  - $\downarrow$ expected output gap
  - $\uparrow$ realized inflation
  - $\downarrow$ realized output gap

Preview: Empirics

Identify news shocks to inflation expectations

- Utilizing the daily interview date in the Michigan Survey of Consumers, we compute the change in inflation expectations in small windows around CPI releases

News shocks to inflation expectations have sizable macroeconomic effects

- Using local projections, a 1pp shock to inflation expectations results in:
  - 0.1pp increase in inflation after 1 year
  - 0.2pp increase in unemployment after 2 years

Literature Review

- Empirical deviations from FIRE:
  Carroll (2003), Mankiw et al (2003), Coibion and Gorodnichenko (2015), Bordalo et al (2020)
- General equilibrium models with deviations from FIRE:
  Mankiw and Reis (2007), Woodford (2013), Maćkowiak and Wiederholt (2015), Carroll et al (2020), Bhandari et al (2023)
- News and noise shocks:
  Beaudry and Portier (2014), Barsky and Sims (2011), and Chahrour and Jurado (2018)
- High-frequency analyses of expectations to announcements:
  Rast (2021), Binder et. al. (2022), Lamla and Vinogradov (2019), DeFiore et. al. (2022)

Model

Model Overview

- We develop a “news shock” NK model where agents learn about future structural shocks
- Key departure from FIRE:
  - News is not separately informative about aggregate demand vs. supply shocks
  - Agents overweight the likelihood that news is informative about supply relative to demand shocks
  - Microfoundation: robustness (or purely behavioral – observationally equivalent)

Setup: Standard RANK Setting

- Standard NK model: representative household, firms facing Calvo frictions
- Equilibrium dynamics:

$$\pi_t = \beta \tilde{E}_t \pi_{t+1} + \kappa x_t + u_t$$
$$x_t = -\varsigma^{-1}(i_t - \tilde{E}_t \pi_{t+1} - v_t) + \tilde{E}_t x_{t+1}$$

- Close the model with a simple Taylor rule ($i_t = \phi_\pi \pi_t$)
- Structural shocks (cost-push u_t and discount rate v_t)

$$u_t = \rho_u u_{t-1} + \varepsilon_t^u \text{ and } v_t = \rho_v v_{t-1} + \varepsilon_t^v, \text{ where } \varepsilon_t^j \sim N(0, \sigma_j^2)$$

  - Signs chosen such that in a FIRE model, $\uparrow u_t$ or $\uparrow v_t \implies \uparrow \pi_t$
- However, subjective expectations $\tilde{E}_t \neq \mathbb{E}_t$ (FIRE)

News Shocks and Subjective Beliefs

- Agents observe all period t variables perfectly (as well as history)
- Departure from FIRE due to perceptions of news shocks
- Agents receive news which is informative about future demand and supply shocks:

$$z_t = \varepsilon^u_{t+1} + \varepsilon^v_{t+1} + \eta_t, \quad \eta_t \sim N(0, \sigma^2_\eta)$$

- FIRE Bayesian updating implies

$$\mathbb{E}_t \left[\varepsilon^u_{t+1} | z_t\right] = K_u z_t \quad \text{and} \quad \mathbb{E}_t \left[\varepsilon^v_{t+1} | z_t\right] = K_v z_t$$

$$K_u = \frac{\sigma^2_u}{\sigma^2_u + \sigma^2_v + \sigma^2_\eta} \quad \text{and} \quad K_v = \frac{\sigma^2_v}{\sigma^2_u + \sigma^2_v + \sigma^2_\eta}$$

- However, news misinterpreted as more informative about supply relative to demand:

$$\tilde{E}_t \left[\varepsilon^u_{t+1} | z_t\right] = \tilde{K}_u z_t \quad \text{and} \quad \tilde{E}_t \left[\varepsilon^v_{t+1} | z_t\right] = \tilde{K}_v z_t$$

$$\tilde{K}_u > K_u > 0 \quad \text{and} \quad 0 \leq \tilde{K}_v < K_v$$

Departures from FIRE: Robustness

- Interpretation: robustness (alternatively, purely behavioral details)
- Agents fully understand the model structure, but are concerned about misspecification regarding the volatility of structural shocks
- Sargent-style robustness "minmax" approach implies:

$$\tilde{K}_u = \frac{\tilde{\sigma}_u^2}{\tilde{\sigma}_u^2 + \tilde{\sigma}_v^2 + \sigma_\eta^2} > K_u \quad \text{and} \quad \tilde{K}_v = \frac{\tilde{\sigma}_v^2}{\tilde{\sigma}_u^2 + \tilde{\sigma}_v^2 + \sigma_\eta^2} < K_v$$

$$\text{where } \tilde{\sigma}_u^2 > \sigma_u^2 \quad \text{and} \quad \tilde{\sigma}_v^2 < \sigma_v^2$$

- Intuition: supply shocks more costly from a welfare perspective $\Rightarrow$ agents overweight the likelihood of supply relative to demand shocks

Misspecification Details

- Particular form of misspecification: uncertainty regarding the distribution of shocks

$$\epsilon_t^u \sim N(0, \tilde{\sigma}_u^2), \quad \epsilon_t^v \sim N(0, \tilde{\sigma}_v^2)$$

- Robustness: agents act as if $\tilde{\sigma}_u^2, \tilde{\sigma}_v^2$ chosen to minimize welfare
- Misspecification constraint:

$$\text{Var}(z_t) \equiv \sigma_u^2 + \sigma_v^2 + \sigma_\eta^2 = \tilde{\sigma}_u^2 + \tilde{\sigma}_v^2 + \sigma_\eta^2$$

    - Agents know the overall volatility of news shocks and the volatility of the noise in the news shocks
    - Misspecification must be consistent with both
    - Similar to entropy constraints used in robustness literature

Robustness Solution

- Quadratic approximation of welfare loss takes the usual form

$$\mathcal{L} \equiv \frac{1}{2}\tilde{E}\left\{\sum_{t=0}^{\infty} \beta^t \left[\pi_t^2 + \frac{\kappa}{\epsilon} x_t^2\right]\right\}$$

- Expectations $\tilde{E}$ taken under the skewed beliefs: $\tilde{\sigma}_u^2, \tilde{\sigma}_v^2$
- For simple analytical results, assume iid dynamics $(\rho_u = \rho_v = 0)$
- Imposing the misspecification constraints from above we have:

$$\frac{\partial \mathcal{L}}{\partial \tilde{\sigma}_u^2} > 0 \implies \text{welfare is strictly decreasing in } \tilde{\sigma}_u^2$$

Subjective Beliefs Under Robustness

- Hence, minmax implies a corner solution where

$$\tilde{\sigma}_v^2 = 0, \quad \tilde{\sigma}_u^2 = \sigma_u^2 + \sigma_v^2$$

$$\tilde{K}_v = 0, \quad \tilde{K}_u = \frac{\sigma_u^2 + \sigma_v^2}{\sigma_u^2 + \sigma_v^2 + \sigma_\eta^2}$$

  - $\implies$ agents perceive news as only informative about future cost-push shocks
- Expectations formed via (misperceived) Bayesian updating:

$$\tilde{E}_t[\varepsilon_{t+1}^u | z_t] = \tilde{K}_u z_t$$

$$\tilde{E}_t[\varepsilon_{t+1}^v | z_t] = 0$$

- Given iid dynamics ($\rho_u = \rho_v = 0$)

$$\implies \tilde{E}_t[u_{t+1} | z_t] = \rho_u u_t + \tilde{E}_t[\varepsilon_{t+1}^u | z_t] = \tilde{K}_u z_t$$

$$\tilde{E}_t[v_{t+1} | z_t] = \rho_v v_t + \tilde{E}_t[\varepsilon_{t+1}^v | z_t] = 0$$

Equilibrium Dynamics

- In equilibrium

$$\tilde{E}_t x_{t+1} = -\varsigma^{-1}\phi_\pi \chi \tilde{K}_u z_t \quad \text{and} \quad \tilde{E}_t \pi_{t+1} = \chi \tilde{K}_u z_t$$

$$\pi_t = \chi\left[\kappa\varsigma^{-1} v_t + u_t + (\beta - \kappa\varsigma^{-1}(\phi_\pi - 1))\chi \tilde{K}_u z_t\right]$$

$$x_t = \chi\varsigma^{-1}\left[v_t - \phi_\pi u_t + (1 - \phi_\pi(1+\beta))\chi \tilde{K}_u z_t\right]$$

  - Composite parameter $\chi \equiv \frac{1}{1+\kappa\varsigma^{-1}\phi_\pi} > 0$
- Equilibrium reactions:

$$\frac{\partial \tilde{E}_t \pi_{t+1}}{\partial z_t} > 0, \frac{\partial \pi_t}{\partial v_t} > 0, \frac{\partial \pi_t}{\partial u_t} > 0, \frac{\partial \pi_t}{\partial z_t} > 0$$

$$\frac{\partial \tilde{E}_t x_{t+1}}{\partial z_t} < 0, \frac{\partial x_t}{\partial v_t} > 0, \frac{\partial x_t}{\partial u_t} < 0, \frac{\partial x_t}{\partial z_t} < 0$$

  - Note that $\frac{\partial \pi_t}{\partial z_t} > 0 \iff \kappa\varsigma^{-1}(\phi_\pi - 1) < \beta$

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Macroeconomic Effects of News Shocks: Intuition

- Suppose agents receive a positive signal $z_t > 0$
- Interpret this signal as next period there will be a supply-driven recession
- Anticipating consumption will be low next period, households smooth consumption by saving more today (output gap falls today)
- Firms pricing has two effects:
  - Lower consumption today puts downward pressure on prices today
  - Optimal price tomorrow will be higher, putting upward pressure on prices today
  - Most reasonable parameterizations imply the second effect dominates

Equilibrium Correlations

- Implication: correlation structure of actual data differs from beliefs
- Inflation and output gap beliefs are negatively correlated

$$\text{Cov}(\tilde{E}_t\pi_{t+1}, \tilde{E}_t x_{t+1}) = -\left(\tilde{K}_u\chi\right)^2 \phi_\pi \varsigma^{-1}(\sigma_u^2 + \sigma_v^2 + \sigma_\eta^2) < 0$$

- Holds even when in the data $\text{Cov}(\pi_t, x_t) > 0$
  - When $\rho_v \neq 0, \rho_u \neq 0$, expressions are more complicated
  - Sign is ambiguous but beliefs are still negatively correlated for wide range of parameterizations

Equilibrium Phillips Curve(s)

- Cost-push shocks u_t create well-known identification issues when estimating $\hat{\kappa}$
- However, the model shows that even when without supply shocks, expectation errors pollute estimates of $\hat{\kappa}$
- Example: with $\rho_v = 0$, $\rho_u = 0$ and $\sigma_u^2 = 0$, standard FIRE NK model implies that a simple bivariate regression recovers κ:

$$\pi_t = \hat{\kappa}^{FIRE} x_t + \varepsilon_{t+1}^{FIRE}$$

- In our model, $\hat{\kappa}^{FIRE} \not\to \kappa$. Adding π_{t+1}?

$$\pi_t = \hat{\beta}^{FIRE} \pi_{t+1} + \hat{\kappa}^{FIRE} x_t + \varepsilon_{t+1}^{FIRE}$$

- Still fails: $\varepsilon_{t+1}^{FIRE} = \beta(\tilde{E}_t \pi_{t+1} - \pi_{t+1})$ which depends on realizations of z_t
- Intuition: even with no dynamics, $\tilde{E}_t \pi_{t+1}$ is an omitted variable

Survey-Augmented Phillips Curve

- Hence, augmenting estimation with measures of expectations can estimate κ

$$\pi_t = \hat{\beta}^{AUG} \tilde{E}_t \pi_{t+1} + \hat{\kappa}^{AUG} x_t + \varepsilon_{t+1}^{AUG}$$

- When $\sigma_u^2 \approx 0$ (and $\rho_v = 0, \rho_u = 0$):

$$\begin{bmatrix} \hat{\beta}^{AUG} \\ \hat{\kappa}^{AUG} \end{bmatrix} = \begin{bmatrix} \mathrm{Var}(\tilde{E}_t \pi_{t+1}) & \mathrm{Cov}(\tilde{E}_t \pi_{t+1}, x_t) \\ \mathrm{Cov}(\tilde{E}_t \pi_{t+1}, x_t) & \mathrm{Var}(x_t) \end{bmatrix}^{-1} \begin{bmatrix} \mathrm{Cov}(\tilde{E}_t \pi_{t+1}, \pi_t) \\ \mathrm{Cov}(x_t, \pi_t) \end{bmatrix} \to \begin{bmatrix} \beta \\ \kappa \end{bmatrix}$$

- Consistent with empirical findings: Coibion, Gorodnichenko, Kamdar (2018) find survey-augmented NKPC estimates are stable
  - More generally: when $\rho_v \neq 0, \rho_u \neq 0$ and $\sigma_u^2 \neq 0$, still need valid IVs for u_t
  - However, IVs may still be correlated with expectation errors
  - Augmenting the IV regression by including subjective measures of $\tilde{E}_t \pi_{t+1}$ as a dependent variable allows for consistent estimation of κ

Fully Subjective Phillips Curve

- Consider an alternative estimate of the NKPC based entirely on subjective beliefs
- Shift the standard NKPC forward a period, and apply subjective expectations:

$$\tilde{E}_t \pi_{t+1} = \hat{\beta}^{SUBJ} \tilde{E}_t \pi_{t+2} + \hat{\kappa}^{SUBJ} \tilde{E}_t x_{t+1} + \varepsilon_{t+1}^{SUBJ}$$

- Does not recover κ!
- Intuition: regression specification suffers from omitted variable bias due to $\tilde{E}_t u_{t+1}$
- In fact when $\rho_v = 0, \rho_u = 0$, we have

$$\hat{\kappa}^{SUBJ} \to -\frac{1}{\phi_\pi \varsigma^{-1}} < 0$$

Fully Subjective Phillips Specification

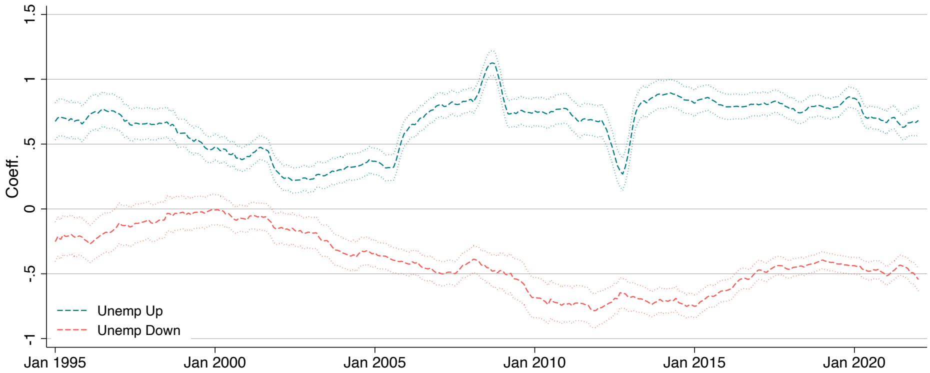
- Simple estimation specification using the Michigan Survey of Consumers
- Since early 90s, MSC asks respondents for 1-year and 5-year inflation expectations
- MSC also asks for 1-year unemployment rate expectations (categorical: will go up, stay the same, will go down)
- Panel regression specification:

$$\tilde{E}_{i,t}\pi_{t+1} = \hat{\alpha}^{SUBJ} + \hat{\beta}^{SUBJ}\tilde{E}_{i,t}\pi_{t+5} + \hat{\kappa}^{SUBJ+}\tilde{E}_{i,t}U^{+}_{t+1} + \hat{\kappa}^{SUBJ-}\tilde{E}_{i,t}U^{-}_{t+1} + \varepsilon^{SUBJ}_{i,t+1}$$

- Model prediction:

$$\hat{\kappa}^{SUBJ+} > 0, \quad \hat{\kappa}^{SUBJ-} < 0$$

Fully Subjective Phillips Curve Estimated



Notes: estimates of $\tilde{E}_{i,t}\pi_{t+1} = \hat{\alpha} + \hat{\beta}^{SUBJ}\tilde{E}_{i,t}\pi_{t+5} + \hat{\kappa}^{SUBJ+}\tilde{E}_{i,t}U^{+}_{t+1} + \hat{\kappa}^{SUBJ-}\tilde{E}_{i,t}U^{-}_{t+1} + \varepsilon^{SUBJ}_{i,t+1}$: subjective one-year ahead inflation expectations on subjective five-year ahead inflation expectations and dummy variables for one-year ahead inflation increasing or decreasing. Data are from the Michigan Survey of Consumers. Four year rolling window regression coefficients, pooled across households. 90% confidence intervals included.

Identifying Inflation News Shocks

Summary of Theoretical Predictions and Preview of Empirics

Model Predictions: given a news shock which $\uparrow$ inflation expectations:

- $\implies \downarrow$ output gap expectations
- $\implies \uparrow$ inflation and $\downarrow$ output gap realizations

News Shock Identification:

- Utilize daily inflation expectation data around CPI releases

Empirical Results: in response to a news shock which $\uparrow$ inflation expectations:

- We find $\uparrow$ in expected unemployment in surveys
- We find $\uparrow$ inflation and $\uparrow$ unemployment over the next 1-2 years

Identifying Inflation Expectation Shocks

- Using the MSC, we construct a news shock series by calculating the difference in average expected inflation in small windows before and after CPI releases
  - Baseline: 5 days before and after
  - Robust to other choices

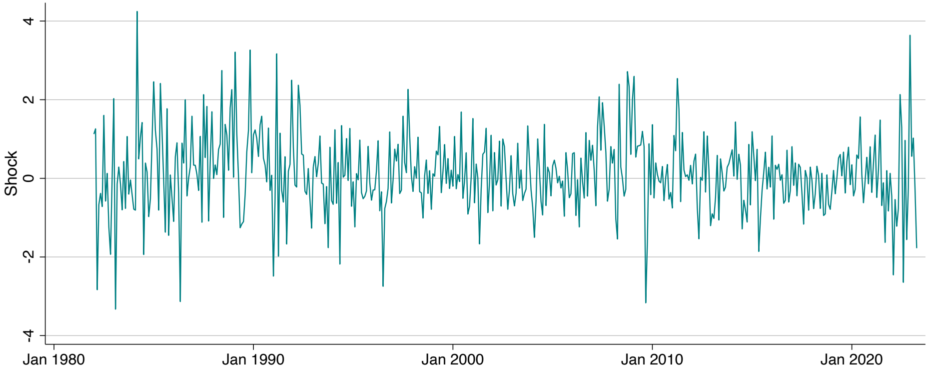
- Identification assumption: only reaction to information revealed at the CPI release

- Also see: York (2023) and Binder, Campbell, and Ryngeart (2022) for daily-frequency survey-based responses to a variety of announcements

News Shock: Endogeneity Concerns

- Compared to “narrow” event studies, we need to be more concerned with endogeneity
- We find news shocks are unpredictable:
  - Shocks are not predictable by contemporaneous or lagged macro data
  - Uncorrelated with high-frequency changes in financial variables (yields, oil prices)
- Also conduct a battery of placebo tests

News Shock Time Series



Notes: News shock time series calculated by taking the difference in average expected inflation in the 5 days before and after CPI releases.

- The mean and median are ≈0 and the standard deviation is ≈1
- Standard deviation varies across the sample

News Shock: Unpredictability

The estimated news shock is uncorrelated with high-frequency changes in yields and oil prices, and not predicted by current or past unemployment and inflation

	(1)	(2)	(3)	(4)	(5)	(6)
$\Delta y_t^{(10)}$	0.343		0.162			0.230
	(0.577)		(0.565)			(0.547)
$\Delta p_t^{(OIL)}$		0.006	0.004			0.007
		(0.020)	(0.020)			(0.020)
U_t				0.042	0.042	0.053
				(0.044)	(0.044)	(0.044)
π_t				-0.094	-0.094	-0.096
				(0.132)	(0.132)	(0.137)
U_{t-1}				-0.015	-0.015	-0.019
				(0.044)	(0.044)	(0.046)
π_{t-1}				0.112	0.112	0.118
				(0.138)	(0.138)	(0.144)
Obs.	472	437	431	479	479	431
R^2	0.001	0.000	0.001	0.004	0.004	0.006
P-val	0.553	0.777	0.940	0.632	0.632	0.630

News Shock: Correlations with Other Expectations

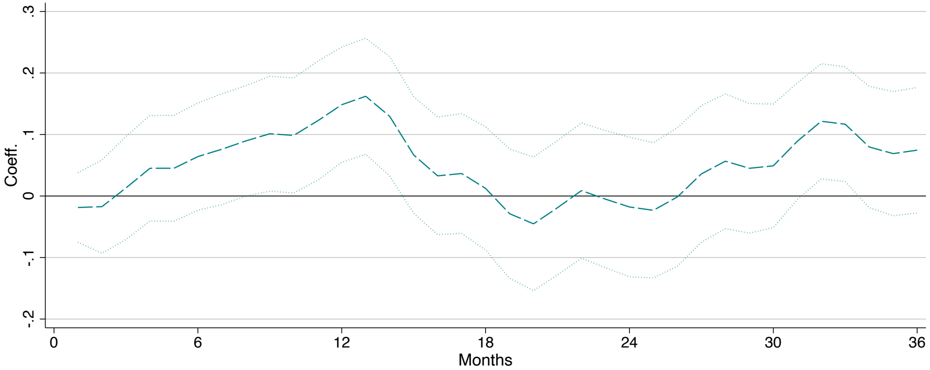
A positive shock to inflation expectations is associated with:

- An increase in households expecting unemployment to rise ($\Delta\tilde{E}_t U^+_{t+1}$)
- A decrease in households expecting unemployment to fall ($\Delta\tilde{E}_t U^-_{t+1}$)
- A decrease in households sentiment ($\Delta\tilde{E}_t s_{t+1}$)

	$\Delta\tilde{E}_t U^+_{t+1}$	$\Delta\tilde{E}_t U^-_{t+1}$	$\Delta\tilde{E}_t s_{t+1}$
$\Delta\tilde{E}_t \pi_{t+1}$	1.623***	-0.802**	-0.041***
	(0.378)	(0.364)	(0.008)
Obs.	490	490	490
R^2	0.039	0.013	0.062

Notes: Using 5-day windows around CPI releases. The change in percent of households expecting unemployment to rise ($\Delta\tilde{E}_t U^+_{t+1}$) and fall ($\Delta\tilde{E}_t U^-_{t+1}$) are regressed on the estimated news shock ($\Delta\tilde{E}_t \pi_{t+1}$) in columns (1) and (2). In column (3) the change in average sentiment ($\Delta\tilde{E}_t s_{t+1}$) is regressed on the estimated news shock ($\Delta\tilde{E}_t \pi_{t+1}$). Sentiment is calculated as the fitted first component of all forward looking variables excluding inflation.

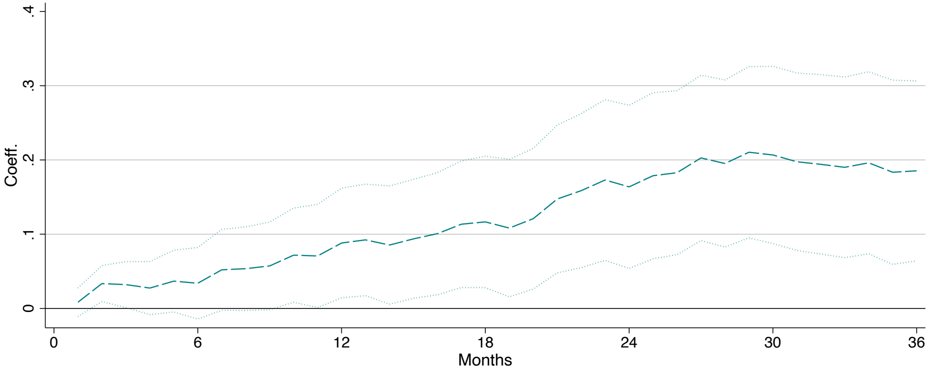
Local Projection: Inflation Response to a News Shock



Notes: Local projection of inflation on the estimated news shock. Four lags of inflation, unemployment, fed funds rate, oil price inflation, and the news shock are included as controls. 90% confidence intervals included. no controls

- A 1pp shock to inflation expectations results in over 0.1pp increase in inflation after one year, before declining to zero

Local Projection: Unemployment Response to a News Shock



Notes: Local projection of unemployment on the estimated news shock. Four lags of inflation, unemployment, fed funds rate, oil price inflation, and the news shock are included as controls. 90% confidence intervals included.

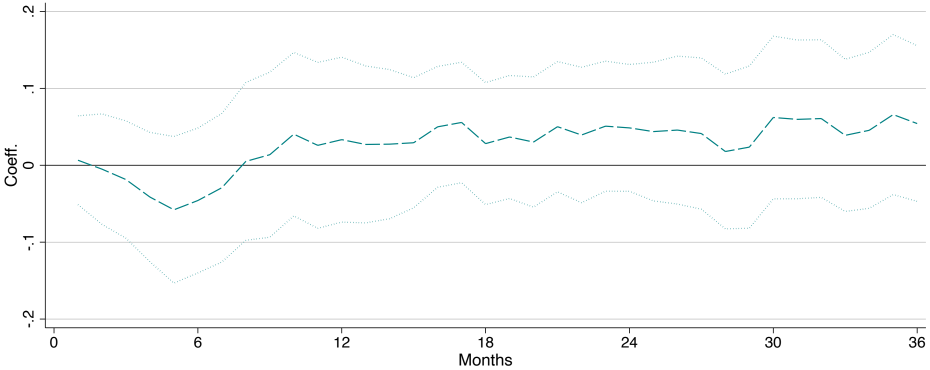
no controls

- A 1pp shock to inflation expectations results in a 0.1pp increase in unemployment after one year and 0.2pp increase in unemployment after two years

Robustness

- The response to a news shock is robust to:
  - Sample (baseline: 1982-2020)
  - Window size used in new shock constructions (baseline: 5 days before and after)
  - Including no controls or more controls (baseline: controlling for four lags of inflation, unemployment, fed funds rate, oil price inflation, and the news shock are included as controls)
- Macroeconomic reactions are specific to CPI releases (placebos follow)

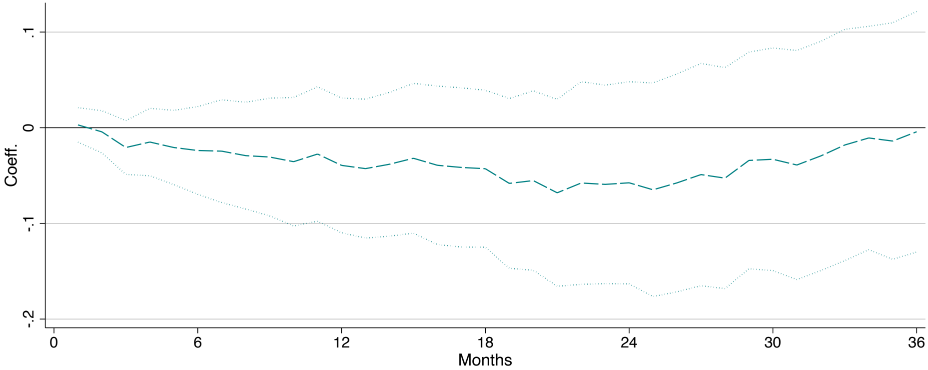
Local Projection: Inflation Response to a Placebo Shock



Notes: Local projection of inflation on a placebo news shock estimated around 15 days after the CPI release. Four lags of inflation, unemployment, fed funds rate, oil price inflation, and the news shock are included as controls. 90% confidence intervals included. no controls

- In response to a placebo shock to inflation expectations (calculated 15 days after the CPI release), inflation is unaffected

Local Projection: Unemployment Response to a Placebo Shock



Notes: Local projection of inflation on a placebo news shock estimated around 15 days after the CPI release. Four lags of inflation, unemployment, fed funds rate, oil price inflation, and the news shock are included as controls. 90% confidence intervals included. no controls

- In response to a placebo shock to inflation expectations (calculated 15 days after the CPI release), unemployment is unaffected

Conclusion

- We develop a NK model featuring consumers whose interpretation of news overweights supply-side factors and derive analytical results for NKPC estimations
- Helps rationalize a number of survey-based empirical puzzles
- Key prediction: news shocks move *realized* inflation and the output gap in opposite directions
- Empirical test: identify news-driven inflation expectation shocks using high-frequency survey data around CPI releases
- Robust result: a 1pp shock to our inflation expectation measure boosts inflation by roughly 0.1pp and unemployment by 0.2pp over the next 2 years
  - If anything, placebo tests show that general increases in inflation expectations are associated with declines in unemployment

Thank You!

Model: Behavioral Interpretation

- Agents do not fully understand the structure of news
- Many ways to formalize this
- For example, agents incorrectly believe they are observing $\tilde{z}_t$, where

$$\tilde{z}_t = \alpha_u \varepsilon^u_{t+1} + \alpha_v \varepsilon^v_{t+1} + \eta_t$$

where $\alpha_u > \alpha_v \geq 0$

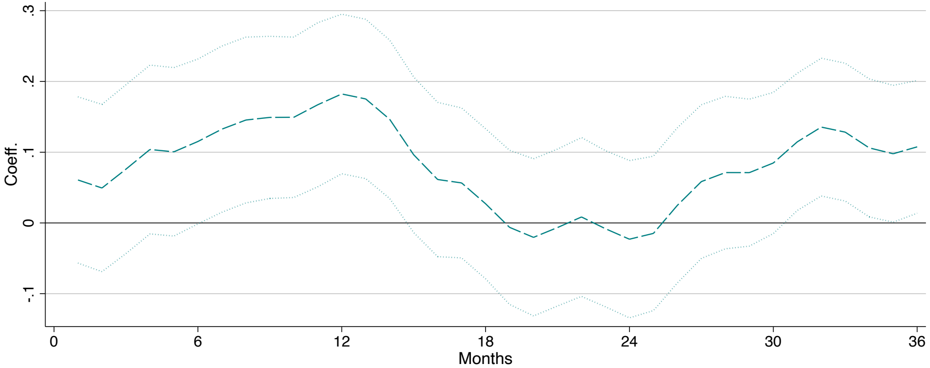
- Implies

$$\tilde{K}_u = \frac{\alpha_u \sigma_u^2}{\alpha_u^2 \sigma_u^2 + \alpha_v^2 \sigma_v^2 + \sigma_\eta^2} > K_u \quad \text{and} \quad \tilde{K}_v = \frac{\alpha_v \sigma_v^2}{\alpha_u^2 \sigma_u^2 + \alpha_v^2 \sigma_v^2 + \sigma_\eta^2} < K_v$$

  - Technical restriction: need $\alpha_u \not\gg 1$ or $\alpha_v \approx 0$

back

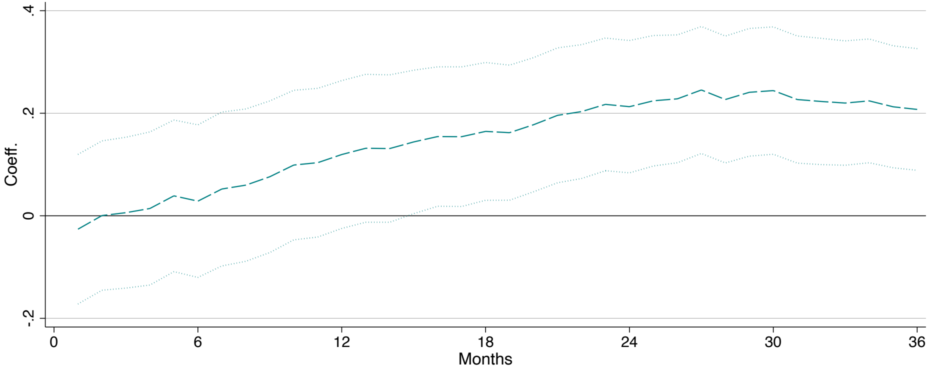
Inflation Response to a News Shock, No Controls



Notes: Local projection of inflation on the estimated news shock. 90% confidence intervals included.

back

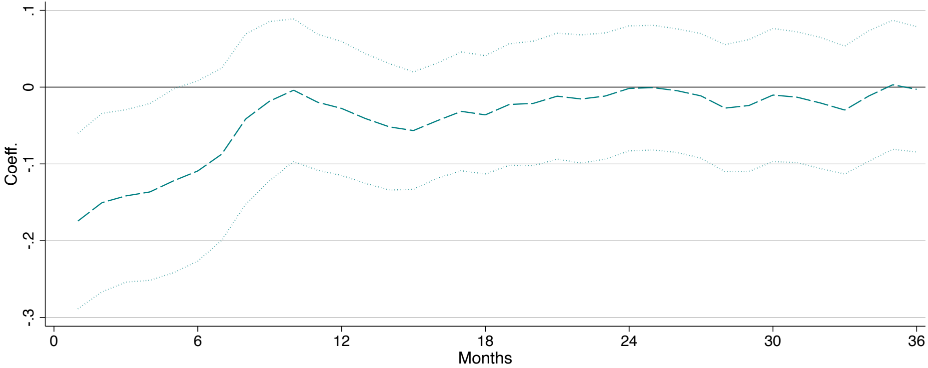
Unemployment Response to a News Shock, No Controls



Notes: Local projection of unemployment on the estimated news shock. 90% confidence intervals included.

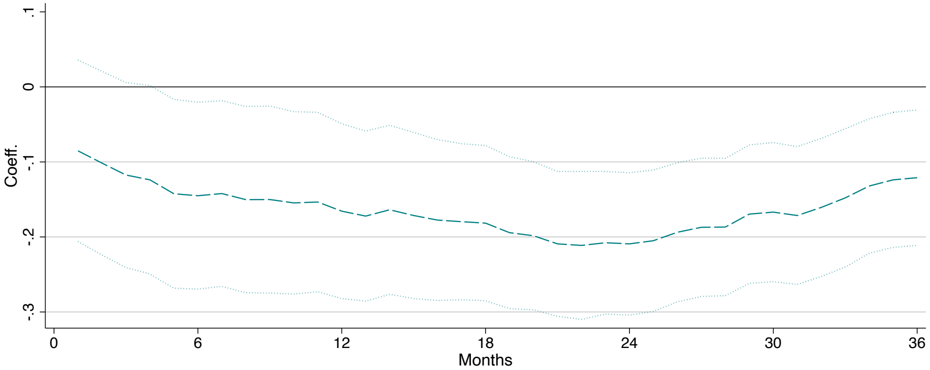
back

Inflation Response to a Placebo Shock, No Controls



Notes: Local projection of inflation on a placebo news shock estimated around 15 days after the CPI release. 90% confidence intervals included. back

Unemployment Response to a Placebo Shock, No Controls



Notes: Local projection of inflation on a placebo news shock estimated around 15 days after the CPI release. 90% confidence intervals included. back