FINANCIAL CONDITIONS AND THE BUSINESS CYCLE

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MOTIVATION

“Business Cycle Anatomy” (2020) empirically identified a *single* business cycle shock that moved

- unemployment, output, investment, hours worked, and consumption,

but the business cycle shock did **not** relate to

- inflation or TFP.

The authors suggest a confidence shock could lead to this result.

We show shocks to financial conditions could also lead to this result.

PREVIEW OF RESULTS

Using volatility financial conditions index (VFCI) to measure financial conditions, we find...

- Targeting VFCI generates same business cycle shock
- Including VFCI links inflation to the business cycle

VAR SETUP

A **SVAR**(p) model for a vector of variables, x_t,

$$B_0 x_t = B_1 x_{t-1} + \cdots + B_p x_{t-p} + \epsilon_t$$

Empirically, only the A_i matrices and reduced form residuals, υ_t, can be estimated

$$x_t = \underbrace{B_0^{-1} B_1}_{A_1} x_{t-1} + \cdots + \underbrace{B_0^{-1} B_p}_{A_p} x_{t-p} + \underbrace{B_0^{-1} \epsilon_t}_{\upsilon_t}$$

This relates υ_t to an unknown linear mapping of stuctural shocks, ϵ_t.

$$\upsilon_t = B_0^{-1} \epsilon_t$$

Identification problem: determining the B_0 matrix.

MAX FORECAST ERROR VARIANCE IDENTIFICATION

1. Pick one variable to target from x_t (i.e. unemployment, $x_t^{(u)}$)
2. Compute the forecast error for target horizon, h

$$F_{t+h} = \underbrace{x_{t+h}^{(u)}}_{realization} - \underbrace{x_{t+h|t}^{(u)}}_{prediction}$$

3. Choose vector $B_0^{(u)}$ to maximize the variance of F_{t+h}

$$\max_{B_0^{(u)}} \quad \mathrm{Var}[F_{t+h}]$$

4. This will identify **one** shock

$$\epsilon_t^u = B_0^{(u)} \hat{\upsilon}_t$$

- Can instead calculate F for frequency range $\{\omega^-, \omega^+\}$

VOLATILITY FINANCIAL CONDITIONS INDEX (VFCI)

VFCI can be interpreted as the **price of risk**. Constructed using

- Asset returns
- Forward consumption growth

Can target consumption growth at different forward horizons.

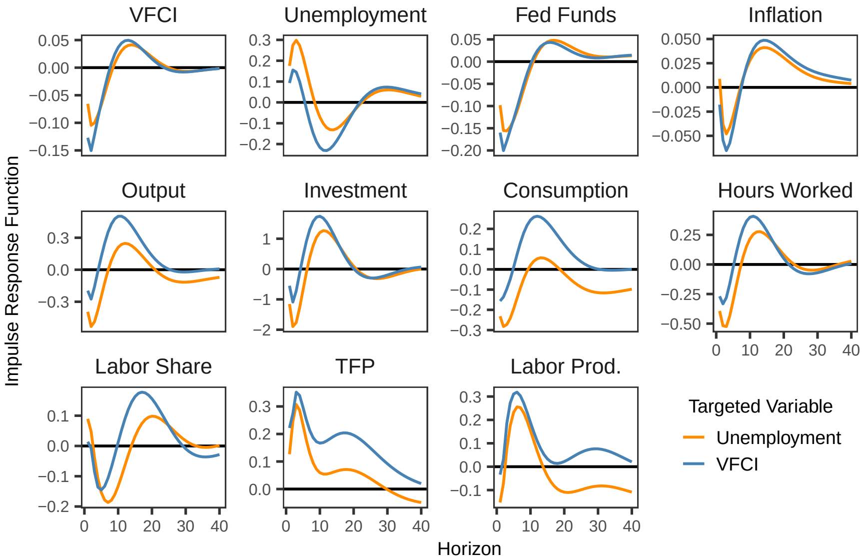
Will use VFCI constructed targeting a horizon of 10 quarters. Why?

- performs well
- lies within the business cycle length

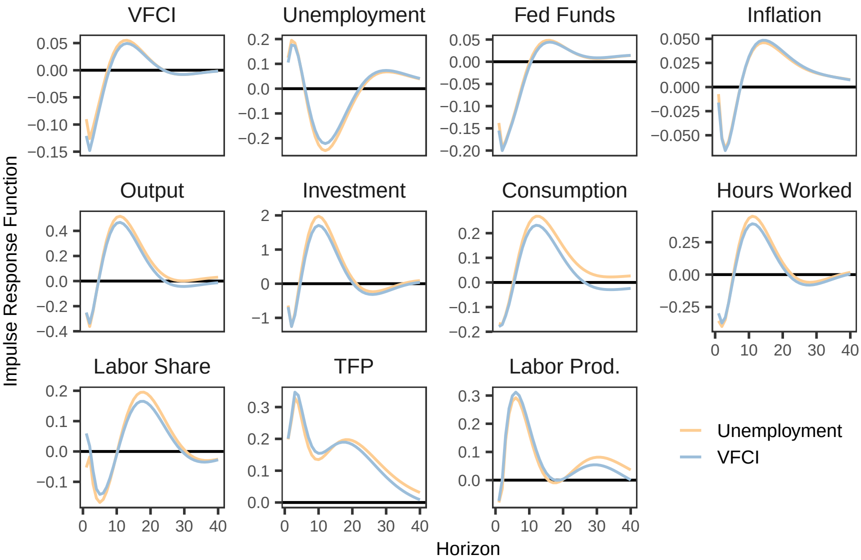
Results are robust to similar horizon targets.

▸ VFCI Estimation

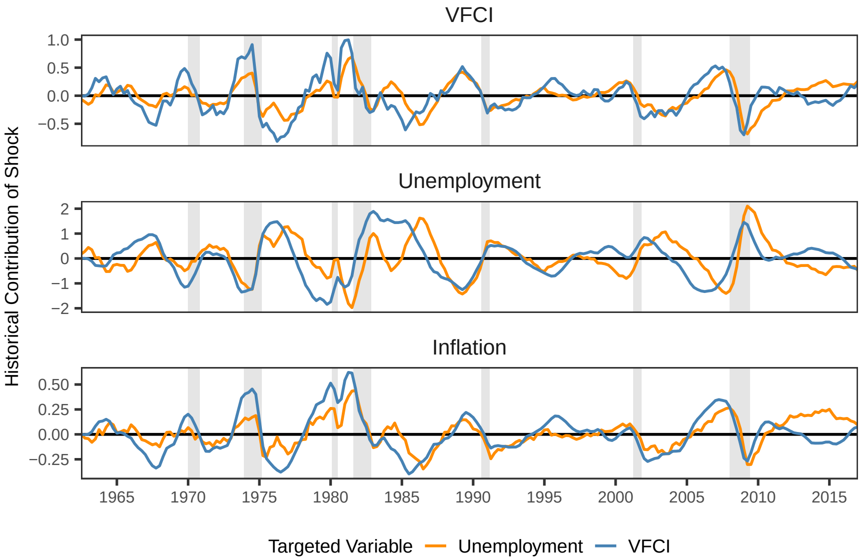
TARGETING VFCI MATCHES THE BUSINESS CYCLE



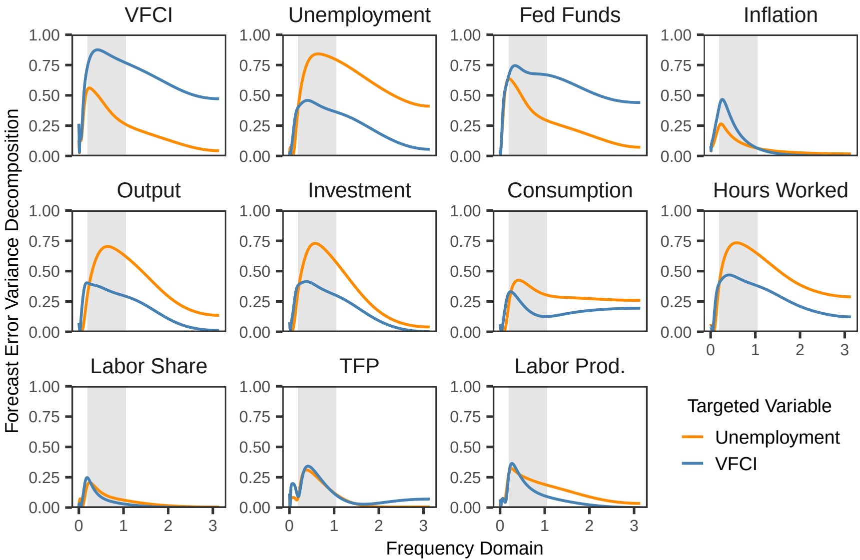
TARGET FREQ. OF 18:36 Q. ALLOWS PERFECT MATCH



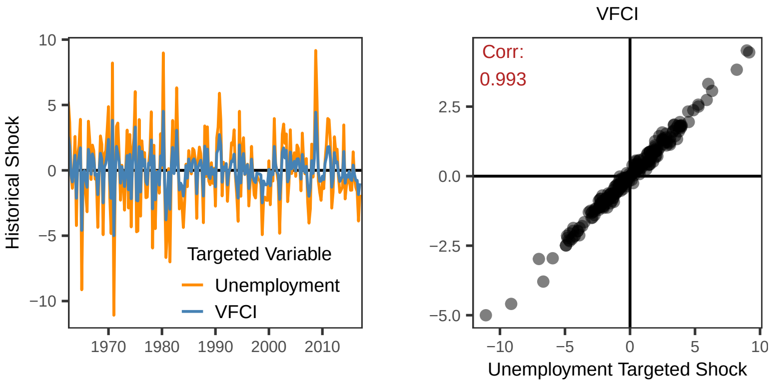
CONTRIBUTION OF SHOCKS SIMILAR OVER TIME



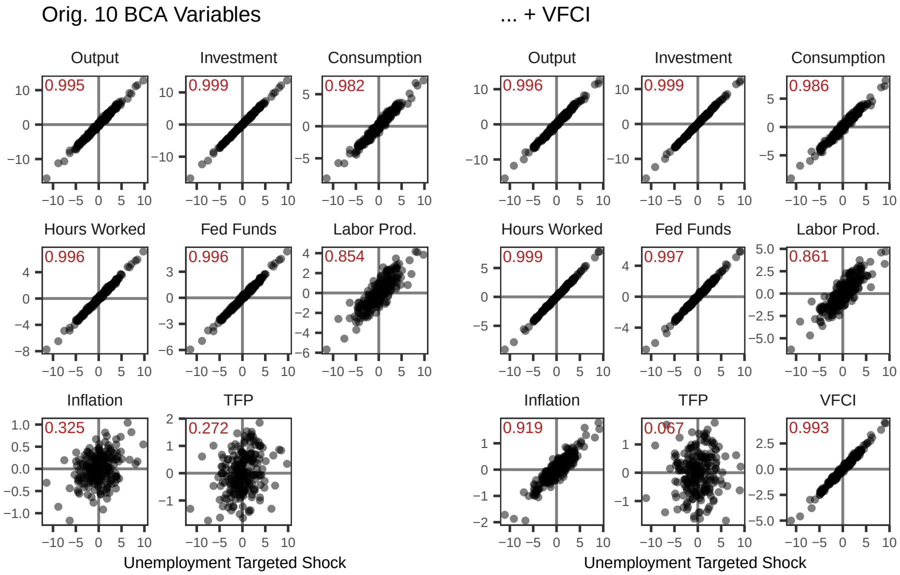
SHOCKS EXPLAIN LARGE PORTION OF VARIANCE



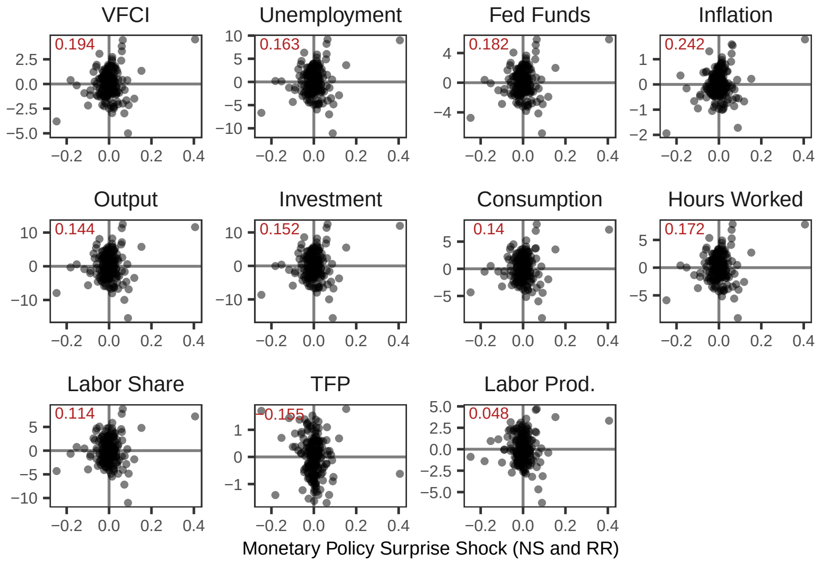
IDENTIFIED SHOCKS THAT TARGET VFCI AND UNEMPLOYMENT ARE HIGHLY CORRELATED



VFCI LINKS INFLATION TO THE BUSSINESS CYCLE



SMALL CORR. WITH MONETARY POLICY SURPRISES



CONCLUSION

Results:

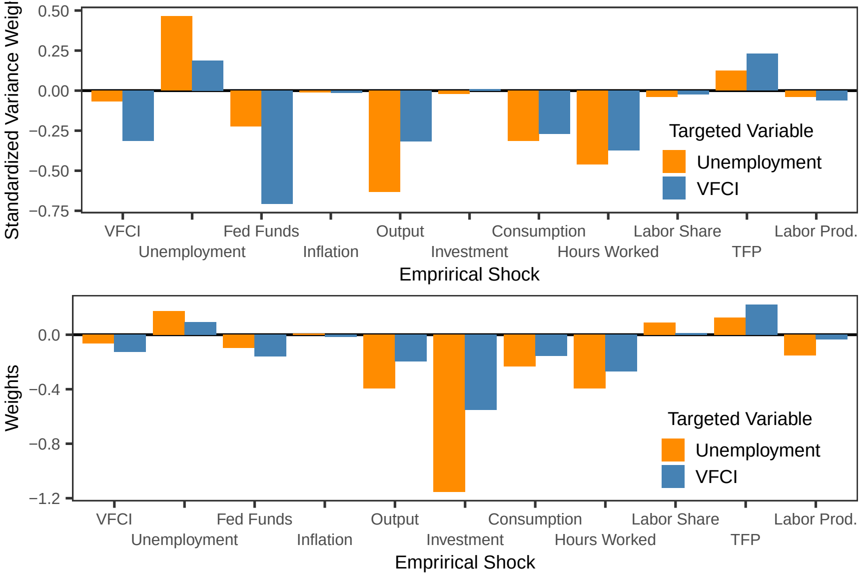
- Targeting VFCI generates same business cycle shock
- Including VFCI links inflation to the business cycle

Defining a business cycle with different frequencies yields even stronger results.

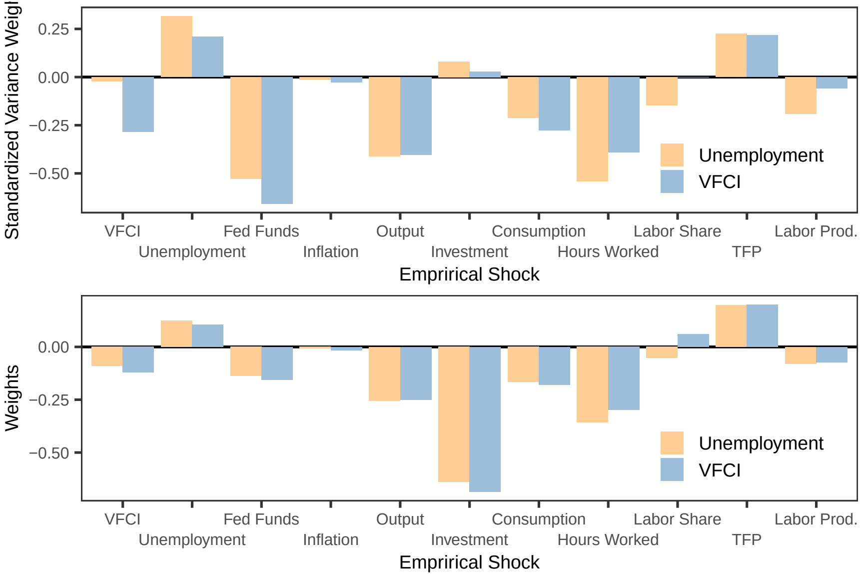
Implies that financial conditions (specifically VFCI) shocks could be driving the business cycle and are at least necessary for understanding it.

APPENDIX

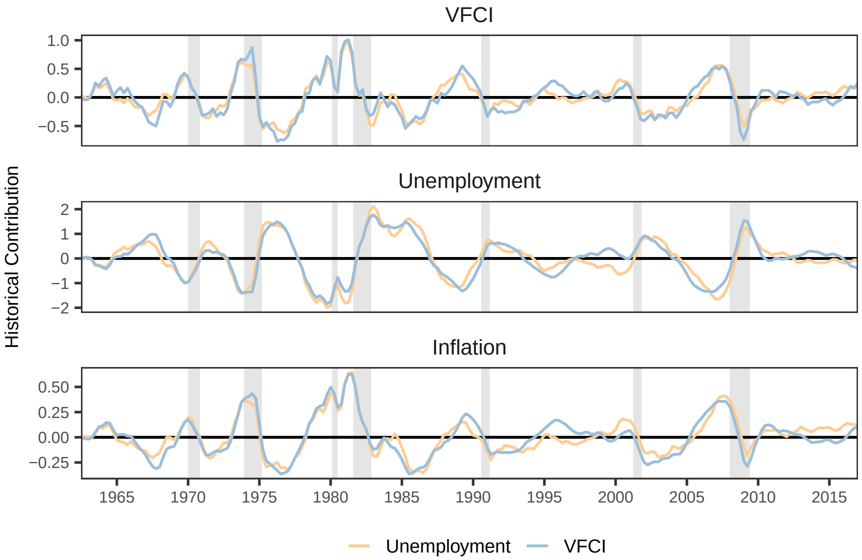
SHOCK WEIGHTS



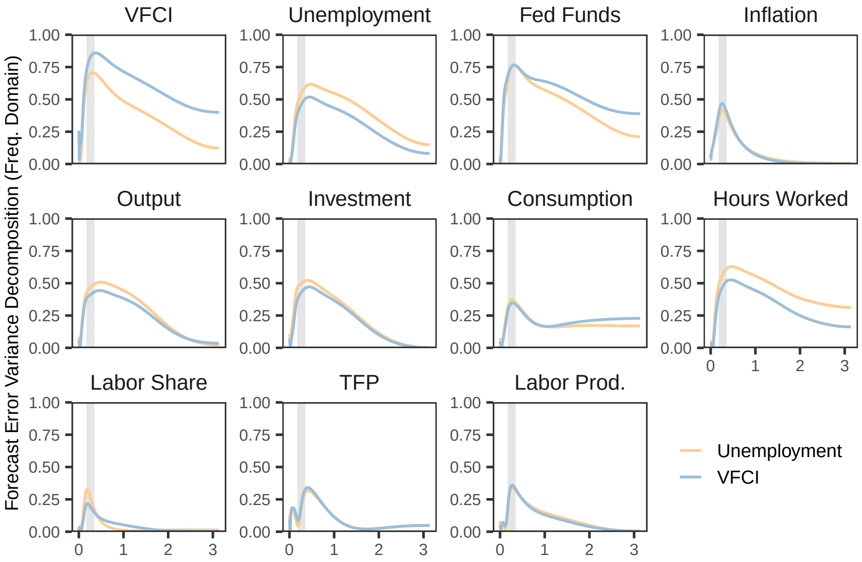
SHOCK WEIGHTS: 18 TO 36 Q



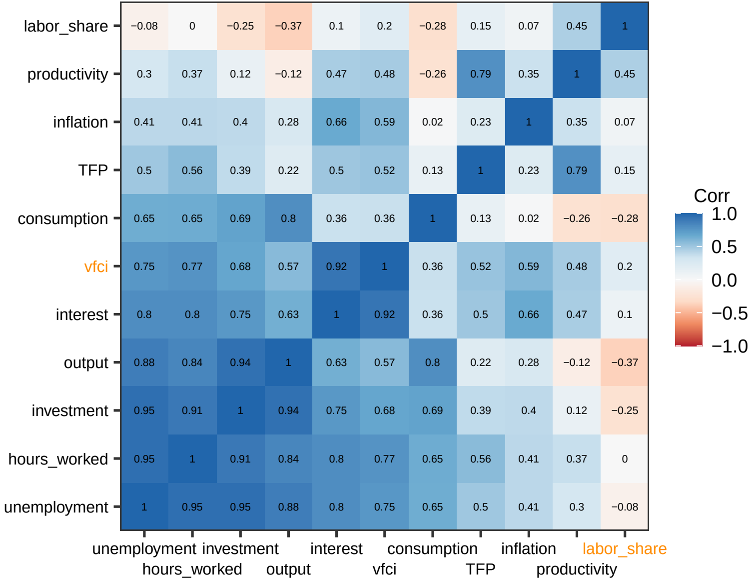
HISTORICAL CONTRIBUTION: 18 TO 36 Q



FEVDFD: 18 TO 36 Q



COMPARING VAR TARGETS



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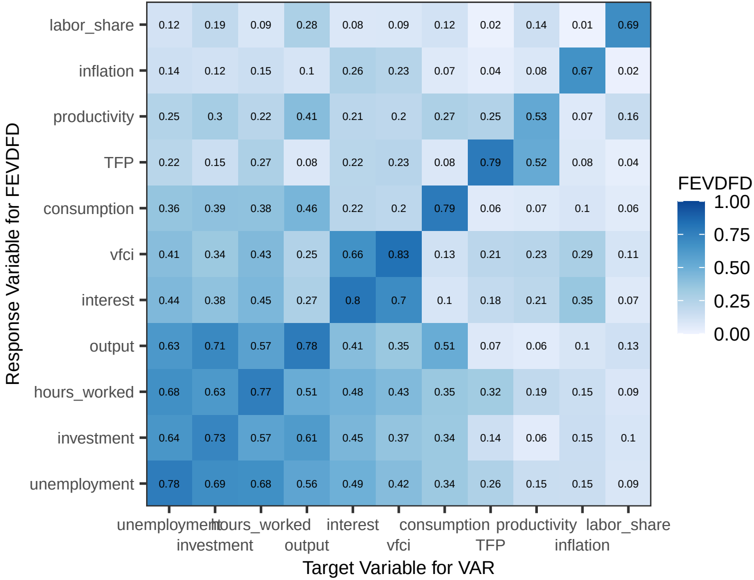
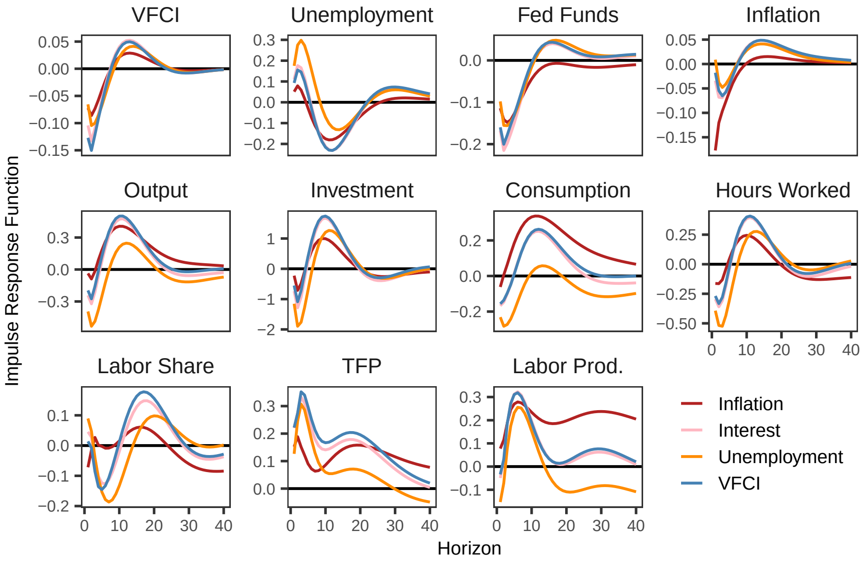


TARGETING INFLATION AND INTEREST RATE



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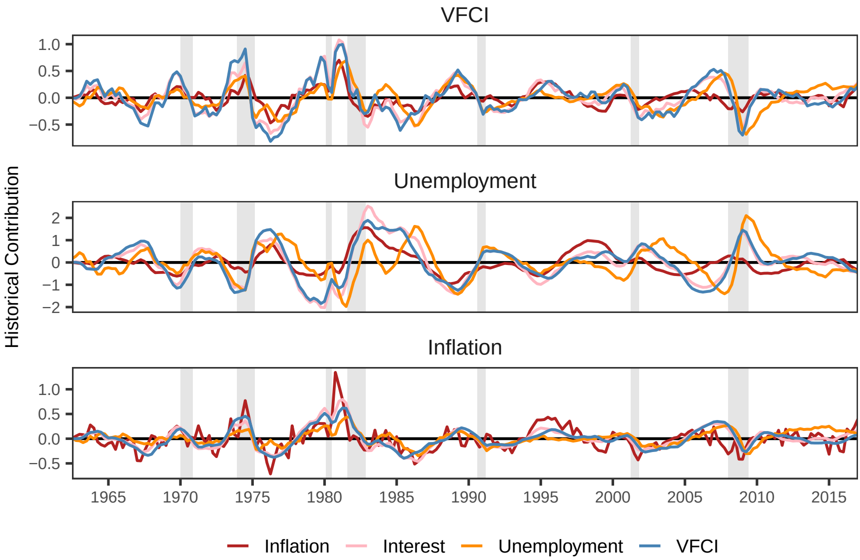

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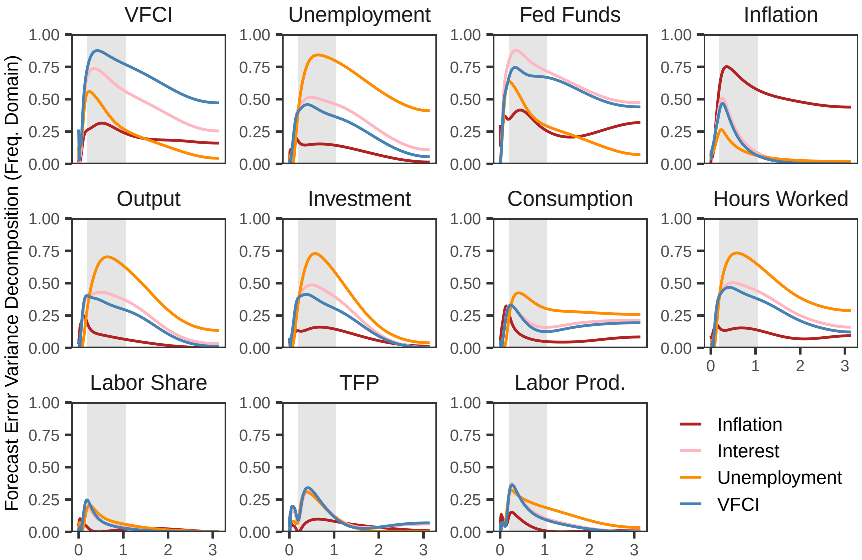

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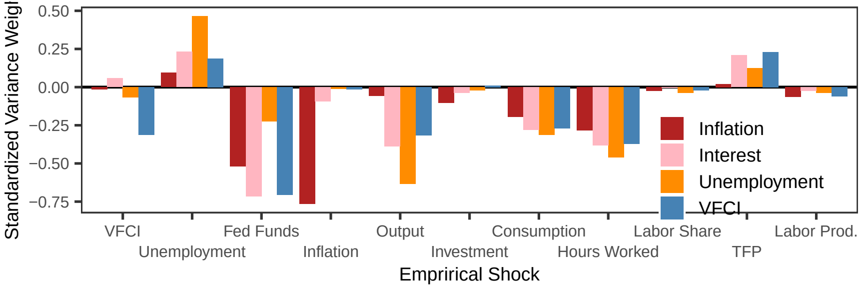

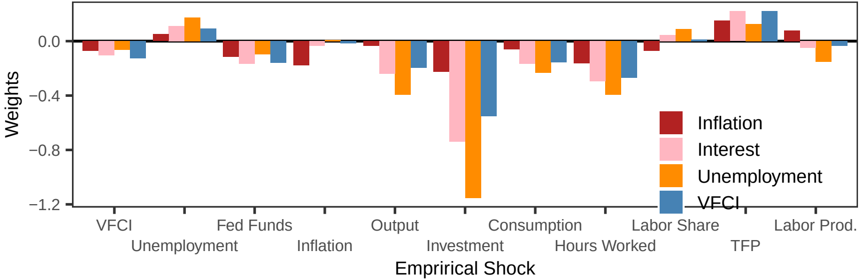

VFCI ESTIMATION

Assuming (1) no arbitrage and (2) a representative agent,

a log-linear approximation of the representative agent's FOC relates

- asset prices, R_t
- future consumption growth, $\Delta c_{t+1} = \ln c_{t+1} - \ln c_t$

This relationship can be estimated empirically:

$$\Delta c_{t+1} = \beta R_t + \varepsilon_t \tag{1}$$

$$\ln \mathrm{Vol}[\varepsilon_t] = \lambda R_t + \upsilon_t \tag{2}$$

VFCI is predicted value from eq. (2). Interpreted as the "price of risk".

$$\mathrm{VFCI}_t \equiv \ln \widehat{\mathrm{Vol}[\epsilon_t]}$$

◂ VFCI

VFCI ESTIMATION

Assuming (1) no arbitrage and (2) a representative agent,

a log-linear approximation of the representative agent's FOC relates

- asset prices, R_t
- future consumption growth, $\Delta c_{t+2} = \ln c_{t+2} - \ln c_{t+1}$

This relationship can be estimated empirically:

$$\Delta c_{t+1} = \beta R_t + \varepsilon_t \tag{1}$$

$$\ln \mathrm{Vol}[\varepsilon_t] = \lambda R_t + \upsilon_t \tag{2}$$

VFCI is predicted value from eq. (2). Interpreted as the "price of risk".

$$\mathrm{VFCI}_t \equiv \ln \widehat{\mathrm{Vol}[\epsilon_t]}$$

Consumption forwarded one more period to align with theory.

VFCI ESTIMATION

Assuming (1) no arbitrage and (2) a representative agent,

a log-linear approximation of the representative agent's FOC relates

- asset prices, R_t
- future consumption growth, $\Delta c_{t+1+h} = \ln c_{t+1+h} - \ln c_{t+1}$

This relationship can be estimated empirically:

$$x\Delta c_{t+1} = \beta R_t + \varepsilon_t \tag{1}$$

$$\ln \mathrm{Vol}[\varepsilon_t] = \lambda R_t + \upsilon_t \tag{2}$$

VFCI is predicted value from eq. (2). Interpreted as the "price of risk".

$$\mathrm{VFCI}_{t,h} \equiv \ln \widehat{\mathrm{Vol}[\epsilon_t]}$$

Can also consider longer forward growth horizons, $h \in [1, \infty)$.

VAR SETUP

1. Run the empirical VAR

$$A(L)X_t = u_t$$

with $\quad A(L) \equiv \sum_{\tau=0}^{p} A_\tau L^\tau, \quad A_0 = I, \quad$ and $\quad \mathbf{E}[u_t u_t'] = \Sigma$

2. Orthogonalize the residuals, S = Choleskey decomposition of Σ

$$u_t = S\epsilon_t$$

with $\quad \mathbf{E}[\epsilon_t \epsilon_t'] = I$

3. Denote all possible rotations, Q, of structural shocks, ϵ_t

$$S = \tilde{S}Q$$

where Q is any orthonormal ($QQ' = I$) rotation matrix.

4. This is the identification problem. Which Q to choose?

MAX VARIANCE IDENTIFICATION

1. Write out the VMA(∞) representation of a VAR(p)

$$X_t = B(L)u_t$$

with $\quad B(L) \equiv \sum_{\tau=0}^{p} B_\tau L^\tau \quad$ and $\quad B(L) = A(L)^{-1}$

2. Substitute in rotations of structural shocks, $u_t = \tilde{S}Q\epsilon_t$

$$X_t = C(L)Q\epsilon_t$$

with $\quad C(L) = B(L)\tilde{S} \quad$ and $\quad \Gamma(L) = C(L)Q \quad$ stores the IRF.

MAX VARIANCE IDENTIFICATION

1. The forecast error variance (FEV) for time horizon of T

$$
\begin{aligned}
FEV_T &= \sum_{t=0}^{T} \Gamma(t)'\Gamma(t) \\
&= \sum_{t=0}^{T} Q'C(t)'C(t)Q
\end{aligned}
$$

2. The forecast error variance for a frequency range, $\{\underline{\omega}, \bar{\omega}\}$

$$
\begin{aligned}
FEV_{\underline{\omega},\bar{\omega}} &= \int_{\underline{\omega}}^{\bar{\omega}} Q'C(e^{-i\omega})'C(e^{-i\omega})Q \, d\omega \\
&= Q' \left(\int_{\underline{\omega}}^{\bar{\omega}} C(e^{-i\omega})'C(e^{-i\omega}) \, d\omega \right) Q
\end{aligned}
$$

...