Disentangling the Channels of the 2007-09 Recession

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Framework

$$X_t \quad = \quad \Theta(L)\ \varepsilon_t \quad + \quad e_t$$

vector of variables → X_t

common shocks → ε_t

idiosynchratic shocks → e_t

Three Questions:

$$X_t = \Theta(L)\,\varepsilon_t + e_t$$

Q1. Stability

- $\Theta(L)_{<2007Q4} = \Theta(L)_{\geq 2007Q4}$?
- Were there "new shocks" for $t \geq$ 2007Q4 ?

Q2: Which shocks were important during 2007-09 recession?

- $X_t = \sum_{i=1}^{r} \Theta_i(L)\varepsilon_{it}$

Q3: Why is this recovery sluggish?

- $X_{t+h/t} = \sum_{i=1}^{r} \Theta_i^h(L)\varepsilon_{it}$ (*set t = 2009Q2 or previous trough date*)

Empirical Model: DFM

$X_t = \Lambda F_t + e_t$ (F_t = 6 factors, e_t = idiosyncratic disturbance)

$\Phi(\mathrm{L})F_t = \eta_t = H\varepsilon_t$ (η are innovations, ε are structural shocks)

F_t and Λ estimated by PC: $\hat{F}_t = (\hat{\Lambda}'\hat{\Lambda})^{-1}\hat{\Lambda}' X_t$

(*detail: F and Λ estimated using "disaggregates" only*)

Φ estimated by OLS using $\hat{F}$

$$X_t = \Lambda F_t + e_t \qquad\qquad \Phi(\mathrm{L})F_t = \eta_t$$

Q1: Stability, new shocks, etc.

$\hat{\Lambda}$ from t < 2007Q4 data and $\hat{F}_t = (\hat{\Lambda}'\hat{\Lambda})^{-1}\hat{\Lambda}'X_t$ for all t

$$X_t = \hat{\Lambda}\hat{F}_t + \hat{e}_t$$

- How does "fit" over $t \geq$ 2007Q4 compare to $t <$ 2007Q4?
- Does $\hat{e}_t$ for $t \geq$ 2007Q4 contain a common shock?
- Are Λ and Φ stable across t = 2007Q4?

$$X_t = \Lambda F_t + e_t \qquad \Phi(\mathrm{L})F_t = \eta_t = H\varepsilon_t$$

Q2: Which shocks were important during 2007-09?

- Innovation in $X_{jt} = \lambda_j'\eta_t = \lambda_j' H\varepsilon_t$
- SVAR analysis: $\varepsilon_t = H^{-1}\eta_t$
  - "External" instrument: Z_t
    - $\mathrm{E}(\varepsilon_{1t}Z_t) = \alpha \neq 0$ (*Relevance*)
    - $\mathrm{E}(\varepsilon_{jt}Z_t) = 0, j = 2, \ldots, r$ (*Exogeneity*)
    - $\mathrm{E}(\varepsilon_t\varepsilon_t') = \mathrm{D}$ (diagonal) (*Uncorrelated shocks*)

$X_t = \Lambda F_t + e_t \qquad \Phi(\mathrm{L})F_t = \eta_t$

Q3: Is this recovery different?

(i) $S_t = (F_t'\ \ F_{t-1}'\ \ldots\ F_{t-p+1}')'$
Π = companion matrix of VAR for F

$F_{t+h/t} = \Pi^h S_t$

$X_{j,t+h/t} = \lambda_j'\Pi^h S_t$

Q3: Is this recovery different?

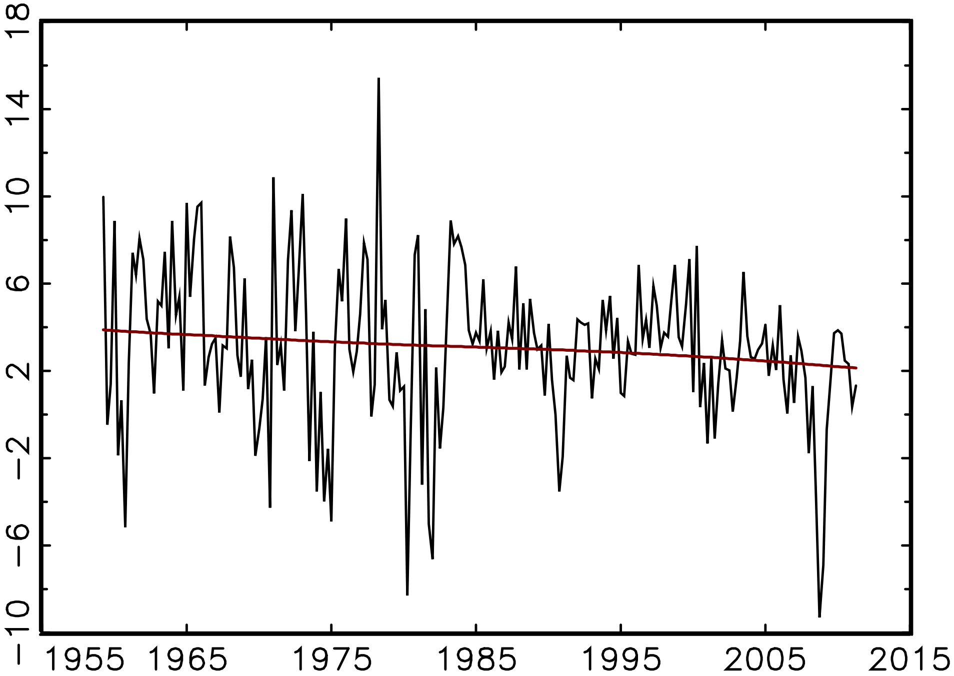
(ii) What about "trends" ?

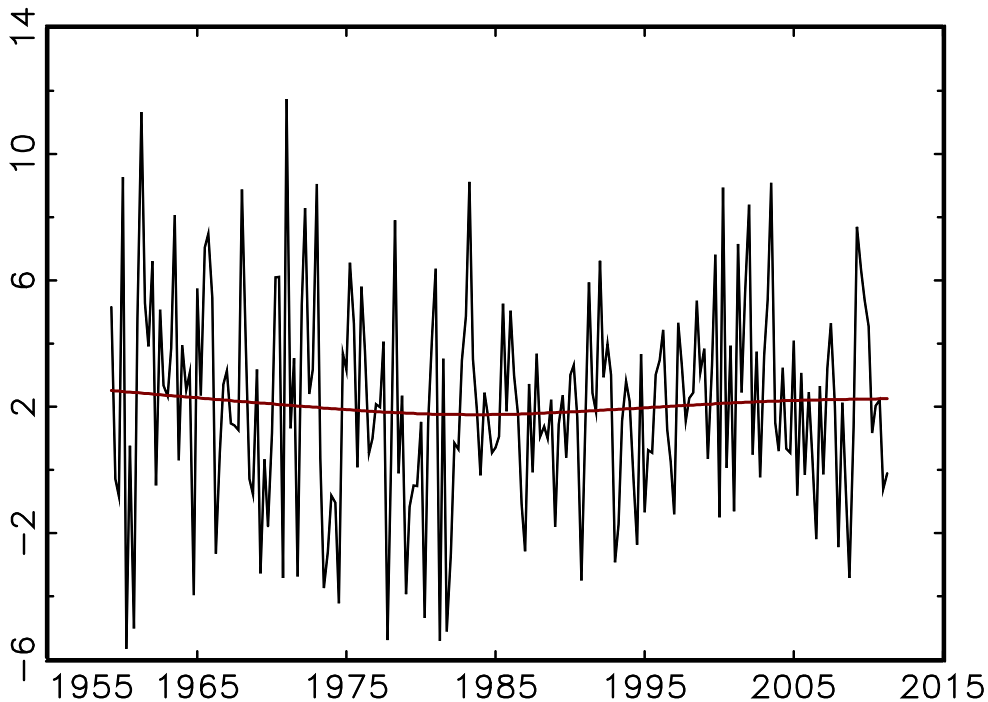
Data

- U.S., quarterly, 1959-2011Q2, 200 time series

- Almost all series analyzed in changes or growth rates

- All series detrended by local demeaning – approximately 15 year centered moving average:





Quarterly GDP growth (a.r.) | Quarterly productivity growth

Trend: 3.7% → 2.5% | 2.3% → 1.8% → 2.2%

Results

1. Structural breaks post 2007Q4

Empirical analysis

1. Estimate DFM parameters using data through 2007Q3
   a. Compute factors using "old" factor loadings:
   b. $\hat{F}_t = (\hat{\Lambda}'\hat{\Lambda})^{-1}\hat{\Lambda}'X_t$, where $\hat{\Lambda}$ are pre-07Q3 factor loadings
   c. How well do pre-07Q3 factors & factor loadings do in explaining post-07Q4 macro variables?

2. Formal stability tests:
   a. Stability of Λ
   b. Test for new factor (excess covariance among idiosyncratic disturbances)

1.1. Fit of pre-07Q3 parameters and factors, post-07Q4

Figures:

Plot of 4-Q growth ($100ln(X_t/X_{t-4})$) *or 4-Q change*:

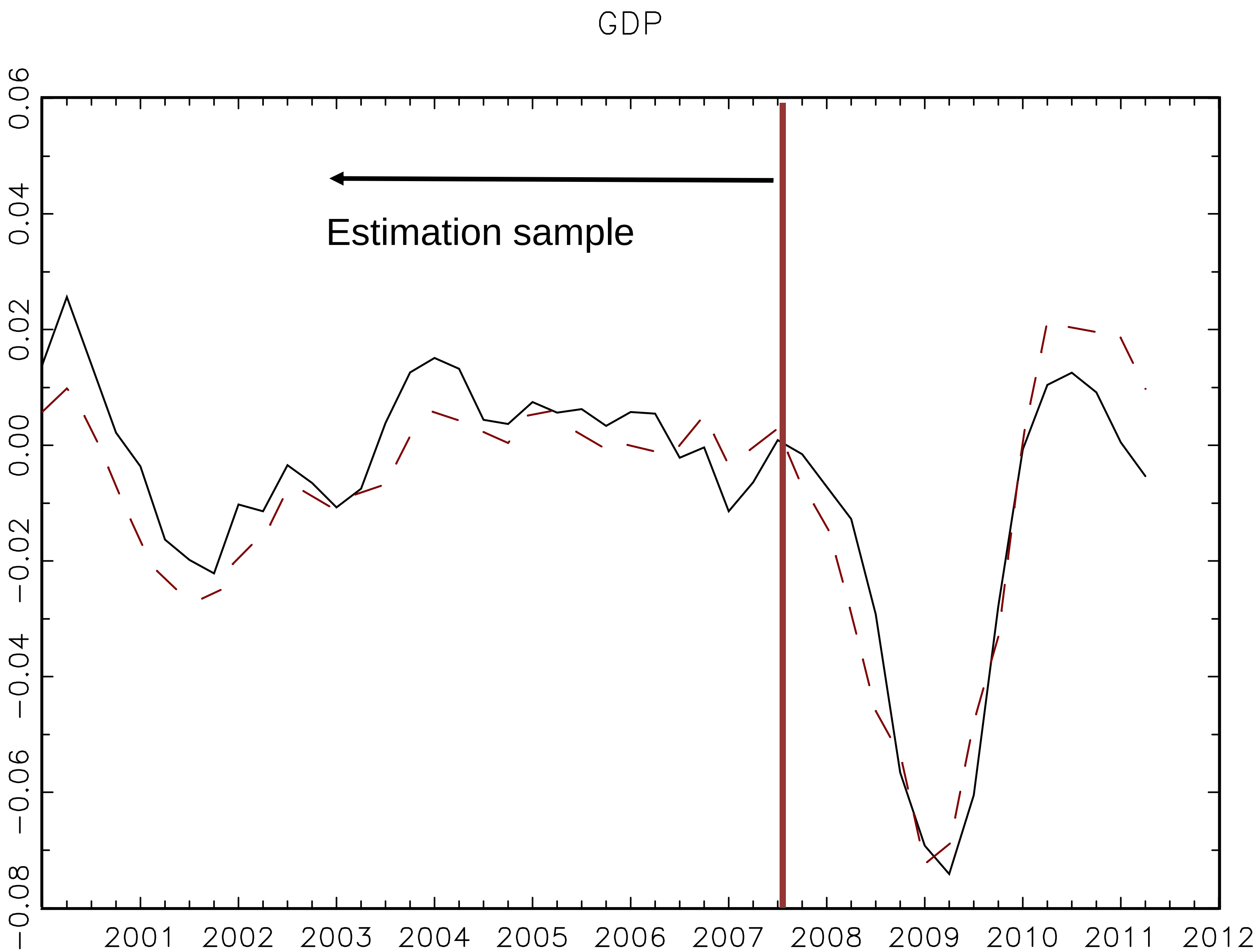
solid = actual

dashed = common component (pre-07Q3 model)

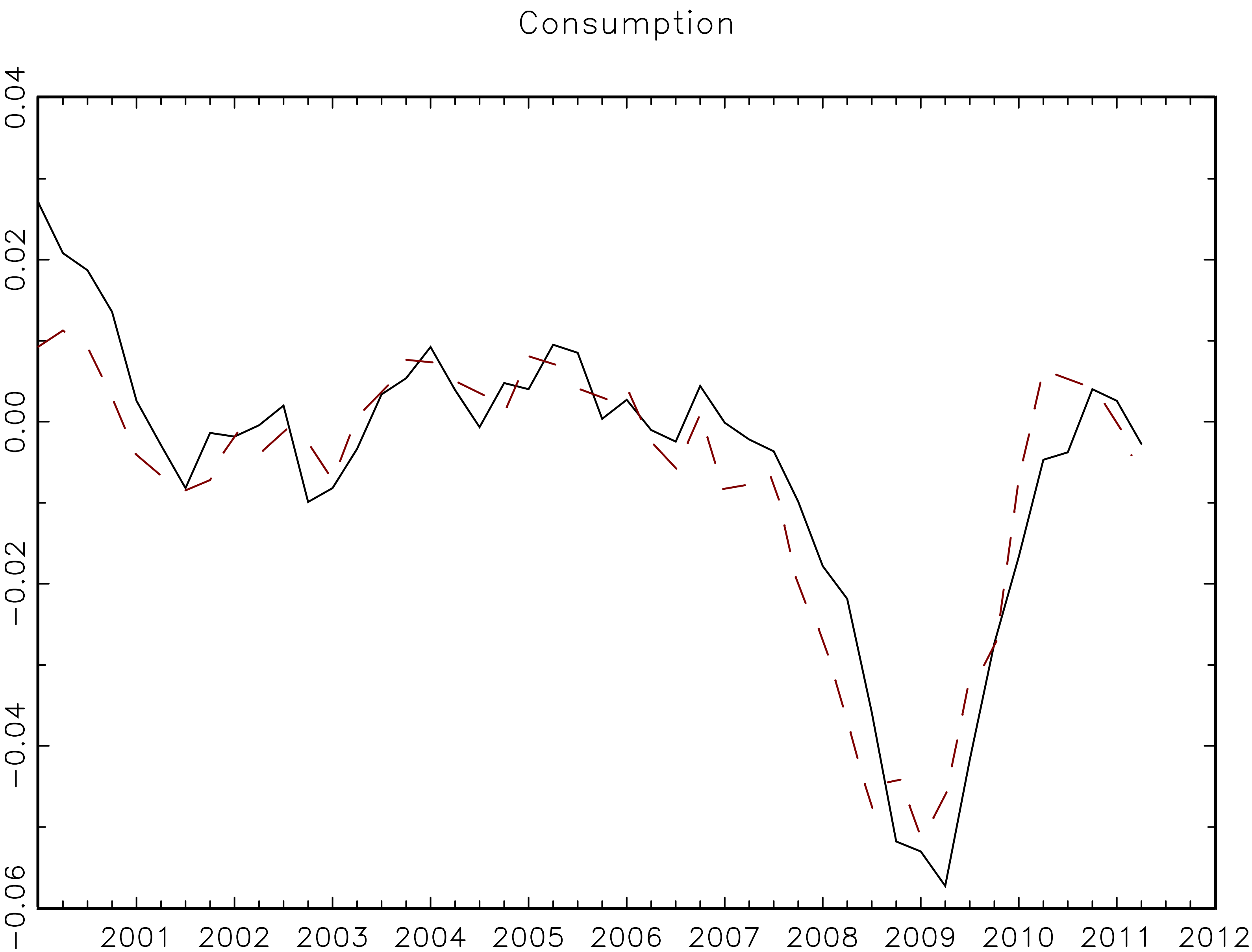
Average R^2 2007Q4 R^2

Average R^2 = 1-quarter R^2 of "ΛF_t", NBER peak to peak + 14 quarters, averaged over previous 7 recessions, 1960Q1,…, 2001Q1

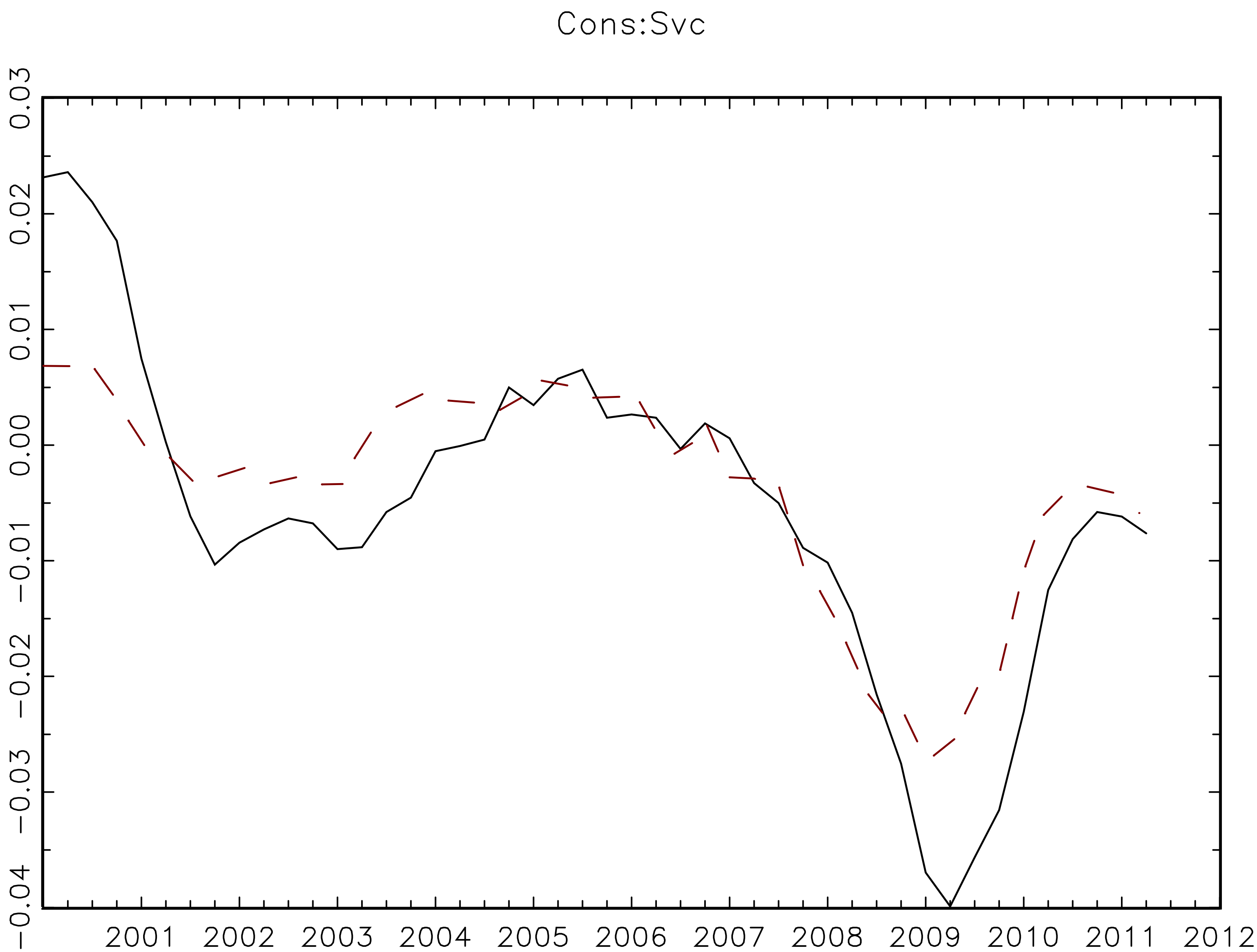
2007Q4 R^2 = value for 2007Q4 – 2011Q2.



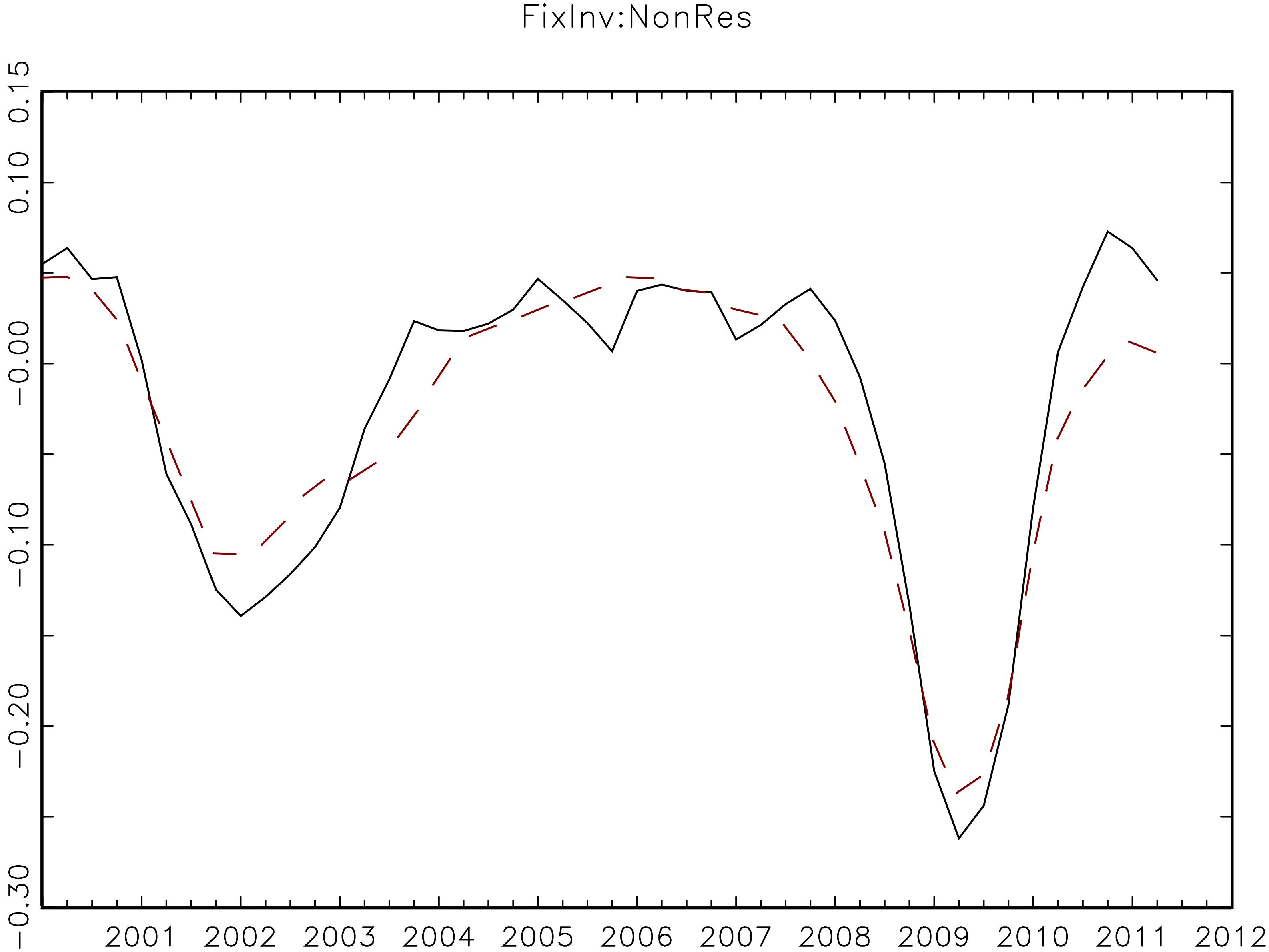
average R^2: 0.78 2007Q4 R^2: 0.64



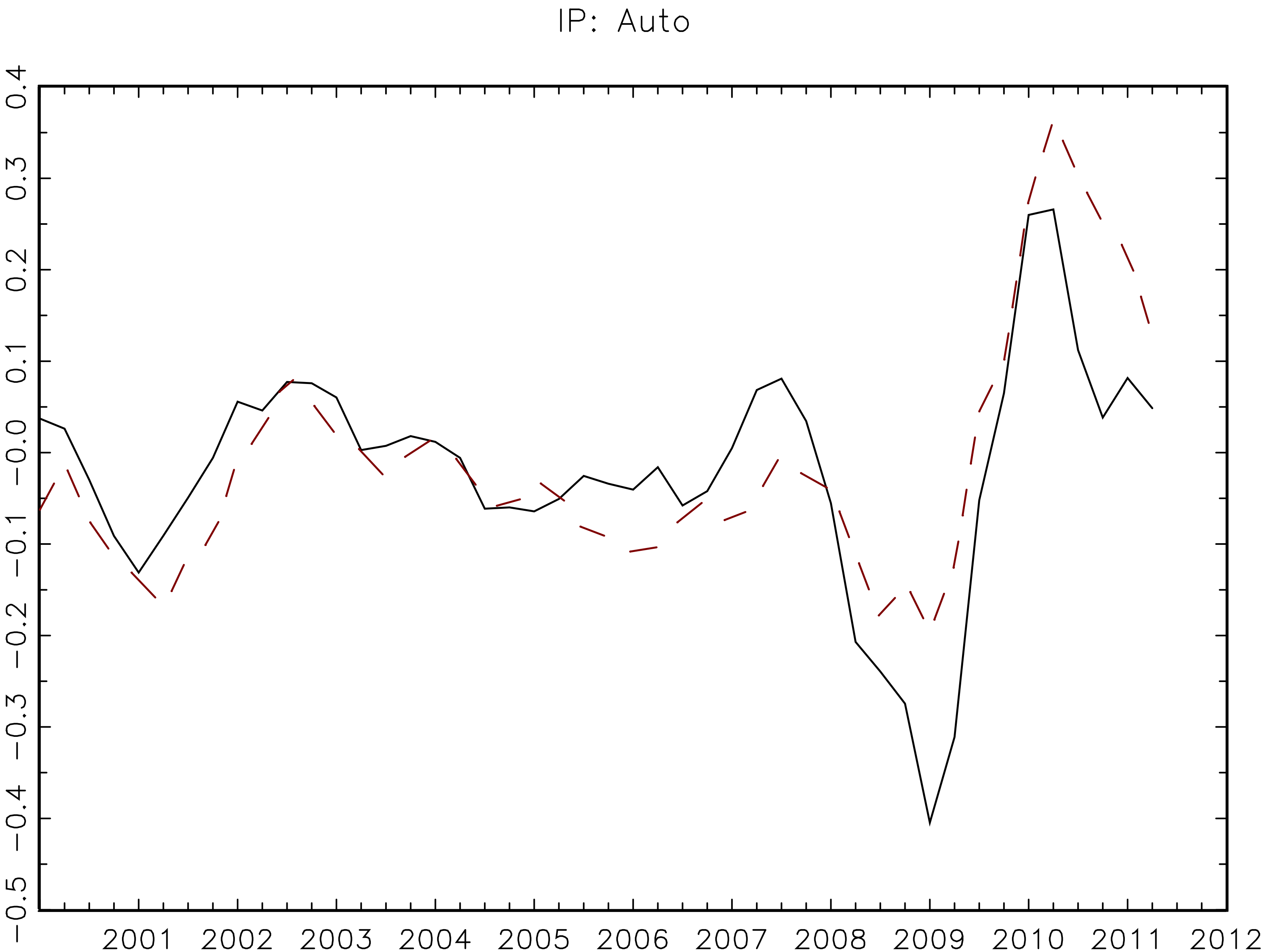
average R^2: 0.62 2007Q4 R^2: 0.56



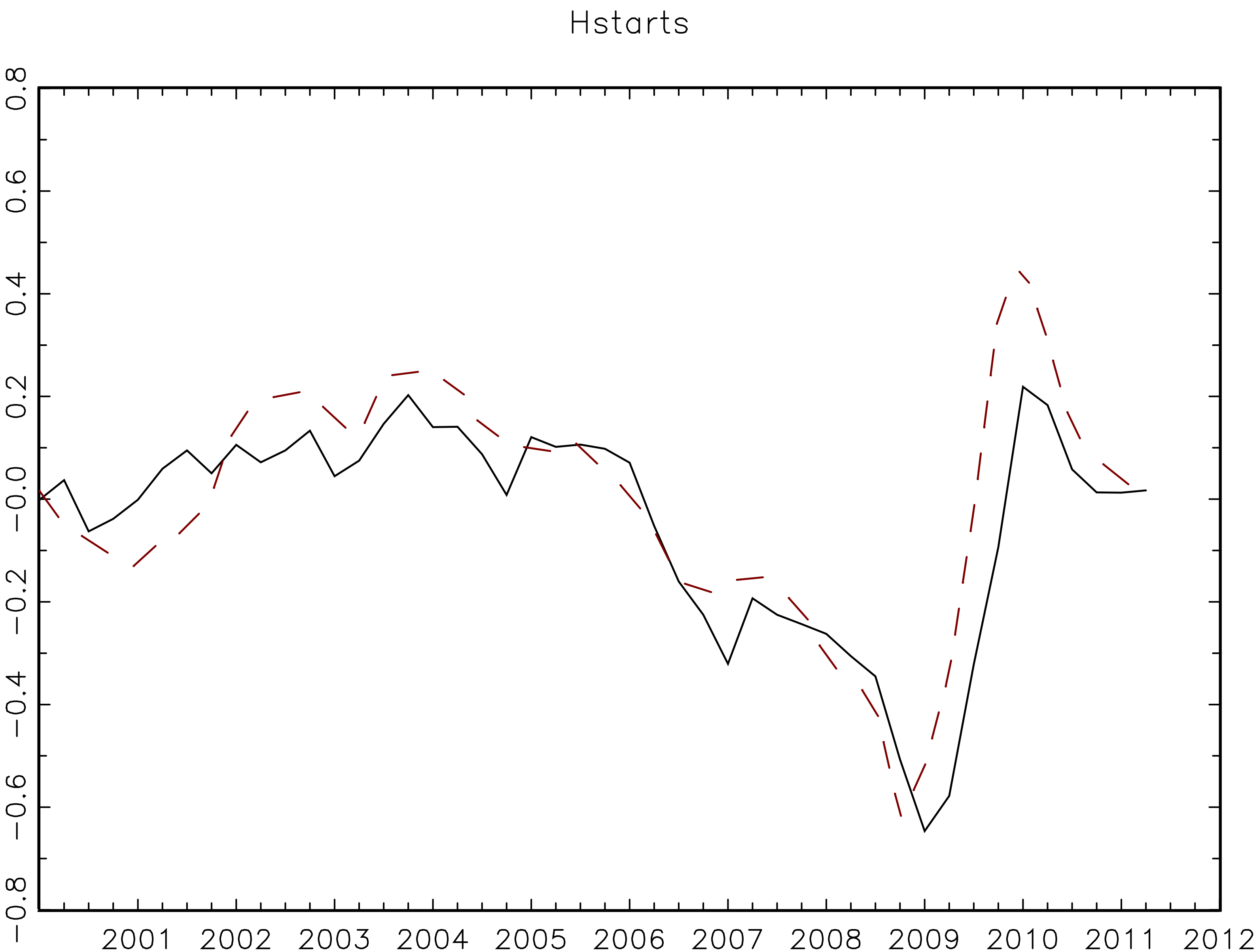
average R^2: 0.29 2007Q4 R^2: 0.83



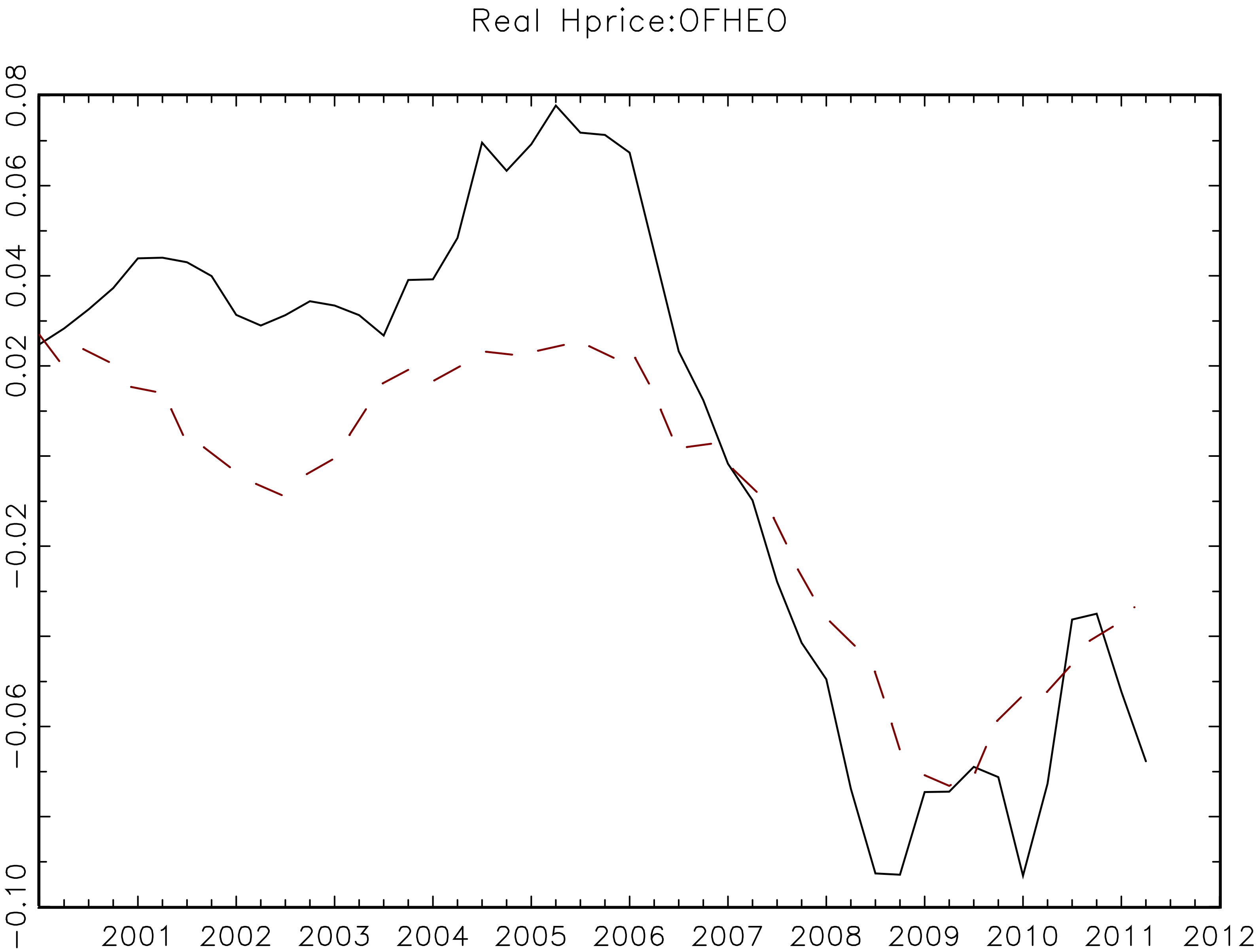
average R^2: 0.66 2007Q4 R^2: 0.86



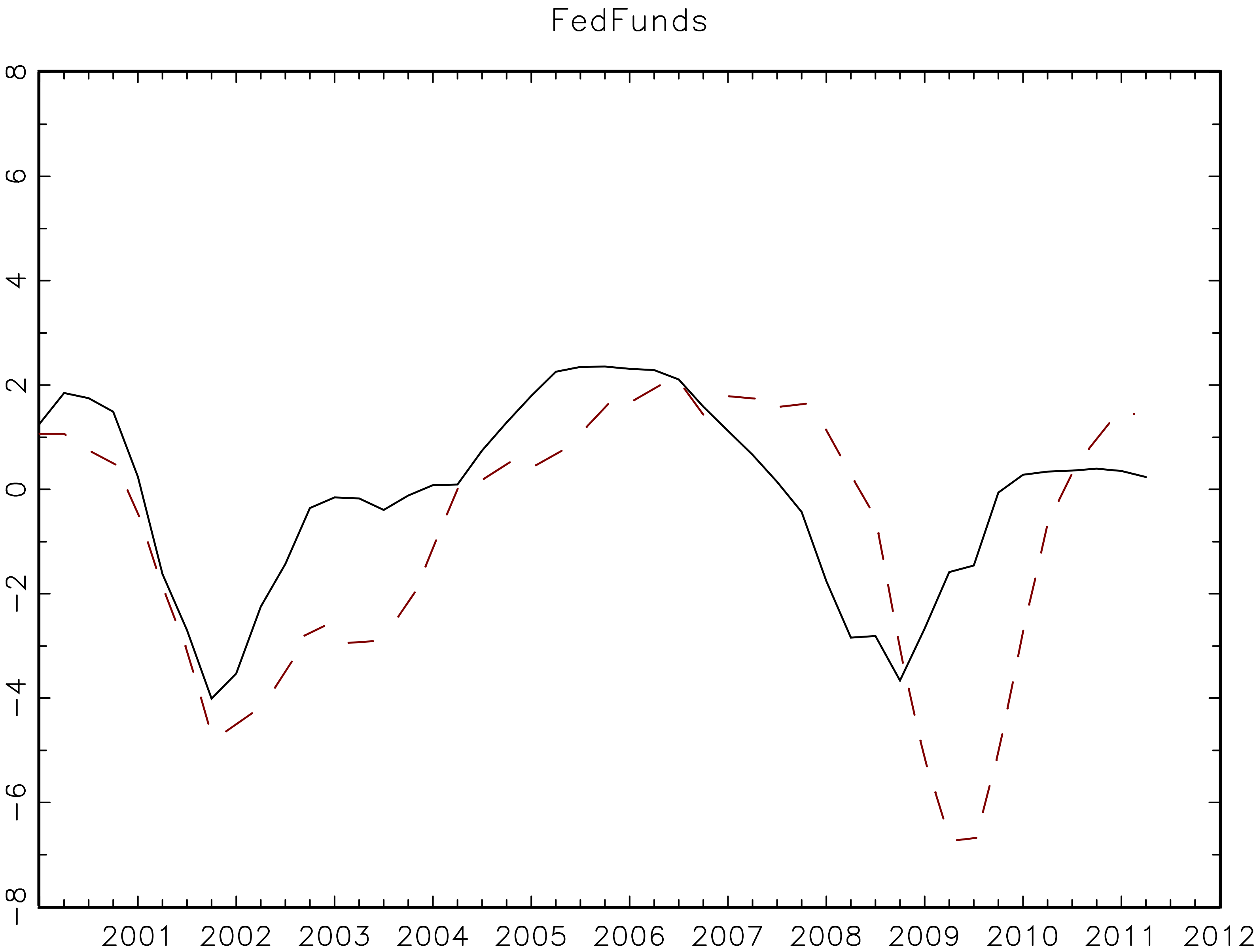
average R^2: 0.54 2007Q4 R^2: 0.62



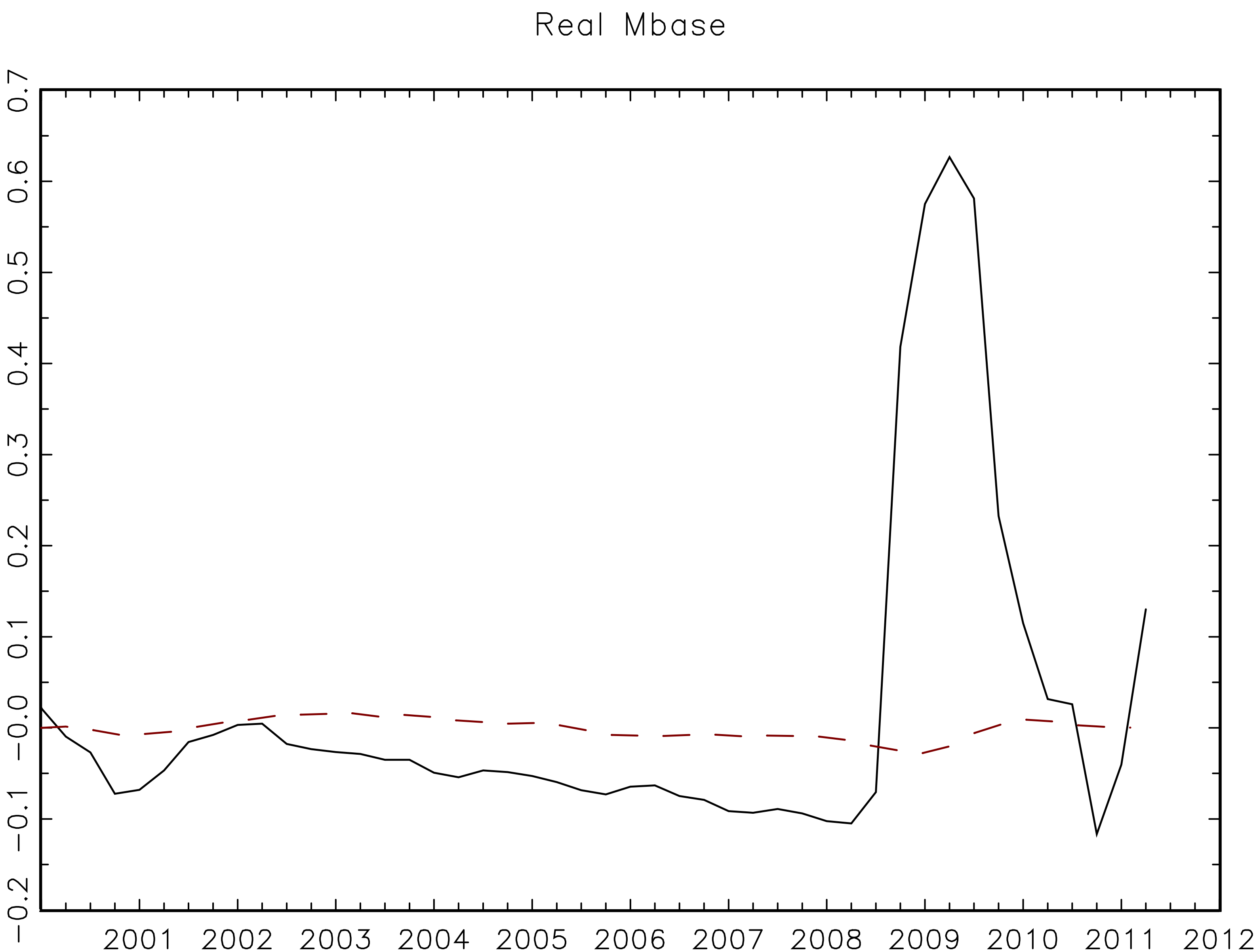
average R^2: 0.59 2007Q4 R^2: 0.53



average R^2: 0.38 2007Q4 R^2: 0.55

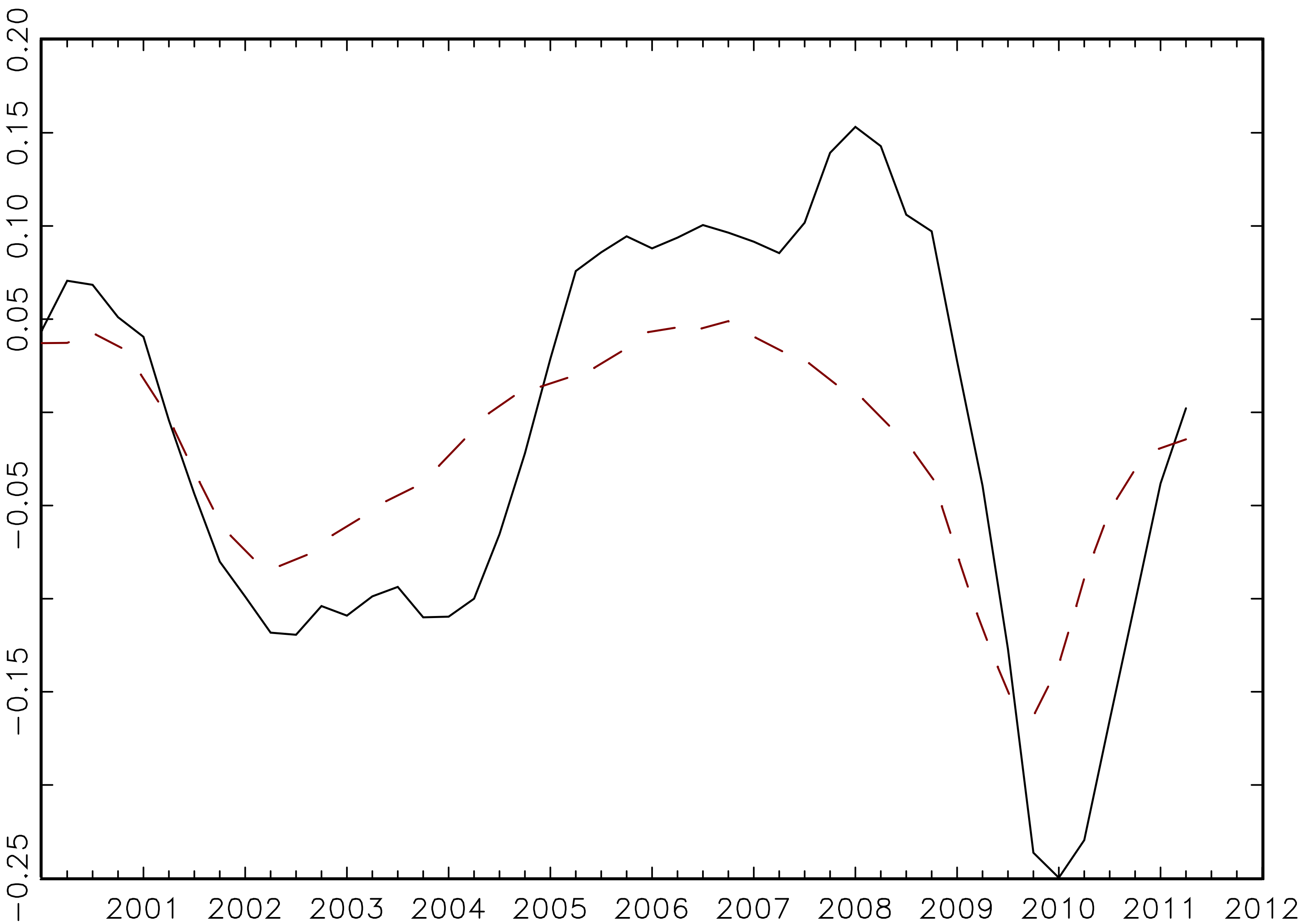


average R^2: 0.39 2007Q4 R^2: -1.54

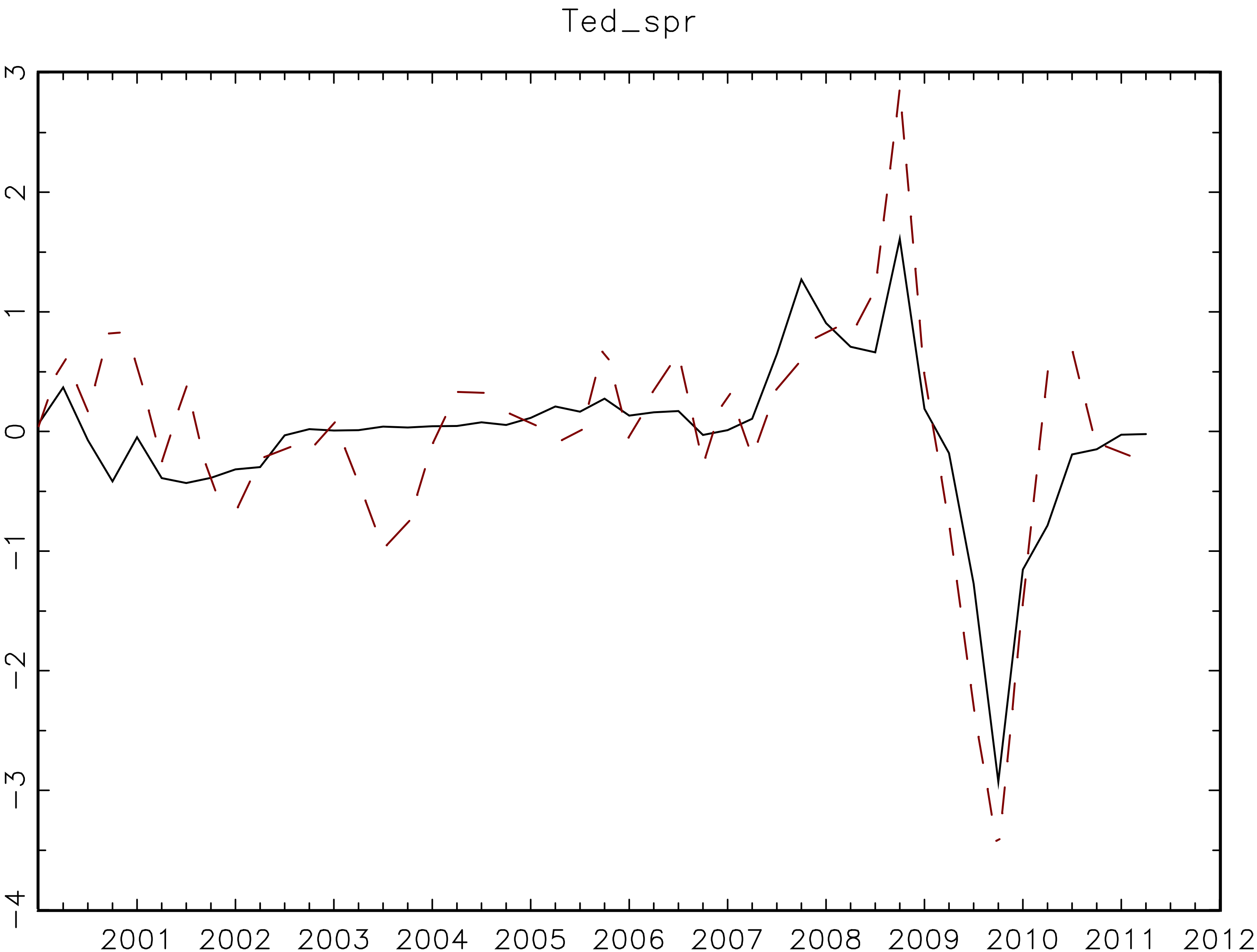


average R^2: 0.22 2007Q4 R^2: -0.03

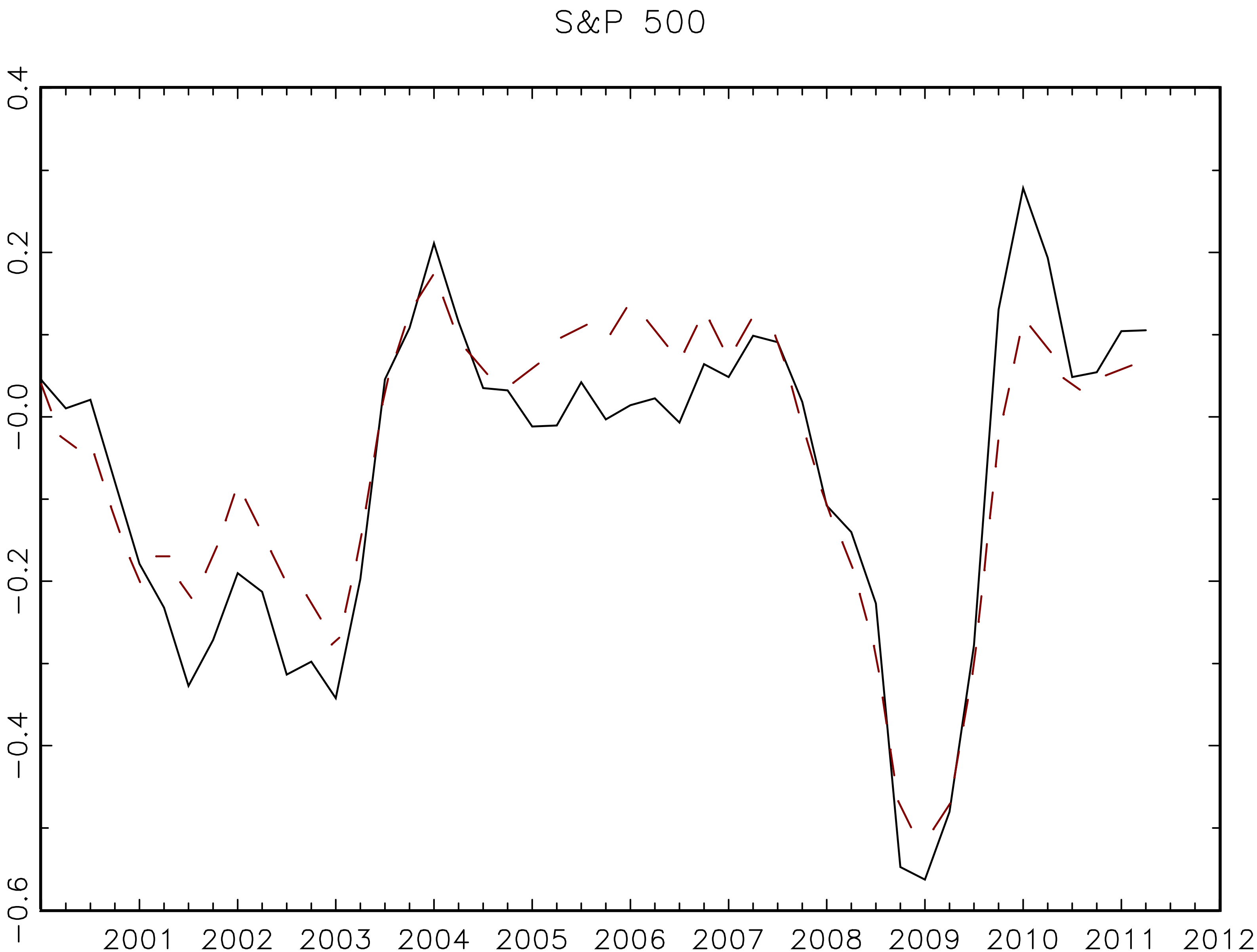
Real C&LLoand



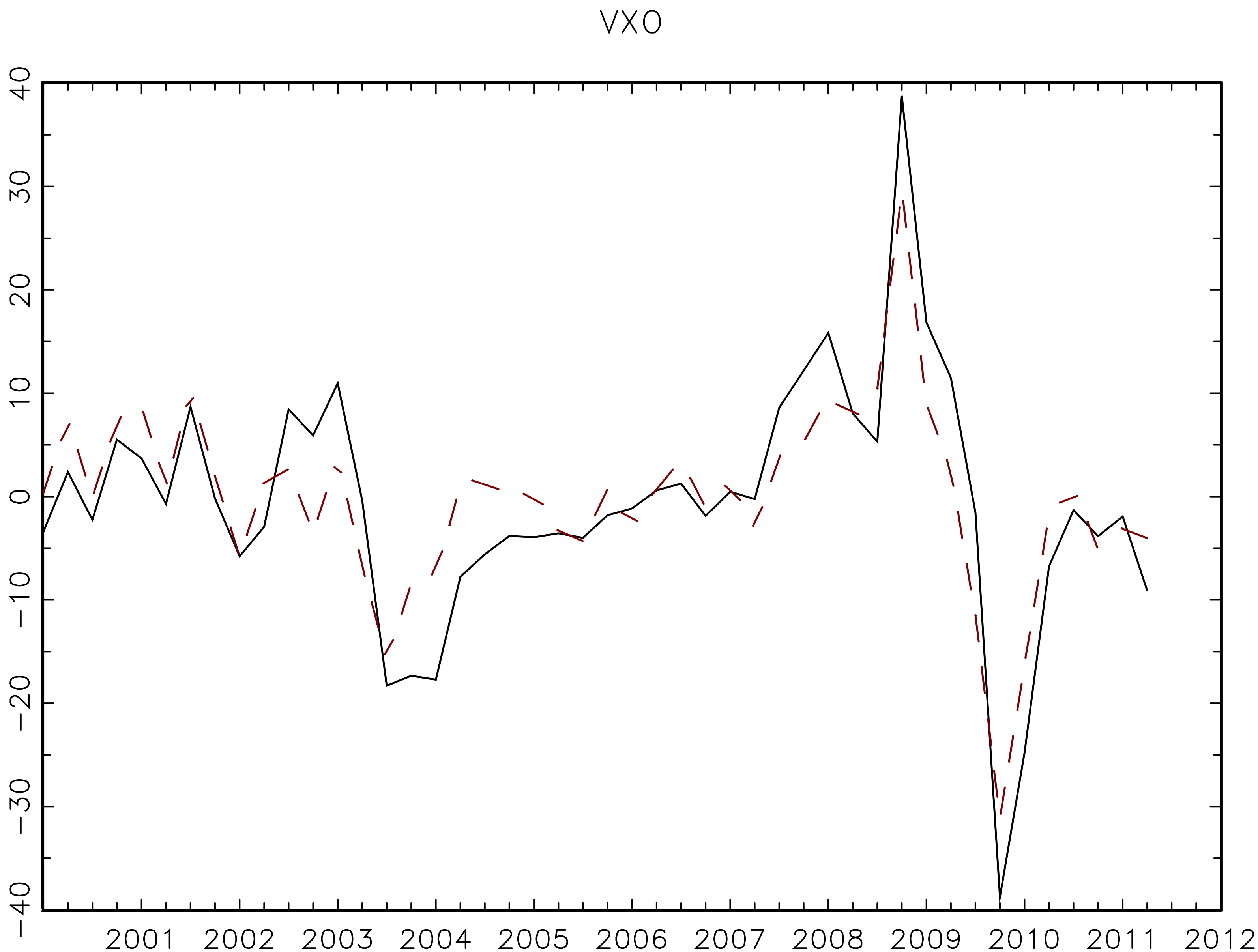
average R^2: 0.43 2007Q4 R^2: 0.78



average R^2: 0.43 2007Q4 R^2: 0.78



average R^2: 0.67 2007Q4 R^2: 0.87



average R^2: 0.12 2007Q4 R^2: 0.89

Table 2: Subsample R^2 of common component of quarterly macro variables by category, based on the six-factor benchmark DFM estimated over 1959Q1 – 2007Q3.

Category	N	1959-2007Q3	1984-2007Q3	Computed over 15 quarters starting at NBER peak							
				60Q1	69Q4	73Q4	80Q1	81Q3	90Q3	01Q1	07Q4
NIPA	21	0.56	0.43	0.56	0.46	0.62	0.66	0.59	0.64	0.49	0.65
Industrial production	13	0.72	0.60	0.78	0.77	0.86	0.86	0.80	0.66	0.61	0.80
Employment & Unemp	46	0.62	0.50	0.64	0.68	0.76	0.76	0.81	0.61	0.63	0.78
Housing starts	8	0.37	0.21	0.09	0.26	0.54	0.46	0.54	0.44	-0.16	0.27
Inventories, orders, & sales	8	0.54	0.35	0.39	0.69	0.72	0.73	0.68	0.66	0.43	0.64
Prices	39	0.15	0.05	0.00	0.15	0.37	0.18	0.08	0.03	0.14	0.13
Earnings & productivity	13	0.37	0.29	0.52	0.38	0.35	0.30	-0.03	0.32	0.36	-0.11
Interest rates	18	0.40	0.30	-0.07	0.39	0.30	0.50	0.44	0.29	0.07	-0.50
Money & credit	12	0.44	0.26	0.22	0.47	0.55	0.65	0.63	0.40	0.06	-0.37
Stock prices & wealth	11	0.47	0.52	0.00	0.67	0.74	0.62	0.50	0.37	0.31	0.77
Housing prices	3	0.67	0.67	.	.	.	0.59	-0.01	0.60	0.72	0.57
Exchange rates	6	0.56	0.66	-2.64	0.47	0.64	0.48	0.66	0.75	0.72	0.60
Other	2	0.42	0.42	-0.40	0.15	0.87	0.89	0.89	0.48	-0.60	0.31

1.2. Tests: Stability of Λ? Evidence of a "missing factor"?

Stability of Λ

- Andrews (1993) end-of-sample stability tests (Table 3)
- 13% of series reject at 5% level, relative to 1984Q1-2007Q3 Λ's
- Main rejections are in prices, money & credit, interest rates, housing

Missing factors?

Unusually large covariance among idiosyncratic errors following 07Q4?

Let $\gamma_{i,\tau}$ denote the ordered eigenvalues of $\Gamma_\tau = \sum_{t=\tau}^{\tau+7} \hat{e}_t \hat{e}_t'$ (a sample covariance matrix over 8 observations),

Let $\kappa_\tau = \frac{\gamma_{1,\tau}}{\sum_{i=1}^{8} \gamma_{i,\tau}}$.

κ will be large if e is dominated by single shock.

Missing factors? ctd.

Is κ unusually large during this recession?

Values of κ in different recessions

1960:2	1969:4	1973:4	1980:1	1981:3	1990:3	2001:1	2007:4
0.84	0.61	0.67	0.62	0.61	0.37	0.60	0.63

The value in 2007:4 (0.63) corresponds to the 42th percentile of the empirical distribution of κ in the sample (where κ is computed over all 8 quarter periods.)

Repeating the exercise over 15 periods following peak: The value in 2007:4 (0.42) corresponds to the 10th percentile of the empirical distribution of κ in the sample (where κ is computed over all 15 quarter periods.)

Summary:

Q1: Stability, new shocks, etc.

$\hat{\Lambda}$ from $t < 2007Q4$ data and $\hat{F}_t = (\hat{\Lambda}'\hat{\Lambda})^{-1}\hat{\Lambda}'X_t$ for all t

$X_t = \hat{\Lambda}\hat{F}_t + \hat{e}_t$

- How does "fit" over $t \geq 2007Q4$ compare to $t < 2007Q4$?
- Does $\hat{e}_t$ for $t \geq 2007Q4$ contain a common shock?
- Are Λ and Φ stable across $t = 2007Q4$?

Q2: Which shocks were important during 2007-09?

- Innovation in $X_{jt} = \lambda_j'\eta_t = \lambda_j'H\varepsilon_t$

Table 5: Innovations to factor components of selected series, by quarter, 2007Q1 – 2011Q2: Standardized innovations

Date	GDP	Consump-Tion	Invest-ment	Employ-ment	Prod-uctivity	Housing Starts	Oil Price	Fed Funds	Ted spread	VIX	Wealth (FoF)
2007Q1	-0.9	-1.3	-0.4	-0.7	-1.2	0.2	1.7	0.3	0.0	-0.6	0.0
2007Q2	0.3	-0.2	0.5	-0.1	0.2	0.8	1.1	0.5	-0.9	-1.4	0.8
2007Q3	-0.3	-0.8	0.0	-0.7	0.0	-0.7	0.3	-0.6	0.7	1.2	-1.0
2007Q4	-0.3	-1.3	0.1	0.3	-0.7	-1.3	1.3	0.4	0.4	0.5	-0.9
2008Q1	-0.3	-0.7	0.1	0.2	-0.4	-1.3	0.2	-0.1	1.4	2.2	-2.0
2008Q2	-1.4	-2.1	-0.4	-1.1	-2.1	1.0	3.4	0.5	0.1	-0.4	-0.8
2008Q3	-1.7	-1.7	-1.0	-0.7	-1.4	**-3.5**	-0.6	0.2	**3.9**	2.9	-2.6
2008Q4	1.0	2.1	-0.1	-0.4	**4.6**	**-8.3**	**-10.3**	-2.5	**7.7**	**8.3**	**-4.1**
2009Q1	0.3	-2.7	2.3	0.9	-0.3	**-4.7**	2.5	**3.5**	**4.0**	1.4	**-3.3**
2009Q2	2.9	1.8	**3.3**	**3.8**	0.7	2.9	2.8	**3.8**	**-3.0**	**-3.4**	1.2
2009Q3	1.6	0.4	1.9	2.3	-0.6	4.8	**5.0**	1.5	**-5.2**	**-3.5**	1.5
2009Q4	-1.2	-0.9	-2.0	-2.1	-0.2	0.1	-0.4	-2.1	-1.7	-2.1	2.7
2010Q1	0.3	-0.1	0.6	0.5	0.0	-0.5	0.3	1.2	0.9	0.0	-0.6
2010Q2	0.7	0.3	0.7	0.3	1.3	-2.4	-1.8	0.3	2.1	1.6	-1.2
2010Q3	0.8	-0.3	1.1	0.4	0.9	-1.7	0.0	0.9	1.0	0.3	-0.7
2010Q4	0.3	-0.6	0.6	0.0	0.0	0.6	1.7	0.8	-1.0	-1.8	0.8
2011Q1	0.4	-0.6	1.1	0.5	-0.6	1.5	2.8	1.2	-0.9	-0.8	-0.5
2011Q2	-0.9	-0.8	-1.1	-1.3	-0.6	0.5	0.4	-1.5	-0.7	0.1	0.3

What are these big shocks?

Digression: SDFM and SVAR identification

$$\Phi(L)F_t = \eta_t, \quad \eta_t = H\varepsilon_t,$$

What is column of H corresponding to "Oil shock"?

Strategy: Method of "external instruments"

Use shocks from the literature as instruments. Let Z_t^{KO} be Killian OPEC Oil Supply Shortfall variable (the instrument).

Selected references.

- Applications: Romer and Romer (1989, 2004, 2008), Ramey and Shapiro (1998), Ramey (2009) (but they don't use IV)
- Methods: Stock and Watson (2008), Mertens and Ravn (2011), Olea, Stock, and Watson (2012).

Method of external instruments, ctd.

Standard approach is to use a constructed exogenous shock series Z_t as a regressor – as a shock itself. But in general Z_t is only part of the shock, and has measurement error, so including Z_t as a regressor (as the shock itself) won't yield consistent estimation.

Instead, treat Z_t as an instrument

Assume:

(i) $E\left(\varepsilon_t^{Oil} Z_t^{KO}\right) \neq 0$ (Relevance)

(ii) $E\left(\varepsilon_t^{i} Z_t^{KO}\right) = 0$ for all other shocks i (Exogeneity)

(iii) $E(\varepsilon_t^{Oil} \varepsilon_t^{i}) = 0$ for all other shocks i

Then we can estimate H^{Oil} and ε_t^{Oil} .

Note Z can be multidimensional, and this imposed OID.

Identification using external instruments (multiple instruments)

$$u_t = H\varepsilon_t = \begin{bmatrix} H_1 & \cdots & H_r \end{bmatrix} \begin{pmatrix} \varepsilon_{1t} \\ \vdots \\ \varepsilon_{rt} \end{pmatrix}$$

Suppose you have an instrumental variable Z_t (not in Y_t) such that

(i) $E\left(\varepsilon_{1t} Z_t'\right) = \alpha' \neq 0$ (relevance)

(ii) $E\left(\varepsilon_{jt} Z_t'\right) = 0, j = 2, \ldots, r$ (exogeneity)

(iii) $E\left(\varepsilon_t \varepsilon_t'\right) = \Sigma_{\varepsilon\varepsilon} = I_r$ (or diagonal)

Under (i) and (ii), you can identify H_1 up to scale

$$E(u_t Z_t') = E(H\varepsilon_t Z_t') = \begin{bmatrix} H_1 & \cdots & H_r \end{bmatrix} \begin{pmatrix} E(\varepsilon_{1t} Z_t') \\ \vdots \\ E(\varepsilon_{rt} Z_t') \end{pmatrix} = H_1 \alpha'$$

Identification using external instruments, ctd.

1. ***Identification of H_1***

$$E(\eta_t Z_t') = E(H\varepsilon_t Z_t') = \begin{bmatrix} H_1 & \cdots & H_r \end{bmatrix} \begin{pmatrix} E(\varepsilon_{1t} Z_t') \\ \vdots \\ E(\varepsilon_{rt} Z_t') \end{pmatrix} = H_1 \alpha'$$

The scale of H_1 can be set by a normalization – e.g. a unit positive value of shock 1 is defined to have a unit positive effect on the innovation to variable 1, which is u_{1t}. This corresponds to

(iv) $H_{11} = 1$ (H_{11} is the first element of H_1) (unit shock normalization)

Identification using external instruments, ctd.

2. ***Identification of ε_{1t}***

The shock ε_{1t} is identified using (iii) (recall the partitioned matrix inversion argument). It is also identified by letting Φ be the coefficient matrix of the population regression of Z_t onto u_t:

$$\Phi = E(Z_t\eta_t')\Sigma_\eta^{-1} = \alpha H_1'(HH')^{-1} = \alpha H_1'H'^{-1}H^{-1} = \alpha H^{1\prime}$$

because $H^{-1}H_1 = (1\ 0\ \ldots\ 0)'$. Thus ε_{1t} is identified up to scale by

$$\Phi\eta_t = \alpha H^{1\prime}\eta_t = \alpha\varepsilon_{1t}$$

This projection is the population predicted value in the reduced rank regression of Z_t on η_t

Identification using external instruments, ctd.

Comments

1. Nearly all papers that use this approach don't actually do IV, they report reduced-form regressions of variables of interest onto Z_t. In general the reduced form regressions don't give you the structural coefficients of interest.

2. Multiple instruments per shock result in overidentification

3. For $r = 2$, a single instrument identifies *both* structural shocks (why?). Thus if each shock has its own instrument, the system is overidentified. (This generalizes to $r > 2$.)

External Instruments: Inference

GMM estimation of H_1

Impose the normalization condition $H_{11} = 1$ and let $H_1 = (H_{11}\ H_{1\bullet}')'$. The moment condition is,

$$E(u_t Z_t') = H_1 \alpha' \text{ or } E(\eta_t \otimes Z_t) = \alpha \otimes \begin{pmatrix} 1 \\ H_{1\bullet} \end{pmatrix}$$

This can be estimated by GMM using the sample moments,

$$T^{-1} \sum_{t=1}^{T} \left(\hat{\eta}_t \otimes Z_t \right)$$

Specialize to case of a single instrument (exact identification):

$$E \eta_t Z_t = \begin{pmatrix} \alpha \\ \alpha H_{1\bullet} \end{pmatrix}$$

so the GMM estimator is,

$$\hat{H}_{2\bullet} = \frac{T^{-1} \sum_{t=1}^{T} \hat{\eta}_{\bullet t} Z_t}{T^{-1} \sum_{t=1}^{T} \hat{\eta}_{1t} Z_t} \text{ where } \eta_t = \begin{pmatrix} \eta_{t1} \\ \eta_{\bullet t} \end{pmatrix}.$$

GMM estimation of H^1

The moment condition is,

$$E(Z_t \eta_t{}')\Sigma_\eta^{-1} = \alpha H^{1\prime} \quad \text{or} \quad E(Z_t \otimes \Sigma_\eta^{-1}\eta_t) = H^1 \otimes \alpha$$

This can be estimated by GMM using the sample moments,

$$T^{-1}\sum_{t=1}^{T}\left(Z_t \otimes \hat{\Sigma}_{\hat{\eta}}^{-1}\hat{\eta}_t\right)$$

Exact identification:

H^1 is estimated (up to scale) by the regression of Z_t on $\hat{\eta}_t$

Overidentification/no-HAC. If these moments have a Kronecker structure (no serial correlation/no heteroskedasticity), the GMM estimator simplifies to reduced rank regression:

$$Z_t = \Phi\hat{\eta}_t + \nu_t$$

Overidentifying restrictions can be tested by testing the reduced rank regression restrictions.

2. What are the shocks? Results I

1. Oil Shocks
    - a. Hamilton (2003) net oil price increases
    - b. Killian (2008) OPEC supply shortfalls
    - c. Ramey-Vine (2010) innovations in adjusted gasoline prices

2. Monetary Policy
    - a. Romer and Romer (2004) policy
    - b. Smets-Wouters (2007) monetary policy shock
    - c. Sims-Zha (2007) MS-VAR-based shock
    - d. Gürkaynak, Sack, and Swanson (2005), FF futures market

3. Productivity
    - a. Gali (200x) long-run shock to labor productivity
    - b. Smets-Wouters (2007) productivity shock
    - c. Fernald (2009)/Basu-Kimball-Fernald (2004) TFP shock

4. Uncertainty
    a. VIX/Bloom (2009)
    b. Baker, Bloom, and Davis (2009) Policy Uncertainty

5. Liquidity
    a. Spread: Gilchrist-Zakrajšek (2011) excess bond premium
    b. TED Spread
    c. Bassett, Chosak, Driscoll, Zakrajšek (2011) bank lending shock

6. Fiscal Policy
    a. Ramey (2011) spending news
    b. Fisher-Peters (2010) excess returns gov. contractors
    c. Romer and Romer (2010) exog. tax changes.

2. What are the shocks? Results I, ctd.

Table 6: Historical importance of shocks

Table 7: Correlation matrix of 18 identified shocks

Table 8: Contributions of shocks to Post-2007 growth

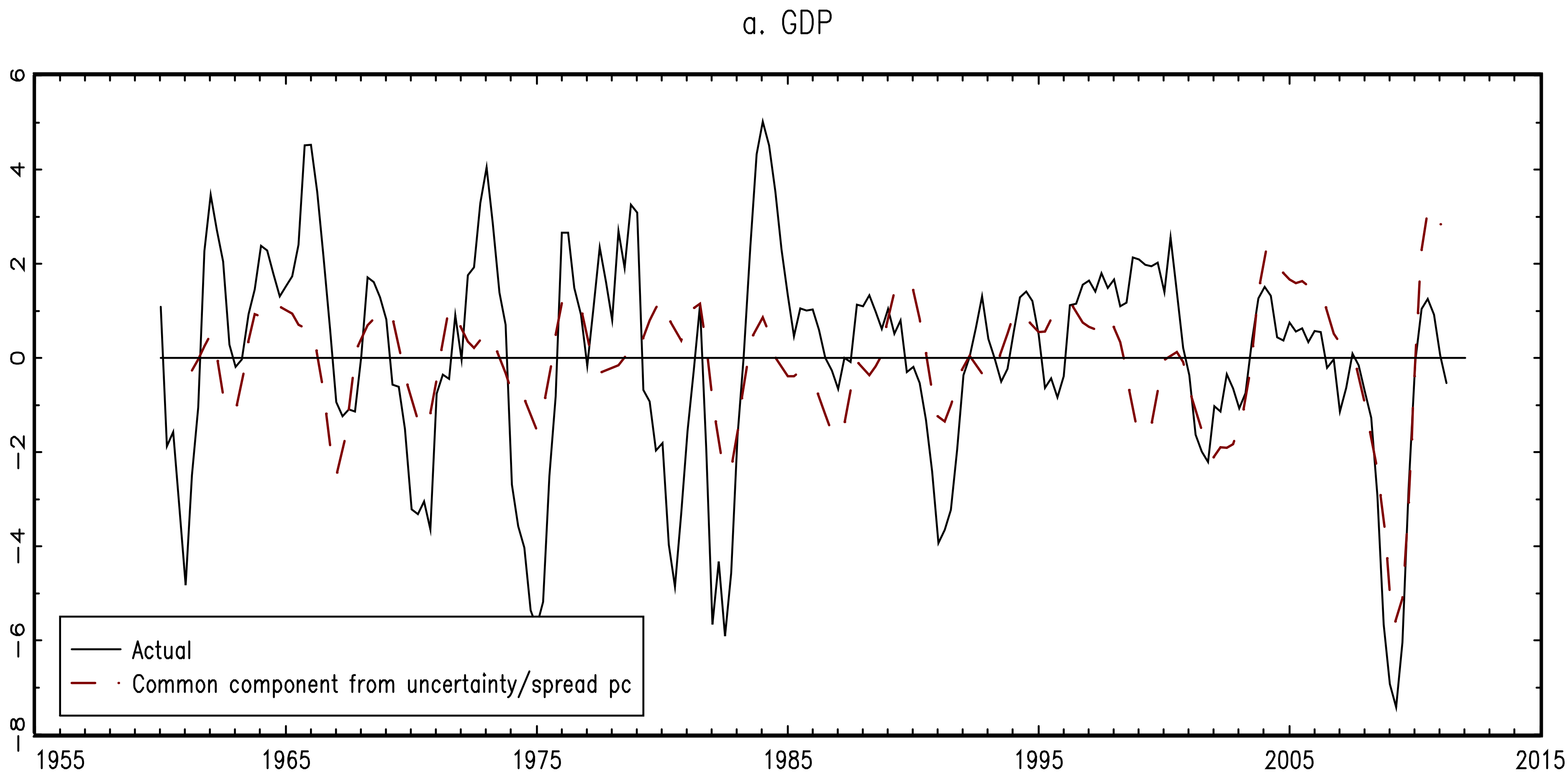
2. What are the shocks? Results I, ctd.

Correlation matrix of identified shocks

	O_{H}	O_{K}	O_{RV}	M_{RR}	M_{SW}	M_{SZ}	M_{GSS}	P_{F}	P_{G}	P_{SW}	U_{B}	U_{BBD}	S_{GZ}	S_{TED}	B_{BCDZ}	F_{R}	F_{FP}	F_{RR}
O_{H}	1.00																	
O_{K}	0.42	1.00																
O_{RV}	0.15	0.60	1.00															
M_{RR}	0.37	**0.65**	**0.77**	1.00														
M_{SW}	0.09	0.11	0.39	0.09	1.00													
M_{SZ}	0.33	0.35	**0.68**	0.93	0.16	1.00												
M_{GSS}	0.44	-0.12	-0.08	0.24	0.43	0.39	1.00											
P_{F}	**-0.64**	0.30	0.24	0.20	-0.09	0.06	-0.57	1.00										
P_{G}	-0.40	0.34	0.01	-0.30	0.35	-0.53	-0.37	0.52	1.00									
P_{SW}	**-0.91**	-0.03	0.00	-0.24	-0.07	-0.36	-0.59	0.82	0.68	1.00								
U_{B}	-0.37	-0.37	-0.58	-0.39	0.30	-0.29	0.37	0.19	0.34	0.27	1.00							
U_{BBD}	0.10	0.11	-0.37	-0.17	0.45	-0.22	0.57	-0.06	0.45	-0.01	0.78	1.00						
L_{GZ}	-0.20	-0.42	-0.51	-0.41	0.44	-0.24	0.34	0.07	0.24	0.08	**0.92**	**0.66**	1.00					
L_{TED}	-0.09	0.01	-0.05	0.03	**0.73**	0.10	0.48	0.21	0.37	0.09	**0.80**	**0.76**	0.84	1.00				
L_{BCDZ}	0.04	0.22	**0.79**	0.56	0.13	0.55	0.04	-0.09	-0.28	-0.06	**-0.69**	-0.54	-0.73	-0.40	1.00			
F_{R}	-0.17	**-0.64**	**-0.77**	**-0.84**	-0.32	**-0.72**	-0.34	-0.17	-0.01	0.01	0.26	-0.08	0.40	-0.13	-0.13	1.00		
F_{FP}	0.04	-0.21	-0.35	**-0.72**	0.20	**-0.78**	-0.03	-0.49	0.40	-0.02	0.03	0.25	0.03	-0.12	-0.12	0.38	1.00	
F_{RR}	0.20	0.15	0.30	**0.77**	-0.10	**0.88**	0.37	0.18	-0.59	-0.28	0.01	-0.10	0.02	0.19	0.19	-0.45	-0.93	1.00

2. What are the shocks? Results II

Contribution to 4-Q **GDP** growth (1959-2011Q2) of first principal component of two term spread shocks & two uncertainty shocks



Q3. Slow Recoveries, 2007Q4 and otherwise

Compute trend and cycle components of recoveries

3.1 Trend

- As before – approximately 15 year centered MA

3.2 Cycle

- Different recessionary shocks lead to different recoveries

$$X_t = \Lambda F_t + e_t$$

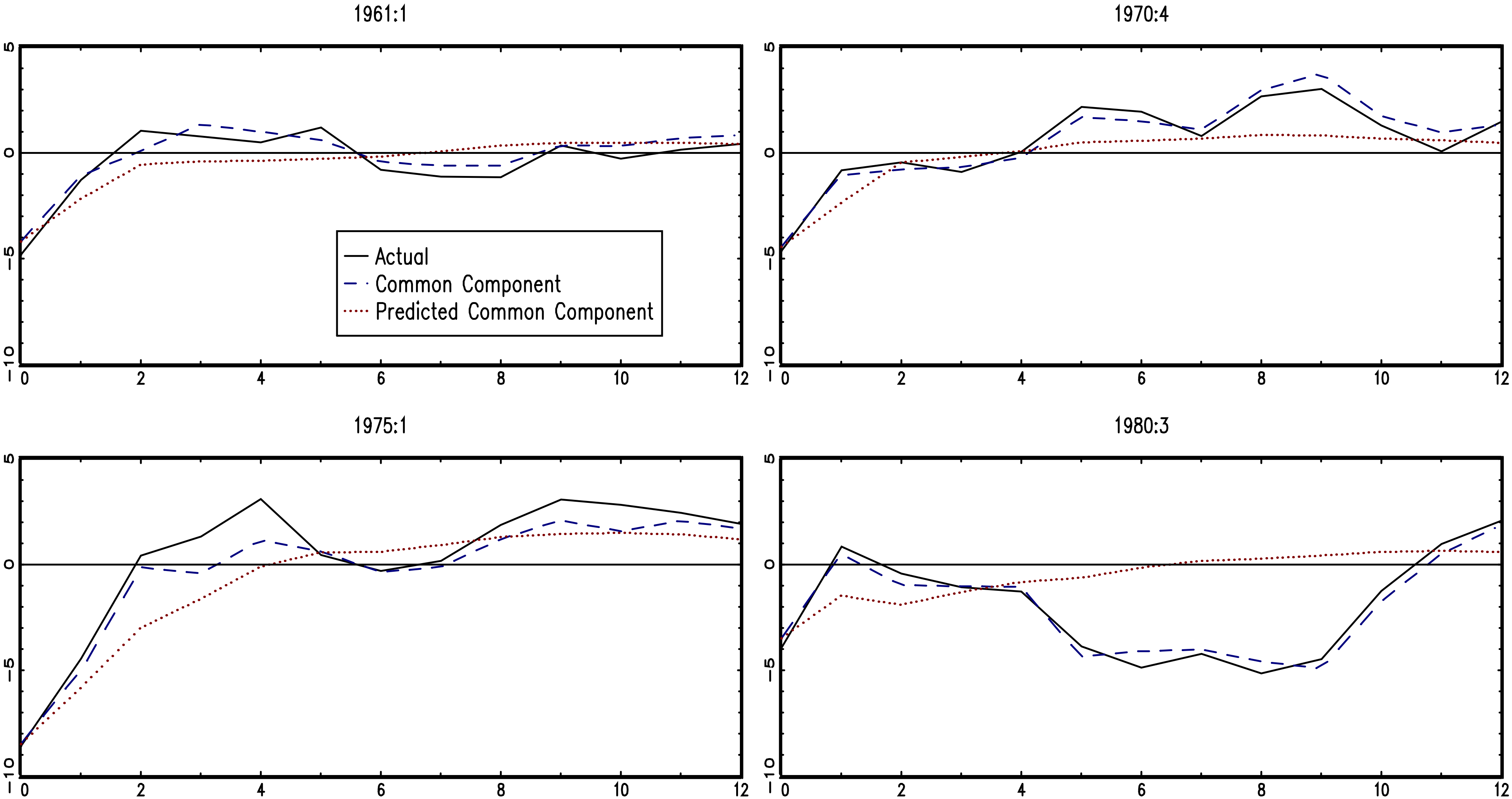
$$\Phi(L) F_t = \eta_t$$

State Vector: $(F_t' \; F_{t-1}' \; \ldots \; F_{t-3}')'$

- Cyclical component: forecast of employment growth, made using factors at the NBER trough

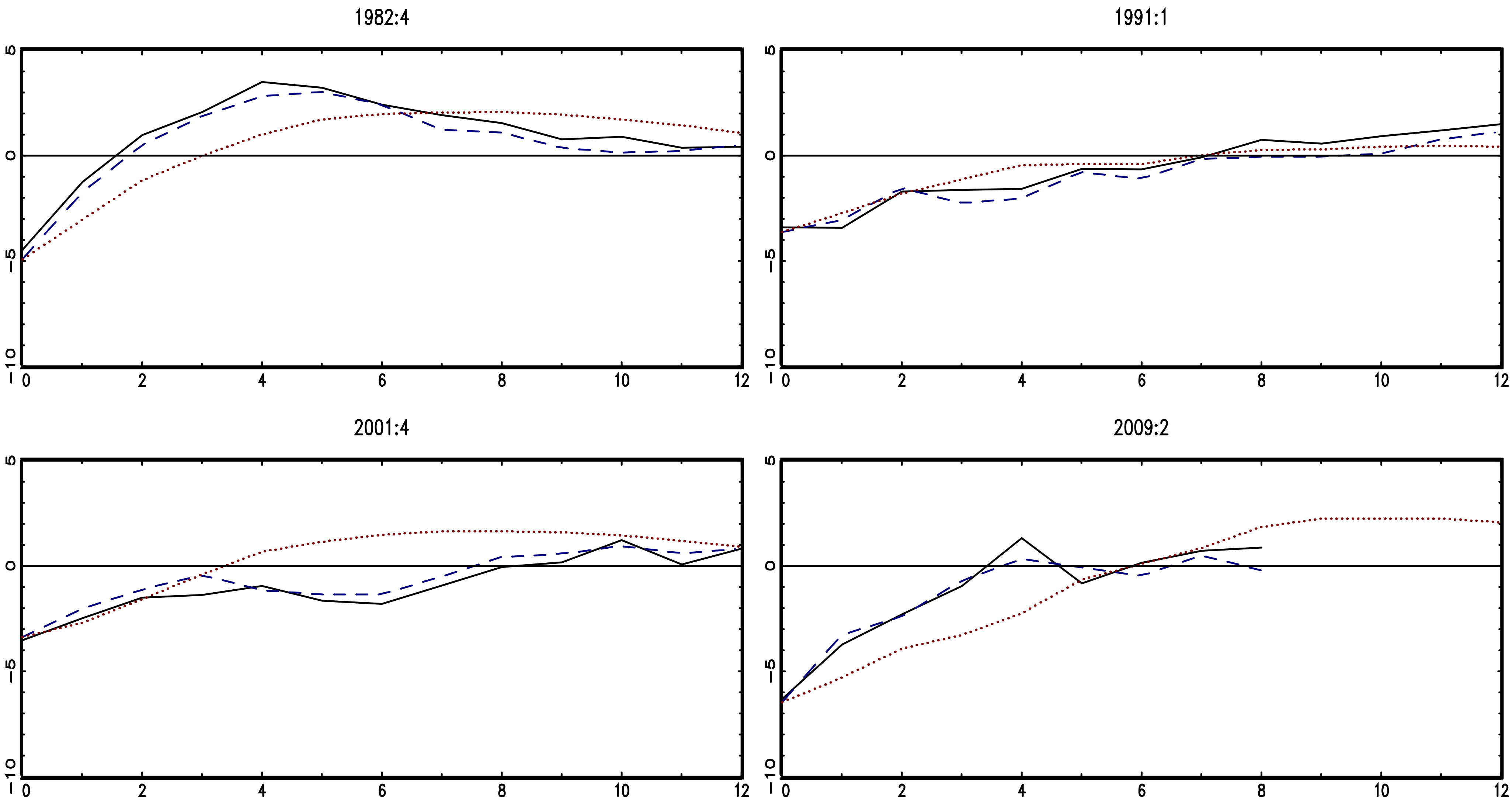
3.1 Slow Recoveries: Cyclical component, 1961Q1 – 1980Q3

Quarterly employment growth from NBER troughs, predicted & actual

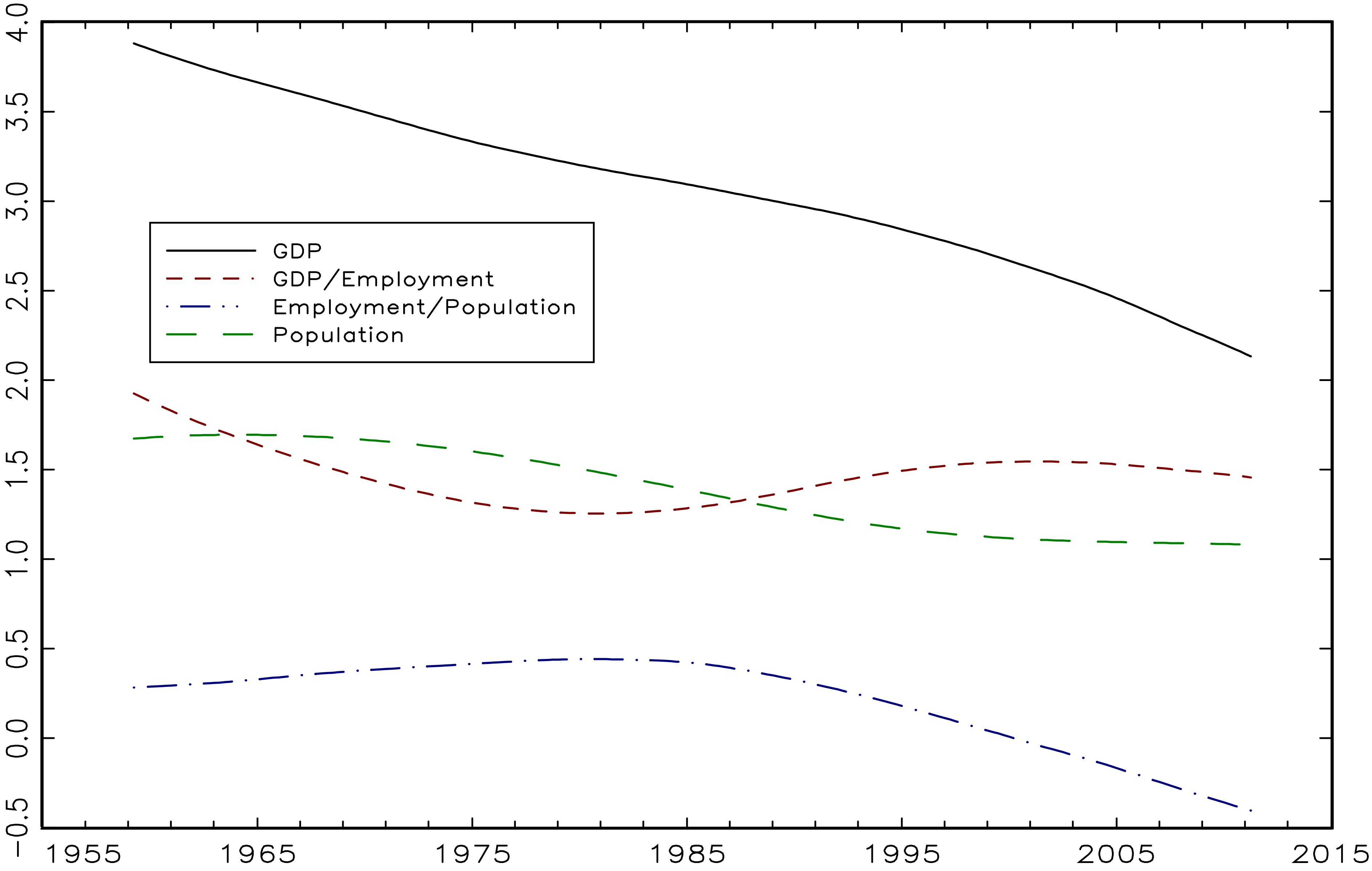


Cyclical component, 1982Q4 – 2009Q2

Quarterly employment growth from NBER troughs, predicted & actual



3.2. Slow Recoveries: Trend component



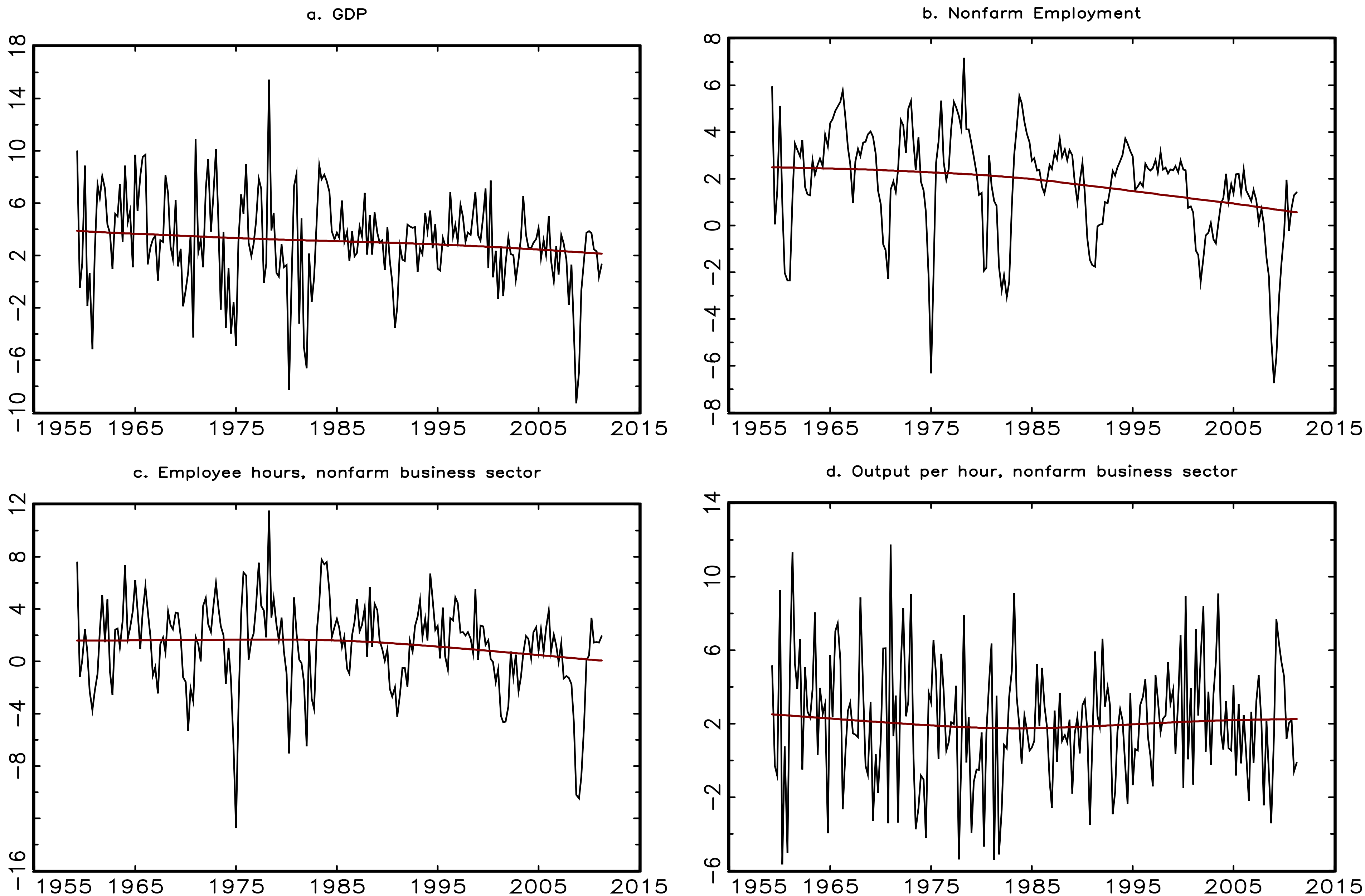

a. GDP
b. Nonfarm Employment
c. Employee hours, nonfarm business sector
d. Output per hour, nonfarm business sector
1955 1965 1975 1985 1995 2005 2015

Table 9
Predicted and actual cumulative growth of output, employment, and productivity in the 8 quarters following a NBER trough

Trough date	Source	GDP	Nonfarm Employment	Output per Hour (nonfarm business)
1961Q1	Cyclical	1.1	**-1.0**	2.0
	Trend	7.5	**4.9**	4.8
	Total	8.7	**4.0**	6.8
1970Q4	Cyclical	2.4	**0.0**	2.6
	Trend	6.9	**4.7**	4.0
	Total	9.3	**4.6**	6.6
1975Q1	Cyclical	3.3	**-1.8**	5.4
	Trend	6.6	**4.5**	3.7
	Total	9.9	**2.7**	9.1
1980Q3	Cyclical	1.1	**-1.5**	2.9
	Trend	6.3	**4.2**	3.5
	Total	7.5	**2.7**	6.4

Predicted and actual growth, ctd.

Trough date	Source	GDP	Nonfarm Employment	Output per Hour (nonfarm business)
1982Q4	Cyclical	5.0	**1.1**	4.3
	Trend	6.2	**4.1**	3.5
	Total	11.2	**5.2**	7.8
1991Q1	Cyclical	0.8	**-1.6**	2.5
	Trend	5.9	**3.3**	3.8
	Total	6.7	**1.6**	6.3
2001Q4	Cyclical	2.9	**0.5**	2.6
	Trend	5.1	**2.1**	4.3
	Total	8.0	**2.6**	6.9
2009Q2	Cyclical	2.4	**-3.1**	6.3
	Trend	4.4	**1.2**	4.5
	Total	6.8	**-1.9**	10.8

Predicted and actual growth, ctd.

Trough date	Source	GDP	Nonfarm Employment	Output per Hour (nonfarm business)
Averages				
1960-1982	Cyclical	3.0	**-0.4**	3.6
	Trend	6.8	**4.5**	4.0
	Total	9.8	**4.1**	7.6
	Actual[a]	11.0	**5.9**	7.3
1960-2001	Cyclical	2.6	**-0.5**	3.2
	Trend	6.4	**3.9**	4.0
	Total	9.0	**3.5**	7.3
	Actual[a]	9.2	**4.0**	7.2
Differences				
2009Q2 – average, 1960-1982	Cyclical	-0.6	**-2.7**	2.7
	Trend	-2.4	**-3.3**	0.5
	Total	-3.0	**-6.0**	3.2

Our interpretation & caveats – Q1

1. The shocks of this recession weren't new – just bigger versions of things we have seen before.

2. The macro responses to those "old" shocks were the same as they were historically, given the size of the shocks.

   Caveat/issue of interpretation:

   - Structural break analysis limited by sample size (power)
   - There *were* new shocks (Lehman, TARP, QE) – but it seems that their (net) effect on macro variables was the same as other financial/uncertainty shocks historically

Our interpretation & caveats – Q2

3. Some combination of financial/uncertainty shocks seems to account for most of the recession

   Caveat

   - The (structural VAR, and maybe DSGE) literature isn't ready to identify separately independent financial/uncertainty shocks.

Our interpretation & caveats – Q3

4. Slow trend employment growth from demographic shifts underlies slow employment growth from the 2001Q4 and 2009Q2 recoveries.

   Caveat

   - Demographic shifts makes trends sound exogenous – but long-term labor supply decisions have endogenous components.