Common uncertainty factors

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Introduction

- Uncertainty (volatility) determines economic decisions.
- Uncertainty shocks and may lead to a recession.
  - (Financial market) uncertainty (Bloom, 2009)
  - inflation uncertainty (Friedman, 1977, Ball, 1992)
  - output uncertainty (Ramey and Ramey, 1995)
  - oil price uncertainty (Elder and Serletis, 2010)
  - policy uncertainty (Baker et al., 2012, Fernandez-Villaverde et al., 2012)
- There are literally hundreds of variables that are surrounded by uncertainty (Goncalves and Kilian, 2004).
- How many "types" of uncertainty exist?
- We may want to have a model for *overall* economic uncertainty.

Introduction (cont.)

- Factor models are applied to analyze large-dimensional data sets (e.g. Sargent and Sims, 1977, Geweke, 1977, Stock and Watson 1989, 1991).
- Stock and Watson (1999, 2002, 2005) and Giannone et al. (2004), for instance, analyze how many fundamental factors drive the entire U.S. economy.
- We use these techniques to analyze:
  - **How many fundamental shocks drive economic uncertainty?**
  - **What are these fundamental factors?**
  - **Are these factors related to economic (business cycle) fluctuations?**

Outline

Measuring uncertainty

- Large-scale data set used by Giannone et al. (2004)
- $N = 163$ monthly post war U.S. variables covering all kinds of economic activity
- $T = 496$ (1970 M1 - 2011 M4)
- 14 categories: industrial production, capacity utilization, employment, sales and consumption, housing and construction, inventories, new and unfilled orders, financial variables, interest rates, monetary variables, prices, wages, merchandize ex- and imports, business outlook.

Measuring uncertainty

- Economic uncertainty is a latent variable.
  - Survey based measures:
    - Subjective probability distributions from surveys available only for some variables (GDP, GDP Deflator, CPI)
    - Disagreement about forecasts or cross-sectional spread among different industries may be a poor proxy
  - GARCH measures:
    - Time series data are available for most economic variables.
    - Requires the formulation of a well-specified statistical model for each of the 163 variables.
    - Numerous GARCH models have been formulated.

Measuring uncertainty (cont.)

- We use a data-driven filter: RiskMetrics (Morgan, 1996)

$$
\begin{aligned}
y_t &= \mu + \sum_{p=1}^{P} \alpha_p y_{t-p} + \sigma_t \epsilon_t, \qquad \text{with } \epsilon_t \sim N(0,1) \qquad (1) \\
\sigma_t^2 &= \lambda \sigma_{t-1}^2 + (1-\lambda)\epsilon_{t-1}^2 = (1-\lambda) \sum_{i=1}^{\infty} \lambda^{i-1} \epsilon_{t-i}^2. \qquad (2)
\end{aligned}
$$

- Use of AR(P) model enforces a forecast perspective: Uncertainty is high if the realization deviates from predictable (in-sample) conditional mean.
- A correction applies at the beginning of the sample t: $\frac{1-\lambda}{1-\lambda^t}$.
- We use $\log(\sigma_{it})$ to ensure non-negativity of uncertainty.

The dynamic factor model

- Notation:

$$\begin{aligned} X_t &= \lambda(L) f_t + \xi_t & (3) \\ f_t &= \Psi(L) f_{t-1} + u_t & (4) \end{aligned}$$

  - X_t: uncertainty measures $\log(\sigma_{it})$ $(N \times 1)$
  - ξ_t: idiosyncratic processes $(N \times 1)$
  - f_t: dynamic factors $(q \times 1)$
  - u_t: fundamental shocks $(q \times 1)$
  - $\lambda(L)$: lag polynomial of order p $(N \times q)$
  - $\Psi(L)$: lag polynomial of order p $(q \times q)$
- $u_t \sim N(0, I_q)$
- $E[\xi_t u'_{t-k}] = 0$ for all k
- ξ_t is gaussian and weakly correlated (approximate factor model).

The dynamic factor model (cont.)

- State space representation with static factors:

$$\begin{aligned} X_t &= \Lambda F_t + \xi_t \qquad (5) \\ &= \chi_t + \xi_t \\ F_t &= A F_{t-1} + B u_t, \qquad (6) \end{aligned}$$

  - χ_t: common component
  - $F_t = (f_t', f_{t-1}', \ldots, f_{t-p}')'$: static factors $(r \times 1)$.
  - $\Lambda = (\lambda_0, \lambda_1, ..., \lambda_p)$: loadings $(N \times r)$, λ_i is $(N \times q)$.
- If r chosen "large enough" a VAR(1) in F_t is sufficient.

Model estimation

- Quasi Maximum Likelihood estimation by EM algorithm combined with Kalman smoother (Doz et al., 2011, 2012).
- To obtain a more parsimonious model we make use of the parametric structure of the model and impose zero restrictions on A. We obtain the usual companion form of the VAR in F_t:

$$A = \begin{pmatrix} A_1 & A_2 & \dots & A_{p-1} & A_p \\ I & 0 & \dots & 0 & 0 \\ 0 & I & \dots & 0 & 0 \\ \vdots & & \ddots & & \vdots \\ 0 & \dots & \dots & I & 0 \end{pmatrix}. \tag{7}$$

The number of static factors r (1)

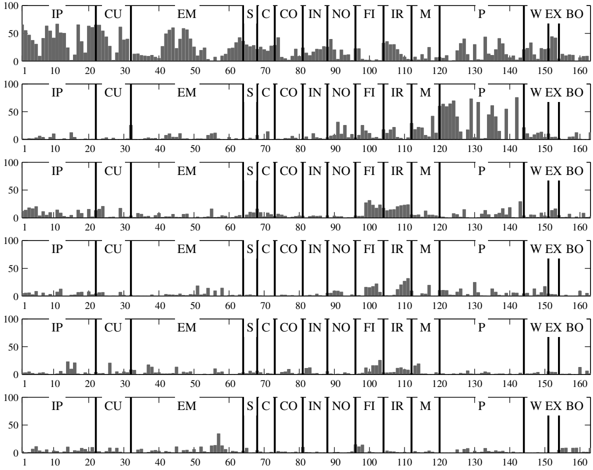


Figure: Change of R^2 for PC 1 to 6

The number of static factors r (2)

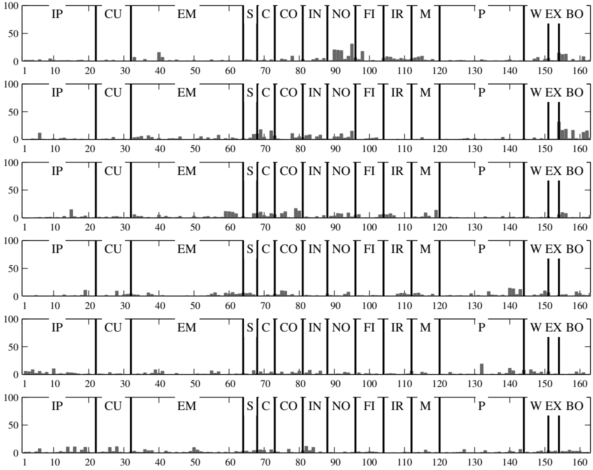


Figure: Change of R^2 for PC 7 to 12

The number of static factors r (3)

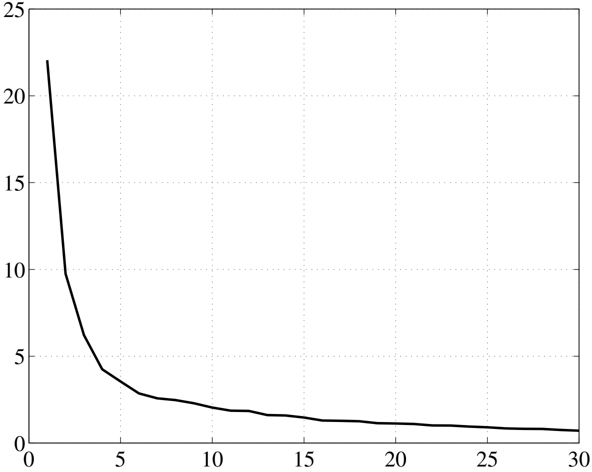


Figure: Scree plot

The number of dynamic factors q (1)

	$r=6$	$r=7$	$r=8$	$r=9$	$r=10$	$r=11$	$r=12$	$r=13$	$r=14$	$r=15$	$r=16$
Bai and Ng (2007)											
	3	3	3	4	3	3	3	3	3	3	3
Amengual and Watson (2007)	$r=6$	$r=7$	$r=8$	$r=9$	$r=10$	$r=11$	$r=12$	$r=13$	$r=14$	$r=15$	$r=16$
$p1$	6	7	8	8	6	5	4	3	2	1	1
$p2$	6	7	6	5	4	3	3	2	1	1	1
$p3$	6	7	8	9	10	11	12	13	14	15	16
Hallin and Liska (2007)	$r=6$	$r=7$	$r=8$	$r=9$	$r=10$	$r=11$	$r=12$	$r=13$	$r=14$	$r=15$	$r=16$
$p1$	2	2	2	2	2	2	2	2	2	2	2
$p2$	2	2	2	2	2	2	2	2	2	2	2
$p3$	1	1	1	1	1	1	1	1	1	1	1

Note: The first table gives the number of dynamic factors determined by the information criterion of Bai and Ng (2007) with $\delta = 0.1$ and $m = 2.25$. The second panel gives the number of dynamic factors determined with the method of Amengual and Watson (2007). The penalty functions are similar to those of the ICP measures in Bai and Ng (2002). The last panel gives the number of dynamic factors determined by the non logarithmic criteria with penalty functions $p1$ to $p3$ proposed by Hallin and Liska (2007). The number of static factors is denoted by r. Results depend on initial random permutation.

Table: Tests for number of dynamic factors q

The number of dynamic factors q (2)

k_0 **vs.** k_1	Onatski (2009)			
	$k_1 = 3$	$k_1 = 4$	$k_1 = 5$	$k_1 = 6$
$k_0 = 0$	0.0390	0.0500	0.0600	0.0700
$k_0 = 1$	0.0280	0.0390	0.0500	0.0600
$k_0 = 2$	0.0160	0.0280	0.0390	0.0500
$k_0 = 3$		*0.9850*	*0.2160*	*0.2890*
$k_0 = 4$			0.1200	0.2160
$k_0 = 5$				0.8030

Note: The table provides p-values of tests on number of dynamic factors k with hypotheses H_0 : $k = k_0$ vs. $H_1 : k_0 < k <= k_1$.

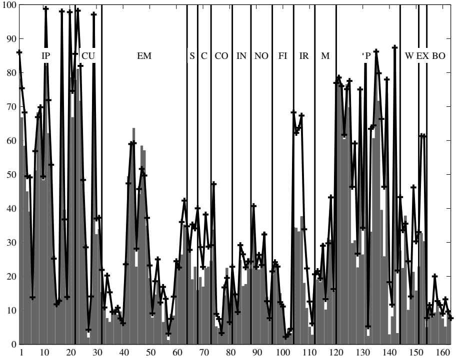
Table: Onatski (2009) test for number of dynamic factors q

The number of dynamic factors q (3)

- The number of fundamental shocks q appears to be low.
- It hovers around 2.
- Two shocks explain the bulk of uncertainty of important variables: industrial production ($R^2 = 0.78$), industrial production ($R^2 = 0.78$), capacity utilization ($R2 = 0.78$), employment ($R^2 = 0.59$), consumer prices ($R^2 = 0.70$).

The number of dynamic factors q (4)

Check against $q = 3$:



Note: Grey bars represent R^2 for individual uncertainty measures in the dataset for $q = 2$. The solid line depicts R^2 for the case $q = 3$.

Figure: R^2 of $q = 2$ vs. $q = 3$

What are the two fundamental shocks? (1)

- MA representation of F_t is given by

$$F_t = (I_r - AL)^{-1} B u_t \tag{8}$$

- Impulse response function of χ_t is given by

$$\chi_t = \Lambda (I_r - AL)^{-1} B u_t = B(L) u_t \tag{9}$$

- Consider the representation $\chi_t = C(L)\nu_t$, where $C(L) = B(L)H$ and $\nu_t = H' u_t$.
- H is any (rotation) matrix with $HH' = I_q$

What are the two fundamental shocks? (2)

- We select the rotation matrix H such that a target function is maximized (Giannone et al., 2004):

$$\frac{\sum_{i\in J_R}\sum_{h=0}^{\infty}(c_{i1}^{h})^2}{\sum_{i\in J_R}\sum_{h=0}^{\infty}(c_{i1}^{h})^2+\sum_{i\in J_R}\sum_{h=0}^{\infty}(c_{i2}^{h})^2} \tag{10}$$

- c_{ij}^{h}: impulse response of variable i to shock j at horizon h.
- J_R selects the subset of uncertainty variables associated with measures of real activity.
- Shock 1 explains uncertainty associated with production variables (No. 1-31).

What are the two fundamental shocks? (3)

We estimate the model with $q = 2$, $p = 6$ and our rotation.

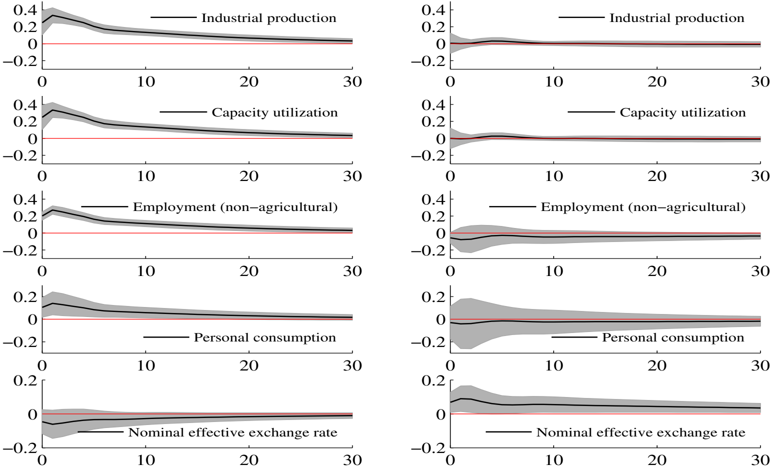


Figure: Impulse responses to shock 1 (left) and shock 2 (right) (1)

What are the two fundamental shocks? (4)

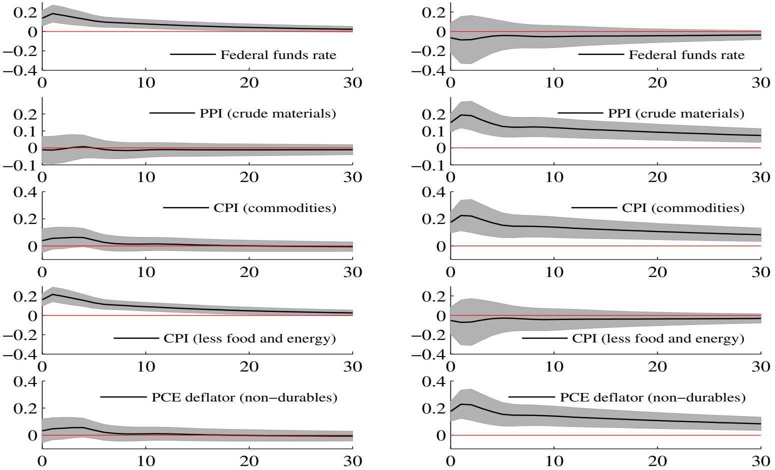
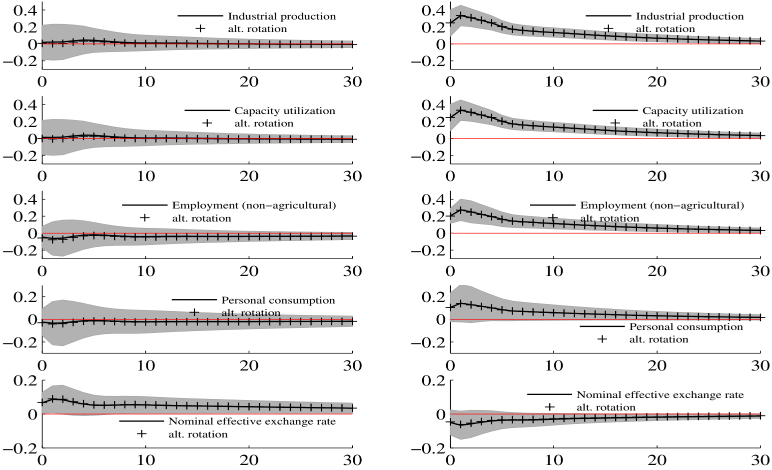


Figure: Impulse responses to shock 1 (left) and shock 2 (right) (2)

What are the two fundamental shocks? (5)

Reverse identification (J_R selects the set of uncertainty variables associated with commodity prices)



What are the two fundamental shocks? (6)

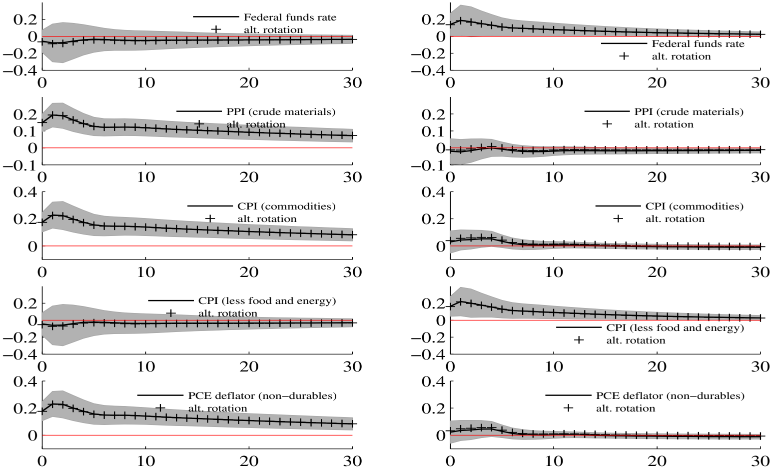
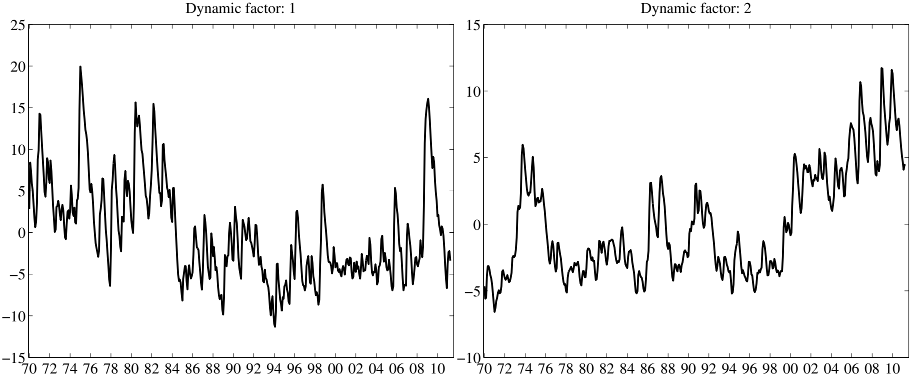


Figure: Impulse responses from alternative identification (2)

What are the two fundamental shocks? (7)

- The first shock drives uncertainty of all variables related to the (domestic) business cycle.
- The second shock explains oil and commodity price uncertainty.
- We extract the two common factors with the Kalman Filter:



How important are the uncertainty factors? (1)

- The two common factors $\widetilde{f}_{1,t}$ and $\widetilde{f}_{2,t}$ provide a measure for overall economic uncertainty.
- How much information about the business cycle is contained in the two uncertainty factors? We regress each variable in the dataset Y_t which consists of the first order moments of variables on (lags of) the two uncertainty factors:

$$Y_{i,t} = \mu + \sum_{l=0}^{L} \gamma_{1,l} \widetilde{f}_{1,t-l} + \sum_{l=0}^{L} \gamma_{2,l} \widetilde{f}_{2,t-l} + e_t. \tag{11}$$

How important are the uncertainty factors? (2)

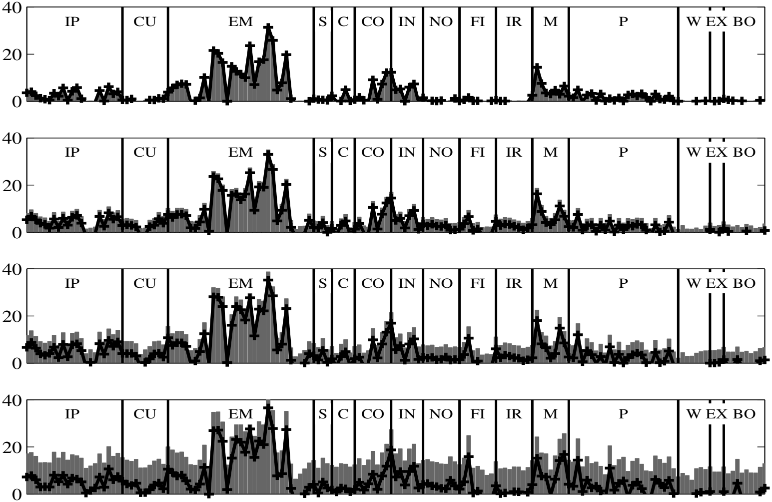


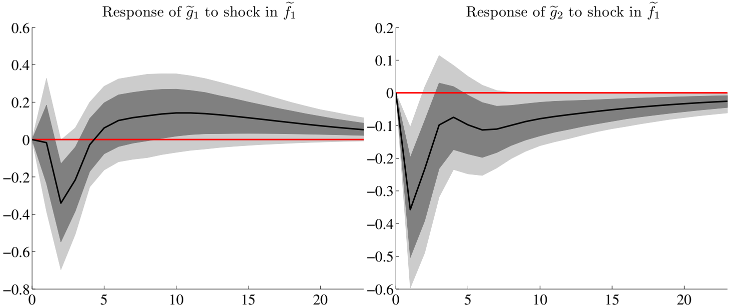
Figure: R^2 and adjusted R^2 for $L = 0, 6, 12,$ and 24

How important are the uncertainty factors? (3)

- We analyze the dynamic relation between first and second order moments.
- Indicator of Giannone et al. (2004): real $\widetilde{g}_{1,t}$ and nominal $\widetilde{g}_{2,t}$.
- We estimate a bivariate VAR for each pair of factors $j = 1, 2$ and $k = 1, 2$. Uncertainty is ordered last.
- We obtain the response of $\widetilde{g}_{k,t}$ to a shock to $\widetilde{f}_{j,t}$.

How important are the uncertainty factors? (4)

Response to a shock to $\widetilde{f}_{1,t}$:

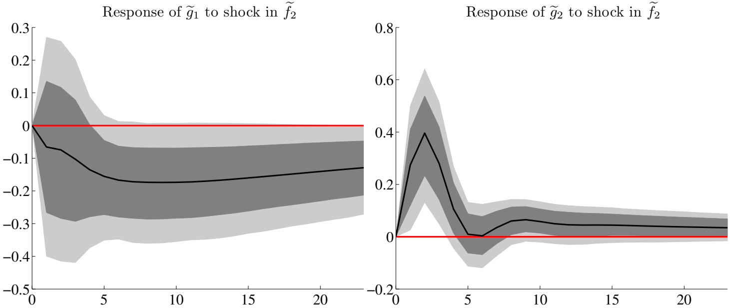


Note: 68% and 90% confidence intervals for impulse responses are indicated by the shaded areas. Confidence intervals are derived from the bias adjusted bootstrap procedure based on 2000 replications (Kilian, 1998).

Figure: Impulse response function from bivariate factor VARs (1)

How important are the uncertainty factors? (5)

Response to a shock to $\widetilde{f}_{2,t}$:



Note: 68% and 90% confidence intervals for impulse responses are indicated by the shaded areas. Confidence intervals are derived from the bias adjusted bootstrap procedure based on 2000 replications (Kilian, 1998).

Figure: Impulse response function from bivariate factor VARs (2)

Summary and outlook

- The bulk of variation in economic uncertainty is driven by a small number of shocks.
- The number of shocks appears to be two.
- Two common factors: business cycle uncertainty and oil price uncertainty.
- Uncertainty factors can explain a part of business cycle fluctuations, in particular, employment dynamics.
- However, both factors lead to rather different responses of the real and the nominal side of the economy.
- It appears to be important for the policymaker to distinguish between both types of uncertainty.

Thank you!

Data (1)

	Series	Transf.	R^2	1	2
	Industrial production				
1	Index of IP: total	3	0.78	0.99	0.01
2	Index of IP: final products and nonindustrial supplies	3	0.67	1.00	0.00
3	Index of IP: final products	3	0.58	0.99	0.01
4	Index of IP: consumer goods	3	0.45	0.99	0.01
5	Index of IP: durable consumer goods	3	0.39	0.99	0.01
6	Index of IP: nondurable consumer goods	3	0.14	0.79	0.21
7	Index of IP: business equipment	3	0.51	0.98	0.02
8	Index of IP: materials	3	0.68	1.00	0.00
9	Index of IP: materials, nonenergy, durables	3	0.68	0.95	0.05
10	Index of IP: materials, nonenergy, nondurables	3	0.48	0.86	0.14
11	Index of IP: mfg	3	0.82	1.00	0.00
12	Index of IP: mfg, durables	3	0.62	1.00	0.00
13	Index of IP: mfg, nondurables	3	0.53	0.98	0.02
14	Index of IP: mining	3	0.26	1.00	0.00
15	Index of IP: utilities	3	0.12	0.23	0.77
16	Index of IP: energy, total	3	0.13	0.88	0.12
17	Index of IP: nonenergy, total	3	0.80	1.00	0.00
18	Index of IP: motor vehicles and parts (MVP)	3	0.40	1.00	0.00
19	Index of IP: computers, comm. equip. and semiconductors (CCS)	3	0.14	0.97	0.03
20	Index of IP: nonenergy excl. CCS	3	0.79	1.00	0.00
21	Index of IP: nonenergy excl. CCS and MVP	3	0.67	0.99	0.01
	Capacity utilization				
22	Capacity utilization: total	2	0.78	1.00	0.00
23	Capacity utilization: mfg	2	0.81	0.99	0.01
24	Capacity utilization: mfg, durables	2	0.72	0.97	0.03
25	Capacity utilization: mfg, nondurables	2	0.47	0.96	0.04
26	Capacity utilization: mining	2	0.29	0.99	0.01
27	Capacity utilization: utilities	2	0.02	0.71	0.29
28	Capacity utilization: CCS	2	0.14	0.99	0.01
29	Capacity utilization: mfg excl. CCS	2	0.78	0.99	0.01
30	Purchasing Managers Index (PMI)	$0/3^{\dagger}$	0.32	0.99	0.01
31	ISM mfg index: production	$0/3^{\dagger}$	0.34	0.97	0.03
	Employment				
32	Index of help-wanted advertising	3	0.15	0.05	0.95
33	No. of unemployed in the civ. labor force (CLF)	3	0.11	0.99	0.01
34	CLF employed: total	3	0.08	0.99	0.01
35	CLF employed: nonagricultural industries	3	0.07	0.94	0.06

Data (2)

	Series	Transf.	R^2	1	2
36	Mean duration of unemployment	3	0.10	0.94	0.06
37	Persons unemployed less than 5 weeks	3	0.10	0.90	0.10
38	Persons unemployed 5 to 14 weeks	3	0.09	0.86	0.14
39	Persons unemployed 15 to 26 weeks	3	0.10	0.81	0.19
40	Persons unemployed 15+ weeks	3	0.06	0.98	0.02
41	Avg. weekly initial claims	3	0.24	0.98	0.02
42	Employment on nonag payrolls: total	3	0.49	0.95	0.05
43	Employment on nonag payrolls: total private	3	0.59	0.93	0.07
44	Employment on nonag payrolls: goods-producing	3	0.64	0.98	0.02
45	Employment on nonag payrolls: mining	3	0.23	0.97	0.03
46	Employment on nonag payrolls: construction	3	0.44	0.92	0.08
47	Employment on nonag payrolls: manufacturing	3	0.58	0.99	0.01
48	Employment on nonag payrolls: manufacturing,durables	3	0.57	0.99	0.01
49	Employment on nonag payrolls: manufacturing, nondurables	3	0.35	1.00	0.00
50	Employment on nonag payrolls: service-producing	3	0.19	0.99	0.01
51	Employment on nonag payrolls: utilities	3	0.08	1.00	0.00
52	Employment on nonag payrolls: retail trade	3	0.15	0.99	0.01
53	Employment on nonag payrolls: wholesale trade	3	0.18	1.00	0.00
54	Employment on nonag payrolls: financial activities	3	0.13	0.38	0.62
55	Employment on nonag payrolls: professional and business services	3	0.07	0.39	0.61
56	Employment on nonag payrolls: education and health services	3	0.12	0.68	0.32
57	Employment on nonag payrolls: leisure and hospitality	3	0.01	0.18	0.82
58	Employment on nonag payrolls: other services	3	0.09	0.94	0.06
59	Employment on nonag payrolls: government	3	0.08	0.99	0.01
60	Avg weekly hrs. of production or nonsupervisory workers (PNW): total	3	0.24	0.92	0.08
61	Avg weekly hrs. of PNW: mfg	3	0.23	0.99	0.01
62	Avg weekly overtime hrs. of PNW: mfg	3	0.26	0.99	0.01
63	ISM mfg index: employment	$0/3^{\dagger}$	0.35	0.99	0.01
	Sales				
64	Sales: mfg and trade-total (mil of chained 05$)	3	0.34	0.98	0.02
65	Sales: mfg and trade-mfg, total (mil of chained 05$)	3	0.31	0.99	0.01
66	Sales: mfg and trade-merchant wholesale (mil of chained 05$)	3	0.19	0.99	0.01
67	Sales: mfg and trade-retail trade (mil of chained 05$)	3	0.23	0.94	0.06
	Consumption				
68	Personal cons. expenditure: total (bil of chained 05$)	3	0.16	0.92	0.08
69	Personal cons. expenditure: durables (bil of chained 05$)	3	0.20	1.00	0.00
70	Personal cons. expenditure: nondurables (bil of chained 05$)	3	0.17	1.00	0.00

Data (3)

	Series	Transf.	R^2	1	2
71	Personal cons. expenditure: services (bil of chained 05$)	3	0.22	0.71	0.29
72	Personal cons. expenditure: durables, MVP, new autos (bil of chained 05$)	3	0.23	0.98	0.02
	Housing and construction				
73	Privately-ownedhousing, started: total (thous)	3	0.25	0.99	0.01
74	New privately-owned housing authorized: total (thous)	3	0.34	1.00	0.00
75	New 1-family houses sold: total (thous)	3	0.05	0.98	0.02
76	New 1-family houses months supply at current rate	3	0.05	0.79	0.21
77	New 1-family houses for sale at end of period (thous)	3	0.03	0.68	0.32
78	Mobile homes mfg shipments (thous)	3	0.14	0.62	0.38
79	Construction put in place: total (in mil of 05$)	3	0.22	0.95	0.05
80	Construction put in place: private (in mil of 05$)	3	0.08	1.00	0.00
	Inventories				
81	Inventories: mfg and trade: total (mil of chained 05$)	3	0.18	0.96	0.04
82	Inventories: mfg and trade: mfg (mil of chained 05$)	3	0.15	0.87	0.13
83	Inventories: mfg and trade: mfg, durables (mil of chained 05$)	3	0.10	0.98	0.02
84	Inventories: mfg and trade: mfg, nondurables (mil of chained 05$)	3	0.25	0.62	0.38
85	Inventories: mfg and trade: merchant wholesale (mil of chained 05$)	3	0.17	0.97	0.03
86	Inventories: mfg and trade: retail trade (mil of chained 05$)	3	0.18	0.96	0.04
87	ISM mfg index: inventories	$0/3^{\dagger}$	0.25	0.99	0.01
	New and unfilled orders				
88	ISM mfg index: new orders	$0/3^{\dagger}$	0.22	0.94	0.06
89	ISM mfg index: suppliers deliveries	$0/3^{\dagger}$	0.37	0.96	0.04
90	Mfg new orders: all mfg industries (in mil of current $)	3	0.24	0.92	0.08
91	Mfg new orders: mfg industries with unfilled orders (in mil of current $)	3	0.22	0.29	0.71
92	Mfg new orders: durables (in mil of current $)	3	0.25	0.88	0.12
93	Mfg new orders: nondurables (in mil of current $)	3	0.33	0.43	0.57
94	Mfg new orders: nondefense capital goods (in mil of current $)	3	0.14	0.85	0.15
95	Mfg unfilled orders: all mfg industries (in mil of current $)	3	0.07	0.29	0.71
	Financial variables				
96	NYSE composite index	3	0.20	0.91	0.09
97	S&P composite	3	0.24	0.84	0.16
98	S&P PE ratio	3	0.23	0.15	0.85
99	Nominal effective exchange rate	3	0.15	0.28	0.72
100	Spot Euro/US	3	0.12	0.43	0.57
101	Spot SZ/US	3	0.02	0.54	0.46
102	Spot Japan/US	3	0.05	0.73	0.27
103	Spot UK/US	3	0.03	0.76	0.24
104	Commercial paper outstanding (in mil of current $)*	-	-	-	-

Data (4)

	Series	Transf.	R^2	1	2
	Interest rates				
105	Interest rate: federal funds rate	2	0.34	0.80	0.20
106	Interest rate: U.S. 3-month Treasury (sec market)	2	0.34	0.89	0.11
107	Interest rate: U.S. 6-month Treasury (sec. market)	2	0.33	0.80	0.20
108	Interest rate: 1-year Treasury	2	0.38	0.74	0.26
109	Interest rate: 5-year Treasury (constant maturity)	2	0.18	0.92	0.08
110	Interest rate: 7-year Treasury (constant maturity)*	-	-	-	-
111	Interest rate: 10-year Treasury (constant maturity)	2	0.11	0.87	0.13
112	Bond yield: Moodys AAA corporate	2	0.05	0.97	0.03
113	Bond yield: Moodys BAA corporate	2	0.03	0.73	0.27
	Monetary variables				
114	M1 (in bil of current $)	3	0.21	0.14	0.86
115	M2 (in bil of current $)	3	0.19	0.36	0.64
116	M3 (in bil of current $)	3	0.18	0.11	0.89
117	Monetary base, adjusted for reserve requirement (rr) changes (bil of $)*	-	-	-	-
118	Depository institutions reserves: total (adj for rr changes)*	-	-	-	-
119	Depository institutions: nonborrowed (adj for rr changes)*	-	-	-	-
120	Loans and securities at all commercial banks: total (in mil of current $)	3	0.30	0.53	0.47
121	Loans and securities at all comm banks: securities, total (in mil of $)	3	0.10	0.68	0.32
122	Loans and securities at all comm banks: securities, U.S. govt (in mil of $)	3	0.31	0.85	0.15
123	Loans and securities at all comm banks: real estate loans (in mil of $)	3	0.31	0.01	0.99
124	Loans and securities at all comm banks: comm and Indus loans (in mil of $)	3	0.16	0.47	0.53
125	Loans and securities at all comm banks: consumer loans (in mil of $)*	-	-	-	-
126	Delinquency rate on bank-held consumer installment loans*	-	-	-	-
	Prices				
127	PPI: finished goods	4	0.77	0.12	0.88
128	PPI: finished consumer goods	4	0.79	0.09	0.91
129	PPI: intermediate materials	4	0.77	0.18	0.82
130	PPI: crude materials	4	0.60	0.01	0.99
131	PPI: finished goods excl food	4	0.77	0.02	0.98
132	Index of sensitive materials prices*	-	-	-	-
133	CPI: all items (urban)	4	0.70	0.33	0.67
134	CPI: food and beverages	4	0.30	0.91	0.09
135	CPI: housing	4	0.31	0.99	0.01
136	CPI: apparel	4	0.23	0.62	0.38
137	CPI: transportation	4	0.73	0.03	0.97
138	CPI: medical care	4	0.26	1.00	0.00
139	CPI: commodities	4	0.85	0.05	0.95
140	CPI: commodities, durables	4	0.02	0.60	0.40

Data (5)

	Series	Transf.	R^2	1	2
141	CPI: services	4	0.33	1.00	0.00
142	CPI: all items less food	4	0.61	0.27	0.73
143	CPI: all items less shelter	4	0.85	0.18	0.82
144	CPI: all items less medical care	4	0.72	0.35	0.65
145	CPI: all items less food and energy	4	0.40	0.90	0.10
146	Price of gold ($/oz) on the London market (recorded in the p.m.)	4	0.26	0.93	0.07
147	PCE chain weight price index: total	4	0.74	0.20	0.80
148	PCE prices: total excl food and energy	4	0.03	0.99	0.01
149	PCE prices: durables	4	0.08	0.93	0.07
150	PCE prices: nondurables	4	0.87	0.04	0.96
151	PCE prices: services	4	0.03	0.83	0.17
	Wages				
152	Avg hourly earnings: total nonagricultural (in current $)	4	0.28	0.71	0.29
153	Avg hourly earnings: construction (in current $)	4	0.22	0.89	0.11
154	Avg hourly earnings: mfg (in current $)	4	0.38	0.96	0.04
155	Avg hourly earnings: finance, insurance, and real estate (in current $)	4	0.10	0.86	0.14
156	Avg hourly earnings: professional and business services (in current $)	4	0.14	0.31	0.69
157	Avg hourly earnings: education and health services (in current $)	4	0.21	0.86	0.14
158	Avg hourly earnings: other services (in current $)	4	0.16	0.99	0.01
	Merchandize ex- and imports				
159	Total merchandize exports (FAS value) (in mil of $)	3	0.23	0.85	0.15
160	Total merchandize imports (CIF value) (in mil of $) (NSA)	3	0.33	0.99	0.01
161	Total merchandize imports (customs value) (in mil of $)	3	0.30	0.99	0.01
	Business outlook				
162	Philadelphia Fed business outlook: general activity	0/2†	0.05	0.61	0.39
163	Outlook: new orders	0/2†	0.11	0.98	0.02
164	Outlook: shipments	0/2†	0.08	0.99	0.01
165	Outlook: inventories	0/2†	0.09	0.88	0.12
166	Outlook: unfilled orders	0/2†	0.13	0.83	0.17
167	Outlook: prices paid	0/2†	0.10	0.05	0.95
168	Outlook: prices received	0/2†	0.08	0.77	0.23
169	Outlook employment	0/2†	0.05	0.99	0.01
170	Outlook: work hours	0/2†	0.09	0.99	0.01
171	Federal govt deficit or surplus (in mil of current $)	0/2†	0.08	0.01	0.99

Variables marked with an $*$ are not available for our full sample period and therefore had to be excluded from the original dataset used in Giannone et al. (2004).

Table: Description of data set

Transformations applied to the data	
0:	X_t
1:	$\ln(X_t)$
2:	$(1-L)X_t$, L denotes the lag-operator
3:	$(1-L)\ln(X_t)$
4:	$(1-L)(1-L^{12})\ln(X_t)$
$\cdot/\cdot^{\dagger}$	left hand side: transformation for first order moment analysis right hand side: transformation for second order moment analysis