Where Are We Now?

Real-Time Estimates of the Macro Economy

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1 Aim

- To describe a method for calculating daily real-time estimates of the current state of the U.S. economy.
- The method needs to allows for:
  - variable reporting lags,
  - temporal aggregation,
  - missing data.
- This paper focuses on the problem of estimating the current level of and growth rate in GDP.
- The method can be applied to any (macro) variable of interest.

2 Why Real-Time Estimates are Needed

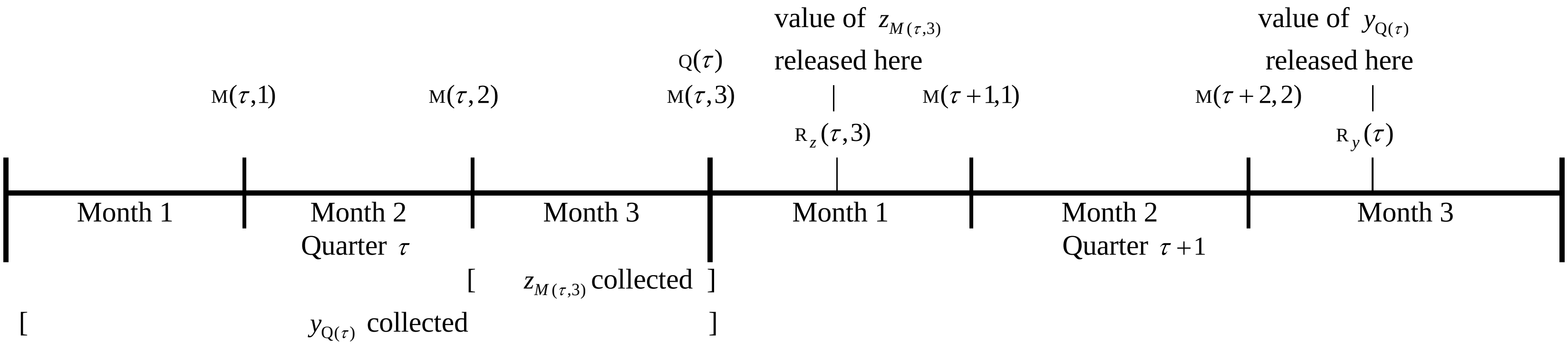
- Policy-making:
  - Information on real economic activity is collected by government agencies, but
  - the collection, aggregation and dissemination process takes time. $\Rightarrow$
  - data releases represent official aggregations of past rather than current economic activity.
- Asset Pricing:
  - Information about the current state of real economic activity is widely dispersed across consumers, firms and policy-makers.
  - Individuals are unaware of the contemporaneous consumption, saving, investment and employment decisions made by others.
  - This lack of timely information can significantly alter the dynamics of asset prices (Evans and Lyons 2004).

3 Real-Time Estimates and Real Time Data

- Real-Time Data: Croushore and Stark (1999, 2001), Orphanides (2001) and others
  - A set of *historical* values for a variable that are know on a particular date.
  - Represents a *subset* of public information available on a particular date.
- Real-Time Estimates:
  - An estimate of the current value of GDP (growth) based on public information available at the time.
  - I use an information set that spans the history of data releases on GDP and 18 other macroeconomic variables.
  - Additional variables (e.g. asset prices) can easily be added.

4 Earlier Work

- Clarida, Kitchen and Monaco (2002):
  - Regression-based method
- Features of this method:
  - Estimates come from a single fully-specified econometric model.
  - A wide variety of variables can be computed from the estimated model.
    - The model can provide real-time forecasts for GDP growth for *any* future quarter.
  - We can construct high frequency estimates of real-economic activity.


value of $z_{M(\tau,3)}$
released here
value of $y_{Q(\tau)}$
released here
$Q(\tau)$
$M(\tau,1)$
$M(\tau,2)$
$M(\tau,3)$
$M(\tau+1,1)$
$M(\tau+2,2)$
$R_z(\tau,3)$
$R_y(\tau)$
Month 1
Month 2
Month 3
Month 1
Month 2
Month 3
Quarter τ
Quarter $\tau+1$
[$z_{M(\tau,3)}$ collected]
[$y_{Q(\tau)}$ collected]

GDP Announcements

The BEA releases GDP data for quarter τ as:

- "advanced" growth
- "preliminary" growth
- "final" growth
- (annual revisions that generally lead to revisions in the "final" data values released over the previous three years).

$$y_{\mathrm{r}(\tau)} = \Delta^{\mathrm{q}} x_{\mathrm{q}(\tau)} + \upsilon_{\mathrm{r}(\tau)}, \tag{1}$$

where

- $x_{\mathrm{q}(\tau)} =$ log of real GDP for quarter τ $(\Delta^{\mathrm{q}} x_{\mathrm{q}(\tau)} \equiv x_{\mathrm{q}(\tau)} - x_{\mathrm{q}(\tau-1)})$
- $y_{\mathrm{r}(\tau)} =$ "final" data released on day $\mathrm{r}_y(\tau)$
- $\mathrm{r}_y(\tau) - \mathrm{q}(\tau)$ = the reporting lag for quarterly data.

"Final" GDP:

$$y_{\mathrm{r}(\tau)} = E\left[\Delta^{\mathrm{q}} x_{\mathrm{q}(\tau)} | \Omega_{\mathrm{q}(\tau)}\right] + E\left[\upsilon_{\mathrm{r}(\tau)} | \Omega_{\mathrm{q}(\tau)}\right] + \left(y_{\mathrm{r}(\tau)} - E\left[y_{\mathrm{r}(\tau)} | \Omega_{\mathrm{q}(\tau)}\right]\right). \quad (2)$$

The noise term can be decomposed as

$$\begin{aligned} y_{\mathrm{r}(\tau)} - E\left[y_{\mathrm{r}(\tau)} | \Omega_{\mathrm{q}(\tau)}\right] \;=\; & \left(E\left[y_{\mathrm{r}(\tau)} | \Omega^{\mathrm{bea}}_{\mathrm{q}(\tau)}\right] - E\left[y_{\mathrm{r}(\tau)} | \Omega_{\mathrm{q}(\tau)}\right]\right) \\ & + \left(y_{\mathrm{r}(\tau)} - E\left[y_{\mathrm{r}(\tau)} | \Omega^{\mathrm{bea}}_{\mathrm{q}(\tau)}\right]\right), \end{aligned} \quad (3)$$

"Advanced" and "Preliminary" GDP:

$$\hat{y}_{\mathrm{r}(\tau)} \;=\; y_{\mathrm{r}(\tau)} + \tilde{e}_{\mathrm{r}(\tau)} + \hat{e}_{\mathrm{r}(\tau)}, \quad (4)$$

$$\tilde{y}_{\mathrm{r}(\tau)} \;=\; y_{\mathrm{r}(\tau)} + \tilde{e}_{\mathrm{r}(\tau)}, \quad (5)$$

The Inference Problem

Decompose quarterly GDP growth into a sequence of daily increments:

$$\Delta^{\mathrm{q}} x_{\mathrm{q}(\tau)} = \sum_{i=1}^{\mathrm{d}(\tau)} \Delta x_{\mathrm{q}(\tau-1)+i}, \tag{6}$$

where $\mathrm{d}(\tau) \equiv \mathrm{q}(\tau) - \mathrm{q}(\tau - 1)$.

Next, project $z^i_{\mathrm{r}(\tau,j)}$ on a portion of GDP growth

$$z^i_{\mathrm{r}(\tau,j)} = \beta_i \Delta^{\mathrm{m}} x_{\mathrm{m}(\tau,j)} + u^i_{\mathrm{m}(\tau,j)}, \tag{7}$$

where $\Delta^{\mathrm{m}} x_{\mathrm{m}(\tau,j)}$ is the contribution to GDP growth in quarter τ during month j:

$$\Delta^{\mathrm{m}} x_{\mathrm{m}(\tau,j)} \equiv \sum_{i=\mathrm{m}(\tau,j-1)+1}^{\mathrm{m}(\tau,j)} \Delta x_i.$$

Real-Time Estimates of GDP

The real-time estimates are based on the 3 GDP releases and 18 monthly macro series; $z^i = 1, 2, ...18$:

$$E[\Delta^{\mathrm{q}} x_{\mathrm{q}(\tau)} | \Omega_{\mathrm{q}(\tau)}], \tag{8}$$

where

$$\begin{aligned} \Omega_t &= \Omega_t^z \cup \Omega_t^y \\ \Omega_t^y &\equiv \left\{ \hat{y}_{\mathrm{r}(\tau)}, \tilde{y}_{\mathrm{r}(\tau)}, y_{\mathrm{r}(\tau)} : \mathrm{r}(\tau) < t \right\} \\ \Omega_t^z &\equiv \textstyle\bigcup_{i=1}^{21} \left\{ z^i_{\mathrm{r}(\tau,j)} : \mathrm{r}(\tau, j) < t \text{ for } j = 1, 2, 3 \right\} \end{aligned}$$

We can also compute *daily* real-time estimates of quarterly GDP, and GDP growth:

$$x_{\mathrm{q}(\tau)|i} \equiv E[x_{\mathrm{q}(\tau)} | \Omega_i] \tag{9}$$

$$\Delta^{\mathrm{q}} x_{\mathrm{q}(\tau)|i} \equiv E[\Delta^{\mathrm{q}} x_{\mathrm{q}(\tau)} | \Omega_i]. \tag{10}$$

for $\mathrm{q}(\tau - 1) < i \leq \mathrm{q}(\tau)$.

7 The Model

Define the partial sums

$$s_t^{\mathrm{q}} \equiv \sum_{i=\mathrm{q}(\tau)+1}^{\min\{\mathrm{q}(\tau),t\}} \Delta x_i, \qquad s_t^{\mathrm{m}} \equiv \sum_{i=\mathrm{m}(\tau,j-1)+1}^{\min\{\mathrm{m}(\tau,j),t\}} \Delta x_i$$

Let

$$\lambda_t^{\mathrm{m}} = \begin{cases} 1 & \text{if } t = \mathrm{m}(\tau,j)+1, \text{ for } j = 1,2,3, \\ 0 & \text{otherwise,} \end{cases}$$
$$\lambda_t^{\mathrm{q}} = \begin{cases} 1 & \text{if } t = \mathrm{q}(\tau)+1, \\ 0 & \text{otherwise.} \end{cases}$$

so

$$s_t^{\mathrm{q}} = (1-\lambda_t^{\mathrm{q}})\, s_{t-1}^{\mathrm{q}} + \Delta x_t, \tag{11}$$
$$s_t^{\mathrm{m}} = (1-\lambda_t^{\mathrm{m}})\, s_{t-1}^{\mathrm{m}} + \Delta x_t. \tag{12}$$

Quarterly GDP growth one and two quarters back are

$$\Delta^{\mathrm{q}(1)} x_t = (1 - \lambda_t^{\mathrm{q}})\, \Delta^{\mathrm{q}(1)} x_{t-1} + \lambda_t^{\mathrm{q}} s_{t-1}^{\mathrm{q}}. \tag{13}$$

$$\Delta^{\mathrm{q}(2)} x_t = (1 - \lambda_t^{\mathrm{q}})\, \Delta^{\mathrm{q}(2)} x_t + \lambda_t^{\mathrm{q}} \Delta^{\mathrm{q}(1)} x_{t-1}. \tag{14}$$

- If t is the first day of a new quarter, $\lambda_t^{\mathrm{q}} = 1, \Rightarrow \Delta^{\mathrm{q}(1)} x_{\mathrm{q}(\tau)+1} = s_{\mathrm{q}(t)}^{\mathrm{q}} = \Delta^{\mathrm{q}} x_{\mathrm{q}(\tau)}$
- On all other days, $\Delta^{\mathrm{q}(1)} x_t = \Delta^{\mathrm{q}(1)} x_{t-1}$.

When the reporting lag for “final” GDP is one quarter

$$y_t = \Delta^{\mathrm{q}(1)} x_t + \upsilon_{\mathrm{r}(\tau)}, \tag{15}$$

and when the lag is two quarters,

$$y_t = \Delta^{\mathrm{q}(2)} x_t + \upsilon_{\mathrm{r}(\tau)}. \tag{16}$$

The contribution GDP growth in the last (completed) month is given by

$$\Delta^{\mathrm{m}(1)} x_t = (1 - \lambda_t^{\mathrm{m}})\, \Delta^{\mathrm{m}(1)} x_{t-1} + \lambda_t^{\mathrm{m}} s_{t-1}^{\mathrm{m}}, \tag{17}$$

and the contribution from $i\ (> 1)$ months back is

$$\Delta^{\mathrm{m}(i)} x_t = (1 - \lambda_t^{\mathrm{m}})\, \Delta^{\mathrm{m}(i)} x_t + \lambda_t^{\mathrm{m}} \Delta^{\mathrm{m}(i-1)} x_{t-1}. \tag{18}$$

If the reporting lag for macro series i is less than one month, the value released on day t can be written as

$$z_t^i = \beta_i \Delta^{\mathrm{m}(1)} x_t + u_t^i. \tag{19}$$

In cases where the reporting lag is two months,

$$z_t^i = \beta_i \Delta^{\mathrm{m}(2)} x_t + u_t^i. \tag{20}$$

If the series $(i = 18)$ is released *before* the end of the month in which the survey data are collected

$$z_t^{18} = \beta_{18} s_t^{\mathrm{m}} + u_t^{18}. \tag{21}$$

To complete the model we need to specify the dynamics for the daily contributions, Δx_t.

$$\Delta x_t = \sum_{i=1}^{k} \phi_i \Delta^{\mathrm{m}(i)} x_t + e_t, \tag{22}$$

- The daily contribution on day t only depends on the history of Δx_t insofar as it is summarized by the monthly contributions, $\Delta^{\mathrm{m}(i)} x_t$.
- The process aggregates up to a AR(k) process for $\Delta^{\mathrm{m}} x_{\mathrm{m}(\tau,j)}$ at the monthly frequency.

8 Estimation

Problems:

1. There is a pure inference problem of how to compute $E[x_{\mathrm{q}(\tau)}|\Omega_i]$ and $E[\Delta^{\mathrm{q}} x_{\mathrm{q}(\tau)}|\Omega_i]$
2. We need to estimate the model parameters from the three data releases on GDP and the 18 other macro series.
   - the individual data releases are irregularly spaced, and
   - arrive in a non-syncronized manner.

Solution: Write the model is State Space Form and Estimate with the Kalman Filter

In the case where Δx_t depend only on last month's contribution, the state equation is

$$\begin{bmatrix} s_t^{\text{Q}} \\ \Delta^{\text{Q}(1)} x_t \\ \Delta^{\text{Q}(2)} x_t \\ s_t^{\text{M}} \\ \Delta^{\text{M}(1)} x_t \\ \Delta^{\text{M}(2)} x_t \\ \Delta x_t \end{bmatrix} = \begin{bmatrix} 1-\lambda_t^{\text{Q}} & 0 & 0 & 0 & 0 & 0 & 1 \\ \lambda_t^{\text{Q}} & 1-\lambda_t^{\text{Q}} & 0 & 0 & 0 & 0 & 0 \\ 0 & \lambda_t^{\text{Q}} & 1-\lambda_t^{\text{Q}} & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1-\lambda_t^{\text{M}} & 0 & 0 & 1 \\ 0 & 0 & 0 & \lambda_t^{\text{M}} & 1-\lambda_t^{\text{M}} & 0 & 0 \\ 0 & 0 & 0 & 0 & \lambda_t^{\text{M}} & 1-\lambda_t^{\text{M}} & 0 \\ 0 & 0 & 0 & 0 & \phi_1 & 0 & 0 \end{bmatrix} \begin{bmatrix} s_{t-1}^{\text{Q}} \\ \Delta^{\text{Q}(1)} x_{t-1} \\ \Delta^{\text{Q}(2)} x_{t-1} \\ s_{t-1}^{\text{M}} \\ \Delta^{\text{M}(1)} x_{t-1} \\ \Delta^{\text{M}(2)} x_{t-1} \\ \Delta x_{t-1} \end{bmatrix} + \begin{bmatrix} 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ e_t \end{bmatrix},$$

or, more compactly

$$\mathbb{Z}_t = \mathbb{A}_t \mathbb{Z}_{t-1} + \mathbb{V}_t.$$

The link between the data releases and elements of the state vector is described by

$$
\begin{bmatrix} \hat{y}_t \\ \tilde{y}_t \\ y_t \\ z_t^1 \\ \vdots \\ z_t^{18} \end{bmatrix} = \begin{bmatrix} 0 & \mathrm{QL}_t^1(\hat{y}) & \mathrm{QL}_t^2(\hat{y}) & 0 & 0 & 0 & 0 \\ 0 & \mathrm{QL}_t^1(\tilde{y}) & \mathrm{QL}_t^2(\tilde{y}) & 0 & 0 & 0 & 0 \\ 0 & \mathrm{QL}_t^1(y) & \mathrm{QL}_t^2(y) & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & \beta_1 \mathrm{ML}_t^0(z^1) & \beta_i \mathrm{ML}_t^1(z^1) & \beta_1 \mathrm{ML}_t^2(z^1) & 0 \\ \vdots & \vdots & \vdots & \vdots & \vdots & \vdots & \vdots \\ 0 & 0 & 0 & \beta_{18} \mathrm{ML}_t^0(z^{18}) & \beta_{18} \mathrm{ML}_t^1(z^{18}) & \beta_{18} \mathrm{ML}_t^2(z^{18}) & 0 \end{bmatrix} \mathbb{Z}_t + \begin{bmatrix} \hat{e}_t + \tilde{e}_t + \upsilon_t \\ \tilde{e}_t + \upsilon_t \\ \upsilon_t \\ u_t^1 \\ \vdots \\ u_t^{18} \end{bmatrix},
$$

or

$$
\mathbb{X}_t = \mathbb{C}_t \mathbb{Z}_t + \mathbb{U}_t.
$$

$\mathrm{QL}_t^i(\varkappa) = 1$ when the reporting lag for series $\varkappa$ lies between $i-1$ and i quarters, and zero otherwise.

$\mathrm{ML}_t^i(\varkappa)$ is the monthly version of $\mathrm{QL}_t^i(\varkappa)$

Table 1: Data Series (4/11/93 - 6/30/99)

	Release	Obs.	Reporting Lag
Quarterly	Advanced GDP	26	1-2 Months
	Preliminary GDP	25	2-3 Months
	Final GDP	26	3-4 Months
Monthly			
Real Activity	Nonfarm Payroll Employment	78	3 - 9 days
	Retail Sales	78	12-15 days
	Industrial Production	78	15-18 days
	Capacity Utilization	78	15-18 days
	Personal Income	76	30-33 days
	Consumer Credit	78	33-40 days
Consumption	Personal Consumption Expenditures	76	30-33 days
	New Home Sales	77	27-33 days
Investment	Durable Goods Orders	77	24-29 days
	Construction Spending	77	31-34 days
	Factory Orders	76	29-35 days
	Business Inventories	78	38-44 days
Government	Government Budget Deficit	78	15-21 days
Net Exports	Trade Balance	78	44-53 days
Forward-looking	Consumer Confidence Index	78	-8-0 days
	NAPM index	78	0-6 days
	Housing Starts	77	14-20 days
	Index of Leading Indicators	78	27-45 days

Distribution of Data Releases

Releases per Day	Fraction of Sample	Observations
0	45.48%	765
1	38.76%	652
2	10.46%	176
3	4.34%	73
4	0.95%	16
> 0	54.52%	917

Table 2: Model Estimates

A:Process for Δx_t

		ϕ_1	ϕ_2	ϕ_3	ϕ_4	ϕ_5	ϕ_6	σ_e
	estimate**	-0.384	0.296	0.266	-0.289	-0.485	0.160	3.800
	standard error**	(0.004)	(0.003)	(0.003)	(0.003)	(0.003)	(0.004)	(0.010)

B: Quarterly Data Releases

		ω_i	sdt(ω_i)*
$i = a$	Advanced GDP Growth	0.508	(0.177)
p	Preliminary GDP Growth	1.212	(0.312)

C: Monthly Data Releases

		α_i	sdt(α_i)*	β_i	sdt(β_i)*	σ_i	sdt(σ_i)*
i =1	Nonfarm Payroll Employment	0.007	(0.218)	0.656	(0.301)	0.932	(0.171)
2	Retail Sales	-0.047	(0.282)	0.285	(0.136)	0.381	(0.082)
3	Industrial Production	-0.028	(0.145)	0.189	(0.090)	0.229	(0.035)
4	Capacity Utilization	0.924	(0.088)	0.125	(0.114)	0.382	(0.020)
5	Personal Income	-0.291	(0.219)	0.038	(0.126)	0.227	(0.040)
6	Consumer Credit	0.389	(0.300)	-0.160	(0.966)	2.961	(0.494)
7	Personal Consumption Expenditures	-0.405	(0.206)	0.133	(0.074)	0.111	(0.029)
8	New Home Sales	0.726	(0.170)	-0.011	(0.171)	0.473	(0.071)
9	Durable Goods Orders	-0.224	(0.258)	0.989	(0.753)	1.999	(0.413)
10	Construction Spending	0.312	(0.197)	-0.135	(0.233)	0.655	(0.123)
11	Factory Orders	-0.194	(0.288)	0.997	(0.489)	-0.856	(0.306)
12	Business Inventories	0.128	(0.277)	-0.019	(0.061)	0.228	(0.032)
13	Government Budget Deficit	-0.359	(0.418)	-0.992	(1.423)	3.262	(0.508)
14	Trade Balance	0.819	(0.189)	0.361	(0.602)	1.585	(0.344)
15	Consumer Confidence Index	0.977	(0.076)	0.208	(0.136)	-0.482	(0.084)
16	NAPM index	0.849	(0.115)	-0.008	(0.047)	0.151	(0.024)
17	Housing Starts	0.832	(0.175)	0.002	(0.026)	0.071	(0.014)
18	Index of Leading Indicators	0.107	(0.240)	0.212	(0.077)	0.231	(0.033)

Notes: "*" and "**" indicate that the reported estimate or standard error is multiplied by 100 and 25 respectively.

Table 3: Model Diagnostics

Innovation Autocorrelations		ρ_1	BPQ(1)	ρ_6	BPQ (6)
Quarterly Releases					
	Advanced GDP	0.058	(0.766)	-0.061	(0.889)
	Preliminary GDP	-0.364	(0.069)	-0.034	(0.012)
	Final GDP	0.001	(0.996)	-0.172	(0.729)
Monthly Releases					
$i = 1$	Nonfarm Payroll Employment	-0.023	(0.841)	0.051	(0.902)
2	Retail Sales	0.005	(0.966)	-0.028	(0.789)
3	Industrial Production	0.005	(0.963)	0.003	(0.981)
4	Capacity Utilization	-0.029	(0.800)	0.147	(0.885)
5	Personal Income	-0.069	(0.687)	0.057	(0.770)
6	Consumer Credit	-0.091	(0.422)	0.310	(0.040)
7	Personal Consumption Expenditures	0.122	(0.477)	-0.021	(0.427)
8	New Home Sales	-0.219	(0.084)	-0.056	(0.220)
9	Durable Goods Orders	-0.094	(0.418)	-0.121	(0.650)
10	Construction Spending	0.064	(0.699)	0.131	(0.798)
11	Factory Orders	-0.161	(0.327)	-0.113	(0.483)
12	Business Inventories	-0.068	(0.552)	0.339	(0.000)
13	Government Budget Deficit	-0.091	(0.421)	-0.137	(0.100)
14	Trade Balance	-0.203	(0.077)	0.087	(0.578)
15	Consumer Confidence Index	0.047	(0.678)	-0.111	(0.624)
16	NAPM index	-0.067	(0.556)	-0.017	(0.639)
17	Housing Starts	-0.160	(0.161)	-0.127	(0.518)
18	Index of Leading Indicators	0.021	(0.850)	0.043	(0.525)

Notes: ρ_i denotes the sample autocorrelation at lag i. p-values are calculated for the null hypothesis of $\rho_i = 0$.

Table 4: Forecast Comparisons

A:	Data Revision		Model	
	Mean	M.S.E.	Mean	M.S.E.
Advanced	0.246	(0.446)	0.090	(0.441)
Preliminary	0.038	(0.067)	0.040	(0.066)
Combined	0.142	(0.257)	0.065	(0.254)

B:	M.M.S.		Model	
	Mean	M.S.E.	Mean	M.S.E
In-sample				
Advanced	0.729	(1.310)	0.190	(1.407)
Preliminary	0.160	(0.249)	0.096	(0.418)
Final	0.042	(0.062)	0.080	(0.395)
Combined	0.310	(0.540)	0.122	(0.740)
Out-of-sample				
Advanced	0.985	(1.464)	0.380	(1.500)
Preliminary	0.046	(0.178)	0.178	(0.801)
Final	-0.015	(0.057)	0.099	(0.208)
Combined	0.338	(0.566)	0.219	(0.836)

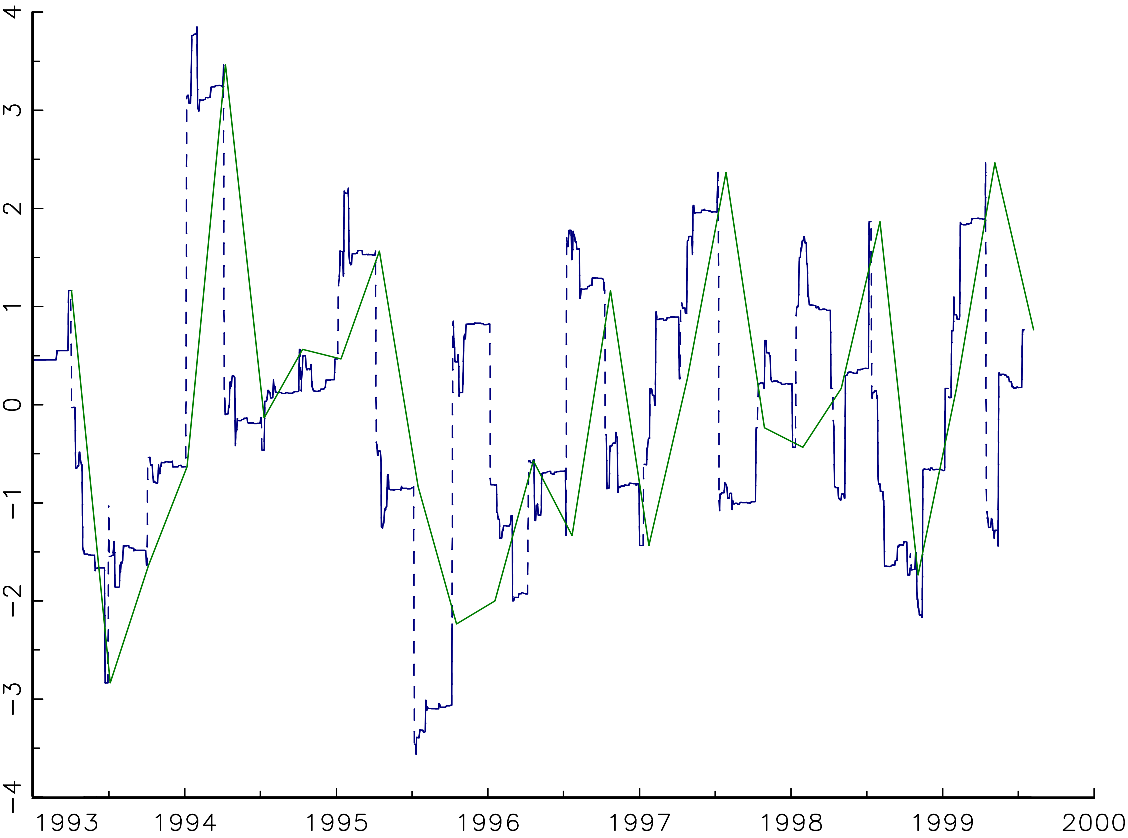


Figure 2: Real-time esimtates of quarterly GDP growth $\Delta^{\mathrm{Q}} x_{\mathrm{Q}(\tau)|t}$ where $\mathrm{Q}(\tau) < t \leq \mathrm{R}_y(\tau)$ (blue line), and "final" releases for GDP growth (green line).

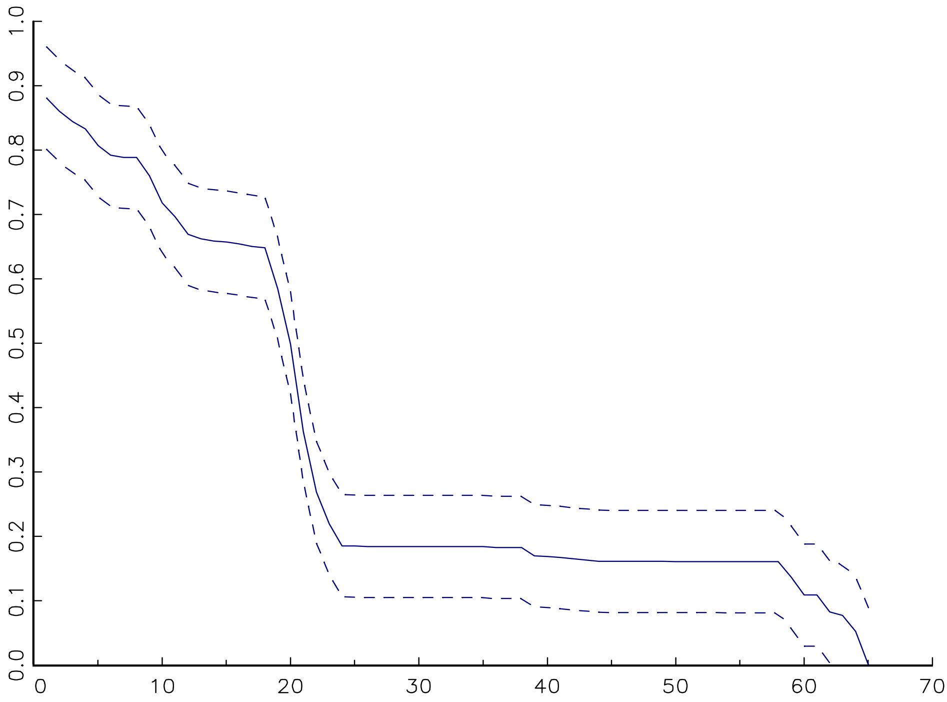


Figure 3: The solid line is the sample average of $\mathbb{V}(\Delta^{\mathrm{Q}} x_{\mathrm{Q}(\tau)} | \Omega_{\mathrm{Q}(\tau)+i})$ for $0 < i \leq \mathrm{R}_y(\tau) - \mathrm{Q}(\tau)$, and the dashed lines denote the 95% confident band. The horizontal axis marks the the number of days i past the end of quarter $\mathrm{Q}(\tau)$.

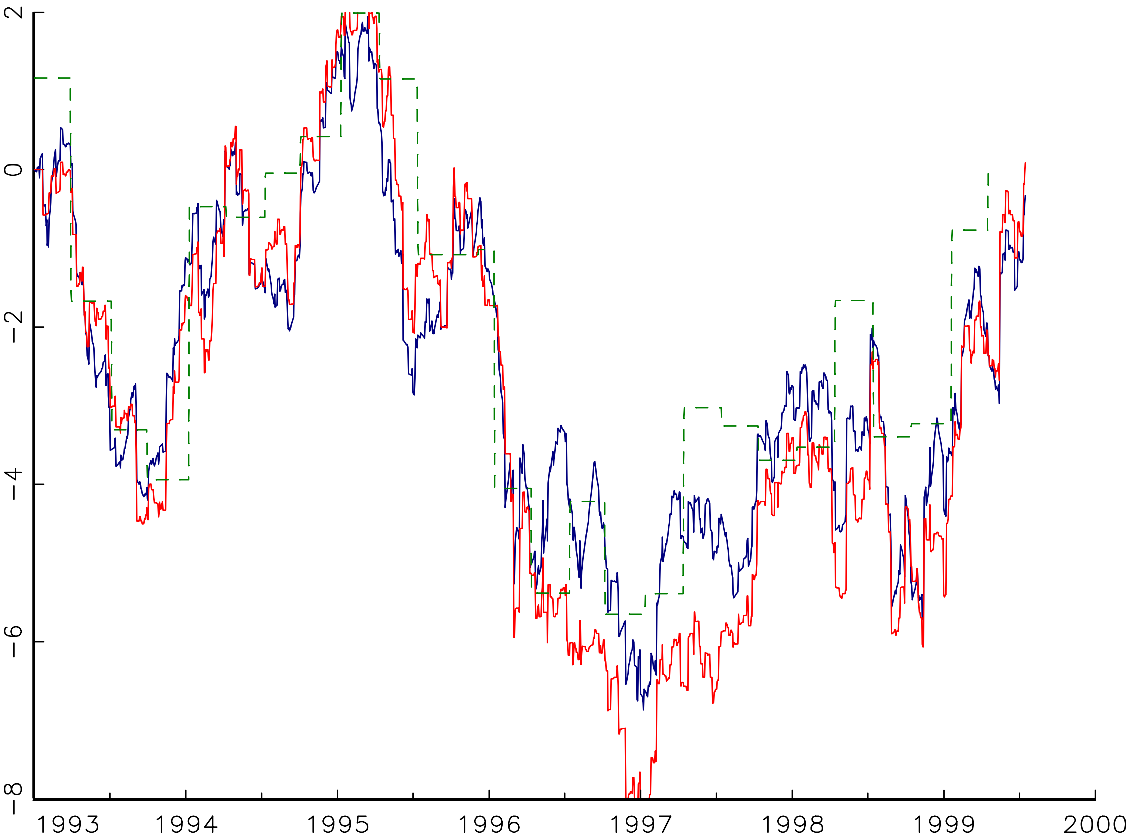


Figure 4: Real-time estimates of log GDP $x_{Q(\tau)|t}$ (red line), $E[x_t|\Omega_t]$ (blue line) and cumulant of "final" GDP releases (green dashed line).

$$x_{Q(\tau)|t} = \mathbb{E}[x_t|\Omega_t] + \sum_{h=1}^{Q(\tau)-t} \mathbb{E}[\Delta x_{t+h}|\Omega_t].$$

Table 5: Monthly Indicator Estimates

	Data Release	a_i	std(a_i)	b_i	std(b_i)	R^2
i =1	Nonfarm Payroll Employment	0.224*	(0.033)	0.330*	(0.050)	0.233
2	Retail Sales	0.520*	(0.074)	0.838*	(0.099)	0.186
3	Industrial Production	0.745*	(0.116)	1.047*	(0.142)	0.233
4	Capacity Utilization	-0.006	(0.034)	0.066	(0.057)	0.010
5	Personal Income	-0.110	(0.132)	0.163	(0.224)	0.003
6	Consumer Credit	0.001	(0.012)	-0.002	(0.019)	0.000
7	Personal Consumption Expenditures	0.377*	(0.182)	0.603*	(0.277)	0.033
8	New Home Sales	0.016	(0.069)	0.181*	(0.088)	0.039
9	Durable Goods Orders	0.013	(0.021)	0.064*	(0.027)	0.030
10	Construction Spending	-0.050	(0.051)	-0.102	(0.060)	0.015
11	Factory Orders	0.097*	(0.038)	0.160*	(0.043)	0.066
12	Business Inventories	-0.013	(0.152)	0.289	(0.247)	0.008
13	Government Budget Deficit	-0.008	(0.011)	-0.017	(0.016)	0.005
14	Trade Balance	-0.071*	(0.021)	-0.068*	(0.030)	0.042
15	Consumer Confidence Index	0.068*	(0.028)	0.060	(0.037)	0.021
16	NAPM index	-0.001	(0.145)	0.514*	(0.216)	0.046
17	Housing Starts	-1.330*	(0.421)	0.705	(0.546)	0.012
18	Index of Leading Indicators	0.164	(0.179)	0.476*	(0.199)	0.038

Notes: The table reports the OLS estimates of a_i and b_i from equations (**??**) and (**??**). Both equations are estimated at the daily frequency, and the standard errors are corrected for the MA(19) process induced by the overlapping data. The right hand column reports the R^2 statistic from estimating equation (**??**). A "*" denotes significance at the 5 per cent level.

9 Conclusion

Results

- the estimates of log GDP display a good deal of high-frequency volatility.
- the gaps between the real-time estimates and ex post GDP data are on occasion both persistent and significant.
- monthly data releases contain information that is useful for forecasting its future path of GDP.
- standard proxies for real actively at the monthly frequency capture only a fraction of the variance in the real-time estimates

Topics for the Future

- Can real-time estimates and forecasts to identify turning points in the business cycle?
- Can real-time estimates bring a new perspective to the link between asset prices and macroeconomic fundamentals? Evans and Lyons (2004a).