

## Forecasting the Euro-area GDP in real time

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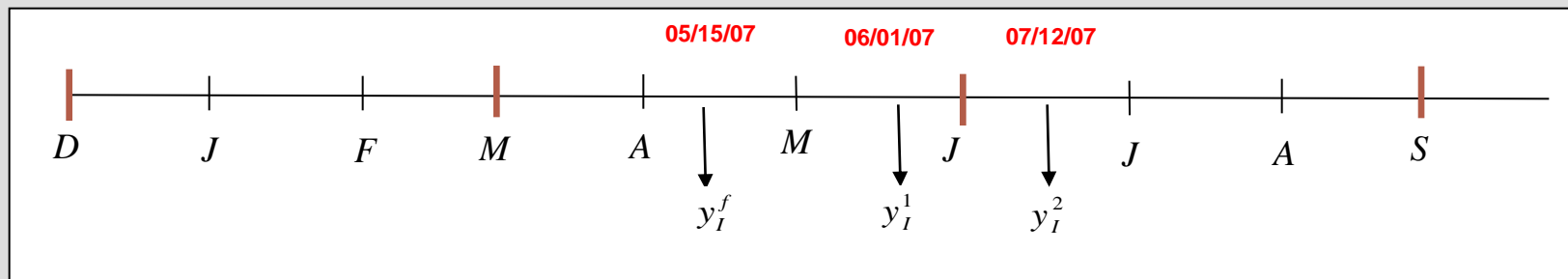
Bank of Canada, October 25, 2007

# 1. Introduction

## Objective

### Short term forecasts of Euro-area “second” GDP growth rates

- Real-time forecasts for last, current and next quarters using
  - Flash, First and Second (Q)
  - Hard indicators: IPI, Exports, Industrial New Orders, Retail Sales, Employment (Q)
  - Soft indicators: ESI, BNB, IFO, PMI manufactures, PMI services
- Updated automatically daily as new information comes
- Easy to interpret: why do we change our prevision? Why did we fail?
- Probabilities of low growth



# 1. Introduction

## Distinctive features:

- **AR and VARs:**

- Short series of GDP: better forecast by combining cross section and time series
- Quarterly series: the same forecasts for the entire quarter

- **Altissimo et. al (2006): New Eurocoin**

- Updated monthly and “almost” in real time: 20th of each month provides an estimate for the previous month and a forecast for the current month.
- Take as target the medium- long-run component of the GDP growth, defined in the frequency domain as including only waves of period larger than one year.
- Provide estimates of latent variables instead of direct estimates of current activity, as opposed to Evans (2005) and Mitchell et al. (2006).
- Large-scale data set: 145 time series from Datastream

# 1. Introduction

## Distinctive features:

- **Evans (2005): Daily contribution**

- Daily contribution to the quarterly growth rates but uses monthly series

$$\Delta x_t = \sum_{i=1}^k \phi_i \Delta^{M(i)} x_t + e_t$$

- US data

- **Mitchell et al. (2006): monthly GDP from quarter data**

- Does not derived from single fully specified econometric model: does not allow for real time forecasts
- UK data

## 2. The model

Based on Mariano and Murasawa (2003)

### ① Treatment of quarterly and monthly series

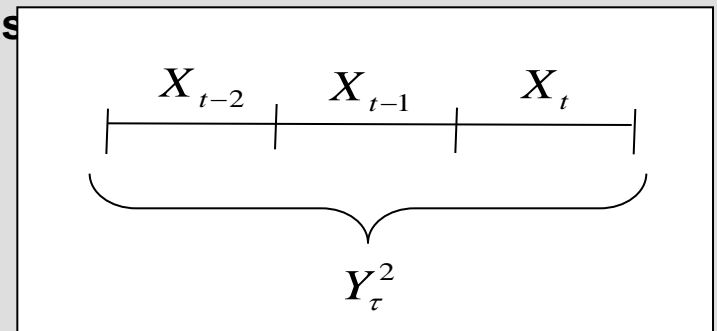
- Make use of cross sectional data: flash, first, and  $r$  monthly/quarterly indicators

$(Z_t)$

$$y_t^2 = f(y_{t-j}^2, y_{t-i}^f, y_{t-i}^1, Z_{t-i})$$

- Infer monthly series from quarterly series: bas

$$Y_t^2 = X_t + X_{t-1} + X_{t-2} \approx (X_t * X_{t-1} * X_{t-2})^{1/3} * 3$$



## 2. The model

- Accordingly

$$Y_t^2 = (X_t * X_{t-1} * X_{t-2})^{1/3} * 3$$

$$\ln Y_t^2 = \frac{1}{3}(\ln X_t + \ln X_{t-1} + \ln X_{t-2}) + \ln 3$$

$$\ln Y_t^2 - \ln Y_{t-3}^2 = \frac{1}{3}(\ln X_t - \ln X_{t-3}) + \frac{1}{3}(\ln X_{t-1} - \ln X_{t-4}) + \frac{1}{3}(\ln X_{t-2} - \ln X_{t-5})$$

- And letting

$$y_t^2 = \Delta_3 \ln Y_t^2 \quad x_t = \Delta \ln X_t$$

- We have a “second” each month

$$y_t^2 = \frac{1}{3}x_t + \frac{2}{3}x_{t-1} + x_{t-2} + \frac{2}{3}x_{t-3} + \frac{1}{3}x_{t-4}$$

## 2. The model

### ② State-space representation and **no flash, first**

- Let us assume that **everything is observable** each month
- Let us assume that we can decompose observable variables into

- Common driving factor  $f_t$
- Idiosyncratic movements  $u_{it}$

$$\begin{pmatrix} x_t \\ z_t \end{pmatrix} = \beta f_t + \begin{pmatrix} u_{1t} \\ u_{2t} \end{pmatrix}$$

- **With dynamics**

$$\begin{aligned} \phi_f(L)f_t &= v_{ft} \\ \Phi_u(L)u_t &= v_{ut} \end{aligned}$$

$$\begin{pmatrix} v_{ft} \\ v_{ut} \end{pmatrix} = NID\left(0, \begin{bmatrix} \sigma_1^2 & 0 \\ 0 & \Sigma_{22} \end{bmatrix}\right)$$

## 2. The model

### State-space representation

- If  $x_t$  (and everything else) is observable then we can rewrite the model as

$$\begin{pmatrix} y_t^2 \\ z_t \end{pmatrix} = \begin{pmatrix} \beta_1 \left( \frac{1}{3} f_t + \frac{2}{3} f_{t-1} + f_{t-2} + \frac{2}{3} f_{t-3} + \frac{1}{3} f_{t-4} \right) \\ \beta_2 f_t \end{pmatrix} + \begin{pmatrix} \left( \frac{1}{3} u_{1t} + \frac{2}{3} u_{1t-1} + u_{1t-2} + \frac{2}{3} u_{1t-3} + \frac{1}{3} u_{1t-4} \right) \\ u_{2t} \end{pmatrix}$$

$$\begin{aligned} \phi_f(L) f_t &= v_{ft} \\ \Phi_u(L) u_t &= v_{ut} \end{aligned}$$

$$\begin{pmatrix} v_{ft} \\ v_{ut} \end{pmatrix} = NID \left( 0, \begin{bmatrix} \sigma_1^2 & 0 \\ 0 & \Sigma_{22} \end{bmatrix} \right)$$

- State-space representation and Kalman filter

- Let us assume observable  $Y_t$  and unobservable  $\beta_t$  whose dynamics are

$$Y_t = H\beta_t + e_t \quad e_t \sim N(0, R)$$

$$\beta_t = F\beta_{t-1} + v_t \quad v_t \sim N(0, Q)$$



## 2. The model

- **Kalman filter**

- Recursive procedure to infer  $\beta_t$  from  $Y_t$ .

$$Y_t = H\beta_t + e_t \quad e_t \sim N(0, R) \quad \beta_t = F\beta_{t-1} + v_t \quad v_t \sim N(0, Q)$$

$$\beta_{0|0}, P_{0|0}, l_0 = 0$$

$$\left. \begin{array}{l} \beta_{t|t-1} = F\beta_{t-1|t-1} \\ n_{t|t-1} = Y_t - Y_{t|t-1} = Y_t - H\beta_{t|t-1} \end{array} \right\} \Rightarrow l_t$$

$$\left. \begin{array}{l} P_{t|t-1} = FP_{t-1|t-1}F' + Q \\ f_{t|t-1} = HP_{t|t-1}H' + R \end{array} \right\} \Rightarrow l_t$$

$$\Rightarrow L = \sum l_t$$

$$\beta_{t|t} = \beta_{t-1|t-1} + K_t n_{t|t-1} \quad P_{t|t} = P_{t|t-1} - K_t H P_{t|t-1}$$

$$K_t = P_{t/t-1} H (H' P_{t/t-1} H + R)^{-1}$$

## 2. The model

### ■ In practise $x_t$ is not observable and there are missing observations

- We only observe  $y_t^2$  (and quarterly) each three months and some missing
- Let us construct a new variable

$$\tilde{y}_t^2 = \begin{cases} y_t^2 & \text{if observable} \\ w_t & \text{otherwise} \end{cases}$$

- $w_t$  is randomly chosen from  $N(0,1)$
- Let's assume that  $t$  refers to non observable and  $\tau$  refers to observable

$$\begin{pmatrix} \tilde{y}_\tau^2 \\ z_\tau \end{pmatrix} = \beta f_\tau + \begin{pmatrix} u_{1\tau} \\ u_{2\tau} \end{pmatrix}$$

$$\begin{pmatrix} \tilde{y}_t^2 \\ z_t \end{pmatrix} = \begin{pmatrix} 0 \\ \beta_2 f_t \end{pmatrix} + \begin{pmatrix} 0 \\ u_{2t} \end{pmatrix} + \begin{pmatrix} w_t \\ 0 \end{pmatrix}$$

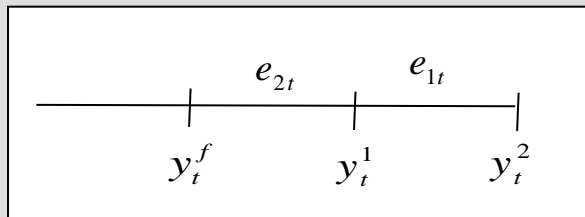
- With observable variables and idiosyncratic dynamics compute estimates of non observable  $\hat{y}_t = \hat{\beta} f_t + \hat{a}_{1t}$

## 2. The model

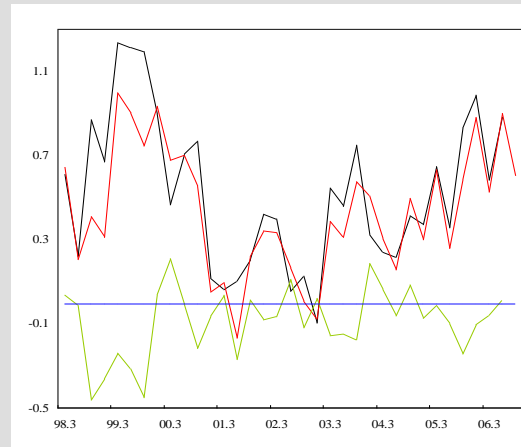
### ③ Flash, first and second

- Let us assume

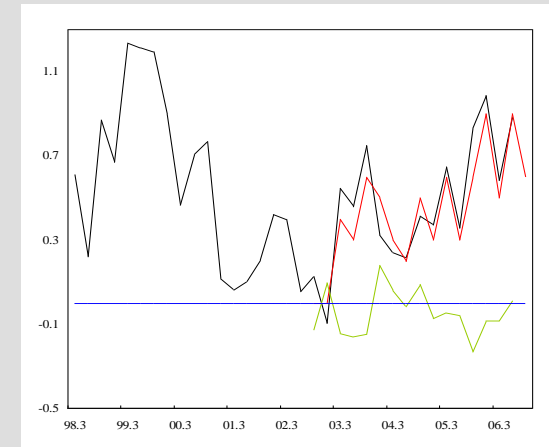
- Eurostat flash and first contain measurement error
  - They are corrected as new information is available
  - Flash and first are noisy signals of second



$$y_t^1 = y_t^2 + e_{1t}$$



$$y_t^f = y_t^2 + e_{1t} + e_{2t}$$



## 2. The model

- The model when everything is observed

$$\begin{pmatrix} y_t^2 \\ y_t^f \\ y_t^1 \\ z_t \end{pmatrix} = \begin{pmatrix} \beta_1 \left( \frac{1}{3} f_t + \frac{2}{3} f_{t-1} + f_{t-2} + \frac{2}{3} f_{t-3} + \frac{1}{3} f_{t-4} \right) \\ \beta_1 \left( \frac{1}{3} f_t + \frac{2}{3} f_{t-1} + f_{t-2} + \frac{2}{3} f_{t-3} + \frac{1}{3} f_{t-4} \right) \\ \beta_1 \left( \frac{1}{3} f_t + \frac{2}{3} f_{t-1} + f_{t-2} + \frac{2}{3} f_{t-3} + \frac{1}{3} f_{t-4} \right) \\ \beta_2 f \end{pmatrix} + \begin{pmatrix} \left( \frac{1}{3} u_{1t} + \frac{2}{3} u_{1t-1} + u_{1t-2} + \frac{2}{3} u_{1t-3} + \frac{1}{3} u_{1t-4} \right) \\ \left( \frac{1}{3} u_{1t} + \frac{2}{3} u_{1t-1} + u_{1t-2} + \frac{2}{3} u_{1t-3} + \frac{1}{3} u_{1t-4} \right) \\ \left( \frac{1}{3} u_{1t} + \frac{2}{3} u_{1t-1} + u_{1t-2} + \frac{2}{3} u_{1t-3} + \frac{1}{3} u_{1t-4} \right) \\ u_{2t} \end{pmatrix} + \begin{pmatrix} 0 \\ e_1 + e_2 \\ e_1 \\ 0 \end{pmatrix}$$

- Otherwise: non observed should be treated as before

$$\tilde{y}_t^f = \begin{cases} y_t^f & \text{if observable} \\ w_t & \text{otherwise} \end{cases}$$

$$\tilde{y}_t^1 = \begin{cases} y_t^1 & \text{if observable} \\ w_t & \text{otherwise} \end{cases}$$

$$\tilde{z}_t = \begin{cases} z_t & \text{if observable} \\ w_t & \text{otherwise} \end{cases}$$

## 2. The model

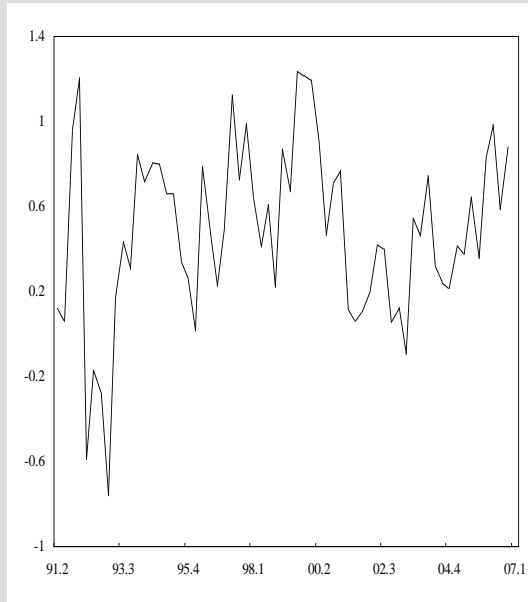
### ④ Filling out the gaps and forecasting

- Standardize variables and estimate the model
- The forecasting exercise has been done as if the series were unobserved
- Our last input: **06/13/2007**

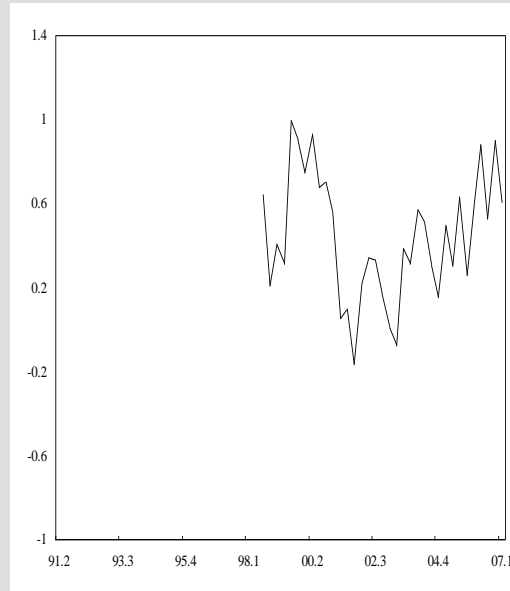
	Second	First	Flash	IPI	Sales	INO	ESI	BNB	IFO	PMIM	Exports	PMIS	Employment
2006.09	0.58	0.52	0.52	-0.97	-0.79	-0.94	1.50	1.40	0.00	0.09	2.58	-0.80	0.24
2006.10	na	na	na	0.11	0.20	0.60	1.10	-0.70	0.40	0.36	-0.34	-0.16	na
2006.11	na	na	na	0.23	0.49	0.65	-0.10	-0.30	1.50	-0.44	1.51	1.06	na
2006.12	0.89	0.90	0.90	1.24	0.46	1.70	-0.10	-1.00	1.80	-0.04	1.88	-0.37	0.29
2007.01	na	na	na	-0.62	-0.94	-0.02	-0.60	-0.40	-0.80	-1.02	-0.65	0.70	na
2007.02	na	na	na	0.46	0.40	-0.64	0.50	1.40	-0.90	0.12	-0.04	-0.37	na
2007.03	na	0.60	0.57	0.54	0.43	2.68	1.40	-2.10	0.70	-0.21	1.17	-0.16	0.38
2007.04	na	na	na	-0.82	0.18	na	-0.10	2.40	0.90	-0.03	na	-0.36	na
2007.05	na	na	na	na	na	na	0.90	0.10	0.00	-0.37	na	0.27	na
2007.06	na	na	na	na	na	na	na	na	na	na	na	na	na
2007.07	na	na	na	na	na	na	na	na	na	na	na	na	na
2007.08	na	na	na	na	na	na	na	na	na	na	na	na	na
2007.09	na	na	na	na	na	na	na	na	na	na	na	na	na

### 3. Empirical results

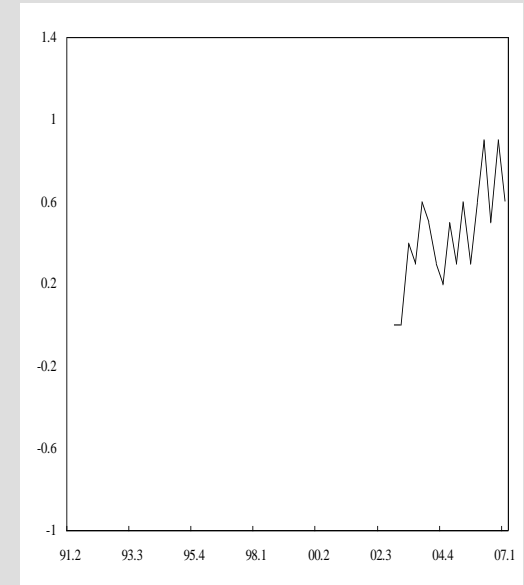
- GDP series



SECOND 1991.II-2006.IV  
Vintage 04/12/2007



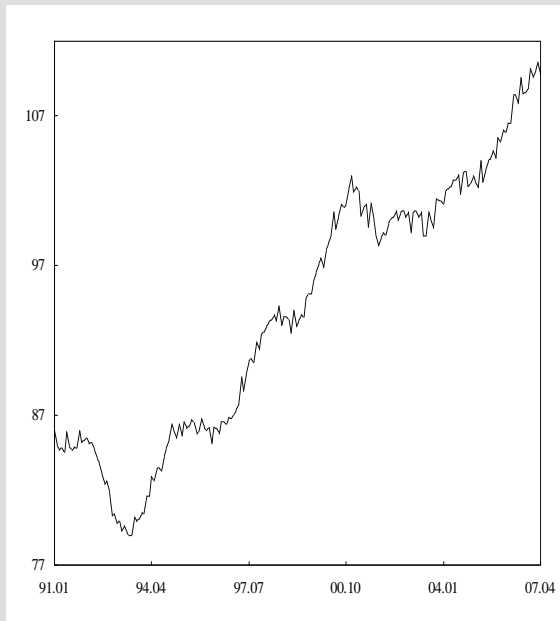
FIRST 1998.II-2007.I  
Vintage 06/01/2007



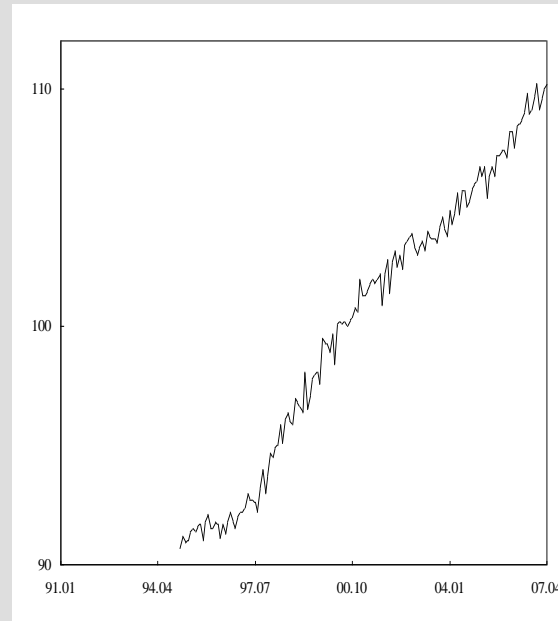
FLASH 2003.0I-2007.I.  
Vintage 05/15/2007

### 3. Empirical results

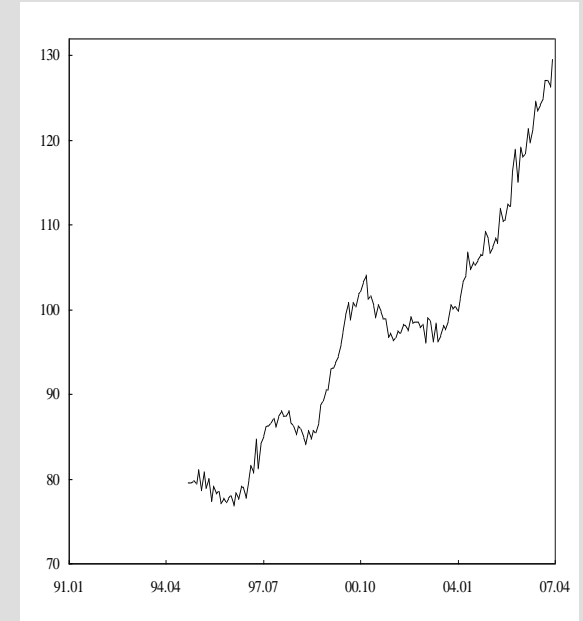
- **Hard indicators: IPI, Retail Sales, Industrial New Orders**



IPI 1991.01-2007.04.  
Vintage 06/12/2007



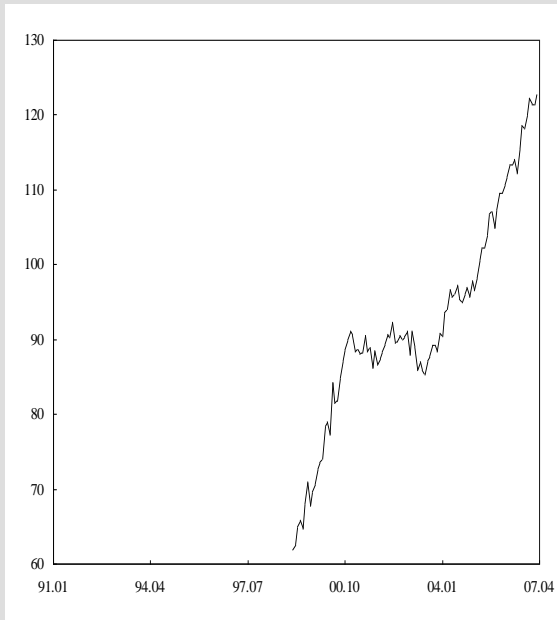
Retail sales 1995.01-2007.04.  
Vintage 06/05/2007



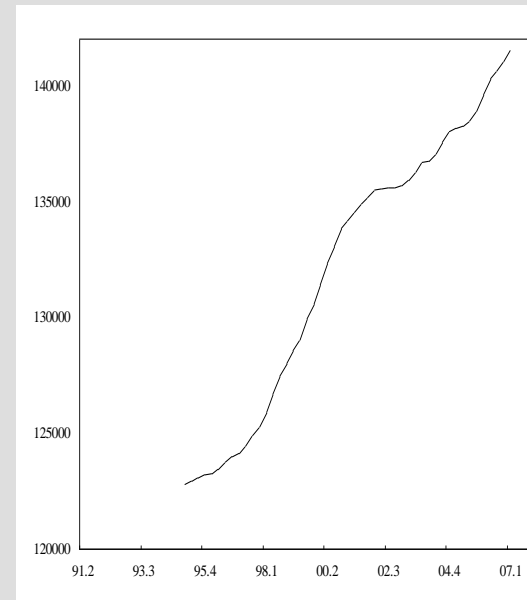
INO 1995.01-2007.03.  
Vintage 23/05/2007

### 3. Empirical results

- **Hard indicators: Exports and Employment**



Exports 1999.01-2007.03.  
Vintage 05/22/2007

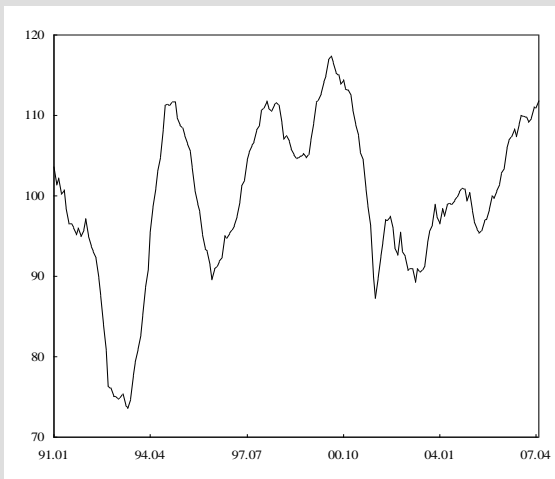


Employment 1991.II-2007.I  
Vintage 06/13/2007

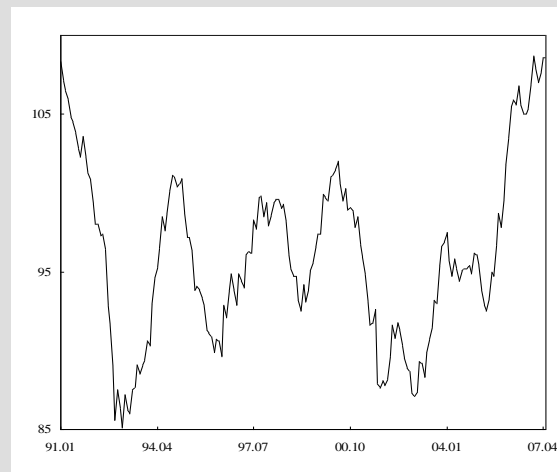


### 3. Empirical results

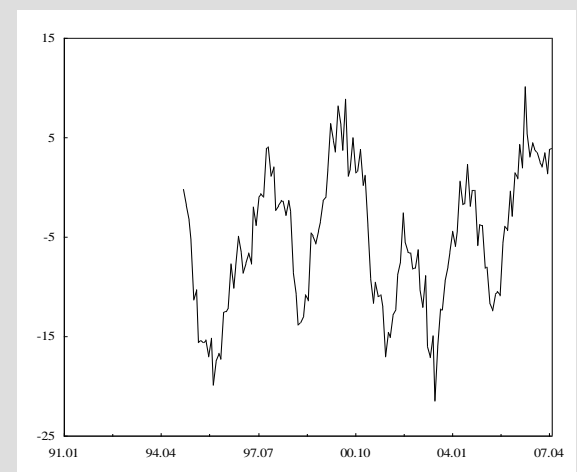
- Soft indicators: ESI, IFO, BNB



ESI 1991.01-2007.05  
Vintage 05/31/2007



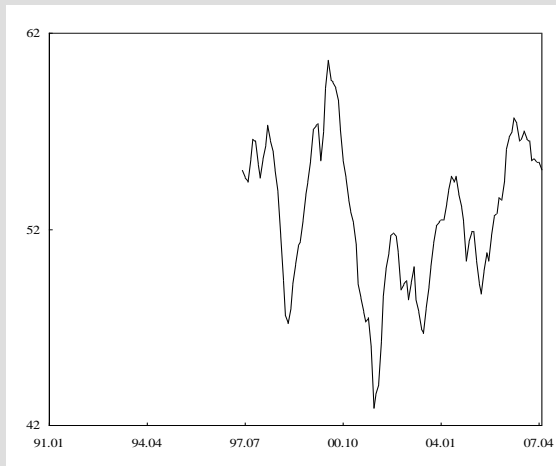
IFO 1991.01-2007.05  
Vintage 05/24/2007



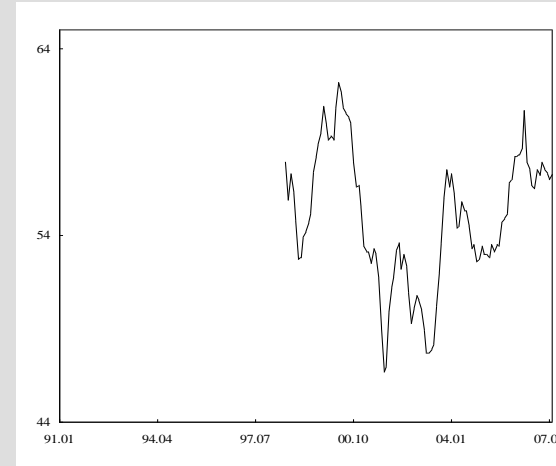
BNB 1995.01-2007.05  
Vintage 05/24/2007

### 3. Empirical results

- **Soft indicators: PMI manufactures and PMI services**



PMIM 1997.06-2007.05  
Vintage 06/01/2007



PMIS 1997.06-2007.05  
Vintage 06/05/2007

### 3. Empirical results

- Parameter estimates with information on 06/14/2006

- Impact of factor on variables

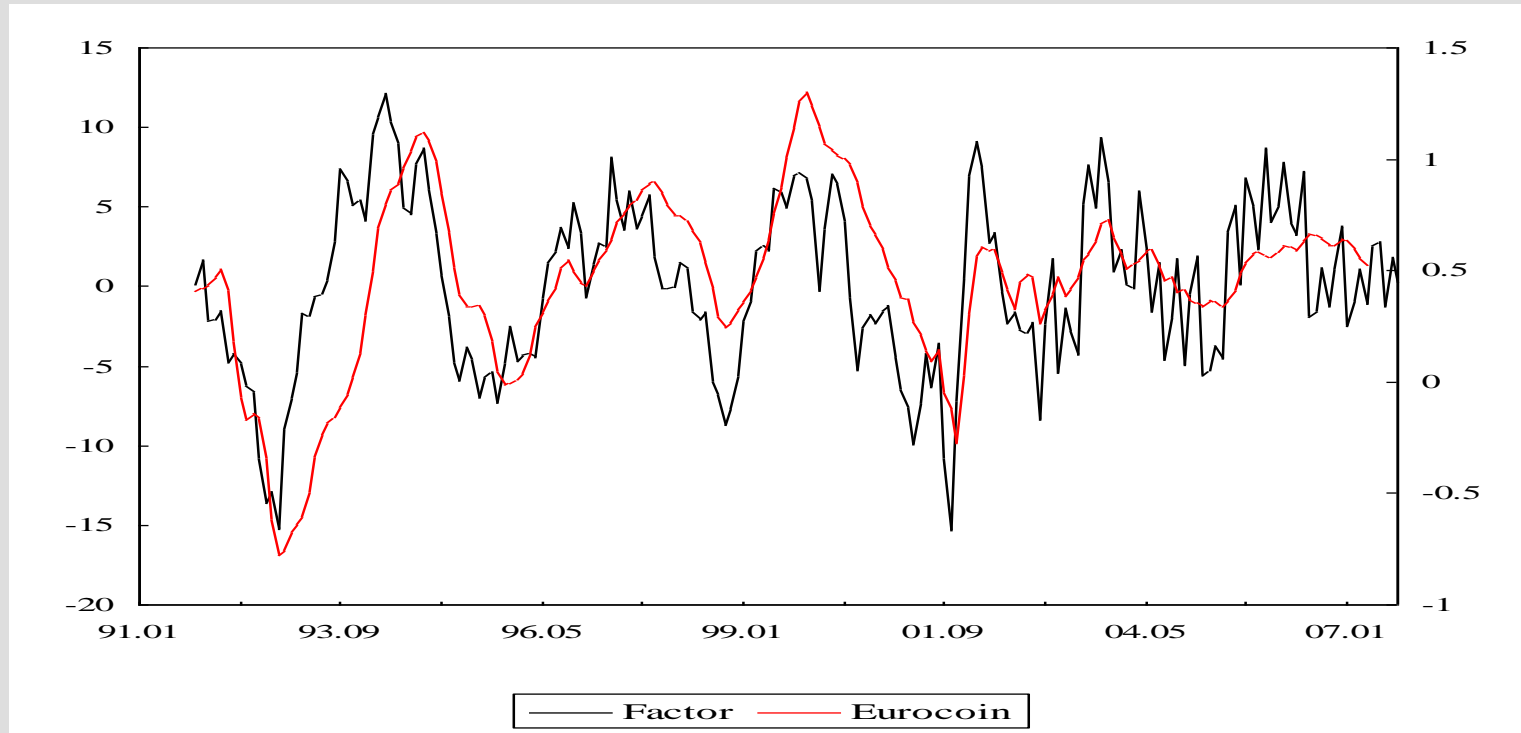
Second	IPI	Sales	INO	ESI	BNB	IFO	PMIM	Exports	PMIS	Employment
0.04	0.06	0.01	0.06	0.13	0.09	0.10	0.14	0.04	0.10	0.02
(0.01)	(0.01)	(0.01)	(0.02)	(0.03)	(0.02)	(0.02)	(0.03)	(0.01)	(0.03)	(0.01)

- Weights measure changes in GDP due to unexpected changes in:

	Second	IPI	Sales	INO	ESI	BNB	IFO	PMIM	Exports	PMIS	Employment	First	Flash
2006.09	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0000	0.00	0.00
2006.10	0.00	0.16	0.03	0.15	0.15	0.15	0.14	0.11	0.04	0.07	0.0000	0.00	0.00
2006.11	0.00	0.17	0.04	0.16	0.13	0.15	0.14	0.09	0.04	0.06	0.0000	0.00	0.00
2006.12	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0000	0.00	0.00
2007.01	0.00	0.16	0.03	0.15	0.15	0.15	0.14	0.11	0.04	0.07	0.0000	0.00	0.00
2007.02	0.00	0.17	0.04	0.16	0.13	0.15	0.14	0.09	0.04	0.06	0.0000	0.00	0.00
2007.03	0.00	0.02	0.01	0.02	0.02	0.02	0.02	0.01	0.01	0.01	0.0006	0.87	0.00
2007.04	0.00	0.21	0.04	0.00	0.18	0.19	0.17	0.13	0.00	0.09	0.0000	0.00	0.00
2007.05	0.00	0.00	0.00	0.00	0.23	0.26	0.24	0.16	0.00	0.11	0.0000	0.00	0.00
2007.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0000	0.00	0.00
2007.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0000	0.00	0.00
2007.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0000	0.00	0.00
2007.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0000	0.00	0.00

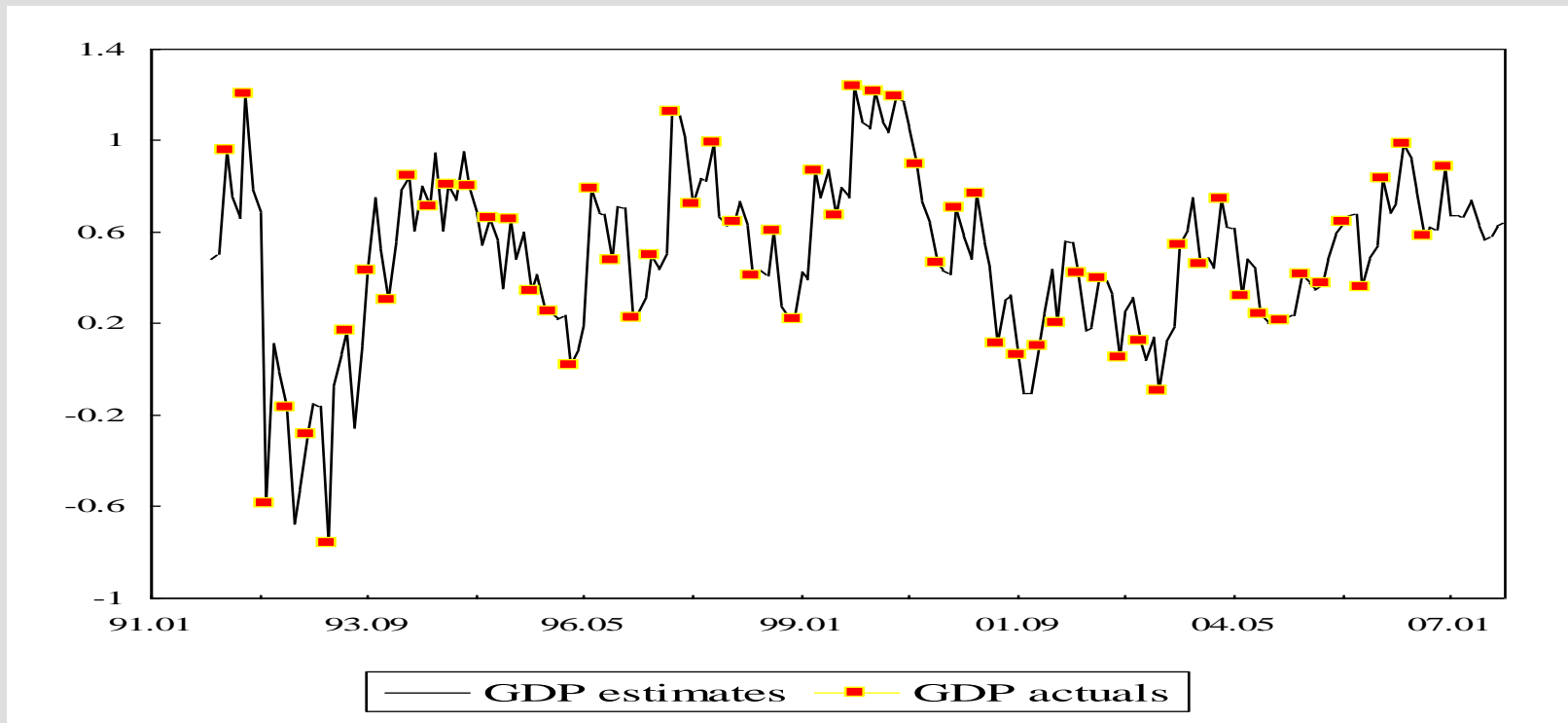
### 3. Empirical results

- Common **factor** 1991.10-2007.09 with information on 06/14/2007



### 3. Empirical results

- Quarterly growth rate of GDP **second** 1991.10-2007.09 with information on 06/14/2007



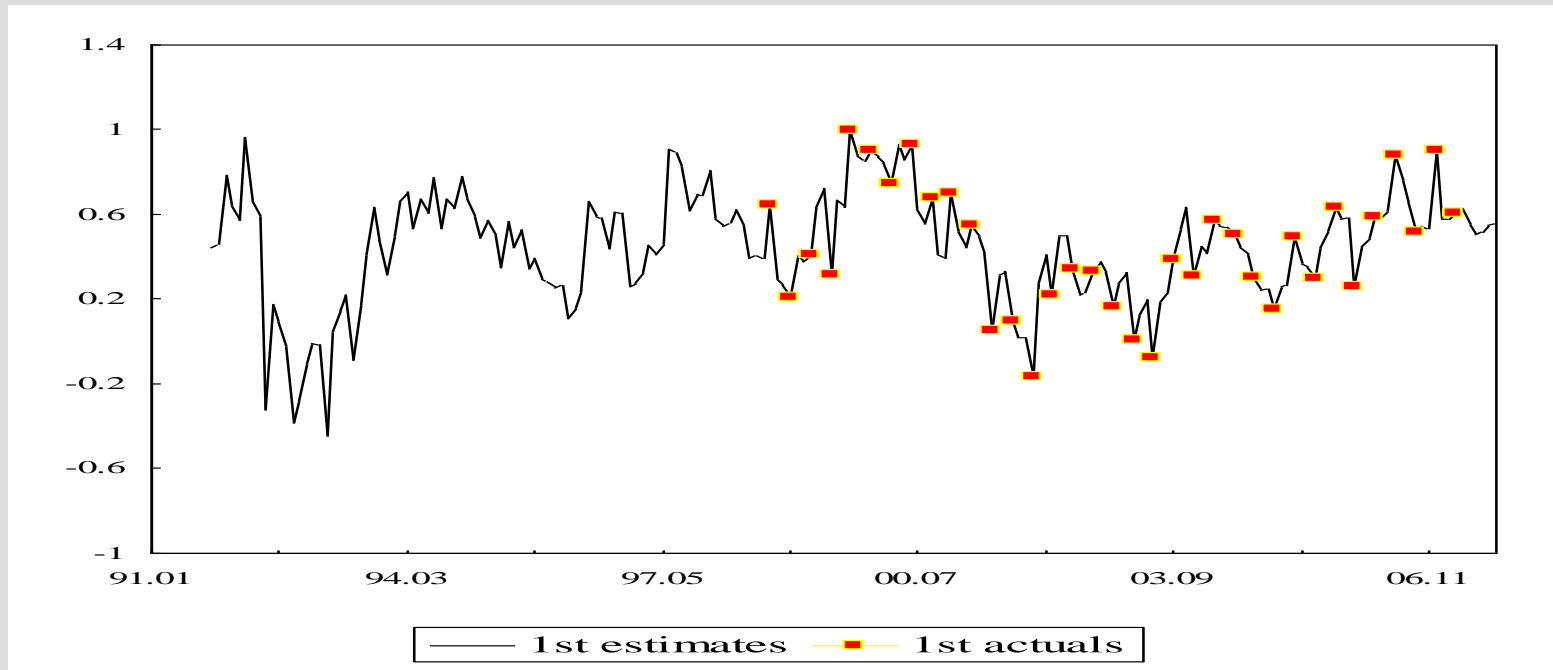
### 3. Empirical results

- Quarterly growth rate of GDP **second** with information on 06/14/2007

	Second	Forecast	se
2006.09	0.58	0.58	0.00
2006.10	na	0.62	0.08
2006.11	na	0.61	0.09
2006.12	0.89	0.89	0.00
2007.01	na	0.67	0.08
2007.02	na	0.67	0.09
2007.03	na	0.67	0.07
2007.04	na	0.74	0.09
2007.05	na	0.63	0.10
2007.06	na	0.57	0.11
2007.07	na	0.58	0.11
2007.08	na	0.63	0.12
2007.09	na	0.64	0.13

### 3. Empirical results

- Quarterly growth rate of **first** 91.10-07.09 with information on 06/14/2007



### 3. Empirical results

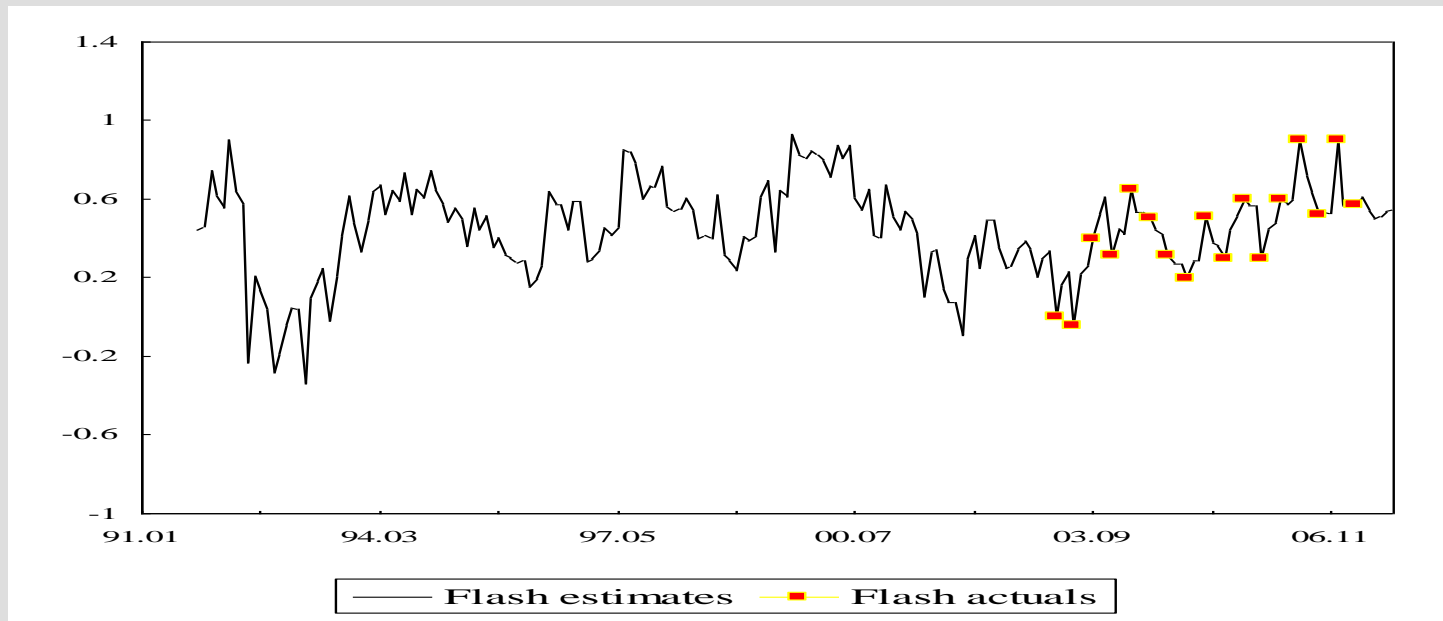
- Quarterly growth rate of **first** with information on 06/14/2007

	First	Forecast	se
2006.09	0.52	0.52	0.00
2006.10	na	0.54	0.06
2006.11	na	0.54	0.06
2006.12	0.90	0.90	0.00
2007.01	na	0.58	0.06
2007.02	na	0.58	0.06
2007.03	0.60	0.60	0.00
2007.04	na	0.63	0.06
2007.05	na	0.55	0.07
2007.06	na	0.50	0.07
2007.07	na	0.51	0.07
2007.08	na	0.55	0.08
2007.09	na	0.55	0.08



### 3. Empirical results

- Quarterly growth rate of **flash** 91.10-07.09 with information on 06/14/2007



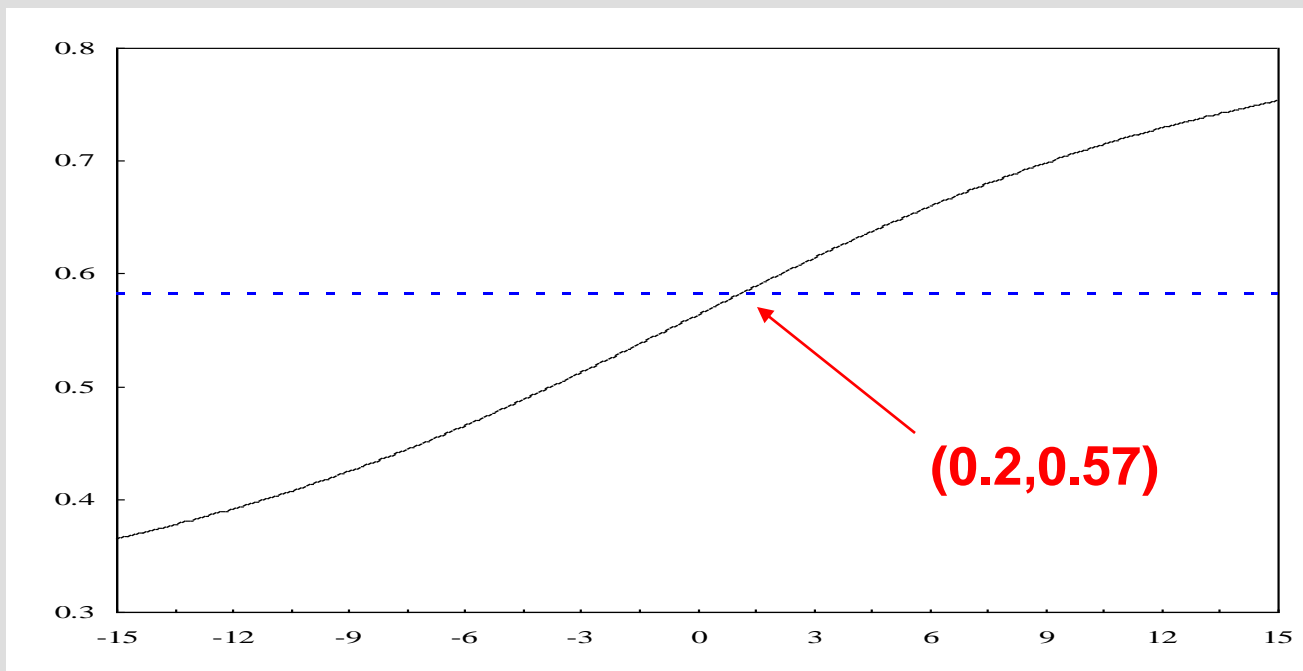
### 3. Empirical results

- Quarterly growth rate of **flash** with information on 06/14/2007

	First	Forecast	se
2006.09	0.52	0.52	0.00
2006.10	na	0.53	0.05
2006.11	na	0.53	0.05
2006.12	0.90	0.90	0.00
2007.01	na	0.56	0.05
2007.02	na	0.56	0.05
2007.03	0.57	0.57	0.00
2007.04	na	0.61	0.05
2007.05	na	0.54	0.05
2007.06	na	0.50	0.06
2007.07	na	0.51	0.06
2007.08	na	0.54	0.06
2007.09	na	0.54	0.06

### 3. Empirical results

- Evaluation: forecasts of GDP second in 2007.II for different IFOs with information up to 06/14/2007 (Note that the expected release IFO is on 06/22/2007)



### 3. Empirical results

- Real-time forecasts evaluation 2003.IV-2007.III: monthly indicators

Release For:	EUROZONE RELEASE CALENDAR								
	HARD INDICATORS				SOFT INDICATORS				
	IPI	INO	RS	Trade	PMI M	PMI S	ESI	IFO	BNB
ene-04	13-mar-04	29-mar-04	<b>05-mar-04</b>	<b>22-mar-04</b>	02-feb-04	04-feb-04	30-ene-04	27-ene-04	23-ene-04
feb-04	19-abr-04	22-abr-04	05-abr-04	20-abr-04	01-mar-04	03-mar-04	27-feb-04	24-feb-04	24-feb-04
mar-04	17-may-04	26-may-04	05-may-04	19-may-04	01-abr-04	05-abr-04	31-mar-04	26-mar-04	23-mar-04
abr-04	17-jun-04	25-jun-04	04-jun-04	18-jun-04	03-may-04	05-may-04	30-abr-04	26-abr-04	23-abr-04
may-04	19-jul-04	22-jul-04	06-jul-04	22-jul-04	01-jun-04	03-jun-04	28-may-04	25-may-04	25-may-04
jun-04	17-ago-04	24-ago-04	04-ago-04	20-ago-04	01-jul-04	05-jul-04	30-jun-04	25-jun-04	23-jun-04
jul-04	17-sep-04	22-sep-04	03-sep-04	22-sep-04	02-ago-04	04-ago-04	30-jul-04	27-jul-04	30-jun-04
ago-04	19-oct-04	22-oct-04	04-oct-04	21-oct-04	01-sep-04	03-sep-04	<b>30-sep-04</b>	26-ago-04	24-ago-04
sep-04	17-nov-04	23-nov-04	05-nov-04	22-nov-04	01-oct-04	05-oct-04	<b>30-sep-04</b>	27-sep-04	22-sep-04
oct-04	17-dic-04	22-dic-04	03-dic-04	21-dic-04	01-nov-04	03-nov-04	29-oct-04	25-oct-04	22-oct-04
nov-04	18-ene-05	24-ene-05	07-ene-05	20-ene-05	01-dic-04	03-dic-04	30-nov-04	25-nov-04	23-nov-04
dic-04	17-feb-05	23-feb-05	04-feb-05	22-feb-05	03-ene-05	05-ene-05	06-ene-05	17-dic-04	22-dic-04
ene-05	17-mar-05	23-mar-05	04-mar-05	23-mar-05	01-feb-05	03-feb-05	31-ene-05	26-ene-05	25-ene-05
feb-05	19-abr-05	22-abr-05	06-abr-05	20-abr-05	01-mar-05	03-mar-05	28-feb-05	23-feb-05	23-feb-05
mar-05	19-may-05	24-may-05	04-may-05	24-may-05	01-abr-05	05-abr-05	31-mar-05	23-mar-05	23-mar-05
abr-05	17-jun-05	22-jun-05	03-jun-05	22-jun-05	02-may-05	04-may-05	29-abr-05	25-abr-05	22-abr-05
may-05	19-jul-05	22-jul-05	05-jul-05	20-jul-05	01-jun-05	03-jun-05	31-may-05	25-may-05	24-may-05
jun-05	18-ago-05	24-ago-05	03-ago-05	19-ago-05	01-jul-05	04-jul-05	30-jun-05	27-jun-05	22-jun-05
jul-05	16-sep-05	22-sep-05	06-sep-05	27-sep-05	01-ago-05	03-ago-05	29-jul-05	26-jul-05	26-jul-05
ago-05	19-oct-05	24-oct-05	05-oct-05	20-oct-05	01-sep-05	05-sep-05	<b>30-sep-05</b>	25-ago-05	24-ago-05
sep-05	17-nov-05	23-nov-05	07-nov-05	21-nov-05	03-oct-05	05-oct-05	<b>30-sep-05</b>	27-sep-05	23-sep-05
oct-05	19-dic-05	22-dic-05	05-dic-05	20-dic-05	01-nov-05	03-nov-05	28-oct-05	25-oct-05	25-oct-05
nov-05	18-ene-06	24-ene-06	05-ene-06	19-ene-06	01-dic-05	05-dic-05	30-nov-05	24-nov-05	23-nov-05
dic-05	17-feb-06	22-feb-06	03-feb-06	21-feb-06	03-ene-06	05-ene-06	05-ene-06	16-dic-05	22-dic-05
ene-06	17-mar-06	22-mar-06	06-mar-06	22-mar-06	01-feb-06	03-feb-06	31-ene-06	25-ene-06	24-ene-06
feb-06	26-abr-06	26-abr-06	05-abr-06	25-abr-06	01-mar-06	03-mar-06	28-feb-06	23-feb-06	22-feb-06
mar-06	16-may-06	23-may-06	04-may-06	22-may-06	03-abr-06	05-abr-06	31-mar-06	28-mar-06	22-mar-06
abr-06	16-jun-06	22-jun-06	07-jun-06	19-jun-06	02-may-06	04-may-06	28-abr-06	25-abr-06	24-abr-06
may-06	17-jul-06	24-jul-06	05-jul-06	19-jul-06	01-jun-06	06-jun-06	31-may-06	24-may-06	23-may-06
jun-06	17-ago-06	22-ago-06	03-ago-06	21-ago-06	03-jul-06	05-jul-06	30-jun-06	27-jun-06	23-jun-06
jul-06	18-sep-06	22-sep-06	05-sep-06	15-sep-06	01-ago-06	03-ago-06	31-jul-06	26-jul-06	24-jul-06
ago-06	17-oct-06	24-oct-06	04-oct-06	18-oct-06	01-sep-06	05-sep-06	31-ago-06	24-ago-06	23-ago-06
sep-06	15-nov-06	22-nov-06	07-nov-06	17-nov-06	02-oct-06	04-oct-06	29-sep-06	26-sep-06	22-sep-06
oct-06	15-dic-06	22-dic-06	05-dic-06	18-dic-06	02-nov-06	06-nov-06	31-oct-06	25-oct-06	24-oct-06
nov-06	15-ene-07	23-ene-07	05-ene-07	17-ene-07	01-dic-06	05-dic-06	30-nov-06	23-nov-06	23-nov-06
dic-06	13-feb-07	22-feb-07	06-feb-07	16-feb-07	02-ene-07	04-ene-07	05-ene-07	19-dic-06	20-dic-06
ene-07	14-mar-07	22-mar-07	06-mar-07	22-mar-07	01-feb-07	05-feb-07	31-ene-07	25-ene-07	24-ene-07
feb-07	13-abr-07	24-abr-07	04-abr-07	17-abr-07	01-mar-07	05-mar-07	28-feb-07	23-feb-07	22-feb-07
mar-07	14-may-07	23-may-07	04-may-07	22-may-07	02-abr-07	04-abr-07	30-mar-07	27-mar-07	22-mar-07
abr-07	12-jun-07		05-jun-07		02-may-07	04-may-07	30-abr-07	25-abr-07	24-abr-07
may-07					01-jun-07	05-jun-07	31-may-07	24-may-07	24-may-07

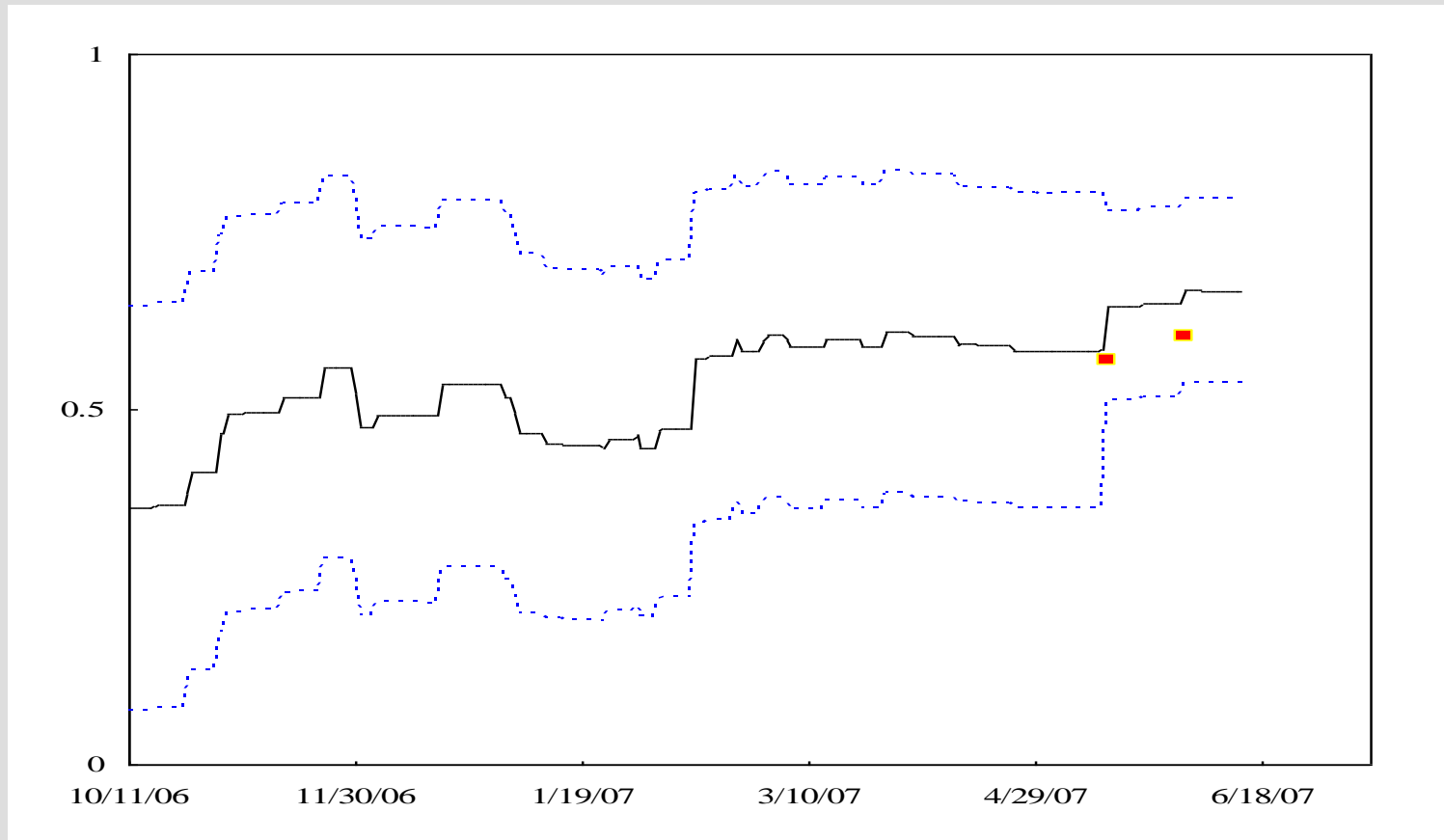
### 3. Empirical results

- Real-time forecasts evaluation 2003.IV-2007.III: quarterly indicators

	EUROZONE RELEASE CALENDAR				
Release For:	GDP			Employment	
	Flash	1st Estimate	2nd Estimate	Provisional	Revised
mar-03	15-may-03	05-jun-03	10-jul-03	20-jun-03	19-ago-03
jun-03	14-ago-03	09-sep-03	09-oct-03	11-sep-03	25-nov-03
sep-03	14-nov-03	03-dic-03	15-ene-04	11-dic-03	05-mar-04
dic-03	13-feb-04	04-mar-04	16-abr-04	15-mar-04	29-mar-04
mar-04	14-may-04	01-jun-04	15-jul-04	15-jun-04	14-sep-04
jun-04	13-ago-04	07-sep-04	14-oct-04	14-sep-04	12-nov-04
sep-04	12-nov-04	01-dic-04	12-ene-05	13-dic-04	29-mar-05
dic-04	15-feb-05	02-mar-05	14-abr-05	29-mar-05	27-may-05
mar-05	12-may-05	01-jun-05	14-jul-05	10-jun-05	12-ago-05
jun-05	11-ago-05	31-ago-05	13-oct-05	14-sep-05	03-nov-05
sep-05	15-nov-05	30-nov-05	13-ene-06	12-dic-05	02-ene-06
dic-05	14-feb-06	03-mar-06	12-abr-06	29-may-06	14-jun-06
mar-06	11-may-06	01-jun-06	12-jul-06	14-jun-06	12-jul-06
jun-06	14-ago-06	01-sep-06	11-oct-06	14-sep-06	11-oct-06
sep-06	14-nov-06	30-nov-06	11-ene-07	14-dic-06	11-ene-07
dic-06	13-feb-07	06-mar-07	12-abr-07	14-mar-07	12-abr-07
mar-07	15-may-07	01-jun-07		13-Jun-07	

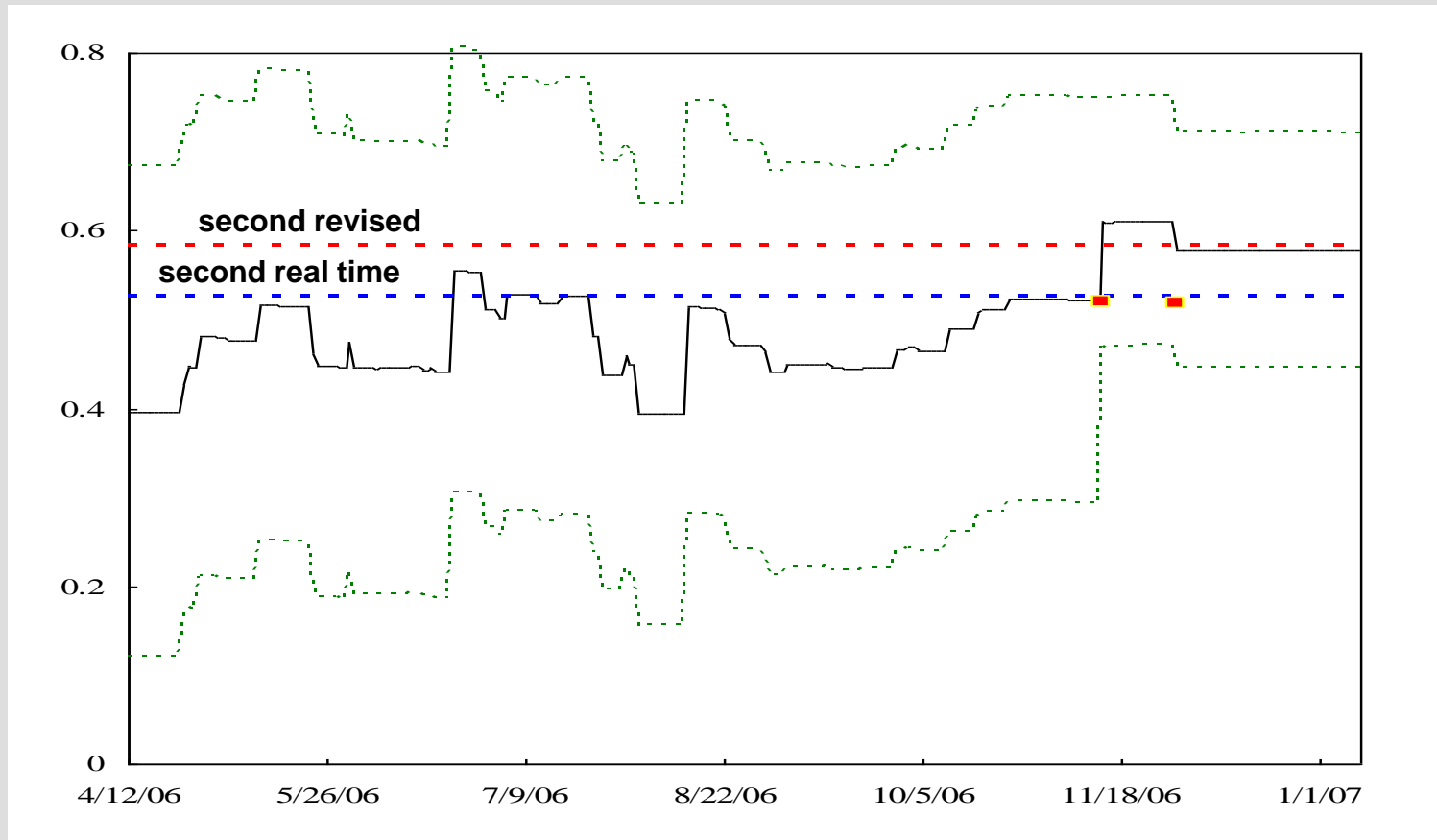
### 3. Empirical results

- Real-time forecasts of **2007.1** from second release 2006.2 to today (06/14/2007)



### 3. Empirical results

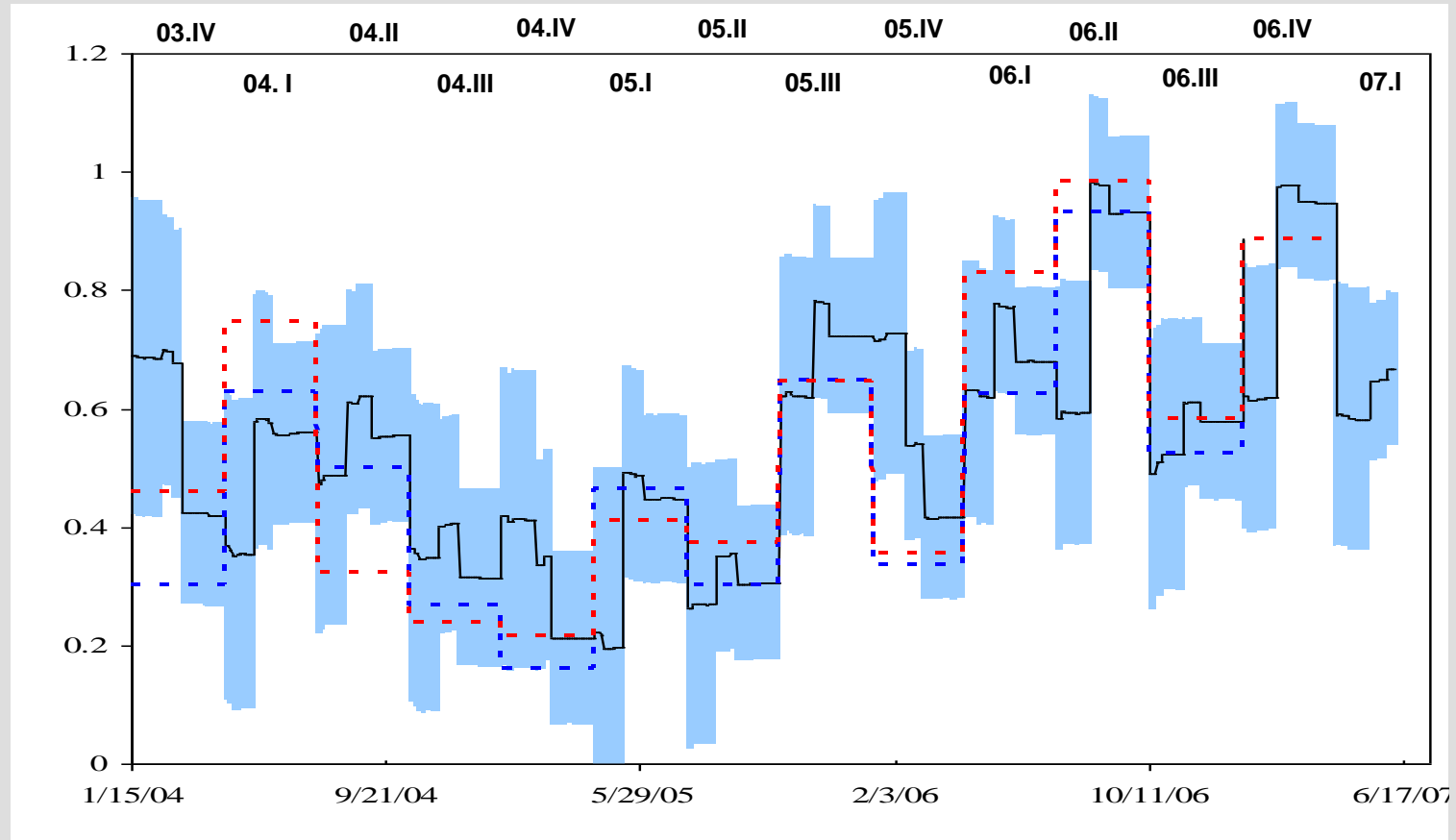
- Real-time forecasts of **2006.3** from 2005.IV release to 2006.3 release



### 3. Empirical results



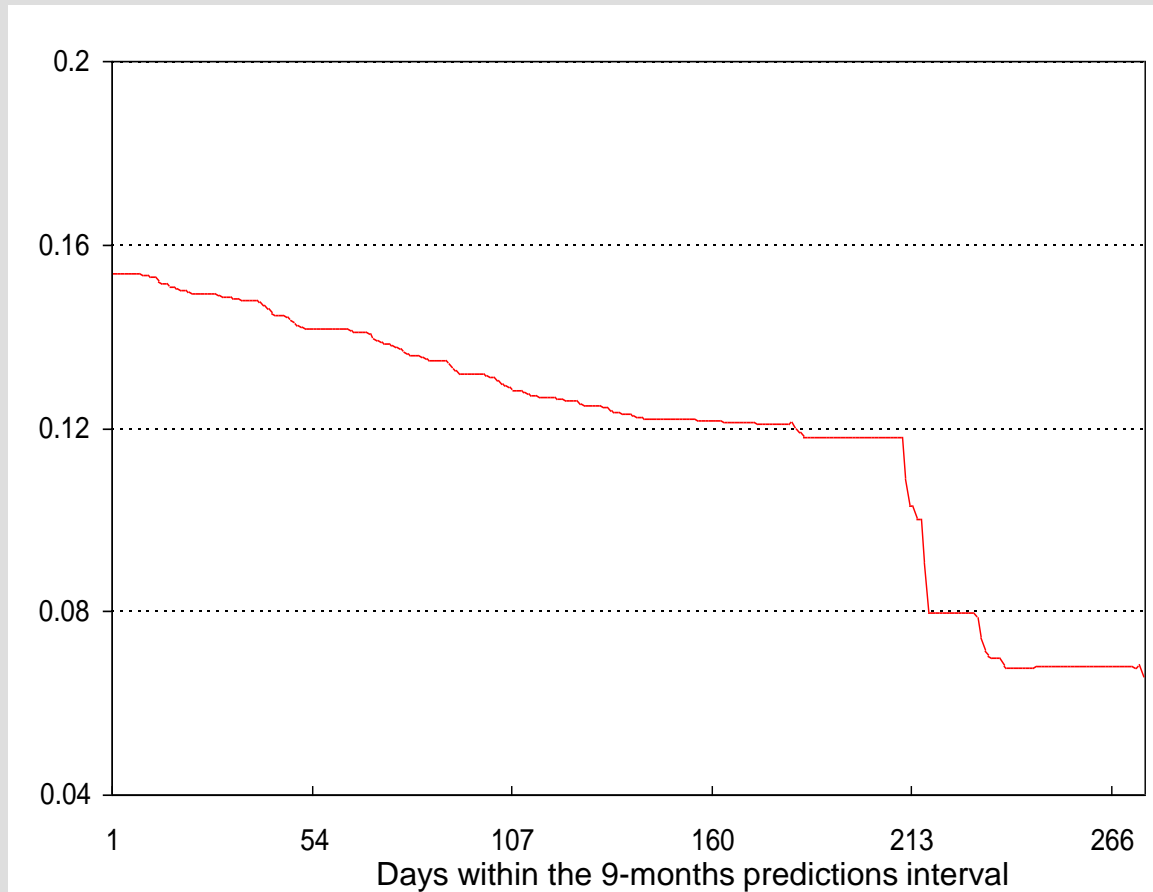
- Real-time *first-quarter* forecasts 2003.IV to 2007.I





### 3. Empirical results

- Averaged standard errors



### 3. Empirical results

- Forecasting evaluation: comparison with competitors

Forecasting period 2003.4-2007.1			
Mean Squared Error			
	<b>1 Months Lag</b>	<b>2 Months Lag</b>	<b>3 Months lag</b>
<b>Eurocoin</b>	0.79	0.62	0.58
<b>CPQ</b>	0.75	0.28	0.14
	<b>4 Months Lead</b>	<b>Current Month</b>	<b>3 Months lag</b>
<b>Central Banks Confidential</b>	0.95	0.62	0.95
<b>CPQ</b>	0.79	0.88	0.66
	<b>3 Months Lead</b>	<b>1 Month Lead</b>	<b>1 Month Lag</b>
<b>Ecomission (2006.1-2007.1)</b>	0.38	0.35	0.38
<b>CPQ</b>	0.43	0.25	0.02
			<b>1 Month Lag</b>
<b>DGECfin</b>			0.80
<b>CPQ</b>			0.71
	<b>5 Months Lead</b>	<b>3 Months Lead</b>	<b>1 Month Lag</b>
<b>IFO_INSEE-INSAE</b>	0.63	0.66	0.63
<b>CPQ</b>	0.58	0.68	0.45
	<b>3 Months Lead</b>	<b>Current Month</b>	
<b>OECD (Only half sample)</b>	0.31	0.28	
<b>CPQ</b>	0.12	0.41	

### 3. Empirical results

- **Markov-switching extension**

- Incorporates the two key features of business cycles
  - comovement among economic variables and
  - switching between regimes of boom and slump

$$\begin{pmatrix} x_t \\ z_t \end{pmatrix} = \beta f_t + \begin{pmatrix} u_{1t} \\ u_{2t} \end{pmatrix}$$

$$f_t = \mu_{s_t} + v_{ft}$$
$$\Phi_u(L)u_t = v_{ut}$$

$$\begin{pmatrix} v_{ft} \\ v_{ut} \end{pmatrix} = NID\left(0, \begin{bmatrix} \sigma_1^2 & 0 \\ 0 & \Sigma_{22} \end{bmatrix}\right)$$

- Two states of the economy:  $s_t = 1$  and  $s_t = 2$ , where

$$E(f_t) = \mu_1 \text{ if } s_t = 1$$

$$E(f_t) = \mu_2 \text{ if } s_t = 2$$

- $s_t$  : unobserved state variable evolving as a Markov chain of order one

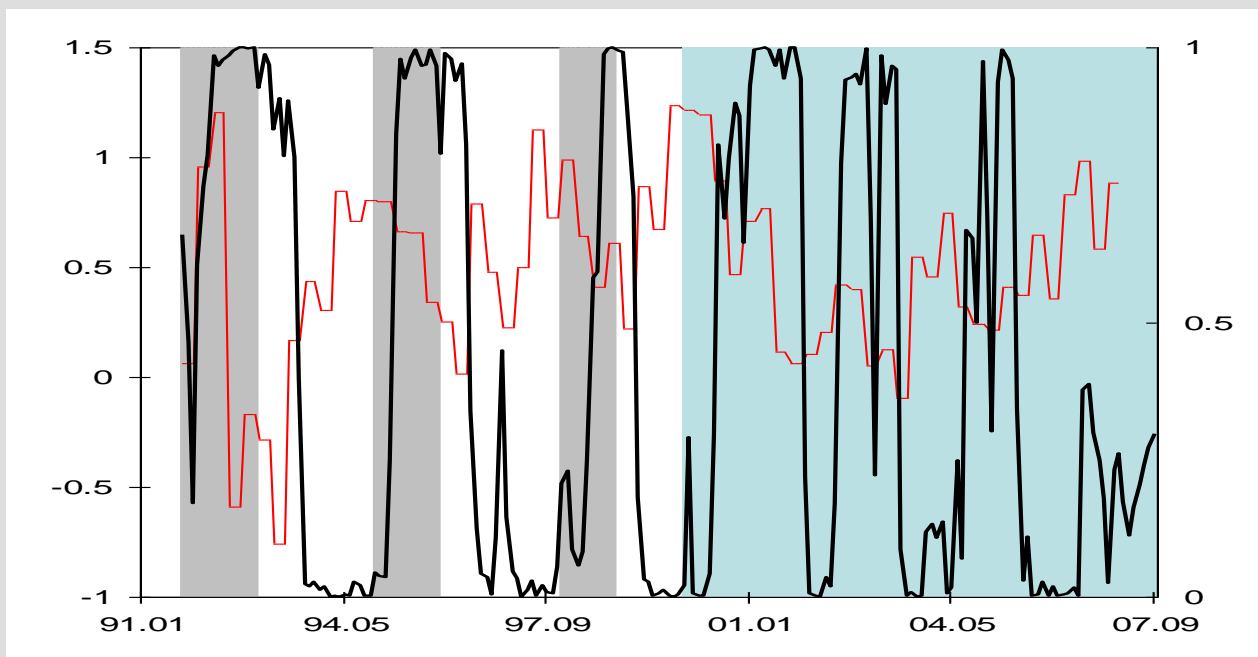
$$P(s_t = i / s_{t-1} = j, \Omega_{t-1}) = P(s_t = i / s_{t-1} = j) = p_{ij}$$

### 3. Empirical results



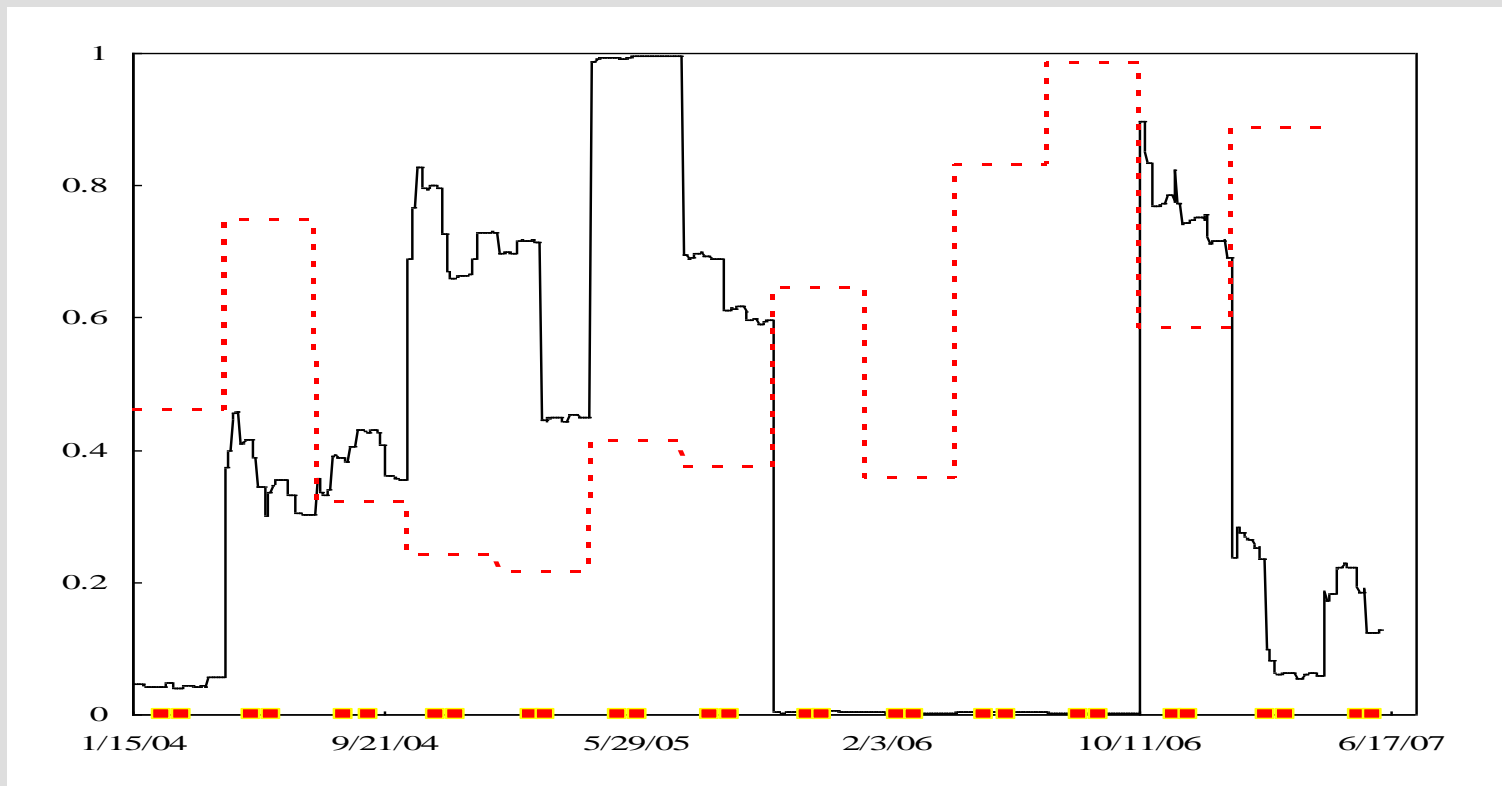
- **Markov-switching extension**

- In-sample and real-time results are similar to linear model
- In-sample low- growth probabilities



### 3. Empirical results

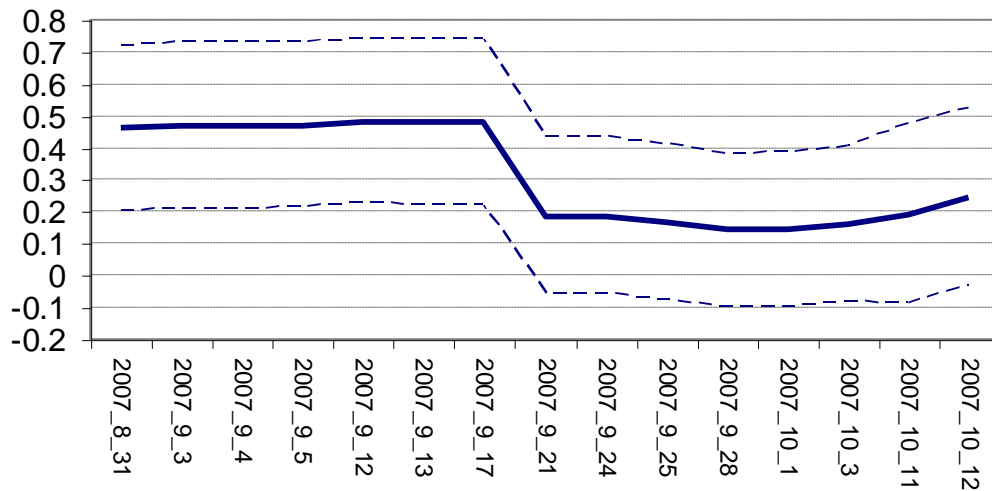
- **Markov-switching extension**
  - Real-time low-growth probabilities



## 4. Very recent developments

- **Bad releases for all the soft indicators in september. Particularly the PMI and specially PMI services**

Figure 3. Evolution of predicted GDP Q-III-2007.



- August 31: Economic Sentiment Indicator. August
- Sept 3rd: PMI manufactures august
- 4 : GDP First, II Quarter.
- 5: PMI services august. Sales July.
- 12 : IPI July.
- 13: Employment second quarter
- 17: Export July
- 21: PMI flash manufactures and services september.
- 24 Industrial new orders july. BNB september.
- 25: IFO september
- 28: ESI september
- October 1st: PMI manufactures september.
- 3 : PMI servicios septiembre. Ventas al por menor agosto
- 11 : GDP second II Quarter.
- 12 : IPI august.

## 4. Extremely recent developments

- Two days ago, exports and INO of august were released, . Yesterday PMI manufactures and services and BNB

Predicted Values. Lineal Model October 22nd 2007

	Third Q. 2007	Fourth Q. 2007	First Q. 2008
<b>FLASH</b>	<b>0.50</b> (0.05)	<b>0.26</b> (0.06)	<b>0.33</b> (0.06)
<b>FIRST</b>	<b>0.51</b> (0.07)	<b>0.23</b> (0.07)	<b>0.32</b> (0.08)
<b>SECOND</b>	<b>0.61</b> (0.09)	<b>0.20</b> (0.11)	<b>0.32</b> (0.15)

Releases and Predictions Indicators last two days

	Predicted	Realized
Exports	0.87	4.85
INO	3.17	0.32
PMI Man	52.38	51.50
PMI Ser	53.84	55.60
BNB	-0.74	-0.10

Predicted Values. Lineal Model October 24nd 2007

	Third Q. 2007	Fourth Q. 2007	First Q. 2008
<b>FLASH</b>	<b>0.50</b> (0.05)	<b>0.26</b> (0.06)	<b>0.33</b> (0.06)
<b>FIRST</b>	<b>0.51</b> (0.07)	<b>0.24</b> (0.07)	<b>0.32</b> (0.08)
<b>SECOND</b>	<b>0.59</b> (0.09)	<b>0.21</b> (0.11)	<b>0.32</b> (0.15)

## 5. Conclusion and further research.

- **Our main results**

- Forecasting the Euro-area GDP and probabilities of recession in real time
- Useful, easy to update tool
- Good results in forecasting

- **Research agenda**

- Euro-area
  - Seasonally adjustment within the model
- Apply this methodology to Spanish data