Now-casting

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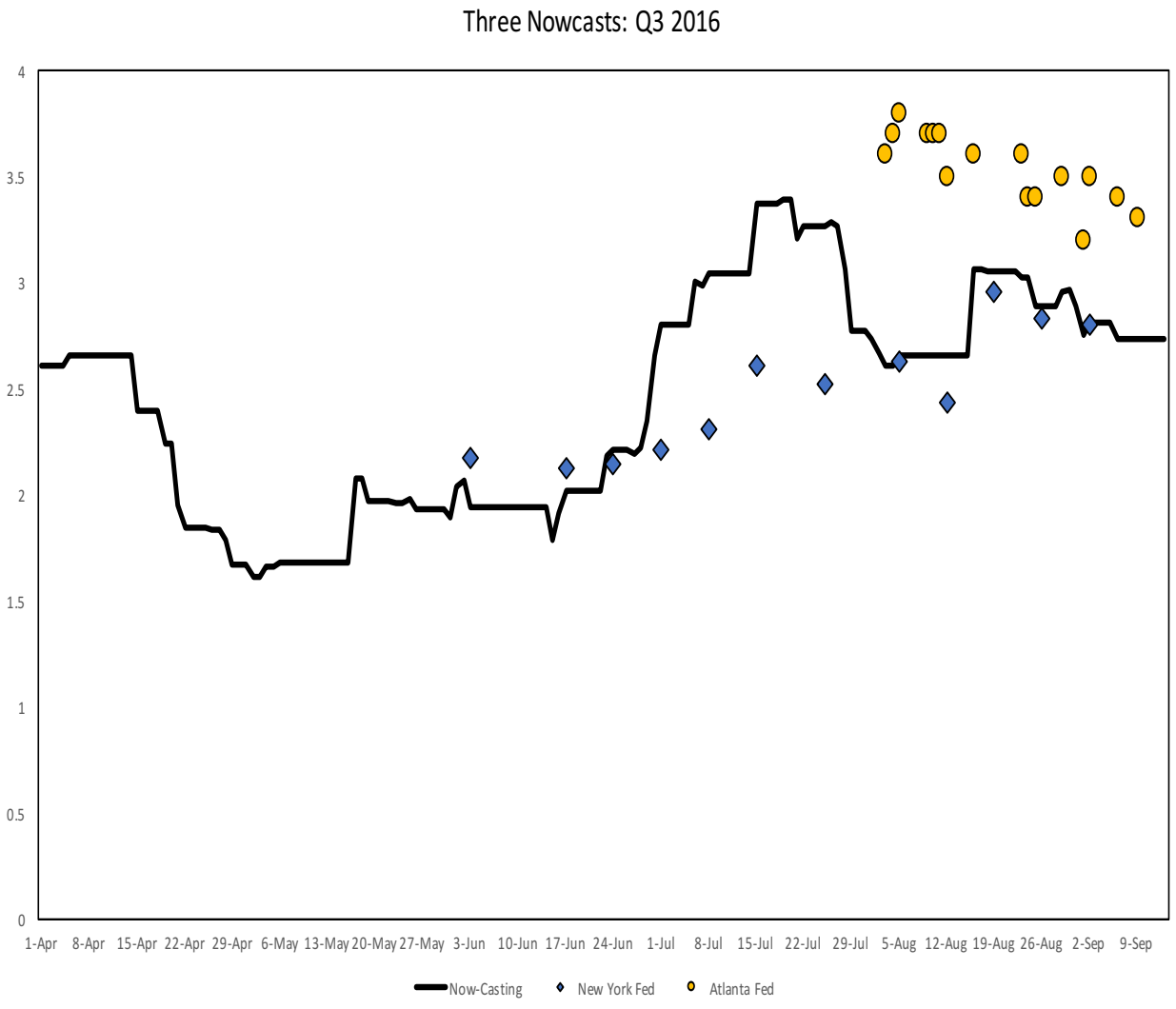
LBS, *Now-Casting Economics ltd* and CEPR

Keynote, Copenhagen
Copenhagen, September 16th, 2016

Where are we now?

Now-casting US GDP 2016q3



Where are we now?

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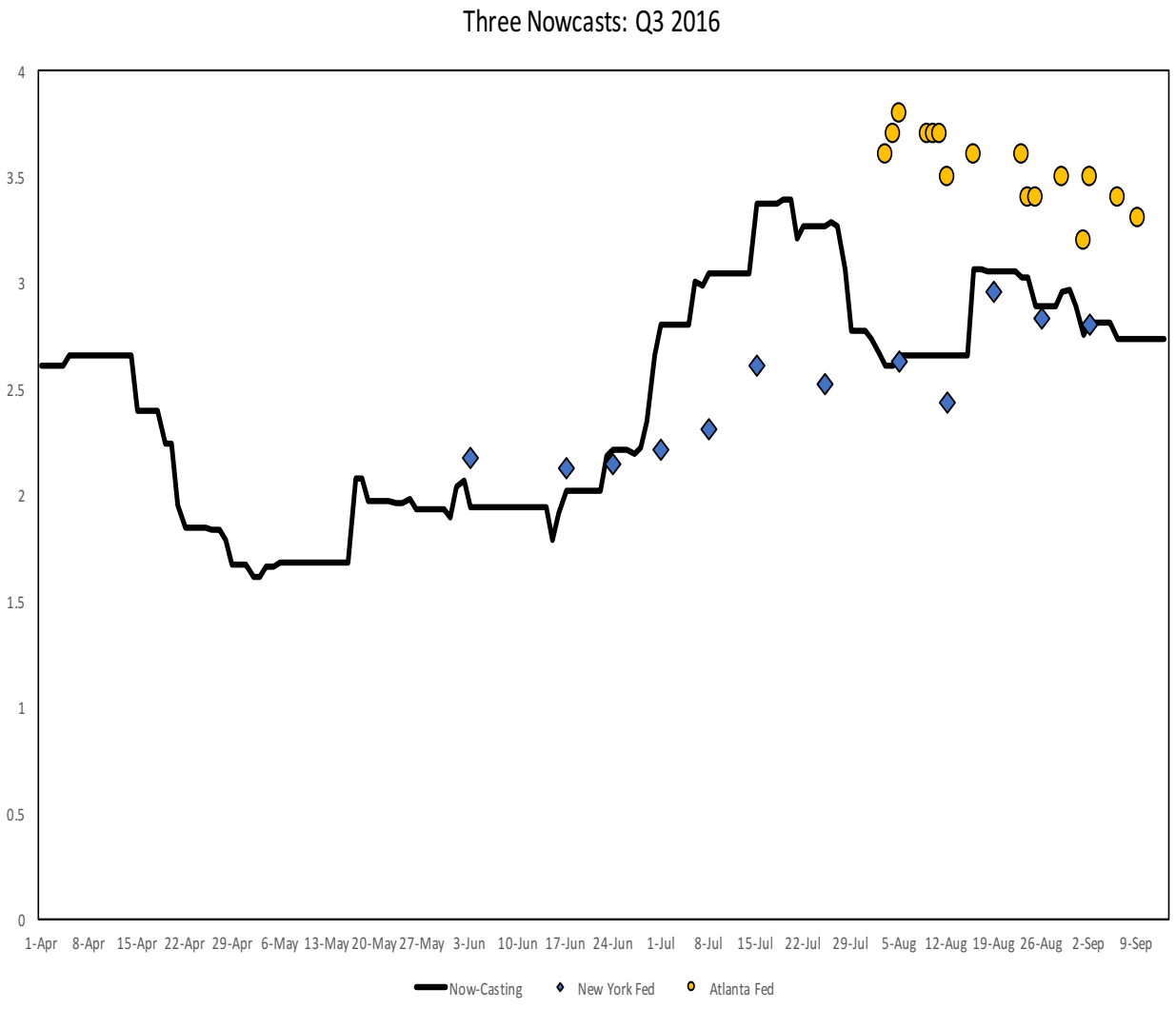
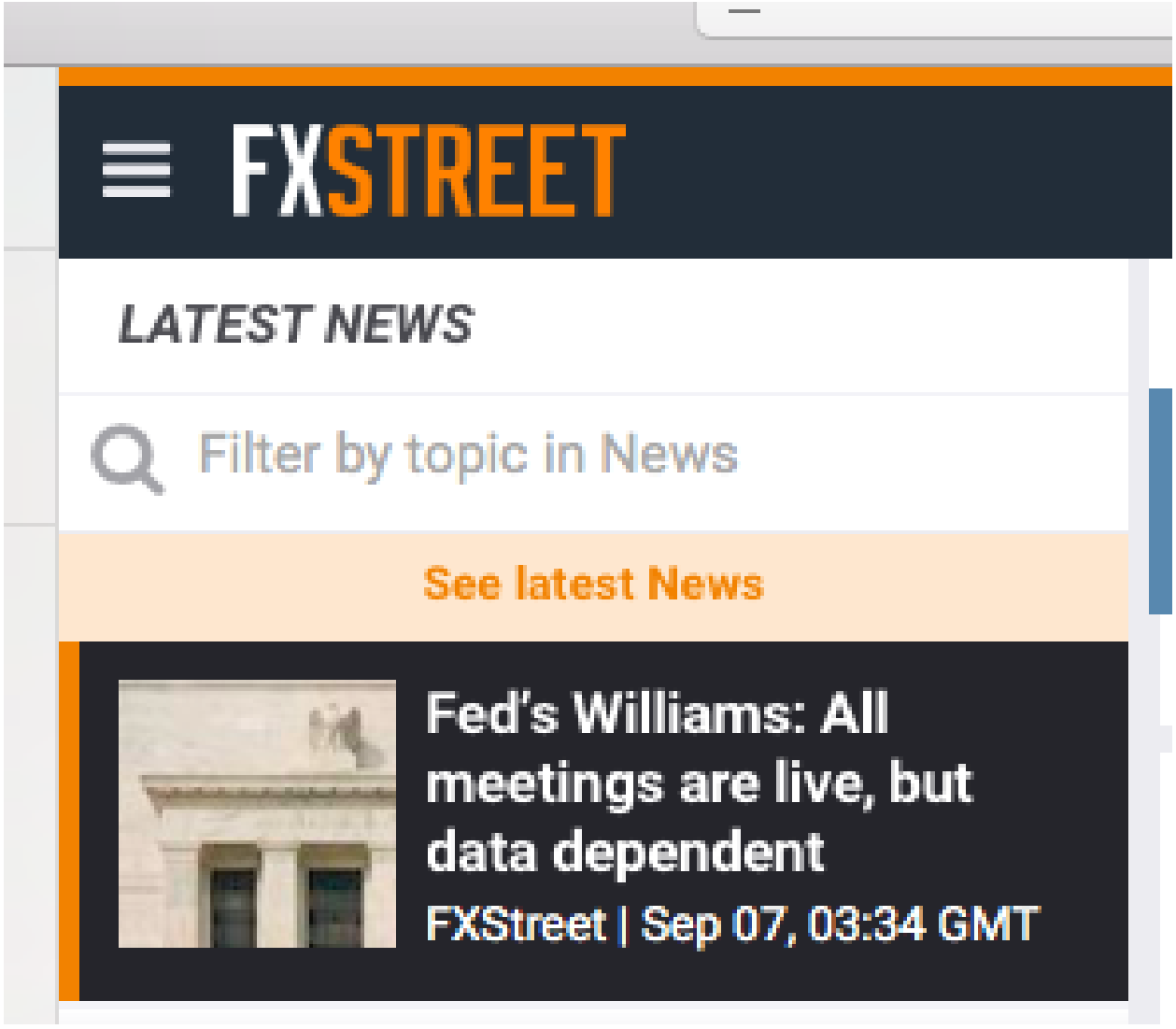


Does it matter?

Fed monetary policy meetings



How do we know? Follow the calendar

Conjuctural information: This Week

Jun 17 - Jun 23									Filter On
Date	10:07am	Currency	Impact		Detail	Actual	Forecast	Previous	Chart
Sun Jun 17									
Mon Jun 18	4:00pm	USD		NAHB Housing Market Index		29	28	28	
	Day 1	ALL		G20 Meetings					
Tue Jun 19	2:30pm	USD		Building Permits		0.78M	0.73M	0.72M	
	2:30pm	USD		Housing Starts		0.71M	0.72M	0.74M	
	Day 2	ALL		G20 Meetings					
Wed Jun 20	4:30pm	USD		Crude Oil Inventories		2.9M	-1.0M	-0.2M	
	6:32pm	USD		FOMC Statement					
	6:32pm	USD		Federal Funds Rate		<0.25%	<0.25%	<0.25%	
	8:00pm	USD		FOMC Economic Projections					
	8:15pm	USD		FOMC Press Conference					
Thu Jun 21	2:30pm	USD		Unemployment Claims		387K	381K	389K	
	3:00pm	USD		Flash Manufacturing PMI		52.9	53.4	54.0	
	4:00pm	USD		Existing Home Sales		4.55M	4.58M	4.62M	
	4:00pm	USD		Philly Fed Manufacturing Index		-16.6	0.7	-5.8	
	4:00pm	USD		CB Leading Index m/m		0.3%	0.2%	-0.1%	
	4:00pm	USD		HPI m/m		0.8%	0.5%	1.6%	
	4:30pm	USD		Natural Gas Storage		62B	64B	67B	
Fri Jun 22	6:30pm	USD		FOMC Member Pianalto Speaks					

How do we know? Follow the calendar

Conjuctural information: Next Week

Jun 24 - Jun 30									Filter On
Date	10:08am	Currency	Impact		Detail	Actual	Forecast	Previous	Chart
Sun Jun 24									
Mon Jun 25	4:00pm	USD		New Home Sales			347K	343K	
Tue Jun 26	3:00pm	USD		S&P/CS Composite-20 HPI y/y			-2.4%	-2.6%	
	4:00pm	USD		CB Consumer Confidence			64.0	64.9	
	4:00pm	USD		Richmond Manufacturing Index			5	4	
Wed Jun 27	2:30pm	USD		Core Durable Goods Orders m/m			1.0%	-0.9%	
	2:30pm	USD		Durable Goods Orders m/m			0.5%	0.0%	
	4:00pm	USD		Pending Home Sales m/m			1.3%	-5.5%	
	4:30pm	USD		Crude Oil Inventories				2.9M	
Thu Jun 28	2:30pm	USD		Unemployment Claims			385K	387K	
	2:30pm	USD		Final GDP q/q			1.9%	1.9%	
	2:30pm	USD		Final GDP Price Index q/q			1.7%	1.7%	
	4:30pm	USD		Natural Gas Storage				62B	
	5:30pm	USD		FOMC Member Pianalto Speaks					
Fri Jun 29	2:30pm	USD		Core PCE Price Index m/m			0.2%	0.1%	
	2:30pm	USD		Personal Spending m/m			0.1%	0.3%	
	2:30pm	USD		Personal Income m/m			0.3%	0.2%	
	3:45pm	USD		Chicago PMI			53.1	52.7	
	3:55pm	USD		Revised UoM Consumer Sentiment			74.3	74.1	
	3:55pm	USD		Revised UoM Inflation Expectations				3.0%	

The idea of now-casting

Mimick market behaviour via an automatic statistical model

Advantage of model:

- free of judgement
- not moody
- cheap to run
- can be run any time

A now-casting platform

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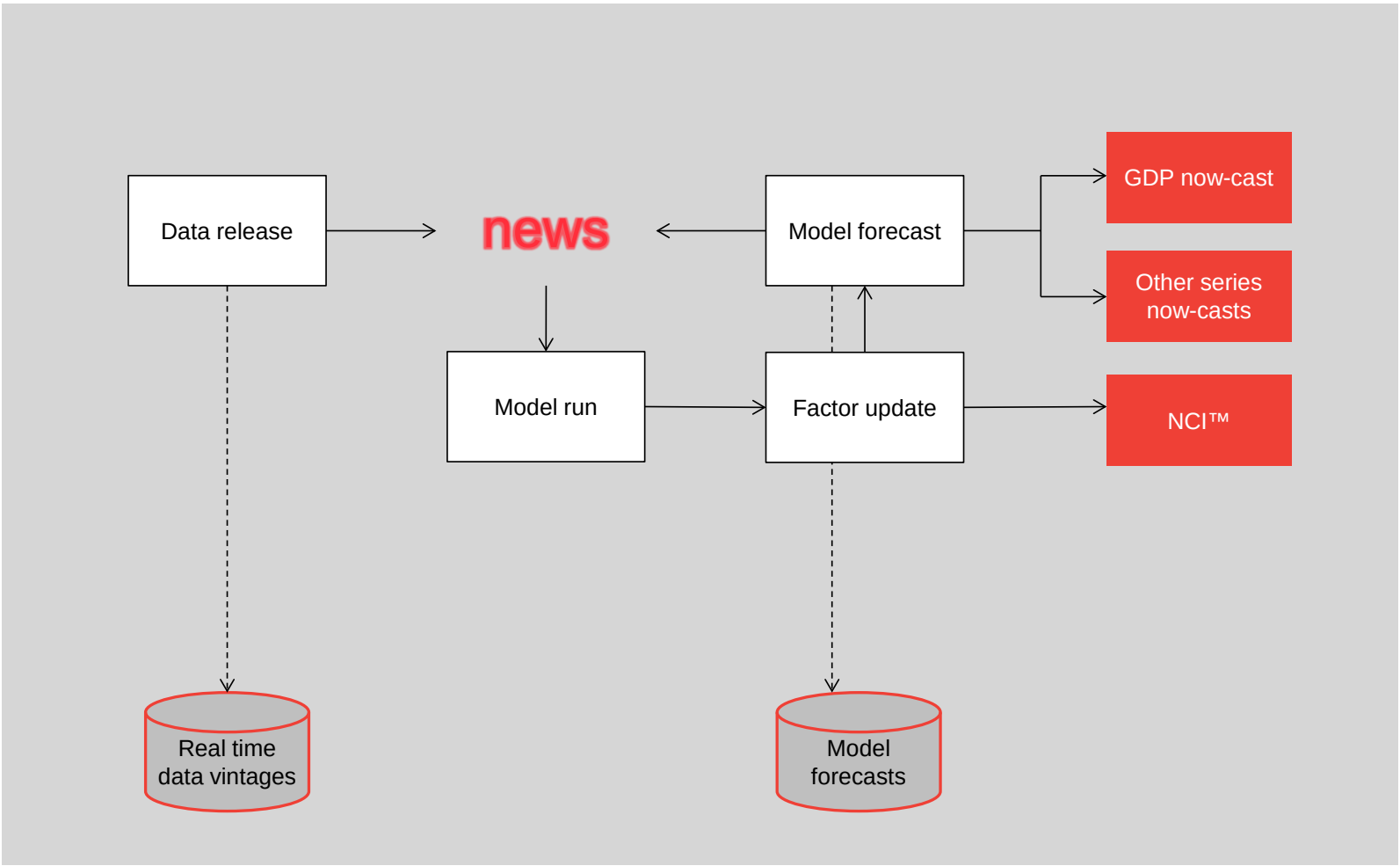
economics in real time



A generic now-casting model

- The now-cast of a single series y_t^Q is the orthogonal projection of y_t^Q on the available information:

$$\mathbb{E}\left[y_t^Q | \Omega_v\right],$$

- Ω_v is vintage of data (quarterly, monthly, possibly daily) available at time v (date of a particular data release)
- The information set Ω_v has particular characteristics:

1. it has a "ragged" or "jagged edge" [publication lags differing across series]
2. it contains mixed frequency series, in our case monthly, daily, weekly and quarterly
3. it could be large

Information structure

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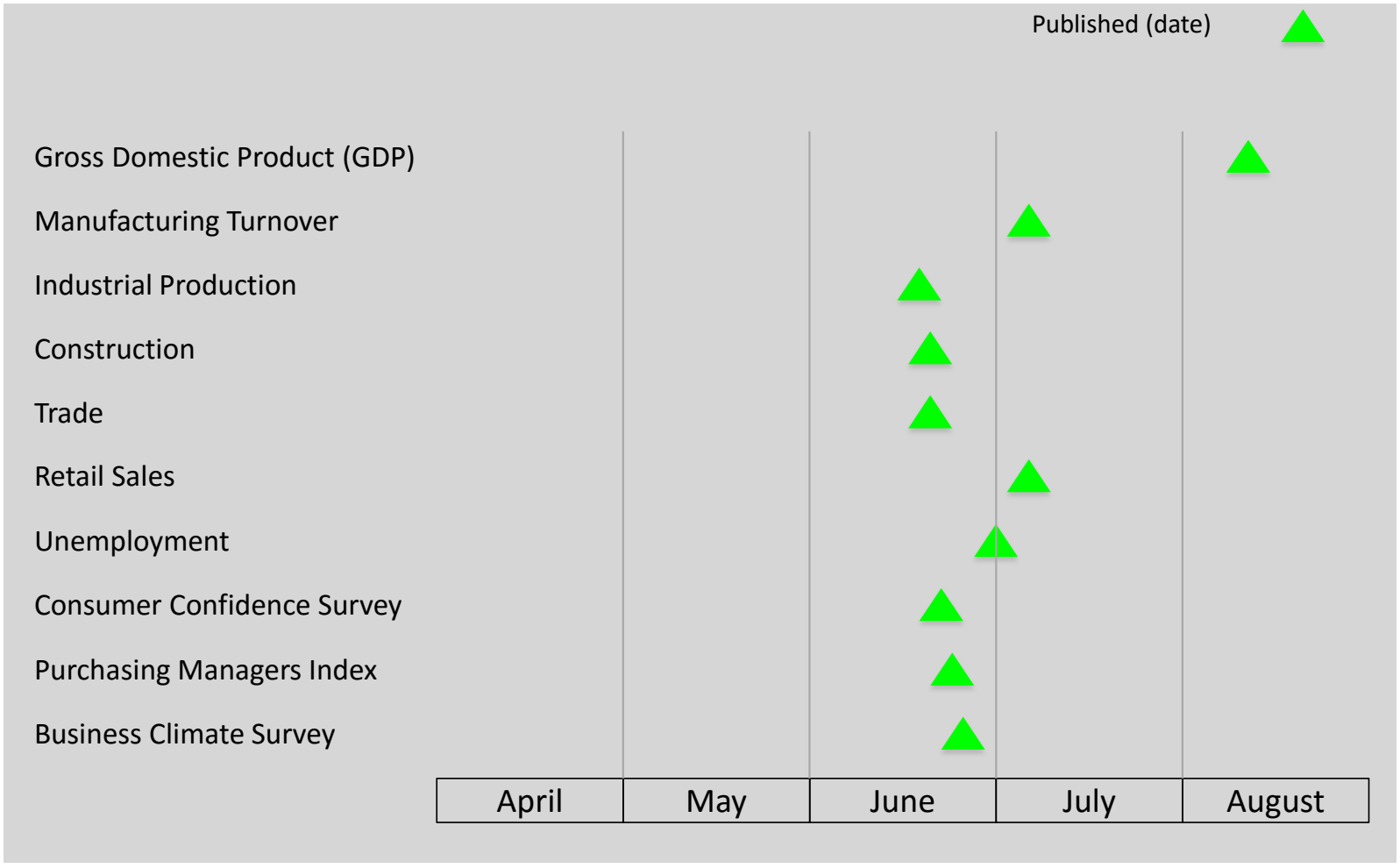

Information structure

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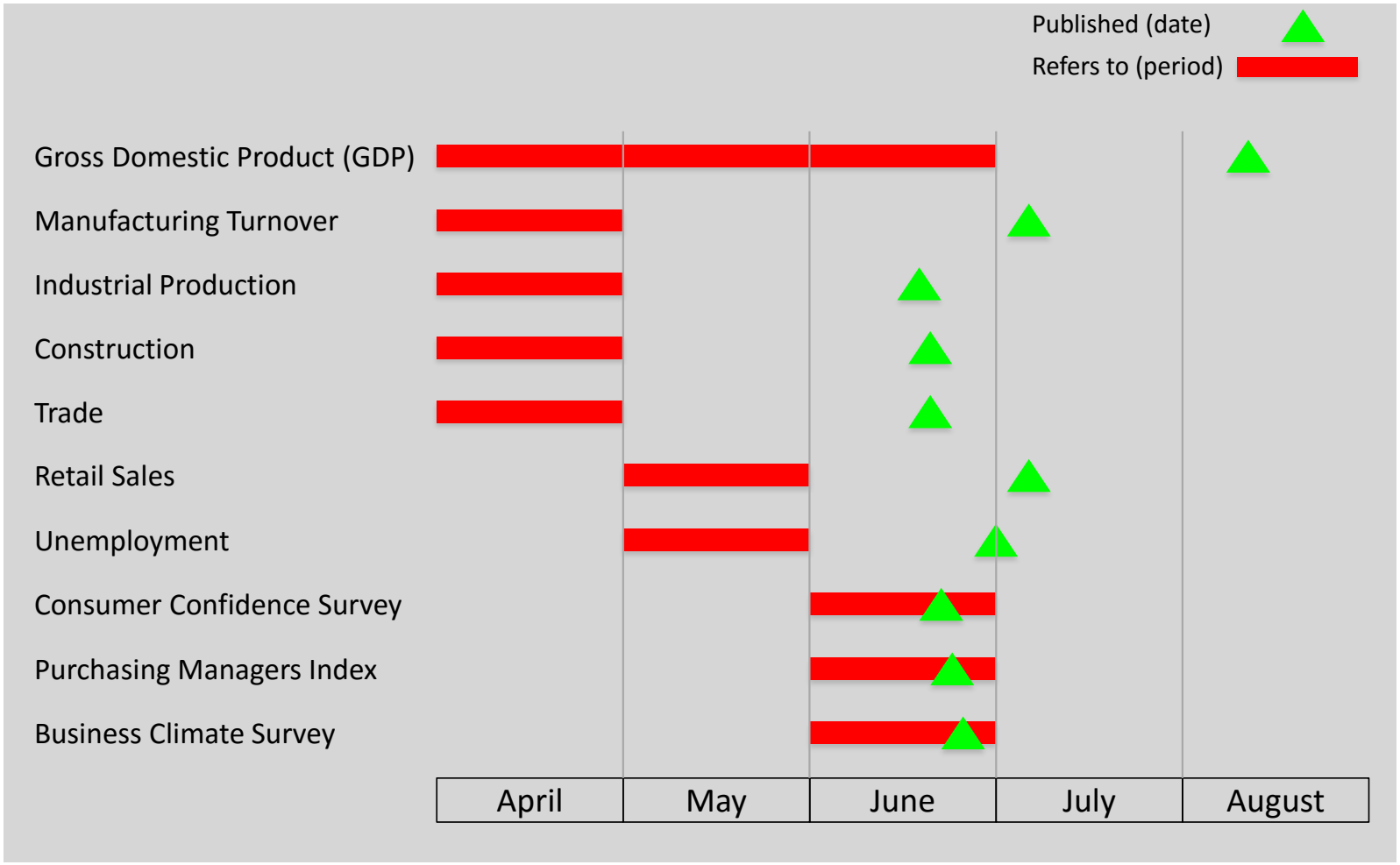

News and now-cast revisions

- New release $\Rightarrow$ the information set expands (new releases): $\Omega_v \subseteq \Omega_{v+1}$
- Decompose new forecast in two orthogonal components:

$$\underbrace{\mathbb{E}\left[y_t^Q|\Omega_{v+1}\right]}_{\text{new forecast}} = \underbrace{\mathbb{E}\left[y_t^Q|\Omega_v\right]}_{\text{old forecast}} + \underbrace{\mathbb{E}\left[y_t^Q|I_{v+1}\right]}_{\text{revision}},$$

I_{v+1} information in Ω_{v+1} "orthogonal" to Ω_v

- If we have a model that can account for joint dynamics of all variables, we can express the forecast revision as a weighted sum of *news* from the released variables:

$$\underbrace{\mathbb{E}\left[y_t^Q|\Omega_{v+1}\right] - \mathbb{E}\left[y_t^Q|\Omega_v\right]}_{\text{forecast revision}} = \sum_{j\in J_{v+1}} b_{j,t,v+1} \underbrace{\left(x_{j,T_{j,v+1}} - \mathbb{E}\left[x_{j,T_{j,v+1}}|\Omega_v\right]\right)}_{\text{news}}.$$

Pre-brexit and post-brexit news

Now-casting UK GDP 2016q3

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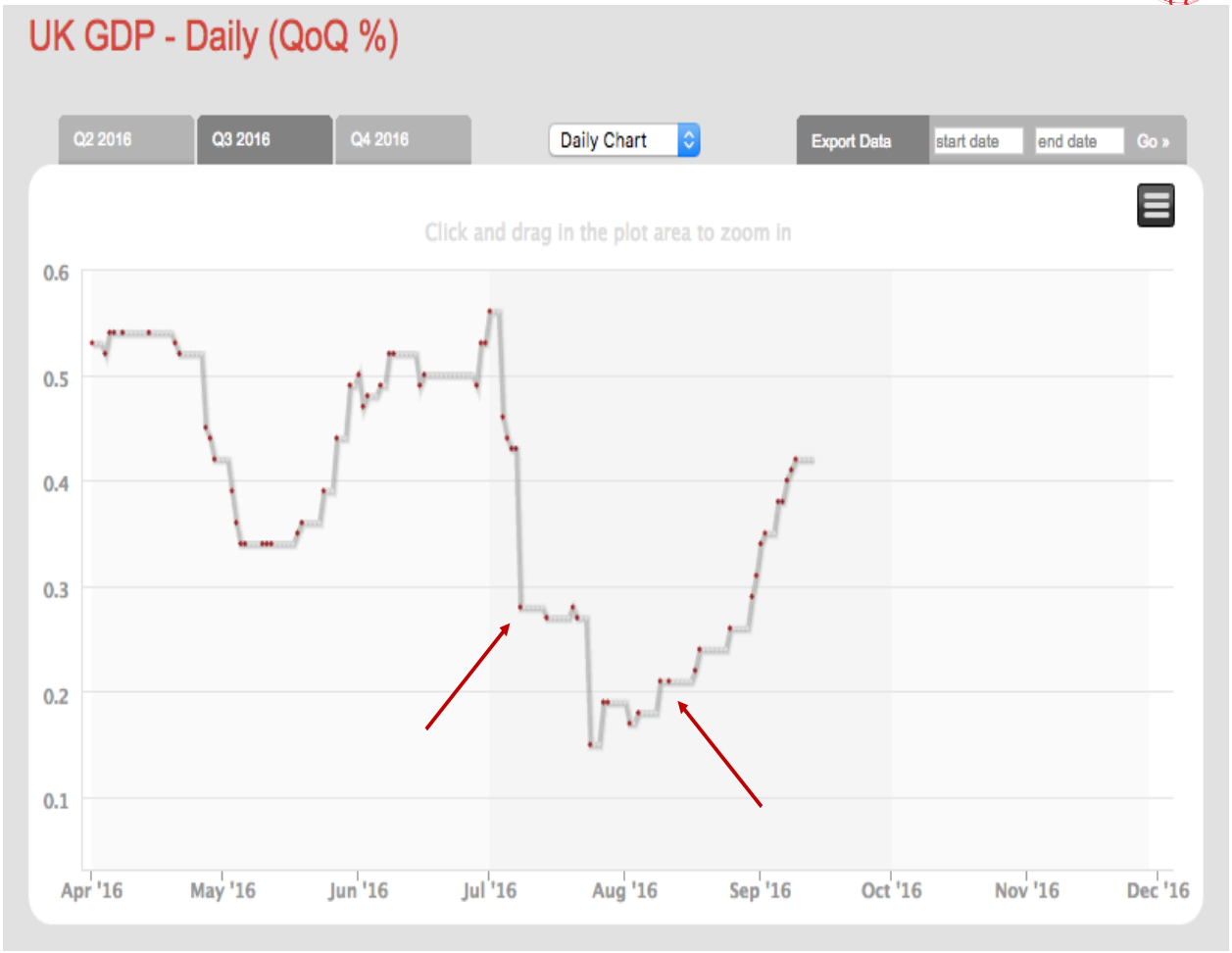

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Q2 2016 | Q3 2016 | Q4 2016

Friday, July 8, 2016

Date	Country	Release	Actual	Unit	Period	Weight (x100)	News	Impact (x100)
08 July 14:54	UK	Consumer Confidence	-9	Index	Jul-16	1.01	-7.29	-7.36
08 July 09:43	UK	Exports	-4.36	MoM %	May-16	0.54	-3.99	-2.16
08 July 09:43	UK	Imports	-3.52	MoM %	May-16	0.90	-3.41	-3.05

Prior GDP Nowcast	0.43
Revised GDP Nowcast	0.28

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Q2 2016 | Q3 2016 | Q4 2016

Tuesday, August 9, 2016

Date	Country	Release	Actual	Unit	Period	Weight (x100)	News	Impact (x100)
09 August 09:42	UK	Industrial Production Excl Construction	0.00	MoM %	Jun-16	2.44	0.03	0.07
09 August 09:42	UK	Exports	2.38	MoM %	Jun-16	0.63	1.00	0.64
09 August 09:42	UK	Imports	3.99	MoM %	Jun-16	1.10	2.42	2.68

Prior GDP Nowcast	0.18
Revised GDP Nowcast	0.21

What have we learned in years of experience?

1. Automatized statistical model performs as well as professional forecasters
2. Timely data matter ... surveys in particular
3. As new data become available, the MSFE decreases
4. Simple models do best

Timely data matter

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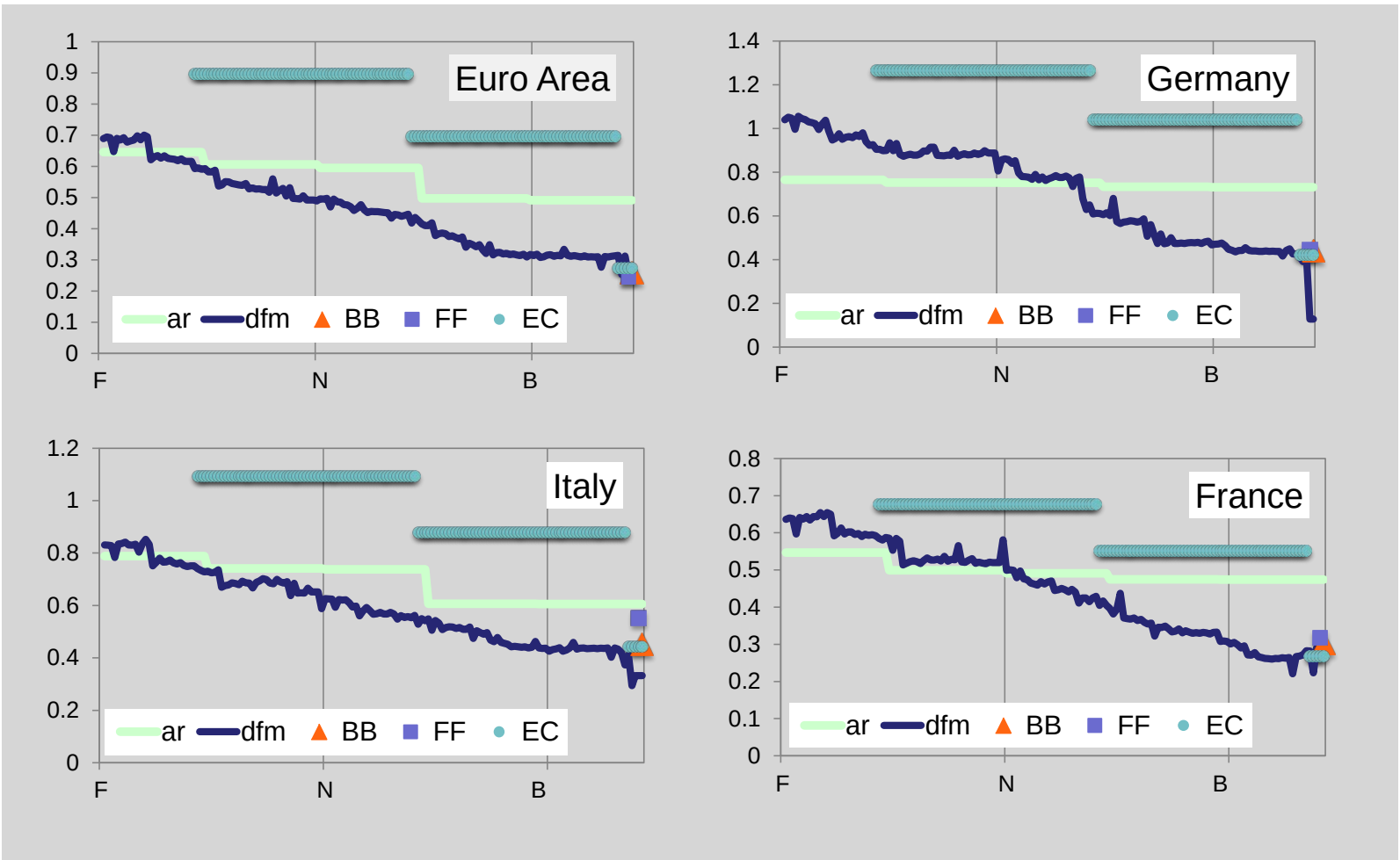

Timely data matter

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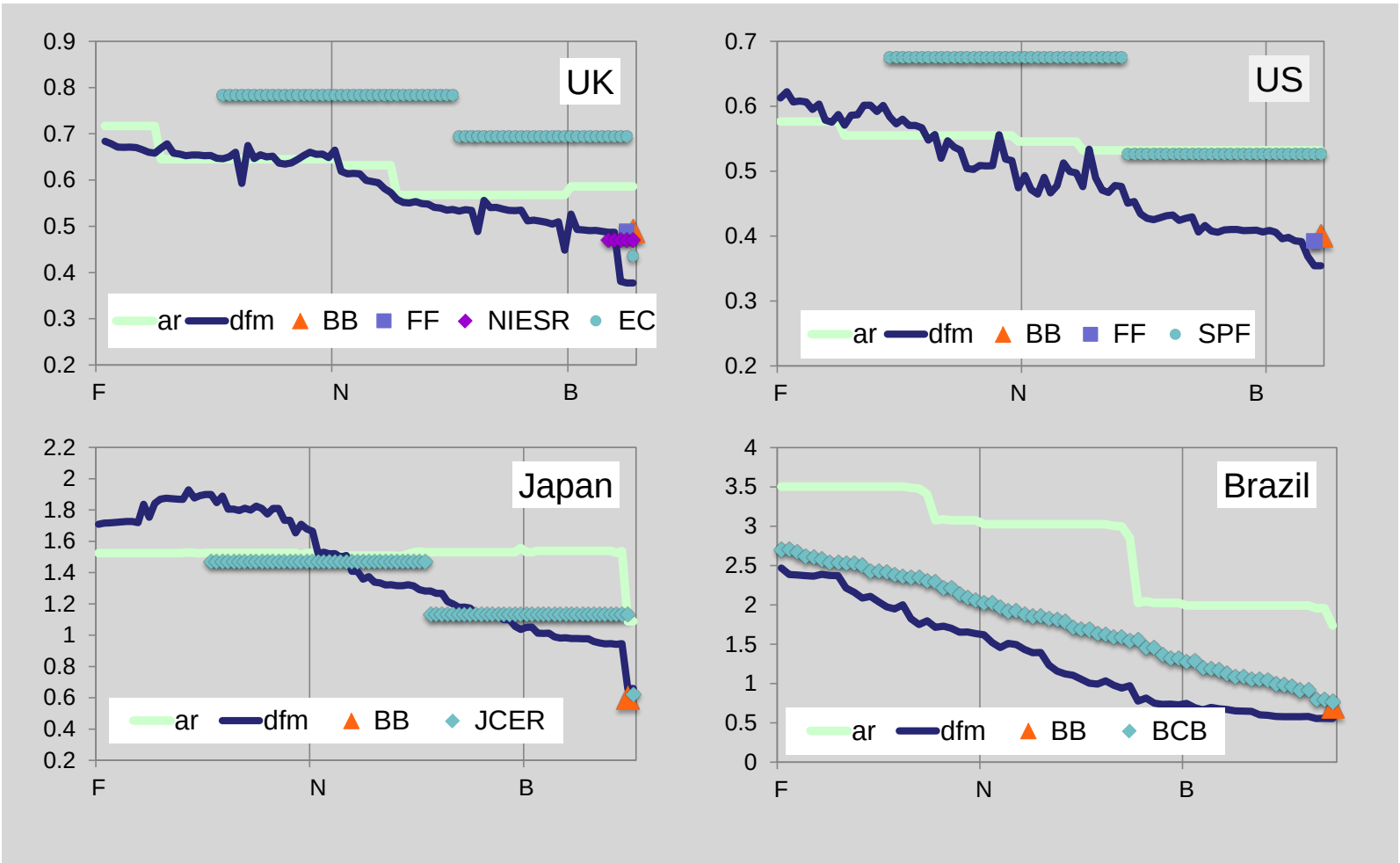

Timely data matter

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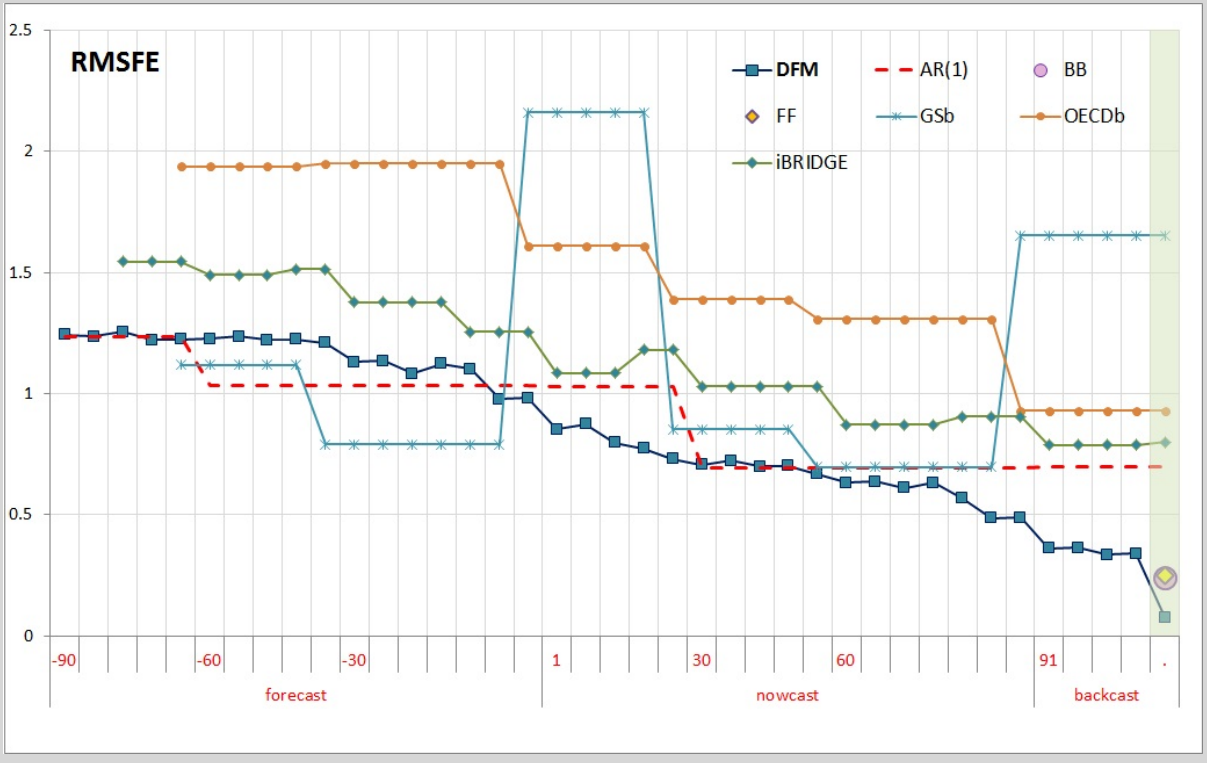


Source: Giannone, Miranda, Modugno 2014

Can we link the now-casting framework to a structural model and what do we gain?

Paper: Giannone, Monti and Reichlin, 2016

Idea: Combine the insight of the reduced form now-casting model with a structural model in order to obtain both a timely assessment of the state economy and a *story telling* device

For example ....

- can evaluate the contribution of identified shocks in real time
- can interpret dynamic of auxiliary variables through the lens of the model
- can obtain early estimates of unobserved model based variables (equilibrium rate, output gap, ...)

Can we link the now-casting framework to a structural model and what do we gain?

Strategy:

1. Given the parameter estimates of the quarterly model obtain a monthly representation and update the now-cast of the variables of the model as new data are published
    - Obtain a monthly specification for an existing DSGE model that maintains the cross-equation restrictions determined by the behavioral assumptions
    - Derive the monthly dynamics of the model: classic problem of time aggregation (see, Hansen and Sargent 1980, 1991).
2. But also augment the model with auxiliary timely variables (not included in the model) and exploit them for updating the now-cast
3. and deal with missing variables and frequencies (now-casting complexity)

The steps of the procedure: STEP 1

STEP 1: Define, estimate and calibrate the quarterly model

Structural model (log-linearized)

quarterly variables $y_{t_q} = \mathcal{M}_{\theta 0}\ s_{t_q} + \mathcal{M}_{\theta 1}\ s_{t_q-1}$

states $s_{t_q} = \mathcal{T}_{\theta}\ s_{t_q-1} + B_{\theta}\ \varepsilon_{t_q}$

(θ: deep parameters)

The steps of the procedure: STEP 2 (1)

STEP 2: From quarterly to monthly ... we are interested in finding a mapping from the quarterly model to the monthly model

Define a vector y_{t_m} of possibly latent monthly variables counterparts of quarterly variables in the model

- transform variables so as they correspond to quarterly variables when observed at the end of the quarter and derive monthly states s_{t_m}
- find a mapping from the quarterly model to its monthly counterpart with real-valued coefficients
- Deal with missing monthly observations and jagged edge problem due non synchronicity of data publications as in reduced form now-casting model

The steps of the procedure: STEP 2 (2)

Quarterly sampling		**Monthly sampling**
the transition equation		
$s_{t_m} = \mathcal{T}_\theta \ \ s_{t_m-3} + B_\theta \ \ \varepsilon_{t_m}$	$\Rightarrow$	$s_{t_m} = \mathcal{T}_\theta^m \ \ s_{t_m-1} + B_\theta^m \ \ \varepsilon_{t_m}^m$
the observation equation		
$y_{t_m} = \mathcal{M}_{\theta 0} s_{t_q} + \mathcal{M}_{\theta 1} s_{t_q-1}$	$\Rightarrow$	$y_{t_m} = \mathcal{M}_{\theta 0} s_{t_m} + \mathcal{M}_{\theta 1} s_{t_m-3}$

The steps of the procedure: STEP 3

STEP 3: Bridge the monthly model with auxiliary monthly variables

Expand the state space with he auxiliary variables X_{t_m}

$$\begin{bmatrix} y_{t_m} \\ X_{t_m} \end{bmatrix} = \begin{bmatrix} \mathcal{M}_\theta^m \\ \Lambda \mathcal{M}_\theta^m \end{bmatrix} s_{t_m} + \begin{bmatrix} u_{t_m} \\ \nu_{t_m} \end{bmatrix} \qquad \text{expanded state-space}$$

Remark: auxiliary variables depends on variables, not states $\rightarrow$ only relevant in real time

- Deal with missing data and missing frequency as usual

The philosophy of our approach

$\Rightarrow$ Be least "invasive" with respect to the original model

- Maintain the parameter estimates of the quarterly model
- Additional variables are relevant only until the model variables are not available

Remark: An alternative approach would have been developing a micro-founded models at higher frequency

- early work: estimating continuous time models from discrete data - Hansen and Sargent (1980), Christiano (1987)

$\Rightarrow$ Advantages of our approach:

- Much knowledge on quarterly calibration - in our approach no need to re-estimate or re-calibrate the model
- Possible to go at even higher frequency

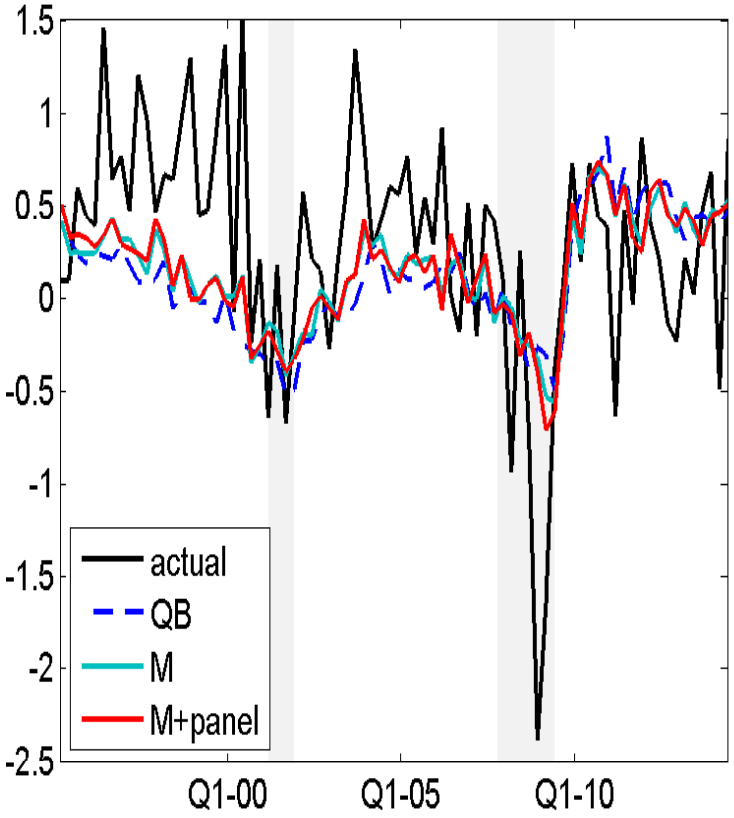
Illustration

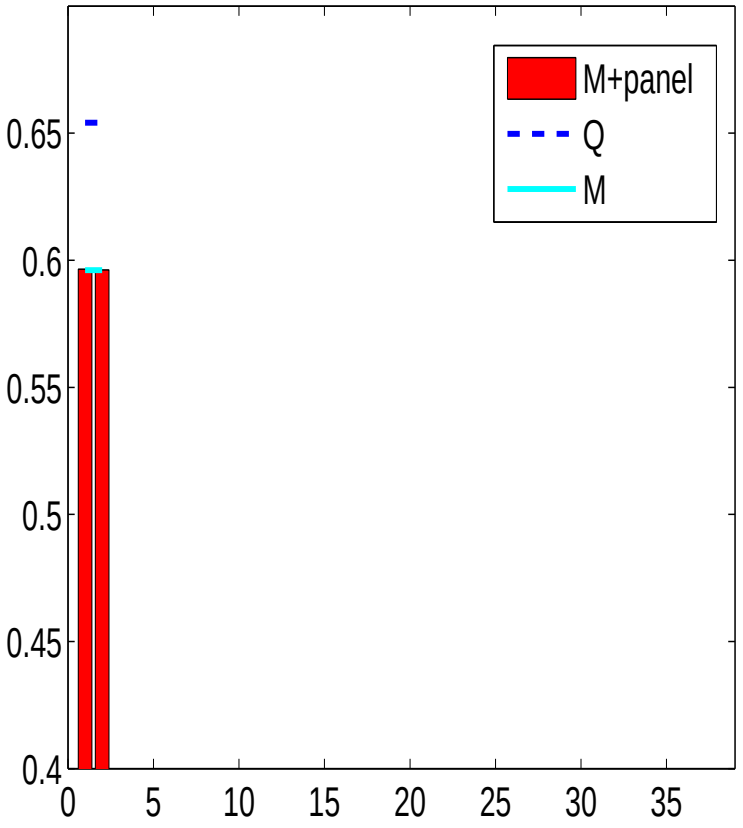
- The quarterly model is out of the shelf
  - Gali', Smets and Wouters (2011) with explicit introduction of unemployment
  - financial frictions *a la* Bernanke, Gertler and Ghilchrist (1999) and Christiano, Motto and Rostagno (2003)
  - nine variables and nine shocks
- We augment it with twelve auxiliary monthly variables (housing, financial, surveys, uncertainty, ...)

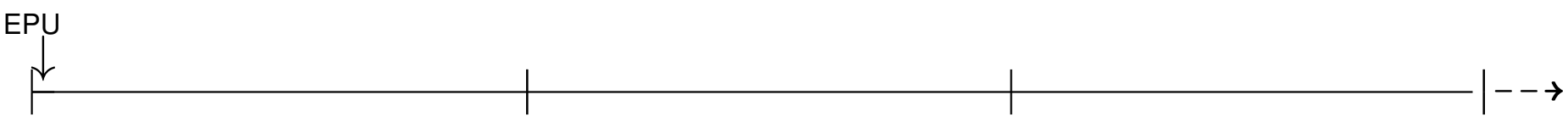
Some empirical exercises

1. Now-casting evaluation
2. What shocks explain the bulk of the variance of auxiliary variables?
3. The great recession: what are the relevant shocks in real time?

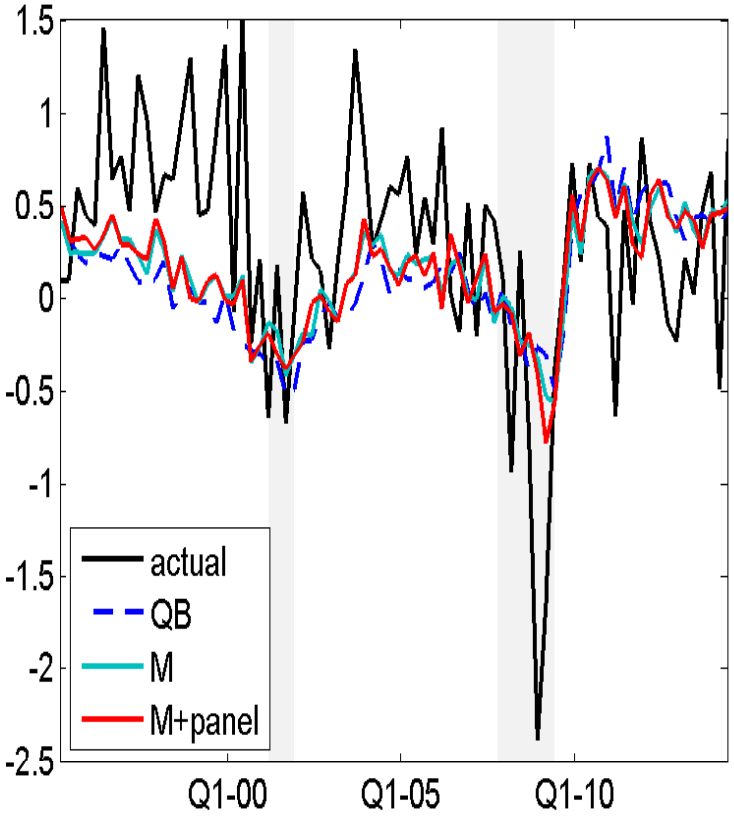
Nowcasting GDP growth

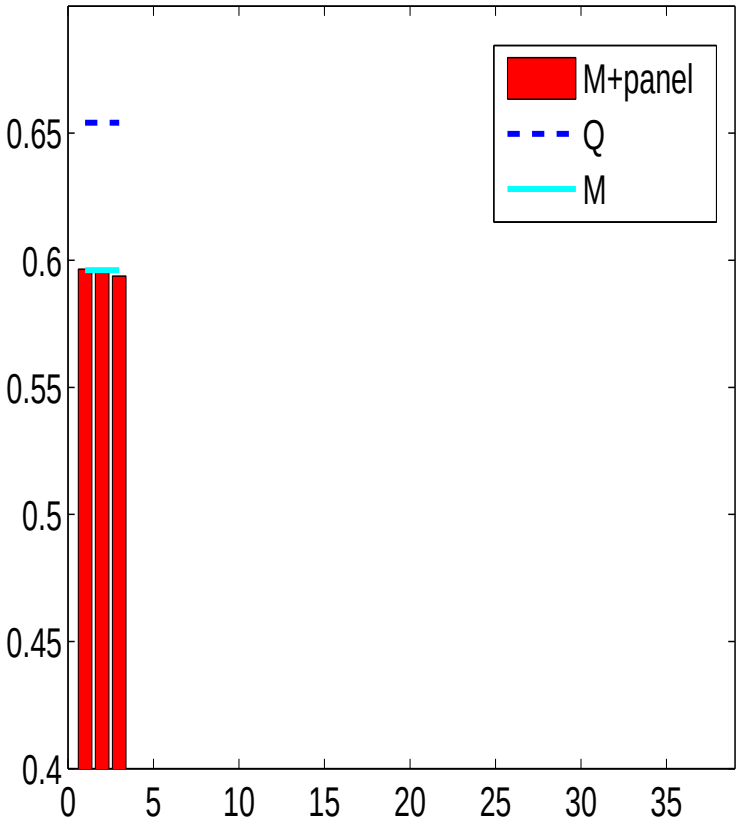


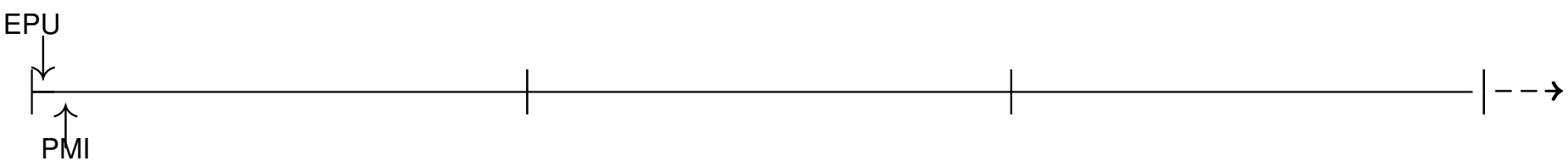




Nowcasting GDP growth







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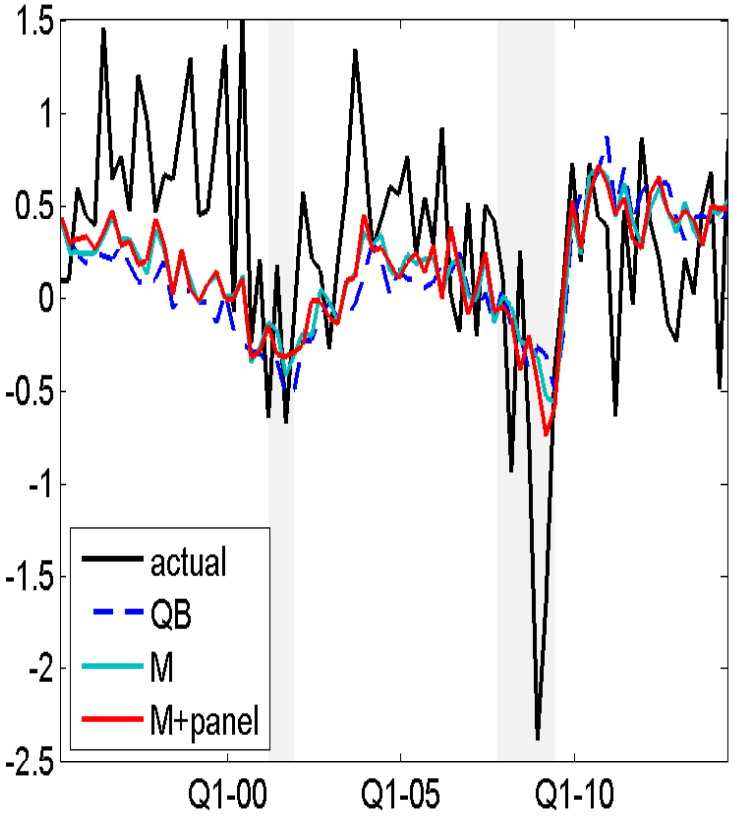

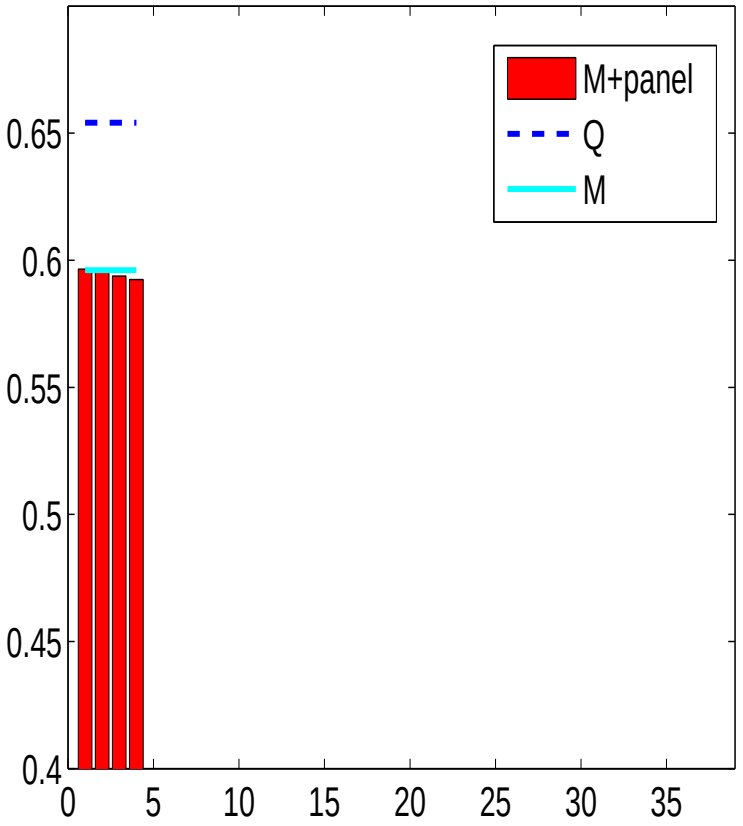

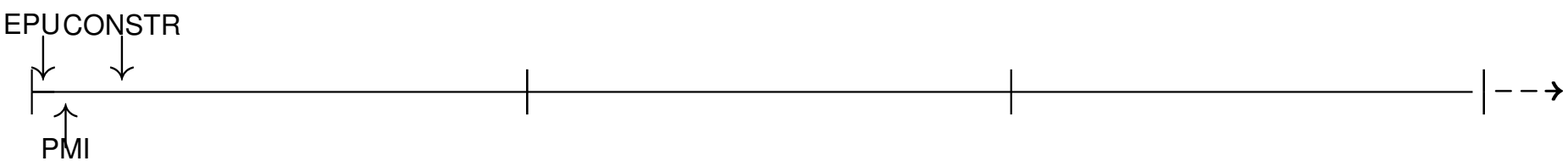

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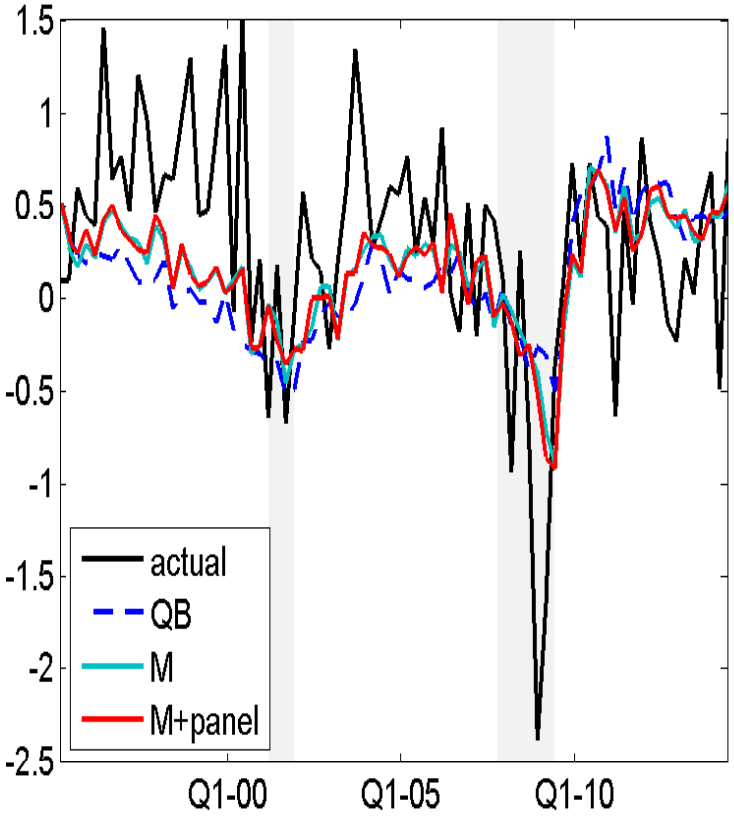

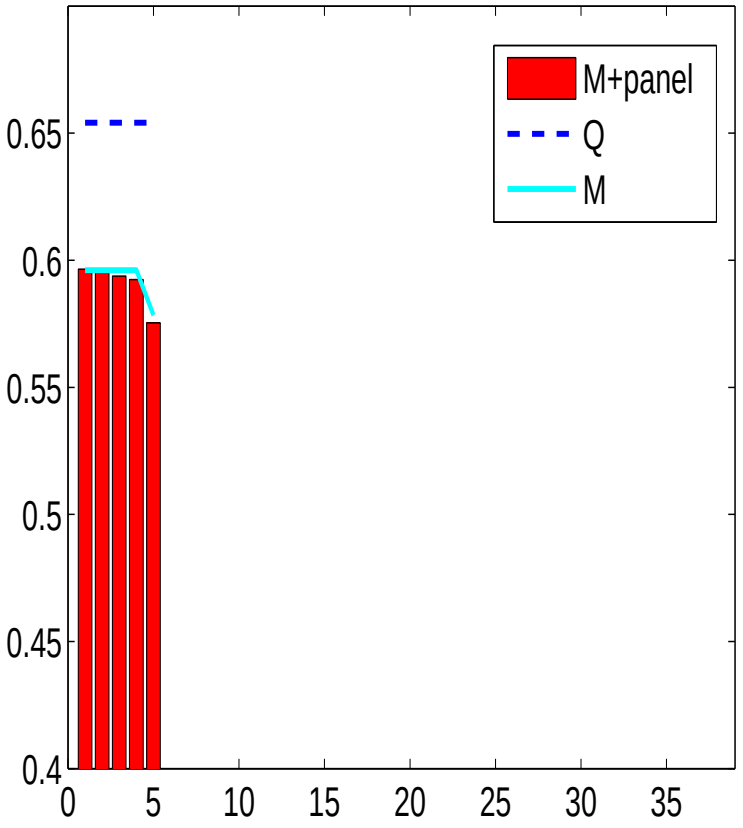

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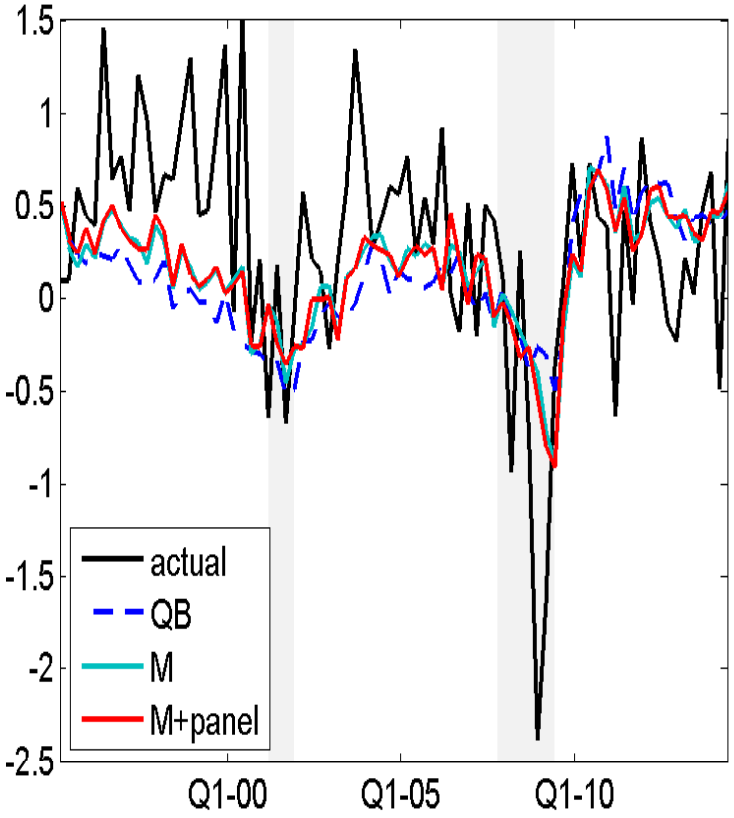

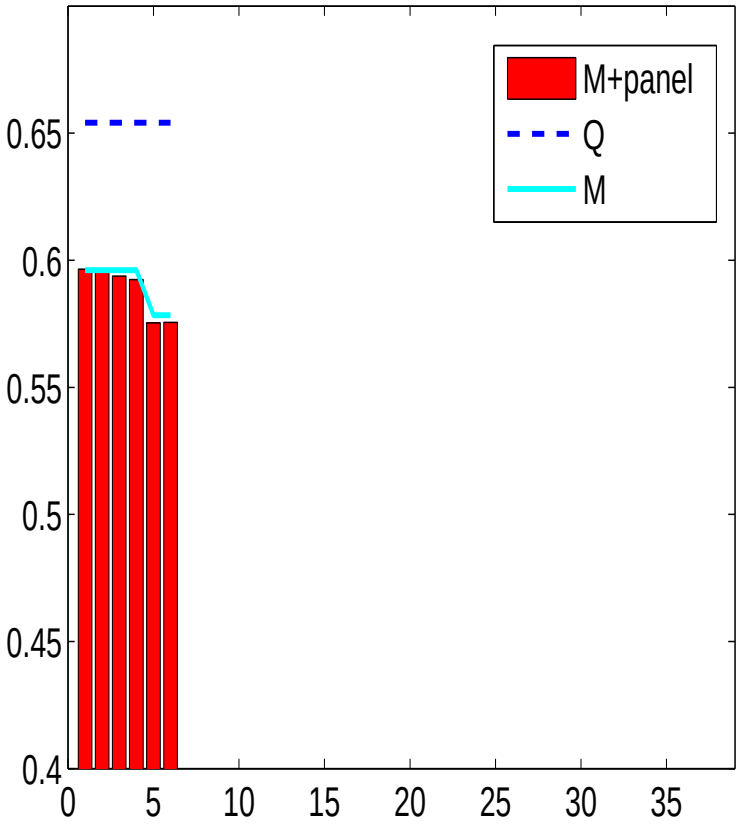

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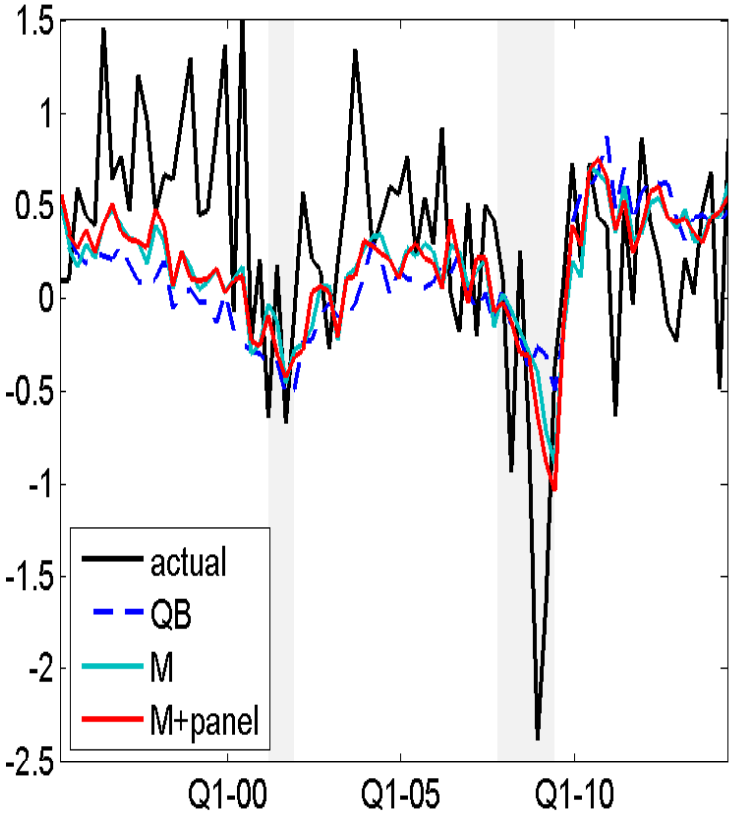

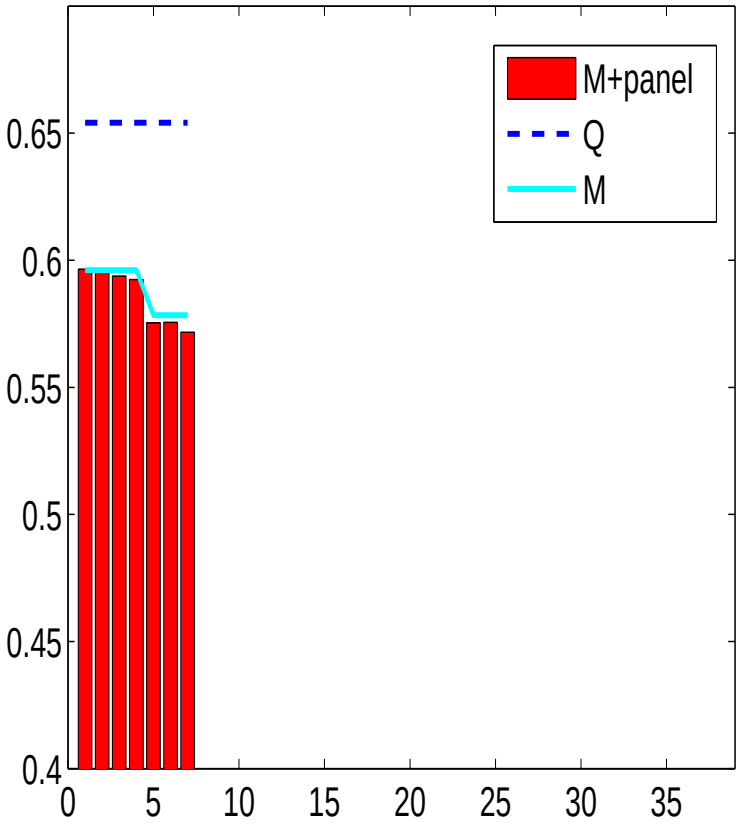

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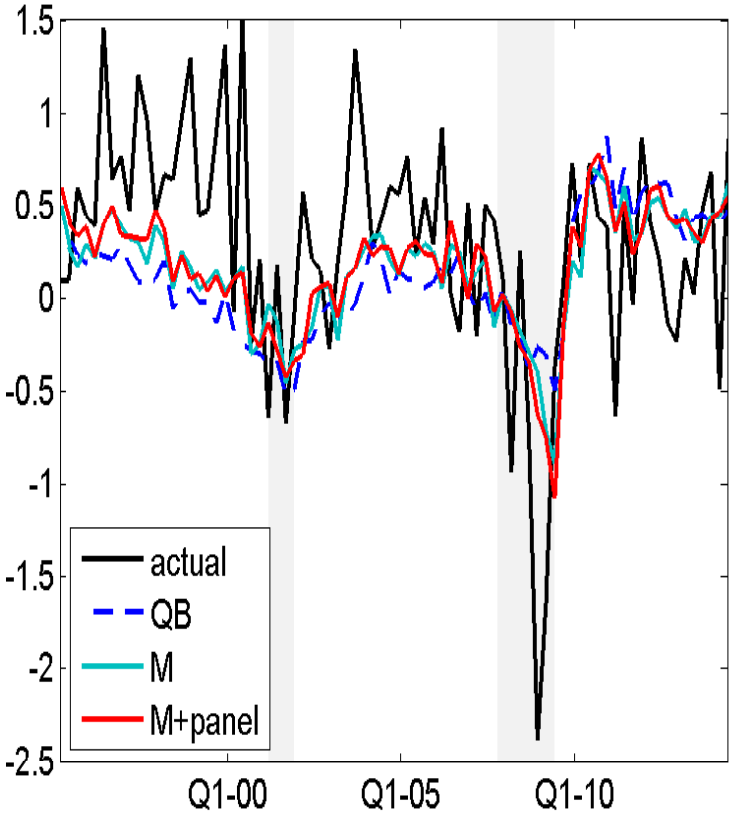

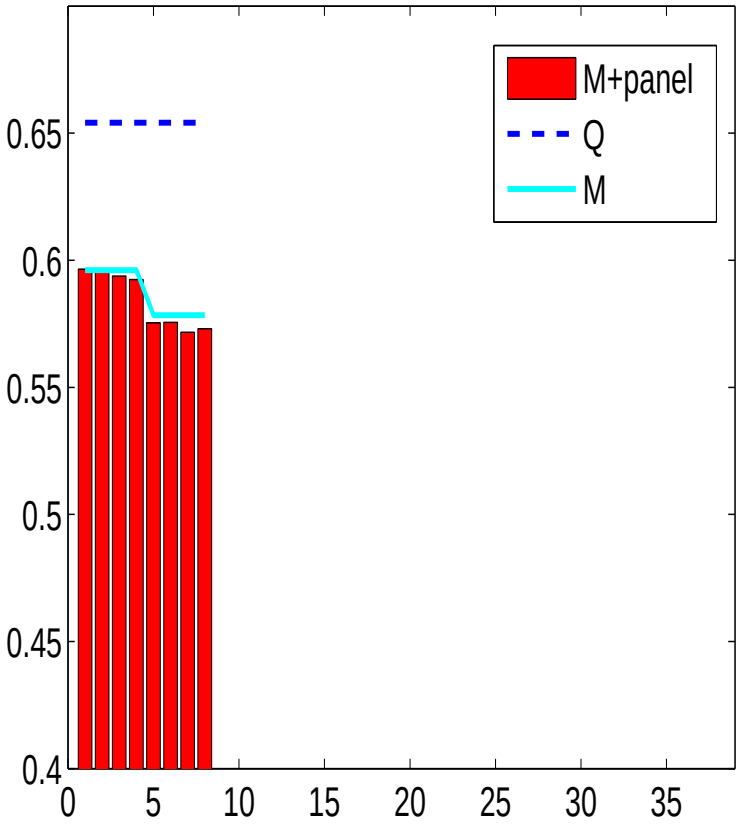

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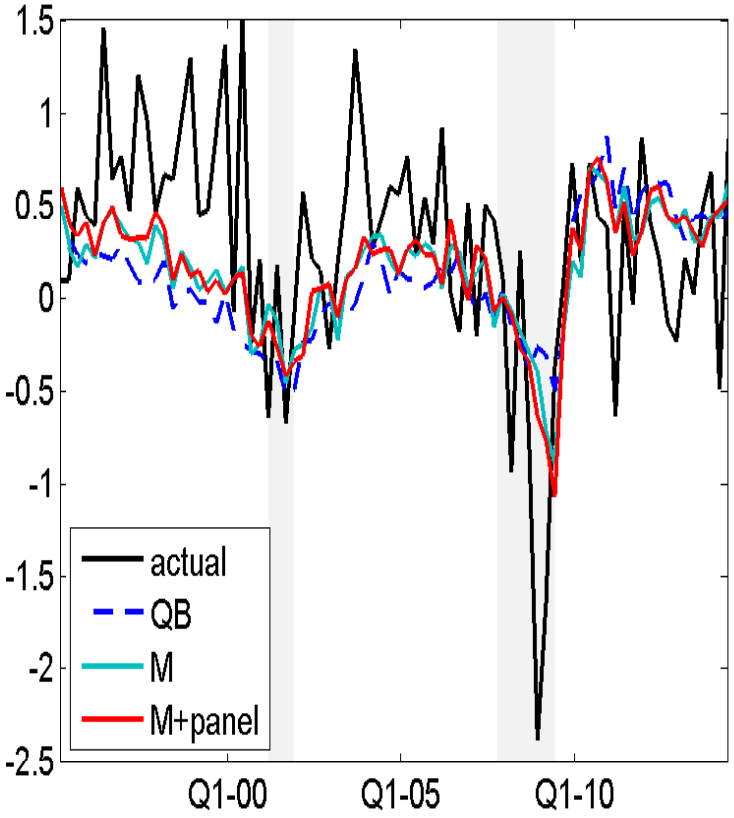

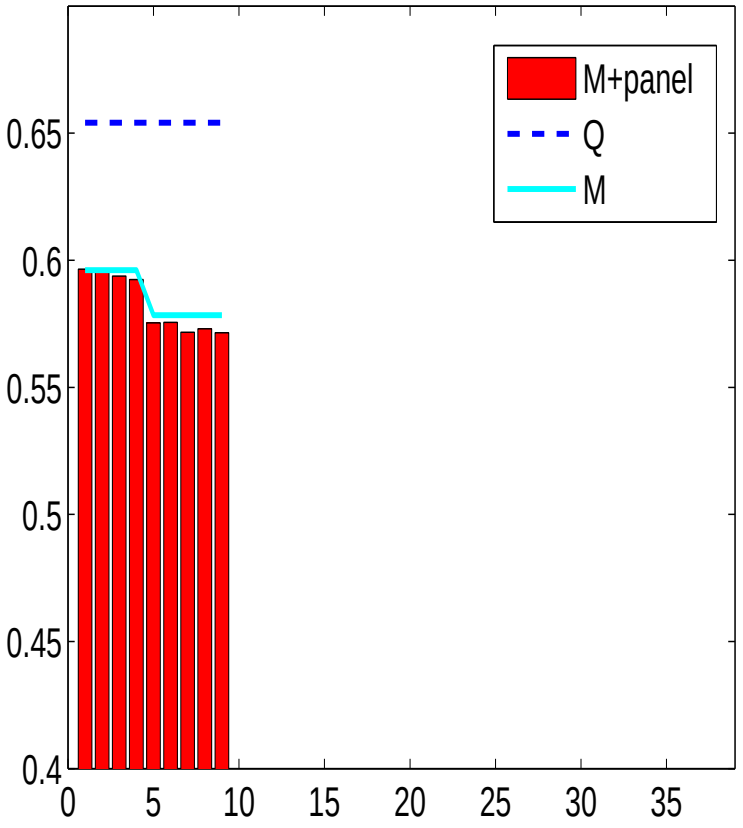

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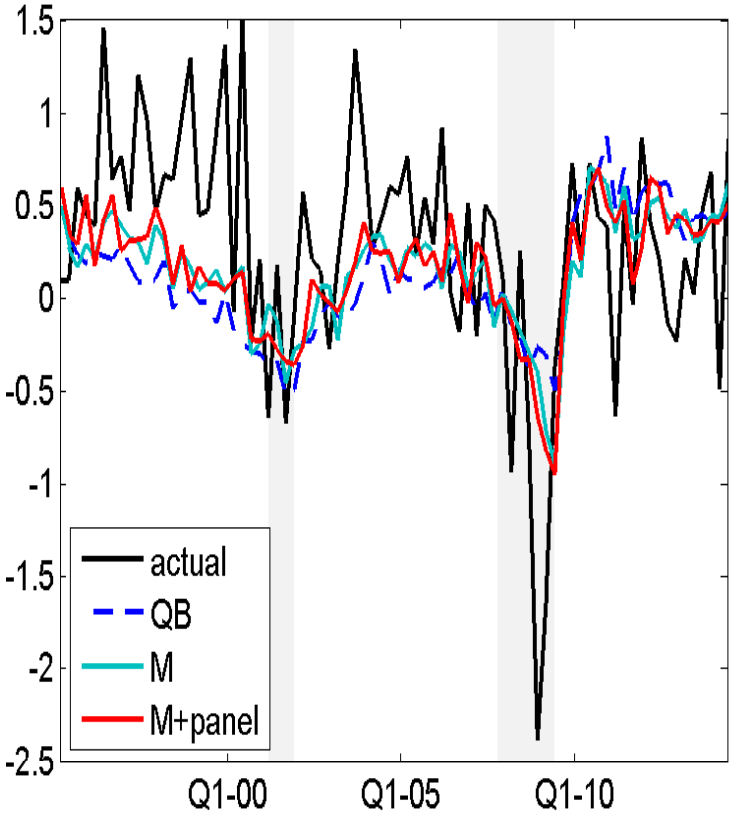

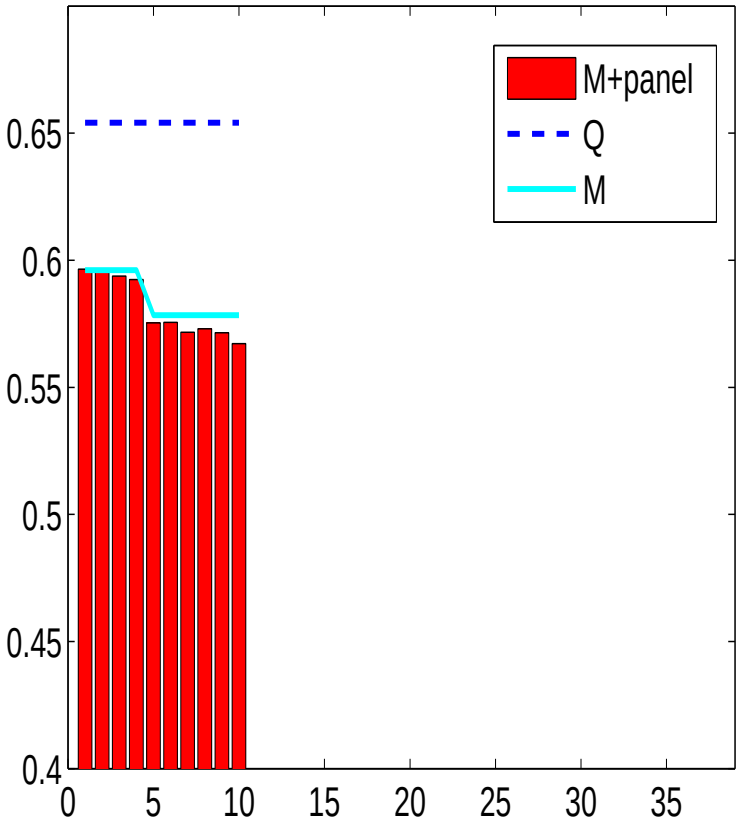

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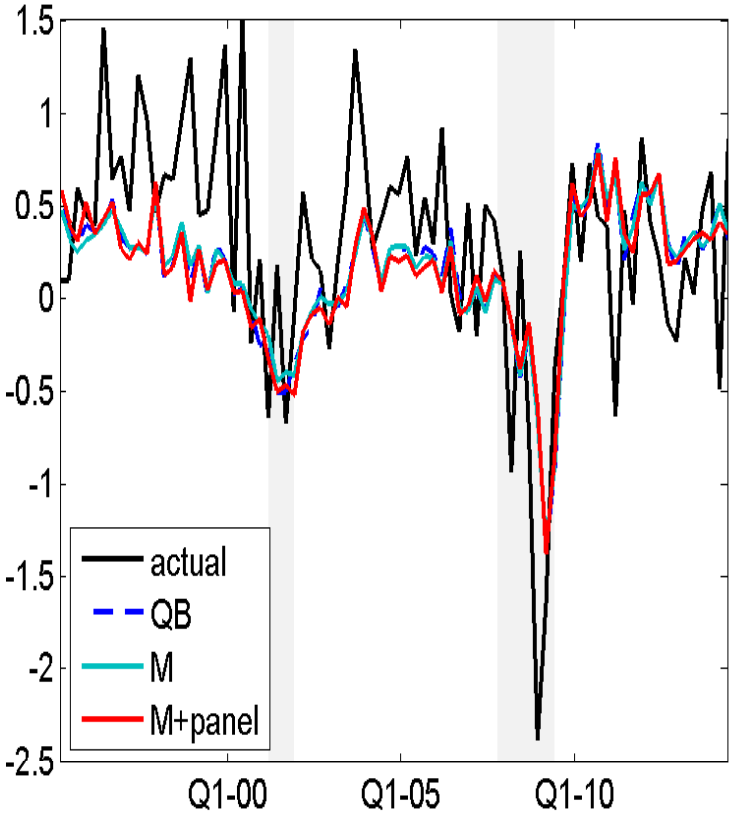

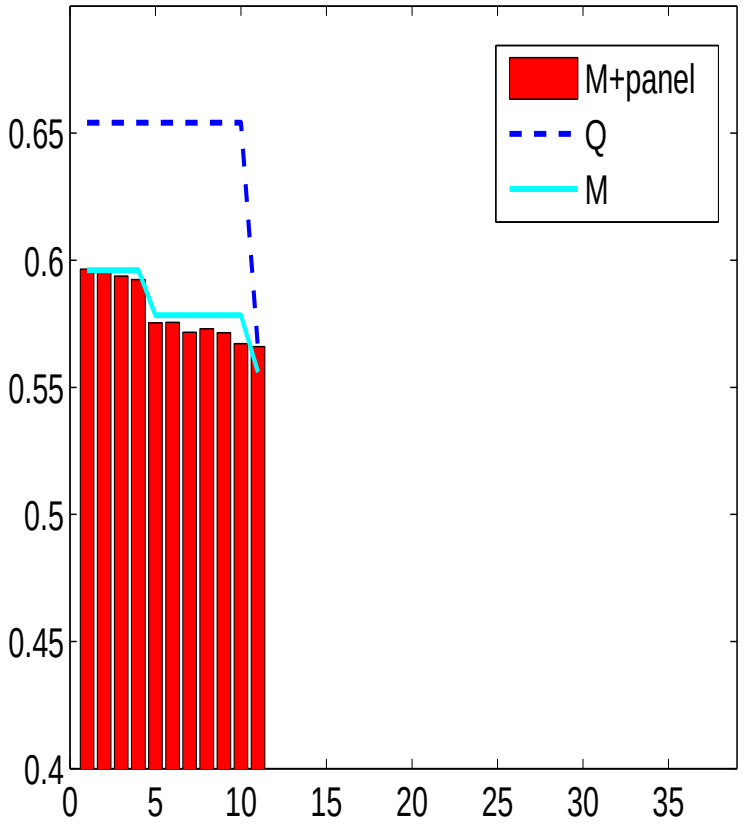

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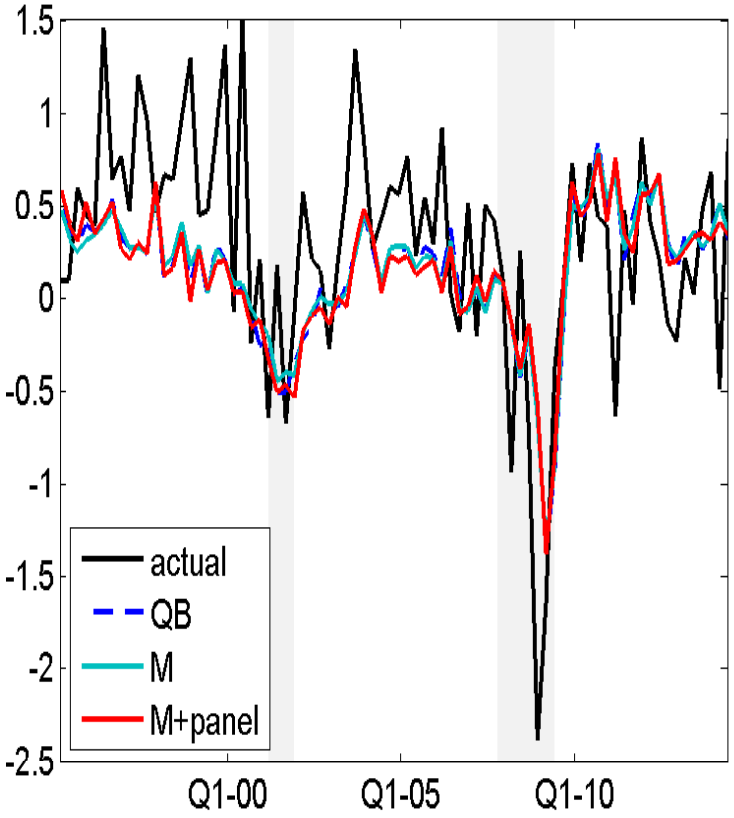
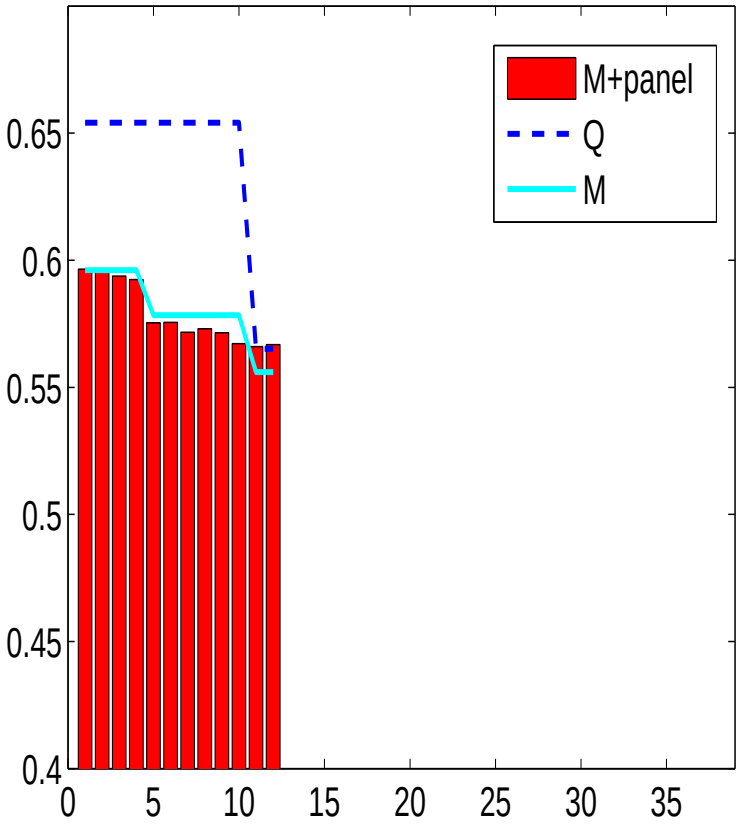
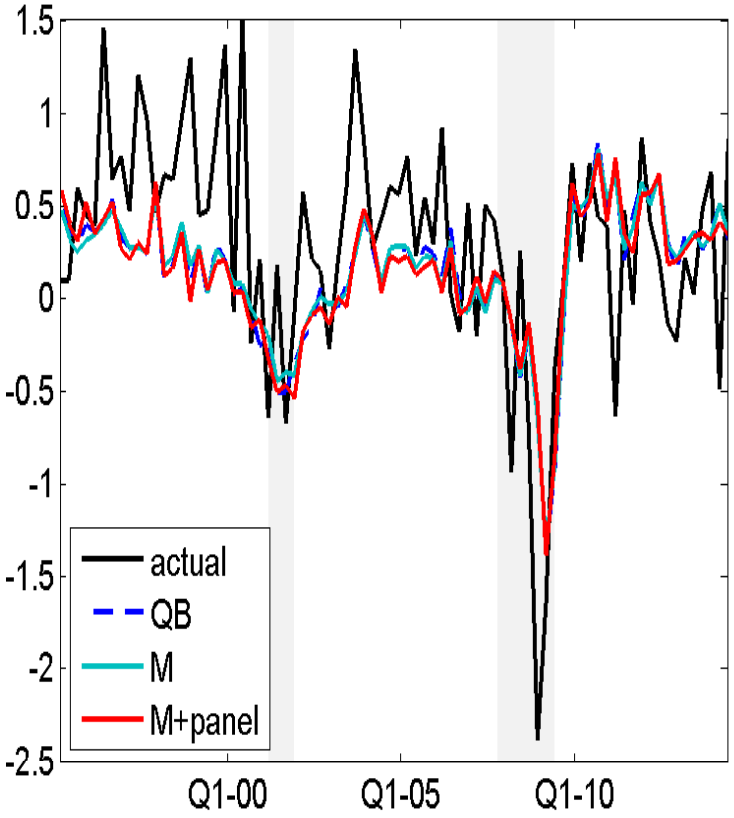
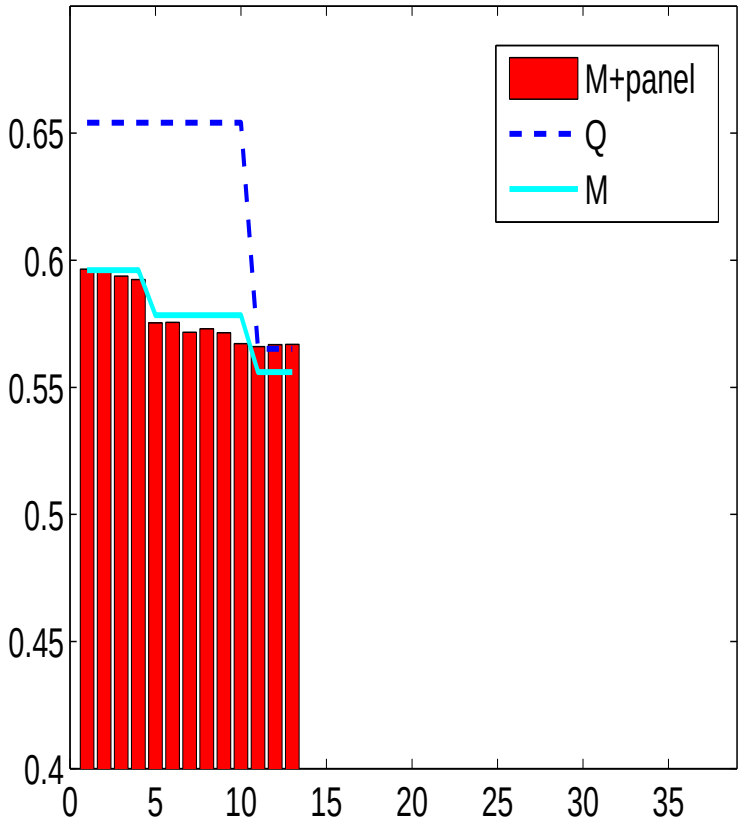


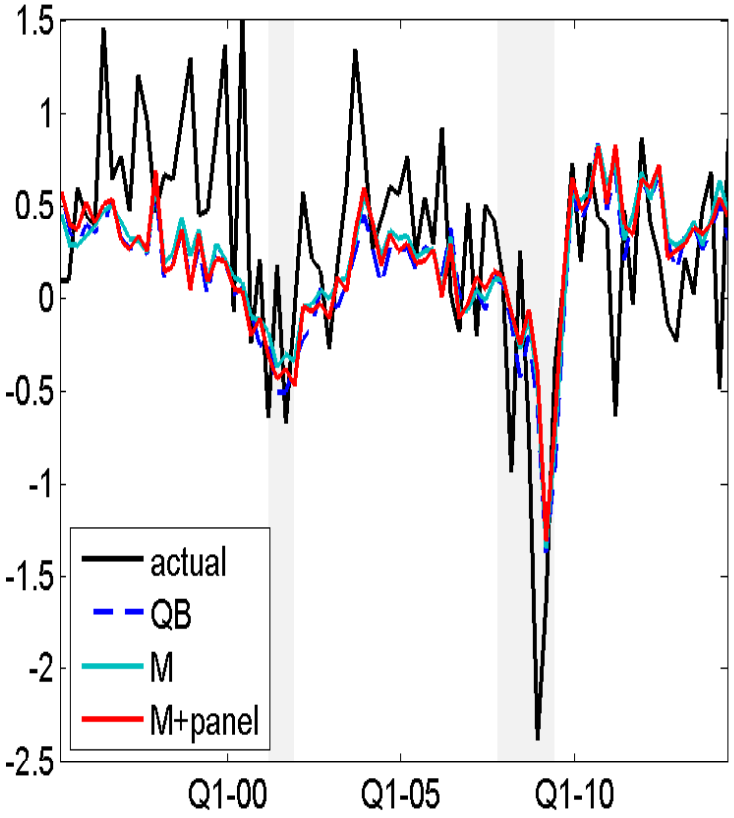


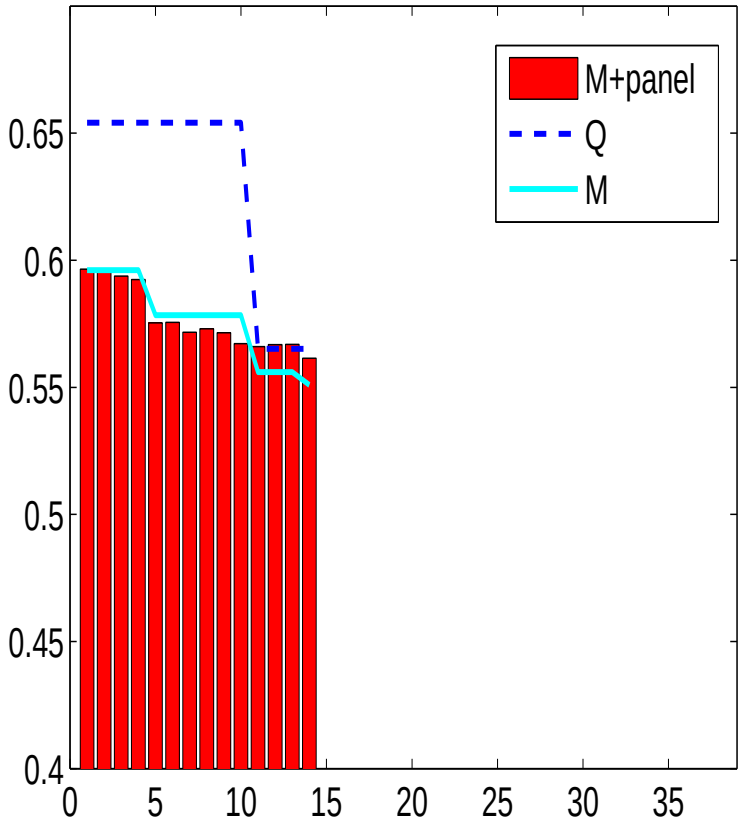
Nowcasting GDP growth





Nowcasting GDP growth





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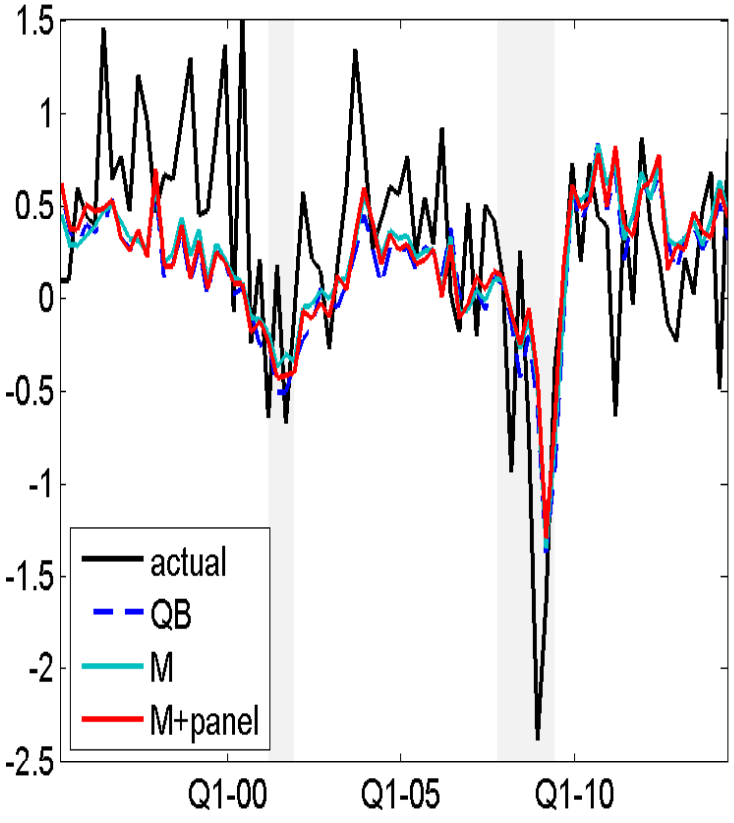

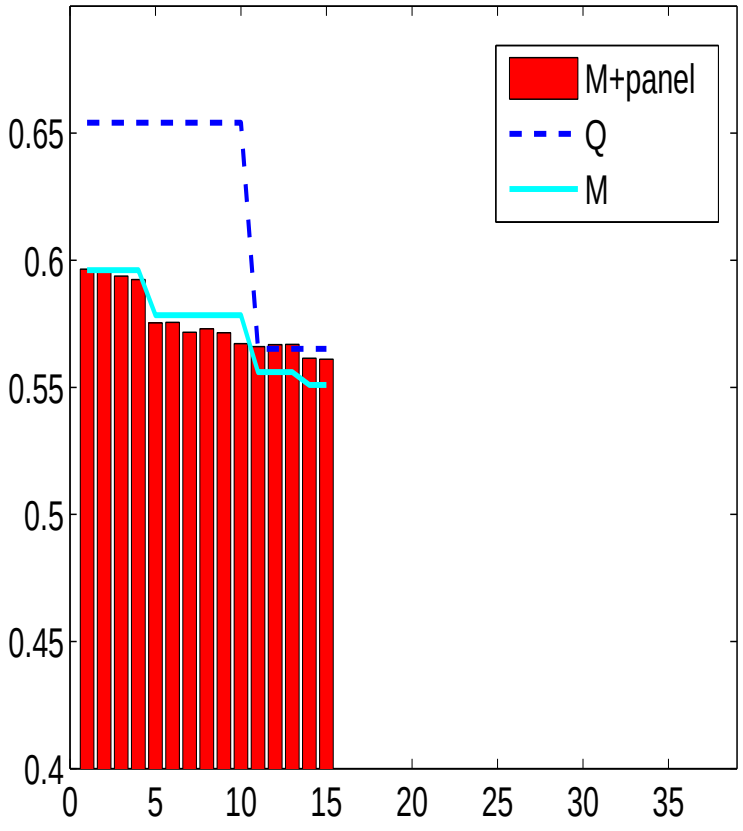

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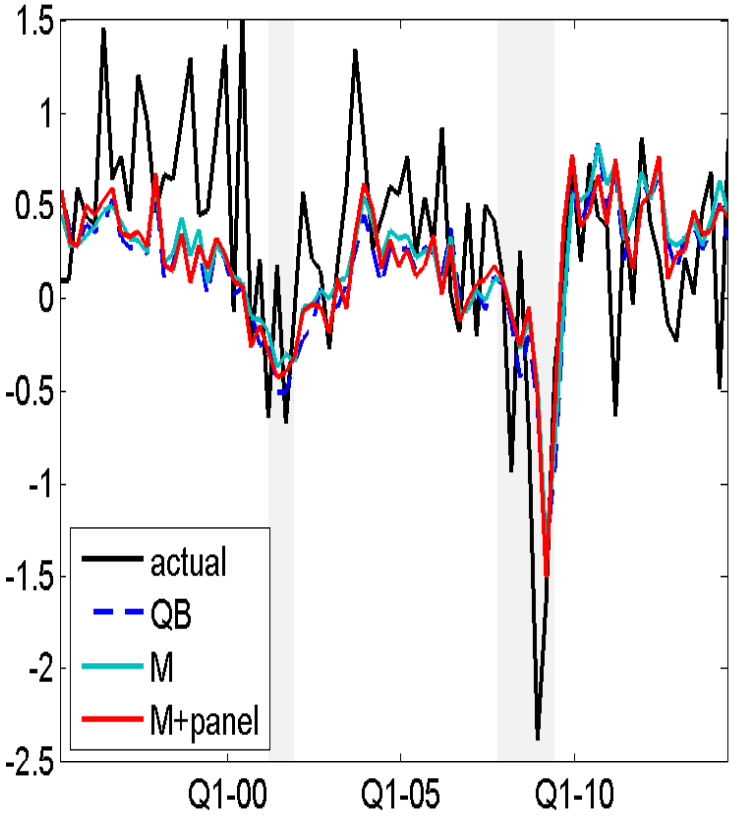
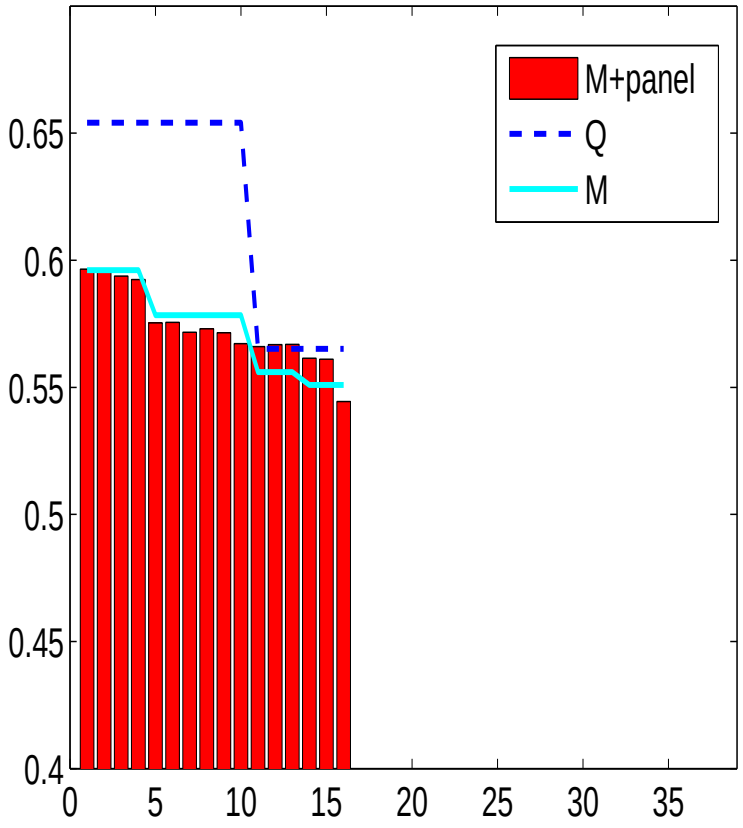
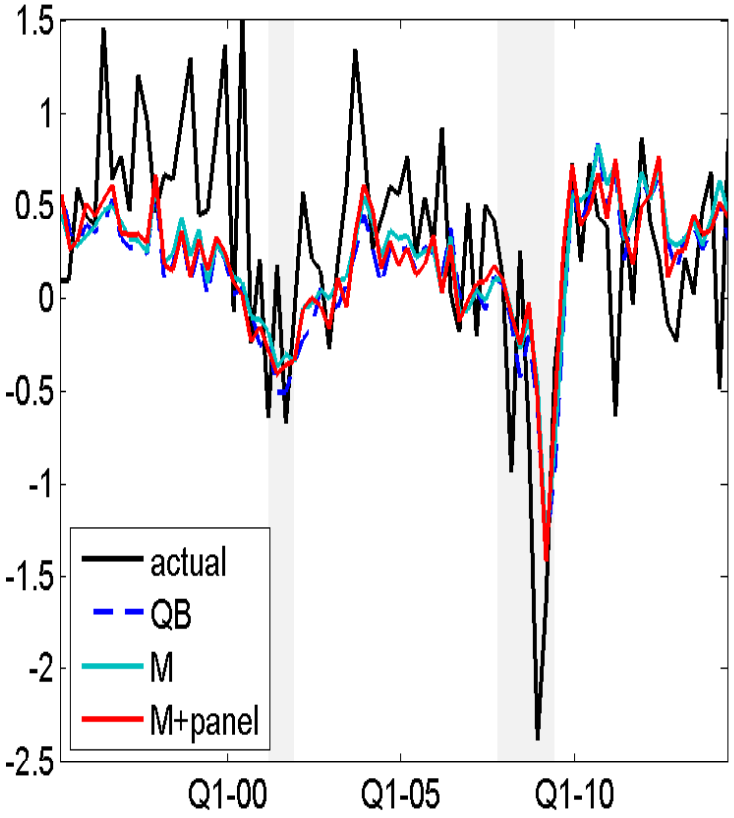
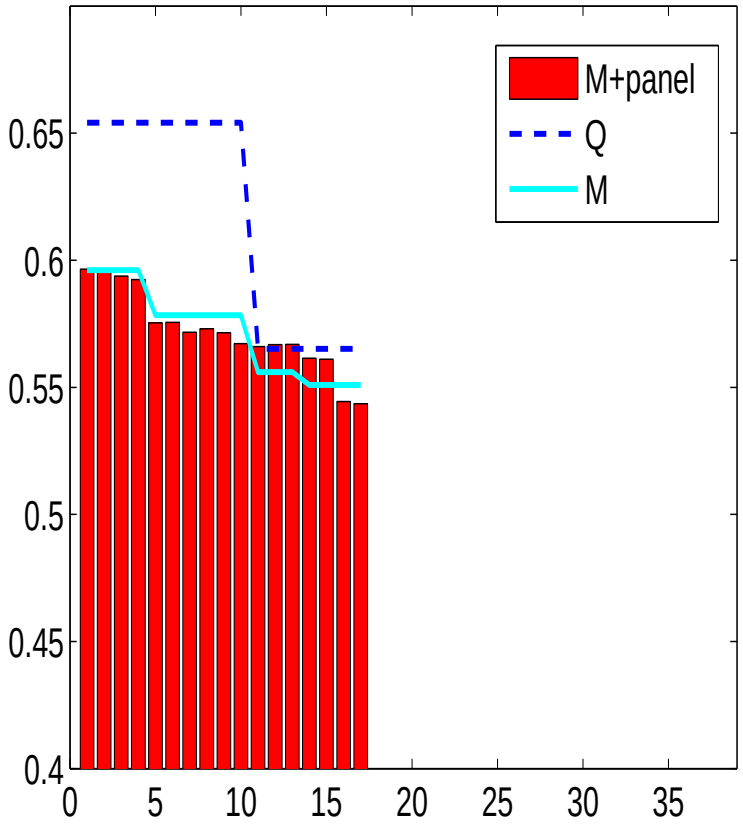
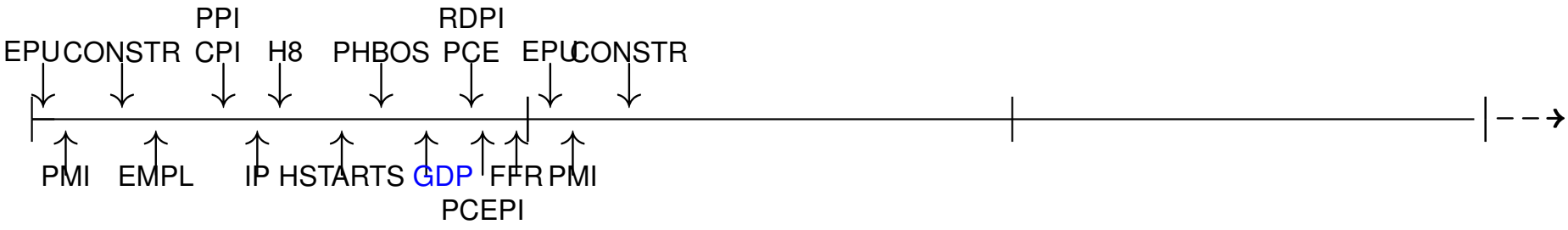




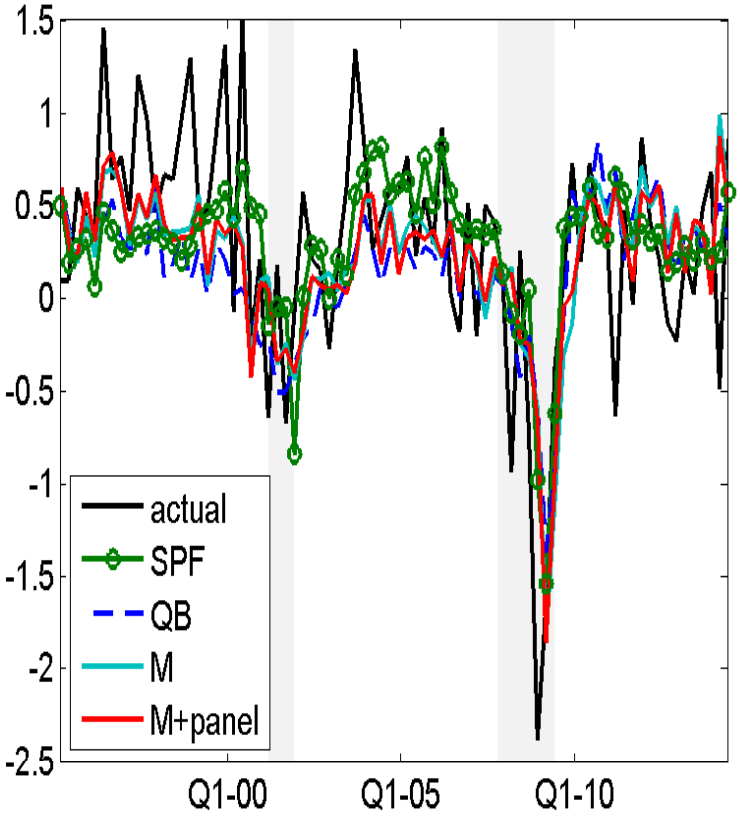
Nowcasting GDP growth

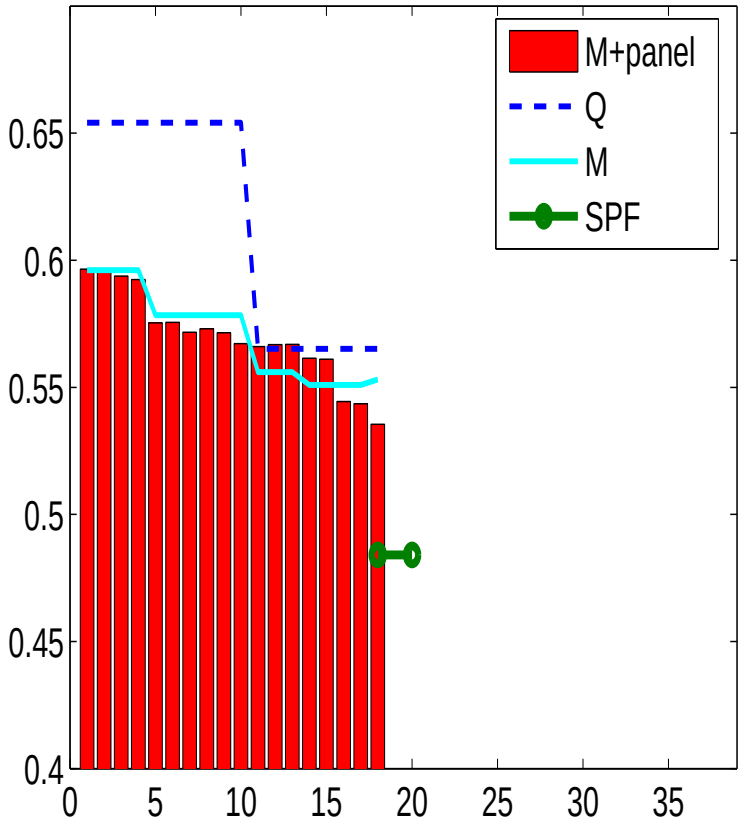


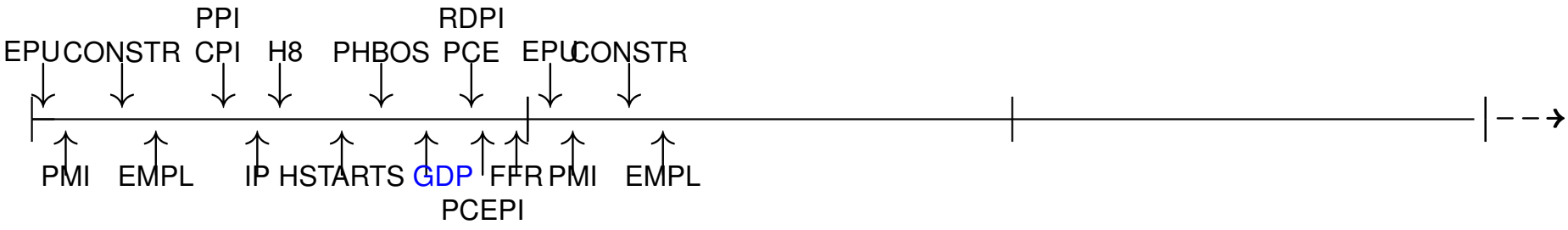




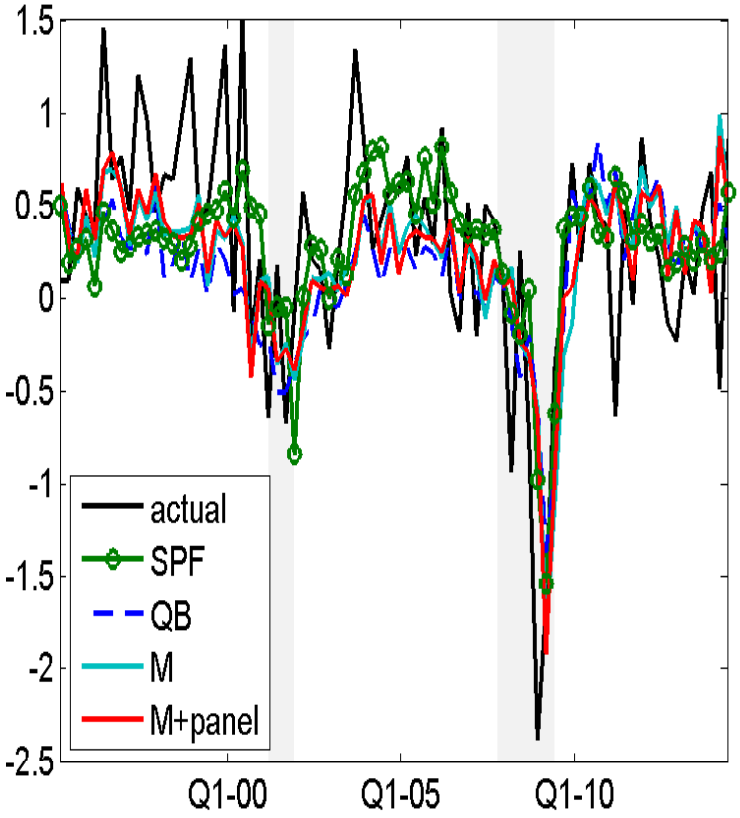
Nowcasting GDP growth

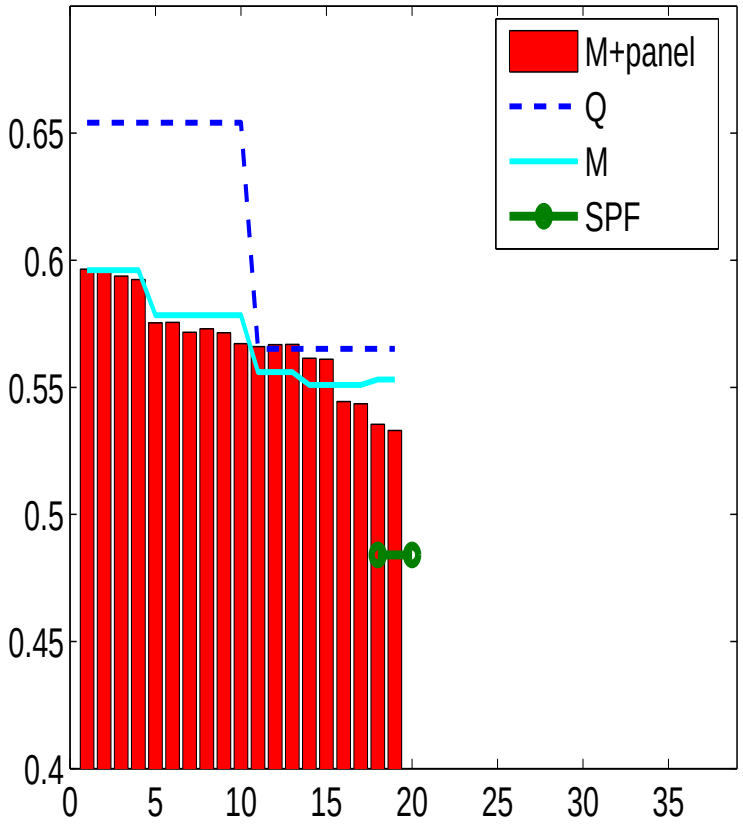


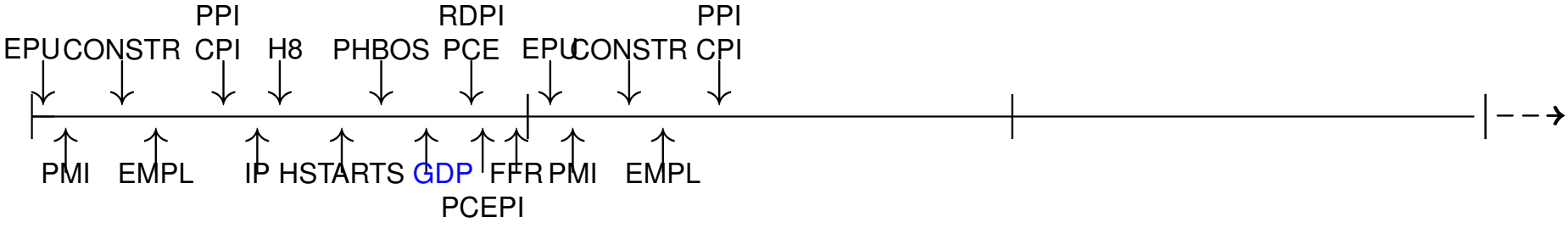




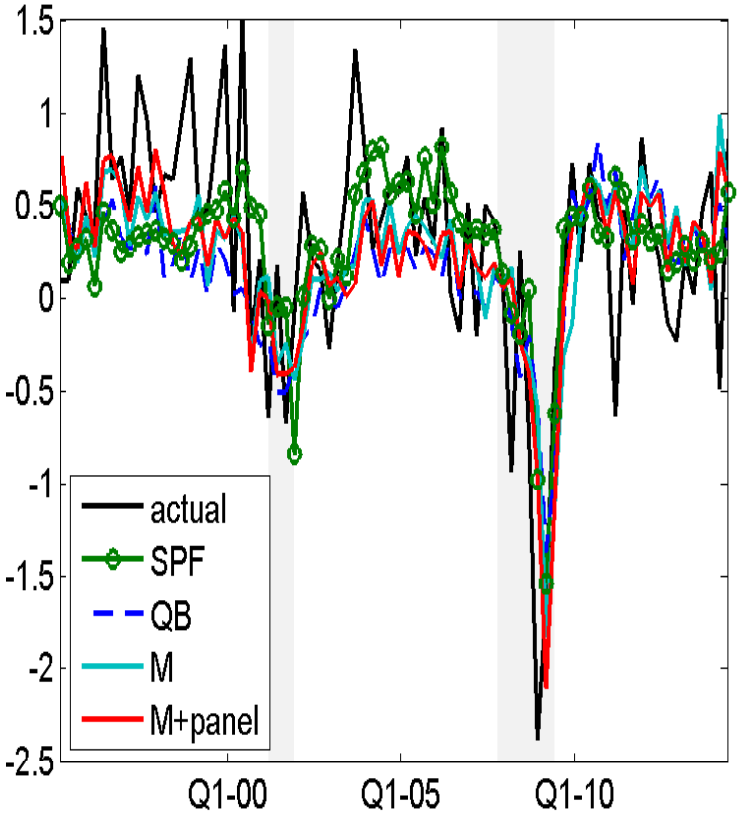
Nowcasting GDP growth

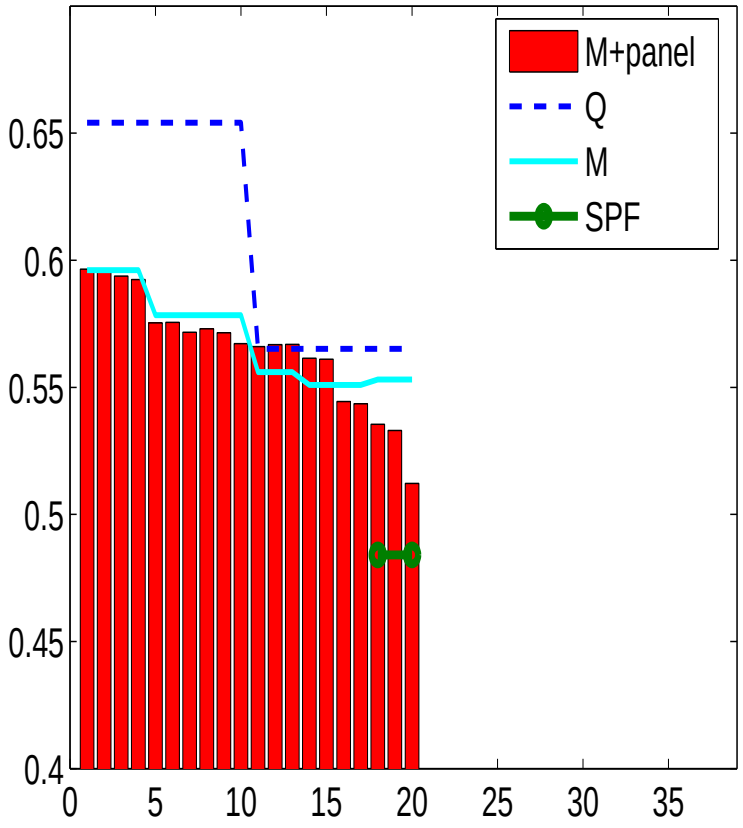


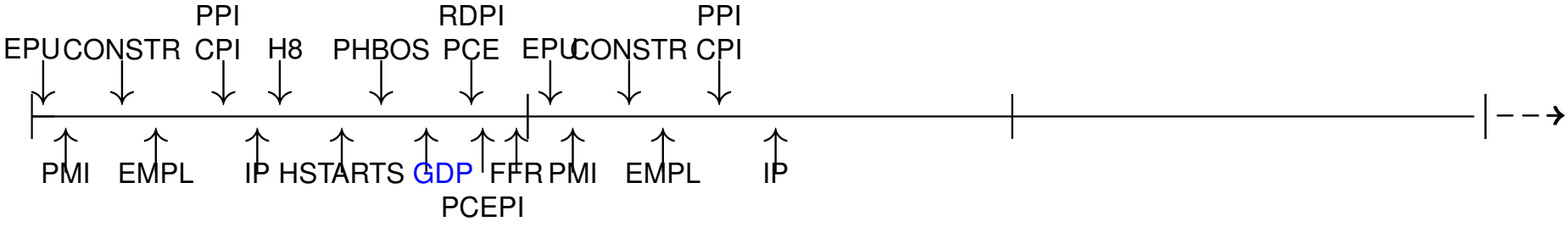




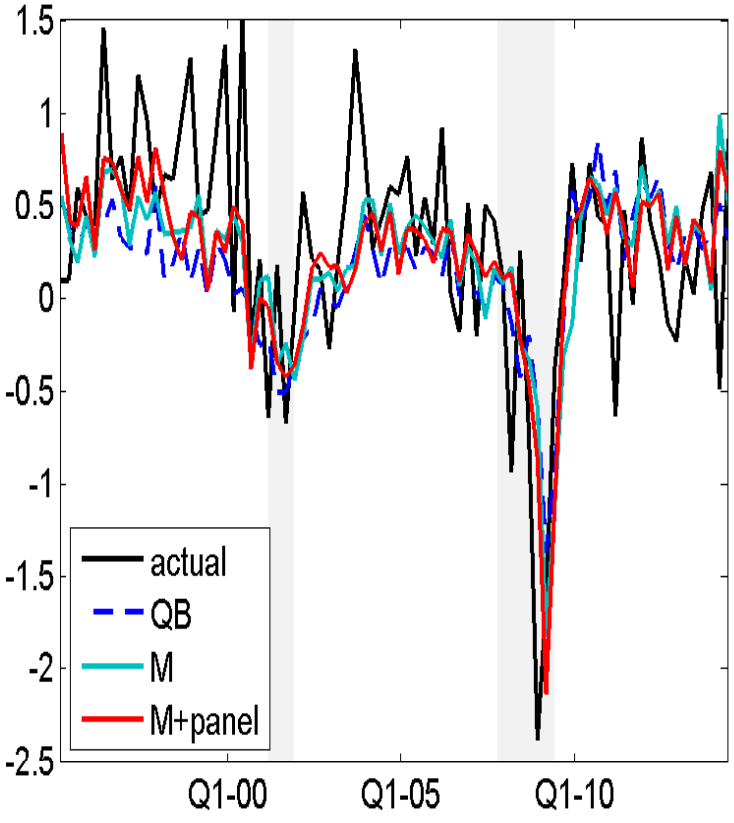
Nowcasting GDP growth

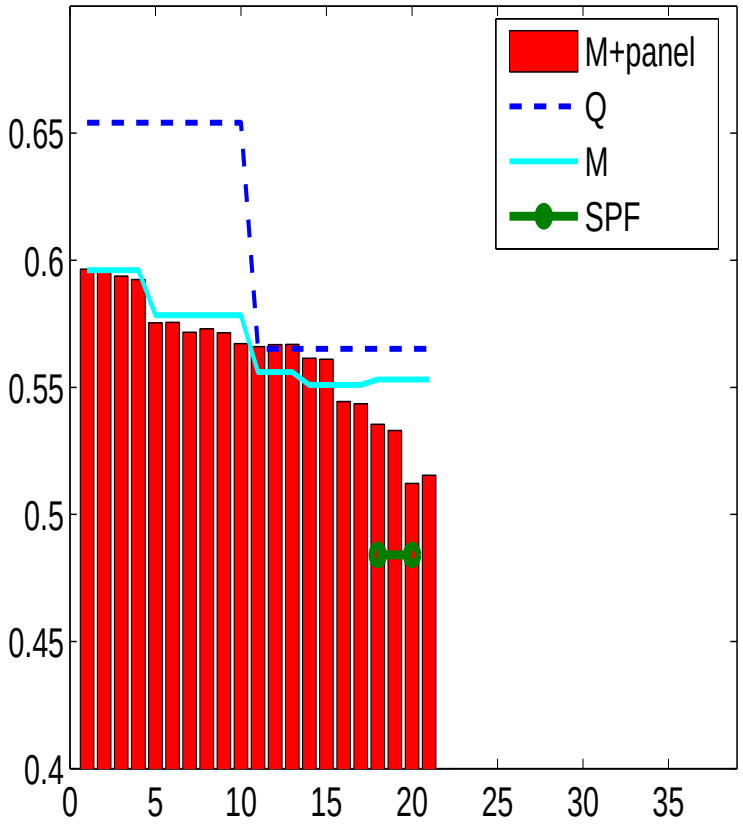


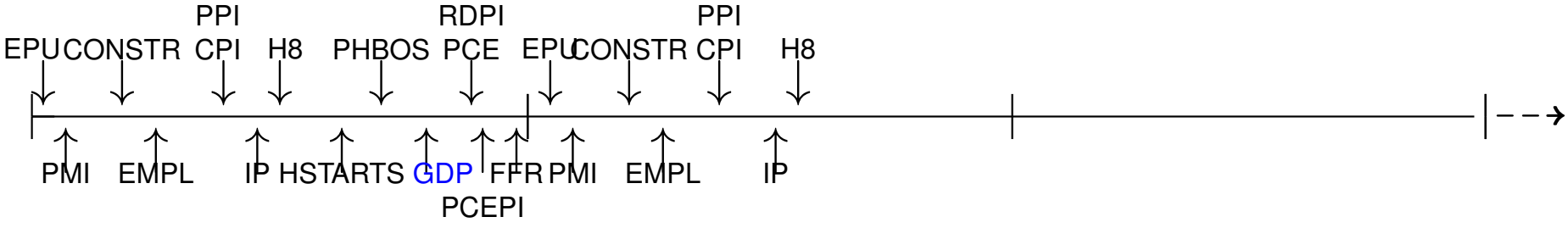




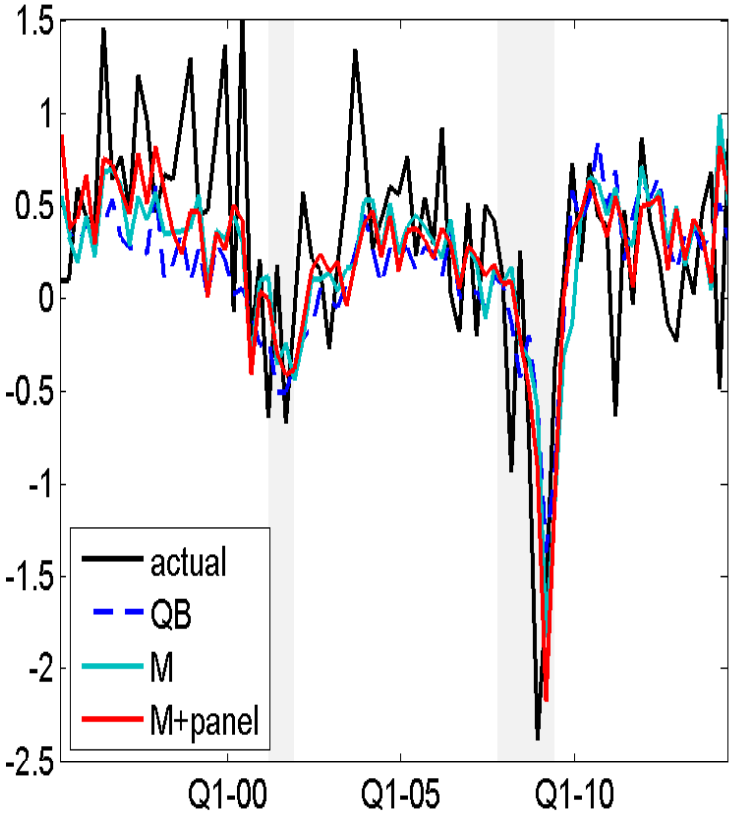
Nowcasting GDP growth

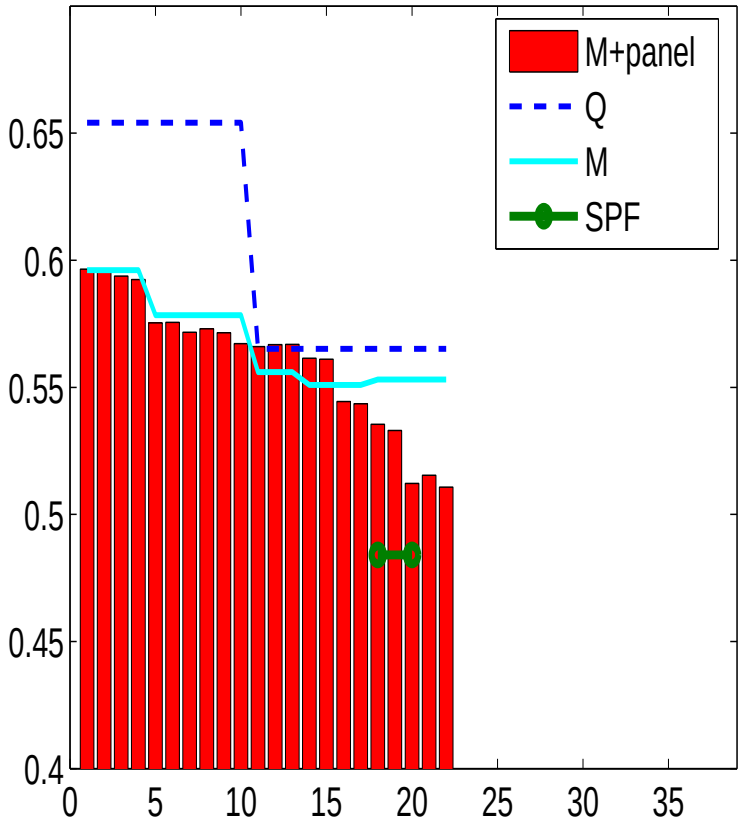


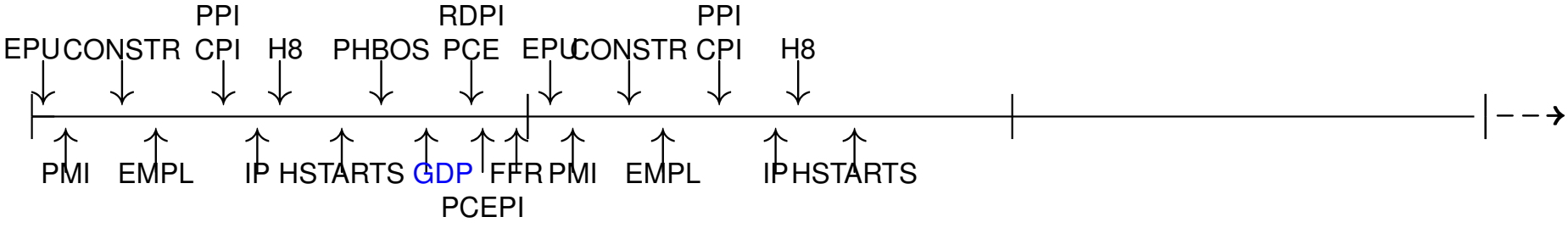




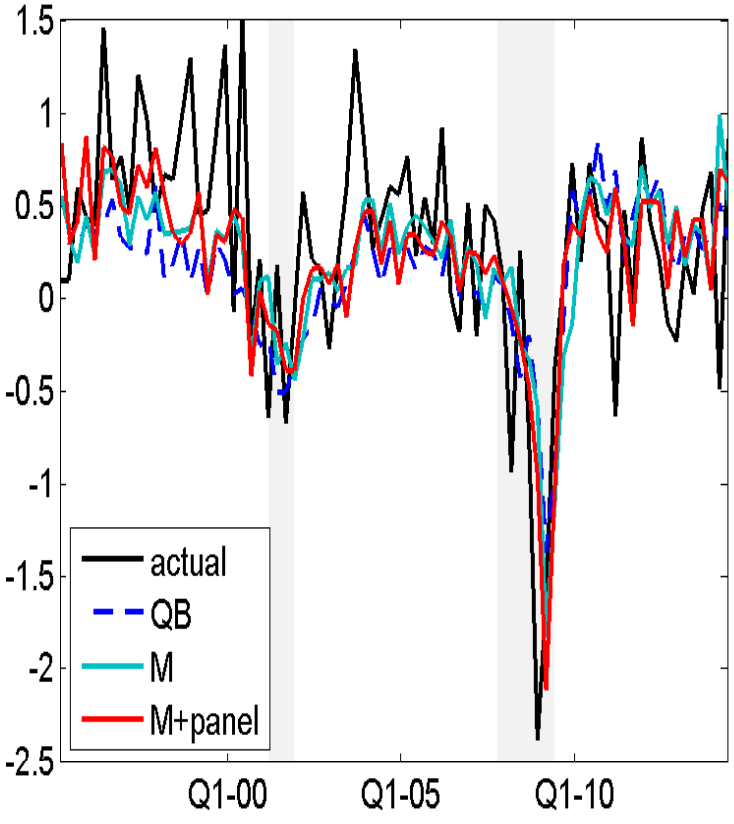
Nowcasting GDP growth

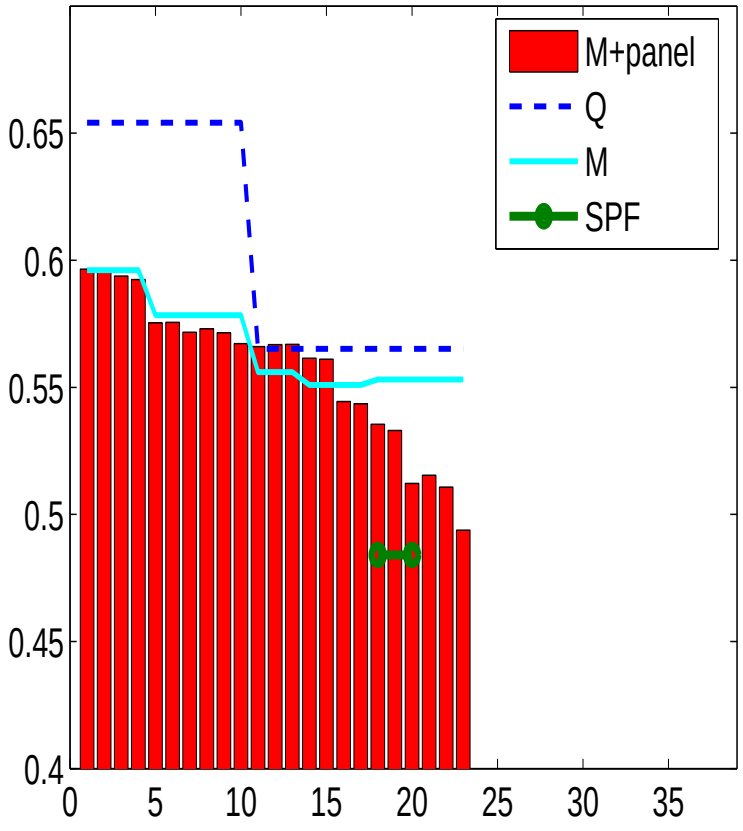


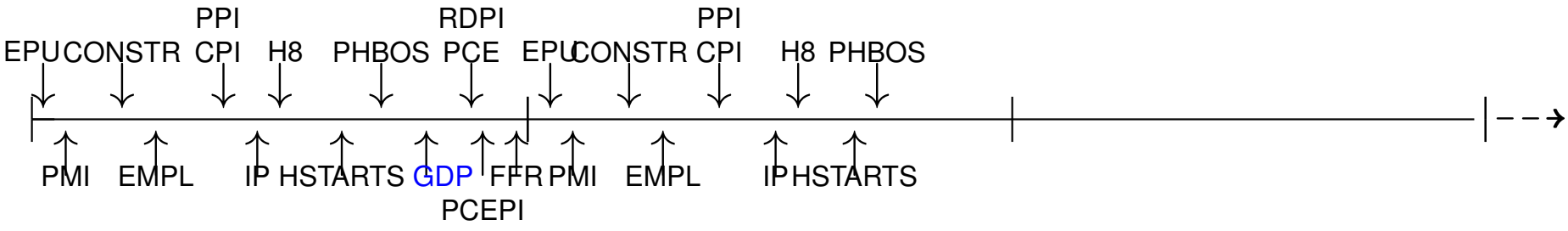




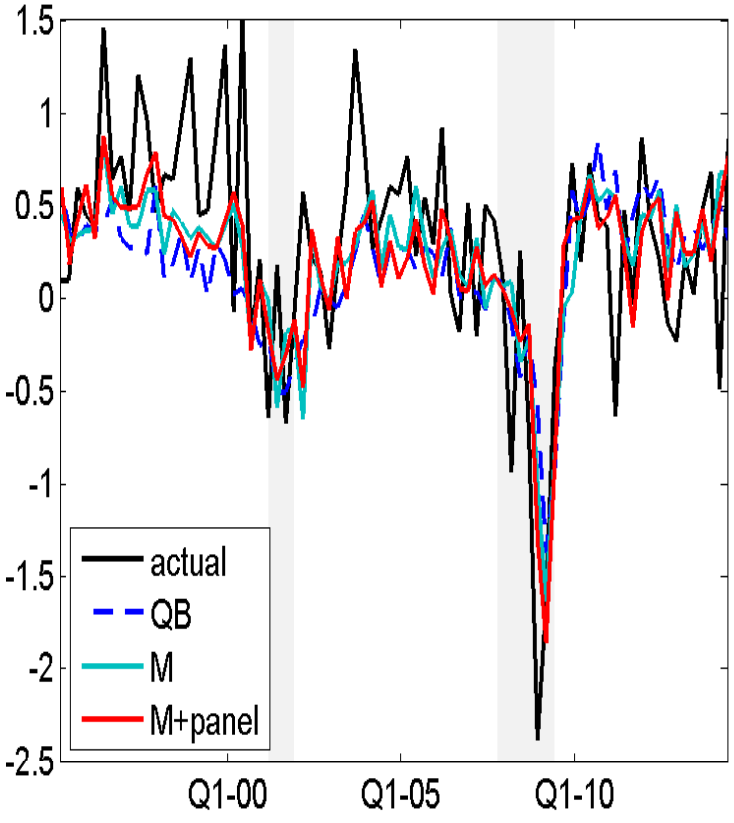
Nowcasting GDP growth

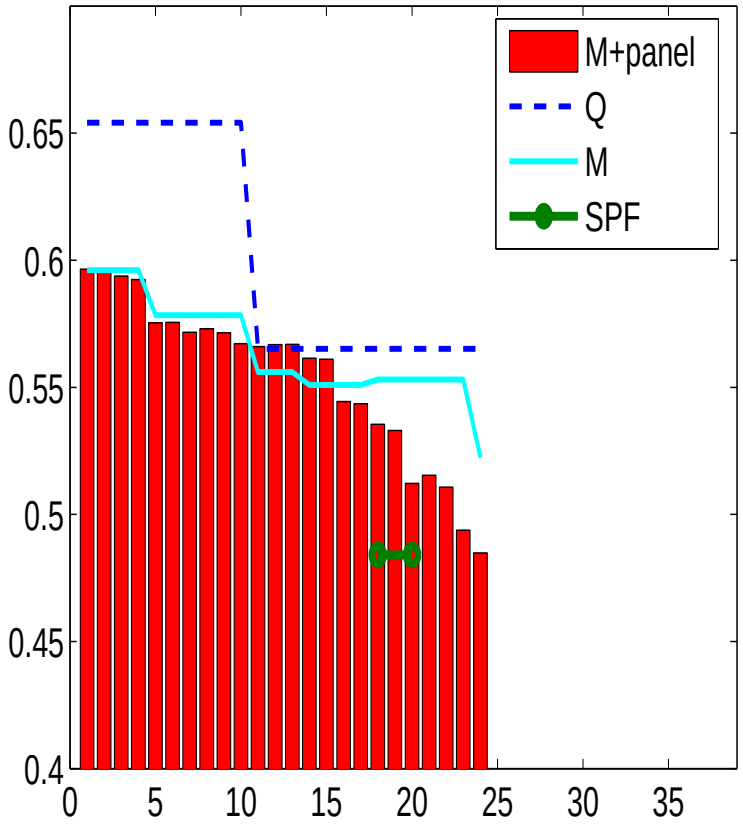


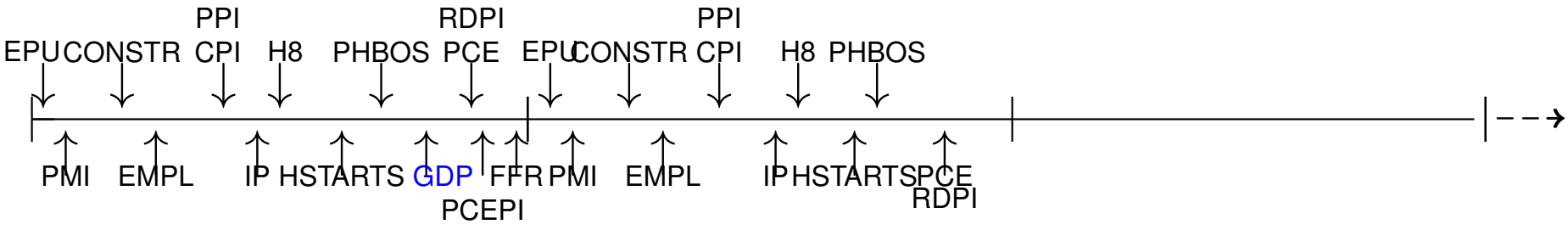




Nowcasting GDP growth







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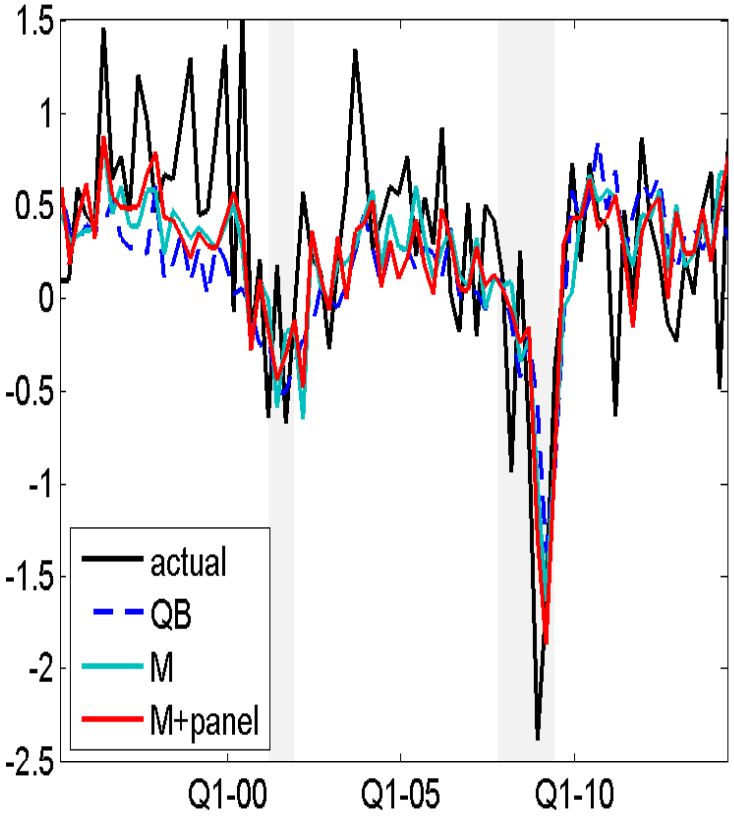
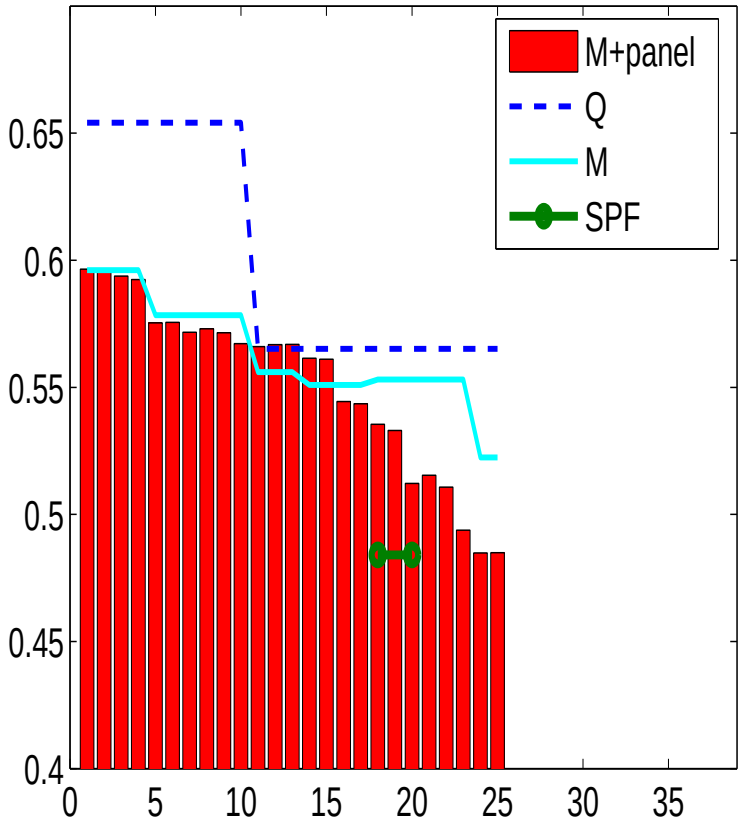
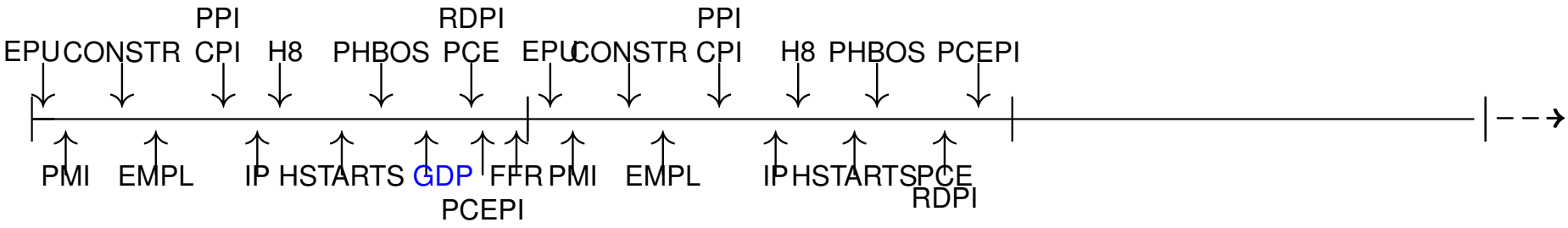
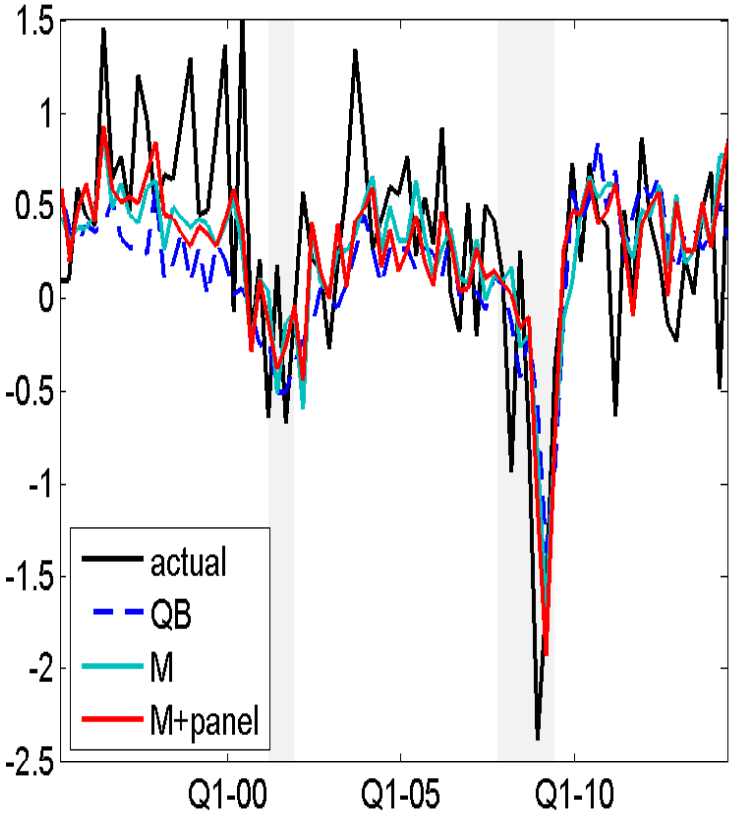
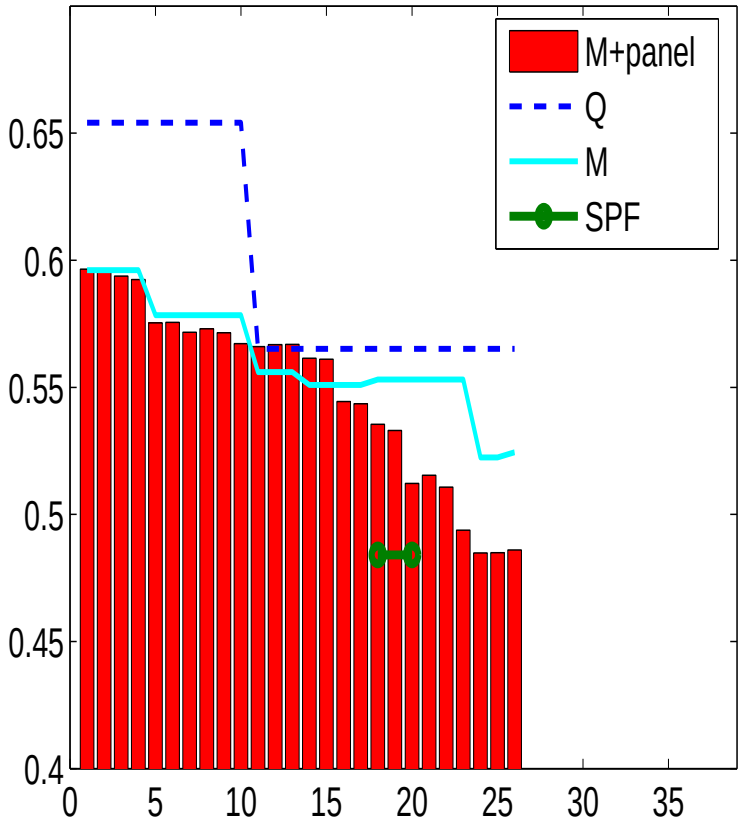


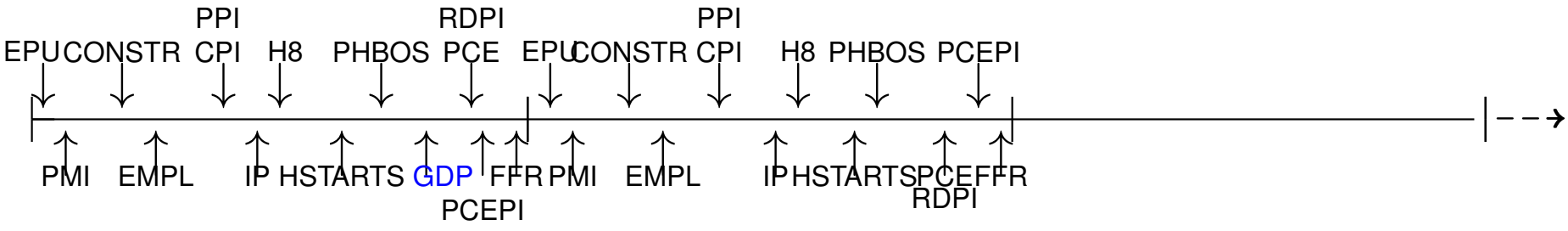




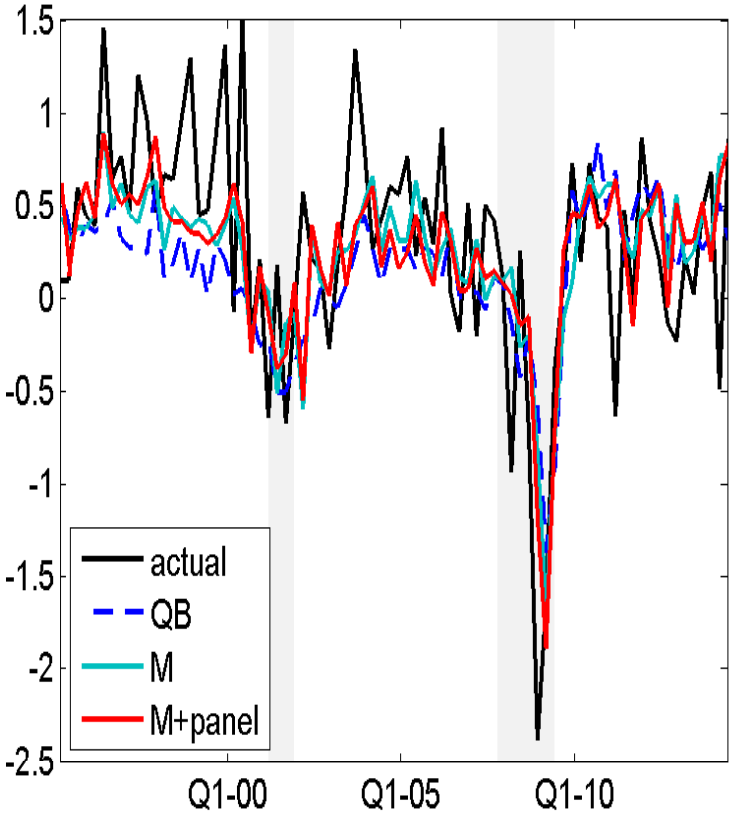
Nowcasting GDP growth

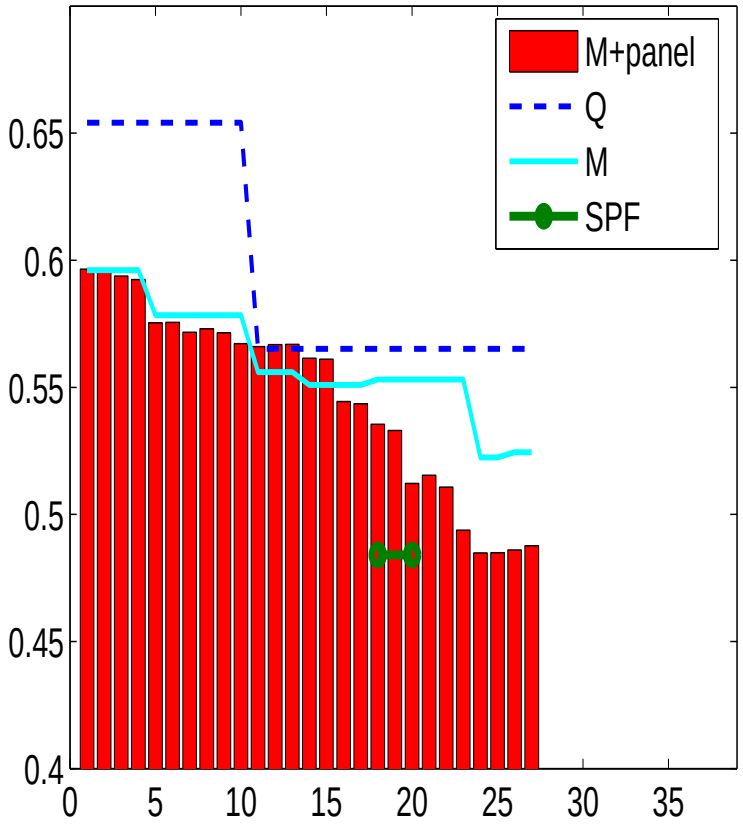


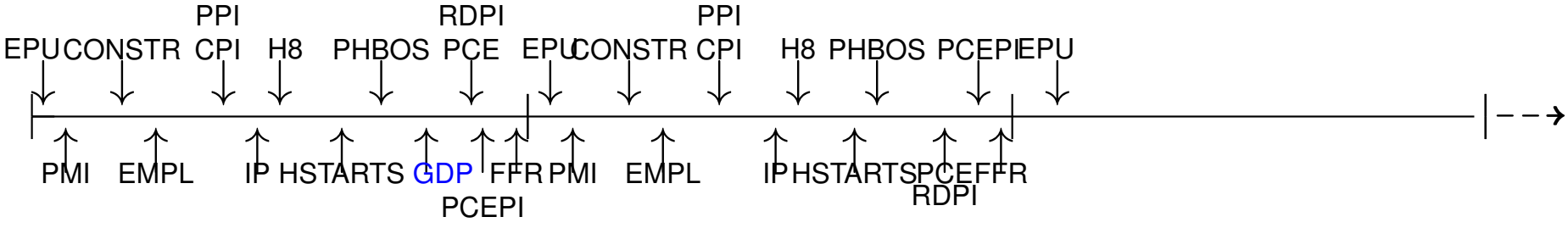




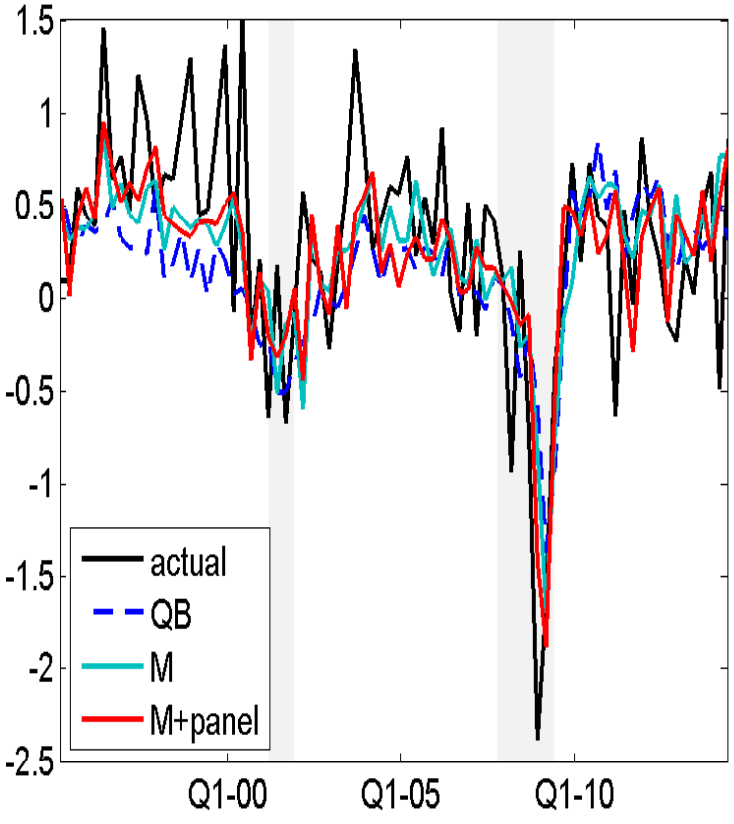
Nowcasting GDP growth

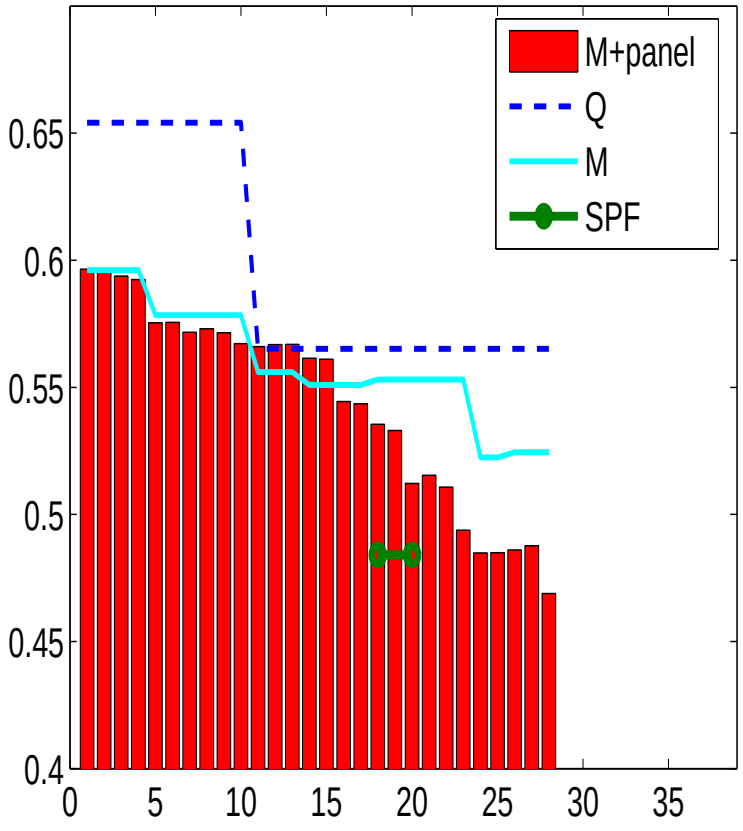


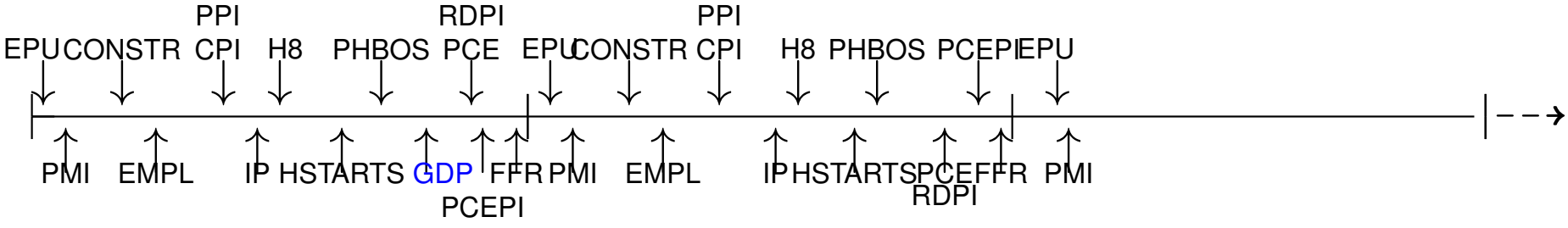




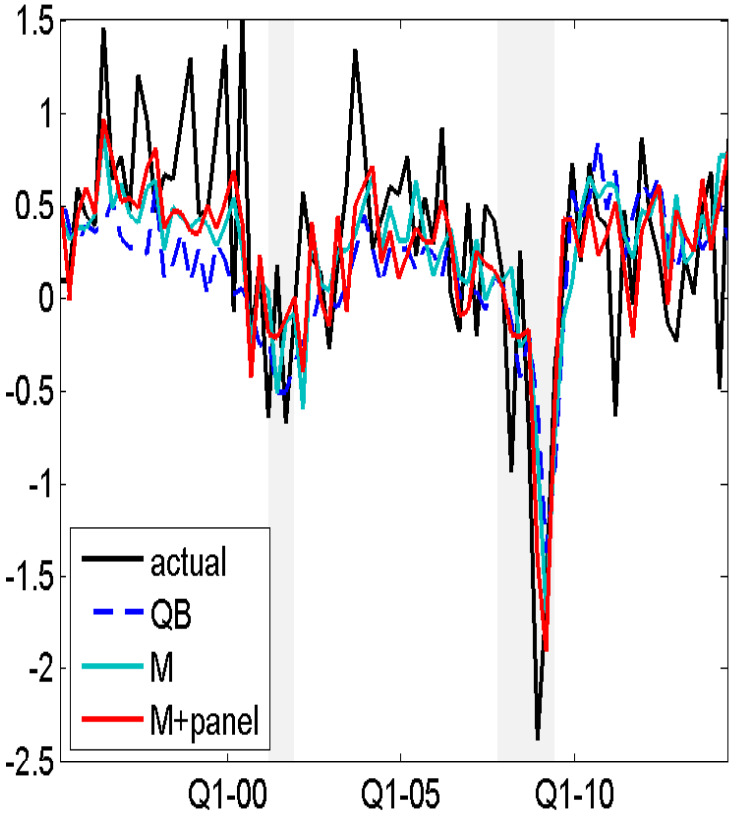
Nowcasting GDP growth

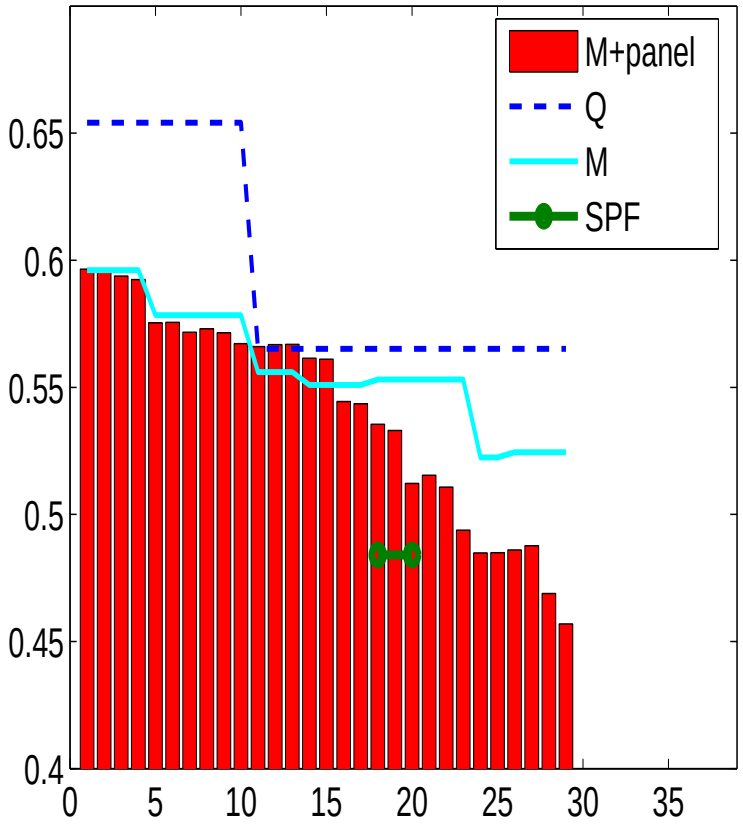


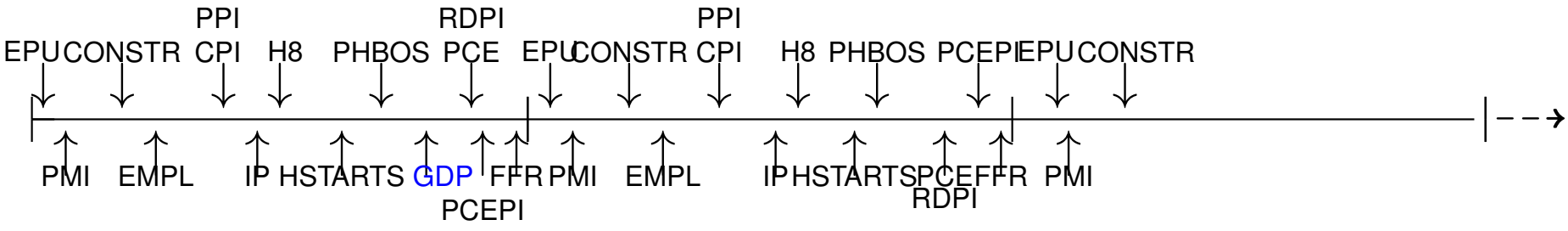




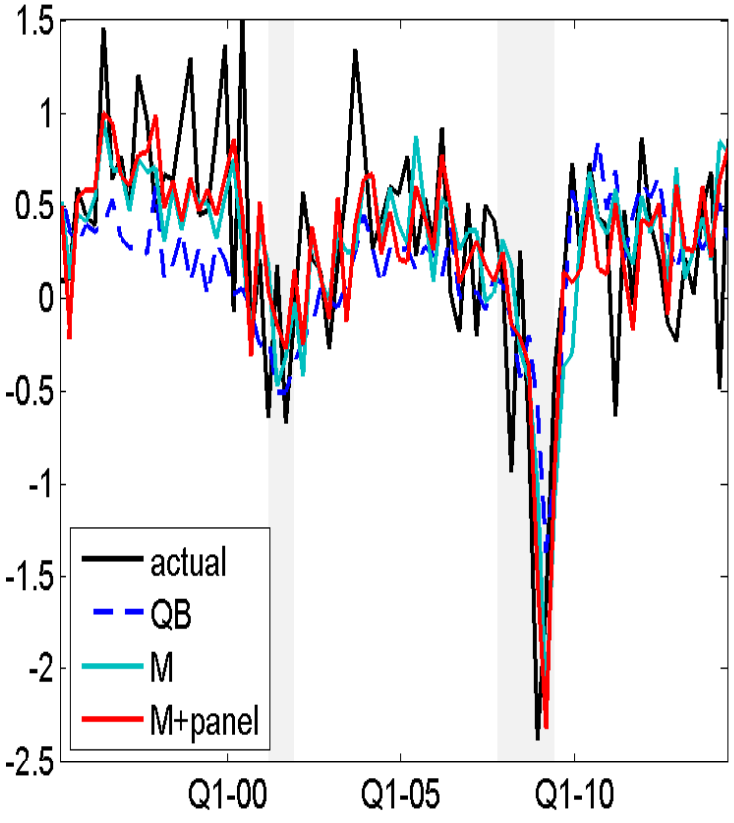
Nowcasting GDP growth

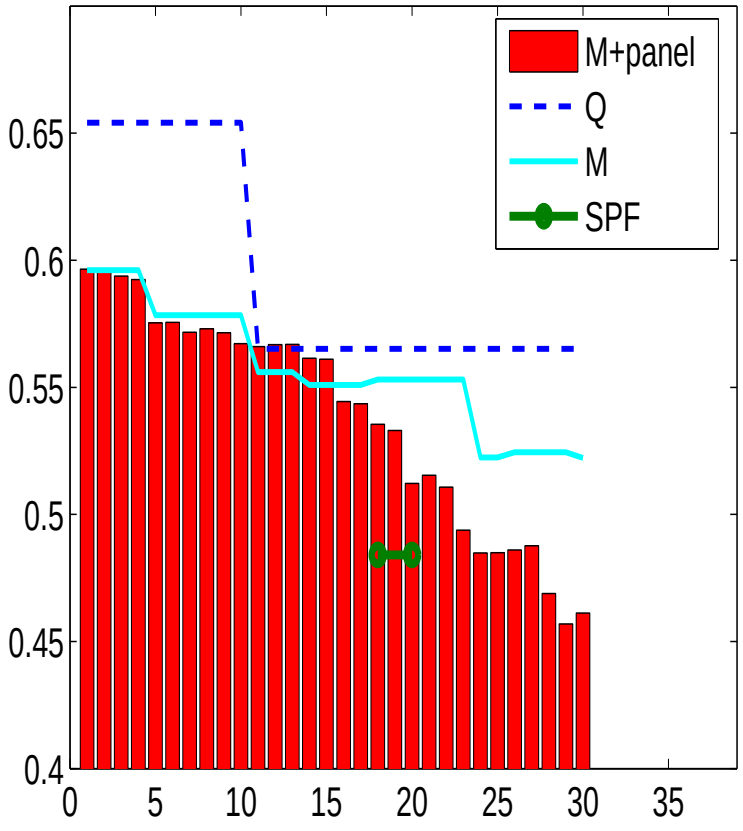


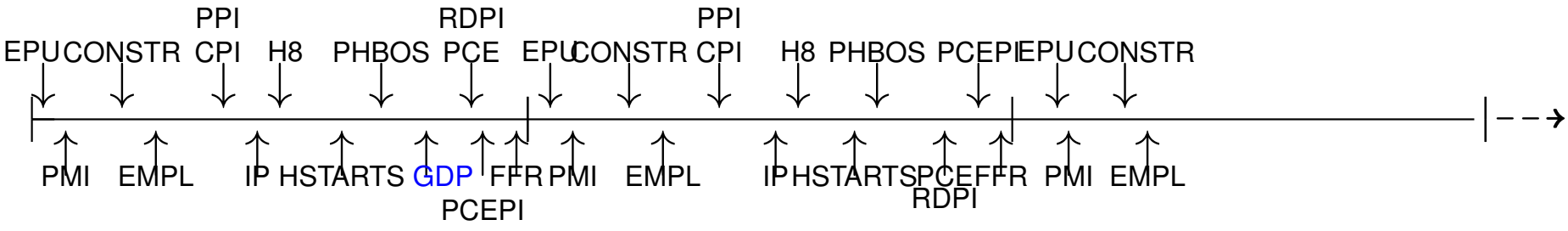




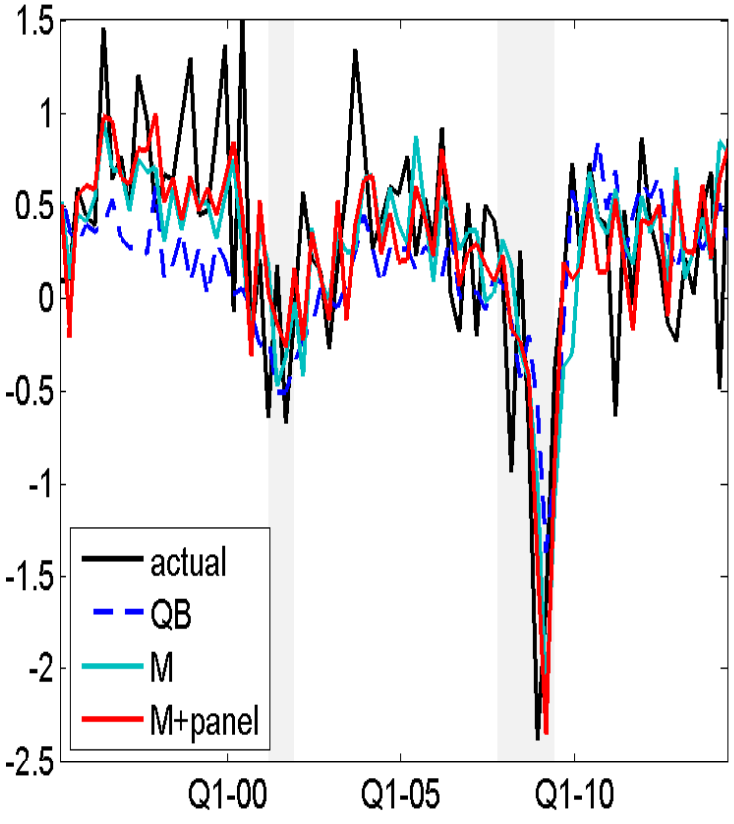
Nowcasting GDP growth

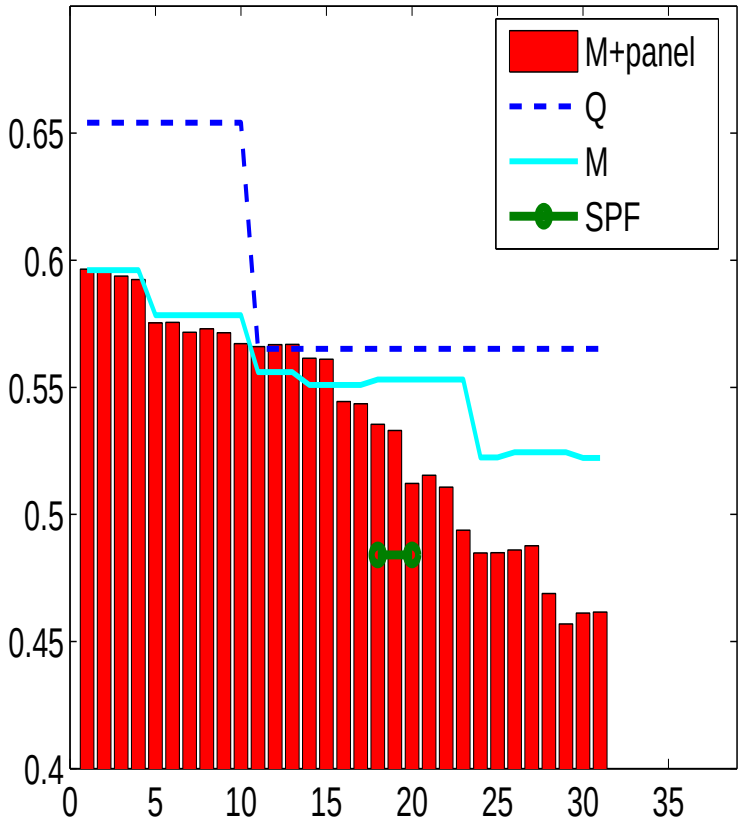


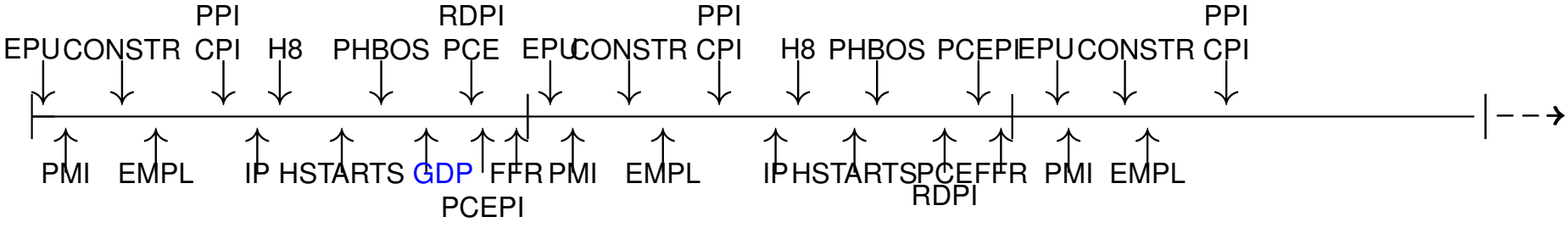




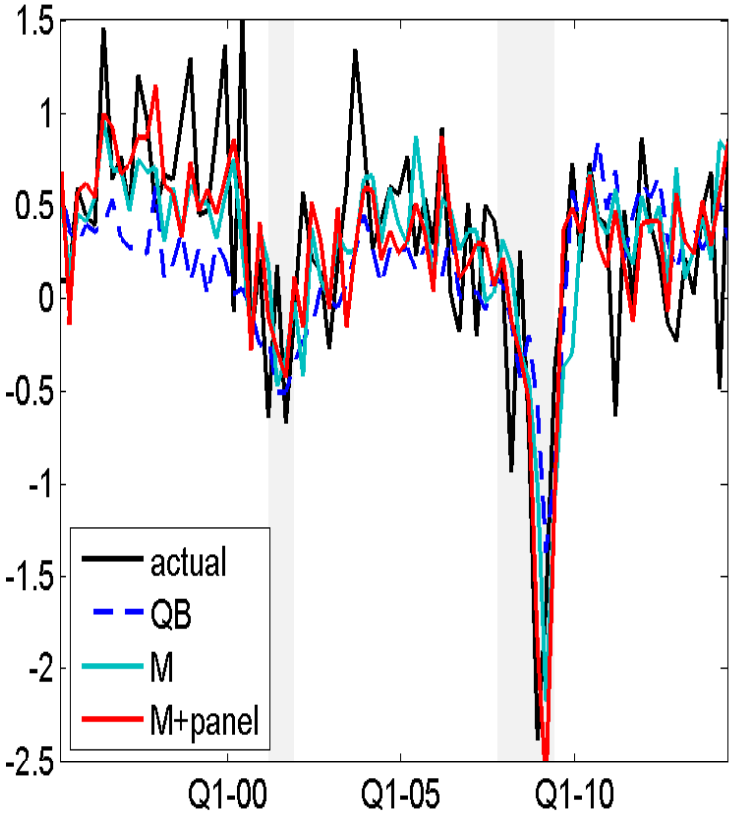
Nowcasting GDP growth

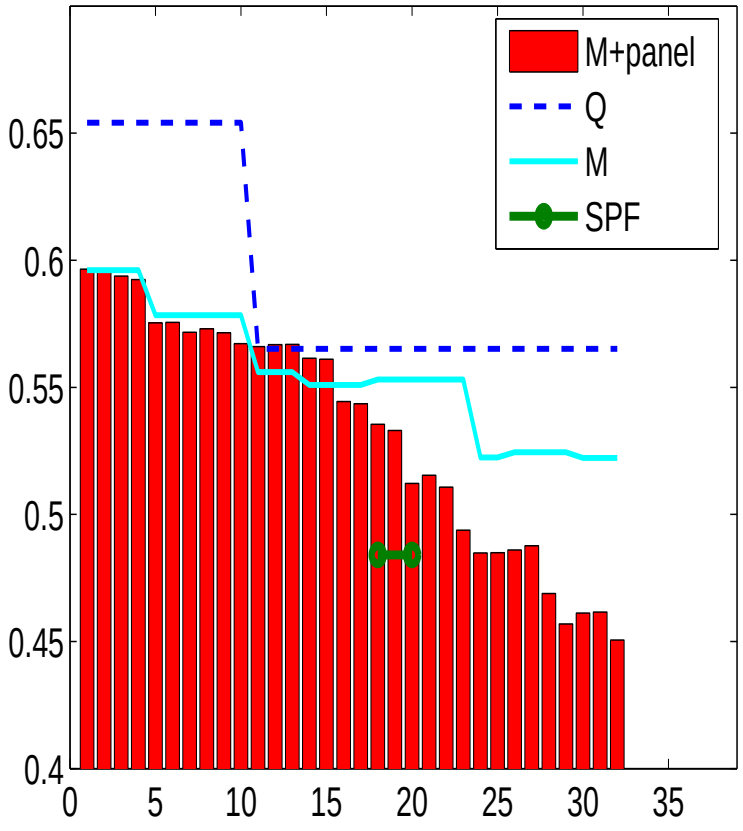


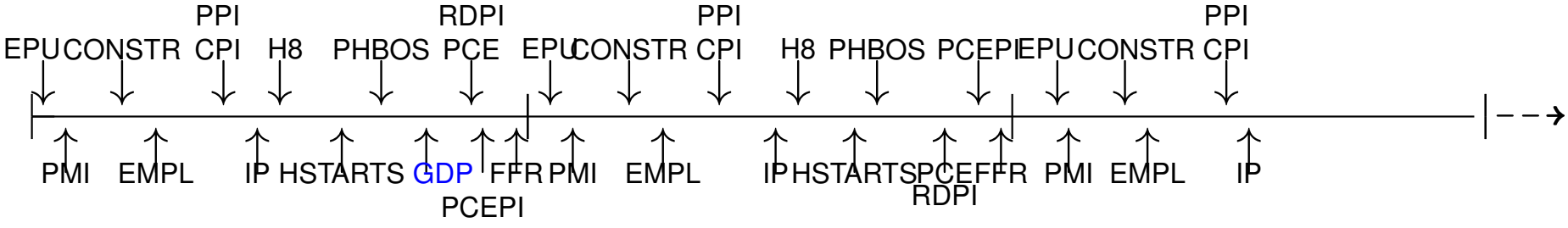




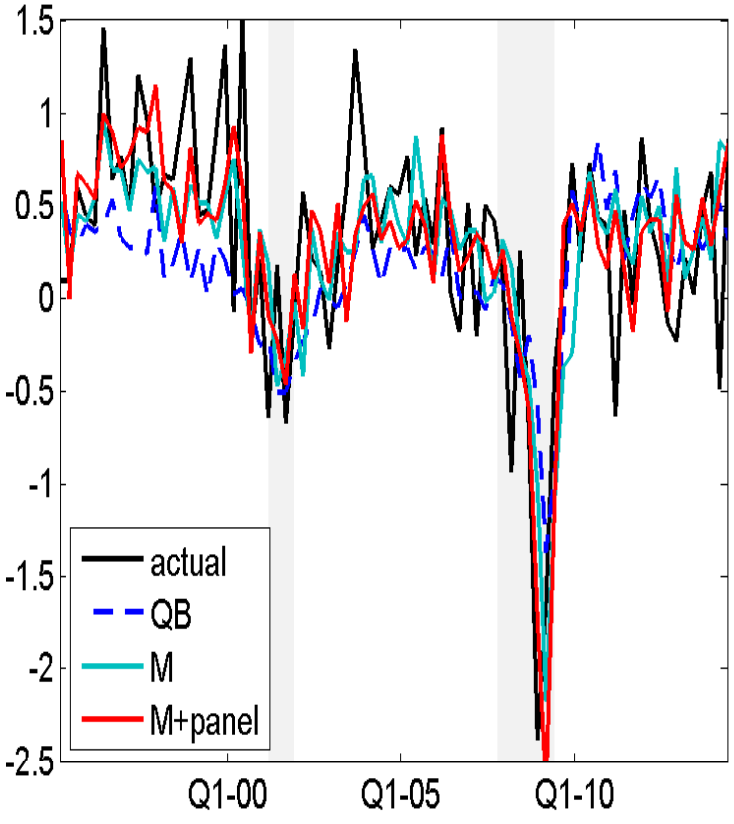
Nowcasting GDP growth

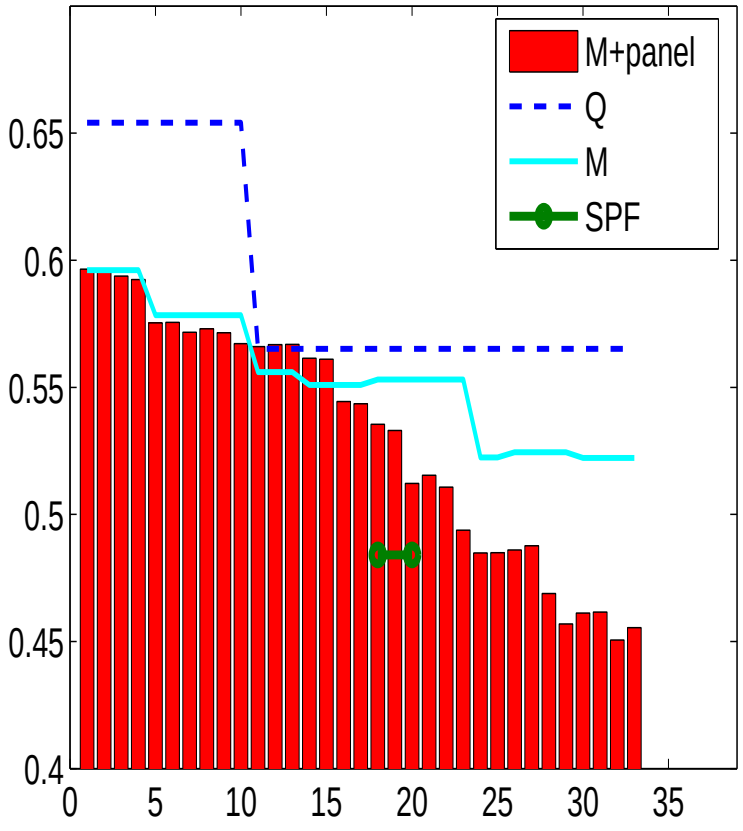


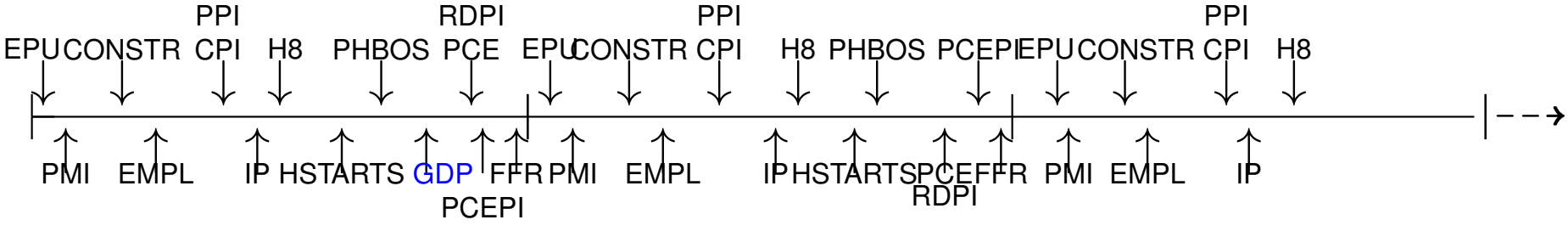




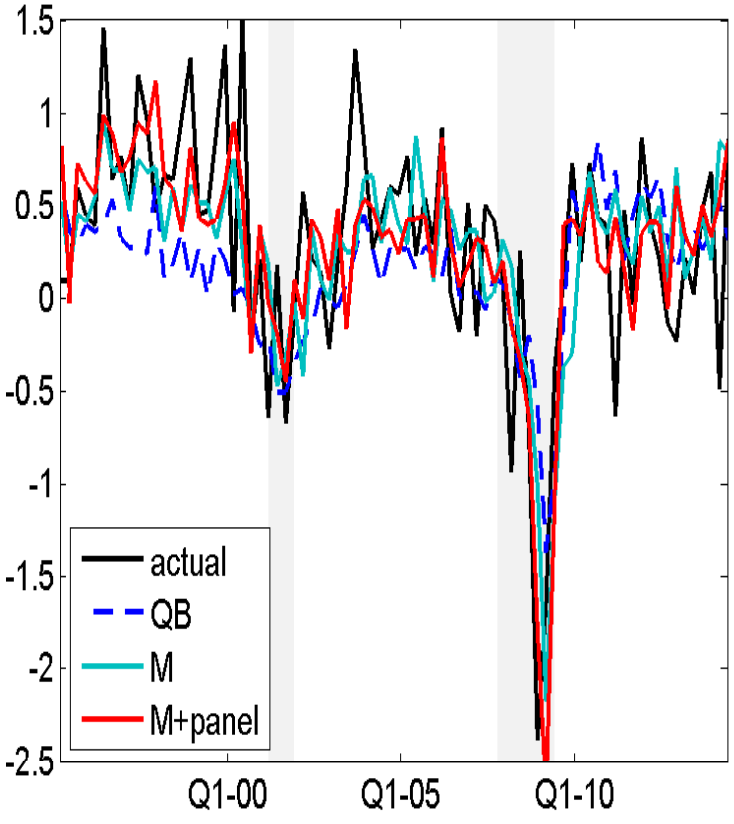
Nowcasting GDP growth

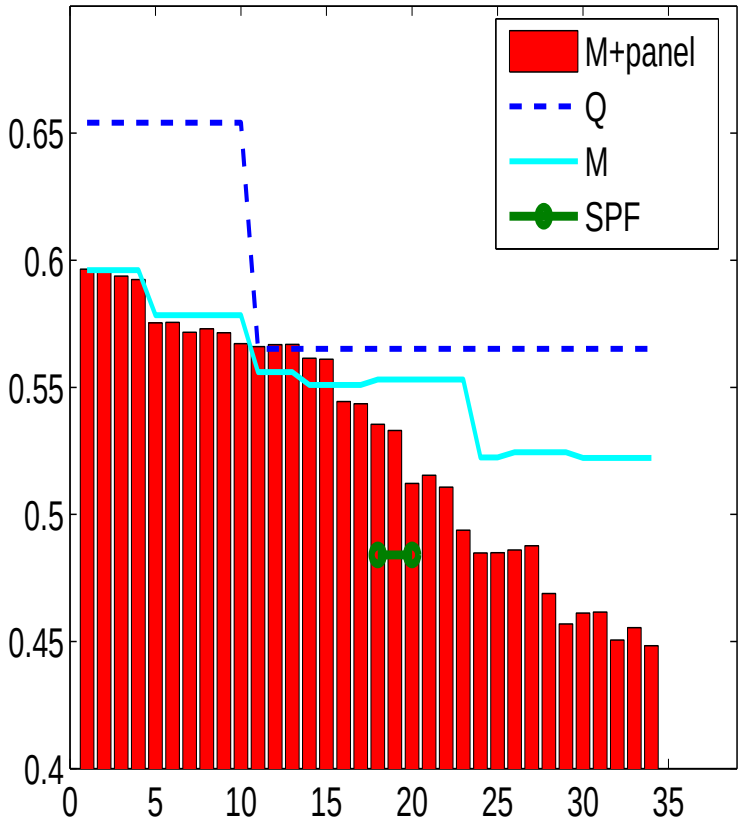


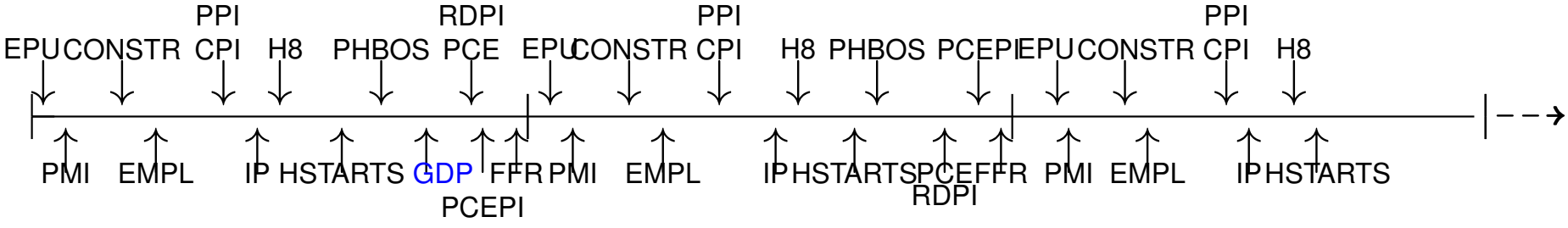




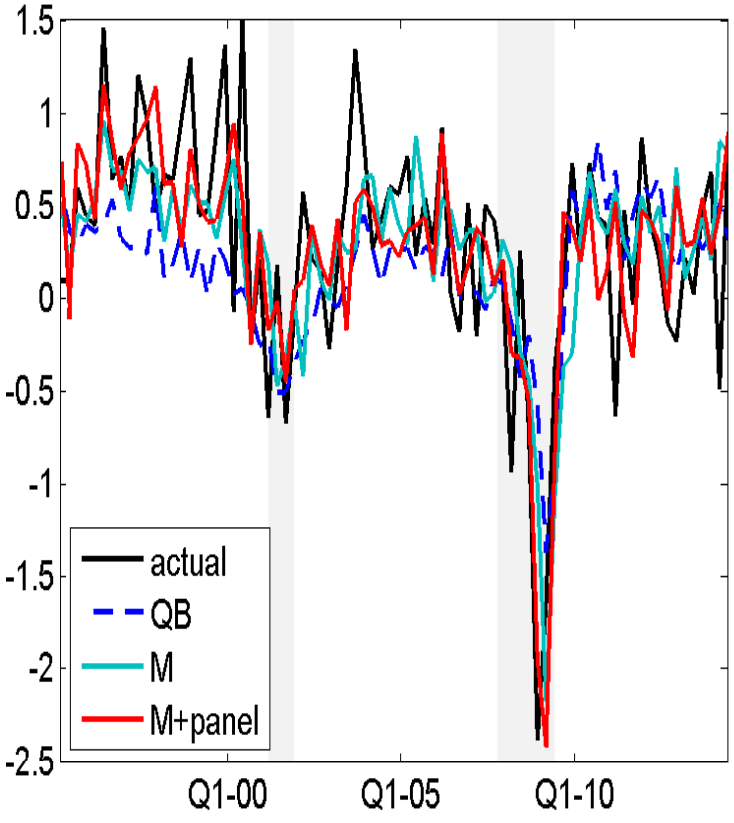
Nowcasting GDP growth

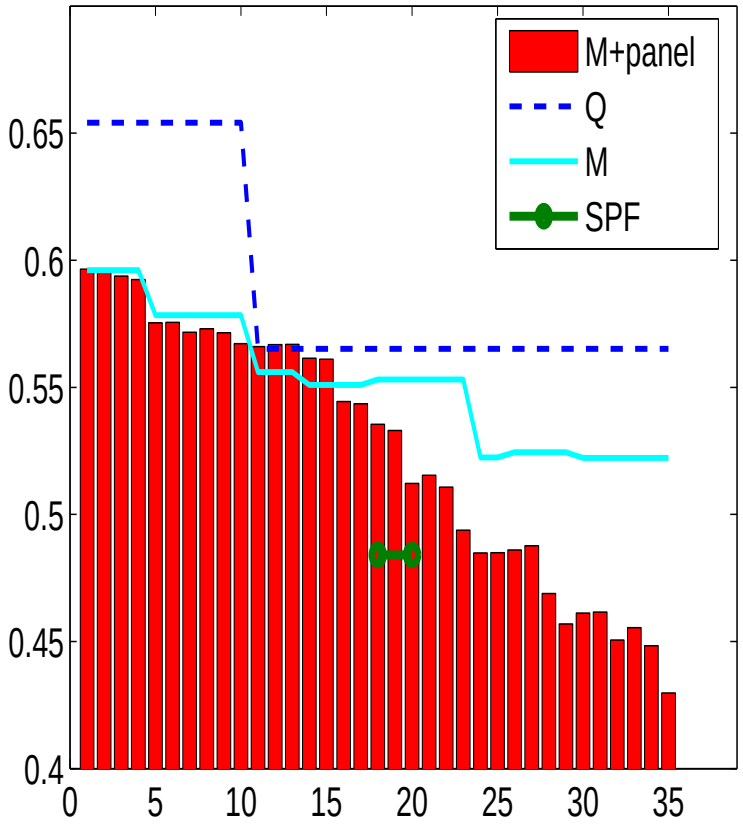


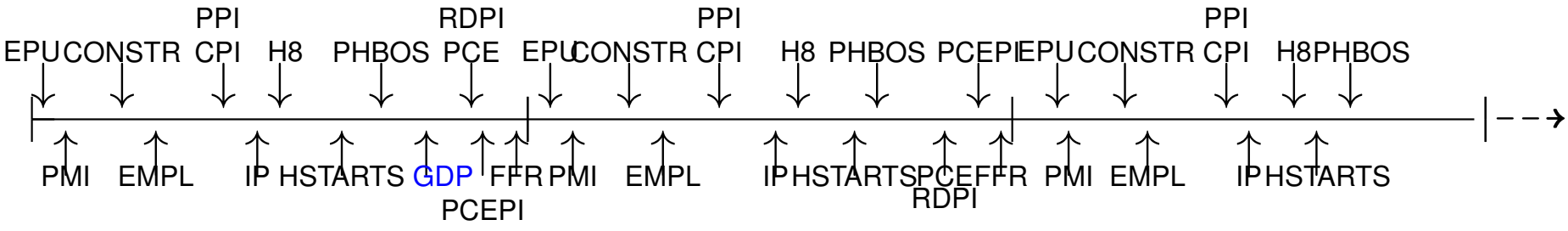




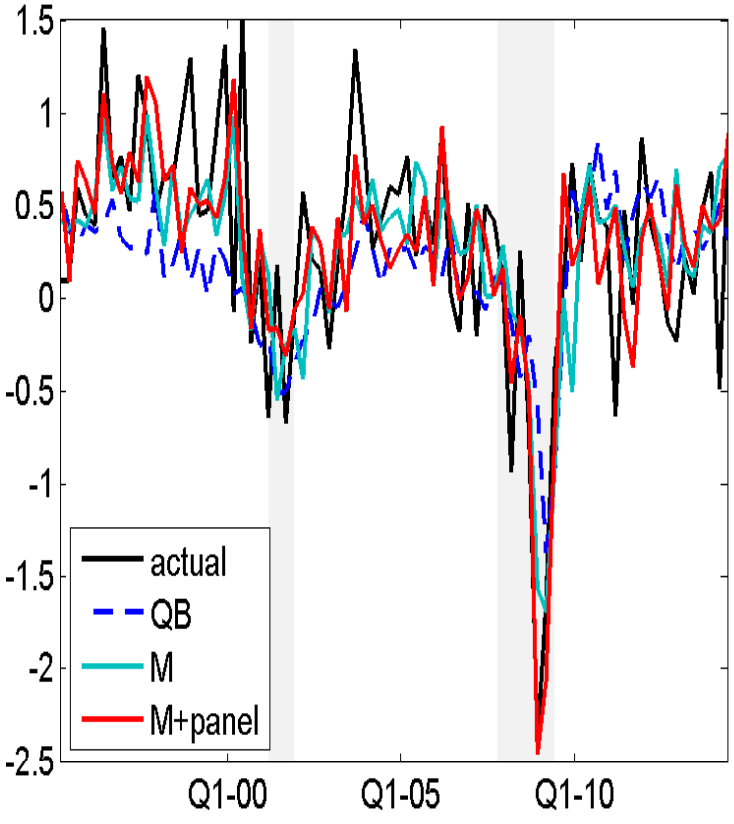
Nowcasting GDP growth

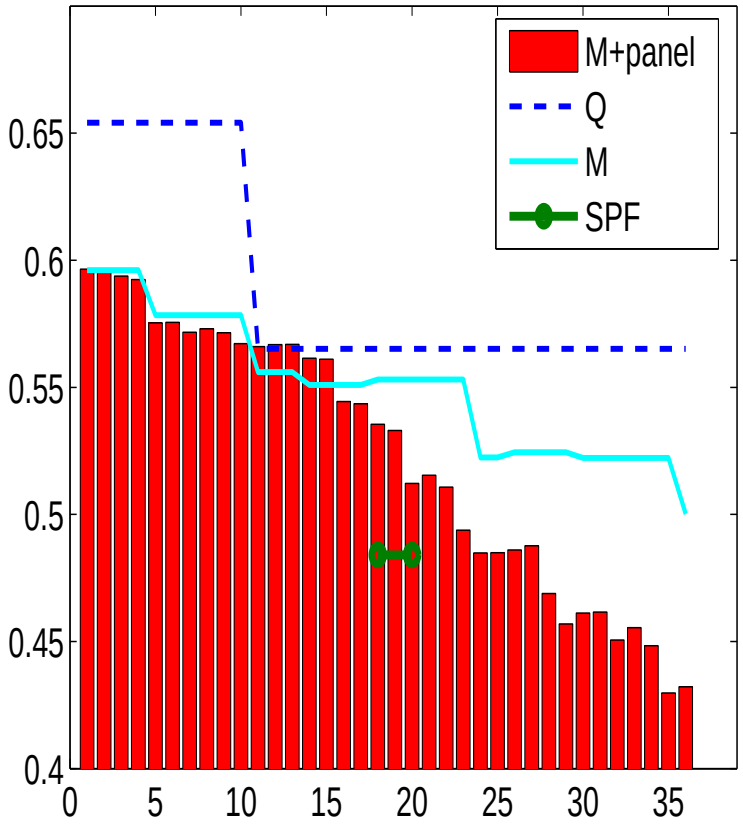


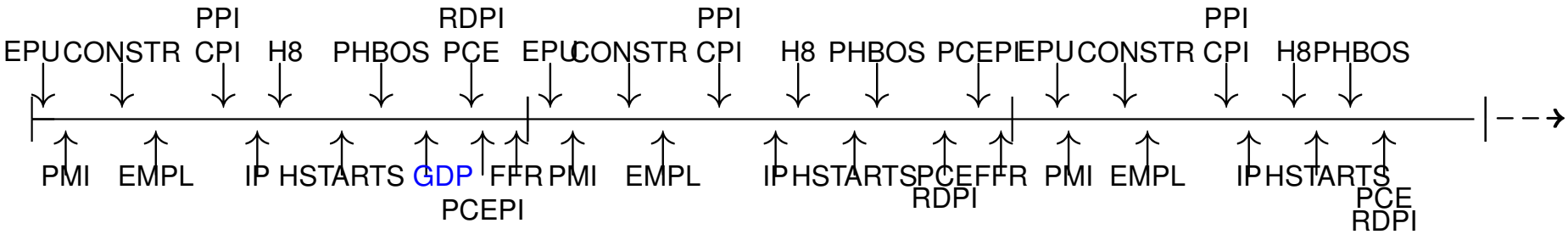




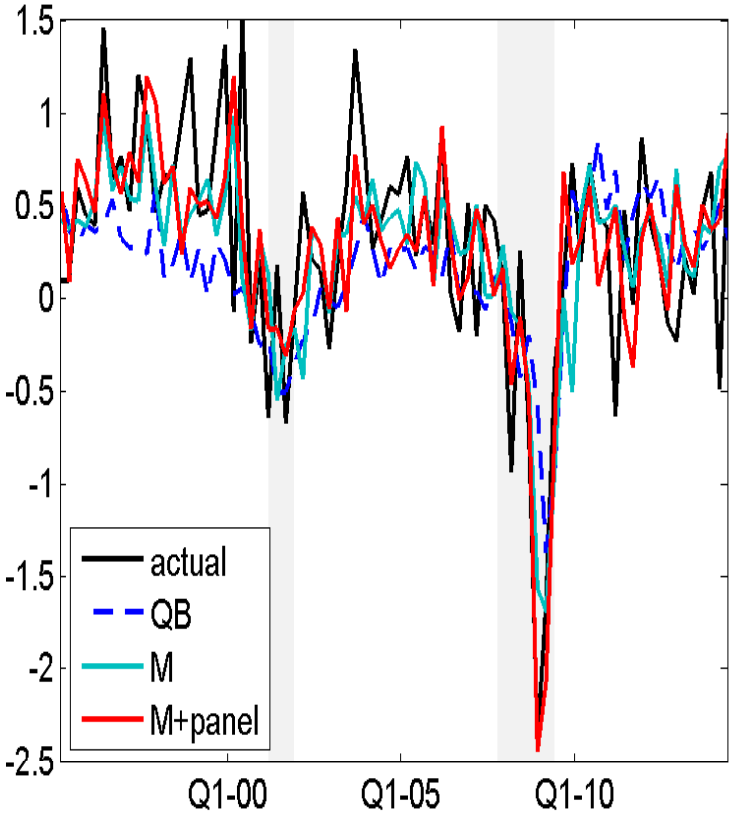
Nowcasting GDP growth

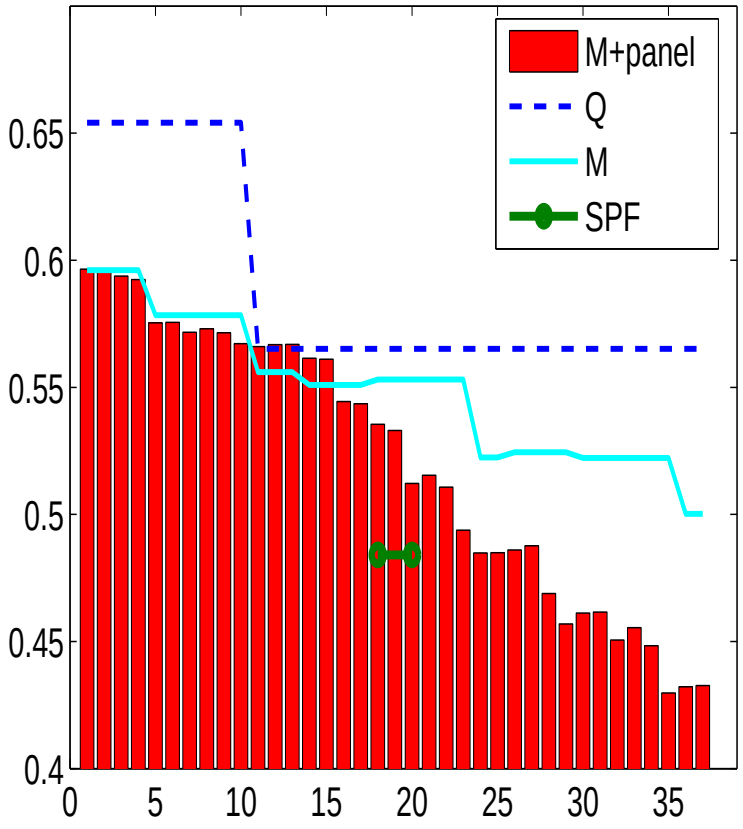


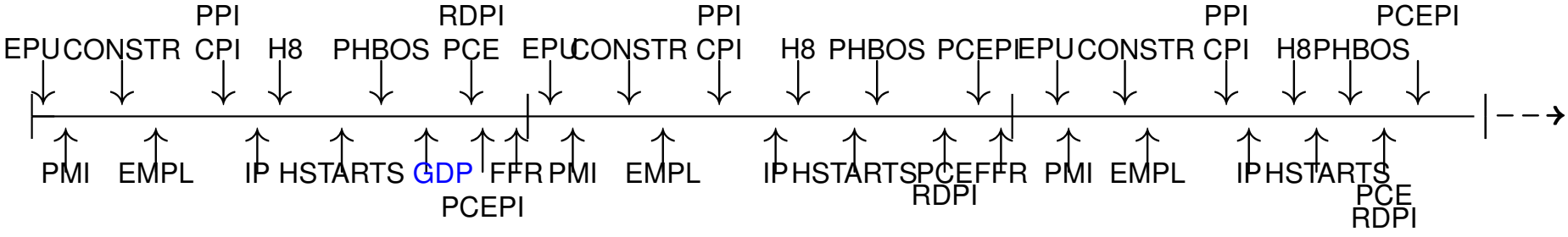




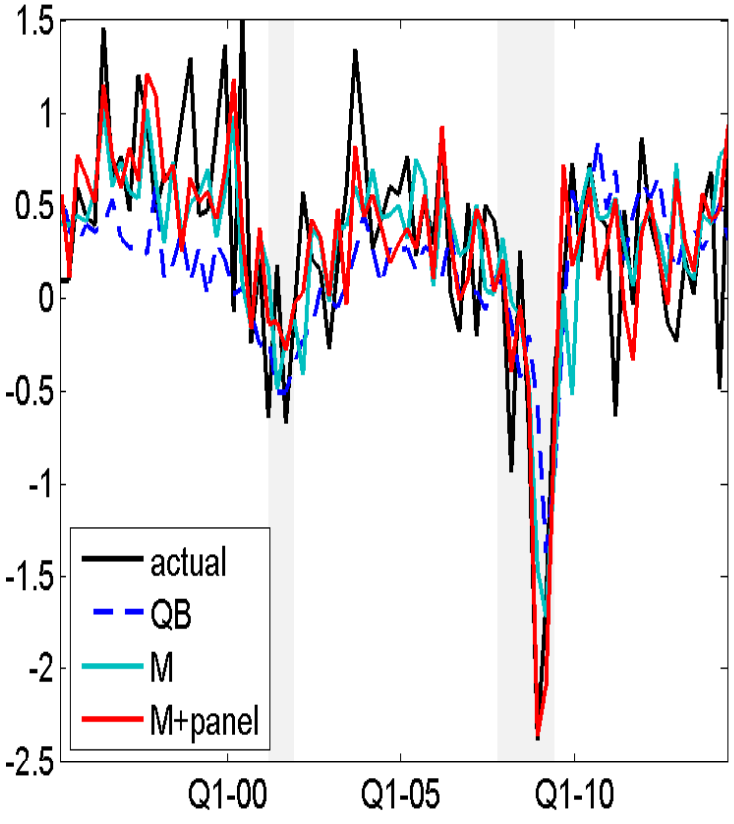
Nowcasting GDP growth

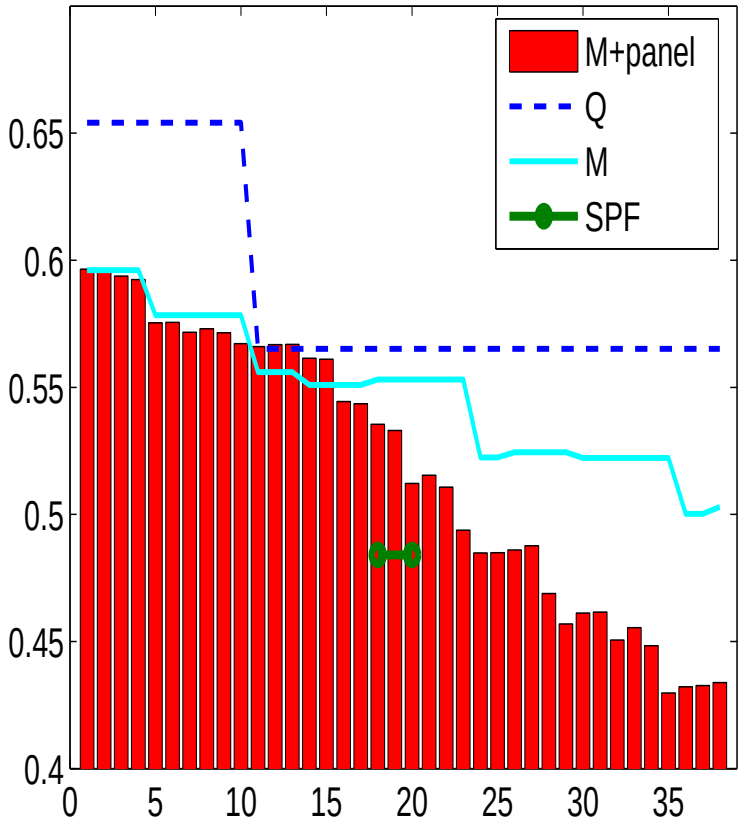


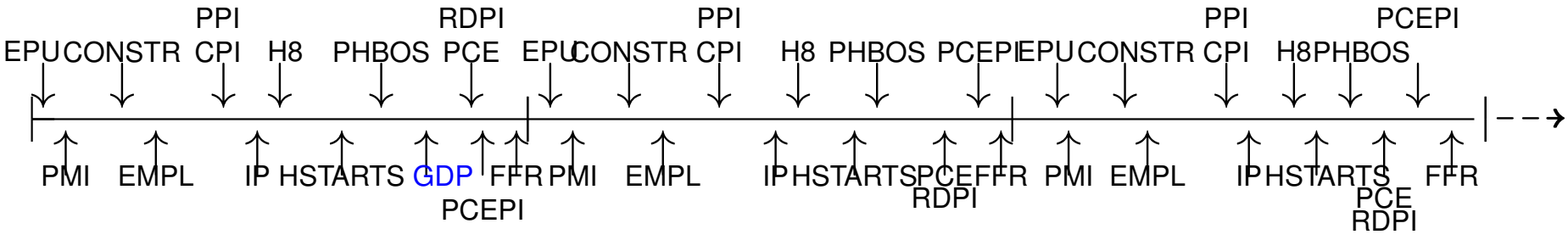




Nowcasting GDP growth





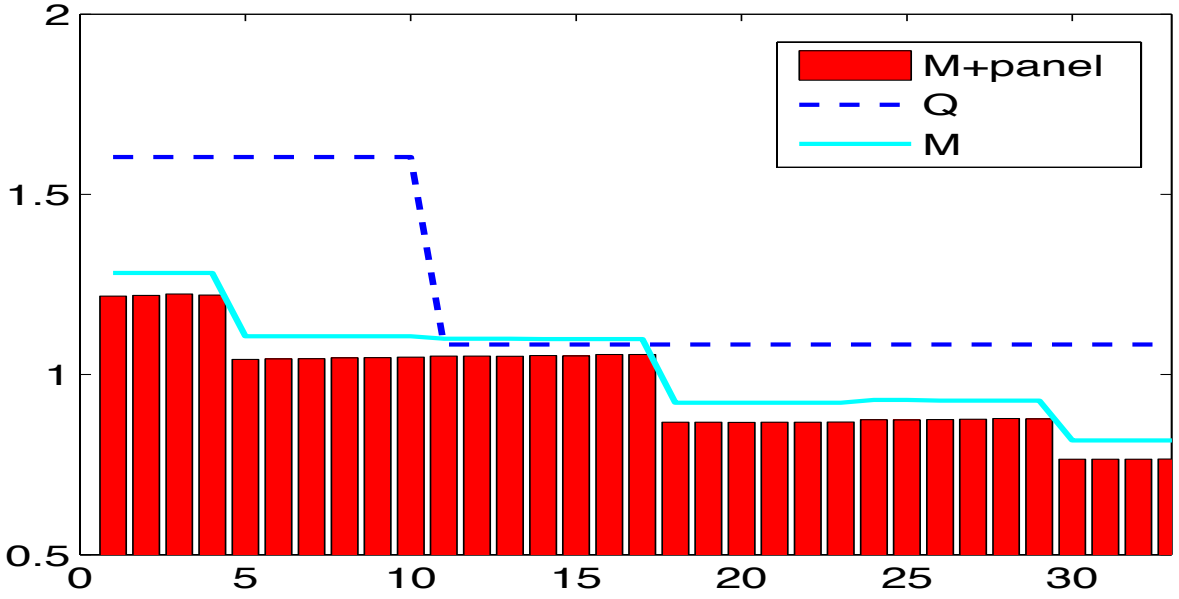


Takeaways

1. Quarterly with auxiliary model outperforms quarterly and monthly model $\rightarrow$ auxiliary variables help!
2. Behaviour of MSFE for confirms evidence from reduced form now-casting models

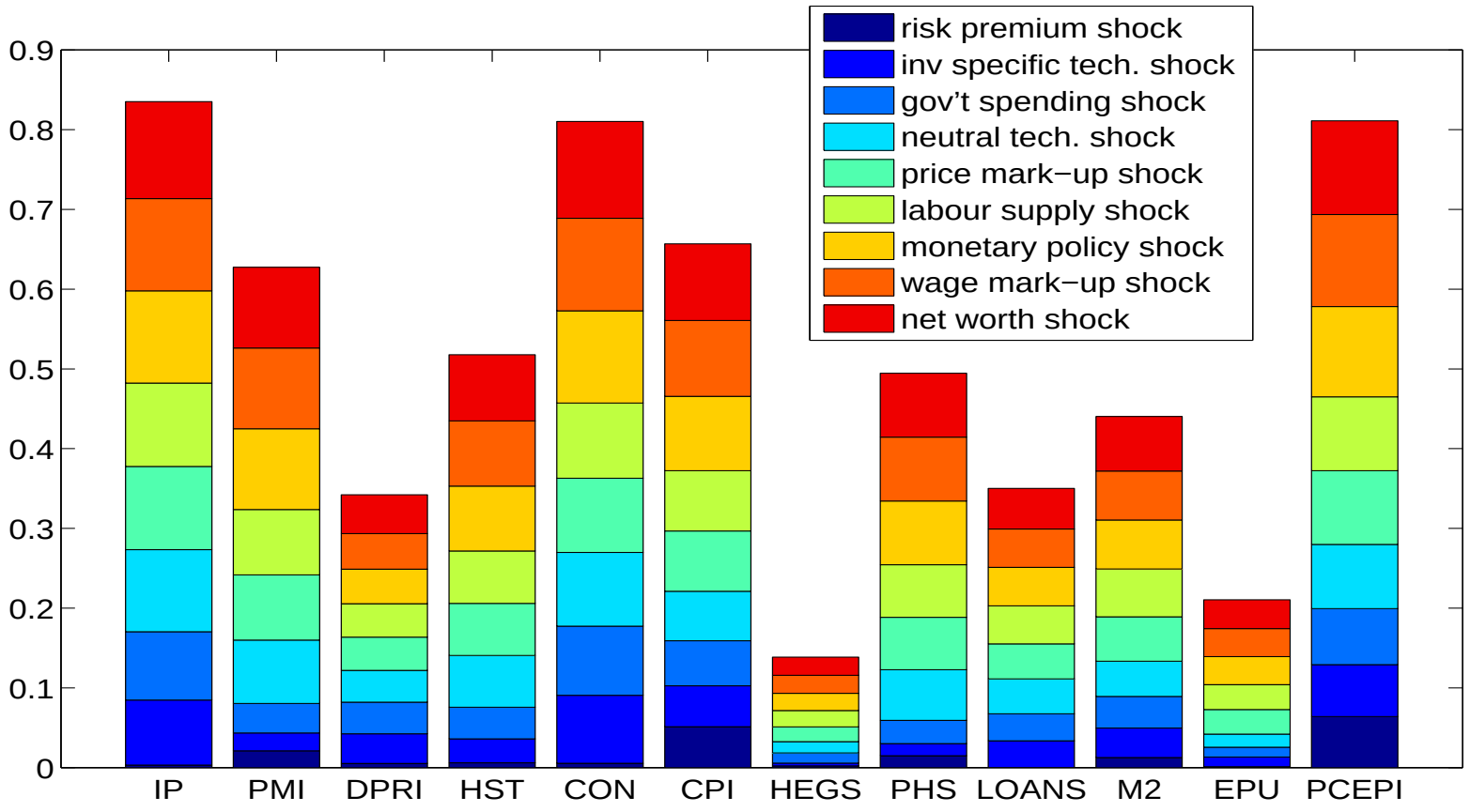
.... other results in the paper for price variables, output gap and unemployment

Now-casting the output gap



Interpreting the auxiliary variables through the lens of the model

Forecast error variance decomposition of the auxiliary variables: 1 quarter ahead



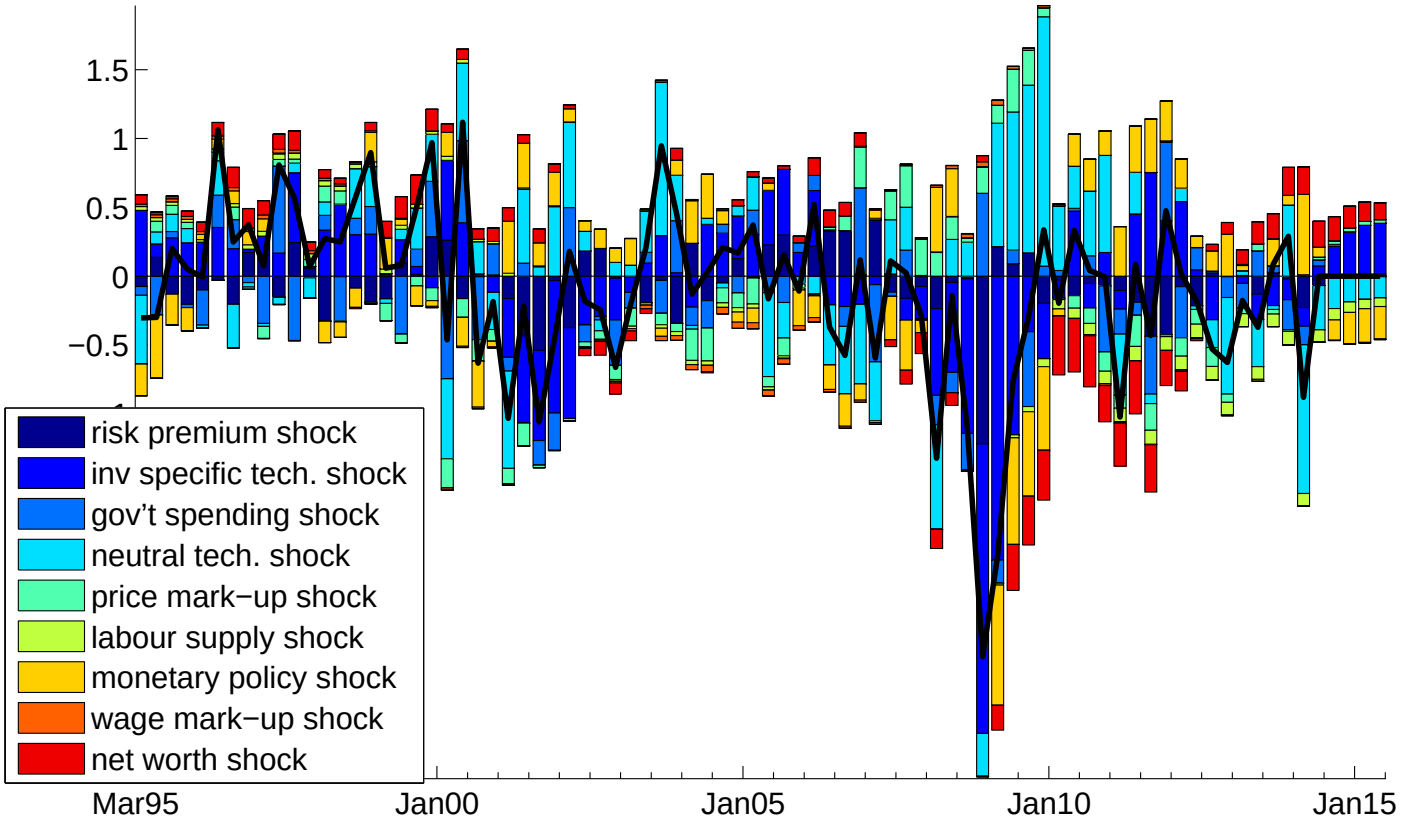
What kind of information do these variables deliver?

1. Prices and real variables are best captured by the model based structural shocks, less so financial and earnings
2. The risk premium shocks is more relevant for nominal variables and surveys
3. The technology shock affect all variables

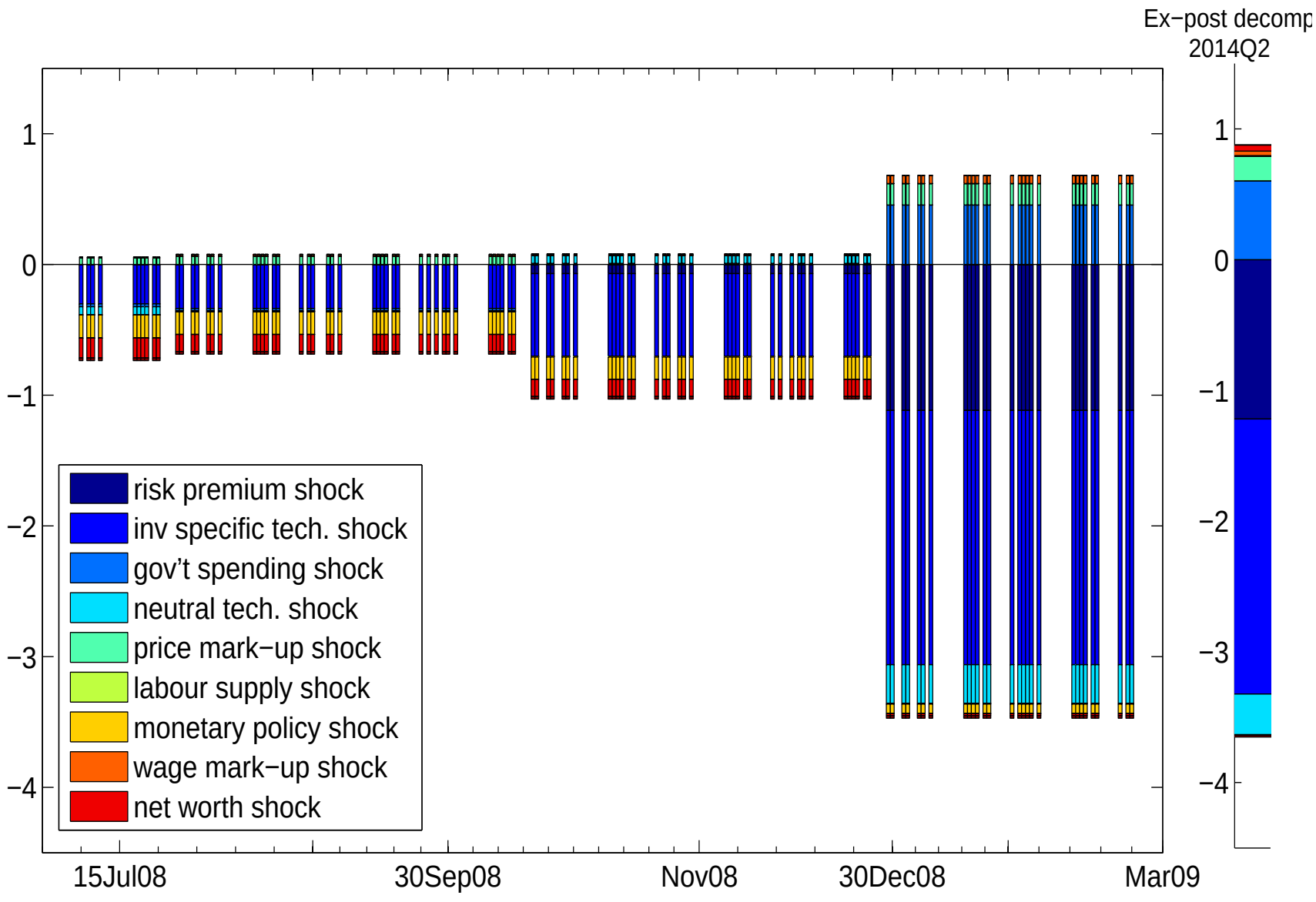
Ex -post and ex-ante variance decomposition

What can we learn from the data flow in real time about the drivers of the business cycle?

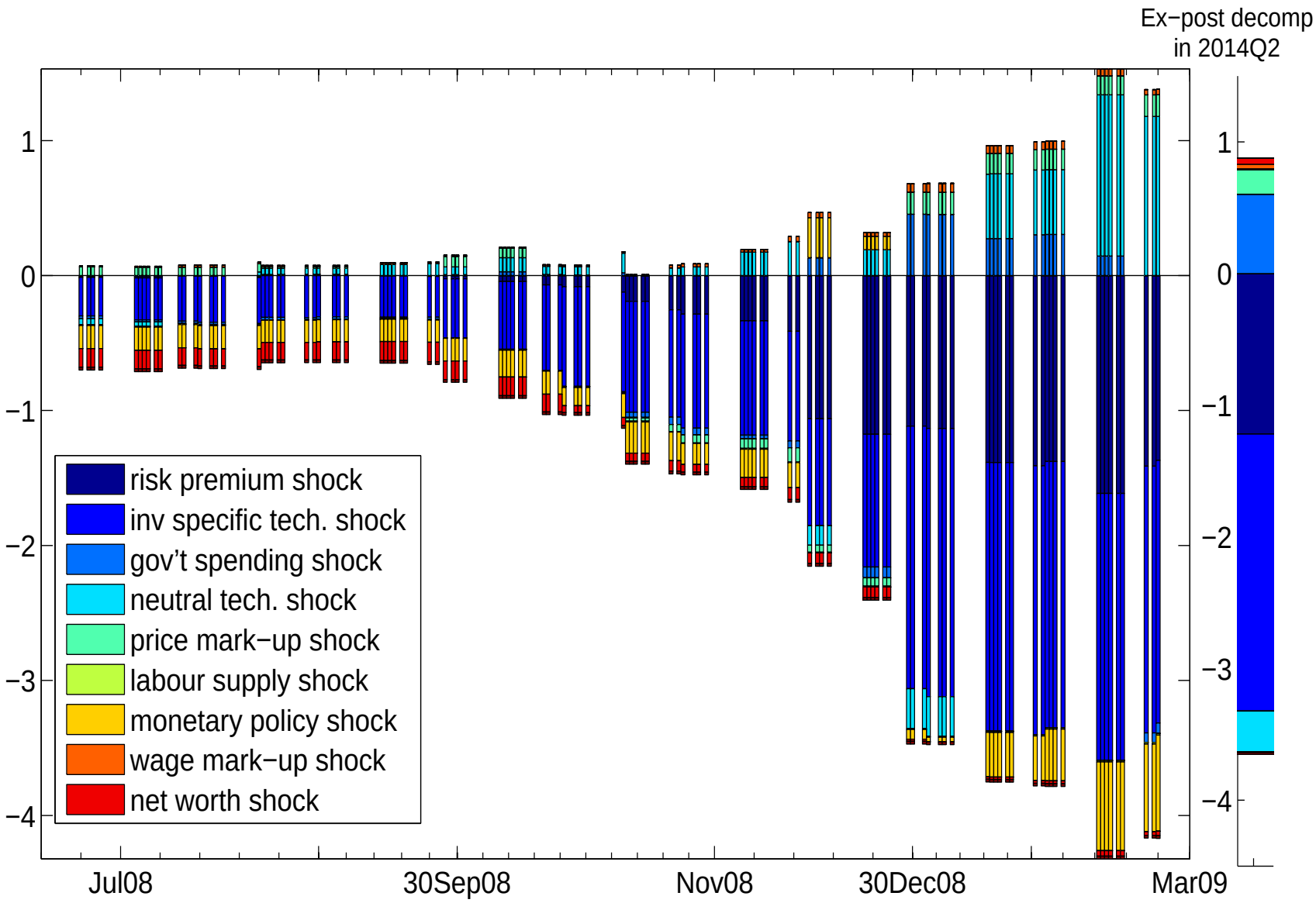
Ex -post shocks decomposition for GDP growth



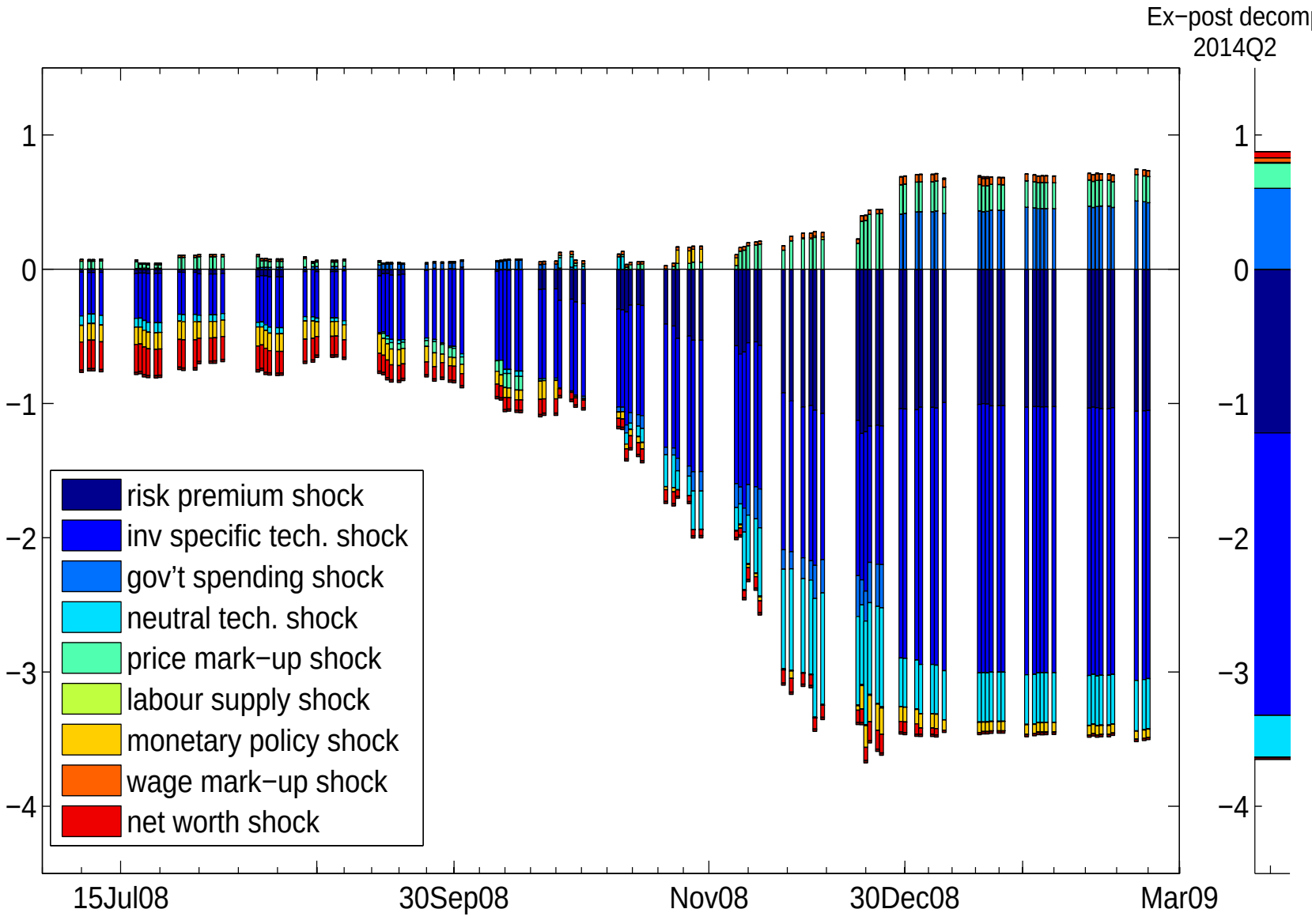
Variance decomposition GDP growth 2008q4: July 2008-March 2009 - Quarterly model



Variance decomposition of GDP growth in 2008 Q4: July 2008 - March 2009 - Quarterly model + SPF



Variance decomposition of GDP growth in 2008 Q4: July 2008 - March 2009 - Monthly+panel



Takeaways

1. It takes time to understand *why* the economy is slowing ...
2. By using timely variables we converge few months in advance to the ex-post decomposition
3. Simply conditioning on the SPF (as suggested by Del Negro and Schorfeide, 2013) provides a good now-cast but does not help the real time identification of the main shocks driving the slow-down ... underestimation of the risk premium and the technology shock
4. Our model helps in particular the early identification of the negative technological shock ... Not surprising since the dynamics of the timely real auxiliary variables are well captured by the technology shock (see early)

Conclusions

- Early signals on the economy help decision making
- Timeliness matters
- Timely data can be exploited by formal modeling
- The latter should be part of the regular economist' toolkit