FORECASTING WORLD OUTPUT: THE RISING IMPORTANCE OF EMERGING ASIAN ECONOMIES

by Alessandro Borin*, Riccardo Cristadoro*, Roberto Golinelli[1] e Giuseppe Parigi*

Abstract

The assessment of current and future global economic outlook is a key issue for international financial institutions, governments and central banks. The rapid growth of the emerging markets is changing the economic landscape: the world trade share of emerging Asia grew from about 13% in 1990 to almost 23% in 2008, their aggregate GDP now accounts for more than 25% of world output, while it was less than 12% in 1990. In this paper we focus on the consequences of the rise of emerging Asian economies for the specification of forecasting equations showing that it is no longer possible to ignore these new global players in formulating policy advice and in assessing global perspectives. Our main results are: (i) a break around 2000 in econometric relationships shows the inadequacy of considering only the industrialized countries to forecast world GDP; (ii) even very simple bridge models *of the main industrialized and emerging countries can provide a reliable and timely monthly signal of global outlook; (iii) our simple models performance is in line with that of most widely quoted predictions (WEO, Consensus) both before and during the recent crisis; in particular, they would have provided a better forecast for some emerging economies.*

Content

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1. Introduction

The assessment of current and future global economic developments is more than ever a central concern for international financial institutions, governments and central banks. In the last twenty years, the rapid growth of the emerging countries has deeply changed the economic landscape: the world trade share of Asian most dynamic economies almost doubled, from about 13% in 1990 to 23 in 2008, and their aggregate GDP now accounts for more than a quarter of world output, whereas it was less than 12% in 1990. The rise of China played a crucial role in this process, as it progressively became a new center of gravity, especially for the other Asian economies. During the last decade, Brazil, Russia and India also entered a path of rapid growth, and the BRIC (from the initials of Brazil, Russia, India and China) came to the fore of economic analysis as witnessed by the replacement of the G8 group of countries by the G20 as the main global economic forum. However, while reliable tools and data to analyze cyclical developments of the advanced countries in a timely and comprehensive fashion have long been available, for the emerging economies it is a relatively new issue, whose importance is rapidly growing.

Exploiting a wide range of sophisticated tools, the more recent literature still analyses and forecasts the global economic trends mainly focusing either on the G7 or on the OECD group of countries, as among others, Arouba et al (2010), Kose et al (2008), Golinelli and Parigi (2007) and Chauvet and Yu (2006).[2] In this paper, we provide some new and original evidence of the excessive limitations of this approach and consider explicitly both the advanced economies and the main emerging countries contributions to the world economic growth. As shown in Section 2, in the recent years the elasticity of world GDP growth to the emerging market GDP rose to 0.4 from virtually zero until the mid-nineties.

The dramatic failure of the traditional as well as the more innovative forecasting tools during the last crisis has underscored the importance of frequent forecast updates concerning single countries and the global activity. The International Monetary Fund (IMF) has recently decided to publish two updates of its *World Economic Outlook* (WEO) projections, in January and July (the complete WEO projections are usually released in April and October, in conjunction with the semi-annual meetings of the Fund). The updating activity is however far from being a simple work, as it implies the maintenance and estimation of high dimension models, as well as very complex data base.

The second ambitious task of this paper is to provide an easy way to update WEO projections (or if you like "further update" WEO updates) by providing *each month* the policymaker with a coherent and reliable flow of information about short run world GDP dynamics. We have chosen to focus on the forecast of world GDP growth because as an indicator of global activity is immediately and more easily comprehensible, compared for instance with cyclical, synthetic indicators of economic activity.[3]

Reliable forecasts of GDP growth may be obtained through *bridge models*, that are very simple econometric tools where the information content of short run indicators is 'translated' into the more coherent and complete 'language' of GDP and national accounts. In this context, we specify a *world bridge model* (WBM), where world GDP growth can be obtained from the aggregation of single countries/areas growth rates. Bridge models, as well as other approaches, need however a benchmark with which to evaluate their reliability, in terms of forecasting ability or of the coherence of their cyclical representation. The natural choice would be the series of world GDP at a higher frequency than the annual, but as no official data of this sort are available, we have

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[2] GVAR models are more general but they have not been devised for short run analysis and forecasting (see Pesaran et al, 2004 and 2009).

[3] See Altissimo et al. (2010) for an alternative way of performing a similar task for euro area growth.

focused on the annual growth rate of the world output published in the WEO. Our quarterly WBM is designed to provide disaggregate, short run, GDP forecasts for fifteen developed and developing countries/areas, subsequently aggregated into three main groups: the *JEU* (Japan, USA, and European Union), the *ASE* (China, India, Hong Kong, Korea, Singapore, Taiwan, Indonesia, Malaysia, Philippines and Thailand) and the *BRRU* (Brazil and Russia). Country group forecasts are finally employed to predict the world aggregate GDP. At this stage we have deliberately decided to keep our WBM very simple, both in terms of the dynamic specification of the single components and of the number of countries and indicators. Nonetheless, the results appear to be very encouraging, also in consideration of the wide margins of improvement.

The paper is organized as follows. In the *second* section we show the impact of the emerging Asia on world trade and output, and provide first evidence of how the GDP of emergent countries has increased its relevance for world GDP forecasting. In the *third* section we investigate how we can use monthly and timely indicators for each country to predict their quarterly GDP over the horizon of one to six quarters ahead. In the *fourth* section we assess the WBM performance in anticipating world GDP forecasts contained in the WEO. of the IMF. Section *five* concludes.

2. The rising importance of emerging markets

2.1 GDP levels, growth and trade

In 1990, the GDP of Japan, the European Union (15) and the United States (JEU hereafter) altogether accounted for 55.8% of the world output (evaluated at purchasing power parity, PPP hereafter); by 2008, their combined share was only 46.3%. In the meantime, China's weight alone grew from 3.6 to 11.5% (see table 1).

Table 1. World GDP and countries' shares

(based on PPP valuation of country GDP)

	1990	1995	2000	2005	2008
World *(Billions of US Dollars based on PPP)*	*25,626.1*	*32,290.2*	*42,116.0*	*56,504.7*	*69,569.4*
	share of world total				
Japan	9.0	8.7	7.6	6.9	6.2
EU 15	24.2	23.5	22.6	20.6	19.3
United States	22.6	23.0	23.6	22.4	20.8
China	3.6	5.7	7.2	9.4	11.5
NIEs (1)	2.7	3.4	3.6	3.8	3.8
Other Developing Asian Economies (2)	5.5	6.6	6.7	7.5	8.2
Russia	5.6	3.0	2.7	3.0	3.3
Brazil	3.1	3.2	2.9	2.8	2.9

(1) It includes Hong Kong, Rep. of Korea, Singapore, Taiwan.

(2) It includes India, Indonesia, Malaysia, Philippines, Thailand and Viet Nam.

The wedge between global GDP and trade, on one hand, and JEU output and exports, on the other, grew larger and larger. This evolution is even more stunning for trade flows: China's share in world exports grew six-folds (from 1.5% to 9%), while it shrunk from 63.6% to 44.6% for the JEU (see table 2).

This evidence clearly points to the rising importance of the "emerging world" for overall GDP growth and its greater role in macroeconomic models and predictions. The average growth rate of the JEU in the nineties was 2.5%, it fell to 1.5% in this decade; over the same periods the emerging Asian economies grew by 7.1% and 7.6%, China alone, by 9.9% and 10.3%. In the last decade, more than 60% of world output growth originated in the emerging world (in particular, China), with respect to about 40% in the nineties (see fig. 1).

Table 2. World trade and countries' export shares

(current US dollars and percentages)

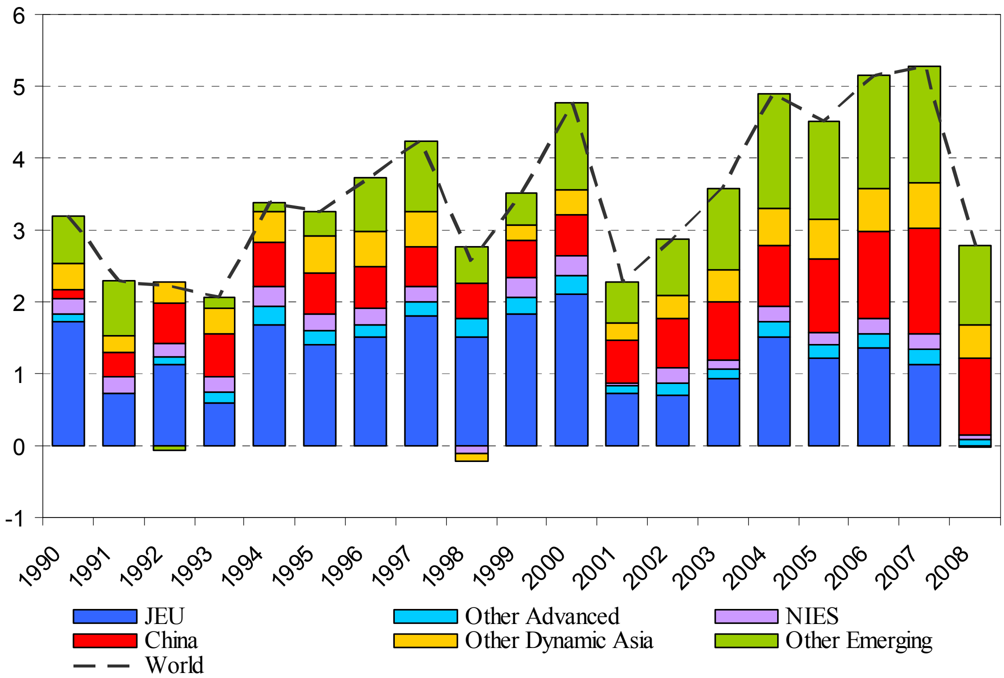
	1990	1995	2000	2005	2008
World *(Billions of US Dollars based on PPP)*	*3,448.1*	*5,077.0*	*6,358.8*	*10,333.5*	*15,858.9*
	share of world total				
Japan	8.2	8.5	7.2	5.5	4.7
EU 15	44.1	39.6	34.9	34.5	31.9
United States	11.2	11.3	12.1	8.6	8.1
China	1.5	2.5	3.9	7.4	9.0
NIEs [1]	7.8	10.7	10.8	9.8	8.8
Other Developing Asian Economies [2]	3.1	4.5	5.1	5.0	5.0
Russia	1.5	1.6	1.7	2.4	3.0
Brazil	0.9	0.9	0.9	1.1	1.2

(1) It includes Hong Kong, Rep. of Korea, Singapore, Taiwan.

(2) It includes India, Indonesia, Malaysia, Philippines, Thailand and Viet Nam.

Fig.1 - Contributions to World GDP growth

(yearly data, composition based on PPP valuation of country GDP)



source: IMF WEO October 2010

Once again, the difference is even greater when we consider trade flows: since the mid-nineties, the shares of Chinese exports have rapidly increased in all destination markets. In 2008 they accounted for 18.8, 16.5 and 13.3% of the Japanese, the US and the EU imports, respectively (see the Appendix A). At the same time, trade within the most industrialized countries shrunk as a share of the total facing the growing importance of China and other emerging economies. For instance, in the case of Japan the cumulative weight of the US and the EU in its total export dropped dramatically from 31% in 2000 to about 19 in 2008. On the contrary, intra regional trade among the East Asian countries gained importance over the last decade. At present, more than one third of Chinese trade takes place with Japan and other east Asian countries; for the latter, the weight of intra-regional trades exceed 50% of total exchanges. The integration of China within the international production chain crucially contributed to this phenomenon. The growth of the Chinese exporting sector has intensified the fragmentation of production processes among Asian partners, while China has become the central hub of this regional network.[4] In particular, China turned out to be a favourite location for assembling parts and components produced in other East Asian economies. Although the rising prominence of the *processing trade* may artificially boost the weight of intra-regional trade in East Asia, it also reveals an increasing interdependency among the economies belonging to the same production network.

So far, the evidence presented shows: (*i*) the rapid growth in terms of GDP and trade flows of big and previously rather poor countries and the rise of new regional centers of gravity; (ii) that fast growth in China and Emerging Asia, together with other developing countries like Brazil and Russia, might have affected the linkages among world economic areas and the degree of comovement within and across the different country groups; (*iii*) consequently, this implies a change in the way of thinking about the evolution of the economies and the specification of their relationships in order to obtain a reliable picture of the present and future developments.

A preliminary insight on the (changing) interdependence among countries is given in table 3, which shows the correlations of the annual GDP growth rates for the main countries and economic areas computed at three time intervals about twenty years apart. On the principal diagonal there appears the average pairwise correlation within each country group, the off-diagonal figures measure the correlation between them. We focus on the G6 group of western advanced economies (*i.e.* the G7 without Japan), two groups of East Asian dynamic economies (Newly Industrialized Asian Economies, NIEs, and Developing Asia, excluding China), Brazil and Russia; Japan and China have been singled out from the respective reference groups, given the peculiar evolutions of their economies.

The maximum correlation between the G6 and world GDP is attained during the seventies and eighties (0.93), while it almost halved in the most recent period (0.49). Comovements between Japan and the G6 follows a similar pattern, while during the last twenty years Japan's correlation with other Asian economies rose. Similarly, comovements among growth rates of Asian economies have steadily increased over time, both within NIEs and Developing Asian economies, and between the country clusters. Looking more in details at the evolution of GDP comovements within east Asia, we note a sharp increase of the pairwise correlations between China and most of the other Asian countries in the last twenty years, with the only exceptions of India and Philippines.

As anticipated, the correlation of growth rates between emerging economies and the G6 remained quite low, while over the last twenty years the correlation with the world growth rose sharply for emerging Asian economies, Brazil and Russia.

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[4] Wang and Wei (2008), Koopman et al (2008), Amiti and Freund (2008), Sasaki and Ueyama (2009), Park and Shin (2009).

Table 3. - Contemporaneous correlations of annual GDP growth
(annual data; intra group average correlation on the principal diagonal)

	1951-1970							
	WORLD	G6(1)	Japan	China	Oth. Dev. Asia. (2)	NIEs(3)	Russia	Brazil
G6(1)	**0.72**	0.14						
Japan	**0.42**	0.31	1					
China	0.37	0.04	-0.29	1				
Other Developing Asia(2)	0.15	-0.22	**0.44**	-0.10	-0.04			
NIEs(3)	0.05	-0.10	-0.15	0.05	0.20	0.16		
Russia	0.32	-0.18	0.08	0.04	0.24	-0.02	1.00	
Brazil	-0.14	-0.23	0.25	-0.27	0.23	0.02	0.02	1.00

	1971-1990							
	WORLD	G6(1)	Japan	China	Oth. Dev. Asia. (2)	NIEs(3)	Russia	Brazil
G6(1)	**0.93**	**0.54**						
Japan	**0.63**	**0.63**	1					
China	0.05	0.23	0.21	1				
Other Developing Asia(2)	0.11	0.11	0.21	-0.03	0.24			
NIEs(3)	**0.80**	**0.76**	**0.41**	0.08	0.16	0.39		
Russia	**0.50**	0.37	0.00	0.00	0.21	**0.61**	1.00	
Brazil	**0.53**	0.31	0.12	-0.21	-0.31	0.25	**0.42**	1.00

	1991-2008							
	WORLD	G6(1)	Japan	China	Oth. Dev. Asia. (2)	NIEs(3)	Russia	Brazil
G6(1)	**0.49**	**0.46**						
Japan	**0.45**	0.01	1					
China	-0.01	-0.10	0.18	1				
Other Developing Asia(2)	**0.52**	-0.10	**0.62**	**0.51**	**0.45**			
NIEs(3)	0.15	0.13	**0.67**	**0.40**	**0.63**	**0.61**		
Russia	**0.65**	0.00	0.21	-0.51	0.20	-0.16	1.00	
Brazil	**0.52**	0.00	**0.30**	0.35	**0.59**	0.29	0.20	1.00

Values greater than 0.4 in bold scripts.

(1) It includes Canada, France, Germany Italy, U.K., U.S.A. **(2)** It includes India, Indonesia, Malaysia, Philippines, Thailand and Viet Nam. **(3)** It includes Hong Kong, Rep. of Korea, Singapore, Taiwan.

source: A. Maddison - OECD, IMF WEO October 2009

2.2 *Preliminary in-sample econometric evidence*

The evidence of the previous paragraph raises the question about the importance of emerging countries to assess the global economic outlook and to forecast world GDP growth. As a first step in addressing this issue, the contributions to world GDP growth of different countries/groups could be estimated. Clearly, there exists an accounting relationship that links the aggregate world GDP with its components, and this is at the basis of the evidence presented in figure 1 and discussed in the previous section. However, the extent to which each country aggregate affects the world GDP growth may differ from its simple weight in the accounting identity. For instance, a particular country/group may play a leading role in the global economy influencing the evolution of many other countries. To investigate this point we try to gauge how the world GDP growth is explained by the output growth of three main aggregates, obtained by grouping countries according to the previous evidence: a group of advanced countries (Japan, the European Union and the US: *JEU*), a cluster of East Asian dynamic economies (China, India, Indonesia, Malaysia, Thailand, Philippines, Hong Kong, Singapore, Korea and Taiwan: *ASE*) and a group formed by Brazil and Russia (*BRRU*). Our aim is to estimate the following relationship, analyzing its evolution over time:[5]

$$\Delta y_t^W = \alpha + w^{JEU} \Delta y_t^{JEU} + w^{ASE} \Delta y_t^{ASE} + w^{BRRU} \Delta y_t^{BRRU} + u_t \qquad (1)$$

where u_t are the errors, that should mainly capture the contribution of countries not included in the analysis; α is a constant and w_i represents the elasticity of world GDP growth to aggregate i output growth (i = *JEU, ASE, BRRU*).

A simple estimation of equation (1) to identify and quantify precise causality relationships is likely to be affected by endogeneity issues, for two main reasons: simultaneity/reverse causality (*i.e.* world growth may drive the dynamics in some areas, rather than the opposite) and omitted variables bias (*i.e.* output growth of countries excluded from (1) may significantly affect the evolution of those included). These are essentially endogeneity problems, which can be dealt with an instrumental variable (IV) approach, employing the first lag of the dependent and the explanatory variables as instruments. Estimates for the whole sample period (1979q1 - 2010q1) are presented in the first column of table B4 (in the Appendix B). The choice of the IV estimator appears justified by the results of the Hausman test; moreover, as the Godfrey test does not detect significant autocorrelation in the residuals, lagged values of the variables may be considered as valid instruments. The estimated coefficients for the whole sample highlight the relevance of *JEU* in explaining the world GDP evolution, while the elasticity associated with the *ASE* output growth is not statistically significant.

As we are mainly interested in evaluating this relationship over time, we computed the Andrews-Quandt test for the detection of breaking points in the coefficients. Figure 2 shows the behaviour of the likelihood ratio *F*-statistic over the time span considered in the detection of a breaking point (1983-2006). The *F*-statistic progressively rises until 1994, then it fluctuates around values largely above the 1% confidence level until 2003. This clearly shows an instability “phase” during the period 1994-2003, while the specific break date can be due to the presence of a particular spike (the second quarter of 2002, according to the Andrews-Quandt sup *F* statistic). We therefore split the sample into two subperiods: 1979q1 – 1993q4 and 1994q1 – 2010q1, consistently with the evidence provided by the *F*-statistic. IV estimation results for the two periods are reported in column 2 and 3 of table B4. The elasticity of world GDP growth to that of the *ASE* group sharply increases from about zero in the first part of the sample to a statistically significant 0.4 in the second, while, not surprisingly, the coefficient associated to *JEU* reduces from 0.8 to 0.5. The

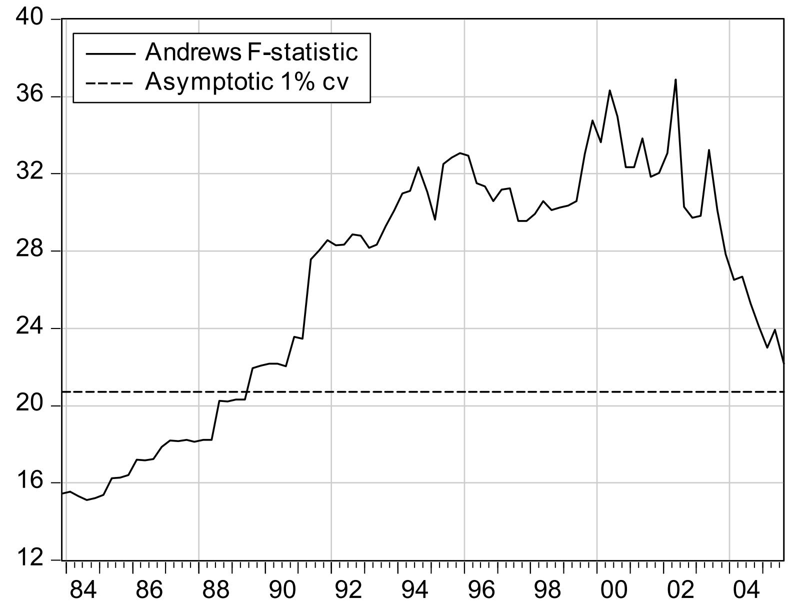
[5] Details about GDP and other data sources are in the Appendix A1; GDP growth is given by the first differences of log-levels. We found that $y_t^W - w^{JEU} y_t^{JEU} - w^{ASE} y_t^{ASE} - w^{BRRU} y_t^{BRRU} \sim I(1)$ hence a stable cointegrating relationship cannot be found due to pervasive and significant parameters (weights) changes over the sample period, as one could expect given the evidence in Section 2.

relationship between world and *BRRU* GDP growth rates is more stable (with an elasticity around .065 in both periods). As shown in column 4, the difference of the estimated coefficients between the two periods is statistically different form zero both for the *JEU* and the *ASE* groups, thus providing further evidence in favour of our partition of the sample. This clearly suggests that the relevant factor in the recent evolution of world output has been the robust growth of East Asian economies.

Another consequence of the emergence of these new global players can be elicited through the analysis of the evolution of the interrelationship among the aggregates. We tackle this point by making use of the following VAR(1) model for Δy_t^{JEU}, Δy_t^{ASE} and Δy_t^{BRRU}, which provides a parsimonious data-congruent representation of the dynamic relationships among the GDP growth of the three groups of interest:[6]

$$\begin{pmatrix} \Delta y_t^{JEU} \\ \Delta y_t^{ASE} \\ \Delta y_t^{BRRU} \end{pmatrix} = \begin{pmatrix} \alpha^{JEU} \\ \alpha^{ASE} \\ \alpha^{BRRU} \end{pmatrix} + \begin{pmatrix} w_{11} & w_{12} & w_{13} \\ w_{21} & w_{22} & w_{23} \\ w_{31} & w_{32} & w_{33} \end{pmatrix} \begin{pmatrix} \Delta y_{t-1}^{JEU} \\ \Delta y_{t-1}^{ASE} \\ \Delta y_{t-1}^{BRRU} \end{pmatrix} + \begin{pmatrix} v_t^{JEU} \\ v_t^{ASE} \\ v_t^{BRRU} \end{pmatrix} \tag{2}$$

Fig.2 – Results of the Andrews (1993) statistic for breaking points



The estimates have been computed over the whole sample and over the two subperiods, previously identified. Table B5 (see Appendix B) presents the *p*-values for non-Granger causality tests (NGC), and the correlation coefficients between VAR shocks. In the first subperiod, NGC never reject the null of non-significant explanatory power of the past values of each aggregate GDP growth to the others, while in the second subperiod clearly emerges a significant role of the *ASE* output growth in explaining the future dynamics of both *JEU* and *BRRU* (this last group, though less significant, contributes to predict the *JEU* growth since the mid-90s). The evidence about a relevant predictive power of the Asian emerging economies with respect to the evolution of *JEU*

[6] The first-order dynamics is enough to have non-autocorrelated reduced-form residuals.

GDP is confirmed by the estimates obtained over the whole sample (column 1), although these results clearly hide the deep changes occurred between the two subperiods. Moreover, the simultaneous correlation between *JEU* reduced-form shocks and both *ASE* and *BRRU* innovations rises sharply in the second part of the sample, signalling a general increase in the international integration of the economies during the last fifteen years ("globalization effect").

The changes in the propagation of shocks occurred over the sample period are clearly summarised by the plots of the generalised impulse-response functions (G-IRF, see Pesaran and Shin, 1998), derived from the VAR estimates and reported in Appendix B (see figure B1). Again, both the impact and the persistence of the effects of *ASE* shocks on the *JEU* and *BRRU* growth are evident only in the second subperiod. The effect of the *ASE* shock always tends to last about 3-4 quarters, while neither *JEU* nor *BRRU* shocks seem to play a significant effect in shaping the future path of emerging Asian economies GDP growth. Nevertheless, from the G-IRF plots clearly emerges the increased interdependence among the three groups of countries.

Overall, our findings imply relevant changes in short run models to predict and analyze world GDP dynamics, as they make evident that knowledge about a wealth of short run indicators for *JEU* countries alone is no longer enough for a good understanding of the world dynamics.

As a final point, it is worth observing that even though our paper does not take into account data revisions, as it uses latest available GDP time series, this fact does not necessarily lead to an artificial improvement of our models forecasting ability. In fact, Croushore and Stark (2001 and 2002) modelling US GDP growth do not find a significant difference between the forecast errors generated using real-time data or latest-available data. The same result is broadly confirmed for other countries, (see e.g. Golinelli and Parigi, 2008, for the Italian case).

3. Assessing out-of-sample bridge models' ability in forecasting quarterly world GDP

The research about short-term forecasting (i.e. within a one year horizon) can be articulated in two main group of tools: bridge models (BM) and dynamic factor models (DFM).[7] This paper deals essentially with the first tool, that has been extensively applied in short run forecasting exercises for the Euro Area, the G7 countries, and Italian GDP; see Baffigi et al. (2004), Golinelli and Parigi (2007; 2008). BM may be particularly effective in the short-term GDP forecasting of emerging economies. Indeed, for these countries only a limited number of high frequency indicators are generally available, and that may reduce the benefits of employing tools that can deal with large amount of information, as factor models. This is confirmed also by a recent IMF study[8] that uses DFM to develop indicators for tracking growth in both in various countries. While for advanced economies the use of a large set of variables results in a appreciable accuracy of the forecasts, DFM estimates on average provide a much poorer fit of actual GDP growth of emerging countries. Another advantage of BM is that they allow to trace developments and changes in predictions to the behavior of specific variables, granting an accurate assessment of the predicted stories.

The World Bridge Model (WBM) introduced in this section exploits industrial production (IP) high frequency information to deliver early GDP estimates for both *JEU*, *ASE* and *BRRU* countries. IP has been chosen since it is reliable as a coincident indicator of GDP and it is usually subject only to small revisions. Furthermore, we focus solely on IP not to incur in the critique of selecting artificially good models (i.e. with best performing indicators) just because our knowledge of "future" (actually past) events creeps into the BM specification, contaminating the reliability of the pseudo out-of-sample forecasting exercises. Consequently, one can think of the WBM predictions presented in this and the next section as some sort of lower bound of the forecasting

[7] For a comparison and a discussion of BM and DF approaches see Bulligan et al. (2010).

[8] See Appendix 1.2 of Chapter 1 in IMF, WEO October 2010.

ability of short run indicators. This intuition is confirmed by comparing – over the common sample 2000q1-2003q4 – the forecasting performance of our raw BMs with that of the carefully specified BMs for the advanced countries reported in Golinelli and Parigi (2007). The superiority of the latter BMs in forecasting GDP is manifest: considering the estimates of current GDP growth (the so called nowcast case) carefully chosen indicators reduce the root mean square errors from 0.69 to 0.31 for Japan, from 0.20 to 0.14 for the European Union and from 0.57 to 0.25 for the US.

We define a simple BM for country *i*, as a fourth order autoregressive distributed lags model – ARDL(4,4) – in error-correction form for the log-levels of GDP and IP:

$$\Delta GDP_t^i = \alpha^i + \sum_{j=0}^{3} \beta_j^i \Delta GDP_{t-j}^i + \sum_{j=1}^{3} \gamma_j^i \Delta IP_{t-j}^i + \pi_{GDP}^i GDP_{t-1}^i + \pi_{IP}^i IP_{t-1}^i + \varepsilon_t^i \tag{3}$$

where $\alpha^i, \beta_j^i, \gamma_j^i$ and π_{GDP}^i, π_{IP}^i are the short- and long-run country specific parameters, and ε_t^i are country specific white noise errors. Four more parsimonious models, nested in (3), can be obtained by imposing parameter restrictions: (3-*i*) the ARDL(3,3) in log-levels: $\beta_3^i = \gamma_3^i = 0$; (3-*ii*) the ARDL(2,2) in log-levels: $\beta_3^i = \gamma_3^i = \beta_2^i = \gamma_2^i = 0$; (3-*iii*) the ARDL(1,1) in differences (i.e. which omits all log-levels): $\beta_3^i = \gamma_3^i = \beta_2^i = \gamma_2^i = \pi_{GDP}^i = \pi_{IP}^i = 0$; and (3-*iv*) the static model in differences ARDL(0,0): $\beta_3^i = \gamma_3^i = \beta_2^i = \gamma_2^i = \pi_{GDP}^i = \pi_{IP}^i = \beta_1^i = \gamma_1^i = 0$. We select the best model out of these five alternatives by minimizing the Schwarz criterion, because of our preference for parsimony in forecasting with potentially mis-specified models.[9]

All BMs are conditioned on simultaneous IP (through the β_0^i parameter), which is a monthly coincident GDP indicator and is available well before the GDP data of the corresponding quarter. However, when forecasting the current quarter, usually not all three months are known and, in any case, IP observations cannot be available for horizons exceeding one quarter. In these circumstances, missing IP data are forecast by auxiliary models. We consider four alternative scenarios corresponding to different situations of data availability in typical forecasting practices: when forecasting GDP one quarter ahead, the conditioning IP may be known just for the first month of the quarter, or for the first two, or, finally, for all three months (this is the so called nowcast case). In the first two instances, IP has to be predicted for two or one step ahead prior to forecasting GDP. More generally, in the h-quarter ahead GDP forecast, when h > 1, IP forecasts are needed at least for (h-1) × 3 months and in the worst case for (h-1) × 3 + 2 months of the forecast horizon.

In all scenarios but the nowcast, auxiliary models are needed, and their reliability in predicting the IP clearly influences the forecasting ability of BMs. In this paper, we use only one auxiliary model: a simple AR(p) for monthly IP log-differences.[10]

For each country, the ordinary least squares (OLS) estimates of both models (AR for IP and BM for GDP) have been obtained through rolling regressions as explained in the previous section.[11]

The pseudo out of sample forecasting exercise covers 10 years and is structured as follows.

[9] Alternative criteria, more prone to (over)fitting, such as Akaike or R^2-bar, would lead to noisier forecasts.

[10] Though the retained data transformation is $\Delta_1 log\ IP$, i.e. month-on-month percent variations, we also considered two other data transformations: 12-month differences (i.e. year-on-year percent variations), and both 1 and 12 month variations. Results in terms of IP forecasting ability are little affected by these alternative data transformations.

[11] The size of the rolling widow to estimate AR models parameters is set to 7 years (84 months) for all countries, as in Bulligan *et al.* (2010). To estimate BM model parameters we set windows of 20 years (80 quarters) for the *JEU* countries, to exploit more information under the assumption of stable parameters. To avoid the effects of possible breaks and regime shifts in the *ASE* and *BRRU* specifications we chose a shorter window of 15 years (60 quarters).

October 1999 is the month in which we start to simulate the behavior of a forecaster who wants to predict world GDP ("first round"): IP is available up to August 1999 (1999m8, two months before the calendar date) and GDP up to the second quarter of 1999 (1999q2). In order to obtain predictions over the following two years (2000-2001), IP has to be forecast up to 28 months ahead and BM up to 10 quarters ahead. In this first round, the BM estimation period ends in 1999q2 and starts 80 quarters earlier for *JEU* countries, 60 quarters for the others groups of countries.

These steps are repeated for the next 119 months, the latter round being September 2009, when IP is known up to 2009m7 and forecast up to 2010m12 (*i.e.* 16 months ahead) and GDP is known up to 2009q2 and forecast up to 2010q4 (6 quarters ahead). For a detailed scheme of each forecast round, see table B6 which reports the calendar of data releases for both GDP and IP, together with the AR forecast horizon for IP and the BM forecast horizon for GDP.

Though BM are normally used only for short run predictions, nonetheless in each forecast round we extrapolate GDP dynamics up to two years, in order to give an extended assessment of the forecasting ability of our approach at longer horizons.[12] Overall, our exercise delivers 40 pseudo out of sample forecast errors for each of the first three 1-step ahead scenarios described above (120 forecasts errors). In addition, we measure forecast errors for 2-, 4- and 6-steps ahead. We compute statistics about BM forecasting ability (mean error, ME, and root mean squared error, RMSE), and compare them with benchmark models using Fair and Shiller (1990), and Giacomini and White (2006) tests (FS and GW henceforth). Benchmark forecasting ability by country is given by an AR quarterly model for world, *JEU, ASE* and *BRRU* GDP growth rates. AR benchmark models are estimated through rolling windows and used in predictions over the same spans of data as those of the BMs.[13]

Along the rows of Table 4, we report the results for the seven countries which sum up to *JEU, ASE* and to *BRRU*, the corresponding aggregates and the world GDP. Along the columns six different forecast horizons are listed: the first three are those described in 1-step ahead scenarios from # 1 to # 3 (see above), and the other three report the results at longer horizons. World GDP is projected by using an aggregator equation of the countries which we forecast, i.e. of *JEU, ASE* and *BRRU* (examples of aggregator equations can be found in Baffigi *et al.*, 2004, and Golinelli and Parigi, 2007).

Results can be summarized in the following three points.

First, in the short run, BM forecasts are usually unbiased (see the ME results), while, over the medium run, forecasts for *JEU*, the US and the European Union (but not those of Japan) tend to overestimate historical levels; the opposite happens with *BRRU* forecasts. The forecast ME for the *ASE* group is close to zero even in the medium run, due to the small bias of some predictions (China, Hong Kong and Thailand), but also to some compensation among the upward bias for Korea, Singapore and Taiwan, and the downward one for India, Indonesia and Philippines. This seems to be true also for the world GDP forecasts. Benchmark models have generally larger biases.

Second, *JEU* countries have lower RMSE than *ASE* and *BRRU*. The usual "average puzzle" applies, as the RMSE for the country aggregates are lower than those of their components. The use of indicator information (here simply the IP) improves appreciably upon the benchmark forecasts. In fact, ratios of BM over the RMSE of AR benchmarks are almost always below one over horizons up to six months (with the only exception of Hong Kong), showing a clear deterioration only at the end of the forecasting horizon (six quarters). BM forecasts of the Chinese GDP have a lower RMSE

[12] Next section will further exploit the 2 year horizon by comparing our forecasts with those of the WEO and *Consensus Forecast*.

[13] In each of the 120 monthly rounds and for each country, the benchmark AR models for first-difference log-GDP are selected by using the Schwarz criterion over a range of lags from 0 to 4.

with respect to the other Asian economies, and markedly improve with respect to the AR benchmark.

Table 4 – Assessment of the forecasting ability of the *Bridge Models*[1]

	GDP forecast horizon					
	1 qrt			*2 qrts*	*4 qrts*	*6 qrts*
	with 1m	*with 2m*	*with 3m*			
World						
ME	0.150	0.170	0.184	0.325	0.513	0.463
RMSE	0.463	0.405	0.380	0.736	1.762	2.436
ratio to AR	**0.715** [a]	**0.635** [b]	**0.596** [b]	**0.612** [a]	**0.854** [a]	1.010 [a]
JEU						
ME	-0.039	-0.005	0.015	-0.053	-0.336	-0.987
RMSE	0.335	0.275	0.241	0.593	1.834	2.666
- ratio to AR	**0.563** [a]	**0.466** [a]	**0.408** [a]	**0.494** [b]	0.774 [b]	0.896
ASE						
ME	-0.060	-0.067	-0.065	-0.102	-0.047	-0.035
RMSE	0.544	0.497	0.480	0.821	1.628	2.379
- ratio to AR	0.727 [a]	0.664 [a]	0.642 [a]	0.647 [a]	0.827 [a]	1.046
BRRU						
ME	0.097	0.112	0.083	0.266	0.774	1.227
RMSE	0.738	0.717	0.718	1.216	3.220	4.377
- ratio to AR	0.545 [b]	**0.533** [a]	**0.534** [a]	**0.493** [a]	0.745 [a]	0.770 [a]

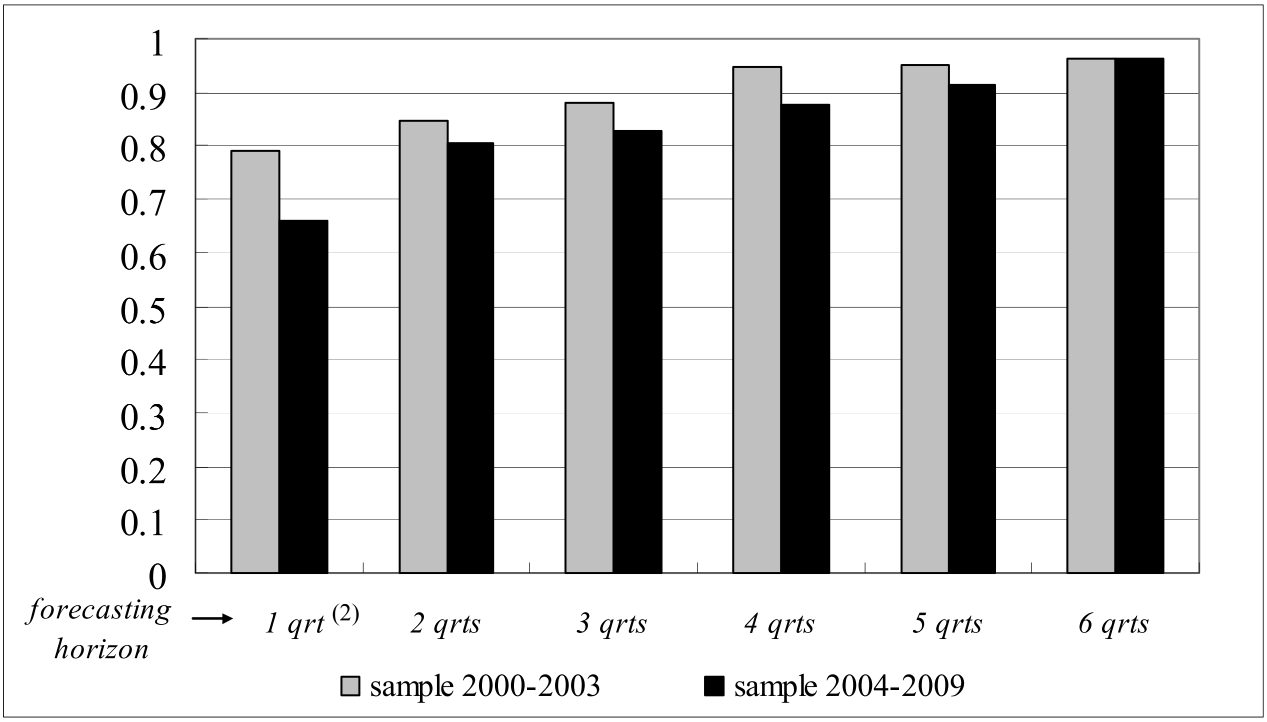
([1]) Ratios are reported in italic when GW is significant at 10%, in bold when it is significant at 5%; further, **a** means that BM parameter in FS equation is 5% significant while AR is not, **b** both parameters are significant. For GW test, we use the test function $h_t = (1, \Delta L_{t-\tau})$.

Third, BM RMSE are not only better "numerically" than those of AR benchmarks, but – in the light of the GW test – they are very often significantly better than benchmark ones. Among the *ASE*, the GW tests show statistically significant improvement for China, Malaysia and Philippines. Furthermore, according to the FS test, BM forecasts are significant explanations of actual GDP development, at least up to one-year (except for Hong Kong and Indonesia), while the significance of benchmark models is often spurious, probably affected by the GDP slowdown of 2008-2009. For this reason, "b" cases in table 4 (where both the BM and AR parameters are significant in the FS regression) tend to be more frequent in *JEU* countries, where the recession was particularly severe. In these particular cases, the results may be influenced by the extreme simplicity of the BM models and some improvement could be obtained by exploiting more indicators.

In Section 2, we argued that the rising contribution of emerging economies to world GDP growth might have relevant implications also for forecasting purposes. We deepen this point by comparing the WBM predictions of the world output growth either including or excluding the groups of *ASE* and *BRRU* in the aggregator equation. In figure 2 we show the ratios between the RMSE obtained from the more comprehensive model (numerator) and from the model excluding the emerging countries (denominator). RMSE ratios for the different forecasting horizons are computed over two sample periods (2000-2003, histograms in grey, and 2004-2009 in black), to evaluate whether the relevance of emerging markets has increased in most recent years.

All the ratios turn out to be lower than one, meaning that the aggregator model which includes also the *ASE* and *BRRU* countries provides more accurate predictions for the world GDP growth. The gain in precision is greater for short term forecasts, attaining the maximum in the case of the nowcast case, while it tends to disappear at longer horizons. The RMSE ratios computed over the second part of the sample (2004-2009) are generally lower than those related to the first forecasting period (2000-2003). The limited number of observations prevents us from computing tests for the significance of these differences. However, these results seem to confirm the evidence presented in Section 2 about the importance of the information content of emerging country dynamics.

Fig. 3 - RMSE ratios between WBM that include or exclude emerging countries(1)



(1) Bars represents the ratios of the RMSE incurred when predicting world GDP with a bridge model that includes emerging economies (*ASE* and *BRRU*) and the RMSE computed when the bridge model includes only advanced economies (*JEU*). Values below 1 prove that the more comprehensive model outperforms the latter. The comparison between grey and black bars, whenever black bars are shorter shows the rising importance of emerging economies.
(2) Results refer to the case in which the conditioning IP is known for all three months of the quarter (nowcast).

4. The WBM, *Consensus* and the IMF's WEO forecasts of world GDP

Having shown the superior accuracy of WBM forecasts, we can now compare them with predictions based on much richer information sets, such as those issued by IMF in April and October of each year in the *World Economic Outlook* (WEO), and those published monthly by *Consensus Forecast.* Our simple WBM is not designed to predict GDP at the horizons typical of the

IMF's WEO and *Consensus Forecast*, nor it can compare with them in terms of model complexity and completeness of the information set. Nonetheless, BMs can be seen as a quick update of the bi-annual WEO's forecasts or as a tool to gauge the changes in the *Consensus* monthly predictions.

4.1 Forecast comparison with the WEO

Once we are equipped with our WBM[14], we might wonder whether, after the publication of the WEO, there is some use for the WBM as we wait for the next WEO release. More specifically, we perform two exercises:

a) an "*updating exercise*" to assess whether our WBM can provide better predictions than what is currently available;

b) an "*anticipating exercise"* to assess the reliability of our WBM in anticipating the predictions that will be published in the next-nearby WEO.

Tab. 5 – Timing of the monthly forecast activity and corresponding WEO forecasts

Month of forecast for WBM	***Month of WEO release used for comparison***		***IP***		***GDP***		***Years predicted***
	Updating	*Anticipating*	*Last available month*	*forecast horizon (in months)*	*data availability*	*Last available quarter*	
October (t)	***October (t)***	***April (t+1)***	**m8**	**28**	**q2**	**10**	**t+1, t+2**
November(t)			m9	27	q2	10	t+1, t+2
December (t)			m10	26	q3	9	t+1, t+2
January (t+1)			m11	25	q3	9	t+1, t+2
February (t+1)			m12	24	q3	9	t+1, t+2
March (t+1)			m1	23	q4	8	t+1, t+2
April (t+1)	***April (t+1)***	***October (t+1)***	**m2**	**22**	**q4**	**8**	t+1, t+2
May (t+1)			m3	21	q4	8	t+1, t+2
June (t+1)			m4	20	q1	7	t+1, t+2
July (t+1)			m5	19	q1	7	t+1, t+2
August (t+1)			m6	18	q1	7	t+1, t+2
September (t+1)			m7	17	q2	6	t+1, t+2

In the *updating* exercise, from October of year *t* to March of *t+1* the WBM allow to "*update*" 6 times the world output growth forecasts for years *t+1* and *t+2* published in October of year *t*; similarly, from April to September of year *t+1* we update 6 times the forecasts published in April *t+1* (see Tab. 5).[15]

Analogously, the *anticipating* exercise is structured as follows: from October of year *t* to March of *t+1* our WBM can "*anticipate*" 6 times the world output growth forecasts for years *t+1*

[14] Obviously, what is said here for the WBM can be replicated for the single BMs of countries and country groups.

[15] Hence from October *t* to March *t+1* we "anticipate" 6 times the world output growth forecasts that will be published in April for years *t+1* and *t+2*; similarly, from April to September of year *t+1* we "update" 6 times these forecasts and compare them with those published in October *t+1*. It is worth recalling that April WEO forecasts are based on data available up to March, while October WEO forecasts on data up to September.

and *t+2* that will be published in April of year *t+1*; similarly, from April to September *t+1* we anticipate 6 times the forecasts that will be published in October *t+1*.

We start our simulation exercise in October 1999 and end it in September 2009. In both exercises the accuracy of the WBM and the WEO are compared with the final estimates of world GDP growth, approximated by the estimates released for the years 2000-2009 in the most recent WEO publication (in this case April 2010).

Table 6a. Evaluation of WBM forecast: updating WEO

Month of forecast for WBM	*Month of WEO release used for comparison*	TARGET YEAR *"t + 1"*		TARGET YEAR *"t + 2"*	
		RMSE of last WEO predictions w.r.t."final" estimates	*RMSE of WBM predictions w.r.t."final" estimates*	*RMSE of last WEO predictions w.r.t."final" estimates*	*RMSE of WBM predictions w.r.t."final" estimates*
October (t)	October (t)	1.53	1.76	–	3.05
November(t)			1.66		2.97
December (t)			1.46		2.78
January (t+1)			1.08		2.59
February (t+1)			0.99		2.83
March (t+1)			0.97		3.00
April (t+1)	April (t+1)	0.52	1.01	2.13	3.25
May (t+1)			0.87		3.07
June (t+1)			0.77		2.69
July (t+1)			0.72		2.56
August (t+1)			0.68		2.39
September (t+1)			0.38		2.11

Table 6b. Evaluation of WBM forecast: anticipating WEO

Month of forecast for WBM	*Month of WEO release used for comparison*	TARGET YEAR "*t + 1*"			TARGET YEAR "*t + 2*"		
		RMSE of WBM w.r.t. "next-nearby" WEO predictions	*RMSE of "next-nearby" WEO predictions w.r.t."final" estimates*	*RMSE of WBM predictions w.r.t."final" estimates*	*RMSE of WBM w.r.t. "next-nearby" WEO predictions*	*RMSE of "next-nearby" WEO predictions w.r.t."final" estimates*	*RMSE of WBM predictions w.r.t."final" estimates*
October (t)	April (t+1)	1.74	0.52	1.76	2.82	2.13	3.05
November(t)		1.62		1.66	2.71		2.97
December (t)		1.40		1.46	2.42		2.78
January (t+1)		0.89		1.08	1.79		2.59
February (t+1)		0.61		0.99	1.48		2.83
March (t+1)		0.51		0.97	1.36		3.00
April (t+1)	October (t+1)	0.73	0.37	1.01	2.08	1.80	3.25
May (t+1)		0.60		0.87	1.92		3.07
June (t+1)		0.54		0.77	1.56		2.69
July (t+1)		0.54		0.72	1.53		2.56
August (t+1)		0.55		0.68	1.51		2.39
September (t+1)		0.23		0.38	1.04		2.11

In the *updating* exercise reported in table 6a, the WBM 1-year ahead predictions (termed *t+1*) appear to be more accurate in the first few months of year *t+1* with respect to the October WEO release. To outperform the predictions of the April WEO, one has to wait until September of the same year, when sufficient new high frequency information (here IP) dramatically improves WBM accuracy. In the last 3 months of the year (not reported in the table) the WBM accuracy is always significantly superior to the October WEO release as to the prediction of "current" year growth.

In the *anticipating* exercise, shown in table 6b, the accuracy of the WEO can be compared to two benchmarks: the final estimates of the annual growth (third column in each "target year" section of table 6b); the next-nearby WEO forecast (first column). Results lend support to the conclusion that the accuracy of WBM forecasts increases as we approach the date of the WEO release, by exploiting more and more monthly information.

Table 7 deepens the comparison between WBM and WEO forecasting ability by focusing on what we previously termed 1-year ahead prediction, i.e. WBM forecasts for year *t+1* produced in the last 3 months of the previous year and in the months from January till September of the year to be forecast. Monthly WBM forecast errors with respect to the "final" GDP are compared with the WEO ones. In particular, we made the same two different types of check termed above *updating* and *anticipating* the WEO.

In other terms, we compare with a statistical test what is descriptively reported in Table 6 above. In both cases, we assess the relative performance of the predictions using a simple forecast encompassing test (see Clements, 2005), which is quite close to that proposed in Fair and Shiller (1990) with the advantage of being based on a more parsimonious model, a particularly welcome characteristic in this context since we have only 10 observations for each variable. For the target-year *t+1* (*t+1* = 2000, 2001,... 2009, i.e. 10 observations), we estimate via OLS the following equation:

$$e^{WBM}_{m,t+1} = \lambda\,(e^{WBM}_{m,t+1} - e^{WEO}_{i,t+1}) + e^{C}_{m,t+1} \qquad \begin{array}{l} m = 1,2,3...12 \\ i = October \text{ or } April \end{array} \tag{4}$$

where $e_{m,t+1}^{WBM} = y_{t+1}^{final} - y_{m,t+1}^{WBM}$ is the forecast error of the WBM in month m and $e_{i,t+1}^{WEO} = y_{t+1}^{final} - y_{i,t+1}^{WEO}$ is the WEO error relative to its issue i ; $e_{m,t+1}^{C}$ is the forecast combination error, to be minimized as a function of the estimated parameter (weight) λ. On the basis of this simple model, the hypothesis that WBM forecast encompasses the WEO ones can be tested imposing $\lambda = 0$ in eq. 5.[16] This test was repeated twelve times, for all the months of each year.

If the WBM forecast error is defined – as above – for m = October to December of year t and January to September of year $t+1$, while the WEO one is for i = October of year t and April of year $t+1$, eq. (5) can be used to test for WBM ability to update next WEO, i.e. the first of the two exercises above. Alternatively, if the WBM forecast error is defined for m = October to December of year t and January to September of year $t+1$ and the WEO one is for i = April and October of year $t+1$, eq. (5) can be used to test for WBM ability to predict next-nearby WEO, as stated the second of the two exercises above. In short, given the same WBM forecast errors in eq. (5), the subject of the two encompassing tests depends on the competing WEO errors: if we use the last published issue errors, we refer to the *updating* exercise, if we use next published issue errors, we refer to the *anticipating* one. The results are reported in Table 7.

Tab. 7 – Evaluating WBM: encompassing WEO [1]

Month of forecast for WBM	Month of WEO release used for comparison	TARGET YEAR "t + 1"							
		World		JEU		ASE		BRRU	
		updating	anticipating	updating	anticipating	updating	anticipating	updating	anticipating
October (t)	October (t)	0.096	0.000	0.084	0.000	0.666	0.005	0.296	0.000
November(t)		0.285	0.000	0.206	0.000	0.938	0.008	0.447	0.000
December (t)		0.497	0.000	0.447	0.000	0.707	0.029	0.820	0.000
January (t+1)		0.479	0.001	0.896	0.000	0.214	0.011	0.000	0.023
February (t+1)		0.709	0.000	0.167	0.000	0.000	0.000	0.981	0.008
March (t+1)		0.040	0.000	0.025	0.000	0.019	0.071	0.887	0.902
April (t+1)	April (t+1)	0.000	0.000	0.000	0.000	0.106	0.001	0.717	0.000
May (t+1)		0.000	0.000	0.000	0.001	0.215	0.003	0.375	0.000
June (t+1)		0.211	0.000	0.016	0.005	0.526	0.374	0.083	0.003
July (t+1)		0.205	0.003	0.042	0.001	0.569	0.573	0.332	0.000
August (t+1)		0.229	0.016	0.073	0.004	0.255	0.580	0.255	0.003
September (t+1)		0.426	0.110	0.034	0.552	0.823	0.408	0.895	0.140

([1]) See Clements (2005, p. 15) for details and notation. λ estimates reported in column (3) are the optimal weight of the WEO forecast. Column (4) reports the corresponding Newey-West (1987) standard errors, and column (5) the p-value of H_0: λ=0, The following two columns report the same information about WBM weights.

Though we must be cautious because of the lack of data (each regression is run over a sample of only 10 observations), the results are sufficiently clear to detect the WBM ability of efficiently exploit information, when data on GDP are not yet released, while indicators are available. BM forecasts from October of year t to February or March of year $t+1$ encompass WEO ones published in the issue of October of year t. WEO forecasts are no more negligible in April, when new IMF predictions are released, but WBM forecasts start encompassing again WEO ones from June to the end of the forecasting exercise. Note that there are a few exceptions to this overall pattern, that repeats itself for world growth and for *JEU, ASE* and *BRRU's* ones. Given the paucity of data points

[16] See Clements and Hendry (2004). Estimation results in Table 7 are robust to the inclusion of an intercept in the test equation in order to allow for biased forecasts. Though the inference about the λ parameter is based on the Newey and West (1987) heteroskedasticity and autocorrelation-consistent standard error estimates, the reported results are robust to alternative estimates of parameters' variance-covariance matrix.

on which the *p-values* are computed, we cannot deny that the presence of a single outlier might hide an otherwise robust pattern. Comparing the results across the different country groups, we note that BM estimates provide a superior forecasting accuracy with respect to the previous WEO in particular for emerging markets (*ASE* and *BRRU*). In this cases *p*-values of the encompassing test are in general larger, and for many countries of the *ASE* group, BM's forecasts always encompass the WEO in the *updating* exercise.

As to the *anticipating* test, from October of year t to March of $t+1$, WBM never encompasses WEO forecasts of world growth in $t+1$ released in April of year $t+1$, while at the very end of the forecast round, i.e. since September $t+1$, WBM forecast narrowly encompasses the next-nearby WEO (October) forecasts. A similar pattern is detectable also for the *JEU* and *BRRU* aggregates, while for *ASE* BM forecasts encompass the predictions that will be released in the "future" WEO since June of year $t+1$.

Overall, we can conclude that, in order to predict the current year, WBM forecasts are generally better than previous WEO ones, with the exception of the months immediately after the April release. If we want to anticipate the world GDP forecast published in October WEO, then only the WBM predictions made since September (when two quarters of GDP and also one month of the third quarter of IP are known) appear to be more accurate. Both in the *updating* and *anticipating* exercises, BM forecasts turn out to be a particularly effective tool, in comparison with the WEO benchmark, in predicting the GDP of emerging economies, in particular for the *ASE* group.

4.2 Forecast performance during the recession: WBM, WEO and Consensus

During the recession of 2007-09 the main forecasting institutions performed particularly poorly, facing a sequence of unprecedented shocks in the sample period normally used for forecasting (see Visco, 2009). It is therefore interesting to check if the bridge models proposed here, although very simple and not tailored for predicting next year growth, could have made a reasonably good job in tracking the evolution of the world economy during the crisis. The sharp slowdown in world GDP growth occurred in 2009 proved particularly hard to anticipate, as shown in table 8. We therefore select this year for our "recession tracking" exercise.

Tab. 8 – April's WEO forecast errors for next year annual growth

WEO's release	***Forecast for target year***	***Final estimate***	***Forecast error***
Apr. 2006 (*Target: 2007*)	4.7	5.2	0.5
Apr. 2007 (*Target: 2008*)	4.9	3.0	-1.9
Apr. 2008 (*Target: 2009*)	3.8	-0.6	**-4.4**

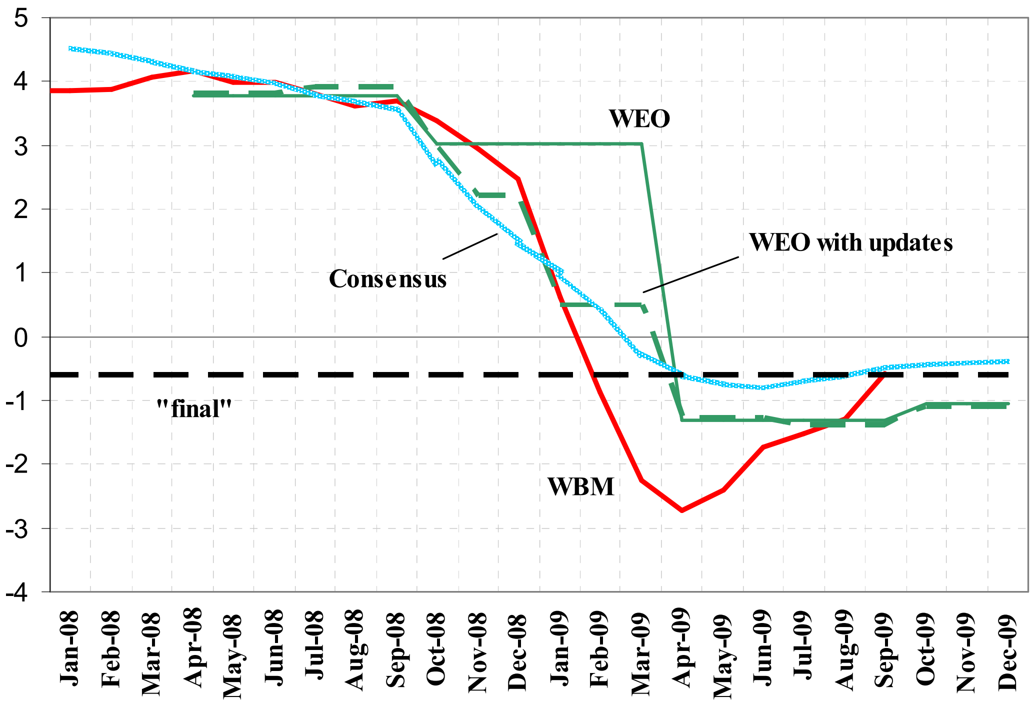
Source: IMF and authors computations

To monitor the forecasting performance of the WBM (and of the countries and country groups BMs) we plot in Figure 4 the monthly prediction for growth in 2009 computed over the January 2008 - December 2009 period. We compare BMs predictions with those of the WEO, considering this time also the "updates" published between the main releases of IMF forecasts. [17] We also look

[17] During this period the IMF published forecasts updates every other quarter, thus effectively providing a new scenario for the world outlook every 3 months.

at *Consensus Forecasts* published monthly for all the countries considered in this paper. The prediction of annual GDP growth for the world and for *JEU, ASE* and *BRRU* were obtained as a weighted sum of those of the countries involved, with weights given by 2000 GDP shares at PPP.[18] As shown in the graph, only at the end of the summer of 2008 the models started signaling a clear deceleration in GDP growth. By the end of that year it became clear that the economic slump was much harsher than previously envisaged. Quite surprisingly, our simple BMs did not perform visibly worse than *Consensus* or the *WEO* (considering the updates to the world outlook). A disturbing feature is the considerable undershooting of the WBM in the spring of 2009, when the US (and probably the world) economy reached a trough according to the NBER business cycle dating.[19] Our BMs – being based solely on industrial production that was hit much harder than the other sectors – are bound by design to produce a starker slump than indicators based on a wider range of activities. We therefore believe that a richer specification of the BM would contribute to reduce the undershooting. Quite interestingly – looking at countries and groupings (see figure B2 in appendix B) – one can observe that the underprediction was strong for advanced countries (both *JEU* and Asian *NIE*s), where services play a larger role in economic growth, while it was not present in the case of China, whose growth is largely determined by manufacturing output and exports.

Fig. 4 - Comparison of WBM monthly forecasts patterns of World GDP growth for 2009 with WEO and *Consensus* predictions [1]



([1]) The horizontal axis measures the calendar dates in which the forecasts are made. WBM line measures the forecasts made with bridge models in rounds # 97-120 (see Appendix B). WEO plot measures the forecasts released by IMF. The latest available data are those published in WEO of April 2010.

[18] As *Consensus* does not publish world output growth, we computed it as the weighted sum of the following countries: USA, Japan, Germany, France, United Kingdom, Italy and Spain (for JEU), and the four single BRIC countries. Weights – constant over time – are derived from IMF (2010), World Economic Outlook, April, p. 148.

[19] The NBER dating committee has recently agreed to pinpoint June 2009 as the trough month in the US for the recession started in December 2007, according to the same institution (see http://www.nber.org/cycles/sept2010.html).

5. Conclusions

Over the last fifteen years financial and economic globalization have proceeded at very high speed. New actors have appeared on the scene of the world economy, moving rapidly to the center of the stage. China and the other East Asian emerging economies (together with Brazil and Russia), play a determinant role in all economic *fora*. The greater relevance acquired by the G20, that has *de facto* taken the place of the G8, is a product of this evolution and at the same time it confirms the deep changes occurred in the economic and political landscape.

The analysis of the global economic developments must not ignore these changes. This is true also for the assessment of its short run evolution. In the first part of this paper we showed that a break occurred in the relationship between the GDP of the world and of the main advanced countries (Japan, the EU and the US). We also showed that this break is due to the increased weight of the Asian emerging economies, characterized by a markedly different cyclical pattern. This implies that considering only the economic situation of the most advanced country (as in Golinelli and Parigi, 2007; and Arouba and Diebold, 2010) might give a biased picture of the main trends at global level.

Exploiting simple bridge models, we provide a natural and easy way to tackle this new environment. The models proposed have been deliberately kept very simple, in order to show the advantage of our approach without unavoidably incurring in criticisms of "data mining" and of using *ex post* knowledge. Using this tool, we also show how the inclusion of information on emerging markets improves the accuracy of world GDP forecasts.

A problem arises, though, when dealing with the world economy: the lack of a benchmark variable at higher frequencies (say, quarterly) with which to evaluate the reliability of the tools proposed for the assessment of the current situation. The solution given in this paper has been to compare our forecasts with those periodically published by international institutions, such as the IMF's WEO or *Consensus*. The results are very encouraging: bridge models estimates fare well with respect to the WEO forecasts, both as an updating (the most recent WEO forecasts) and as an anticipating (the next WEO forecasts) device. Forecasting accuracy, however, is not the whole story: the value of bridge model estimates lies also in the their real time availability and in the extreme simplicity of the computations.

The comparison with more complete and broad based forecasts has underlined the importance of employing a set of indicators which may cover the most prominent sectors of the economy in the various countries/areas. The models used in this paper exploit only the information contained in the industrial production index, which clearly provides a partial view of the evolution of the economic activity at least in the most advanced countries. This is the main reason for the undershooting of bridge models estimates during the crisis of 2009, that do not take into account confidence effects stemming primarily from the service, and more specifically the financial sector.

This is an important direction for further research that depends on the availability of reliable indicators. This is particularly crucial for the emerging economies where the economic structure and the available data themselves are changing very rapidly.

It is also worth noting that the forecasting experiment carried out in this paper is conservative also in another dimension: regarding the timing of the data releases. In fact, at least for some countries, monthly IP and quarterly GDP data are more timely than what we assumed here. In addition, it could be that early monthly releases of IP can also help improving IP forecasting ability over that of our simple AR models. Of course, the actual assessment of the improvement of BM forecasting ability implementing all these refinements is left to future research.

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Appendix A – Data sources

We collected the longest available series of both quarterly GDP and monthly IP for: US, European Union, Japan, Brazil, Russia, China, India, Indonesia, Malaysia, Thailand, Philippines, Hong Kong, Singapore, Korea and Taiwan.

GDP quarterly data. NIESR provides quarterly world GDP data which are coherent with annual WEO figures. Regarding the other 15 countries/areas we used the respective sources, listed in Table A1. In order to have comparable GDP national levels, we re-scaled all the "final" quarterly GDP time series to match the 2000 annual levels expressed in international Dollars (PPP), as they are reported by the IMF's WEO.

IP monthly data. The source of data for US, European Union, Japan, Brazil, India and Russia is the OECD Main Economic Indicators (MEI) database, the series selected is *production of total industry, seasonally adjusted (2005=100)*. Data for this series are available at least since 1975 with only two exceptions: India, whose series starts in 1994 and Russia, whose series starts in 1993. For India data from 1960 to 1993 are constructed using the growth rates of the corresponding series published by the IMF's International Financial Statistic (seasonally adjusted with X12 ARIMA). In the case of Russia data are backcasted to 1989 using the monthly interpolation (quadratic match sum) of Bessonov (2002, Tab. 4) annual growth rates. China IP data rely on a series built by the Bank of Italy, data prior to 1989 are constructed using the growth rate of electricity consumption. Other Asian countries' IP series (Indonesia, Malaysia, Thailand, Philippines, Singapore, Korea and Taiwan) we used the respective national sources, listed in Table A2.. Monthly data for Indonesia (prior to 1994) and Philippines (prior to 1995) are backcasted using the monthly interpolation (quadratic match sum) of the available quarterly growth rates. Monthly data for Malaysia (prior to 1990) are backcasted using the monthly growth rate of the nominal sales deflated by CPI. For Hong Kong, IP data are replaced by the series (available from 1983) of cement production (volume index).

Table A1 – GDP National sources [1]

country	seasonality [2]	from-to	source
US	sa	1947-2010	The Real-Time Data Research Center, Federal Reserve Bank of Philadelphia.
EU 15	sa	1960-2010	OECD Stats
Japan	sa	1960-2010	OECD Stats
Brazil	sa	1996-2010	OECD, National Accounts for Non-Member Economies
	sa	1980-1995	Institute of Applied Economic Research (IPEA), Presidencia da Republica, Brasil
	sa	1951-1979	quarterly interpolation (quadratic match sum) of Maddison's annual growth rates
Russia	sa	1995-2010	OECD, National Accounts for Non-Member Economies
	sa	1951-1994	quarterly interpolation (quadratic match sum) of Maddison's annual growth rates
China	sa	2005-2010	NBS China, seasonally adjusted y-o-y growth rate
	nsa	1999-2004	NBS China, not seasonally-adjusted y-o-y growth rate

	nsa	1978-1998	Abeysinghe and Gulasekaran (2004), and updates on Tilak Abeysinghe's webpage
	sa	1952-1977	quarterly interpolation (quadratic match sum) of Maddison's annual growth rates
India	sa	1996-2010	OECD, National Accounts for Non-Member Economies
	sa	1983-1996	Vineet and Kapoor (2003)
	sa	1951-1982	quarterly interpolation (quadratic match sum) of Maddison's annual growth rates
Indonesia	nsa	2000-2010	Badan Pusat Statistik
	nsa	1975-1999	Abeysinghe and Gulasekaran (2004), and updates on Tilak Abeysinghe's webpage
Malaysia	nsa	2000-2010	Department of Statistics, Malaysia
	nsa	1975-1999	Abeysinghe and Gulasekaran (2004), and updates on Tilak Abeysinghe's webpage
Philippines	sa	1992-2010	National Statistics Coordination Board
	nsa	1975-1991	Abeysinghe and Gulasekaran (2004), and updates on Tilak Abeysinghe's webpage
Thailand	sa	1993-2010	Office of National Economic and Social Development
	nsa	1975-1992	Abeysinghe and Gulasekaran (2004), and updates on Tilak Abeysinghe's webpage
Hong Kong	nsa	1973-2010	Census and Statistics Departments
Singapore	sa	1975-2010	Department of Statistics, Singapore
Korea	sa	1970-2010	The Bank of Korea
Taiwan	nsa	1961-2010	Directorate General of Budget, Accounting and Statistics

([1]) When more sources are listed for the same country, the most recent source is "backcasted" by using the growth rates of the other available sources after comparability checks for the overlapping periods. ([2]) Not seasonally adjusted (nsa) data are filtered by using X12 ARIMA.

Table A2 – Industrial Production Indices of other Asian countries - National sources [1]

country	description	seasonality (2)	from-to	source
Indonesia	Industrial production index, volume	nsa	1994-2010	Badan Pustat Statistik
Malaysia	Industrial production index, volume	nsa	1990-2010	Department of Statistics, Malaysia
Philippines	Manufacturing industrial production index, volume	nsa	1995-2010	Philippines National Statistical Office
Singapore	Industrial production (excluding rubber) index, volume	nsa	1983-2010	Department of Statistics, Singapore

South Korea	Industrial production index, volume	sa	1980-2010	Kostat - Department of Statistics, Korea
Taiwan	Industrial production index, volume	nsa	1971-2010	MOEA, Ministry of Economic Affairs
Thailand	Manufacturing industrial production index, volume	nsa	1987-1999	Bank of Thailand
	Manufacturing industrial production index, volume	nsa	2000-2010	OIE, Ministry of Industry of Thailand
Hong Kong	Cement production	nsa	1983-2010	Census and Statistics Department, Hong Kong

([1]) When more sources are listed for the same country, the most recent source is "backcasted" by using the growth rates of the other available sources after comparability checks for the overlapping periods. ([2]) Not seasonally adjusted (nsa) data are filtered by using X12 ARIMA.

Appendix B – Additional tables and graphs

Table B1 - Weights of different destination markets in total China export
(values in current US dollars, percent shares)

	1995	2000	2005	2008
EU	**12.9**	**15.3**	**17.4**	**18.0**
USA	**16.6**	**20.9**	**21.4**	**17.7**
Japan	**19.1**	**16.7**	**11.0**	**8.1**
NIES	**33.1**	**26.7**	**25.3**	**22.6**
Hong Kong	*24.2*	*17.9*	*16.3*	*13.3*
Korea	*4.5*	*4.5*	*4.6*	*5.2*
Singapore	*2.4*	*2.3*	*2.2*	*2.3*
Taiwan	*2.1*	*2.0*	*2.2*	*1.8*
Other Developing Asia(2)	**4.7**	**5.0**	**6.0**	**7.7**
India	*0.5*	*0.6*	*1.2*	*2.2*
Malaysia	*0.9*	*1.0*	*1.4*	*1.5*
Vietnam	*0.5*	*0.6*	*0.7*	*1.1*
Indonesia	*1.0*	*1.2*	*1.1*	*1.2*
Thailand	*1.2*	*0.9*	*1.0*	*1.1*
Philippines	*0.7*	*0.6*	*0.6*	*0.6*
Russia	**1.1**	**0.9**	**1.7**	**2.3**
Brazil	**0.5**	**0.5**	**0.6**	**1.3**

source: UN Comtrade

Table B2 - China's share in each importing county/group
(values in current US dollars, percent shares)

	1995	2000	2005	2008
EU	**4.4**	**6.7**	**11.8**	**13.3**
USA	**6.3**	**8.6**	**15.0**	**16.5**
Japan	**10.8**	**14.5**	**21.1**	**18.8**
NIES	**11.3**	**14.9**	**23.0**	**25.2**
Hong Kong	*36.2*	*43.1*	*45.0*	*46.6*
Korea	*5.6*	*8.1*	*14.8*	*17.7*
Singapore	*3.3*	*5.3*	*10.3*	*10.6*
Taiwan	*0.4*	*2.9*	*22.0*	*25.7*
Other Developing Asia(2)	**7.2**	**4.8**	**10.1**	**12.5**
India	*2.2*	*3.0*	*7.9*	*10.7*
Malaysia	*2.3*	*4.0*	*11.7*	*13.1*
Vietnam	*3.5*	*9.0*	*16.4*	*20.5*
Indonesia	*30.0*	*5.2*	*8.8*	*11.5*
Thailand	*3.0*	*5.5*	*9.4*	*11.6*
Philippines	*2.3*	*2.4*	*6.3*	*7.6*
Russia	**1.6**	**2.8**	**7.3**	**13.0**
Brazil	**0.8**	**2.2**	**7.3**	**11.6**

source: UN Comtrade

Table B3 - China's weight in total export from each county/group
(values in current US dollars, percent shares)

	1995	2000	2005	2008
EU	**2.5**	**2.5**	**4.0**	**4.8**
USA	**2.0**	**2.1**	**4.7**	**5.6**
Japan	**5.0**	**6.3**	**13.5**	**16.1**
NIES	**10.9**	**13.0**	**24.3**	**26.3**
Hong Kong	*33.3*	*34.5*	*45.0*	*48.5*
Korea	*7.5*	*10.8*	*21.8*	*21.7*
Singapore	*2.3*	*3.9*	*8.6*	*9.2*
Taiwan	*0.4*	*2.9*	*22.0*	*25.7*
Other Developing Asia(2)	**2.8**	**4.3**	**8.3**	**8.7**
India	*1.0*	*1.7*	*7.2*	*5.6*
Malaysia	*2.7*	*3.1*	*6.5*	*9.6*
Vietnam	*5.2*	*10.6*	*10.0*	*7.8*
Indonesia	*3.8*	*4.5*	*7.8*	*8.5*
Thailand	*2.9*	*4.1*	*8.3*	*9.3*
Philippines	*1.2*	*1.7*	*9.9*	*11.2*
Russia	**5.4**	**3.9**	**4.6**	**5.3**
Brazil	**2.6**	**2.0**	**5.8**	**8.3**

source: UN Comtrade

Table B4 – Explaining the World GDP growth : estimation results[1]

dependent variable: **World GDP growth**

	(1)	(2)	(3)	(4)
Sample period	**1979 Q1-2010 Q1**	**1979 Q1-1993 Q4**	**1994 Q1-2010 Q1**	
observations	125	60	65	
constant	0.0008	0.0019	-0.0016	-0.0035
	(0.0045)	(0.0017)	(0.002)	(0.0026)
JEU GDP growth	0.5188 ***	0.8214 ***	0.5376 ***	-0.2838 **
	(0.1291)	(0.0877)	(0.0866)	(0.1211)
ASE GDP growth	0.2150	-0.0001	0.4186 ***	0.4186 ***
	(0.2971)	(0.114)	(0.1213)	(0.1636)
BRRU GDP growth	0.1403 ***	0.0683 *	0.0649 *	-0.0035
	(0.0362)	(0.041)	(0.0416)	(0.0591)
sum of *w(i)*	0.8740	0.8896	1.0210	
	(0.1775)	(0.0923)	(0.1169)	
Godfrey AC (p-val):				
- 1st order	0.0851	0.7470	0.6772	
- 4th order	0.2781	0.8677	0.0773	
Andrews breakpoint:				
- Sup F-statistic ((p-val)	0.0000	0.1477	0.0952	
Hausman test:				
- weak exogeneity	0.0267			

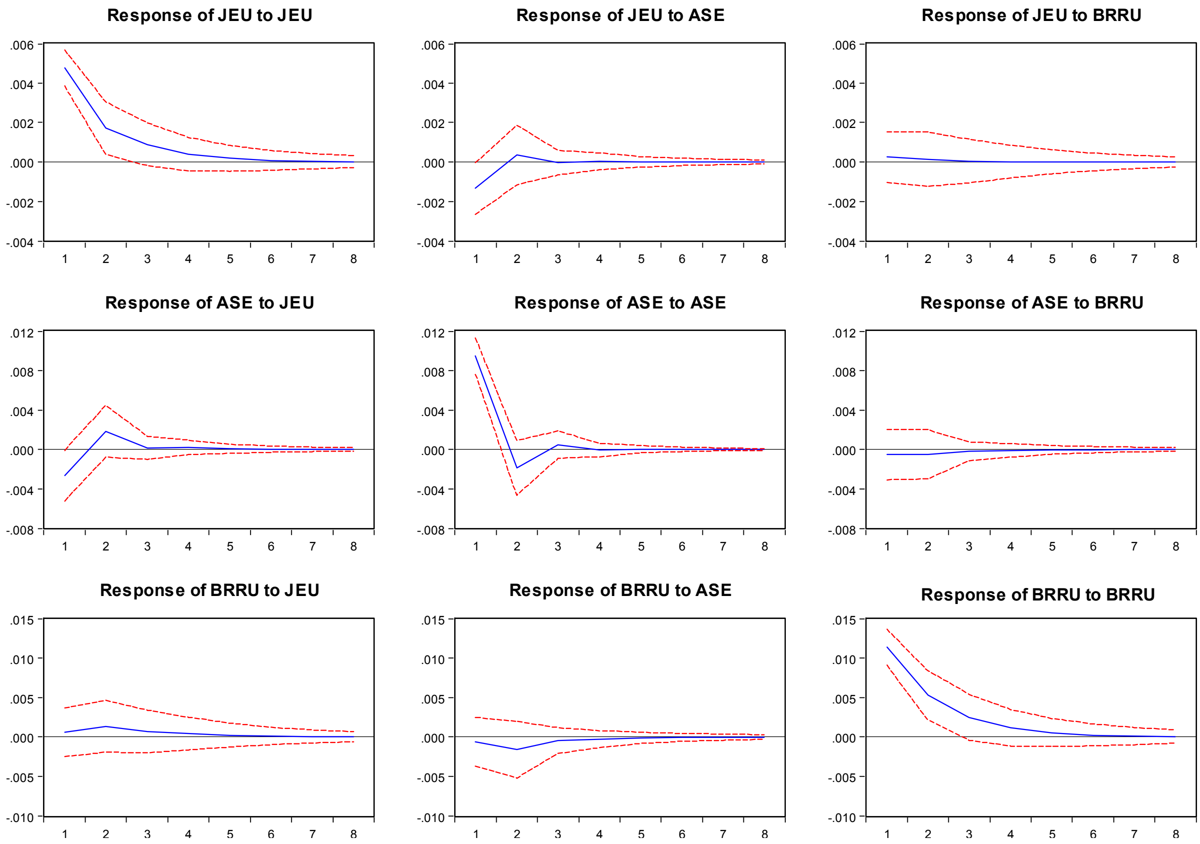
(1) HAC standard errors are reported in brackets.

Table B5 – The dynamic relationship among country groups: VAR estimation results

	(1)	(2)	(3)
Sample period	**1979 Q1-2010 Q1**	**1979 Q1-1993 Q4**	**1994 Q1-2010 Q1**
observations	125	60	65
Standard errors			
- JEU equation	0.004	0.005	0.004
- ASE equation	0.009	0.009	0.008
- BRRU equation	0.013	0.011	0.012
Godfrey AC (p-val):			
- 1st order	0.794	0.647	0.114
- 4th order	0.746	0.093	0.099
Non Granger causality NGC (p-values)			
- ASE NGC JEU	0.002	0.147	0.006
- BRRU NGC JEU	0.280	0.886	0.035
overall in JEU equation	0.005	0.347	0.006
- JEU NGC ASE	0.154	0.210	0.710
- BRRU NGC ASE	0.646	0.566	0.747
overall in ASE equation	0.360	0.409	0.818
- JEU NGC BRRU	0.141	0.574	0.194
- ASE NGC BRRU	0.151	0.459	0.001
overall in BRRU equation	0.113	0.584	0.001
Correlation between VAR shocks			
- JEU, ASE	-0.027	-0.280	0.296
- JEU, BRRU	0.191	0.053	0.294
- ASE, BRRU	0.101	-0.054	0.131

Figure B1 – Impulse-response from VAR(1) estimates: response to generalized one S.D. Innovations ± 2 S.E.

Sample period 1979q1 - 1993q4



Sample period 1994q1 - 2010q1

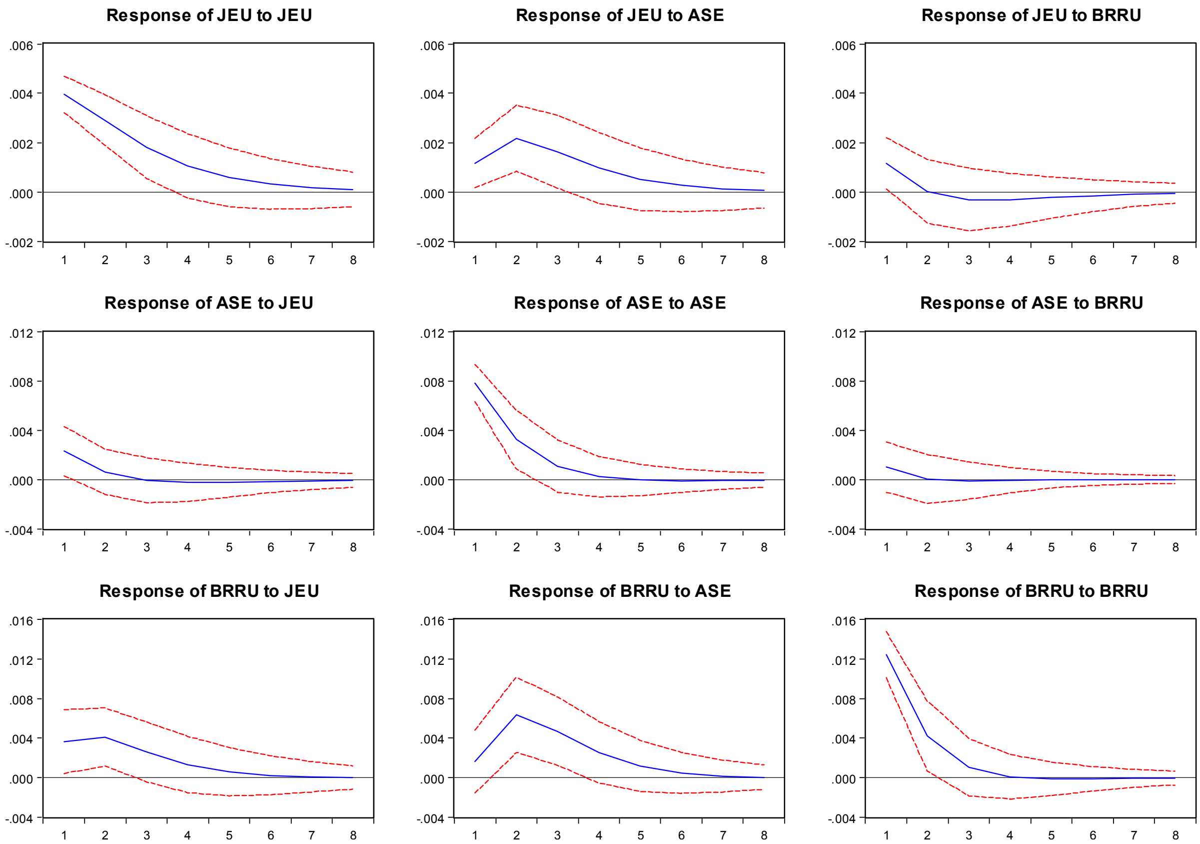


Table B6 – The calendar of the forecasting exercise

#	calendar date:		Monthly IP forecasts							Quarterly GDP forecast						
			latest av. month		forecast period				h	latest av. quarter		forecast period				h
1	oct	1999	1999	8	1999	9	2001	12	28	1999	2	1999	3	2001	4	10
2	nov	1999	1999	9	1999	10	2001	12	27	1999	2	1999	3	2001	4	10
3	dec	1999	1999	10	1999	11	2001	12	26	1999	3	1999	4	2001	4	9
4	jan	2000	1999	11	1999	12	2001	12	25	1999	3	1999	4	2001	4	9
5	feb	2000	1999	12	2000	1	2001	12	24	1999	3	1999	4	2001	4	9
6	mar	2000	2000	1	2000	2	2001	12	23	1999	4	2000	1	2001	4	8
7	apr	2000	2000	2	2000	3	2001	12	22	1999	4	2000	1	2001	4	8
8	may	2000	2000	3	2000	4	2001	12	21	1999	4	2000	1	2001	4	8
9	jun	2000	2000	4	2000	5	2001	12	20	2000	1	2000	2	2001	4	7
10	jul	2000	2000	5	2000	6	2001	12	19	2000	1	2000	2	2001	4	7
11	aug	2000	2000	6	2000	7	2001	12	18	2000	1	2000	2	2001	4	7
12	sept	2000	2000	7	2000	8	2001	12	17	2000	2	2000	3	2001	4	6
13	oct	2000	2000	8	2000	9	2002	12	28	2000	2	2000	3	2002	4	10
14	nov	2000	2000	9	2000	10	2002	12	27	2000	2	2000	3	2002	4	10
15	dec	2000	2000	10	2000	11	2002	12	26	2000	3	2000	4	2002	4	9
16	jan	2001	2000	11	2000	12	2002	12	25	2000	3	2000	4	2002	4	9
17	feb	2001	2000	12	2001	1	2002	12	24	2000	3	2000	4	2002	4	9
18	mar	2001	2001	1	2001	2	2002	12	23	2000	4	2001	1	2002	4	8
19	apr	2001	2001	2	2001	3	2002	12	22	2000	4	2001	1	2002	4	8
20	may	2001	2001	3	2001	4	2002	12	21	2000	4	2001	1	2002	4	8
21	jun	2001	2001	4	2001	5	2002	12	20	2001	1	2001	2	2002	4	7
22	jul	2001	2001	5	2001	6	2002	12	19	2001	1	2001	2	2002	4	7
23	aug	2001	2001	6	2001	7	2002	12	18	2001	1	2001	2	2002	4	7
24	sept	2001	2001	7	2001	8	2002	12	17	2001	2	2001	3	2002	4	6
25	oct	2001	2001	8	2001	9	2003	12	28	2001	2	2001	3	2003	4	10
26	nov	2001	2001	9	2001	10	2003	12	27	2001	2	2001	3	2003	4	10
27	dec	2001	2001	10	2001	11	2003	12	26	2001	3	2001	4	2003	4	9
28	jan	2002	2001	11	2001	12	2003	12	25	2001	3	2001	4	2003	4	9
29	feb	2002	2001	12	2002	1	2003	12	24	2001	3	2001	4	2003	4	9
30	mar	2002	2002	1	2002	2	2003	12	23	2001	4	2002	1	2003	4	8
31	apr	2002	2002	2	2002	3	2003	12	22	2001	4	2002	1	2003	4	8
32	may	2002	2002	3	2002	4	2003	12	21	2001	4	2002	1	2003	4	8
33	jun	2002	2002	4	2002	5	2003	12	20	2002	1	2002	2	2003	4	7
34	jul	2002	2002	5	2002	6	2003	12	19	2002	1	2002	2	2003	4	7
35	aug	2002	2002	6	2002	7	2003	12	18	2002	1	2002	2	2003	4	7
36	sept	2002	2002	7	2002	8	2003	12	17	2002	2	2002	3	2003	4	6
37	oct	2002	2002	8	2002	9	2004	12	28	2002	2	2002	3	2004	4	10
38	nov	2002	2002	9	2002	10	2004	12	27	2002	2	2002	3	2004	4	10
39	dec	2002	2002	10	2002	11	2004	12	26	2002	3	2002	4	2004	4	9
40	jan	2003	2002	11	2002	12	2004	12	25	2002	3	2002	4	2004	4	9
41	feb	2003	2002	12	2003	1	2004	12	24	2002	3	2002	4	2004	4	9
42	mar	2003	2003	1	2003	2	2004	12	23	2002	4	2003	1	2004	4	8
43	apr	2003	2003	2	2003	3	2004	12	22	2002	4	2003	1	2004	4	8
44	may	2003	2003	3	2003	4	2004	12	21	2002	4	2003	1	2004	4	8
45	jun	2003	2003	4	2003	5	2004	12	20	2003	1	2003	2	2004	4	7
46	jul	2003	2003	5	2003	6	2004	12	19	2003	1	2003	2	2004	4	7
47	aug	2003	2003	6	2003	7	2004	12	18	2003	1	2003	2	2004	4	7
48	sept	2003	2003	7	2003	8	2004	12	17	2003	2	2003	3	2004	4	6
49	oct	2003	2003	8	2003	9	2005	12	28	2003	2	2003	3	2005	4	10
50	nov	2003	2003	9	2003	10	2005	12	27	2003	2	2003	3	2005	4	10
51	dec	2003	2003	10	2003	11	2005	12	26	2003	3	2003	4	2005	4	9
52	jan	2004	2003	11	2003	12	2005	12	25	2003	3	2003	4	2005	4	9
53	feb	2004	2003	12	2004	1	2005	12	24	2003	3	2003	4	2005	4	9
54	mar	2004	2004	1	2004	2	2005	12	23	2003	4	2004	1	2005	4	8
55	apr	2004	2004	2	2004	3	2005	12	22	2003	4	2004	1	2005	4	8
56	may	2004	2004	3	2004	4	2005	12	21	2003	4	2004	1	2005	4	8
57	jun	2004	2004	4	2004	5	2005	12	20	2004	1	2004	2	2005	4	7
58	jul	2004	2004	5	2004	6	2005	12	19	2004	1	2004	2	2005	4	7
59	aug	2004	2004	6	2004	7	2005	12	18	2004	1	2004	2	2005	4	7
60	sept	2004	2004	7	2004	8	2005	12	17	2004	2	2004	3	2005	4	6
61	oct	2004	2004	8	2004	9	2006	12	28	2004	2	2004	3	2006	4	10
62	nov	2004	2004	9	2004	10	2006	12	27	2004	2	2004	3	2006	4	10
63	dec	2004	2004	10	2004	11	2006	12	26	2004	3	2004	4	2006	4	9
64	jan	2005	2004	11	2004	12	2006	12	25	2004	3	2004	4	2006	4	9
65	feb	2005	2004	12	2005	1	2006	12	24	2004	3	2004	4	2006	4	9
66	mar	2005	2005	1	2005	2	2006	12	23	2004	4	2005	1	2006	4	8
67	apr	2005	2005	2	2005	3	2006	12	22	2004	4	2005	1	2006	4	8
68	may	2005	2005	3	2005	4	2006	12	21	2004	4	2005	1	2006	4	8
69	jun	2005	2005	4	2005	5	2006	12	20	2005	1	2005	2	2006	4	7
70	jul	2005	2005	5	2005	6	2006	12	19	2005	1	2005	2	2006	4	7
71	aug	2005	2005	6	2005	7	2006	12	18	2005	1	2005	2	2006	4	7

72	sept	2005	2005	7	2005	8	2006	12	17	2005	2	2005	3	2006	4	6
73	oct	2005	2005	8	2005	9	2007	12	28	2005	2	2005	3	2007	4	10
74	nov	2005	2005	9	2005	10	2007	12	27	2005	2	2005	3	2007	4	10
75	dec	2005	2005	10	2005	11	2007	12	26	2005	3	2005	4	2007	4	9
76	jan	2006	2005	11	2005	12	2007	12	25	2005	3	2005	4	2007	4	9
77	feb	2006	2005	12	2006	1	2007	12	24	2005	3	2005	4	2007	4	9
78	mar	2006	2006	1	2006	2	2007	12	23	2005	4	2006	1	2007	4	8
79	apr	2006	2006	2	2006	3	2007	12	22	2005	4	2006	1	2007	4	8
80	may	2006	2006	3	2006	4	2007	12	21	2005	4	2006	1	2007	4	8
81	jun	2006	2006	4	2006	5	2007	12	20	2006	1	2006	2	2007	4	7
82	jul	2006	2006	5	2006	6	2007	12	19	2006	1	2006	2	2007	4	7
83	aug	2006	2006	6	2006	7	2007	12	18	2006	1	2006	2	2007	4	7
84	sept	2006	2006	7	2006	8	2007	12	17	2006	2	2006	3	2007	4	6
85	oct	2006	2006	8	2006	9	2008	12	28	2006	2	2006	3	2008	4	10
86	nov	2006	2006	9	2006	10	2008	12	27	2006	2	2006	3	2008	4	10
87	dec	2006	2006	10	2006	11	2008	12	26	2006	3	2006	4	2008	4	9
88	jan	2007	2006	11	2006	12	2008	12	25	2006	3	2006	4	2008	4	9
89	feb	2007	2006	12	2007	1	2008	12	24	2006	3	2006	4	2008	4	9
90	mar	2007	2007	1	2007	2	2008	12	23	2006	4	2007	1	2008	4	8
91	apr	2007	2007	2	2007	3	2008	12	22	2006	4	2007	1	2008	4	8
92	may	2007	2007	3	2007	4	2008	12	21	2006	4	2007	1	2008	4	8
93	jun	2007	2007	4	2007	5	2008	12	20	2007	1	2007	2	2008	4	7
94	jul	2007	2007	5	2007	6	2008	12	19	2007	1	2007	2	2008	4	7
95	aug	2007	2007	6	2007	7	2008	12	18	2007	1	2007	2	2008	4	7
96	sept	2007	2007	7	2007	8	2008	12	17	2007	2	2007	3	2008	4	6
97	oct	2007	2007	8	2007	9	2009	12	28	2007	2	2007	3	2009	4	10
98	nov	2007	2007	9	2007	10	2009	12	27	2007	2	2007	3	2009	4	10
99	dec	2007	2007	10	2007	11	2009	12	26	2007	3	2007	4	2009	4	9
100	jan	2008	2007	11	2007	12	2009	12	25	2007	3	2007	4	2009	4	9
101	feb	2008	2007	12	2008	1	2009	12	24	2007	3	2007	4	2009	4	9
102	mar	2008	2008	1	2008	2	2009	12	23	2007	4	2008	1	2009	4	8
103	apr	2008	2008	2	2008	3	2009	12	22	2007	4	2008	1	2009	4	8
104	may	2008	2008	3	2008	4	2009	12	21	2007	4	2008	1	2009	4	8
105	jun	2008	2008	4	2008	5	2009	12	20	2008	1	2008	2	2009	4	7
106	jul	2008	2008	5	2008	6	2009	12	19	2008	1	2008	2	2009	4	7
107	aug	2008	2008	6	2008	7	2009	12	18	2008	1	2008	2	2009	4	7
108	sept	2008	2008	7	2008	8	2009	12	17	2008	2	2008	3	2009	4	6
109	oct	2008	2008	8	2008	9	2010	12	28	2008	2	2008	3	2010	4	10
110	nov	2008	2008	9	2008	10	2010	12	27	2008	2	2008	3	2010	4	10
111	dec	2008	2008	10	2008	11	2010	12	26	2008	3	2008	4	2010	4	9
112	jan	2009	2008	11	2008	12	2010	12	25	2008	3	2008	4	2010	4	9
113	feb	2009	2008	12	2009	1	2010	12	24	2008	3	2008	4	2010	4	9
114	mar	2009	2009	1	2009	2	2010	12	23	2008	4	2009	1	2010	4	8
115	apr	2009	2009	2	2009	3	2010	12	22	2008	4	2009	1	2010	4	8
116	may	2009	2009	3	2009	4	2010	12	21	2008	4	2009	1	2010	4	8
117	jun	2009	2009	4	2009	5	2010	12	20	2009	1	2009	2	2010	4	7
118	jul	2009	2009	5	2009	6	2010	12	19	2009	1	2009	2	2010	4	7
119	aug	2009	2009	6	2009	7	2010	12	18	2009	1	2009	2	2010	4	7
120	sept	2009	2009	7	2009	8	2010	12	17	2009	2	2009	3	2010	4	6

Table B7 – Assessment of the forecasting ability of the Bridge Models

JEU (1)

	GDP forecast horizon					
	1 qrt			*2 qrts*	*4 qrts*	*6 qrts*
	with 1m	*with 2m*	*with 3m*			
US						
ME	-0.034	0.006	0.041	-0.020	-0.337	-1.147
RMSE	0.510	0.486	0.462	0.817	2.096	2.734
ratio to AR	*0.759* [a]	**0.736** [a]	**0.699** [a]	**0.724** [a]	0.956 [a]	0.963
EU						
ME	0.353	0.364	0.364	0.719	1.462	2.016
RMSE	-0.105	-0.070	-0.062	-0.197	-0.590	-1.253
- ratio to AR	**0.563** [b]	**0.423** [a]	**0.385** [a]	**0.424** [b]	**0.734** [a]	0.950
Japan						
ME	0.166	0.185	0.197	0.334	0.539	0.478
RMSE	0.760	0.690	0.648	1.269	2.881	3.938
- ratio to AR	**0.608** [a]	**0.553** [a]	**0.519** [a]	**0.612** [a]	0.817 [a]	0.995

ASE (1)

	GDP forecast horizon					
	1 qrt			*2 qrts*	*4 qrts*	*6 qrts*
	with 1m	*with 2m*	*with 3m*			
China						
ME	-0.199	-0.202	-0.209	-0.339	-0.358	-0.337
RMSE	0.774	0.739	0.731	1.019	1.286	2.091
ratio to AR	**0.893** [a]	*0.848* [a]	0.838 [a]	**0.767** [a]	0.842 [a]	1.057
India						
ME	0.230	0.238	0.218	0.407	0.911	1.467
RMSE	1.162	1.154	1.099	1.549	2.529	3.427
ratio to AR	0.976 [a]	0.968 [a]	0.922 [a]	0.934 [a]	0.958 [a]	1.006
Indonesia						
ME	0.292	0.269	0.271	0.641	1.432	2.308
RMSE	0.990	0.990	0.992	1.433	2.127	2.933
ratio to AR	0.985	0.987	0.989	1.068	*1.238*	*1.359*
Malaysia						
ME	0.053	0.061	0.098	0.016	-0.275	-0.747
RMSE	0.868	0.880	0.783	1.443	3.059	3.870
ratio to AR	**0.674** [a]	**0.680** [a]	**0.605** [a]	**0.610** [a]	*0.773* [b]	*0.898*

ASE *(continued)* [(1)]

	GDP forecast horizon					
	1 qrt			*2 qrts*	*4 qrts*	*6 qrts*
	with 1m	*with 2m*	*with 3m*			
Thailand						
ME	-0.215	-0.232	-0.222	-0.315	-0.238	-0.369
RMSE	1.548	1.326	1.106	1.979	4.283	6.065
ratio to AR	1.206 [a]	**0.976** [a]	**0.814** [a]	0.859 [b]	1.059 [b]	1.407
Phillippines						
ME	0.245	0.273	0.270	0.500	1.048	1.614
RMSE	0.753	0.736	0.742	1.258	2.144	2.893
ratio to AR	0.889 [b]	0.871 [b]	0.878 [b]	**0.949** [b]	0.982 [b]	1.047
Hong Kong						
ME	0.235	0.282	0.260	0.418	0.560	0.437
RMSE	2.016	2.012	2.006	3.009	4.750	5.622
ratio to AR	1.058	1.062	1.059	1.071	1.025	1.006
Singapore						
ME	-0.251	-0.328	-0.215	-0.406	-0.842	-1.551
RMSE	1.795	1.414	1.171	2.762	5.057	6.271
ratio to AR	0.801 [a]	0.633 [a]	0.524 [a]	0.755 [a]	0.862 [b]	0.926
Korea						
ME	-0.197	-0.306	-0.245	-0.495	-1.287	-2.122
RMSE	1.311	0.979	0.918	1.662	3.100	3.948
ratio to AR	0.999 [a]	0.758 [a]	0.711 [a]	**0.754** [a]	0.925 [a]	0.955 [a]
Taiwan						
ME	-0.250	-0.161	-0.161	-0.312	-0.471	-0.837
RMSE	1.451	1.451	1.396	3.141	6.216	8.391
ratio to AR	0.774 [a]	0.778 [a]	0.749 [a]	0.972 [a]	1.160 [a]	1.396

BRRU [(1)]

	GDP forecast horizon					
	1 qrt			*2 qrts*	*4 qrts*	*6 qrts*
	with 1m	*with 2m*	*with 3m*			
Brazil						
ME	0.102	0.092	0.112	0.353	0.790	0.999
RMSE	0.976	0.826	0.691	1.243	2.612	3.006
ratio to AR	0.817 [a]	0.703 [a]	0.588 [a]	0.654 [a]	0.950 [a]	1.040
Russia						
ME	0.112	0.151	0.069	0.214	0.854	1.622
RMSE	1.321	1.329	1.245	1.940	4.719	7.086
ratio to AR	0.671 [a]	*0.675* [a]	**0.632** [b]	**0.557** [a]	0.738 [a]	0.785

(1) Ratios are reported in italic when GW is significant at 10%, in bold when it is significant at 5%; further, [a] means that BM parameter in FS equation is 5% significant while AR is not, [b] both parameters are significant. For GW test, we use the test function $h_t = (1, \Delta L_{t-\tau})$.

Table B8 – Evaluating WBM: encompassing WEO and tracking the crisis in 2008-09

JEU[(1)]

Month of forecast for WBM	Month of WEO release used for comparison	TARGET YEAR "t + 1"					
		USA		EU		JAPAN	
		updating	anticipating	updating	anticipating	updating	anticipating
October (t)	October (t)	0.006	0.000	0.084	0.000	0.048	0.000
November(t)		0.008	0.000	0.206	0.000	0.024	0.000
December (t)		0.089	0.000	0.447	0.000	0.017	0.000
January (t+1)		0.152	0.000	0.896	0.000	0.413	0.007
February (t+1)		0.261	0.000	0.167	0.000	0.070	0.003
March (t+1)		0.282	0.000	0.025	0.000	0.001	0.040
April (t+1)	April (t+1)	0.000	0.004	0.000	0.000	0.010	0.007
May (t+1)		0.000	0.001	0.000	0.001	0.180	0.044
June (t+1)		0.000	0.001	0.016	0.005	0.857	0.043
July (t+1)		0.000	0.002	0.042	0.001	0.600	0.081
August (t+1)		0.000	0.001	0.073	0.004	0.855	0.075
September (t+1)		0.006	0.328	0.034	0.552	0.170	0.833

ASE[(1)]

Month of forecast for WBM	Month of WEO release used for comparison	TARGET YEAR "t + 1"							
		INDIA		CHINA		HONG KONG		INDONESIA	
		updating	anticipating	updating	anticipating	updating	anticipating	updating	anticipating
October (t)	October (t)	0.779	0.008	0.172	0.000	0.056	0.000	0.248	0.001
November(t)		0.594	0.009	0.392	0.000	0.062	0.000	0.262	0.011
December (t)		0.049	0.107	0.149	0.000	0.264	0.006	0.085	0.012
January (t+1)		0.316	0.144	0.194	0.000	0.312	0.004	0.109	0.004
February (t+1)		0.263	0.201	0.211	0.000	0.403	0.004	0.130	0.008
March (t+1)		0.147	0.037	0.176	0.000	0.707	0.000	0.002	0.000
April (t+1)	April (t+1)	0.026	0.000	0.000	0.003	0.001	0.000	0.001	0.000
May (t+1)		0.039	0.000	0.001	0.008	0.001	0.000	0.001	0.000
June (t+1)		0.125	0.008	0.116	0.166	0.320	0.000	0.005	0.000
July (t+1)		0.078	0.021	0.233	0.198	0.335	0.000	0.004	0.000
August (t+1)		0.047	0.030	0.178	0.067	0.308	0.000	0.003	0.000
September (t+1)		0.561	0.989	0.302	0.857	0.158	0.000	0.270	0.034

ASE *(continued)*[1]

Month of forecast for WBM	Month of WEO release used for comparison	TARGET YEAR "t + 1"							
		MALAYSIA		PHILIPPINES		SINGAPORE		KOREA	
		updating	anticipating	updating	anticipating	updating	anticipating	updating	anticipating
October (t)	October (t)	0.051	0.000	0.097	0.000	0.456	0.004	0.662	0.030
November(t)		0.371	0.000	0.081	0.000	0.878	0.004	0.912	0.037
December (t)		0.999	0.000	0.186	0.001	0.830	0.024	0.185	0.051
January (t+1)		0.735	0.000	0.479	0.002	0.986	0.023	0.000	0.292
February (t+1)		0.330	0.008	0.966	0.004	0.800	0.090	0.000	0.026
March (t+1)		0.222	0.649	0.011	0.090	0.248	0.443	0.001	0.038
April (t+1)	April (t+1)	0.223	0.000	0.071	0.000	0.802	0.001	0.001	0.000
May (t+1)		0.329	0.001	0.021	0.000	0.736	0.000	0.124	0.000
June (t+1)		0.875	0.221	0.755	0.587	0.173	0.001	0.354	0.102
July (t+1)		0.612	0.024	0.494	0.945	0.310	0.033	0.203	0.028
August (t+1)		0.380	0.007	0.397	0.749	0.122	0.345	0.007	0.002
September (t+1)		0.807	0.411	0.767	0.603	0.941	0.654	0.217	0.156

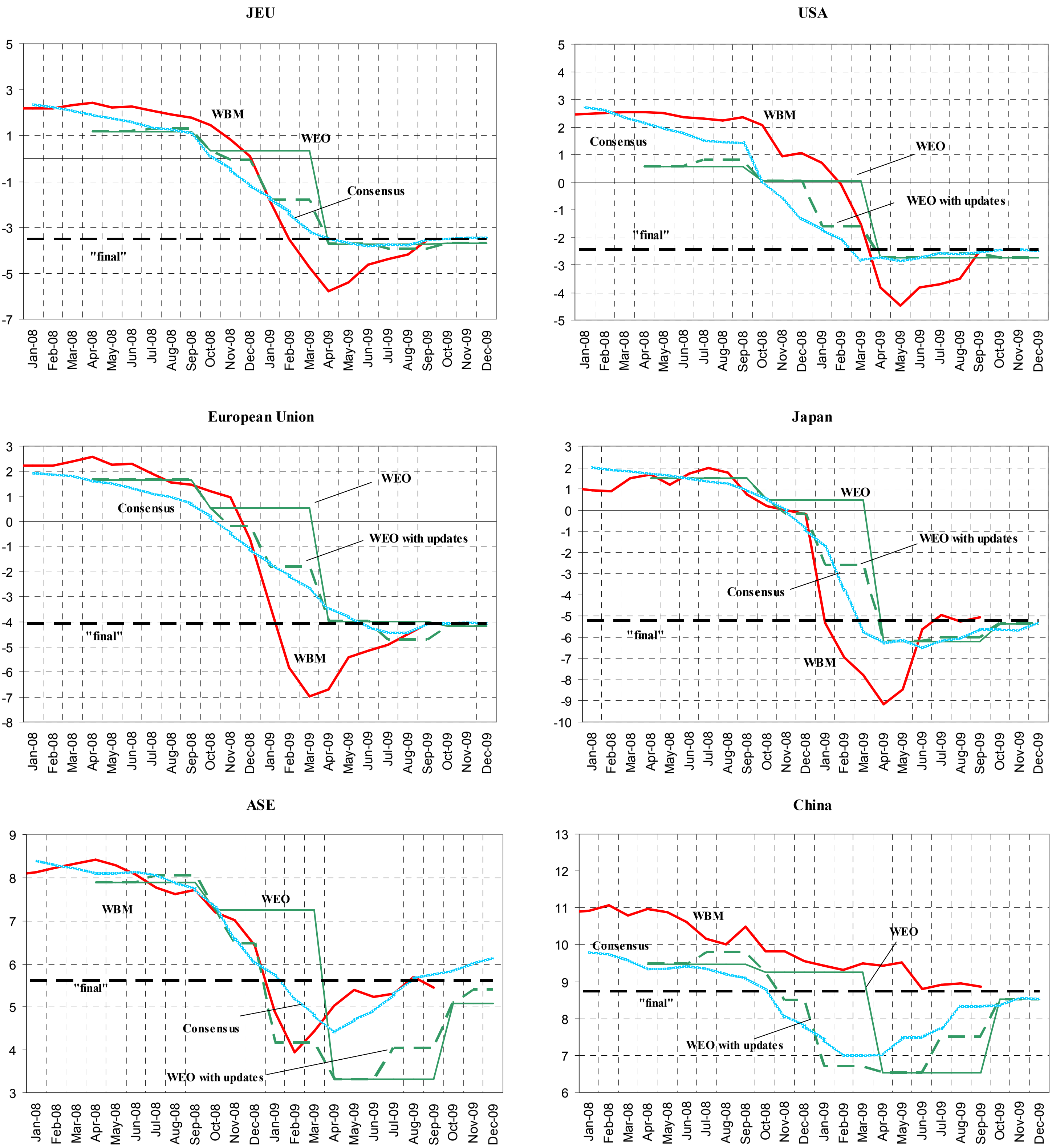
Month of forecast for WBM	Month of WEO release used for comparison	TARGET YEAR "t + 1"			
		TAIWAN		THAILAND	
		updating	anticipating	updating	anticipating
October (t)	October (t)	0.001	0.010	0.669	0.000
November(t)		0.001	0.035	0.644	0.000
December (t)		0.079	0.137	0.940	0.001
January (t+1)		0.000	0.000	0.036	0.015
February (t+1)		0.000	0.000	0.000	0.000
March (t+1)		0.007	0.101	0.000	0.000
April (t+1)	April (t+1)	0.785	0.004	0.000	0.000
May (t+1)		0.797	0.001	0.004	0.000
June (t+1)		0.970	0.098	0.017	0.029
July (t+1)		0.885	0.488	0.017	0.053
August (t+1)		0.521	0.321	0.054	0.176
September (t+1)		0.902	0.663	0.337	0.299

BRRU[1]

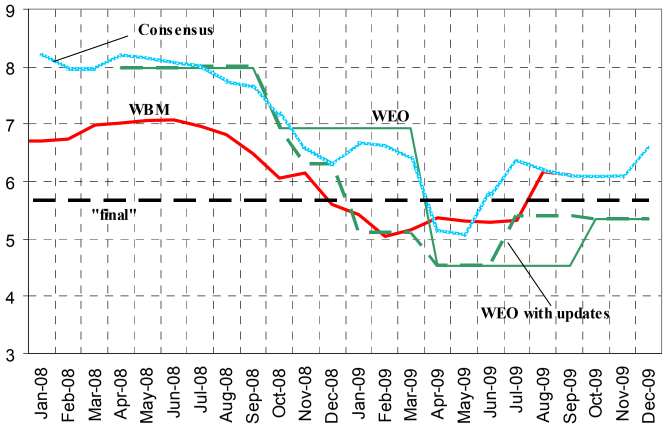
Month of forecast for WBM	Month of WEO release used for comparison	TARGET YEAR "t + 1"			
		BRAZIL		RUSSIA	
		updating	anticipating	updating	anticipating
October (t)	October (t)	0.298	0.000	0.128	0.000
November(t)		0.384	0.000	0.155	0.000
December (t)		0.087	0.000	0.979	0.000
January (t+1)		0.880	0.003	0.057	0.025
February (t+1)		0.019	0.024	0.935	0.001
March (t+1)		0.004	0.019	0.023	0.929
April (t+1)	April (t+1)	0.126	0.000	0.758	0.000
May (t+1)		0.965	0.014	0.448	0.000
June (t+1)		0.468	0.069	0.000	0.000
July (t+1)		0.260	0.652	0.206	0.004
August (t+1)		0.534	0.199	0.203	0.021
September (t+1)		0.829	0.082	0.489	0.994

([1]) See Clements (2005, p. 15) for details and notation. λ estimates reported in column (3) are the optimal weight of the WEO forecast. Column (4) reports the corresponding Newey-West (1987) standard errors, and column (5) the p-value of H_0: λ=0, The following two columns report the same information about WBM weights.

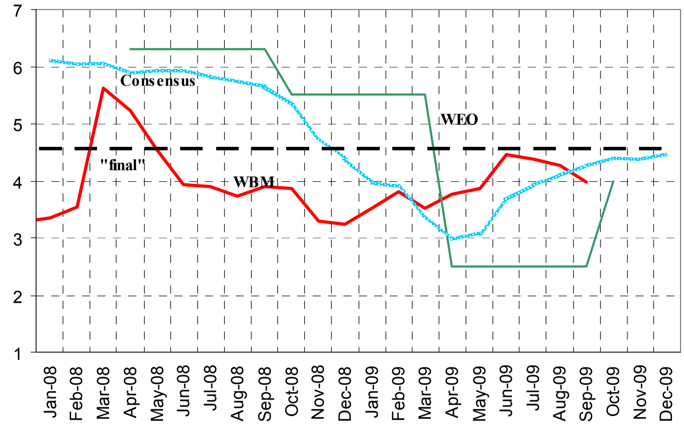
Figure B2 - Comparison of WBM monthly forecasts patterns of GDP growth for 2009 with WEO and *Consensus* predictions



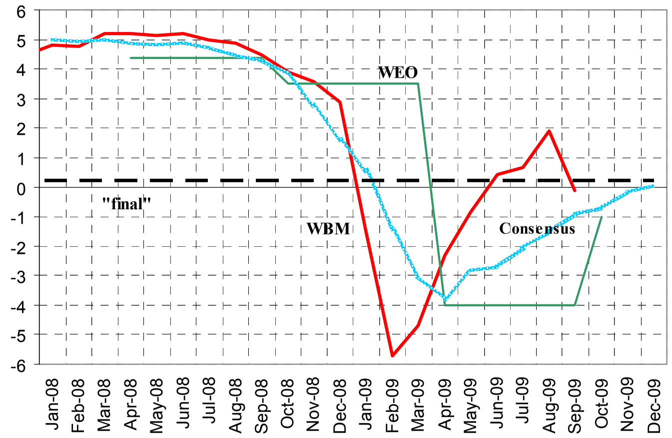
India



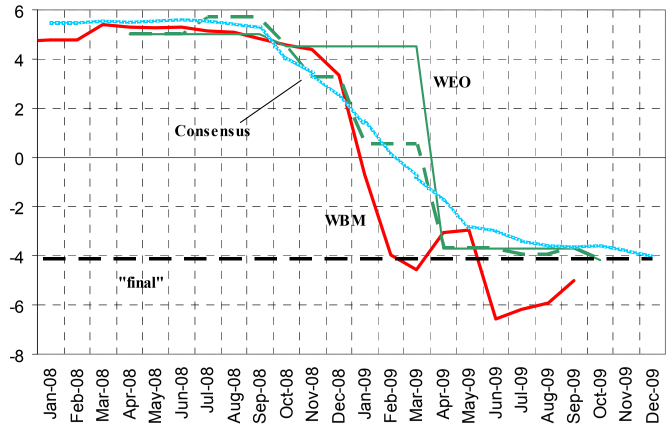
Indonesia



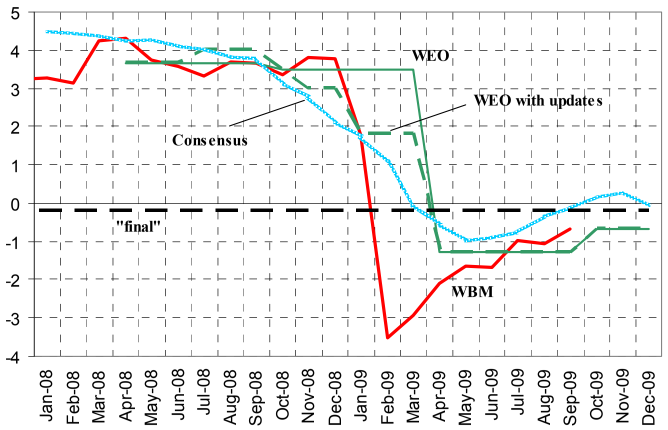
Korea



BRRU



Brazil



Russia