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A monthly assessment of Euro Area cyclical situation

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MONTHLY ASSESSMENT
OF THE EURO AREA CYCLICAL SITUATION

By Gian Luigi Mazzi and Filippo Moauro

1 INTRODUCTION

This document presents the aim, structure and main messages of the monthly cyclical assessment for the euro area, which is regularly issued as Eurostat internal note since March 2009. Delivering clear, easy to understand and statistically sound messages on the economic situation is of crucial importance for a statistical office. The fact that statisticians have a better knowledge of the data characteristics and peculiarities as well as of their production process, place them in a privileged position to give objective and reliable information going beyond data themselves. The structure of the paper is the following: Section 2 presents as background some essential information on Eurostat activities in the field of Business Cycle Analysis and turning points detection. Section 3 sketches out the structure of the assessment with some details on information provided, also in terms of tables and charts. Section 4 is dedicated to some short conclusions and to the description of further lines of research and improvements. The Annex presents the November 2009 Internal Note on cyclical assessment.

2 BACKGROUND INFORMATION

Since 2006, Eurostat has started several activities in the field of the Business Cycle Analysis and turning points detection. A summary of such activities is presented in Mazzi, Montana (2009) while further details are presented in Anas, Billio, Ferrara, Mazzi (2008); Billio, Ferrara, Guegan, Mazzi (2009) and Lemoine, Mazzi, Mont-Perrus, Reynes (2009); Mazzi, Mitchell, Moauro (2009). Those activities have mainly concerned: 1) the elaboration and regular updating of a euro area turning points chronology for business cycle and growth cycle following the ABCD approach, 2) the construction of coincident turning points indicators for business cycle and growth cycle, 3) the investigation of alternative of univariate and multivariate trend-cycle decompositions. For the purpose of the preparation of the Eurostat Internal Note, the attention is focused mainly on the first two lines of research.
Since the end of 2006, Eurostat is regularly producing a turning points chronology for the business cycle and growth cycle, updated on quarterly basis, and two monthly coincident indicators on business cycle and growth cycle (BCCI and GCCI). Whilst for the chronology, a purely non parametric approach has been chosen, for the coincident turning points indicators it has been decided to follow a parametric approach based on non linear time series modelling.
The GCCI and BCCI are based on PEEIs data (including Business and Consumer Surveys) with the only exception of the New cars registration, which is not included in the PEEIs list but it is disseminated by Eurostat as official statistic.
The two indicators are based on univariate Markov Switching models fitted on each component variable. The final result is a weighted average of the results of each model, where the weights are fixed and defined on the basis of the reliability of the signal extracted from each component. The reference series for both indicators is the Industrial Production Index. Nowadays, the BCCI and GCCI are respectively composed by three and five components, selected on a large dataset. The selection procedure has been based on the QPS and the Concordance Index with respect to the reference chronology within a real time simulation exercise. The selected variables are characterised by the minimum QPS and the maximum Concordance Index. Further details on the construction of the two indicators and the variables selection procedures can be found in Anas, Billio, Ferrara, Mazzi (2008) and Mazzi, Montana (2009). Each month t, we compute the recession probability for the month $t-2$ on the basis of the information available at time t and estimated recession probabilities for the months $t-1$ and

t. When these indicators are over 0.5 we are in a recessionary phase; by contrast when the value is lower than 0.5 we are in an expansionary phase.

After more than 2 years of regular production of these indicators, complemented by a longer real-time exercise, the results are very positive in terms of stability of the indicators across vintages as well as in terms of absence of false signals. The only remark to the performance of the two indicators is that they have a slightly lagging behaviour, which, under certain conditions, can not be considered as a big default for such kind of indicators especially if it is associated to a general absence of false signals. Unfortunately, for the BCCI there is a lagging behaviour of several months which can represent a problem, when the economy is supposed to be in the proximity of a turning point.

In order to overcome the mentioned drawback of the BCCI, since September 2009 it has been produced in parallel another business cycle coincident indicator based on SETAR models (Self Exciting Threshold Auto-Regressive). The SETAR based business cycle indicator detects turning points more timely than the BCCI based on Markov Switching model, but this gain is largely counterbalanced by a higher number of false recession signals. For this reason, at the moment it is suggested a careful use of such kind of models in combination with those ones based on Markov Switching. Further details of the comparison of the relative performance of Markov Switching and SETAR models can be found in Billio, Ferrara, Guegan, Mazzi (2009). Due to the positive results obtained during the simulation exercises, it was decided to make available the delivered information by such indicator to Eurostat management in order to contribute to a better assessment of the current economic situation. This kind of information is considered of particular relevance especially in a period characterized by a high degree of uncertainty as the current one.

3 THE FORM AND THE INFORMATION PROVIDED

The form chosen for the internal note of the cyclical assessment of the euro area follows directly Eurostat press release format. After the title, which also highlights the main message of the assessment, latest developments of both indicators are immediately described. The title is followed by a box explaining aims, scope and limits of the note. The following two sections provide the description of the evolution of the GCCI and the BCCI. From the assessments of last September an additional section describes the results of the alternative business cycle indicator based on SETAR models. Afterwards, a one page table with the latest PEEIs trends is presented as background information of the signals related to the two indicators. A methodological note concludes the assessment.

The title of the note synthesizes the main content of the assessment. It is split in two parts: first, in large format, it is simply quoted 'Cyclical assessment of the euro area' followed by the month *t* of the assessment; then the main message characterizing the result of the indicators for the month *t-2* is provided. This message is very concise, maximum two lines, and it is presented in an emphasized format.

A synthetic analysis of the evolution of the two indicators is immediately presented after the title. Usually it consists of two-three lines, but occasionally it could also contain longer explanations, especially while approaching a turning point.

After the box explaining aims, scope and limits of the note, full details of the cyclical evolution are given in two separate sections, the first for the GCCI and the latter for the BCCI. Both the sections present the following information: first a graph of the indicator over a sample period starting in 1991 (July for the GCCI and January for the BCCI) till time *t*. Note that estimated probabilities for time *t-1* and *t* are highlighted through a yellow-boxed-red line; then it is provided a table with filtered probabilities by component time series for the month *t-3* and *t-2,* together with estimated probabilities for the month *t-1* and *t* flagged with an asterisk; finally a short comment to a graph presenting the sequence of last releases of the indicators. In this way it is given a clear view of the revision histories for both the GCCI and

the BCCI indicators. From the release of September 2009 a third section presents the results of the BCCI based on SETAR models.

The last part of the assessment consists of a one-page table with latest PEEIs trends in last months/quarters as background information of the signals related to the two indicators. The cyclical assessment is complemented by a methodological note containing synthetic explanations of the ABCD dating and detecting approach as well as of the construction of BCCI and GCCI, including variable selection procedures.

4 CONCLUSIONS

The paper has provided a short description of the content of the internal cyclical assessment of Growth and Business Cycle issued since March 2009 and internally disseminated at Eurostat. The decision to make available internally the results of these indicators comes from the need to provide Eurostat management with a new instrument to complement the usual view on economic evolution based only on data inspection. The monthly assessment has been conceived in order to be easily read and understood both by non professional and professional readers by combining simple and synthetic messages with more sophisticated statistical analyses. This assessment is still in an experimental phase, so that we will benefit of all comments and remarks in order to improve its contents, structure and understandability. At the same time, we carry out several methodological investigations to improve the quality and usefulness of the Eurostat turning points indicators, in particular the possible benefits deriving from moving towards a multivariate specification of BCCI and GCCI, either by using Markov Switching models or SETAR ones. We are also exploring the possibility of including additional variables especially into the BCCI to reduce its lagging behaviour. Finally, we are comparing the effect on the dating process in relation to the change of threshold level from the traditional 0.5 value.

REFERENCES

Anas J., Billio M., Ferrara L., Mazzi G.L., (2008) 'A system for dating and detecting turning points in the Euro Area', Manchester School, 76(5), pp 549-77;
Billio, Ferrara, Guegan, Mazzi (2009) 'Evaluation of nonlinear time series models for real time business cycle analysis', paper presented at the 3rd Growth and Business Cycles in Theory and Practice Conference held in June 2009 at Manchester and at CFE09 held in Cyprus;
Lemoine M., Mazzi G.L., Montperrus-Veroni P., Reynes F. (forthcoming) ' Real time estimation of potential output for the euro-area: comparing production function, unobserved components and SVAR approaches', Journal of Forecasting;
Mazzi, Mitchell, Moauro (2009) 'Structural VAR based estimates of the euro area output gap: Theoretical considerations and empirical evidences', paper presented at the JSM09;
Mazzi, Montana (2009) 'A system of rapid estimates to improve real-time monitoring of the economic situation: the case of the Euro Area', National Institute Economic Review n.210 October 2009 pp 63-70.

Cyclical assessment of the euro area. November 2009
Persistence of uncertain signals of recovery from the growth cycle and the business cycle

In September 2009 the growth cycle coincident indicator (GCCI) confirms the recovery of the economy registered in August, whereas that of the business cycle (BCCI) a continuation of recessionary trends. This behaviour is in not in line with the ABCD approach for which a trough of the growth cycle should be preceded by one of the business cycle. Two explanations are possible: it might be due to the lagging behaviour of the BCCI with respect to the GCCI, albeit also the more timely BCCI based on SETAR models doesn't return any recovery signals; on the other hand the economy might be entered in a double deep phase, which is a quite uncommon event occurred only in the period 1980-82. A double deep is characterized by a complete growth cycle fluctuation within a recessionary business cycle phase. In this period we have to keep a very prudent and conservative approach in order to avoid false signals and misleading interpretations and wait to have more robust statistical evidence.

This note aims to show statistical evidence of regime switching in growth cycle and business cycle. It is based on official statistics complemented by surveys data compiled by DG-ECFIN. Any economic interpretation as well as any forecasting purpose is out of the scope of this note. The two indicators provide estimates for the month *t-2* based on filtered probabilities of being in the low phase of, respectively, the growth cycle and the business cycle of the euro area including 16 Countries. Estimates for the months *t-1* and *t* based on forecasting probabilities are also provided.

As for the assessment of September and October 2009, in order to better detect recovering signals, we complement the business cycle coincident indicator based on Markov-switching models, with a more timely indicator based on SETAR (Self Exciting Threshold Auto-Regressing) models. This new indicator has to be considered with cautions. Despite its higher timeliness with respect to the former, it is characterized by a higher risk of false signals. Our aim by looking simultaneously at both classes of indicators is to achieve a more timely identification of recovering signals.

Growth Cycle Coincident Indicator

In September 2009 the Growth Cycle Coincident Indicator (GCCI) shows for the euro area economy a low probability of being in a slowdown, equal to 0.314; in August the GCCI was equal to 0.387. The preliminary assessments for October and November 2009 based on forecasting probabilities show the values of 0.186 and 0.172 respectively. Then, the current assessment confirms August 2009 as the first month since April 2007 in which the GCCI signals a recovery in the euro area economy, with latest peak and trough of the euro area growth cycle located in March 2007 and July 2009 respectively.

Figure 1 shows the GCCI from July 1991 to November 2009, with the last two months based on forecasting probabilities (yellow-boxed-red line in the figure). It emerges that the slowdown phase has characterized the GCCI the period from April 2007 to July 2009, since the GCCI has exceeded the 0.5 probability threshold. This behaviour is the result of main trends of the 5 component time series comprised in the GCCI. From Table 1 it comes out

that the slight decrease of the GCCI from August to September 2009 is the reflex of lower values registered for Employment expectations for the month ahead, dropped from 0.060 to nil, Construction confidence indicator, from 0.944 to 0.737, Industrial production index, from 0.024 to nil and Imports of intermediate goods from outside EA, from 0.908 to 0.833. From the other hand, the component of Financial situation over last 12 months is stable from August 2009 to September 2009.

Figure 2 provides a graphical representation of the sequence of the last 6 releases of the GCCIs, starting from the June 2009 assessment. The graph focuses on the recent evolution of the indicators, presenting the revision histories of filtered probabilities only in the time frame spanning from October 2008 to September 2009.

Table 1 - GCCI probabilities by component

Component time series	August 2009	September 2009	October 2009 (*)	November 2009 (*)
Employment expectations for the months ahead	0.060	0.000	0.000	0.026
Construction confidence indicator	0.944	0.737	0.122	0.024
Financial situation over last 12 months	0.000	0.000	0.001	0.025
Industrial production index	0.024	0.000	0.034	0.064
Imports of intermediate goods from outside EA	0.908	0.833	0.771	0.719
GCCI	**0.387**	**0.314**	**0.186**	**0.172**

Note: The value of the GCCI is the simple average of filtered probabilities related to the above 5 component series. Values for the months flagged with (*) refer to forecasted probabilities.
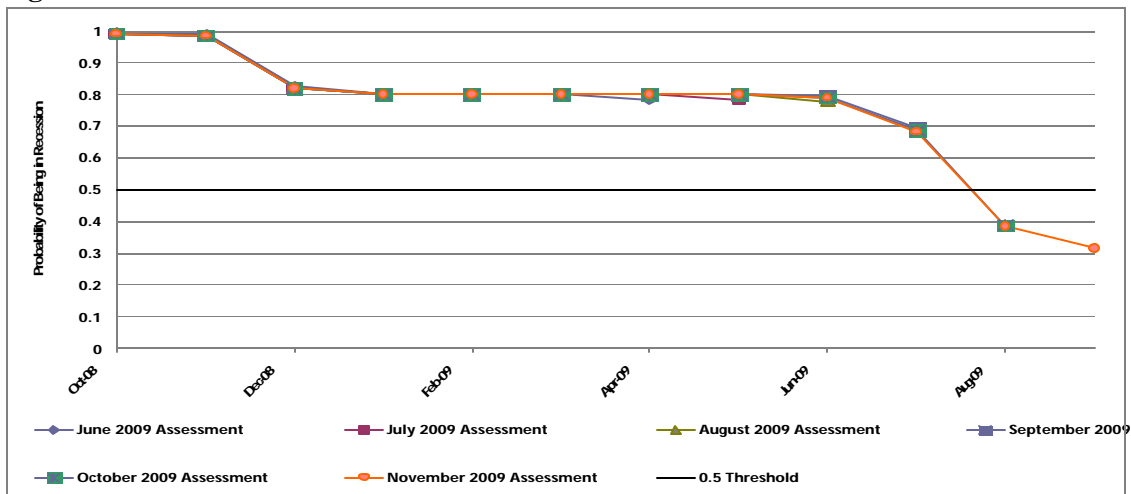
Figure 1 - Growth Cycle Coincident Indicator. July 1991 - November 2009
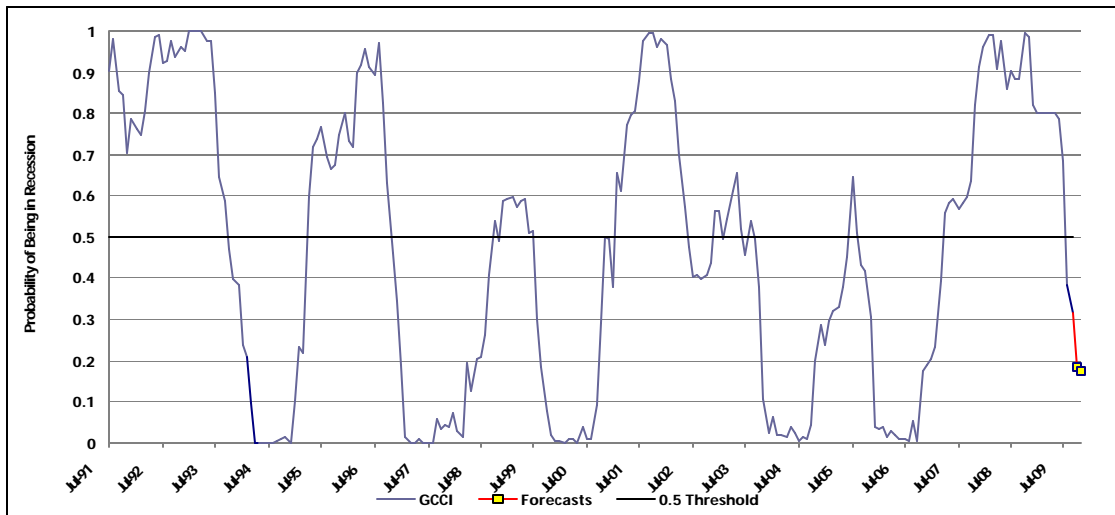
It appears that the patterns of coincident indicators vintages are quite overlapping; it follows that there is evidence in favour of the persistence of the signal detected and consequently of the associated interpretation.

Figure 2 - Recent evolution of the GCCI

Business Cycle Coincident Indicator

In September 2009 the Business Cycle Coincident Indicator (BCCI) shows for the euro area a high probability of being in a recessionary phase, i.e. a value equal to 0.800; almost the same value was registered in August 2009, i.e. 0.801. The BCCI posted very high filtered probabilities also in all the months from September 2008 to July 2009. The preliminary assessment of October and November 2009 based on forecasting probabilities is again of a severe recessionary phase of the business cycle. However the BCCI shows a decreasing pattern, since the values in October and November 2009 are respectively 0.759 and 0.719.

The behaviour of the BCCI is in not in line with the ABCD approach (see the methodological note accompanying this assessment) for which a trough of the growth cycle should be preceded by one of the business cycle. Two explanations are possible: it might be due to the lagging behaviour of the BCCI with respect to the GCCI, albeit also the more timely business cycle indicator based on SETAR models (see next section) doesn't return any recovery signals; on the other hand the economy might be enter into a double deep phase, which is a quite uncommon event occurred only in the period 1980-82. A

double deep is characterized by a complete growth cycle fluctuation within a recessionary business cycle phase. In this period we have to keep a very prudent and conservative approach in order to avoid false signals and misleading interpretations, and wait to have more robust statistical evidence.

A further element of caution in the interpretation of the behaviour of the BCCI is due to the temporary measures adopted by several countries to stimulate the sales of new cars.

In Figure 3, it is depicted the pattern of the latest BCCI from January 1991 to November 2009, with the last two months based on forecasting probabilities (yellow-boxed-red line in the figure). It emerges that the recessionary phase started in September 2008, when the BCCI indicator has exceeded the 0.5 probability threshold.

Table 2 - BCCI probabilities by component

Component time series	August 2009	September 2009	October 2009 (*)	November 2009 (*)
Industrial production Index	1.000	1.000	0.921	0.852
Unemployment rate	0.994	0.994	0.962	0.926
New Passenger Car Registrations	0.005	0.000	0.000	0.029
BCCI	0.801	0.800	0.759	0.719

Note: The value of the BCCI is the weighted average of filtered probability related to the above 3 component time series. The weights are 0.34, 0.46 and 0.20 for the Industrial Production Index, the Unemployment Rate and the New Passenger Car Registrations series respectively. Values for the months flagged with (*) refer to forecasted probabilities.

Figure 3 - Business Cycle Coincident Indicator. January 1991 – November 2009
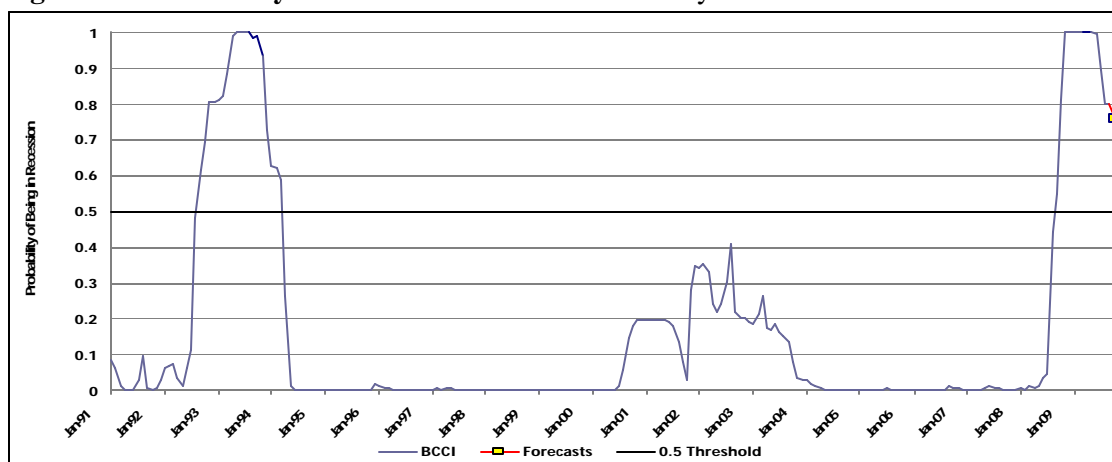
This behaviour is the result of main trends of the 3 component time series comprised in the BCCI. Looking at Table 2 it comes out that in September 2009 there are no

changes in filtered probabilities for the Unemployment Rate time series and the Industrial Production Index. Accordingly, the New passenger Car Registrations

component registers only a slight reduction from the value of 0.005 in August 2009 to nil in September 2009.

Based on forecasting probabilities the BCCI depicts again a continuing recession in October and November 2009, however, with a slightly decreasing pattern. Looking at the components, a substantial stability is registered for all the components with respect to September.

Figure 4 provides a graphical inspection of the sequence of the last 6 BCCIs released from the June 2009 assessment to the current one. The graph focuses on the recent evolution of the indicators, presenting the revision histories in the time frame August 2008-September 2009.

From graphical inspection, we are able to recognise that 5 out of the last 6 releases establish the start of the recessionary phase in September 2008, apart the assessment of June 2009 for which it occurs in October 2009.

Figure 4 - Recent evolution of the BCCI
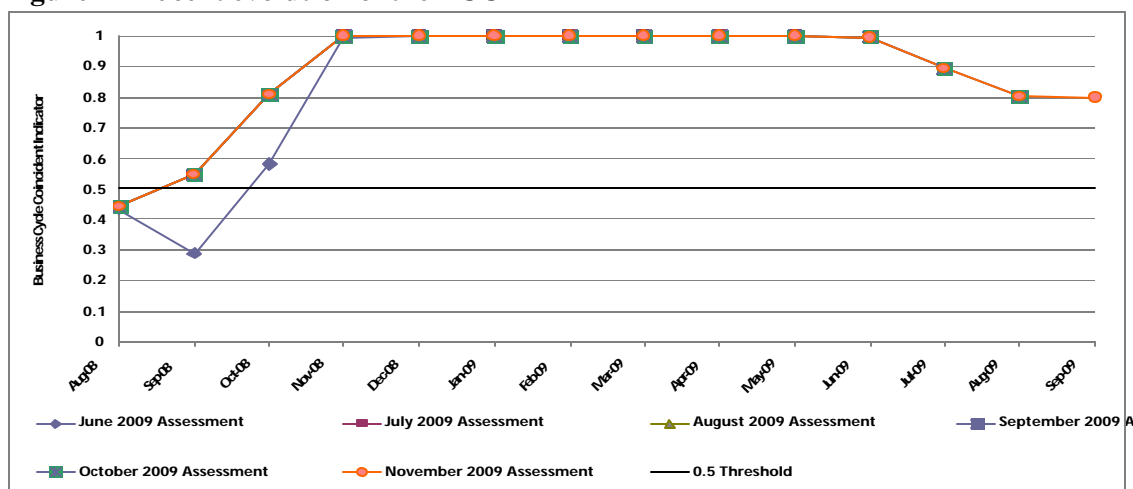
SETAR based indicator of business cycle

From the assessment of September 2009, we have started to present the results of an alternative indicator of business cycle based on 'SETAR models'.

This alternative method complements the assessment based on the usual BCCI indicator which, on the basis of our simulations, emits delayed signals with respect to historical dating. By contrast SETAR models are more timely, but could emit false signals of being in recession.

In September 2009 the SETAR based indicator returns a value of 0.57, corresponding to a signal of recession for the euro area economy. The same estimate has been obtained in all the months starting from June 2009; in all the preceding months from May 2008 the indicator posted a value of 1. Therefore, according to the signal provided by the SETAR based indicator, May 2008 is the beginning of the ongoing recession.

Note that according to the BCCI based on Markov switching models the start of the ongoing recession was September 2008 (see previous section), 4 months after that registered for this alternative SETAR based BCCI.

The SETAR based indicator of business cycle is obtained as weighted average of the 0-1 signals extracted by the 2 component series: Unemployment Rate and Industrial Production Index. The weights are fixed over the sample period and are given by 0.57 and 0.43 respectively for the 2 components.

In September 2009 the transition variable estimated for the Unemployment rate returns a value of 1, corresponding to a signal of recession. Same results have been obtained for all the months starting from May 2008; by contrast, the Industrial Production Index returns a value of 0, corresponding to a signal of expansion. Same value has been obtained for the months from June 2009.

Latest PEEIs trends

This section shows, as background information, the recent evolution of selected PEEIs from the PEEIs webpage of the Euro-Indicators/PEEIs special topic. The results shown in the table are in line with our assessment, which is not surprising since, with except of new car registration, the GCCI and the BCCI are derived from PEEIs or sub-components of PEEIs.

Table 3 - Selected PEEIs for the euro area

	Release date latest	next	Unit	Reference period					
				2008q02	**2008q03**	**2008q04**	**2009q01**	**2009q02**	**2009q03**
GDP in volume	13/11/2009	08/01/2010	% (Q/Q-1)	-0.3	-0.4	-1.8	-2.5	-0.2	0.4
			% (Q/Q-4)	1.9	0.8	-1.8	-5.2	-5.6	(:)
Private final con-sumptions in volume	07/10/2009	03/12/2009	% (Q/Q-1)	-0.4	0.0	-0.5	-0.5	0.1	(:)
			% (Q/Q-4)	0.8	0.4	-0.9	-1.7	-1.3	(:)
Investments in volume	07/10/2009	03/12/2009	% (Q/Q-1)	-1.3	-1.5	-3.5	-5.4	-1.5	(:)
			% (Q/Q-4)	2.3	0.0	-5.4	-11.4	-12.6	(:)
				2009m05	**2009m06**	**2009m07**	**2009m08**	**2009m09**	**2009m10**
Ext. trade balance	17/11/2009	18/12/2009	mio euro	1313	1627	5643	2235	6801	(:)
Current account tot.	NA	NA	mio euro	-13187	3532	10089	-3501	-5021	(:)
				2009m05	**2009m06**	**2009m07**	**2009m08**	**2009m09**	**2009m10**
Inflation (HICP all items)	16/11/2009	30/11/2009	% (M/M-1)	0.1	0.2	-0.7	0.3	0.0	0.2
			% (M/M-12)	0.0	-0.1	-0.7	-0.2	-0.3	-0.1
				2009m05	**2009m06**	**2009m07**	**2009m08**	**2009m09**	**2009m10**
Unemployment rate Total	30/10/2009	01/12/2009	%	9.3	9.4	9.5	9.6	9.7	(:)
Unemployment rate 15-24 years	30/10/2009	01/12/2009	%	19.3	19.5	19.8	20.0	20.1	(:)
Unemployment rate above 24 years	30/10/2009	01/12/2009	%	8.1	8.2	8.3	8.4	8.5	(:)
				2008q02	**2008q03**	**2008q04**	**2009q01**	**2009q02**	**2009q03**
Labour cost index	15/09/2009	15/12/2009	% (Q/Q-1)	0.6	1.1	1.1	0.8	1.0	(:)
			% (Q/Q-4)	2.5	3.6	4.2	3.6	4.0	(:)
Employment	14/09/2009	14/12/2009	% (Q/Q-1)	0.1	-0.3	-0.3	-0.7	-0.5	(:)
			% (Q/Q-4)	1.1	0.5	0.0	-1.2	-1.8	(:)
				2009m05	**2009m06**	**2009m07**	**2009m08**	**2009m09**	**2009m10**
Industrial producer prices (Nace Rev.2)	04/11/2009	02/12/2009	% (M/M-1)	-0.04	0.41	-0.70	0.50	-0.34	(:)
			% (M/M-12)	-5.91	-6.52	-8.41	-7.47	-7.64	(:)
Industrial Production	12/11/2009	14/12/2009	% (M/M-1)	1.11	0.90	0.32	1.16	0.21	(:)
			% (M/M-12)	-17.73	-16.73	-15.87	-15.06	-12.96	(:)
Industrial new orders	24/11/2009	06/01/2010	% (M/M-1)	1.43	2.79	4.41	0.55	1.43	(:)
			% (M/M-12)	-30.42	-25.84	-24.98	-23.27	-16.60	(:)
Construction production	18/11/2009	17/12/2009	% (M/M-1)	-1.98	-0.20	-1.45	0.02	-0.95	(:)
			% (M/M-12)	-8.58	-7.78	-9.77	-10.14	-7.74	(:)
Retail trade deflated turnover	05/11/2009	03/12/2009	% (M/M-1)	-0.49	-0.01	-0.21	-0.09	-0.66	(:)
			% (M/M-12)	-3.05	-1.89	-1.75	-2.18	-3.39	(:)
				2003	**2004**	**2005**	**2006**	**2007**	**2008**
Government deficit surplus	22/10/2009	22/04/2010	%	-3.1	-2.9	-2.5	-1.2	-0.6	-2.0
General government gross debt	22/10/2009	22/04/2010	%	69.2	69.6	70.2	68.4	66.2	69.6
				2009m05	**2009m06**	**2009m07**	**2009m08**	**2009m09**	**2009m10**
Economic sentiment indicator	29/10/2009	27/11/2009	index	70.2	73.2	76.0	80.8	82.8	86.2
				2009m05	**2009m06**	**2009m07**	**2009m08**	**2009m09**	**2009m10**
3 months Interest Rate	NA	NA	%	1.28	1.23	0.98	0.86	0.77	0.74
Long term govern-ment bond yields	NA	NA	%	3.93	4.06	3.87	3.70	3.68	3.65
Euro-dollar exchange rate	NA	NA	$	1.365	1.4016	1.4088	1.4268	1.4562	1.4816

Note: Last update 26/11/2009 11:05:04. The set of indicators is selected from the PEEIs list (COM/2002/661) and complemented by certain Monetary and Financial Indicators as well as the Economic Sentiment Indicator. Data source is mostly Eurostat, with the exception of Current account, 3 months Interest rate, Long term government bond yields and Euro-dollar exchange rate source ECB; Economic Sentiment Indicator source DG ECFIN.

The ABCD approach

The idea of monitoring the cyclical behaviour by means of the two indicators measuring the growth cycle and the business cycle is the so called *ABCD* approach. The chronology in the sequence of turning points of the business cycle and growth cycle can be somewhat identified. The usual concepts are the *business cycle*, made up of expansions and recessions in terms of the levels of the series and the *growth cycle*, which represents the fluctuation around the trend.

Figure 5 shows a series generated by the sum of an upward linear trend and a deterministic cycle. In the first panel the ABCD sequence comes up quite naturally.

It is clear that when the interest goes to the deviation from the trend the turning points to detect are A and D. Points A and D correspond to the intersections of the series with the two tangent lines parallel to the trend over and below the trend itself. The cycle which emerges in this way is called *growth cycle*.

Look also at the correspondence of points A and D with the de-trended values of the series presented in the second panel of the figure.

In case the interest goes to the maximum and minimum values of the level of the series the turning points to look at are B and C. These points depict the *classical* or *business cycle*.

This example shows how the peak (trough) in the growth cycle (business cycle) leads that of the business cycle (growth cycle). Note also that we can observe a growth cycle fluctuation without a business cycle fluctuation when the series is characterized by a lower slope in its underlying trend. This occurrence is denoted as 'double deep' phase.

The Growth Cycle Coincident Indicator

The Growth Cycle Coincident Indicator considered in this note measures each month the probability of being in the low phase of the growth cycle of the euro area including 16 Countries. Each month it assesses the occurrence of turning points A and D in the ABCD approach according to the methodology developed in J. Anas, M. Billio L. Ferrara and G.L. Mazzi (2008) *"A system for dating and detecting turning points in the euro area"*.

The indicator summarizes the information coming from 5 component series:

1) Employment expectations for the months ahead in the industry survey, source DG-ECFIN, available from January 1985 as balance of opinions;

2) Construction confidence indicator, source DG-EcFin , available from January 1985 as balance of opinions;

3) Financial situation over the last 12 months in the consumer survey, source DG-EcFin, available from January 1985 as balance of opinions;

4) Industrial production index, total except construc tion, source Eurostat, available from January 1990 as index of volume 2000=100;

Figure 5 – The ABCD sequence
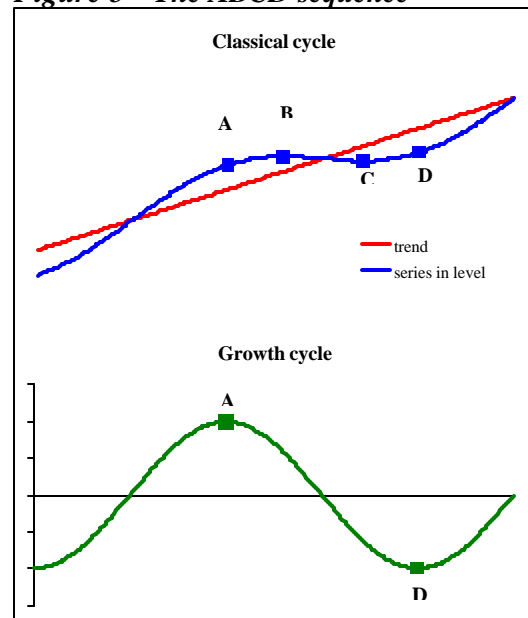
5) Imports of intermediate goods from outside euro area, source Eurostat, available from January 1989 as index of volume 2000=100;

All the series are adjusted for trading day and seasonal effects and further subject to a proper differentiation to get a stationary indicator.

Starting date of the GCCI is July 1991. For each of the 5 components a monthly latent

variable is associated taking a value of 1 if the time series belongs to the low phase of the growth cycle and 0 otherwise. A Markov-switching (MS) model-based approach is adopted to measure the state of the economy at each time period and the corresponding transition probabilities of moving from one state to the other. For all the components, model estimation is carried out with a 2-regime MS model with the same variance in each regime.

The final value for the GCCI at time t is obtained aggregating the estimated probabilities of being in a low phase of the growth cycle obtained for the 5 component series. These measures are referred as *filtered probabilities,* i.e. conditional to the information set available up to time t. The simple average is used as aggregation criterion among the 5 component series.

The Business Cycle Coincident Indicator

The Business Cycle Coincident Indicator considered in this note measures each month the probability of being in the low phase of the business cycle of the euro area including 16 Countries. Each month it accesses the occurrence of turning points B and C in the ABCD approach according to the methodology developed in J. Anas, M. Billio L. Ferrara and G.L. Mazzi (2008) *"A system for dating and detecting turning points in the euro area".*

The indicator summarizes the information coming from 3 component series:
1) Industrial production index, total except construction, source Eurostat, available from January 1990 as index of volume 2000=100; the series is completed by a provisional back-calculation of the index until January 1977;
2) Unemployment rate in percentage, source Eurostat since January 1993 further completed by provisional back-calculated values until January 1975;
3) New car registrations in volume, source ACEA since January 1978.

All the series are adjusted for trading day and seasonal effects and further subject to a proper differentiation to get a stationary indicator.

Starting date of the BCCI is June 1979. For each of the 3 components a monthly latent

variable is associated taking a value of 1 if the time series belongs to the low phase of the business cycle and 0 otherwise. A MS model-based approach is adopted to measure the state of the economy at each time period and the corresponding transition probabilities of moving from one state to the other. For all the components, model estimation is carried out with a 3 regime MS model with the same variance in each regime.

The final value for the BCCI at time t is obtained aggregating the estimated probabilities of being in a low phase of the business cycle obtained for the 3 component series. These measures are referred as *filtered probabilities,* i.e. conditional to the information set available up to time t. A weighted average is used as aggregation criterion among the 3 component series, with values 0.34, 0.46 and 0.20 respectively for the Industrial Production Index, the Unemployment Rate and the New Passenger Car Registrations series.

The SETAR based indicator of business cycle

In order to complement the analysis of the BCCI based on MS models, an alternative indicator of business cycle is considered from this assessment on. The alternative indicator is based on Self Exciting Threshold Auto-Regressive (SETAR) models. In this class of models the transition variable measuring the phase of the business cycle is observed, since it is obtained as a linear combination of lagged values of the component time series. This is the main difference with the approach based on MS models, where the transition variable to estimate is unobserved.

The SETAR based indicator summarizes the information coming from 2 out of the 3 components employed in the indicator based on MS models: notably, the Industrial Production Index and the Unemployment Rate time series.

As in the BCCI based on MS models both the series are adjusted for trading day and seasonal effects and further subject to a proper differentiation to reach stationarity.

The final value at time t is obtained as a weighted average of the transition (0-1) variable of the state of the economy for the two component series; the weights are 0.43 for the Industrial Production Index and 0.57 for the Unemployment Rate. Starting date of this indicator is April 1971.

An extensive real-time simulation on the time series discussed in this note has shown how MS models have been proved to return a higher concordance with the historical dating then SETAR models. Moreover MS models do not detect extra-cycles but emit a delayed signal with respect to SETAR models. Finally SETAR models do not miss any recession episodes of the reference chronology but emit some false signal of turning points. For details we refer to M. Billio, L. Ferrara, D.Guégan and G.L. Mazzi (2009) *"Evaluation of Nonlinear time-series models for real-time business cycle analysis of the Euro area"*.
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