Revisiting the monthly coincident indicators of Banco de Portugal

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Abstract
After a decade releasing the monthly coincident indicators of Banco de Portugal, this article revisits the main features of these indicators which play an important role in the conjunctural assessment of the Portuguese economy. In particular, it is analyzed its behavior as underlying measures of the evolution of the corresponding macroeconomic aggregates as well as their real-time behavior in monitoring economic developments. (JEL: C10, E32)

Introduction

For macroeconomic policymaking it is crucial to have tools that allow assessing the current economic evolution. In particular, the coincident indicators play an important role for monitoring the ongoing economic developments by synthesizing in a single indicator a larger information set which may present heterogeneous behavior.

Banco de Portugal has a long tradition in compiling and releasing coincident indicators for the Portuguese economy. The first wave of coincident indicators goes back to the work of Dias (1993) with the construction of a quarterly coincident indicator for economic activity based on the approach developed by Stock and Watson (1989). Following the same methodology, Gomes (1995) suggested a quarterly coincident indicator for private consumption. The compilation and release of these two indicators ended up being replaced by the monthly coincident indicators proposed by Rua (2004, 2005) for economic activity and private consumption, respectively. Drawing on the methodology proposed by Azevedo *et al.* (2006), these indicators encompass a larger information set and are available on a monthly frequency in contrast with its predecessors.

A decade after the beginning of its release, it is useful to revisit the coincident indicators in several dimensions.[1] On the one hand, it is formally

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1. One should mention that, in a similar fashion, Dias (2003) also conducted an analysis of the quarterly coincident indicator for the economic activity after a decade.

analyzed the role of the monthly coincident indicators as underlying measures of the evolution of the corresponding macroeconomic aggregate. Given that, by construction, the coincident indicators do not aim to pinpoint at each moment in time the year-on-year change of the corresponding reference variable, it is important to assess if the coincident indicators display a set of features desirable for underlying measures. This evaluation allows to reinforce the role of the coincident indicators in the economic conjunctural analysis and to contribute to a more educated reading by the users.

On the other hand, this article intends to assess the real-time behavior of the coincident indicators namely through the analysis of the information content of the estimates available at each point in time. This exercise can be very useful as the assessment of the past experience may contribute to a better use in the future. In particular, the characterization of the behavior around turning points, which constitute challenging episodes by all means for real-time analysis, intends to frame what one could expect in future similar periods.

Some general features of the coincident indicators

In the spirit of the well-known work developed by Burns and Mitchell (1946) in the United States, one of the main building blocks underlying the construction of the coincident indicators is that the business cycle consists of expansions and recessions occurring in several economic activities. Hence, under this assumption, it seems natural that the cyclical component can be better identified resorting to a larger information set instead of relying solely on a single variable.

Based on the above idea, besides the natural inclusion of the corresponding macroeconomic aggregates, namely real quarterly GDP and private consumption, it were included other series in the construction of the coincident indicators. Among the several selection criteria one could mention the availability on a monthly frequency, timeliness, a reasonable time span, a noteworthy co-movement with the economic cycle and the aim of obtaining a broadly based measure.

In the case of the coincident indicator for economic activity the set of information includes the retail sales volume (retail trade survey) which intends to capture private consumption developments. Regarding investment, the sales of heavy commercial vehicles reflect GFCF in transportation equipment while cement sales are linked to the GFCF in the construction sector. From the supply side, the manufacturing production index captures the industrial sector behavior which is typically the most cyclical sector. In order to take on board the evolution of income and wealth, it is included the households' assessment of their current financial situation. Concerning the labor market, new job vacancies were included. Finally, to reflect external

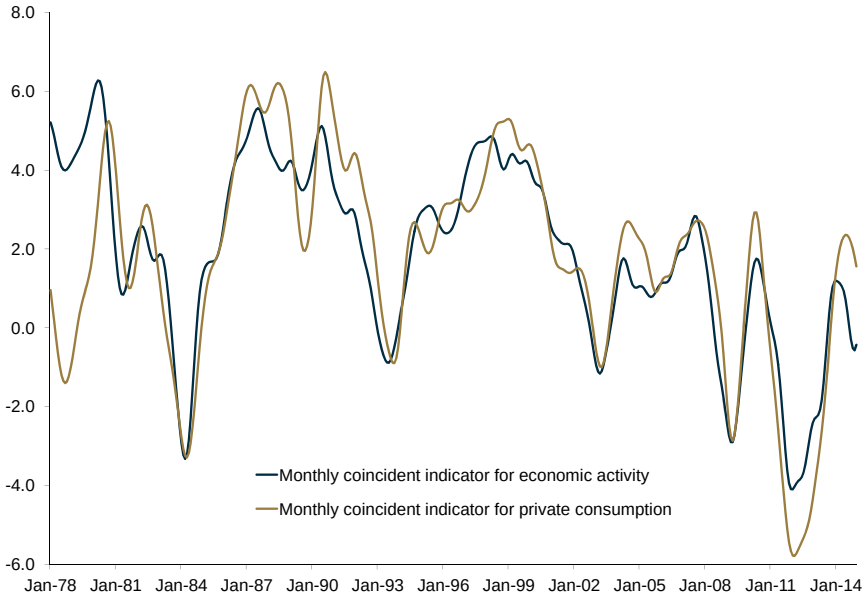


FIGURE 1: Monthly coincident indicators

environment, it was included a weighted average of the current economic situation assessment (consumers' survey) of the Portuguese main trade partners, where the weights are each country's share in Portuguese exports.

In what concerns the coincident indicator for private consumption it was considered the real retail trade turnover index and light passenger vehicles sales which provide quantitative data on the evolution of goods consumption, both durables and non-durables. These data is complemented with qualitative one, namely retail sales volume assessment (retail trade survey). The inclusion of the number of nights spent in Portugal by residents intends to capture, to some extent, developments in services consumption. From the supply side, it is considered the real industrial turnover index of consumer goods in the domestic market. Given that income and wealth are key determinants of consumption behavior, it was included the households' assessment of their current financial situation. Finally, in order to take into account the macroeconomic situation, consumers' opinion on the general economic situation is also considered.

From a methodological stance, the coincident indicators are estimated following the approach suggested by Azevedo *et al.* (2006) which corresponds to the generalization to the multivariate case of the trend-cycle modeling developed by Harvey and Trimbur (2003) which allows extracting a smooth cycle. The model can be casted in state-space form and estimated by maximum

likelihood. The coincident indicator is obtained by computing the year-on-year rate of change change of the trend-cycle resulting from the estimated model, with the cyclical component being common to all series while the trend is the one that results implicitly for the reference variable.

The monthly coincident indicators for economic activity and private consumption are presented in Figure 1.

Indicators of the underlying evolution of the corresponding macroeconomic aggregates

Given that, by definition, the coincident indicators focus on the trend-cycle component, they do not aim to match exactly the year-on-year evolution of the reference variable at each point in time. In particular, the coincident indicators are composite indicators intended to reflect the underlying movement of the year-on-year change of the corresponding macroeconomic aggregates. Therefore, one should not expect a total concordance between the evolution of both variables. Although the average difference is almost null, from time to time, there may be significant differences in absolute terms.[2] From Figure 2 it is visible that such differences are larger in the case of GDP than in private consumption given the higher irregularity in the first case.

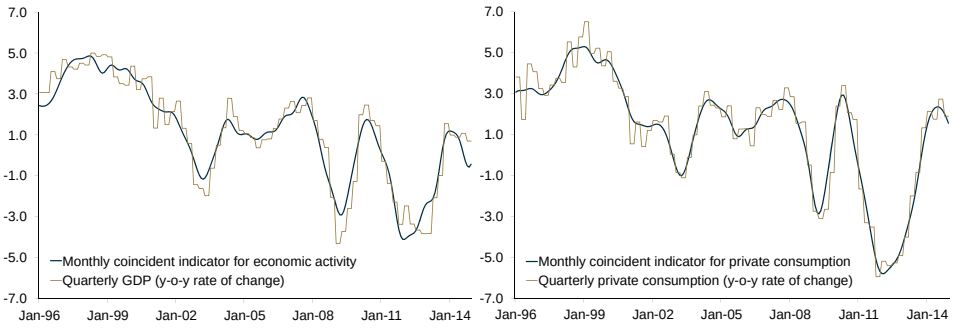


FIGURE 2: The coincident indicators and corresponding macroeconomic aggregates

One possible way of assessing the information content of the coincident indicators in tracking the underlying evolution of macroeconomic aggregates is through its comparison with the year-on-year change of the trend-cycle of GDP and private consumption. To isolate the trend-cycle component it is used the filter proposed by Christiano and Fitzgerald (2003) which presents several

2. In quarterly terms, the average absolute difference is 0.8 p.p. in the case of the coincident indicator for economic activity and 0.6 p.p. in the case of the coincident indicator for private consumption.

advantages over other popular filters in the literature (such as the well-known Hodrick and Prescott 1997 or the filter suggested by Baxter and King 1999).

By comparing the quarterly evolution of the coincident indicators with the year-on-year rate of change of the trend-cycle of the corresponding reference variables (see Figure 3), one can conclude that the coincident indicators seem to capture quite well what they intend to track.[3] In fact, both coincident indicators have a correlation around 0.97 with the year-on-year change of the trend-cycle obtained with the above mentioned statistical filter.

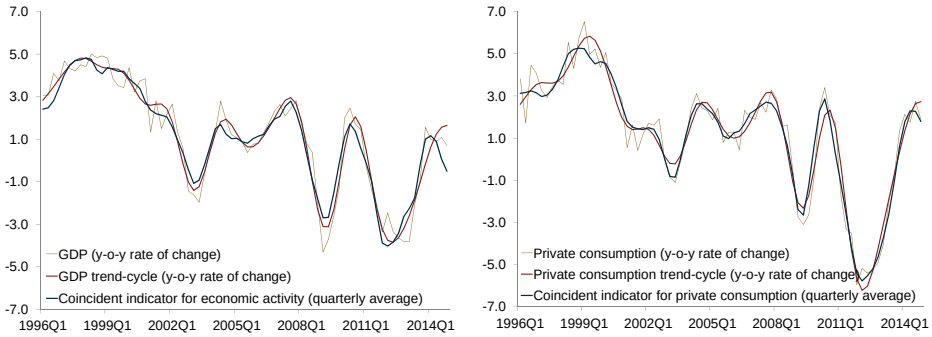


FIGURE 3: The coincident indicators and the year-on-year change of the trend-cycle

A complementary exercise consists in testing formally if the coincident indicators present a set of desirable features in indicators aimed to track the underlying evolution of the reference variable. In particular, Marques *et al.* (2003) proposed a set of conditions that properly adjusted to the current context can be described as follows. The coincident indicator, IC, constitutes an indicator of the underlying behavior of the reference variable, y, if:

$i)$ There is no systematic difference between the coincident indicator and the reference variable.

$ii)$ The coincident indicator should be an attractor of the reference variable. This means that the reference variable should converge to the coincident indicator in the sense that if y is above (below) IC than one should expect that y decreases (increases) and converges to IC.

$iii)$ The reference variable does not Granger cause the coincident indicator. That is, past values of y do not contribute to anticipate the evolution of IC otherwise it would be very difficult to infer about the behavior of y based on IC. One should mention that this condition also implies that the reference variable does not act as an attractor of the coincident indicator.

3. One should mention that the evolution in the most recent period should be read with additional caution as it is potentially subject to revisions as discussed in the next section.

Through the estimation of appropriate econometric models, it is possible to statistically test the above conditions (see Appendix). From the empirical results obtained one can conclude that both the coincident indicator for economic activity and the coincident indicator for private consumption fulfill all the conditions required to be underlying evolution indicators.

Real-time behavior

In practice, the assessment of the underlying evolution of the economy in real-time is extremely hard. On the one hand, the split between signal and noise in the most recent period is difficult due to the uncertainty regarding the future behavior. In fact, the distinction between the observed and the underlying evolution for a given point in time reflects both the preceding and subsequent behavior to that point in time. Hence, the assessment of the underlying evolution can be potentially revised with the arrival of new information. On the other hand, statistical data can be subject to revisions that result from the natural incorporation of additional information in its compilation or due to changes, from time to time, of a more methodological nature.

In light of this, it is relevant to document the real-time behavior of the coincident indicator for economic activity and the coincident indicator for private consumption. Hence, all the real-time estimates released by Banco de Portugal were collected since the beginning of its publication, namely June 2004 in the case of the coincident indicator for economic activity and October 2005 in the case of the coincident indicator for private consumption.

The evaluation of the real-time reliability focus on assessing how close a given estimate is from the subsequent ones. In this context, it is reported in Tables 1 and 2 a set of descriptive statistics regarding the different estimates of the coincident indicators. In particular, it is analyzed the monthly revisions between the first and second estimates, between the second and the third, between the third and the fourth and between the fourth and fifth estimates. In addition, it is assessed the revisions between the first and fifth estimates, so as to capture the cumulative sequence of revisions, as well as the revisions between the first and the final estimate, considered as the latest estimate. The report of the revisions up to the fifth estimate is to assure that the monthly estimate that takes on board the quarterly information of the reference variable for the quarter to which that month belongs is considered. By its turn, the revision of the final estimate vis-à-vis the first estimate reflects the whole cumulative process of revision over time.

	1^{st} vs 2^{nd} estimate	2^{nd} vs 3^{rd} estimate	3^{rd} vs 4^{th} estimate	4^{th} vs 5^{th} estimate	1^{st} vs 5^{th} estimate	1^{st} vs Final estimate
Mean revision	0.0	0.0	0.0	0.0	−0.1	0.0
1^{st} quartile	−0.2	−0.1	−0.1	−0.1	−0.4	−0.5
Median	0.0	0.0	0.0	0.0	0.0	0.2
3^{rd} quartile	0.1	0.1	0.1	0.0	0.2	0.6
Mean absolute revision	0.2	0.2	0.1	0.1	0.4	0.2
Standard deviation	0.3	0.2	0.2	0.2	0.5	0.8
Noise-to-signal ratio	0.15	0.12	0.10	0.09	0.27	0.44
Sign concordance	0.94	0.97	0.94	0.95	0.89	0.83
Direction concordance	0.86	0.94	0.99	0.97	0.87	0.80

TABLE 1. Monthly revisions of the coincident indicator for economic activity

	1^{st} vs 2^{nd} estimate	2^{nd} vs 3^{rd} estimate	3^{rd} vs 4^{th} estimate	4^{th} vs 5^{th} estimate	1^{st} vs 5^{th} estimate	1^{st} vs Final estimate
Mean revision	−0.1	0.0	0.0	0.0	−0.2	0.0
1^{st} quartile	−0.2	−0.1	−0.1	−0.1	−0.7	−0.4
Median	0.0	0.0	0.0	0.0	−0.1	0.1
3^{rd} quartile	0.1	0.1	0.1	0.1	0.3	0.6
Mean absolute revision	0.3	0.2	0.2	0.1	0.6	0.9
Standard deviation	0.4	0.4	0.3	0.2	0.8	1.3
Noise-to-signal ratio	0.16	0.13	0.11	0.09	0.28	0.48
Sign concordance	0.94	0.95	0.96	0.98	0.88	0.83
Direction concordance	0.92	0.94	0.95	0.95	0.86	0.82

TABLE 2. Monthly revisions of the coincident indicator for private consumption

Firstly, one can conclude that the mean revision is close to zero which means that there is no evidence in terms of bias of the different estimates. The median is also approximately nil with a large proportion of the revisions presenting a relatively small size.[4]

In terms of the size of absolute revisions, both the mean absolute revision and the standard deviation of the revisions point to relatively low figures in the initial estimates while increasing with the revision horizon. The signal-to-noise ratio, computed as the ratio between the standard deviation of the revisions and the standard deviation of the final estimate and which allows to assess the relative importance of the revisions, point to the same findings. One should note that these results also reflect the revisions of the Quarterly National Accounts (see Cardoso and Rua 2011). The latter revisions can be noteworthy when Annual Accounts are released, with a typical lag of two years, or due to methodological changes like base changes which can influence significantly the comparison between the first and final estimates.

Besides the analysis of the size of the revisions, it was also computed measures like the concordance both in terms of sign and direction between the different estimates of the coincident indicators. In the first case, it measures the percentage of times that both estimates share the same sign whereas the latter measures the percentage of times that the estimates give the same qualitative indication in terms of increase/decrease. In both cases, it was recorded very high concordance rates.

Additionally, to have an idea of the uncertainty associated with the coincident indicators over time, it was calculated the standard deviation of the different estimates for each month since the beginning of its publication (see Figure 4). Despite the relatively small standard deviation, it is visible that the uncertainty is higher around turning points as expected.

Given that turning points are usually the points in time which are more challenging for real-time performance, one now focus in more detail on the reliability of the coincident indicators around turning points. Hence, it was considered four turning points namely two local maxima and two local minima. For a comparison term, it was also considered the performance that one would have in real-time with the year-on-year change of the trend-cycle extracted with the Christiano-Fitzgerald filter. One should note that the latter only takes on board data regarding the reference variable, that is, quarterly GDP or private consumption. Given the typical end-of-sample filtering problem, the latest values can be subject to substantial revisions. One possible way to mitigate such problem consists in using multivariate information, which is basically one of the main building blocks of the methodology used to compile the coincident indicators. In fact, the use of

4. One should note that since both coincident indicators were re-estimated around mid-2009 the revisions might be a bit larger in that period of time.

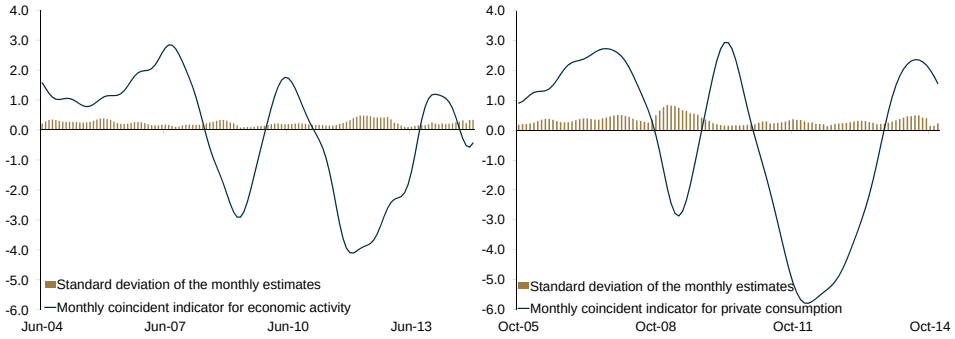
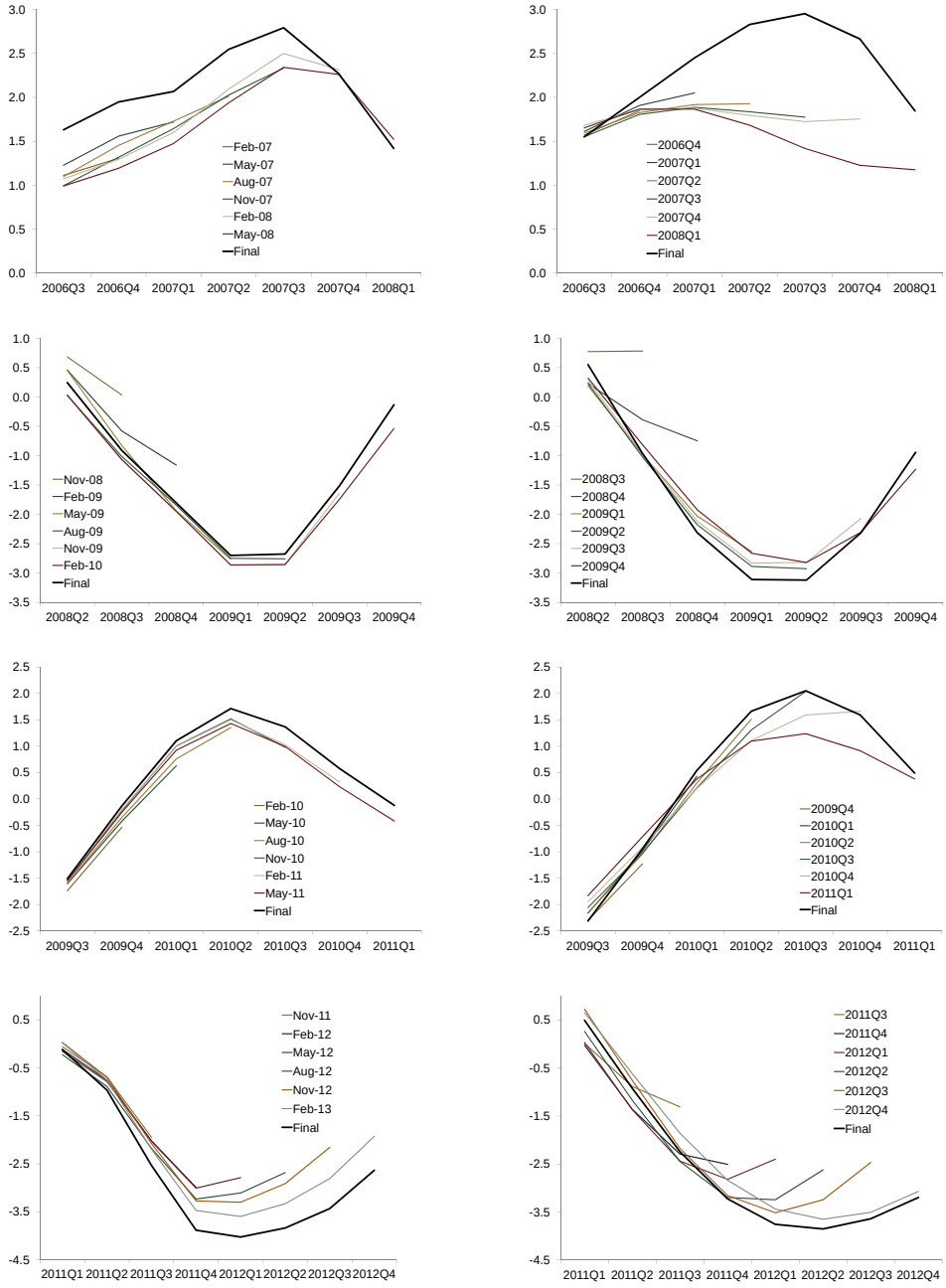


FIGURE 4: Coincident indicators and corresponding standard deviation of the monthly estimates

information beyond that conveyed by reference variable may allow mitigating the size of the revisions and reinforcing the real-time information content.

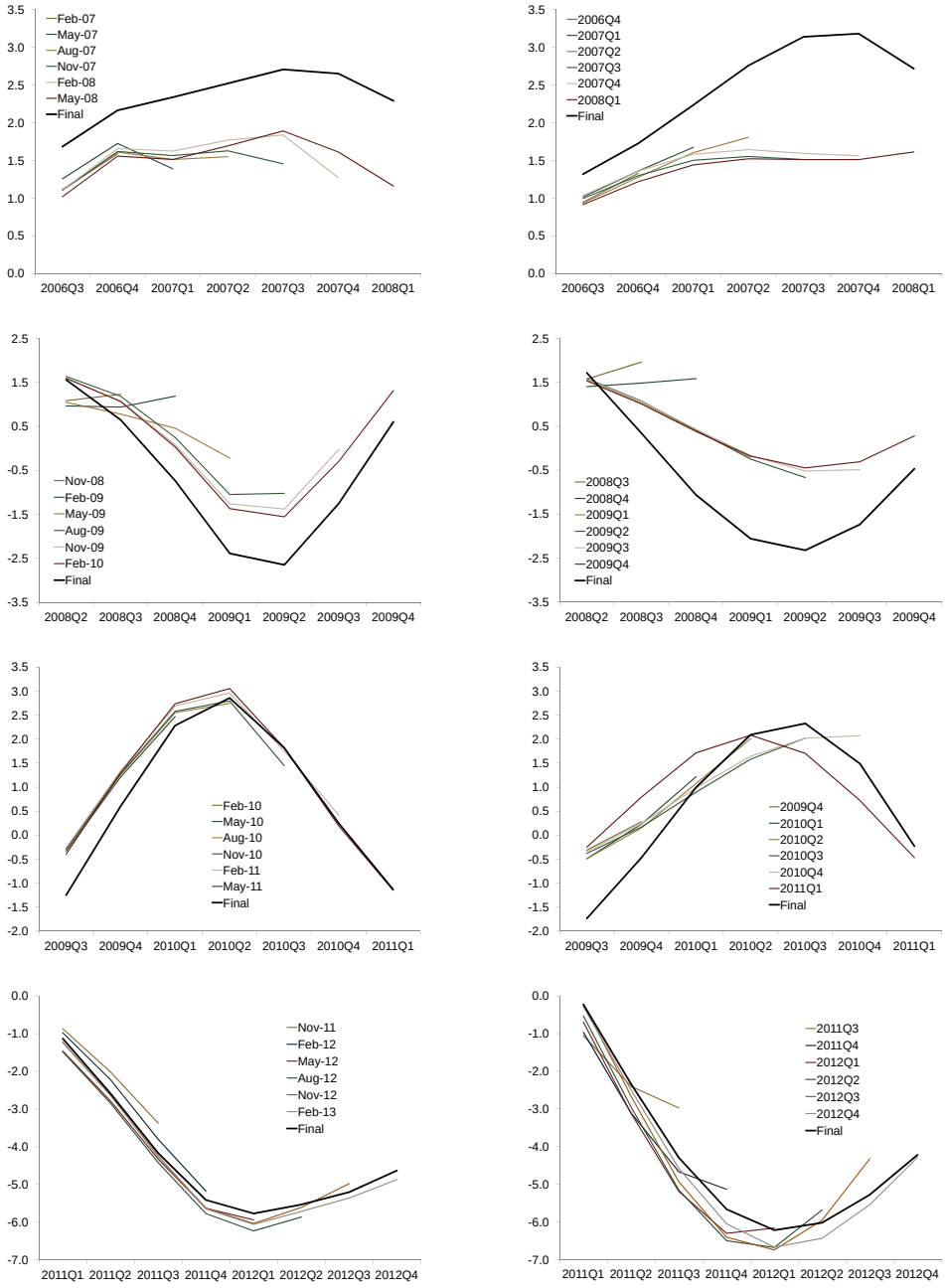
In Figures 5 and 6, the real-time estimates of the coincident indicators as well as the year-on-year change of the trend-cycle extracted with the above mentioned filter are presented. Note that the subsequent analysis is conducted on quarterly frequency so as to allow for the above mentioned comparison and all the estimates have been obtained using the available vintages at each point in time. In the case of the coincident indicators, it corresponds to the public releases by Banco de Portugal whereas in the case of the statistical filter it was required to collect all the vintages for GDP and private consumption. One should mention that the estimates presented in the figures correspond to the estimates obtained at the time of release of the Quarterly National Accounts by INE being therefore comparable in terms of closing date of information.

From Figures 5 and 6 it is possible to conclude that the coincident indicators have presented a higher information content in real-time in the identification of the turning points since the qualitative indication provided in real-time does not seem to have changed significantly with the arrival of new information. By its turn, the estimates obtained with the above mentioned filter are much more sensible to the inclusion of additional quarterly observations for the macroeconomic aggregate.



Coincident indicator Christiano-Fitzgerald filter

FIGURE 5: Coincident indicator for economic activity in quarterly terms around turning points



Coincident indicator Christiano-Fitzgerald filter

FIGURE 6: Coincident indicator for private consumption in quarterly terms around turning points

	Revisions vis-à-vis the final estimate			Concordance vis-à-vis the final estimate	
	Mean	Median	Standard deviation	Sign	Direction
Quarterly estimate of the coincident indicator at the time of release of the Quarterly National Accounts	−0.1	0.1	0.6	0.96	0.91
Y-o-y rate of change of the trend-cycle extracted with Christiano-Fitzgerald filter	−0.2	−0.1	0.8	0.96	0.74
Memo					
First quarterly estimate of the coincident indicator for a given quarter	−0.3	0.0	0.8	0.91	0.87

TABLE 3. Quarterly revisions of the coincident indicator for economic activity around turning points

	Revisions vis-à-vis the final estimate			Concordance vis-à-vis the final estimate	
	Mean	Median	Standard deviation	Sign	Direction
Quarterly estimate of the coincident indicator at the time of release of the Quarterly National Accounts	−0.1	0.0	1.0	0.96	0.83
Y-o-y rate of change of the trend-cycle extracted with Christiano-Fitzgerald filter	−0.3	−0.2	1.1	0.91	0.74
Memo					
First quarterly estimate of the coincident indicator for a given quarter	−0.4	−0.3	1.5	0.78	0.74

TABLE 4. Quarterly revisions of the coincident indicator for private consumption around turning points

From a quantitative point of view, the different estimates of the coincident indicators are relatively close to both the preceding and immediately subsequent estimates while the indication given by the year-on-year change of the trend-cycle extracted in real-time with the statistical filter is subject to larger revisions. One should recall that due to the above mentioned reasons the revisions can be large. In particular, in 2007 there was a base change in the national accounts involving methodological changes in the Annual National Accounts which contributed to a larger discrepancy between the real-time estimates and the final estimate. In particular, the release of the Annual National Accounts led to a revision, for 2007 as a whole, of 0.5 p.p. in the case of GDP and around 1.0 p.p. in the case of private consumption. Moreover, regarding private consumption it was also recorded a revision of -1.5 p.p. in 2009 with the release of the corresponding Annual National Accounts.

The information conveyed by Figures 5 and 6 is complemented with a set of descriptive statistics presented in Tables 3 and 4 respectively.

Tables 3 and 4 support quantitatively the above findings. In light of all the statistical measures presented, both the coincident indicator for economic activity and the coincident indicator for private consumption are more reliable in real-time than what would be possible to achieve by resorting to the statistical filter. In particular, the mean revision and the median are almost null for both coincident indicators. By its turn, the standard deviation of the revisions vis-à-vis the final estimate is higher for private consumption than for economic activity which may reflect the larger revisions recorded in the corresponding macroeconomic aggregate in the national accounts. In terms of concordance, it is observed high percentages both in terms of signal and direction. Besides being available at a higher frequency which allows a monthly monitoring of the economic evolution, the coincident indicators also present a more reliable real-time behavior in quarterly terms when compared with the statistical filter.

Additionally, it was also assessed the first quarterly estimate available for the coincident indicators for a given quarter. This estimate corresponds to the one which can be typically obtained two months before the other estimates analyzed. As expected, since the information available is more scarce and preliminary, such estimate is subject to larger revisions and presents lower information content when compared with the estimate for the coincident indicator at the time of the release of the national accounts. However, one should highlight that in the case of economic activity, this first estimate delivers a similar performance to that of the statistical filter with a higher concordance in terms of direction. In the case of the coincident indicator for private consumption, the first quarterly available estimate presents a behavior close to the one of the statistical filter.

Conclusions

After a decade of releases by Banco de Portugal, this article revisited the monthly coincident indicators in several dimensions. On the one hand, the role of the coincident indicators as measure of the underlying evolution of the corresponding macroeconomic aggregates was evaluated. Based on a formal approach, it was possible to conclude that both the coincident indicator for economic activity and the coincident indicator for private consumption present a set of features desirable for underlying indicators.

On the other hand, the revisions of the coincident indicators since the beginning of its publication were also analyzed. Although by resorting to a multivariate set of information one can eventually mitigate the revisions and improve the real-time information content, one should bear in mind that the classical problem of evaluating the underlying evolution in real-time will be hardly ever fully overcome whatever the tool used.

The analysis of the real-time behavior of the coincident indicators has shown that these composite indicators have proved to be quite useful in monitoring and tracking the evolution of the Portuguese economy, even during turning points which are the most challenging periods of time marked by a higher uncertainty. In fact, the monthly coincident indicators have presented a reliable real-time behavior in terms of both the size of the revisions and concordance.

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Appendix

In this appendix, it is presented the econometric models used to assess the set of desirable features in indicators aimed to track the underlying evolution of the reference variable.

The condition of no systematic difference between the coincident indicator, IC, and the reference variable, y, can be assessed by estimating the following model

$$y_t = \alpha + \beta IC_t + \upsilon_t$$

and testing jointly if $\alpha = 0$ and $\beta = 1$.

Regarding the condition that the coincident indicator should be an attractor of the reference variable, the model to be estimated is given by

$$\Delta y_t = \sum_{j=1}^{m} \alpha_j \Delta y_{t-j} + \sum_{j=1}^{n} \beta_j \Delta IC_{t-j} - \gamma \left(y_{t-1} - IC_{t-1} \right) + \varepsilon_t$$

and test if $\gamma \neq 0$.

The condition that the reference variable does not Granger cause the coincident indicator can be tested through the model

$$IC_t = \mu + \sum_{j=1}^{r} \delta_j IC_{t-j} + \sum_{j=1}^{s} \theta_j y_{t-j} + \eta_t$$

and assess if $\theta_1 = \theta_2 = \ldots = \theta_s = 0$.

The main estimation results of the above mentioned models are reported in Table 5. One can conclude that both coincident indicators fulfill all the conditions.

	Coincident indicator for economic activity	Coincident indicator for private consumption
Condition i) $\alpha = 0$ and $\beta = 1$	$\widehat{\alpha} = \underset{(0.109)}{-0.034}$ $\widehat{\beta} = \underset{(0.040)}{1.036}$ $F(2, 146) = 0.507$ [0.603]	$\widehat{\alpha} = \underset{(0.062)}{0.027}$ $\widehat{\beta} = \underset{(0.021)}{1.013}$ $F(2, 146) = 0.568$ [0.567]
Condition ii) $\gamma \neq 0$	$\widehat{\gamma} = \underset{(0.182)}{1.767}$	$\widehat{\gamma} = \underset{(0.170)}{1.124}$
Condition iii) $\theta_1 = \theta_2 = \ldots = \theta_s = 0$	$F(4, 135) = 0.333$ [0.855]	$F(4, 135) = 1.256$ [0.290]

TABLE 5. Conditions for underlying evolution indicators

Note: In round brackets are reported the heteroscedasticity and autocorrelation consistent standard errors while in square brackets appear the p-value of the test statistics.