UNECE Seminar on the Role of National Statistical Offices in The Production of Leading, Composite and Sentiment Indicators

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ISTAT Experience in the Compilation of an Italian Economic Sentiment Indicator

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1. Introduction[1]

The Business and consumer tendency surveys fall within a wide range of cyclical surveys harmonized at European level. They aim to gather the opinions (assessments and expectations) of firm managers and of consumers on the developments of variables that are directly related to their activity and/or to the course of variables over which they have no control. Starting from the survey results, the so-called confidence climate indicators (more specifically, the consumer confidence climate indicator and the business confidence climate indicators concerning, respectively, the sectors of the industry, construction, services and retail trade) are elaborated and disseminated by all the partner countries on a monthly basis.

In our country the tendency surveys were carried out by the Italian Institute of Economic Studies and Analyses (ISAE) up until December 2010. Subsequently, as of January 2011, the National Institute of Statistics (ISTAT) became the Italian partner of the harmonized project.
In occasion of the transition from the ISAE to the ISTAT, we were also asked to elaborate, in addition to the usual monthly confidence indices, a new synthetic confidence climate indicator that would have been able to reflect the confidence of the whole supply side, excluding from its definition the consumer confidence.

Bearing this in mind, the specific aim of the ISTAT contribution in this seminar is to illustrate what was done at that time to work out such an indicator. That is to say, what the ISTAT experience was in the compilation of an economic sentiment indicator suitable for interpretation of the psychological status of Italian firms.

More specifically, we will describe the data we used, the methodologies applied, the results obtained, the criteria used to choose the best result and, to conclude, the synthetic indicator that was finally considered the best one

[1] Although the work reports the results of a joint research of both authors, Luciana Crosilla wrote the section 6, Solange Leproux is responsible for sections 1, 2, 3, 4 and 5. The authors wish to thank Emilia Matera for having contributed to the first data elaborations and to an initial draft of the work.

among all those elaborated: the one that the Institute subsequently named "Istat Economic Sentiment Indicator" (IESI, in short).

To conclude, we will also take this important occasion to present a new business confidence indicator that has been recently processed applying the dynamical factorial analysis, a further methodology of multivariate analysis that was not originally used.

2. The dataset description

Having to build a synthetic indicator able to reflect the confidence of the supply side, only data stemming from the business tendency surveys were taken into consideration, excluding the information obtained from the ISTAT monthly survey carried out among the Italian consumers.
As a consequence, the dataset was composed by the monthly balance series of the variables included in the definition of only industrial, construction, services and retail trade confidence indicators[2].

Altogether, 11 seasonally adjusted series made up the dataset[3]. More specifically: 3 series pertaining to the industrial confidence indicator (assessments on current overall order books; assessments on current stock of finished products; expectations on production development), 2 for the construction sector (assessments on current overall order books; expectations on total employment), 3 for the services one (assessments and expectation on order book; expectations on business situation development) and, finally, 3 for the retail trade sector (assessments and expectations on business trend; assessments on current stock).

The analysis was performed on the data available in April 2012, and so the dataset covered the historical period between January 1992 and December 2011[4].

3. The methodology applied

The construction of the business confidence indicator based on the qualitative variables stemmed from the business surveys was faced following two methodological approaches.
It is important to underline that, before proceeding to aggregate the seasonally adjusted series included on the dataset, they were standardized to make them comparable in terms of both their average level and their volatility.

After that, fully in line with the construction methodology that is applied by the European Commission for the elaboration of the Economic Sentiment Indicator (ESI)[5], the new synthetic indicator was initially calculated as a sample weighted average. In this step of the analysis, four different confidence indicators were elaborated using alternatively four different kind of weights.

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[2] In the harmonized questionnaires of the business surveys, the questions to collect qualitative information have generally an answer scheme with three-options ordinal scale (for example, "The situation has increased", "The situation has remained unchanged", "The situation has decreased"). For each question, the balances are the algebraic difference between positive and negative answering options, expressed as percentage points of total answers. The confidence indicators are defined as the simple arithmetic average of the (seasonally adjusted) balances of the specific variables that are chosen from the full set of questions of each individual survey. The ones that are characterized by an anti-cyclical behavior, enter in the calculation with inverted sign (in particular, the balance of assessments on current stocks that are surveyed in the industrial and retail trade sector).

[3] The Institute uses the TRAMO SEATS method to the seasonal adjustment of the historical series.

[4] As for balances of the service tendency survey, they enter the dataset since January 2003 (year in which this survey was born).

[5] The Economic Sentiment Indicator elaborated by European Commission (ESI) represents a higher level of aggregation of the results of the business and consumer surveys carried out by all the countries participating in the harmonized project. It includes into its definition the components of the industrial, construction, services, retail trade and consumer confidence indicators. For further details one can see European Commission (2007).

Afterwards, two more sophisticated confidence indicators were calculated applying the principal component analysis and the static factorial analysis.

Therefore, six different possible business confidence indicators were built on the whole. In particular:

4 average based indicators (according to the first methodological approach)
2 factor based indicators (according to the second methodological approach)

After having elaborated the indicators, their performances were compared to the cyclical movements of the Italian economic activity using, in particular, the Italian (seasonally adjusted) GDP and, alternatively, the Italian (seasonally adjusted) Value Added as reference series.
The choice was addressed towards these series bearing in mind the goal that the new business confidence indicator should have pursued (namely, to be a measure able to summarize the confidence climate of all Italian firms).

Both the series were provided by the (ISTAT) National Accounts, however, the one pertaining to the Value Added aggregate was further elaborated in order to make it more consistent with the target universe of the business surveys[6]. With reference to the GDP series, the data was not available with a sufficient level of disaggregation to make such an elaboration and so the total GDP was taken in consideration.

Since these series were both quarterly-based, the monthly frequencies of the indicators were converted into quarterly frequencies before comparing them with the reference series[7].
Moreover, the cyclical features of the GDP and of the Value Added aggregates were identified through the Bry-Boschan routine[8]. In particular, according to the growth cycle approach, the trend component was first estimated using the Hodrick-Prescott filter[9]. Consequently, its estimation was also obtained using the Christiano-Fitzgerald asymmetric filter and, finally, the fourth logarithmic differences[10].

All in all, we compared the performances of the six potential confidence indicators with two different reference series, each one filtered applying three different methodologies in turn (table 1).

Table 1 – Indicators, reference series and filters

Potential confidence indicators	Reference series	Filters
First average based indicator Second average based indicator third average based indicator Fourth average based indicator First factor based indicator Second factor based indicator	Italian GDP Italian Value Added	Hodrick-Prescott Christiano-Fitzgerald (asymmetric) The fourth differences of logarithms

[6] Following the review carried out on the National Accounts, the aggregate reference was obtained as a sum of the Value Added of the sectors: industry, construction, trade, repair, hotels, public services and services. From the so-obtained series the chain linked indices (with reference year 2005) were subsequently calculated.
[7] The transformation from monthly to quarterly series was computed using simple three-term averages.
[8] Bry, Boschan (1971). A version of the quarterly data of the bry-Boschan routine (Schlitzer, 1993) was processed and proposed by Cacciotti, Cerciello, De Arcangelis and Giovannetti (2005).
[9] Hodrick, prescott (1980).
[10] Gyorgy Gyomai, Cicle Exstraction: a Comparison of the Phase-Average Trend method, The Hodrick-Prescott and Christiano-Fitzgerald Filters, OCSE, Statistics Directorate, Wirking Paper no. 39, 2011

Following Moore and Shiskin[11], the relationship between each confidence indicator obtained and each reference series was checked looking at, in particular:

- the time consistency (the average lead/lag of the indicator at the reference series turning points);
- the conformity (the directional coherence of the indicator compared to the reference series);
- the economic significance (the cross correlation function of the indicator with respect to the reference series);

Lastly, in order to test the forecasting abilities of the all indicators, these were subjected to further tests using same econometric tools. More specifically:

- the Granger test[12] (with reference to the in sample properties)
- the out-of-sample test of the Theil inequality coefficient

Finally, all the results were then compared to each other and the so-called "ISTAT E*conomic* S*entiment* I*ndicator*" was identified as the best indicator. The ISTAT disseminates this indicator via press releases since 2012, on a monthly basis.

3.1. The average based indicators

As above-mentioned, to elaborate a new synthetic indicator able to track, or even to anticipate, the Italian economic trend, first we used a weighted average of balances of the dataset stemming from the ISTAT business tendency surveys.

At this point, having already chosen the reference series to be used as aggregated measures of economic activity (as already mentioned, the Italian GDP growth and the Italian Value Added growth), the issue of weight assignment had to be taken into consideration. Regarding this point, it was decided to allocate to the different sectors as weights, alternatively:

1) the total number of employees in the companies investigated. With reference to each survey, the average number of the employees in 2010 (ISTAT_Numadd, the relevant indicator);
2) the total number of interviews conducted for each survey. Also in this case it was considered to be the average of 2010 (ISTAT_NumInterv, the relevant indicator);
3) the weights used by the European Commission for the calculation of the ESI (IESI_CE, the relevant indicator)[13];
4) the Value Added pertaining to each economic sector. In particular, in order to allocate to each sector a weight as close as possible to the actual field of observation of each survey, the aggregate was calculated net of the economic sectors that are not included in the domains of observation of each survey. For example, as regards the retail trade sector, the weight has been derived from the series of the aggregate stated net of hotels, transport and communications. Once again, the average values of 2010 of each (seasonally adjusted) series were calculated (IESI_VA, the relevant indicator).

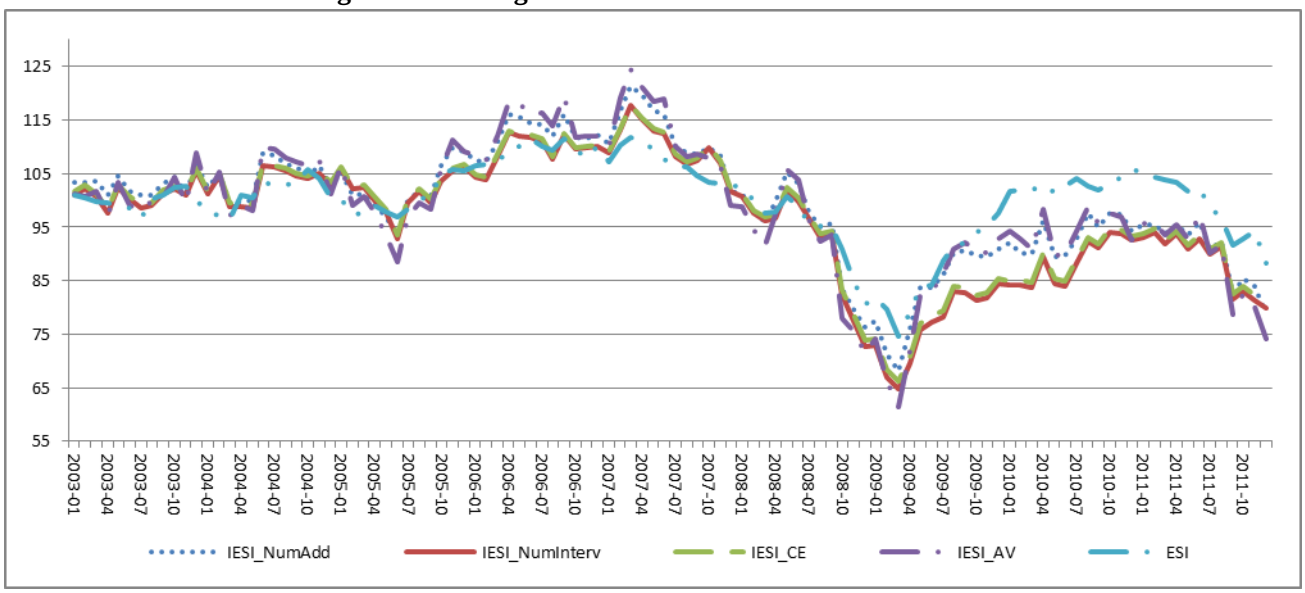
[11] Moore and Shiskin (1967).
[12] Laszlo (2004).
[13] The European Commission weights have been determined according to two criteria, that is, the "representativeness" of each sector and its tracking performance vis-à-vis the reference series. They are, in particular: 40% with reference to Industry; 30% to Services; 5% to Construction; 5% to Retail Trade and 20% to Consumers. This last weight, being consumers excluded from the definition of the IESI, was assigned evenly on other surveys.

It is important to underline that in order to calculate the weighted averages, the weights taken from time to time into consideration (average number of employees, of interviews, and so on) were divided by the number of the (seasonally adjusted and standardized) balances making up the related confidence indicator. Only then were the weighted averages computed.

So, for example, the whole weight pertaining to the retail trade was divided into three equal shares, three the balances being enclosed into the retail trade confidence indicator. It goes without saying that this was done for the weights of all the other sectors.

Lastly, according to the European Commission methodology to compute the Economic Sentiment Indicator (ESI), the so-obtained weighted averages were finally scaled to have a long-term mean of 100 and a standard deviation of 10[14].

Figure 1 – Average based confidence indicators and ESI



Source: processing of ISTAT data

The graph shows the evolution of the four average based indicators processed according to the methodology above described (IESI_NumAdd, IESI-NumInterv, IESI_CE, IESI_VA) as well as the Economic Sentiment Indicator calculated by the European Commission (ESI). As it is readily observable, there is a great similarity among the ISTAT sentiment indicators. They show a quite similar trend and at times even coincide. The ESI line appears, on the contrary, more distinguishable and shows greater dynamism in the expansion phase following the low point in March 2009. Nevertheless, in comparing the trends, it is important to keep in mind that the calculation of the Economic Sentiment indicator also includes the opinions of European consumers who, conversely, are not included in the calculation of the four indicators IESI.

3.2. The factor based indicators

To synthesize the information contained in the dataset, an Italian business sentiment indicator was built also using the principal component analysis and the static factor analysis[15]. The indicator was obtained as a linear combination of the original variables, using as weights the "loadings" of the latent factors identified by the procedures.

[14] Assuming approximate normality, it means that about the 68% of the cases the elaborated indicators will fall between 90 and 110.
[15] Bruno, Malgarini (2002). Marcellino (2006). Gayer, Genet (2006). Crosilla, Leproux, Malgarini, Spinelli (2009).

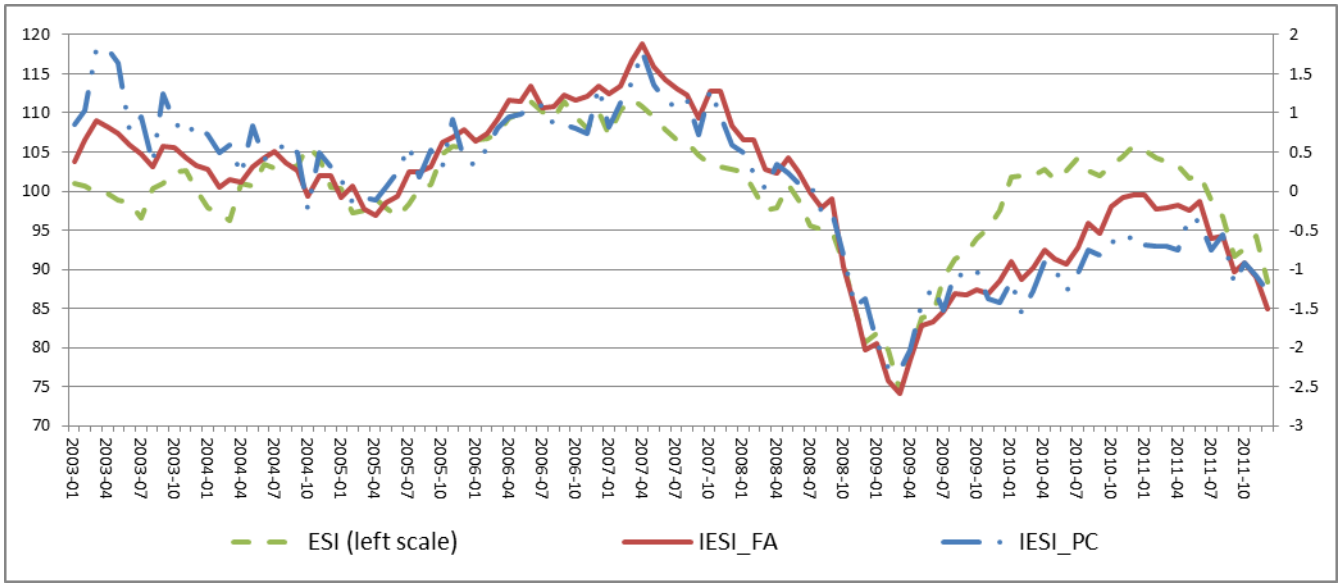
Starting from the principal component analysis, it allowed the identification of eleven components. In keeping with standard practice, according to which the factors that explain individually more than 10% of the overall variance and together more than 60% are chosen, the first two components were selected. Each of them, in fact, were able to explain 53% (the first) and 23% (the second) of the total variance. So they reached, in cumulative terms, 76% of the total variance. Given that the third component alone explained about 8% of the total variance, the indicator (IESI_PC) was constructed by taking only the first two factors.

In order to obtain the confidence indicator, these two components were aggregated by assigning a weight to each of them equal to the proportion of the variance explained, following in this step the OECD methodology for the composite indicators construction[16].

With reference to the static factor analysis, it allowed the identification of only one common factor able to explain 50% of the total variance. As a consequence, the indicator (IESI_FA) was constructed by weighting the variables of the initial data base with the loadings of this factor.

The following graph compares the two factor based indicators with the Economic Sentiment Indicator (ESI) elaborated by the European Commission. It shows a quite good degree of conformity between the three series, in particular between March 2005 and March 2009. Also in this case, it is important to keep in mind the different composition of the ESI indicator.

Figure 2 – Factor based indicators and ESI



Source: processing of ISTAT data

4. The performance evaluation

As above-mentioned, following Moore and Shiskin to evaluate the behaviour of the confidence indicators against the developments in the reference series, in particular, we looked at time consistency, directional coherence and correlation. Lastly, in order to further test the forecasting capabilities of the composite indicator we investigated its forecasting properties in sample and out of sample applying the Granger causality test and the Theil inequality test.

By doing so, we got a great mass of results[17]. So it seemed initially difficult to identify the indicator characterized by the best performance with respect to one of the reference series among those considered. In fact,

[16] OECD (2008).

some indicators among those calculated seemed better for certain results, but worse for others. Moreover, some indicators showed very similar results compared to those of other indicators. We then decided to transfer all our results into a synoptic table useful to identify the best indicator (table 2) [18]. While taking into account the cross correlation and the directional coherence results, to select the indicator characterised by the best leading capacity vis-à-vis the reference series, in the table we reported only the results of the Bry-Boschan routine and the ones of in-sample and out-sample tests.

Table 2 –the synoptic table

	CF_ASYMM_GDP			**HP_GDP**			**DIF_TEND_GDP**		
	Time consistency	In sample	Out sample	Time consistency	In sample	Out sample	Time consistency	In sample	Out sample
IESI_AV	++	-	++	**++**	**++**	**+**	++	+	+
IESI_CE	+	-	++	+	+	+	-	++	+
IESI_NumAdd	++	-	++	++	+	+	-	+	+
IESI_NumInterv	+	-	++	+	++	+	-	++	+
IESI_FA	++	-	++	-	++	+	-	+	-
IESI_PC	++	-	++	-	-	+	+	-	-

	CF_ASYMM_AV			HP_AV			DIF_TEND_AV		
	Time consistency	In sample	Out sample	Time consistency	In sample	Out sample	Time consistency	In sample	Out sample
IESI_AV	++	-	++	++	+	+	+	-	+
IESI_CE	+	-	++	-	+	+	-	++	+
IESI_NumAdd	++	-	++	+	+	+	-	-	+
IESI_NumInterv	+	-	++	-	++	+	-	++	+
IESI_FA	++	-	++	+	+	-	-	+	-
IESI_PC	+	-	++	-	-	+	-	-	-

To this end, in particular, it was used:

- pertaining to the time consistency, the sign "++" to highlight the indicators able to anticipate more than one quarter the reference series taken into consideration; the sign "+" to point the indicators able to anticipate less than one quarter the reference series; the sign "-" to indicate the indicators unable to anticipate the reference series;

- pertaining to the in sample forecasting capabilities (Granger causality test), the sign "++" to highlight the refusal of the null hypothesis of non-causality in Granger'terms at the level of significance of 1%; the sign "+" to point the refusal of the null hypothesis at the level of 5%; the sign "-" when the null hypothesis had to be rejected;

- pertaining to the out sample forecasting capabilities (Theil inequality coefficient), the sign "++" to highlight a Theil value up to 0.1; the sign "+" to point a Theil value from 0.1 to 0.4; the sign "-" for a Theil value upper to 0.4.

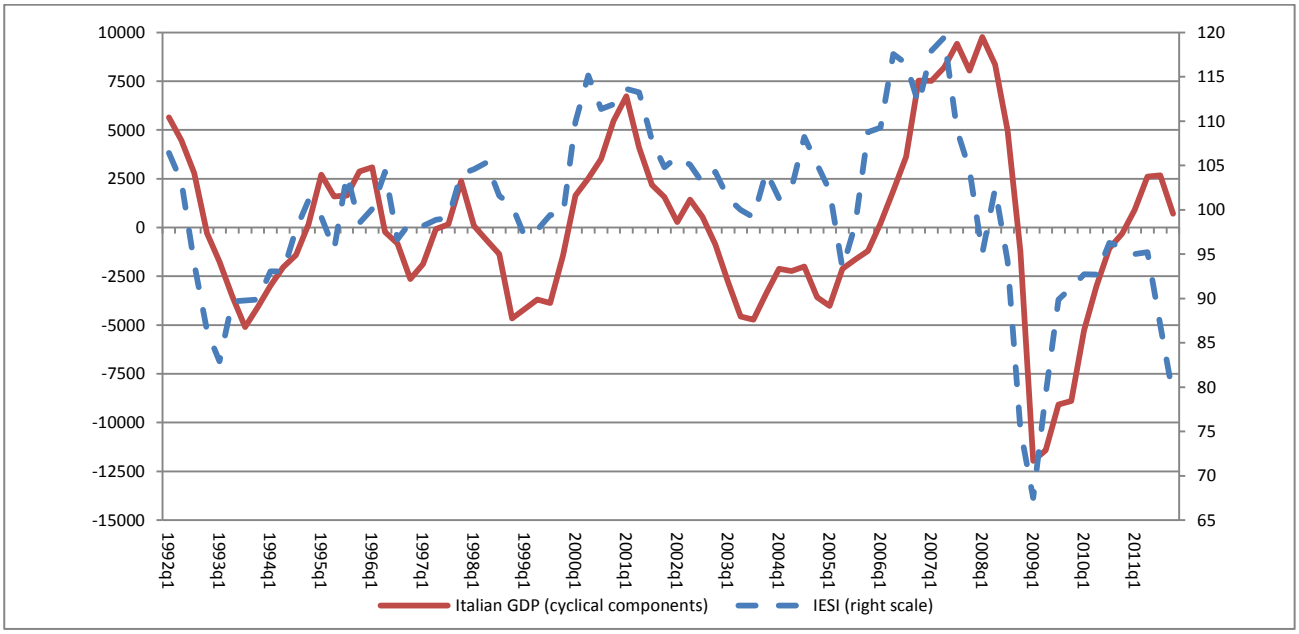
[17] They are provided in the appendix.

[18] In particular, even taking into account the cross correlation and directional coherence results, to select the indicator characterised by the best leading capacity vis-à-vis reference series, the results in "Time consistency" column are those only of the Bry-Boschan routine.

Consequently, the capability of each confidence indicator to closely monitor the cyclical evolution of each reference series is indicated by the presence of the higher possible number of "++" and/or "+".

On the basis of such criteria, the confidence indicator IESI_VA compared to the GDP series filtered with the Hodrick-Prescott method was judged the best one among all. It was called ISTAT Economic Sentiment Indicator (IESI in short).

Figure 3 – IESI e Italian GDP*



*GDP cyclical component = GDP/trend-1.
Source: processing of ISTAT data

5. The recent methodological review of the IESI

In 2014, ISTAT started a methodological review of the consumer and business tendency surveys. In particular, the revision aimed to update both the weights used in the balance series calculation and the bases of all consumer and business confidence indices[19].

In line with what was done for the tendency surveys, also the weighting system used in the process of aggregation of balances falling in the calculation of the IESI indicator and the base of the IESI index were updated.

Before the revision, the weighting system used for the IESI calculation was based on Value Added estimates of year 2010. These weights were stemmed from the ISTAT National Accounts.

The weighting system introduced following the revision is based on data of Value Added in 2012, derived from a source called FRAME SBS (Structural Business Statistics). This is the new micro-based integrated information system, made by ISTAT and based on the use of data of administrative and tax source, integrated with survey data.

This information system has allowed the use of sector weights characterized by a high level of detail of the estimates. As a result, it has secured an increase in the quality of sectional estimates used in the process of aggregation of balances.

[19] On this occasion, the seasonal adjustment models were also revised for all series.

Table 3 – IESI computation: the new micro-based weights allocated to the different sectors

SECTOR	*TOTAL WEIGHT (%)*	*NUMBER SERIES**	*UNIT WEIGHT (%)*
Industry	40,22	3	13,41
Construction	8,95	2	4,47
Retail trade	11,68	3	3,89
Services	39,15	3	13,05

* Number of the (seasonally adjusted and standardized) balances making up confidence indicators.

In the light of the results obtained following the review process, the newly-revised indicator IESI was subjected to a new check in order to assess its capacity both in terms of timeliness in identifying the turning points of the cyclical economy and in terms of ability to anticipate the GDP growth rate[20].

In particular, to evaluate the "new" Istat Economic Sentiment Indicator behaviour vis-à-vis developments in reference series, for the period 20031Q-2015Q1, we again looked at turning points coherence, correlation with reference series, directional coherence, in sample and out sample on predictive power (Granger causality test and Theil test, respectively).

Table 4 – Turning points and directional coherence revised IESI/ Italian GDP – Period: 2003.1- 2015.1

Bry-Boschan Routine	**PIL (Cyclical components)**	**IESI**
Number of cycles	2	2
Average duration (from trough to trough)	16.0	14.5
Average length of an expansion	10.0	8.0
Average length of a recession	5.0	5.3
Tourning points		
Peak	2004q2	2004q3
Trough	2005q1	2005q2
Peak	2008q1	2007q2
Trough	2009q2	2009q1
Peak	2011q2	2011q1
Trough	2013q1	2012q3
Mean lead (-) /lag (+) at turning points		
Total	/	-0.83
Upturns	/	-0.67
downturns	/	-1.0
Directional coherence	0.64	

Source: processing of ISTAT data

Table 5 – In sample and out sample properties revised IESI/Italian GDP – Period: 2003.1- 2015.1

Correlation function		**Granger causality test (lags 2)**		**Out sample performance (static - one step ahead)**				
IESI/PIL (cyclical components)		IESI/PIL (annual growth rate)						
ρ (0)	0,52	**F-Statistic**	3,84	**Theil Coefficient**	***Total***	***Bias***	***Variance***	***Covariance***
ρ max (lead)	0.68 (-2)	**Probability**	0,03*		0,098	0,361	0,004	0,635

*Significant at 5%

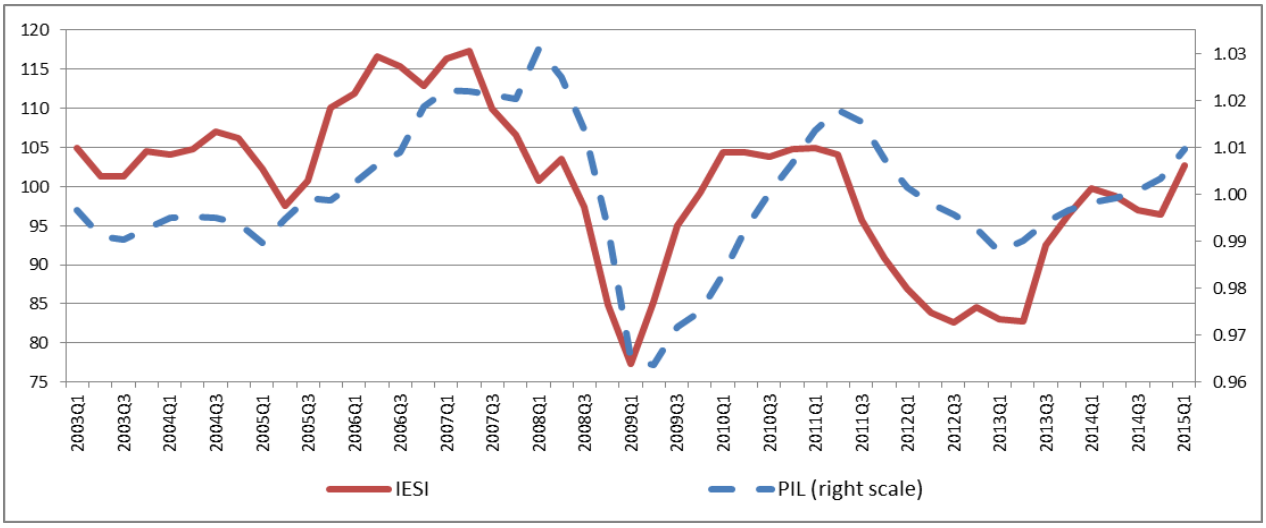
[20] For more details on this topic, one can see the work of S.,Leproux, E., Matera "The Revised Istat Economic Sentiment Indicator: its Structure and Verification of Performance Against the Cyclical Movements of the Italian GDP", currently in course of publication as a ISTAT working paper.

Source: processing of ISTAT data

In the light of the obtained results, the newly revised IESI seems to be characterized by:

- two complete cycles (like the GDP) and an average duration from trough to trough of 14.5 quarters (GDP 16.0);
- according to the turning points alignment, a global leading ability (-1.0);
- a quite good score of directional coherence (0.64);
- a low contemporary cross-correlation coefficient (0.52), but a quite high maximum correlation two quarter in advance (0.68);
- the ability to «Granger-cause» the reference series (GDP);
- all in all, an acceptable forecasting out-of-sample ability;

Figure 4 – The newly-revised IESI e Italian GDP* – Period: 2003.1- 2015.1



*GDP cyclical component = GDP/trend-1.
Source: processing of ISTAT data

6. A newly elaborated factor based sentiment indicator: preliminary results

To build a synthetic sentiment indicator, ISTAT originally used methodologies that don't take into account the dynamic aspect typical of time series. To fill this gap, lately factor analysis in a dynamic framework has been considered. When variables are auto-correlated, as it is often the case with time series, a proper dynamic specification is required. In the literature, various approaches were considered to take into account the dynamic aspect. One of the first attempts to account for dynamic dimension was proposed in Stock and Watson[21] which introduced autoregressive processes for both common factors and specific components; a generalised Dynamic Factor Model, i.e. a dynamic approach based on frequency domain analysis, was proposed by Forni et altri[22].

In the exercise presented hereinafter, we follow the approach based on Dynamic Factor Analysis (DFA) thought of as a principal components analysis for time series data; in this context n time series may be observations of the same state process: each observed time series is treated as a linear combination of a set of m hidden random

[21] Stock and Watson (1989, 1991).
[22] Forni et al. (2000,2002).

walks, with m < n, common to all initial time series. The hidden trends, or factors, are estimated and may be combined (when m > 1) to obtain the factor based indicator.

A DFA model used in the exercise has the following structure[23]:

$$\begin{aligned} x_t &= x_{t-1}+w_t \quad \text{where } w_t \sim MVN(0;Q_t) \\ y_t &= Z_t\, x_t + a_t + v_t \quad \text{where } v_t \sim MVN(0;R_t) \\ x_0 &\sim MVN(\pi;\Delta) \end{aligned} \tag{1}$$

where:

- x is a *m x T* matrix of states. Each x_t is a realization of the random variable X_t at time t;
- w is a *m x T* matrix of the process errors. The process errors at time t are multivariate normal with mean 0 and covariance matrix Q_t ;
- y is a *n x T* matrix of the observations;
- v is a *n x T* column vector of the non-process errors. The observation errors at time t are multivariate normal with mean 0 and covariance matrix R_t;
- Z_t is a *n x m* matrix of parameters;
- Q_t and R_t are parameters and are *m x m* and *n x n* variance-covariance matrices;
- π is a *m x 1* matrix fixed prior;
- Δ is a *m x m* variance-covariance matrix fixed prior.

In the model, the observations (y) are shaped as a linear combination of hidden trends (x) and factor loadings (Z) plus some offsets (a). Z is a loading matrix representing how these trends are linearly combined to explain the larger set of n observed time series. Model selection[24] has been used to select the size of m: the goal is to find the lower number of underlying trends (size of m) plus their weightings (Z matrix) that explain the larger dataset.
The DFA model (1) has been implemented with some constraints to ensure identifiability (not all the parameters can be estimated simultaneously):

- in the first m-1 rows of Z, the z-value in the j-th column and i-th row is set to zero if j > i;
- a is constrained so that the first m values are set to zero;
- Q is set equal to the identity matrix (I_m);
- the initial state vector (x_0) is set to have zero mean and a diagonal variance-covariance matrix (independent states) with large variances.

[23] Holmes et al. 2014.
[24] Model selection criteria are based on Akaike's Information Criterion (AIC). Models with the lowest AIC are interpreted as receiving more data support (Holmes et al., 2012).

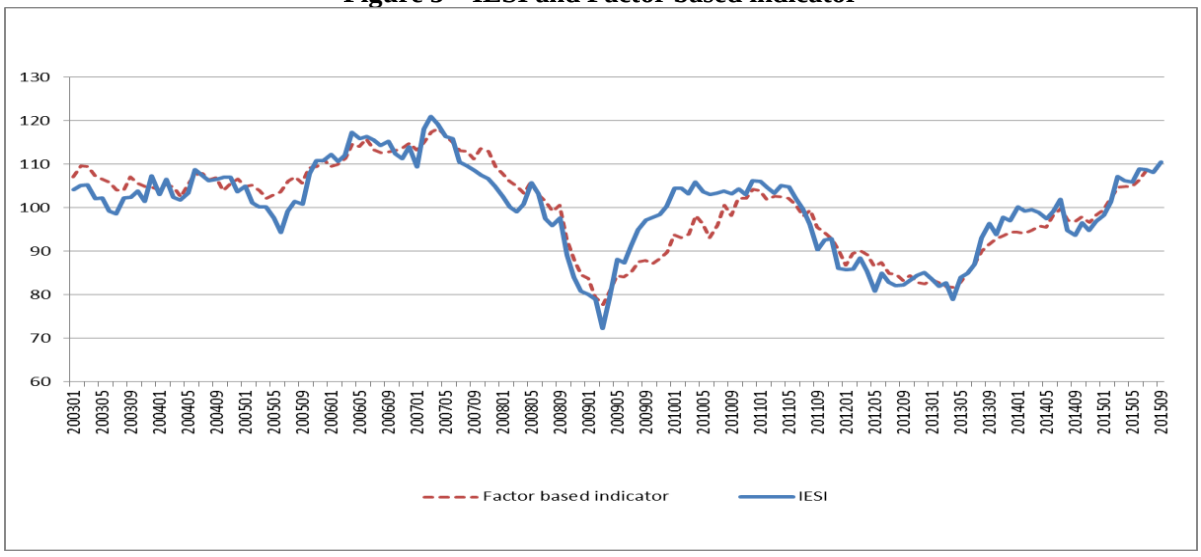
The model has been estimated via likelihood maximization using the Kalman filter/smoother, combined with an Expectation-Maximization (EM) algorithm[25]. The model selection has suggested to use 1 underlying trend[26] and the R matrix unconstrained, i.e. with different variances e covariances to be estimated.

The DFA model (1) has been applied to the time series of balances (conveniently standardized) included in the IESI. The time–span considered is 2003, January - 2015, September.

The estimated time series of the underlying trend has been standardized (mean equal 0 and standard deviation 1) and then, to make it comparable to IESI, it has been become to have a long term mean of 100 and standard deviation of 10.

The factor based indicator and IESI are shown in figure 5.

Figure 5 – IESI and Factor based indicator



Source: processing of ISTAT data

As first conclusion, the graphic analysis highlights that two indicators are very similar. The factor based indicator has been then evaluated according to the criteria, aiming at gauging its performance in tracking GDP, described in section 4. Hereinafter we present the performance of the factor based indicator in respect to GDP. To simplify the comparison between IESI and factor based indicator, the performance of IESI introduced in table 4 and 5, is presented again in table 6 and 7.

[25] The estimation process is implemented via MARSS package (Holmes et al., 2014). MARSS is an R package for fitting linear multivariate autoregressive state-space (MARSS) models with Gaussian errors to time-series data. The maximization algorithm used by the package is the Expectation-Maximization (EM) algorithm (Holmes, 2012) considerably more robust than other routines.

[26] For $1 \leq m \leq 6$ the value of AIC decreases slightly if m increased; form > 6 the difference between AIC values is not significant. The possibility of using more than one factor has not been tested in this exercise.

Table 6 – Directional coherence and conformity at turning points Indicators/GDP

BRY-BOSCHAN ROUTINE	PIL	IESI	FACTOR BASED INDICATOR
Number of cycles	2	2	2
Average duration (from trough to trough)	16.0	14.5	12.5
Average length of an expansion	10.0	8.0	5.6
Average length of a recession	5.0	5.3	6.3
TURNING POINTS			
Peak	2004q2	2004q3	2004q3
Trough	2005q1	2005q2	2005q2
Peak	2008q1	2007q2	2007q2
Trough	2009q2	2009q1	2009q1
Peak	2011q2	2011q1	2010q4
Trough	2013q1	2012q3	2013q1
	Mean lead (-) /lag (+) at turning points		
TOTAL		**-0,8**	**-0.7**
Upturns		**-0,7**	0
Downturns		**-1,0**	-1.3
DIRECTIONAL COHERENCE		0.64	0.85

Source: processing of ISTAT data

Table 7 – In sample and out of sample properties of factor based indicator/GDP

CORRELATION FUNCTION		**GRANGER CAUSALITY TEST (2 lags)**		**FORECAST OUT OF SAMPLE (static - 1 step ahead)**			
ρ (0)	0.83	F Statistic	7.80	THEIL			
				Total	Bias	Variance	Covariance
ρmax (lead)	0.83 (0)	Probability	0.001*	0.083	0,039	0,014	0,946

*Significant at 1%

Source: processing of ISTAT data

Directional coherence and conformity at turning points. Table 6 shows the percentage of cases in which each indicator is able to correctly track the rate of change of the reference series. The factor based indicator correctly predict the sign of the rate of change of the GDP in 85% of the cases while IESI in 64% of the cases. Table 6 also presents turning points analysis, evaluating the average lead/lag with respect to the reference series. Both the indicators generally lead GDP; IESI leads GDP in downturns and upturns while factor based indicator leads downturns only.

Economic significance: *cross correlations*. Cross correlation between IESI and GDP peaks at lead -2 (value is 0.68 – see tab.5) and coincident correlation appears weak. With regard to the factor based indicator, cross correlation peaks at lag 0 with a correlation magnitude equal 0.83 (see tab.7).

In sample and out of sample properties. Both indicators Granger-cause the GDP but factor based indicator outperform IESI (the test is significant at 1% against 5% of IESI). The forecasted values by the model including factor based indicator are generally more suitable than those obtained by the model including IESI (for factor based indicator, Theil coefficient and bias are lower and covariance is higher – see tab.5 and tab.7).

To sum up, the two indicators provide similar results when subject to turning points analysis; better results are obtained for factor based indicator when subject to directional coherence, econometric tests and cross-correlation analysis.

All in all, the results seem promising: this exercise may be a starting point to consider a factor based sentiment indicator. However, further research is needed in order to test the methodology used to extract the factors (especially the initial constraints expressed for the identifiability of the model) and the possibility to use more than one factor. Moreover, a more thorough evaluation of the indicator's performance should be realized. In regards to this last aspect, we stress the performance presented here was calculated on time series available at the moment. Estimates of the reference series and factor estimation may vary over time: official series are often updated when more information become available and factor estimation may change over time, as soon as new data are available. Therefore, the performance of the factor based indicator should be validated using "real time" data on the indicator and on the reference series.

APPENDIX

Time consistency – GDP reference series

Bry-Boschan Routine	CF_ASYMM_GDP	IESI_AV	IESI_CE	IESI_NumAdd	IESI_NumInterv	IESI_FA	IESI_PC
Number of cycles	5	5	5	5	5	1	2
Average duration (from trough to trough)	12.6	12.8	12.8	12.8	12.8	16	10
Average length of an expansion	6.8	7.0	7.0	7.2	7.0	9.0	5.7
Average length of a recession	5.8	5.6	5.8	5.6	5.8	7.0	5.0
Tourning points							
Trough	1993q3	1993q1	1993q1	1993q1	1993q1		
Peak	1995q4	1994q4	1995q3	1994q4	1995q3		
Trough	1996q4	1995q2	1996q4	1995q2	1996q4		
Peak	1997q4	1998q2	1998q1	1998q2	1998q1		
Trough	1999q1	1999q1	1999q1	1999q1	1999q1		
Peak	2000q4	2000q2	2001q4	2000q2	2001q1		
Trough	2003q3	2003q3	2003q3	2003q3	2003q3		2004q1
Peak	2004q2	2004q3	2004q3	2004q4	2004q4		2004q3
Trough	2005q2	2005q2	2005q2	2005q2	2005q2	2005q1	2005q2
Peak	2008q1	2007q2	2007q2	2007q2	2007q2	2007q2	2007q2
Trough	2009q2	2009q1	2009q1	2009q1	2009q1	2009q1	2009q1
Peak		2010q3	2010q4	2010q4	2010q4	2011q2	2010q4
	Mean lead(-)/lag at turning points (in quarters) - Reference series: CF_GDP						
Total		-1.4	-0.1	-1.3	-0.3	-1.7	-1.4
Upturns		-1.5	-0.5	-1.5	-0.5	-1.0	-1.5
downturns		-1.2	0.4	-1.0	0.0	-3.0	-1.2

Bry-Boschan Routine	HP_GDP	IESI_AV	IESI_CE	IESI_NumAdd	IESI_NumInterv	IESI_FA	IESI_PC
Number of cycles	5	5	5	5	5	1	2
Average duration (from trough to trough)	12.4	12.8	12.8	12.8	12.8	16	10
Average length of an expansion	7.8	7.0	7.0	7.2	7.0	9.0	5.7
Average length of a recession	4.6	5.6	5.8	5.6	5.8	7.0	5.0
Tourning points							
Trough	1993q3	1993q1	1993q1	1993q1	1993q1		
Peak	1996q1	1994q4	1995q3	1994q4	1995q3		
Trough	1996q4	1995q2	1996q4	1995q2	1996q4		
Peak	1997q4	1998q2	1998q1	1998q2	1998q1		
Trough	1998q4	1999q1	1999q1	1999q1	1999q1		
Peak	2001q1	2000q2	2001q4	2000q2	2001q1		
Trough	2003q3	2003q3	2003q3	2003q3	2003q3		2004q1
Peak	2004q3	2004q3	2004q3	2004q4	2004q4		2004q3
Trough	2005q1	2005q2	2005q2	2005q2	2005q2	2005q1	2005q2
Peak	2008q1	2007q2	2007q2	2007q2	2007q2	2007q2	2007q2
Trough	2009q1	2009q1	2009q1	2009q1	2009q1	2009q1	2009q1
		2010q3	2010q4	2010q4	2010q4	2011q2	2010q4
	Mean lead(-)/lag at turning points (in quarters) - Reference series: HP_GDP						
Total		-1.4	-0.1	-1.3	-0.3	1.0	0.0
Upturns		-1	0.0	-1.0	0.0	0.0	1.0
downturns		-1.8	-0.2	-1.6	-0.6	-3.0	-1.5

Bry-Boschan Routine	DIF_TEND_GDP	IESI_AV	IESI_CE	IESI_NumAdd	IESI_NumInterv	IESI_FA	IESI_PC
Number of cycles	5	5	5	5	5	1	2
Average duration (from trough to trough)	9.8	12.8	12.8	12.8	12.8	16	10
Average length of an expansion	5.3	7.0	7.0	7.2	7.0	9.0	5.7
Average length of a recession	5.2	5.6	5.8	5.6	5.8	7.0	5.0
Tourning points							
Trough	/	1993q1	1993q1	1993q1	1993q1		
Peak	1995q1	1994q4	1995q3	1994q4	1995q3		
Trough	1996q4	1995q2	1996q4	1995q2	1996q4		
Peak	1997q4	1998q2	1998q1	1998q2	1998q1		
Trough	1998q4	1999q1	1999q1	1999q1	1999q1		
Peak	2000q3	2000q2	2001q4	2000q2	2001q1		
Trough	2002q1	\	\	\	\		
Peak	2002q3	\	\	\	\		
Trough	2003q2	2003q3	2003q3	2003q3	2003q3		2004q1
Peak	2004q3	2004q3	2004q3	2004q4	2004q4		2004q3
Trough	2005q1	2005q2	2005q2	2005q2	2005q2	2005q1	2005q2
Peak	2006q4	2007q2	2007q2	2007q2	2007q2	2007q2	2007q2
Trough	2009q1	2009q1	2009q1	2009q1	2009q1	2009q1	2009q1
Peak	2010q4	2010q3	2010q4	2010q4	2010q4	2011q2	2010q4
	Mean lead(-)/lag at turning points (in quarters) - Reference series: DIF_TEND_GDP						
Total		-2.0	1.2	0.0	1.0	0.7	-1.0
Upturns		-0.6	0.6	-0.6	1.3	0.0	0.0
downturns		0.2	1.7	0.5	0.6	2.0	-2.5

Period: GDP, IESI_AV, IESI_CE, IESI_NumAdd, IESI_NumInterv - 1992q1-2011q4; IESI_PC, IESI_FA - 2003q1- 2011q4

Source: Processing of ISTAT data

Time consistency – Value Added reference series

Bry-Boschan Routine	CF_ASYMM_AV	IESI_AV	IESI_CE	IESI_NumAdd	IESI_NumInterv	IESI_FA	IESI_PC
Number of cycles	5	5	5	5	5	1	2
Average duration (from trough to trough)	12.8	12.8	12.8	12.8	12.8	16	10
Average length of an expansion	6.4	7.0	7.0	7.2	7.0	9.0	5.7
Average length of a recession	6.4	5.6	5.8	5.6	5.8	7.0	5.0
Tourning points							
Trough	1993q3	1993q1	1993q1	1993q1	1993q1		
Peak	1995q3	1994q4	1995q3	1994q4	1995q3		
Trough	1997q1	1995q2	1996q4	1995q2	1996q4		
Peak	1997q4	1998q2	1998q1	1998q2	1998q1		
Trough	1999q2	1999q1	1999q1	1999q1	1999q1		
Peak	2000q4	2000q2	2001q4	2000q2	2001q1		
Trough	2003q3	2003q3	2003q3	2003q3	2003q3	/	2004q1
Peak	2004q2	2004q3	2004q3	2004q4	2004q4	/	2004q3
Trough	2005q1	2005q2	2005q2	2005q2	2005q2	2005q1	2005q2
Peak	2008q1	2007q2	2007q2	2007q2	2007q2	2007q2	2007q2
Trough	2009q3	2009q1	2009q1	2009q1	2009q1	2009q1	2009q1
Peak	/	2010q3	2010q4	2010q4	2010q4	2011q2	2010q4
	Mean lead(-)/lag at turning points (in quarters) - Reference series: CF_AV						
Total		-1.5	-0.2	-1.4	-0.4	-1.7	-0.2
Upturns		-1.8	-0.8	-1.8	-0.8	-1.0	0.3
downturns		-1.0	-0.6	-0.8	0.2	-3.0	-0.5

Bry-Boschan Routine	HP_AV	IESI_AV	IESI_CE	IESI_NumAdd	IESI_NumInterv	IESI_FA	IESI_PC
Number of cycles	5	5	5	5	5	1	2
Average duration (from trough to trough)	12.6	12.8	12.8	12.8	12.8	16	10
Average length of an expansion	7.0	7.0	7.0	7.2	7.0	9.0	5.7
Average length of a recession	5.6	5.6	5.8	5.6	5.8	7.0	5.0
Tourning points							
Trough	1993q3	1993q1	1993q1	1993q1	1993q1		
Peak	1996q1	1994q4	1995q3	1994q4	1995q3		
Trough	1996q4	1995q2	1996q4	1995q2	1996q4		
Peak	1997q4	1998q2	1998q1	1998q2	1998q1		
Trough	1999q2	1999q1	1999q1	1999q1	1999q1		
Peak	2001q1	2000q2	2001q4	2000q2	2001q1		
Trough	2003q2	2003q3	2003q3	2003q3	2003q3	/	2004q1
Peak	2004q1	2004q3	2004q3	2004q4	2004q4	/	2004q3
Trough	2004q4	2005q2	2005q2	2005q2	2005q2	2005q1	2005q2
Peak	2007q3	2007q2	2007q2	2007q2	2007q2	2007q2	2007q2
Trough	2009q2	2009q1	2009q1	2009q1	2009q1	2009q1	2009q1
Peak	/	2010q3	2010q4	2010q4	2010q4	2011q2	2010q4
	Mean Lead(-)/lag at turning points (in quarters) - Reference series: HP_AV						
Total		-1.1	0.1	-0.8	0.2	-0.3	1.0
Upturns		-1.2	-0.2	-0.8	0.2	0.0	1.3
downturns		-1.0	0.6	-0.8	0.2	-1.0	1.5

Bry-Boschan Routine	DIF_TEND_AV	IESI_AV	IESI_CE	IESI_NumAdd	IESI_NumInterv	IESI_FA	IESI_PC
Number of cycles	5	5	5	5	5	1	2
Average duration (from trough to trough)	10	12.8	12.8	12.8	12.8	16	10
Average length of an expansion	4.8	7.0	7.0	7.2	7.0	9.0	5.7
Average length of a recession	5.5	5.6	5.8	5.6	5.8	7.0	5.0
Tourning points							
Trough	/	1993q1	1993q1	1993q1	1993q1		
Peak	1995q1	1994q4	1995q3	1994q4	1995q3		
Trough	1996q4	1995q2	1996q4	1995q2	1996q4		
Peak	1997q4	1998q2	1998q1	1998q2	1998q1		
Trough	1998q4	1999q1	1999q1	1999q1	1999q1		
Peak	2000q3	2000q2	2001q4	2000q2	2001q1		
Trough	**2002q1**	/	/	/	/		
Peak	**2002q3**	/	/	/	/		
Trough	2003q2	2003q3	2003q3	2003q3	2003q3	/	2004q1
Peak	2004q2	2004q3	2004q3	2004q4	2004q4	/	2004q3
Trough	2005q1	2005q2	2005q2	2005q2	2005q2	2005q1	2005q2
Peak	2006q4	2007q2	2007q2	2007q2	2007q2	2007q2	2007q2
Trough	2009q2	2009q1	2009q1	2009q1	2009q1	2009q1	2009q1
Peak	/	2010q3	2010q4	2010q4	2010q4	2011q2	2010q4
	Mean lead(-)/lag at turning points (in quarters) - Reference series: DIF_TEND_AV						
Total		-0.3	1.3	0.0	1.0	0.3	1.2
Upturns		-1.2	2.2	-0.8	1.6	-0.5	1.0
downturns		0.6	0.4	0.8	0.4	2.0	2.0

Period: AV - 1990q1-2010q4; IESI_AV, IESI_CE, IESI_ NumAdd, IESI_NumInterv - 1992q1-2011q4; IESI_PC, IESI_FA - 2003q1- 2011q4

Source: Processing of ISTAT data

Cross correlation IESI/GDP

Cross-correlation function (on cyclical components) (1)	IESI_AV	IESI_CE	IESI_NumAdd	IESI_NumInterv	IESI_FA	IESI_PC
	CF_ASYMM_GDP					
ρ (0)	0.62	0.78	0.69	0.76	0.83	0.83
ρ max (lead)	0.75 (-1)	0.85 (-1)	0.77 (-1)	0.85 (-1)	0.92 (-1)	0.88 (-1)

Cross-correlation function (on cyclical components) (1)	IESI_AV	IESI_CE	IESI_NumAdd	IESI_NumInterv	IESI_FA	IESI_PC
	HP_GDP					
ρ (0)	0.66	0.8	0.72	0.78	0.83	0.83
ρ max (lead)	0.77 (-1)	0.85 (-1)	0.79 (-1)	0.86 (-1)	0.90 (-1)	0.86 (-1)

Cross-correlation function (on cyclical components) (1)	IESI_AV	IESI_CE	IESI_NumAdd	IESI_NumInterv	IESI_FA	IESI_PC
	DIFF_TEND_GDP					
ρ (0)	0.68	0.75	0.68	0.76	0.75	0.66
ρ max (lead)	0.61 (-1)	0.62 (-1)	0.57 (-1)	0.65 (-1)	0.63 (-1)	0.53 (-1)

Cross correlation IESI/VA

Cross-correlation function (on cyclical components) (1)	IESI_AV	IESI_CE	IESI_NumAdd	IESI_NumInterv	IESI_FA	IESI_PC
	CF_ASYMM_AV					
ρ (0)	0.62	0.78	0.75	0.70	0.81	0.81
ρ max (lead)	0.76 (-2)	0.86 (-1)	0.86 (-1)	0.80 (-1)	0.91 (-1)	0.88 (-1)

Cross-correlation function (on cyclical components) (1)	IESI_AV	IESI_CE	IESI_NumAdd	IESI_NumInterv	IESI_FA	IESI_PC
	HP_AV					
ρ (0)	0.64	0.78	0.71	0.77	0.82	0.81
ρ max (lead)	0.78 (-1)	0.87 (-1)	0.80 (-1)	0.87 (-1)	0.89 (-1)	0.85 (-1)

Cross-correlation function (on cyclical components) (1)	IESI_AV	IESI_SUPPL_B	IESI_NumAdd	IESI_NumInterv	IESI_FA	IESI_PC
	DIF_TEND_AV					
ρ (0)	0.69	0.79	0.70	0.80	0.76	0.66
ρ max (lead)	0.66 (-1)	0.68 (-1)	0.62 (-1)	0.70 (-1)	0.65 (-1)	0.55 (-1)

In-sample properties IESI/GDP

Granger causality test (lags 4) (on cyclical components) (1)	IESI_AV	IESI_CE	IESI_NumAdd	IESI_NumInterv	IESI_FA	IESI_PC
	CF_ASYMM_GDP					
F-Statistic	0.39	1.04	0.43	1.38	0.36	0.17
Probability	0.81	0.39	0.78	0.24	0.83	0.95

Granger causality test (lags 4) (on cyclical components) (1)	IESI_AV	IESI_CE	IESI_NumAdd	IESI_NumInterv	IESI_FA	IESI_PC
	HP_GDP					
F-Statistic	4.85 **	3.88 *	3.97 *	4.71 **	4.44 **	2.33
Probability	0.00	0.01	0.01	0.00	0.01	0.09

Granger causality test (lags 4) (on cyclical components) (1)	IESI_AV	IESI_CE	IESI_NumAdd	IESI_NumInterv	IESI_FA	IESI_PC
	DIFF_TEND_PIL					
F-Statistic	2.96*	5.04 **	2.67*	6.23 **	3.75 *	2.56
Probability	0.03	0.00	0.04	0.00	0.02	0.1
(*) significant at 5%						
(**) significant at 1%						

In-sample properties IESI/VA

Granger causality test (lags 4) (on cyclical components) (1)	IESI_AV	IESI_CE	IESI_NumAdd	IESI_NumInterv	IESI_FA	IESI_PC
	CF_ASYMM_AV					
F-Statistic	0.20	0.54	0.23	1.02	0.63	0.83
Probability	0.94	0.70	0.92	0.40	0.65	0.52

Granger causality test (lags 4) (on cyclical components) (1)	IESI_AV	IESI_CE	IESI_NumAdd	IESI_NumInterv	IESI_FA	IESI_PC
	HP_VA					
F-Statistic	3.57 *	3.44 *	2.88 *	4.18 **	4.27 *	2.53
Probability	0.01	0.01	0.03	0.00	0.01	0.07

Granger causality test (lags 4) (on cyclical components) (1)	IESI_VA	IESI_CE	IESI_NumAdd	IESI_NumInterv	IESI_FA	IESI_PC
	DIF_TEND_AV					
F-Statistic	2.40	4.70 **	2.28	5.63 **	3.75 *	2.56
Probability	0.61	0.00	0.10	0.00	0.02	0.10
(*) significant at 5%						
(**) significant at 1%						

Out-sample proprieties IESI/ GDP

Out sample performance (one step ahead static forecast)						
Theil Inequality Coefficient						
	rmse	mae	Total	Bias	Variance	Covariance
Cyclical components (1)	*CF_ASYMM_GDP*					
IESI__AV	289.694	240.573	0.023	0.023	0.030	0.678
IESI_CE	299.408	245.705	0.024	0.012	0.279	0.701
IESI_NumAdd	284.518	240.135	0.022	0.028	0.281	0.691
IESI_NunInterv	312.497	256.174	0.025	0.244	0.267	0.708
IESI_FA	353.581	306.451	0.027	0.001	0.451	0.548
IESI_PC	3250.05	301.138	0.028	0.143	0.414	0.443

Out sample performance (one step ahead static forecast)						
Theil Inequality Coefficient						
	rmse	*mae*	*Total*	*Bias*	*Variance*	*Covariance*
Cyclical components (1)	*HP_GDP*					
IESI__AV	2404.93	2039.69	0.176	0.047	0.340	0.613
IESI_CE	1767.99	1293.79	0.138	0.039	0.026	0.935
IESI_NumAdd	2315.55	1945.59	0.172	0.070	0.251	0.679
IESI_NumInterv	1782.31	1380.7	0.138	0.011	0.238	0.965
IESI_FA	3660.65	2974.76	0.302	0.001	0.055	0.94
IESI_PC	2121.53	1637.77	0.174	0.159	0.125	0.716

Out sample performance (one step ahead static forecast)						
Theil Inequality Coefficient						
	rmse	*mae*	*Total*	*Bias*	*Variance*	*Covariance*
Cyclical components (1)	*DIFF_TEND_GDP*					
IESI__AV	0.014	0.010	0.232	0.275	0.841	0.641
IESI_CE	0.013	0.011	0.230	0.308	0.182	0.51
IESI_NumAdd	0.0137	0.010	0.234	0.219	0.103	0.678
IESI_NumInterv	0.0125	0.01	0.213	0.309	0.127	0.564
IESI_FA	0.0426	0.333	0.689	0.611	0.006	0.382
IESI_PC	0.0358	0.0295	0.618	0.635	0.015	0.35

Out-sample proprieties IESI/ VA

Out sample performance (one step ahead static forecast)						
	Theil Inequality Coefficient					
	rmse	***mae***	***Total***	***Bias***	***Variance***	***Covariance***
Cyclical components (1)			***CF_ASYMM_AV***			
IESI__AV	0.288	0.227	0.016	0.209	0.000	0.791
IESI_CE	0.296	0.254	0.017	0.242	0.022	0.736
IESI_NumAdd	0.282	0.23	0.016	0.184	0.011	0.805
IESI_NumInterv	0.294	0.261	0.017	0.238	0.011	0.750
IESI_FA	0.507	0.379	0.030	0.129	0.506	0.365
IESI_PC	0.495	0.378	0.029	0.109	0.361	0.530

Out sample performance (one step ahead static forecast)						
	Theil Inequality Coefficient					
	rmse	***mae***	***Total***	***Bias***	***Variance***	***Covariance***
(Cyclical components)			***HP_AV***			
IESI__VA	2.987	2.496	0.170	0.007	0.185	0.809
IESI_CE	2.635	2.159	0.156	0.027	0.004	0.969
IESI_NumAdd	2.893	2.455	0.167	0.001	0.120	0.879
IESI_NumInterv	2.750	2.272	0.161	0.062	0.002	0.936
IESI_FA	10.387	7.814	0.610	0.007	0.006	0.987
IESI_PC	4.980	3.871	0.357	0.019	0.215	0.766

Out sample performance (one step ahead static forecast)						
	Theil Inequality Coefficient					
	rmse	***mae***	***Total***	***Bias***	***Variance***	***Covariance***
(Cyclical components)			***DIFF_TEND_AV***			
IESI__AV	0.016	0.012	0.190	0.173	0.012	0.815
IESI_CE	0.014	0.012	0.172	0.201	0.075	0.723
IESI_NumAdd	0.016	0.012	0.190	0.153	0.026	0.821
IESI_NumInterv	0.014	0.012	0.163	0.147	0.044	0.809
IESI_FA	0.049	0.039	0.698	0.646	0.048	0.307
IESI_PC	0.038	0.032	0.592	0.677	0.09	0.233

Directional coherence IESI/GDP

	IESI_AV	**IESI_CE**	**IESI_NumAdd**	**IESI_NumInterv**	**IESI_FA**	**IESI_PC**
			CF_ASYMM_GDP			
Coerenza direzionale (1)	0.62	0.709	0.633	0.722	0.657	0.571

	IESI_AV	**IESI_CE**	**IESI_NumAdd**	**IESI_NumInterv**	**IESI_FA**	**IESI_PC**
			HP_GDP			
Coerenza direzionale (1)	0.620	0.709	0.633	0.722	0.657	0.571

	IESI_VA	**IESI_CE**	**IESI_NumAdd**	**IESI_NumInterv**	**IESI_FA**	**IESI_PC**
			DIFF_TEND_GDP			
Coerenza direzionale (1)	0.560	0.653	0.547	0.667	0.686	0.600

Directional coherence IESI/VA

	IESI_VA	**IESI_CE**	**IESI_NumAdd**	**IESI_NumInterv**	**IESI_FA**	**IESI_PC**
			CF_ASYMM_AV			
Directional coherence	0.592	0.676	0.606	0.690	0.645	0.581

	IESI_VA	**IESI_CE**	**IESI_NumAdd**	**IESI_NumInterv**	**IESI_FA**	**IESI_PC**
			HP_AV			
coerenza direzionale (1)	0.576	0.661	0.592	0.678	0.613	0.613

	IESI_VA	**IESI_CE**	**IESI_NumAdd**	**IESI_NumInterv**	**IESI_FA**	**IESI_PC**
			DIFF_TEND_AV			
coerenza direzionale	0.522	0.597	0.507	0.612	0.548	0.483

(1) Period: IESI_AV, IESI_CE, IESI_NumAdd, IESI_NumInterv - 1992Q1-2011Q4; IESI_FA, IESI_PC - 2003Q1-2011Q4

Source: Processing of ISTAT data

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