

Subjective forecasts of the Industrial Production Index based on the confidence of the manufacturing companies

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Agenda

- ① Brief introduction to the importance of the short-time forecast for IPI
- ② **Methods:** Short-time forecasts using a cointegration approach on anticipatory variables
- ③ Application and results
- ④ Summary and Conclusions

Motivation

The Industrial Production Index is one of the most important indicators to evaluate the state of health of the economy of a country.

Dealing with official data, the issue of the delay in the publication of the provisional estimate is a very actual theme.

For this purpose, it appears fundamental to have anticipations of these indicators.

Many contributions have tried to give predictions about the future tendency of this quantity using different statistical models based on possible relationships with other micro or macro-economic variables.

Proposal

This study proposes a forecast approach based on the subjective expectations on the future given by the entrepreneurs of manufacturing companies.

The main aim of this contribution is to give a systematic approach to obtain very-short term predictions for the Industrial Production Index using the long-term relationship between this time-series and the confidence of the manufacturing companies in terms of judgement and expectations.

Subjective predictions of the entrepreneurs

An important source of information are surveys on subjective qualitative expectation addressed to firms.

Actually, entrepreneurs are often able to pick up some signals from the economic system, on the contrary, statistical models cannot perceive unforeseen event in advance.

Particularly, among qualitative surveys, here the look is on the Istat Economic Sentiment Indicator (IESI). Since June 2012, Istat disseminates the composite indicator regarding the confidence climate of the entire Italian productive sector.

The Istat Economic Sentiment Indicator (IESI)

The indicator has been calculated by aggregating the balances of the variables (seasonally adjusted and standardised) included in the confidence climate indicator of the:

- **manufacturing sector (assessments on order books, expectations on production and assessments on stocks)**
- construction sector (assessments on order books and/or construction plans and expectations on employment)
- market service sector (assessments and expectations on order books and assessments on business situation)
- retail trade sector (assessments and expectations on business situation and assessments on stocks)

A possible anticipatory variable to predict the IPI

The principal idea behind this innovation lies in the use of the expectation on the production over the next 3 months as a possible anticipatory variable directly connected with the IPI.

To do this, making explicit this connection, it is possible to use this link to make short-time forecasts on the IPI.

Before to search the bond between the expectations on the production and the IPI, it is necessary to ensure that these expectations are coherent with the assessments present in the same survey.

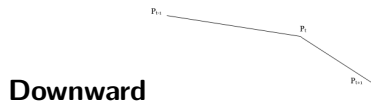
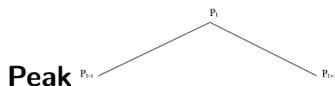
This coherence could be verified using an approach based on the classification of the turning points in a time series.

Classification of the turning points in a time series

In times of uncertainty for economic time-series, great attention is about to the analysis of turning points.

Each point can be classified as a turning point in 4 categories:

- peak
- trough
- upward
- downward



Indexes based on the classification of the turning points

Some indexes could be computed to verify the coherence between two time-series (Naik and Leuthold, 1986).

	P	T	U	D
P	f_{11}	f_{12}	f_{13}	f_{14}
T	f_{21}	f_{22}	f_{23}	f_{24}
U	f_{31}	f_{32}	f_{33}	f_{34}
D	f_{41}	f_{42}	f_{43}	f_{44}

Ratio of accurate forecasts

$$RAF = (f_{11}+f_{22}+f_{33}+f_{44})/\sum_j \sum_i f_{ij}$$

Ratio of worst forecasts

$$RWF = (f_{12}+f_{21}+f_{34}+f_{43})/\sum_j \sum_i f_{ij}$$

Ratio of accurate to worst forecasts

$$RAWF = RAF/RWF$$

Ratio of inaccurate forecasts

$$RIF = (f_{13}+f_{14}+f_{23}+f_{24}+f_{31}+f_{32}+f_{41}+f_{42})/\sum_j \sum_i f_{ij}$$

Long-term relationship between economic variables

If this coherence between assessments and expectations is verified, then it is possible to search for a long-term relationship between the expectations and the IPI.

To follow this purpose, a well-known approach of multivariate time-series is applied estimating a cointegration vector that measures this tie.

Two time series are cointegrated if they own the same order of integration and it exists a linear combination between them that is stationary.

The cointegration vector is obtained through the estimation of a Vector Error Correction Model and the application of the Johansen test (Johansen, 1988, Lütkepohl, 2006).

Forecast of the cointegration vector and of the IPI

Once estimated the cointegration vector measuring the long-term relationship between the expectations and the IPI, the Box-Jenkins procedure has been used to obtain forecasts (Box and Jenkins, 1968).

This approach provides forecasts through an ARIMA (Auto-Regressive Integrated Moving Average) model.

Finally, substituting these forecasts and the data about the expectations for the next three months in the equation representing the cointegration vector, it is possible to obtain prediction of the IPI for the next three months.

Forecast of the cointegration vector and of the IPI

Let y the cointegration vector, then:

$$y = IPI + \beta * expectations$$

forecasts for IPI are obtained as:

$$IPI_{t+1,t+2,t+3} = y_{t+1,t+2,t+3} - \beta * expectations_{t+1,t+2,t+3}$$

where β is the cointegration coefficient and $expectations_{t+1,t+2,t+3}$ are the values declared by entrepreneurs in the last 3 months for the future.

Features of the survey on the manufacturing sector

Target universe: Italian firms with five or more employees, classified in Section C of the NACE rev.2 classification

Frequency: monthly (2010-2024)

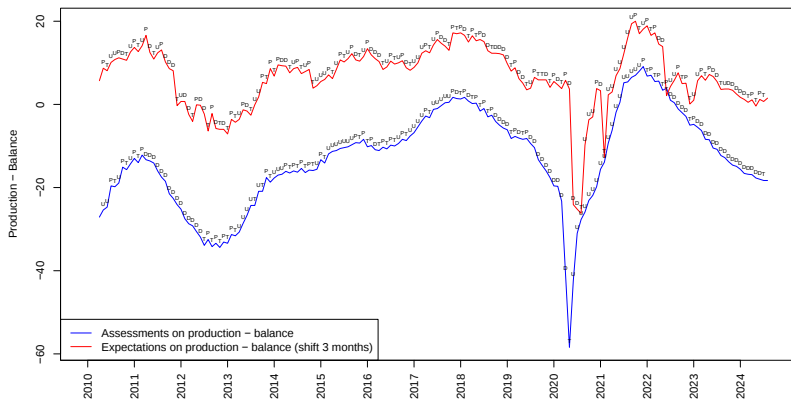
Data collection: CATI (Computer Assisted Telephone Interviewing)

Sample: panel of about 4000 firms stratified by economic sectors (identified by the divisions of section C in NACE rev.2), geographic partitions and firm sizes (in terms of employees)

Sampling frame: extracted by the official ASIA archive (the statistical archive of active enterprises elaborated by ISTAT)

The confidence climate is built as an arithmetic average of the balances on the assessments on the order books and the stocks of finished products (with a negative sign) and **the expectation on the production over the next 3 months.**

Turning points for assessments and expectations



$RAF = 37.4\%$

$RWF = 19.3\%$

$RAWF = 1.939$

$RIF = 43.3\%$

Relation between expectations on production and IPI

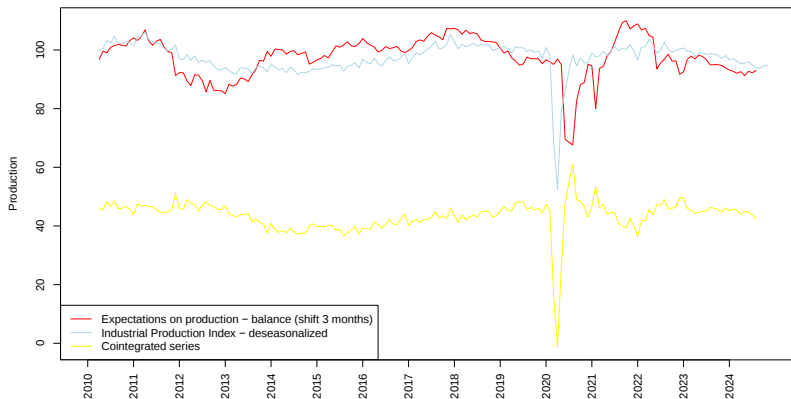
The figure shows the relation between the IPI (de-seasonalized series) and the expectations on production by the entrepreneurs.



$cor(expectations, IPI - deseas) = 0.35$, this correlation suggests the possibility of a cointegration tie.

The cointegration relationship

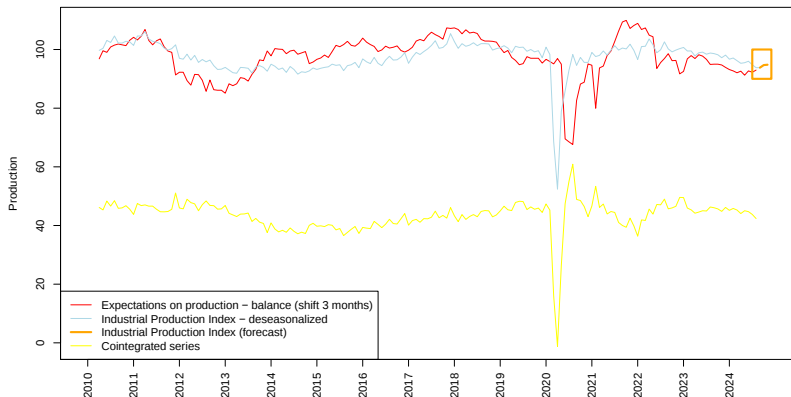
To obtain reliable values for the cointegration link, the expectations on production have been standardized in the same scale of IPI.



The Johansen test confirms the existence of a cointegration tie, using the VECM this long-term relationship is equal to $y = IPI - 0.55309 * expectations$

Forecasts for the IPI

Using the last step of the procedure, forecasts for the cointegrated series $y_{t+1,t+2,t+3}$ has been obtained through ARIMA models, and they are included in the equation: $IPI_{t+1,t+2,t+3} = y_{t+1,t+2,t+3} + 0.55309 * expectations_{t+1,t+2,t+3}$



where $expectations_{t+1,t+2,t+3}$ are last values of confidence declared by the entrepreneurs.

Forecasts for the IPI

The proposed approach generated predictions for IPI for September, October and November of 2024, in the following table, the forecasts are compared with the real values:

	<i>Sep 2024</i>	<i>Oct 2024</i>	<i>Nov 2024</i>
IPI real	94.3	94.2	94.2
IPI forecasts	93.8	94.7	94.8

The short-term forecasts obtained are in line with the real values of the IPI time-series.

Conclusions

- This study proposes a forecast approach based on the subjective expectations on the future given by the entrepreneurs of manufacturing companies used as anticipatory variables of the Industrial Production Index through a long-term relationship.
- The proposed approach based on cointegration confirms the existence of a relationship between the two time series, producing reliable estimates of the IPI 3-months ahead.
- About limitations, the period of prediction is very short because in the qualitative survey, the subjective expectations are only requested for the next three months.
- Future studies could regard the implementation of this approach at NUTS-1 level, since data for confidence climate are available at this level.