A Composite Leading Cycle Indicator for Uruguay

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Abstract:
This study estimates a composite leading cycle indicator for the Uruguayan economy following the methodology of The Conference Board. Prediction is based on the analysis of multiple series that have a leading relationship to the Industrial Production Index, which is used as the reference variable of the overall economic activity. Once selected, these series are aggregated into a single composite indicator. Our index covers a 20-year period (from 1994 to 2014). It includes variables covering diverse aspects of economic activity and reaches to advance, with a three-month difference, the two turning points occurred in Uruguay during that period.

Keywords: leading indicator, business cycle, turning points, economic conjuncture, Uruguay.
1. Introduction

Analyzing the economic conjuncture requires a systematic diagnosis of the actual economic situation as well as the projection of its future evolution in the short and medium term. In particular, predicting business cycles’ turning points accurately is of major importance for decision makers and economic agents. Therefore, having an indicator that reveals the current situation of the economy and allows detecting changes in its future path becomes especially relevant.

Indicators used to monitor economic activity must consider as much information as possible to provide signs regarding economic cycles and allow agents to anticipate them. Although, structural and uniequational models are very popular among economists, they must deal with the problem of the delay in data availability. Moreover, the publishing of statistics regarding different aspects of the economy, presents sometimes contradictory information, as they have different time relationships with the economic activity; i.e. some of them lead the future path of the economy while others react simultaneously or even with some lag.

The use of leading indicators permits to characterize the phase of the cycle that an economy is going through, as well as detecting break points in the trend of economic activity. Moreover, due to its construction they allow to focus attention in a reduced number of economic series that conform the index. Therefore, if they have a good performance, leading indicators complement standard models used to identify current economic situation and to predict the future path of economic activity, resulting potentially useful for policy makers.

In a statistical sense, a business cycle turning point represents a special moment in time that requires it to be forecasted separately from growth within the phases. It reveals a non-linearity that would reduce the usefulness of standard time series models, which are often based on linear difference equation (Everhart and Hernandez, 2000). The literature on leading indicators is vast and dates back to the thirties with the pioneering work of Arthur Burns and Wesley Mitchell (1938, 1946). More recent discussions can be found in Moore and Shiskin (1967), Auerbach (1983), Klein and Moore (1983) and Stock and Watson (1988, 1989, 1993).

The main goal of leading indicators is to provide an early alert to future changes in the economic activity. A non-observable variable which reflects the state of the economy is supposed to exist. Although this variable cannot be observed directly it is assumed that it is captured by other variables such as the GDP, the Industrial production index, unemployment, etc. Burns and Mitchell define Business cycles as “expansions occurring at about the same time in many economic activities, followed by similarly general recessions, contractions and revivals which merge into the expansion phase of the next cycle.” (Burns and Mitchell, 1946; p. 21).

The literature distinguishes three types of cycles: business cycle, growth cycle and acceleration cycle. The first one considered as the classic cycle defined by Burns and Mitchell, it is defined in terms of the level of GDP, i.e.: expansions are phases with positive GDP growth rates while recessions present decreases in GDP. Therefore, turning points separate periods of expansions and contractions in GDP. The growth cycle focus is understood to be the result of deviations of the economy from its long term trend. Periods can be classified depending on their growth rate being above or below the trend of growth. Explicitly, a decline in the rate of growth can be
interpreted as a contractionary phase although there is not necessarily an absolute decline in economic activity. Finally, in the acceleration cycle periods can be identified according to increases and decreases in the growth rate of economic activity. Thus, turning points indicate a change from acceleration to deceleration—or vice versa—in the rate of growth (Bondt and Hahn, 2010).

Composite cycle indicators combine diverse variables into one index, reflecting different features of economic activity and evolving similarly to it. In case of business cycle indicators, their evolution is analogous to that of GDP growth. The Conference Board, distinguishes three types of business cycle indicators: (a) leading indicators, that shift their tendency in advance of the reference cycle, so they can be used to predict the evolution of economic activity. For this reason, they have been widely analyzed and interpreted in previous research. Their representativeness increases considerably when they are part of a system of cyclical indicators including coincident and lagging indexes; (b) coincident indicators, which measure aggregate economic activity defining the business cycle and; (c) lagging indicators that evolve after coincident series and the reference variable. Although they do not have any predictive capacity, these indicators can reveal relevant information regarding structural imbalances that may be developing in the economy. Furthermore, they can be used to confirm the evolution of both leading and coincident indexes, enabling to identify true turning points.

The main purpose of this research is to estimate a composite leading business cycle indicator for the Uruguayan economy. To construct the index we follow The Conference Board (TCB) Methodology, one of the most publicly well-known tools of business cycle forecasting. Prediction is based on the analysis of multiple series that have leading relationship to the Industrial Production Index (IPI), which is used as the reference variable. Once selected, these series are aggregated into a single composite indicator. Our index covers a 20-year period (from 1994 to 2014) and includes variables representing different aspects of economic activity. The estimated index reaches to advance, with a three-month difference, the two turning points occurred since 1994 (i.e.: in 1998 and in 2002).

The rest of the article is structured as follows: in the next section we start with a literature review on composite business cycle indicators with a special focus on empirical research in Latin America and, particularly, in Uruguay. Section three explains all methodological procedures we followed to estimate our indicators. Resulting indexes are presented in section four and evaluated in section five. Finally, section six presents some final remarks.

2. Literature Review

Business cycle indicators have been studied since the seminal work of Burns and Mitchell (1946). In that research, the authors selected a set of series showing clear turning points contemporary or prior to the reference cycle. By standardizing and averaging the selected series, Burns and Mitchell provided the first composite cyclic indicator for the US economy.

Since then, politicians and business managers considered leading indicators a very useful tool for economic policy and business organization. However, economists adopted a more critical
perspective. For example, Koopmans’ (1947) considered the work of Burns and Mitchell as an exercise in measurement without theory.

Decades later, Neftci (1979) and Auerbach (1983) followed regression-based approaches to estimate new cycle indicators. More precisely, they analyzed the predictive capacity of linear regressions of coincident variables on leading indicators. Later on, Wecker (1979) and Kling (1987) translated such linear projections into turning point forecasts.

In an attempt to provide a formal probabilistic basis for Burns and Mitchell’s coincident and leading indicators, Stock and Watson (1989 and 1993) estimated a coincident index of economic activity as the unobservable factor in a model for four coincident indicators: industrial production, real disposable income, hours of work and sales. The authors developed a model with observable coincident and leading variables in order to obtain an unobservable process as the coincident index and use the six-month forecast of this unobserved factor as the leading index.

Later on, and based on sequential probability recursion, Diebold and Rudebusch (1989) developed a formal probability-assessment scoring rule for the detection of turning points. This rule evaluated the ability of leading indicators avoiding false predictions while identifying correctly every real turning point.

Some institutions have developed their own composite index systems. For example, since the 1960’s the US Commerce Department calculated different indexes using the NBER’s methodology. In 1995, The Conference Board took charge of these estimations and adopted – and improved – the mentioned methodology to develop leading, coincident and lagging indicators for the US economy (TCB, 2001). Also, the OECD elaborated, since the 1970’s, a system of composite leading indicators (OECD, 2001). The OECD’s methodology considers cycles as fluctuations on the output gap, i.e.: the difference between potential and actual output.

The literature on cycle indicators in Latin America is recent and mostly made of empirical studies. For example, Jorrat and Cerro (2000) developed coincident and leading indexes for Argentina based on the NBER’s methodology. Melo et al. (2001) adopted several variations on the Stock and Watson method to calculate a coincident index for Colombia. Firinguetti and Rubio (2003) developed a leading index for Chile following NBER’s methodology and including estimations of trend, cycle and stationary components of series. Ochoa and Lladó (2003) estimated two leading indicators for Peru: one to indicate the evolution of GDP, using the methodology of Auerbach (1983) and Bravo and Franken (2001); other, following The Conference Board, to identify the turning points of the GDP cycle. Adopting the methodology of NBER, Cantú et al. (2010) calculated a leading index for Argentina, Brazil, Chile, Colombia, Mexico and Peru.

Furthermore, some Governments and Central Banks in Latin America estimated composite indexes: the Mexican National Bureau of Statistics (INEGI) calculated a coincident and leading index based on NBER’s methodology. The Peruvian Ministry of Economy also built a leading indicator of economic activity. Finally, with less satisfactory results, Central Banks of Costa Rica and Guatemala developed leading indicators to approximate the inflation cycle.
Some applications of composite cycle indicators to the Uruguayan case have been made in the last years. Lorenzo et al. (1999) developed a monthly activity index made of a linear combination of 38 variables from almost all economic sectors. The weight of each sector is calculated according to its influence on the total GDP. The results showed that the index is well adjusted to the evolution of GDP; however, its prediction usefulness depends on the availability date of each variable.

Masoller (2002) followed Stock and Watson methodology to estimate a coincident index of GDP evolution. The index is calculated using data on real collection of value added tax, net imports of goods, industrial production index and total sales of Portland cement.

Other relevant contribution have been made by Lanzilotta (2006), who calculated four indexes (two leading and two coincident): three of them were linear indexes based on empiricists models and obtained following the methodology of Emerson and Hendry (1994), the fourth is a non linear leading index calculated using switching-regime models. The study concluded that leading indexes obtain better results than coincident ones; however, all of them have a better predictive performance than pure autoregressive models of GDP prediction.

Fossati and Moreda (2009) estimated an indicator to predict turning points of industrial production index in Uruguay. The index is composed of two variables associated with the international economy (industrial production in the USA, and spot price of livestock) and two related to the regional economy (industrial production index of Argentina and real exchange rate of Uruguay with Argentina and Brazil). This index is published monthly by the Industries Chamber of Uruguay (CIU).

Other leading index was developed by CERES (Reseach Centre for the Economic and Social Reality). Following the methodology of The Conference Board – and its variants for Argentina developed by Universidad Torcuato di Tella (1999) –, this index selected ten variables according to their predictive capacity, representativeness, activity coverage and availability.

Finally, other recent studies on business cycle in Uruguay may help to frame the present research. Zunino (2010) studied the volatility in GDP and inflation in Uruguay between 1985 and 2009. His results illustrated stabilization in macroeconomic variables with a reduction of inflation from 1993 on, and a relative moderation in GDP fluctuations after 2003. Lanzilotta et al. (2014) analyzed the origins and evolution of cyclical fluctuations in Uruguay. They proved that the main sources of fluctuations in the last decades were the prices of exports and imports and the Argentinian economic growth. The influence of other countries such as Brazil, China and USA has increased considerably in the last years.

3. Methodological Aspects

The methodology employed to estimate our leading indicator is supported by previous research on the subject. Although we analyzed and evaluated a wide range of papers, we mainly follow The Conference Board (TCB, 2001) to set our key methodological aspects. These aspects are related to (1) the type of prediction carried out –predicting turning points or cycle evolution–, (2) the reference variable used as an indicator of economic activity, (3) the process
followed to select the index components, (4) the procedure used to weight and aggregate these components, and (5) the techniques employed to detect turning points.

3.1. Turning Points or Cycle Evolution

The composite index presented in this research focuses on predicting the arrival of turning points, which separate recessions from expansions. The attention on turning points, rather than on future values of economic variables is in line with a great amount of previous studies on the subject considering that composite leading indexes are particularly useful in this type of predictions (see e.g. Diebold and Rudebusch, 1986; The Conference Board, 2001; Cantú et al., 2010).

The relevance of turning points is based on the belief that “the economy behaves differently in the downturn phase than in the upturn phase of the cycle and, in particular, that turning points delineate essential changes in the empirical relations among economic variables” (Diebold and Rudebusch, 1986; p. 371). These shifts in economic relations give turning points especial prominence and, for this reason, our leading indicator aims to predict them.

3.2. Reference variable

The reference or target variable is used to represent the evolution of economic activity. It is, therefore, the variable to be forecasted. Most of previous works on the subject recommend the use of an overall indicator of economic activity, such as the GDP. However, these kinds of indicators are usually available only quarterly. In such case, it is suggested to employ the Industrial Production Index (IPI), which is calculated on a monthly basis (Marcellino, 2006; Cantú et al., 2010).

Based on these criteria, in this paper we use the IPI –without refinery– calculated by the National Bureau of Statistics of Uruguay (INE). This variable estimates the monthly evolution of economic activity in the industrial sector. To obtain the index, the INE uses the value of production at constant prices, the hours of work and the number of jobs in different industrial subsectors. The subsectors considered in the index are the following: food and beverages, tobacco, textiles, wood, paper and press, chemicals, mining, steel, machinery and transport equipment, and other industries. The index has national coverage and considers both private and public industrial companies.

To sustain the use of IPI as the reference variable, besides the recommendations of previous literature on the subject, we test its relation with an overall indicator like the GDP (see Annex 2). We first compare the cyclical evolution of both variables transforming IPI monthly data into quarterly average data. Then, we calculate its correlation with GDP and extend this analysis to include its correlation with lagged and leaded GDP in several periods. Finally, we analyze the causality relationship among GDP and IPI using the Granger test. Results of these tests are clearly satisfactory: IPI and GDP present a very similar progression of their cycles, furthermore we find high contemporary and leading correlations among both variables –with IPI slightly
leading GDP—, and Granger causality tests confirm this idea, sustaining the use of IPI as the reference variable of overall economic activity.

3.3. Selection of the series included in the composite index

The essential feature taken into account for selecting a component of the leading indicator is that it leads the reference series with a similar cyclical profile. However, this is not the only condition; other aspects must be taken into consideration. In this sense, Marcellino (2006; p. 881) summarizes the basic requirements for an economic variable to be a useful leading indicator:

i. Consistent timing: systematically anticipate peaks and troughs in the target variable, possibly with a rather constant lead time.

ii. Conformity to the general business cycle: have good forecasting properties not only at peaks and troughs.

iii. Economic significance: being supported by economic theory either as possible causes of business cycles or, perhaps more importantly, as quickly reacting to negative or positive shocks.

iv. Statistical reliability of data collection: provide an accurate measure of the quantity of interest.

v. Prompt availability without major later revisions: being timely and regularly available for an early evaluation of the expected economic conditions, without requiring subsequent modifications of the initial statements.

vi. Smooth month to month changes: being free of major high frequency movements.

Based on the above criteria, other indexes elaborated in different countries and data availability for Uruguay, we start with a set of 73 variables (see Annex I). These data series cover diverse aspects of economic activity such as agriculture and livestock, industry, construction, energy, external sector, labor market, monetary variables, fiscal variables, economic activity in countries maintaining relevant links with Uruguay (Argentina, Brazil, USA and the EU, as suggested by Lanzilotta et al., 2014), international prices (oil, meat, dried milk, soy and rice), price indexes (commodities, food and raw materials) and exchange rates.

Sources for the national series analyzed are the Central Bank of Uruguay (BCU), the Institute of National Statistic (INE), Tax Revenue Office (DGI), Uruguay Chamber of Industries (CIU), National Meat Institute (INAC), Commerce and Service Chamber, Montevideo Municipal Government (IDM), Ministry of Industry, Energy and Mining (MIEM). Series from Brazil come from IPEA data while series from Argentina are taken from INDEC. Data on International prices come from International Monetary Fund (IMF), while series from the United States are from the Bureau of Labor Statistic (BLS) and The Federal Reserve. Finally, data from the European Union comes from Eurostat.

Many of the originally selected series were rejected because they present incomplete data or inconsistent cyclical patterns with that of IPI. The remaining 38 series were subjected to the
selection process. For this process we analyze the trend-eliminated version of the series.\(^1\) We carry out a correlation study with IPI – current, lagged and leaded from one to 8 months – and a turning point analysis of all series, focusing on their leading capacity. These two steps allow us to identify which variables present a cyclical evolution similar to that of the IPI, but leading it some months.

As a result, we end up with a set of 25 series able to be included in the leading index. The final combination of variables is decided taking into account the economic significance criterion. The aim here is to select a set of series covering a wide range of economic activity aspects, so the composite leading index can reflect – at least, partially – the variety of relevant features in the Uruguayan economy.

### 3.4. Weighting and Aggregation of the Series

The steps we follow to weight and aggregate the series into the composite index are based on the methodology proposed by The Conference Board (TCB, 2001) and applied by several previous studies (e.g. Cantu et al., 2010; Torcuato di Tella, 1999). We firstly calculate the monthly variations for each component \((r_{i,t})\). In the case of series expressed in percent form, simple differences are calculated:

\[ r_{i,t} = x_{i,t} - x_{i,t-1} \]

Where \(x_i\) represents the monthly value for each variable. For the rest of the variables, we use a symmetric percent change formula as follows:

\[ r_{i,t} = 100 \cdot \frac{x_{i,t} - x_{i,t-1}}{x_{i,t} + x_{i,t-1}} \]

Secondly, each component is weighted using a standardization factor that considers its volatility \((w_i)\), giving more weight to those components less volatiles. This standardization factor is calculated, for every variable, as the inverse of the standard deviation of its monthly variation \((sd_i)\) as follows:

\[ w_i = \frac{1}{\sum_i sd_i} \]

As a result, we obtain the monthly contributions of each component \((c_{i,t})\) to the composite indicator:

\[ c_{i,t} = r_{i,t} \cdot w_i \]

The next step is the aggregation or sum of these adjusted contributions \((s_t)\):

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\(^1\) Following Fossati and Moreda (2009) we filter the series using the Tramo-Seats methodology (Gómez and Maravall, 1996) and, afterwards, we de-trend them using the Hodrick-Prescott filter.
Finally, we calculate the index \( I_t \) using a recursive formula that starts from an initial value of \( I_1 = 100 \) and calculates the subsequent values as follows:

\[
I_t = I_{t-1} \cdot \frac{200 + s_t}{200 - s_t}
\]

It is important to notice that the availability of data varies among series. This fact required us to include relevant series only when available, recalculating the standardization factors each time a new variable is included in the index.

### 3.5. Turning Points Detection

One of the most relevant aspects of composite index systems is the criteria used to determine true signals of turning points. The aim here is to avoid false predictions based on the index evolution, while marking correctly every factual turning point. And this is not an easy task, as “expansions are interspersed with occasional months of decline, and recessions include months of increase” (TCB, 2001; p. 17).

To face this complexity, we apply the three Ds rule stated by The Conference Board: duration, depth and diffusion (TCB, 2001). This rule is based on the idea that true changes in the business cycle must meet three requirements:

1. **Duration**: a real alteration in the business cycle must persist in time, compared to eventual changes or false signals. A commonly accepted measure of duration is the three-month rule (i.e.: after a change in the tendency, at least three months of persistent evolution are required).

2. **Depth**: factual turning points also require significant intensity in the index percentage change. The greater the movement, the more likely it is that the tendency is not a random fluctuation but a real new phase in the cycle.

3. **Diffusion**: finally, it is required that the turning point is caused by a major proportion of the index components instead of being motivated by a reduced number of them. According to this criterion, turning points will be considered only when diverse aspects of economic activity (reflected by index components) evolve together in the same direction.

In other words, we can conclude that “the longer the weakness [strength] continues, the deeper [higher] it gets; and the more widespread it becomes, the more likely a recession [expansion] will occur.” (TCB, 2001; p. 16).
3.6. **Diffusion Indexes**

We complete our analysis calculating a diffusion index which will be used to complement our composite indicator. This index will provide relevant information about how the cycle movements are disseminated among the components of the estimated leading indicator.

Again, we follow The Conference Board and work with a smoothed trend of the series, i.e., after filtering and de-trending them through the Tramo-Seats and the Hodrick-Prescott filters. Then, we use the symmetric monthly percent change for each variable to calculate the diffusion index \((DI_t)\) as follows:

\[
DI_t = \frac{R_t + 0.5 \cdot r_t}{i}
\]

Where:
- \(R_t\) is the number of series with a monthly growth higher than 0.5% in the last month,
- \(r_t\) is the number of series with a variation between 0 and 0.5% in the last month,
- \(i\) is the total number of series included in the composite indicator.

By measuring the number of components increasing in any given month, diffusion indexes will reveal the proportions of series evolving in the same direction of the economic activity. Consequently, this index is expected to decrease before—and during—recessions, while it may increase when expansions are about to start.

4. **Results**

The series, selected due to their close relationship with the IPI, can be combined in different ways in the construction of a composite leading indicator. Actually, we reach to estimate three different CLI that were subjected to different test. We finally choose the one composed by the following variables (See Table 1): total exports, consumption tax, country risk, building permissions, real average asset interest rate in local money, unemployment benefits in Montevideo (from 1994-2002) and unemployment benefits request in Montevideo (from 2003 on).

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2 More precisely, diffusion indexes will be applied to calibrate the third D—diffusion— in the 3 Ds’ rule.
Table 1. Composite Leading Indicator Variables

<table>
<thead>
<tr>
<th>Variable</th>
<th>Explanation</th>
<th>Data availability</th>
<th>Data Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Exports</td>
<td>Sales of goods and services to foreign countries in dollars. Values have been deflated using US import prices index.</td>
<td>Monthly</td>
<td>Uruguay Central Bank (BCU) and Bureau of Labor Statistic (BLS)</td>
</tr>
<tr>
<td>Country Risk</td>
<td>Measures the risk of investing in Uruguay. It depends on economic, social and political factors that make up business environment and may affect the results and value of investments in the country.</td>
<td>Daily</td>
<td>Banco República del Uruguay (BROU)</td>
</tr>
<tr>
<td>Consumption Tax</td>
<td>Measures the taxes collected by the Tax Revenue Office, related to consumption (VAT and IMESI). Values have been deflated by Uruguay Consumption Price Index</td>
<td>Monthly</td>
<td>Ministry of Economy (MEF) and Institute of National Statistics (INE)</td>
</tr>
<tr>
<td>Unemployment Benefits in Montevideo</td>
<td>Quantity of unemployment benefits actually paid in Montevideo.</td>
<td>Monthly</td>
<td>Social Security Bank (BPS)</td>
</tr>
<tr>
<td>Building Permissions</td>
<td>Measures the surface to be built (in m2) granted monthly by the Municipality of Montevideo</td>
<td>Monthly</td>
<td>Municipality of Montevideo (IDM)</td>
</tr>
<tr>
<td>Unemployment Benefits Requests in Montevideo</td>
<td>Quantity of unemployment benefits requested in Montevideo</td>
<td>Monthly</td>
<td>Social Security Bank (BPS)</td>
</tr>
<tr>
<td>Average Asset Interest Rate</td>
<td>Real Average Asset Interest rate in local money</td>
<td>Monthly</td>
<td>Uruguay Central Bank (BCU)</td>
</tr>
</tbody>
</table>

Source: Authors

These variables cover a wide range of economic fields and activities: external sector, domestic consumption, monetary policy, labor market, building sector and the risk of investing in the country. Also, the variables appear to be effective in predicting recent movements in the reference series. However, it is important to note that these components are by no means definitive. Their relevance as well as their predictive ability must be re-evaluated from time to time.

Figures 1 and 2 represent the evolution of our leading index compared to that of the IPI, as well as the evolution of their trend-cycle series. As we can observe, the cyclical evolution of the composite index is clearly similar to that of the IPI, but advancing its two turning points.³

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³ The trend-cycle of the IPI starts with a recession (up to October 1995). However, the overall economic activity—measured by the GDP—did not experience a real downturn in that period. For this reason, we will only consider and analyze turning points of IPI and composite index after October 1995.
Figure 1. Leading Indicator and IPI Evolution

Source: Authors’ own estimations

Figure 2. Leading Indicator and IPI Evolution (Trend-Cycle series)

Source: Authors’ own estimations
Analyzing the trend cycle series allows us to compare the turning points of both the IPI and the leading indicator (see Table 2). By doing so, we can observe that our estimated leading indicator reaches to anticipate both turning points with a three-month margin.

Table 2. Dates of Turning Points

<table>
<thead>
<tr>
<th></th>
<th>First turning point</th>
<th>Second turning point</th>
</tr>
</thead>
<tbody>
<tr>
<td>IPI</td>
<td>May-98</td>
<td>Dec-02</td>
</tr>
<tr>
<td>Leading index</td>
<td>Feb-98</td>
<td>Sep-02</td>
</tr>
<tr>
<td>Months in advance</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>

Source: Authors’ own estimations

Regarding diffusion indexes, it can be seen that they help to corroborate the turning points signaled by the leading index (see Figure 3). In particular, the first turning point, which signals the beginning of a recession, is anticipated and followed by a sharp decrease in the diffusion index: from 60% in June 2007 to 33% in April 1998 –one month before the turning point– and 16.7% five months later. This evolution clearly confirms the start of a recession.

The second turning point, which indicates the beginning of an expansion, is analogously preceded and followed by an increase in the diffusion index: 33.3% in October 2002, 50% in November –one month before the turning point– and 57.1% in March 2003 –after one sporadic decrease in February–. Again, diffusion index plainly signals the existence of a turning point and the start of a new business cycle phase.

Figure 3. Diffusion Index Evolution

Source: Authors’ own estimations
5. Index Evaluation

The aim here is to calibrate the index performance. To do so, we proceed testing the relationship between the IPI and the leading index with both a correlation analysis and a Granger causality test. Results of these tests will help to deduce whether our estimated index adequately precedes the evolution—and turning points—of IPI or not.

Figure 4 shows the correlation function between the growth rates of the tendency-cycle series of the leading indicator and the IPI. That is, it shows the correlation value with the number of lag or lead of the transformed IPI. The maximum value is reached between the growth rate of the leading index and the IPI, when this last one is lagged between three and four months. Also, we can observe that after the sixth lag in the IPI, the index correlates better with the IPI than with itself. We therefore can conclude that correlation analysis shows satisfactory results.

![Figure 4. Correlation Function, Change rates series T-C](image)

Source: Authors’ own estimations

Regarding Granger tests, Table 3 presents the analysis of causality between the leading index and the IPI seasonally adjusted. As both series present a unit root, the test is done using their first differences. With the exception of two and three lags, in all cases we reject the null hypothesis that changes in the leading index does not granger cause variations in the IPI. Furthermore, in all cases we cannot reject the hypothesis that changes in the IPI does not granger cause variations in the leading Index. From these results we can infer that our leading indicator precedes the IPI.

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4 This is a general correlation between the series, so it represents the correlation between the whole points of the series and not only the turning points.
6. Final Remarks

This research contributes to the previous literature on composite indicators in Latin America by estimating a leading index for the Uruguayan economy. Using a well accepted methodology –that of The Conference Board–, the indicator presented here aims to assist business managers and policy makers in a better comprehension of the national economy’s cyclical movements.

The study presents some limitations. First, due to the reduced availability of data, the period analyzed includes only two turning points (in 1998 and in 2002). This fact seriously complicates applying alternative methods of turning points prediction, such as the formal recursive probability scoring rule, which may reinforce substantially its predictive capacity. Also, there is a difficulty with the reference variable (IPI) as it starts with a decreasing trend that does not reflect a real downturn in economic activity. Therefore, the number of cycle phases in the reference variable does not coincide with that of the estimated leading indicator. Apart from theoretical contradictions, this issue generates some methodological problems when testing the relationship between the indicator components and the IPI.

Even with these limitations, we can conclude that the leading index estimated here shows a visibly good performance. Its trend-cycle reaches to predict with three months in advance the turning points of the IPI, its diffusion indexes offer clear and useful signs of turning points’ arrival and the evaluation tests results –both correlation and granger causality analyses– are clearly satisfactory, revealing that the indicator precedes the IPI.

Future research may advance elaborating both a coincident and a lagging index, which by being read together with the leading indicator permit a better comprehension of the whole economy. Also, progress can be made on the turning point prediction tool applying a recursive probability scoring rule –overcoming the mentioned limitations on data–. Finally, the focus on turning points can be completed with a different leading index that estimates future values of economic variables.
7. References


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# ANNEX 1

## Table A.1. List of analyzed series

<table>
<thead>
<tr>
<th>Cattle</th>
<th>Milk submitted to plants</th>
<th>Sales of fuel and oil derivatives</th>
<th>Sales of gas-oil and petrol</th>
<th>Sales of gas</th>
<th>Energy residential sales</th>
<th>Energy great costumers sales</th>
<th>Energy medium costumers sales</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total energy sales</td>
<td>Total Import</td>
<td>Import without oil and oil products</td>
<td>Import of oil and oil products</td>
<td>Consumption goods import</td>
<td>Machinery imports</td>
<td>Capital goods imports</td>
<td>Intermediate goods imports</td>
</tr>
<tr>
<td>Car sales</td>
<td>Total Exports</td>
<td>Urban Activity rate</td>
<td>Urban Employment rate</td>
<td>Montevideo Activity rate</td>
<td>Montevideo Emloyment rate</td>
<td>Total Unemployme nt benefits</td>
<td>Montevideo Unemploymen t benefits</td>
</tr>
<tr>
<td>Total unemployment benefits requests</td>
<td>Montevideo unemployment benefits requests</td>
<td>Number of employed people</td>
<td>Number of urban people employed</td>
<td>Consumption taxes</td>
<td>Foreign trade taxes</td>
<td>IVA</td>
<td>IMESI</td>
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<tr>
<td>Rent taxes</td>
<td>Industrinals’s economy expectation</td>
<td>Industrial’s enterprise expectation</td>
<td>Industrial’s export expectations</td>
<td>Industrial’s domestic market expectation</td>
<td>Issuance of money</td>
<td>Reserve assets</td>
<td>M1</td>
</tr>
<tr>
<td>M2</td>
<td>Country risk (UBI)</td>
<td>Real asset rate in domestic money</td>
<td>Real asset rate in dollars</td>
<td>Real asset rate in domestic money for enterprises</td>
<td>Uruguay regional real exchange rate</td>
<td>Uruguay real exchange rate</td>
<td>Public sector income</td>
</tr>
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<td>Central Government income</td>
<td>Tax Revenue Office income</td>
<td>EMI</td>
<td>EMAE</td>
<td>Argentina’s real exchange rate</td>
<td>Argentina’s industrial production</td>
<td>Argentina’s export</td>
<td>Argentina’s import</td>
</tr>
<tr>
<td>Brasil’s industrial production</td>
<td>Brasil’s real exchange rate</td>
<td>Brasilian exports</td>
<td>Brasilian imports</td>
<td>US 10 years bond rate</td>
<td>US FED rate</td>
<td>US industrial production</td>
<td>UE industrial production</td>
</tr>
<tr>
<td>Food price index</td>
<td>Agricultural raw material index</td>
<td>Commodities price index</td>
<td>WTI price</td>
<td>US rice price</td>
<td>Tailand rice price</td>
<td>Argentina soy price</td>
<td>Mexico soy price</td>
</tr>
</tbody>
</table>

**Notes:**
1) Data in pesos was deflated by Consumption price index.
2) Imports were deflated by US export price index.
3) Exports were deflated by US import price index.
ANNEX 2. IPI and GDP Analysis

Figure A.1. Industrial Production Index and Gross Domestic Product

(Trend-Cycle series)

Table A.2. Correlation coefficients between IPI and GDP

<table>
<thead>
<tr>
<th></th>
<th>GDP</th>
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<tr>
<td>IPI</td>
<td>-4</td>
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<tr>
<td></td>
<td>0.54</td>
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</tbody>
</table>

Table A.3. Results of Granger Causality Tests

<table>
<thead>
<tr>
<th>Null Hypothesis/Lags</th>
<th>F-Statistic</th>
<th>Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>D(GDP_SA) does not Granger Cause D(IPI_SA)</td>
<td>1.044</td>
<td>0.591</td>
</tr>
<tr>
<td>D(IPI_SA) does not Granger Cause D(GDP_SA)</td>
<td>1.480</td>
<td>0.955</td>
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</table>