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Resumen

En ese ensayo se estima un indicador compuesto de predicción para la economía uruguaya, basados en la metodología de "The Conference Board". La predicción se calcula a partir de series de datos múltiples que tienen una relación estrecha con índice de producción industrial, el cual es una referencia clave para la actividad económica global. Una vez seleccionadas, las series se agrupan en el indicador compuesto mencionado. El indicador calculado en este trabajo abarca un período de veinte años (1994-2013), incluye diversos ámbitos de la actividad económica y logra anticipar los dos puntos de inflexión que ocurrieron en Uruguay durante los años que cubre el estudio.

Palabras clave: *indicador adelantado, ciclos económicos, puntos de inflexión, Uruguay.*

Abstract

This study estimates a composite leading business 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 2013). It includes variables covering diverse aspects of economic activity and reaches to advance the two turning points occurred in Uruguay during that period.

Key words: *leading indicator, business cycle, turning points, Uruguay.*

JEL: *C53, E32, E37.*

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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 introduced by Burns and Mitchell, 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.

Secondly, 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. (c) Lagging indicators that evolve after coincident series and the reference variable. Although they do not have any predictive capacity, lagging 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. The indicator is created based on the analysis of multiple series that have leading relationship to the Industrial Production Index (IPI), which is used as the reference variable. The selected series are aggregated into a single composite indicator. Our index covers a 20-year period (from 1994 to 2013) and includes variables representing different aspects of economic activity. The estimated index reaches to advance 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).

Other leading index was developed by CERES (Research 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 Argentinean 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 1). 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 2). 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. We start by filtering the original series. We use Tramo – Seats methodology (Gómez and Maravall, 1996) to obtain the trend-cycle component[1] and then apply the Hodrick-Prescott filter to get the trend. Afterwards, we carry out a three-step analysis for all our selected variables.

i. First, we carry out a correlation study between the percent changes of each variable and that of the IPI – current, lagged and leaded from one to eight months.

1 The estimation of the IPI and the other series included in the leading indicator considers the Easter effect, which turned out to be significant.

ii. Then, those with higher correlation to the leaded IPI were subjected to a turning point analysis rejecting the series which turning points are systematically lagged regarding those of the IPI.

iii. Finally, we carry on granger causality tests to observe whether the variables adequately precede IPI or not.

These three steps allow us to identify which variables present a cyclical evolution similar to that of the IPI, leading it by 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 an economic significance criterion. The aim 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:

$$r_{i,t} = x_{i,t} - x_{i,t-1} \quad (1)$$

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:

$$r_{i,t} = 200 \cdot \frac{x_{i,t}-x_{i,t-1}}{x_{i,t}+x_{i,t-1}} \quad (2)$$

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 $(\mathrm{sd_i})$ as follows:

$$w_i = \frac{\frac{1}{\mathrm{sd_i}}}{\sum_\mathrm{i} \mathrm{sd_i}} \quad (3)$$

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

$$c_{i,t} = r_{i,t} \cdot w_i \tag{4}$$

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

$$s_t = \sum_i c_{i,t} \tag{5}$$

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:

$$I_t = I_{t-1} \cdot \frac{200+s_t}{200-s_t} \tag{6}$$

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:

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).

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.

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.[2] 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 considering the Easter effect and filtering them through the Tramo-Seats and the Hodrick-Prescott methodologies. Then, we use the symmetric monthly percent change for each variable to calculate the diffusion index (DI_t) as follows:

$$DI_t = \frac{R_t + 0.5 \cdot r_t}{i} \qquad (7)$$

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.

2 More precisely, diffusion indexes will be applied to calibrate the third D –diffusion– in the 3 Ds’ rule.

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 tests. We finally choose the one composed by the following variables (See Table 1): total exports, value added tax, country risk, building permissions, real average asset interest rate in local money and unemployment benefits in Montevideo.

Table 1
Composite Leading Indicator Variables

Variable	Explanation	Data availability	Data Source
Total Exports	Sales of goods and services to foreign countries in dollars. Values have been deflated using US import prices index.	Monthly	Uruguay Central Bank (BCU) and Bureau of Labor Statistic (BLS)
Country Risk	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.	Daily	República AFAP (RAFAP)
Value Added Tax	Measures the value added taxes (VAT) collected by the Tax Office. Values have been deflated by Uruguay Consumption Price Index.	Monthly	Ministry of Economy (MEF) and Institute of National Statistics (INE)
Unemployment Benefits in Montevideo	Quantity of unemployment benefits actually payed in Montevideo.	Monthly	Social Security Bank (BPS)
Building Permissions	Bulding permissions granted in Montevideo in square metres.	Monthly	Montevideo Department Goverment (IDM)
Average Asset Interest Rate	Real Average Asset Interest rate in local money.	Monthly	Uruguay Central Bank (BCU)

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.

The predictive capacity of selected components can be calibrated using the three-step selection process described in section 3.3. (i.e. correlation, turning points and causality). According to our results, all series –taken independently¬– show a good predictive performance. Table 2 presents the main results of correlation and turning point analyses. As we can observe, all maximum correlations indicate leading capacity –from three to eight months– in all variables. Also, turning points appear in advance of those of the IPI –excepting the first for Value Added Tax and the second for Country Risk–. Furthermore, results of granger causality tests, shown in Annex 3, reveal that series adequately precede the evolution of IPI.[1]

Table 2

Correlation and Turning Point Analyses

Variable	Max. Correlation with IIP		Turning Points Leads (-) or lags (+) in months	
	Value	Period leads (-) or lags (+) in months	First May-98	Second Dec-02
Total Exports	0.90	-8	-1	-9
Country Risk	0.89	-3	-19	3
Value Added Tax	0.95	-3	3	-1
Unemployment Benefits in Montevideo	0.52	-8	-10	-19
Building Permissions	0.86	-8	NA	-13
Average Asset Interest Rate	0.94	-6	NA	-4

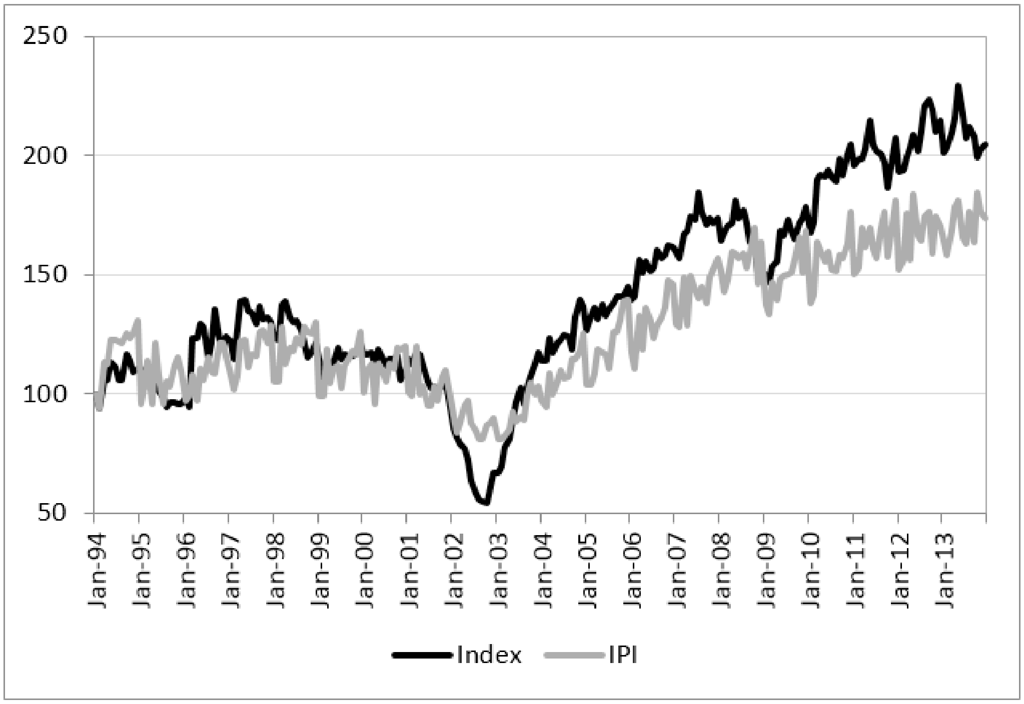
Source: Authors.

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.[2]

1 Except for the case of Unemployment Benefits in Montevideo, in all series results lead us to reject the null hypothesis that changes in the corresponding component does not granger cause variations in the IPI while we cannot reject the hypothesis that changes in the IPI does not granger cause variations in the component.

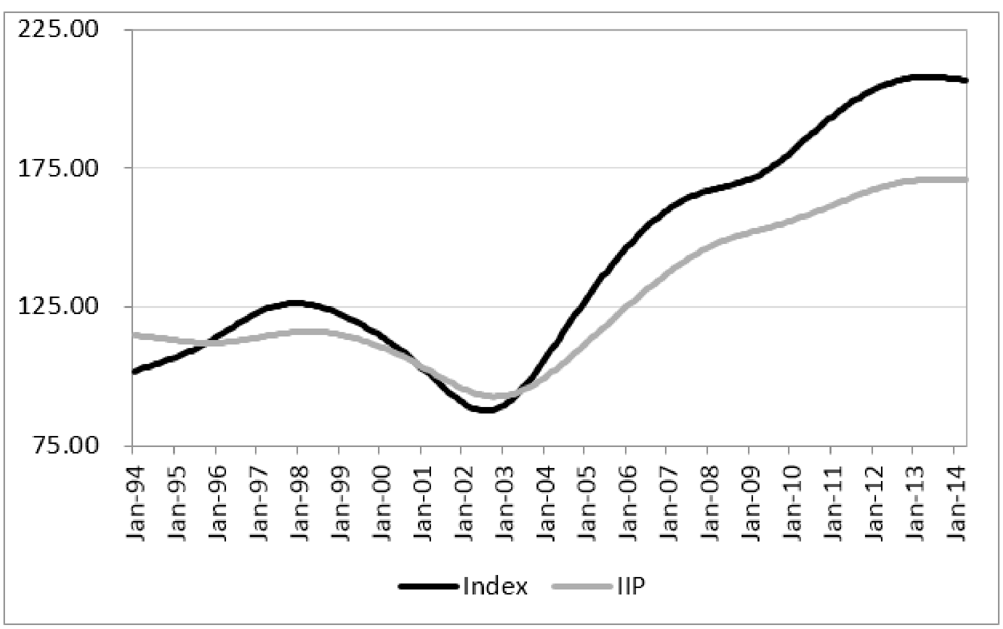
2 The trend-cycle of the IPI starts with a recession (up to October 1995). However, the overall economic activity –measured by the GDP– did not experience a real downturn in that period. For this reason, we will only consider and analyze turning points of IPI and composite index after October 1995.

Figure 1
Leading indicator and IPI evolution



Source: Authors.

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



Source: Authors.

Analyzing the trend cycle series allows us to compare the turning points of both the IPI and the leading indicator (see Table 3). By doing so, we can observe that our estimated leading indicator reaches to anticipate all turning points with a margin of four, three and two months respectively.

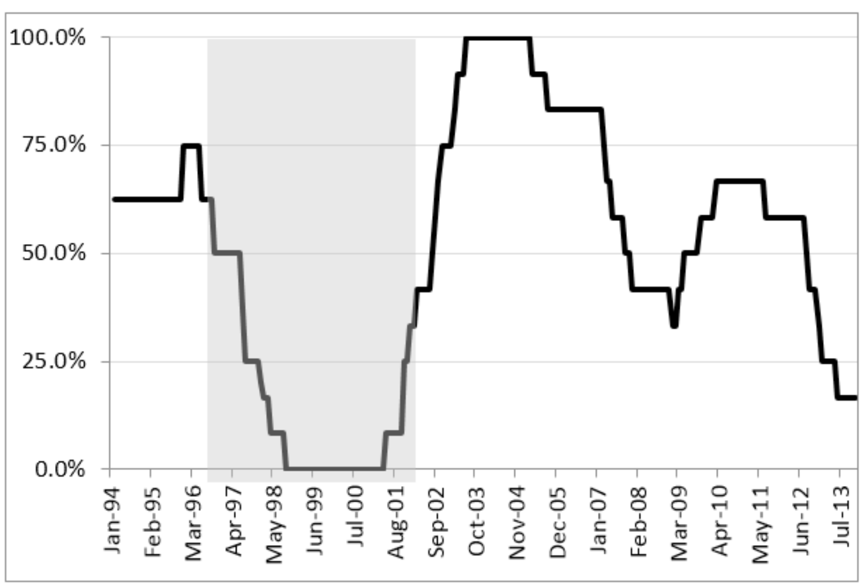
Table 3
Dates of Turning Points

	First turning point	Second turning point
IPI	May-98	Dec-02
Leading index	Jan-98	Sep-02
Months in advance	4	3

Source: Authors.

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.

Figure 3
Diffusion Index Evolution



Source: Authors.

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

.

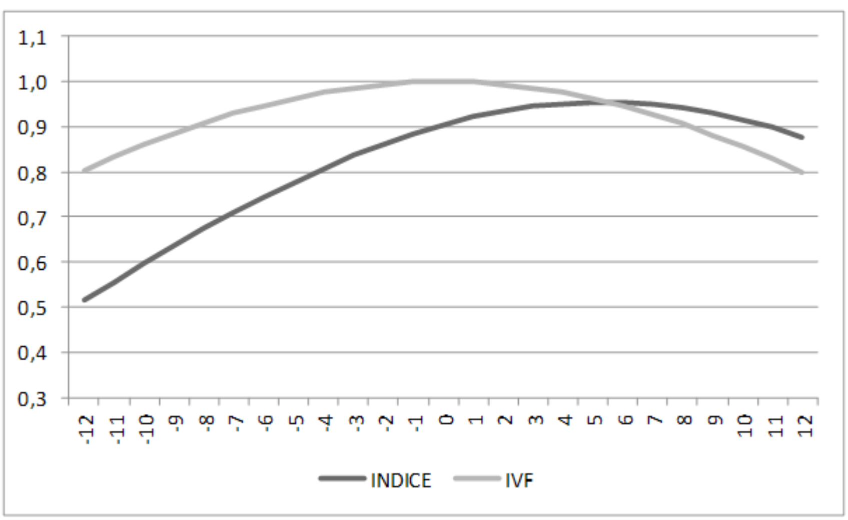
5. Index evaluation.

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 presents the correlation value with the number of lag or lead of the transformed IPI.[1] The maximum value is reached between the growth rate of the leading index and the IPI, when this last one is lagged between five and six 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



Source: Authors.

1 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.

Regarding Granger tests, Table 4 presents the analysis of causality between de leading index and the IPI seasonally adjusted. As both series present a unit root, the test is done using their first differences. From the fifth lag on, we can 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.

Table 4

Results of Granger Causality Tests

	F-Statistic										
Null Hypothesis/Lags	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
DIPI does not Granger Cause **Dindex**	3.533	2.177	1.649	1.270	1.347	1.134	1.157	1.051	1.209	1.100	1.180
DIndex does not Granger Cause DIPI	0.424	2.449	1.853	2.242	1.963	2.042	2.200	1.806	1.693	1.737	2.553
	Probability										
DIPI does not Granger Cause DIndex	0.031	0.092	0.163	0.278	0.238	0.343	0.327	0.401	0.286	0.363	0.299
DIndex does not Granger Cause DIPI	0.655	0.064	0.120	0.051	0.072	0.051	0.029	0.069	0.084	0.067	0.004

Source: Authors.

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.

The future research agenda includes elaborating both a coincident and a lagging index, which by being read together with the present 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–. Besides, for the future it is necessary to define a systematic methodology to evaluate if the series included in the index remain pertinent or should be changed to predict the evolution of the business cycle. Finally, the focus on turning points can be completed with a different leading index that estimates future values of economic variables.

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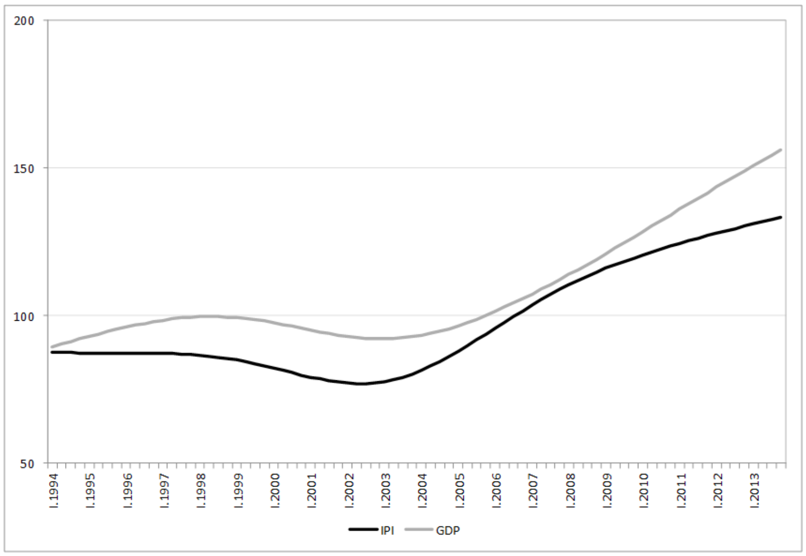
Annex 1

IPI and GDP Analysis

Figure A1.1.

Industrial Production Index and Gross Domestic Product

(Trend-Cycle series)



Source: Authors' own estimations.

Table A1.1.

Correlation coefficients between IPI and GDP

	GDP								
	-4	-3	-2	-1	0	1	2	3	4
IPI	0,54	0,61	0,68	0,74	0,79	0,83	0,87	0,89	0,91

Source: Authors' own estimations.

Table A1.2.

Results of Granger Causality Tests

	F-Statistic						
Null Hypothesis/Lags	2	3	4	5	6	7	8
D(GDP_SA) does not Granger Cause D(IPI_SA)	1,044	0,591	0,818	0,557	0,706	0,563	0,784
D(IPI_SA) does not Granger Cause D(GDP_SA)	1,480	0,955	0,723	2,832	2,467	3,402	3,825
	Probability						
	2	3	4	5	6	7	8
D(GDP_SA) does not Granger Cause D(IPI_SA)	0,357	0,623	0,518	0,732	0,646	0,782	0,619
D(IPI_SA) does not Granger Cause D(GDP_SA)	0,234	0,419	0,579	0,023	0,034	0,004	0,001

Source: Authors' own estimations.

Annex 2

Original Series

Table A2.1.

List of analyzed series

Cattle	Milk submited to plants	Sales of fuel and oil derivatives	Sales of gas-oil and petrol	Sales of gas	Energy residential sales	Energy great costumers sales	Energy medium costumers sales
Total energy sales	Total import	Import without oil and oil products	Import of oil and oil products	Consumption goods import	Machinery imports	Capital goods imports	Intermediate goods imports
Car sales	Total Exports	Urban Activity rate	Urban Employment rate	Montevideo Activity rate	Montevideo Emlyment rate	Total Unemployment benefits	Montevieo Unemployment benefits
Total unemployment benefits requests	Montevideo unemployment benefits requests	Number of urban people employed	Number of employed people in Montevideo	Consumption taxes	Foreign trade taxes	IVA	IMESI
Rent taxes	Industrials's eocnomy expectation	Industrial's enterprise expectation	Industrial´s export expectations	Industrial's domestic market expectation	Issuance of money	Reserve assets	M1
M2	Country risk (UBI)	Real asset rate in domestic money	Real asset rate in dollars	Real asset rate in domestic money for enterprises	Uruguay regional real exchange rate	Uruguay real exchange rate	Public sector income
Central Goverment income	Tax Revenue Office income	EMI	EMAE	Argentina's real exchange rate	Argentina's industrial production	Argentina's export	Argentina`s import
Brasil's industrial production	Brasil's real exchange rate	Brasilian exports	Brasilian imports	US 10 years bond rate	US FED rate	US industrial production	UE industrial production
Food price index	Agricultral raw material index	Commodities price index	WTI price	US rice price	Tailand rice price	Argentina soy price	Mexico soy price
Skimmed milk price	Milk price	Meat price					

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

Source: Authors' own estimations.

Annex 3

Granger Causality Tests for Index Components

Table A3.1.

Granger causality tests

Null Hypothesis/Lags	F-Statistic										
	2	3	4	5	6	7	8	9	10	11	12
DIPI does not Granger Cause **DCONSTRUCTION**	0,001	0,595	0,628	1,204	1,292	1,109	1,035	1,097	1,355	1,385	1,265
DCONSTRUCTION does not Granger Cause DIPI	1,492	1,094	1,026	0,000	1,365	1,698	2,018	2,207	1,965	1,585	1,386
	Probability										
DIPI does not Granger Cause **DCONSTRUCTION**	0,999	0,619	0,643	0,309	0,263	0,360	0,412	0,368	0,206	0,185	0,244
DCONSTRUCTION does not Granger Cause DIPI	0,228	0,353	0,395	0,497	0,232	0,112	0,047	0,024	0,040	0,108	0,178

Null Hypothesis/Lags	F-Statistic										
	2	3	4	5	6	7	8	9	10	11	12
DIPI does not Granger Cause **DUNEMPLOYMENT**	3,828	2,806	2,864	2,598	2,145	1,967	2,007	2,067	1,907	1,970	1,821
DUNEMPLOYMENT does not Granger Cause DIPI	0,795	1,077	0,954	0,748	0,758	0,997	1,099	1,681	1,555	1,524	1,550
	Probability										
DIPI does not Granger Cause **DUNEMPLOYMENT**	0,023	0,041	0,024	0,026	0,050	0,061	0,047	0,034	0,046	0,033	0,047
DUNEMPLOYMENT does not Granger Cause DIPI	0,453	0,360	0,434	0,589	0,604	0,434	0,365	0,095	0,122	0,125	0,109

Null Hypothesis/Lags	F-Statistic										
	2	3	4	5	6	7	8	9	10	11	12
DIPI does not Granger Cause **DRATE**	0,089	0,385	0,535	1,026	1,153	1,517	1,507	1,678	1,534	1,395	1,791
DRATE does not Granger Cause DIPI	1,848	2,396	2,397	2,250	2,234	2,317	2,255	1,694	1,508	1,385	1,259
	Probability										
DIPI does not Granger Cause **DRATE**	0,915	0,764	0,710	0,404	0,334	0,164	0,158	0,098	0,132	0,180	0,054
DRATE does not Granger Cause DIPI	0,160	0,070	0,052	0,051	0,042	0,028	0,026	0,094	0,141	0,185	0,249

Null Hypothesis/Lags	F-Statistic										
	2	3	4	5	6	7	8	9	10	11	12
DIPI does not Granger Cause **VAT**	1,512	0,902	0,647	0,751	1,822	1,830	1,649	1,481	1,632	1,572	1,401
DVAT does not Granger Cause DIPI	0,142	0,253	0,986	0,918	0,838	0,648	0,716	0,455	1,819	1,652	1,820
	Probability										
DIPI does not Granger Cause **VAT**	0,223	0,441	0,629	0,586	0,096	0,083	0,113	0,157	0,099	0,109	0,167
DVAT does not Granger Cause DIPI	0,868	0,859	0,416	0,470	0,541	0,716	0,677	0,903	0,059	0,087	0,047

Null Hypothesis/Lags	F-Statistic										
	2	3	4	5	6	7	8	9	10	11	12
DIPI does not Granger Cause **DUBI**	0,831	0,777	0,739	1,008	0,909	0,936	1,136	1,144	0,975	1,016	1,016
DUBI does not Granger Cause DIPI	6,344	4,547	3,892	3,640	3,042	2,529	3,431	2,766	2,464	2,070	2,075
	Probability										
DIPI does not Granger Cause **DUBI**	0,437	0,508	0,566	0,414	0,490	0,480	0,340	0,333	0,466	0,433	0,435
DUBI does not Granger Cause DIPI	0,002	0,004	0,005	0,004	0,007	0,016	0,001	0,004	0,008	0,024	0,020

Null Hypothesis/Lags	F-Statistic										
	2	3	4	5	6	7	8	9	10	11	12
DIPI does not Granger Cause **DEXPORT**	1,656	1,058	2,558	1,762	1,914	1,902	1,469	1,704	1,803	1,777	1,855
DEXPORT does not Granger Cause DIPI	2,334	2,625	2,103	1,390	0,971	0,883	1,660	1,451	1,408	1,137	1,012
	Probability										
DIPI does not Granger Cause **DEXPORT**	0,193	0,368	0,040	0,122	0,080	0,070	0,170	0,090	0,062	0,060	0,042
DEXPORT does not Granger Cause DIPI	0,099	0,051	0,081	0,229	0,446	0,521	0,110	0,168	0,178	0,334	0,439

Source: Authors' own estimations.

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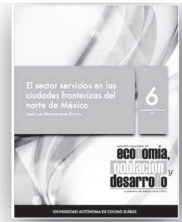

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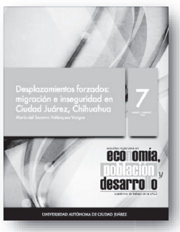

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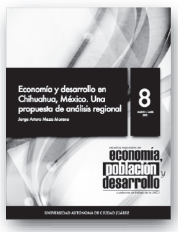

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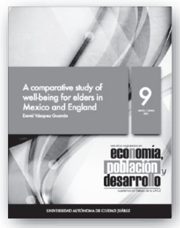

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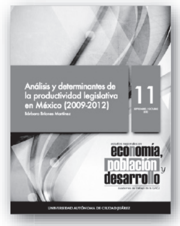

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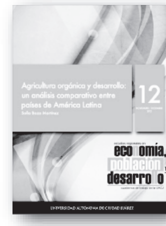

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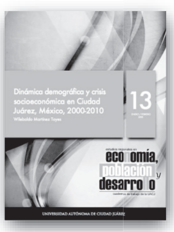

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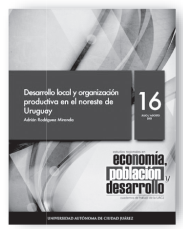

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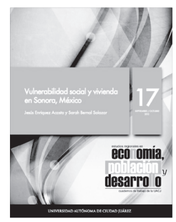

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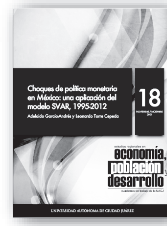

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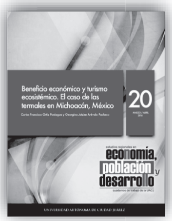

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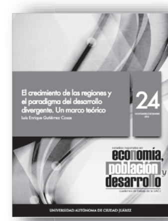

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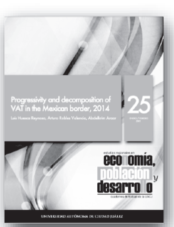

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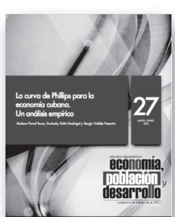

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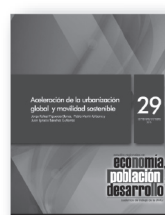

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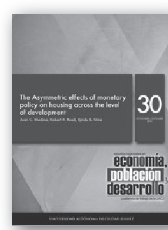

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I. Para el documento general:

Tipo de letra: Times New Roman.
Tamaño: 11 puntos.
Interlineado: 1.5 espacios.
Títulos y subtítulos:
El texto principal en 11 puntos. Títulos 12 puntos (en resaltado). Subtítulos 11 puntos. Cada título y subtítulo deberá numerarse bajo el siguiente orden: 1, 1.1, 2, 2.1, 2.2…
La extensión máxima de los cuadernos de trabajo será de 40 cuartillas.
La primera vez que se emplee una sigla en el texto se especificará primero su equivalencia completa y después la sigla.

II. Hoja de presentación:

Título:
14 puntos, centrado, resaltado.
Nombre de autor(es):
12 puntos
Resumen y abstract:
Debe incluir resumen en español y abstract (diez puntos), no mayor a 250 palabras
Palabras clave:
Incluir entre tres y cinco palabras clave, en español e inglés
Referencia del autor o autores:
Institución de adscripción, grado académico y líneas-grupos de investigación que desarrolla y a los que pertenece.

III. Sistema de referencia de citas:

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Las citas bibliográficas en el texto deberán incluir entre paréntesis sólo el apellido del autor, la fecha de publicación y el número de página; por ejemplo: (Quilodrán, 2001: 33).

IV. Notación en sección de bibliografía y fuentes de información:

Se deberá incluir al final del texto. Toda referencia deberá estar mencionada en el texto o notas de pie de página.
Cada referencia iniciará con el primer apellido o los apellidos, luego el nombre del autor, y después, entre paréntesis, el año de publicación seguido de un punto. Ejemplos:
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Artículo:
Ros, Jaime (2008). "La desaceleración del crecimiento económico en México desde 1982", en Trimestre Económico, vol. 75, núm. 299, pp. 537-560.
Libro:
Villarreal, René (2005). Industrialización, competitividad y desequilibrio externo en México. Un

enfoque macroindustrial y financiero (1929-2010), México, Fondo de Cultura Económica.
Capítulo de libro:
Castillo, Manuel Ángel (2003). "La política de inmigración en México: un breve recuento", en Manuel Ángel Castillo, Alfredo Lattes y Jorge Santibáñez (coords.), Migración y fronteras, Tijuana, El Colegio de la Frontera Norte / Asociación Latinoamericana de Sociología / El Colegio de México, pp. 425-451.

V. Notas de pie de página:

Se utilizarán para hacer indicaciones complementarias, aclaraciones o ampliación de una explicación. La notas de pie de página en Times New Roman, 10 puntos.

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Cuadro
Gráfica
Diagrama
Mapa
Figura
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Las indicaciones de la imagen: tipo y número de imagen, título de imagen y fuente se escriben en 10 puntos. En el texto poner como imagen los mapas, figuras, gráficas y diagramas –con el ánimo de no perder el formato realizado por el autor.

VII. Ecuaciones y fórmulas:

Si se utilizan ecuaciones o fórmulas deberá utilizarse el editor de ecuaciones de Word y numerarse.

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La aceptación de cada colaboración dependerá de la evaluación de dos dictaminadores especialistas en la materia que se conservarán en el anonimato, al igual que el autor (autores) para efectos de la misma.

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Size: font size 11.
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Titles and subtitles: Main text font size 11. Titles font size 12 (Bold). Subtitles font size 11.
Each title and subtitle should be numbered in the following order: 1, 1.1, 2, 2.1, 2.2…
The maximum length of the workbooks will be 40 pages.
The first time an abbreviation is used in the text will be specified first complete equivalence and then stands.

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Book:
Villarreal, René (2005). Industrialización, competitividad y desequilibrio externo en México. Un enfoque macroindustrial y financiero (1929-2010), México, Fondo de Cultura Económica.
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V. Footnotes:

Must be used to make additional indications, clarification or expansion of an explanation. The footnotes must be in Times New Roman, font size 10.

VI. Image typology inside text:

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Graph
Diagram
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Figure

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