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New Coincident and Leading Indicators for the Lebanese Economy

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Abstract

Weak economic statistics in Lebanon impede economic analysis and decision making. This paper presents a new coincident indicator and a leading indicator for the Lebanese economy. A new methodology, based on the National Bureau of Economic Research–Conference Board approach, was used to construct these indicators. The indicators can be used as monthly proxies for the evolution of real gross domestic product with a relatively small time lag (four to five months). Notwithstanding the relatively small sample period, the results reveal promising statistical properties that should make these new indications valuable coincident and leading (one-year ahead) indicators for analyzing the dynamics of the Lebanese economy. However, given limitations on the length of the gross domestic product time series in Lebanon, the accuracy of these indicators in tracking the business cycle of the Lebanese economy is expected to improve over time as more data points become available.

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1. Introduction

Lebanon's weak economic statistics are impeding timely decision making by businesses, investors and policy makers. The quality of economic statistics in Lebanon has been extremely weak in terms of data compilation and frequency, even relative to countries with similar level of development (IMF, 2012). Statistical weaknesses include areas such as national accounts, balance of payments, prices and inflation, and labor and social measures. For example, a reliable Consumer Price Index (CPI) that reflects international standards is only available since December 2013 after the Central Administration of Statistics (CAS) rebased Lebanon's CPI data to December 2013 providing (i) a much more comprehensive breakdown of prices (prices for rent are now collected on a monthly basis) and (ii) an updated weighting scheme to the inflation basket.[1] On the labor market front, the latest official unemployment rate dates from 2009, as indicated on CAS's website. In addition to the absence of recent and up to date labor force surveys reflecting the dynamics of the Lebanese labor market especially after the large influx of Syrian refugees since 2012, the latest population census in Lebanon dates back to 1932. Notwithstanding recent improvements in the compilation of national accounts,[2] as of May 2014 Lebanon's latest GDP data are from 2011 and are only available on an annual basis.

Faced with weak economic statistics, the private sector started recently to develop new indices that would assist in understanding the economic situation in Lebanon in a timelier basis. For example, the dynamics of private consumption which constituted 88.7 percent of GDP in 2011 (latest actual data) can be proxied using the monthly consumer confidence index produced by "ARA Research & Consultancy".[3] In order to analyze private sector economic activity, BLOM bank and Markit launched in November 2013 a new indicator called the BLOM Purchasing Managers' Index[4] (BLOM PMI). To capture the activity of the retail sector which accounted for 14.4 percent of GDP in 2011, the Beirut Traders Association (BTA) launched in 2012 and in partnership with Fransabank the "Beirut Traders

[1] Prior to December 2013, the CPI as measured by CAS did not accurately reflect the dynamics of aggregate prices in Lebanon because rental surveys, which accounted for 16 percent of the old CPI basket, were only undertaken every three years, leading to unexpected jumps in the housing sub-component of the CPI. Furthermore, CAS did not collect CPI data from January to May 2013 resulting in a break in the CPI series.

[2] In October 2013, CAS published for the first time revised national accounts from 2004-2011 using (i) new data (VAT returns, imports of services and the latest household budget survey 2011-2012) and (ii) a revised National Accounts framework that is consistent with the latest international standards (UN SNA 2008).

[3] Another indicator of the level of consumer confidence in Lebanon would be the Byblos Bank/AUB consumer confidence index; however this indicator is published with a six to nine months lag. As of June 2014, the latest Byblos Bank/AUB Index dates back to December 2013.

[4] The PMI is a globally used indicator used by policy makers, economists and investors to forecast GDP growth and/or make investment decisions.

Association – Fransabank Retail Index", with Q4-2011 as the base year. Moreover, and in order to reflect the dynamics of the private sector investment which represented 23.3 percent of GDP in 2011, the BTA and BankMed designed a "Beirut Traders Association - BankMed Investment Index" starting from Q3-2013.

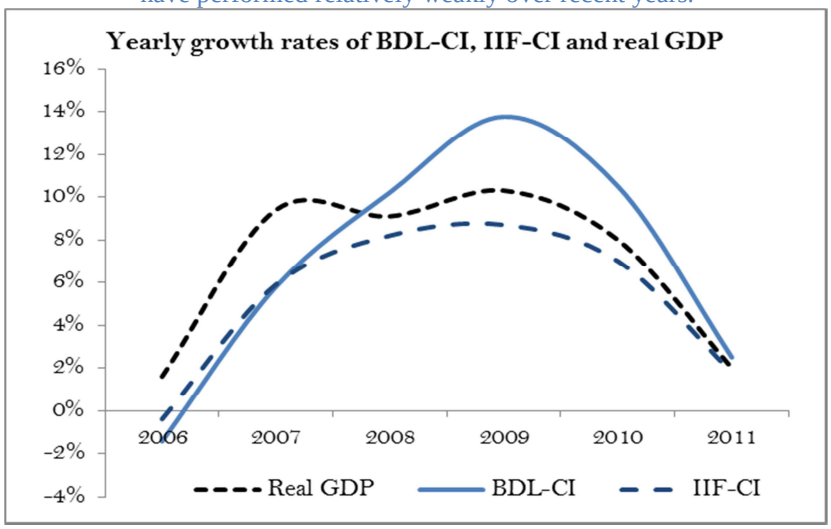
To provide a more timely and comprehensive assessment of economic activity in Lebanon, Banque du Liban (BdL) and the International Institute of Finance (IIF) separately developed coincident indicators. The former, which we denote by *"BdL-CI"*, was developed in 1993, immediately following the end of the civil war and is composed of eight variables.[5] Notwithstanding the profound structural changes in Lebanon's economy that took place since the end of the civil war, the weights of the eight BdL-CI variables in the index have remained fixed since 1993. None of the eight BdL-CI variables include the public administration sector, which represented on average 9.6 percent of GDP between 2004 and 2011. The IIF coincident indicator, denoted by *"IIF-CI"*, follows the same approach as the BdL-CI but includes an additional five variables (IIF, 2010).[6]

While providing a useful gauge of economic activity in Lebanon, analysis reveals that the statistical properties of these two coincident indicators—such as accuracy and unbiasedness—could be improved. As illustrated Figure 1, the IIF-CI, for example, consistently underestimated actual GDP growth between 2006 and 2011. While the BdL-CI has no systematic estimation error, its accuracy has recently been weak as the gap between the BdL-CI and actual growth has been relatively large in several years, and in one year (2006), the BdL-CI also qualitatively misdiagnosed the strength of economic activity (the BdL-CI signaled that the economy was contracting by 1.4 percent while it actually grew by 1.6 percent).

[5] These are: electricity production (Volume terms), imports of petroleum derivatives (Volume terms), M3 (in real monetary terms), cleared checks (in real monetary terms) total airport passengers (Volume terms), cement deliveries (Volume terms) and imports and exports (in real monetary terms).

[6] These are "real growth in credit to the private sector (instead of growth in deposits), growth in tourist arrivals (instead of passengers arrivals), real growth in government revenues excluding grants, real growth in government consumption (current expenditure minus transfers minus interest payments), and real growth in imports of machinery and equipment". For details, see Iradian and Zouk (2010).

Figure 1. Current coincident indicators of the Lebanese economy have performed relatively weakly over recent years.



Source: BDL, CAS, IIF and own calculations

To improve the timeliness and accuracy of estimates of economic activity in Lebanon, we designed two new indicators for the Lebanese economy: a coincident *(WB-CI)* and a leading *(WB-LI)* indicator. The starting point in developing these composite indices is the NBER-Conference Board approach (Conference Board, 2012), modified by the use of minimization and calibration techniques to improve statistical properties of the two indicators. Specifically, the novelty of these two WB indicators compared to the NBER-Conference Board approach is in the choice of weights assigned to each variable. The weights are chosen so that the yearly growth rate of the $WB - CI_t$ ($\mathrm{WB - LI_t}$) converges to the yearly growth rate of $GDP_t(WB - CI_{t+12})$ at any point in time t.

The rest of this paper is structured as follows: Section 2 presents a brief historical overview of coincident and leading indicators. Section 3 describes the methodologies used to construct the WB-CI and WB-LI. Section 4 presents the results while section 5 discusses some policy implications derived from these newly developed indicators. Finally, Section 6 presents the caveats and limitations of the indicators and section 7 concludes.

2. Literature Review

Knowing the current and the expected state of the economy is of foremost importance for businesses, policymakers and investors. Depending on the quality of statistics in a given country, two distinct methodologies have been used to develop coincident and leading indicators: (i) the National Bureau of Economic Research (NBER) and/or Conference Board (CB) methodology and (ii) the Stock and Watson (SW, 1989) methodology. While the NBER-CB approach is not based on a theoretical model, the SW methodology is based on advanced econometric techniques such as dynamic factor models or Markov switching models. Although the latter provides a proper statistical framework, the former can be applied in countries that suffer from weak statistical systems (like Lebanon). The NBER-CB approach also has the important advantage of being easy to construct, explain and analyze. These are valuable properties in constructing composite indices aimed at a wide public.

The idea of quantitatively monitoring a business cycle, which according to Stock and Watson (1989) commonly refers to co-movements in different forms of activity, not just fluctuations in GNP, was firstly introduced in 1938 by a research team at the NBER. This team, which was led by Wesley Mitchell and Arthur Burns, examined the dynamics of some economic variables to see whether these changes lagged, led or coincided with changes observed in US business cycles. Twenty years later, and based on Burns and Mitchell's research conducted in 1946, Moore and Shiskin (1967) developed for the first time a methodology to construct composite indices of real economic activity. They designed "a scoring plan that has been developed to help in the evaluation and selection of indicators" (Moore and Shiskin, 1967). The scoring plan of each variable was based on (i) statistical adequacy, (ii) timeliness of publication, (iii) smoothness, (iv) economic significance, (v) historical business cycle conformity, and (vi) cyclical timing. This approach, which was adopted by the Conference Board in 1995 and developed later on, is, however, subject to some criticism. In addition to being described as a "measurement without theory" by Koopmans (1946) many econometricians argued that the NBER-CB methodology did not rely on any econometric techniques as the selected variables and their respective weights were subjectively chosen (Marcellino, 2005).

In a first attempt to respond to these criticisms, Stock and Watson (1989) developed an econometric model to construct new coincident and leading indicators for the US**.** In their method, the coincident indicator (or Index) is represented by an unobserved reference cycle representing what they call the "state of the economy". The Index formed is then measured using a dynamics factor model,

where the parameters of the series[7] forming the index are estimated using the maximum likelihood and the Kalman filter methods. In addition, they developed a leading indicator that forecasts the growth of the coincident indicator over the next six months, using a set of variables[8] in a Vector Autoregressive model (VAR).

Economic research examining business cycles in emerging countries accelerated during the last decade. Historically, economic research in this area was focused on developed countries. However, as a result of the improvement witnessed in the quality and frequency of data in emerging countries, economists were able during the last decade to better analyze business cycles and develop, in many of these countries, coincident and/or leading indicators. For example, Saadi-Sedik and Mongardini (2003) presented an econometric model to construct coincident and leading indicators for Jordan, while Elias Pereira constructed in 2012 a coincident indicator for the Cape Verdean economy, and Issler et al. (2013) designed coincident indicators for Argentina, Brazil, Chile, Colombia and Mexico.

[7] The four variables that composed the coincident indicator proposed by Stock and Watson (1989) were: employee-hours in nonagricultural establishments, industrial production, real personal income less transfer payments and real manufacturing and trade sales.

[8] The variables used in the construction of a leading indicator were: Average weekly hours of production, Average weekly initial claims of state unemployed insurance, Manufacturing new orders, S&P 500, Building permits, M2 and change in business and consumer credit outstanding.

3. Methodology

3.1. World Bank Coincident Indicator for Lebanon (WB-CI)

The construction of the WB-CI starts with the choice of a benchmark series, which in our case is the (recently revised) annual GDP series from 2005[9] till 2011 as published by CAS in October 2013. The next step is to select the corresponding variables that track as closely as possible the current dynamics of the real GDP. The potential variables which satisfy the objective should be, above all, available with a monthly frequency and with historical data from as far back as the new real GDP series as published by CAS. This selection is crucial for computing the WB-CI, because if the set of variables used in the WB-CI does not cover all (or most) of the sectors of the Lebanese economy, then the WB-CI will not be a robust estimate of real GDP. Consequently, and in order to account for all the sectors of the Lebanese economy, we refer to Lebanon's GDP decomposition (Table 1) and map each sector of the economy to a high frequency variable that reflects its economic dynamics.

Table 1. Lebanon's GDP decomposition from the supply side

Agriculture and Forestry	Industry	Services
Agriculture & forestry	Mining & quarring	Wholesale & retail trade
Livestock & livestock produts; fishing	Manufacturing of food products	Vehicle maintenace & repair
	Beverages & tobacco manufacturing	Transport
	Textile & leather manufacturing	Hotels & restaurants
	Wood & paper manufacturing; printing	Informatio n & Communication
	Chemicals, ruuberr & plastics manufacturing	Financial services
	Non-metalic mineral manufacturing	Real estate
	Metal products, machinery & equipment	Professional services
	Other manufacturing	Administrative services
	Electricity	Public administration
	Water Supply & waste management	Education
	Construction	Health & social care
		Personal & community services

Source: Central Administration of Statistics

Unfortunately, the availability of sufficiently long time series is a major constraint in Lebanon. As a result, a relatively small number of variables exist to proxy for economic activity, some of these would clearly not be a first choice in a country with a more developed statistical system. Furthermore, many variables used in the literature to develop coincident indicators are not available in the case of

[9] The sample starts, however, in 2005 since (i) the new methodology adopted by CAS to compile national accounts only covers the 2004-2011 period and (ii) some of the variables such as lending to the private sector and built property tax were not fully reported in 2004.

Lebanon such as real personal income less transfers and the number of employees on non-agricultural payrolls. According to Anguyo (2011), the former captures the aggregate spending behavior of consumers while changes in the latter reflect net hiring in the economy.

3.1.1. Existing data and potential variables for the WB-CI

A set of twenty one potential variables, capturing the dynamics of most of the sectors of the Lebanese economy, was included in the construction of the WB-CI (Table 2) based on the following rationale:

1. The dynamics of the wholesale & retail trade sector, which is the main sector of the Lebanese economy, representing 14.8 percent of GDP in 2011, are captured using cleared checks obtained from BdL and VAT revenues published in the public finance monitor by the ministry of finance.
2. The real estate sector, the second biggest sector of the Lebanese economy representing 13.8 percent of GDP in 2011 is proxied using (i) real estate registration fees and (ii) tax on property. Data for both variables are also obtained from the public finance monitor published by the ministry of finance.
3. The public administration services sector is the third biggest sector of the economy representing 9.6 percent of GDP in 2011. For activities in this sector, we use the primary spending (total spending minus interest payments) of the central government as a proxy.
4. While the financial sector, representing 7.3 percent of GDP in 2011, is measured using M3, lending to the private sector and non-resident private sector deposits, the construction sector which constituted 4.5 percent of GDP in 2011, is captured using cement deliveries and construction permits. Data for both variables are obtained from BdL.
5. Due to the scarcity of variables reflecting the activity of the industrial and agricultural sectors, which represented respectively 3.8 and 13.4 percent of GDP in 2011, these sectors are measured using net exports of goods (excluding energy imports) calculated based on data provided by the Lebanese customs.
6. Finally the information and communication, tobacco manufacturing, administrative services, transport, electricity and hotels and restaurants sectors are captured using, respectively, transfer from the telecom surplus, tobacco excise, administrative fees and charges, private car registration

fees, imports of energy and tourist arrivals[10]. In addition, current economic index, current personal income index and the current security index were used as proxies for consumer sentiment.

Table 2. Potential candidates for inclusion in the WB-CI

Variable	Unit	Source
Administrative fees and charges	LBP bln	Ministry of Finance
Car Excise	LBP bln	Ministry of Finance
Cement Deliveries	thousands of tons	Banque du Liban
Cleared checks	LBP bln	Banque du Liban
Construction Permits	m^2	Banque du Liban
Current Economic Index	Index	ARA marketing research and consultancy
Current Personal Income Index	Index	ARA marketing research and consultancy
Current Security Index	Index	ARA marketing research and consultancy
Energy Imports	LBP bln	Lebanese Customs
Exports of Goods	LBP bln	Lebanese Customs
Imports of Goods without energy products	LBP bln	Lebanese Customs
Lending to the private sector	LBP bln	Banque du Liban
M3	LBP bln	Banque du Liban
Primary spending	LBP bln	Ministry of Finance
Private car registration	LBP bln	Ministry of Finance
Non-Resident Private sector deposits	LBP bln	Banque du Liban
Taxes on real-estate \1	LBP bln	Ministry of Finance
Tobacco Excise	LBP bln	Ministry of Finance
Tourist arrivals	number	Ministry of Tourism
VAT revenues	LBP bln	Ministry of Finance

\1 Taxes on real-estate = Built Property Tax + Real Estate Registration Fees

3.1.2. Steps followed to construct the WB-CI

The methodology for constructing the WB-CI, which is based on the NBER-CB approach, follows nine distinct steps. In the methodology (M) below, t represents the current month while $x_{i,t}$ denotes the raw data for variable $i = 1, \dots, 21$ at period $t = 1, \dots, T$.

1. The X-12-ARIMA technique is used to remove the seasonal trend from all the variables $x_{i,t}$.

2. In order to measure the real economic activity, all the variables that are in monetary terms are deflated by the Consumer Price Index (CPI) published by the Consultation and Research Institute (CRI)[11] with December 2006 as the base year.

3. Some of the variables exhibit unusual volatility at a monthly frequency. To eliminate this "noise" we smooth all the series using moving averages.

Following the data transformations in steps 1, 2 and 3, all the variables will be denoted by:

[10] We use tourist arrivals and not the number of airport arrivals, because the latter includes Lebanese expatriates that are not considered as tourists, hence they are not a proxy for the tourism sector. However, the contribution of expatriates to the economy (mainly through remittances) is reflected by the non-resident deposits at commercial banks.

[11] The CRI CPI is used rather than the one from CAS because the latter started to compile its new corresponding CPI series in December 2013 while the WB-CI starts in December 2006. CRI's CPI, however, dates back to January 1988.

$$s_{i,t}\ for\ i = 1, \dots, 21\ and\ t = 1, \dots, T.$$

4. Then, the month-to-month symmetric percentage change is calculated.[12] If the variable s is an interest rate or in a percentage form, then the percentage change is calculated as:

$$C_{i,t} = s_{i,t} - s_{i,t-1}\ for\ i = 1, \dots, 21\ and\ t = 1, \dots, T. \quad (1)$$

In any other case, the symmetric percentage change formula is applied.

$$C_{i,t} = 200 * \left(\frac{s_{i,t} - s_{i,t-1}}{s_{i,t} + s_{i,t-1}}\right)\ for\ i = 1, \dots, 21\ and\ t = 1, \dots, T. \quad (2)$$

Before proceeding, let w_i denote the weight assigned to each variable $s_{i,t}\ for\ i = 1, \dots, 21$.

5. Afterwards, random weights w_i are chosen for each variable $s_{i,t}$ so that: $\sum_{i=1}^{n} w_i = 1$.

6. Using steps 4 and 5 the growth rates $g_{i,t}$ of each variable are then calculated using the following formula:

$$g_{i,t} = C_{i,t} * w_i\ for\ i = 1, \dots, 21\ and\ t = 1, \dots, T. \quad (3)$$

7. Next, the growth rates of all the variables are summed in order to get the month to month growth rate, G_t, of the WB-CI such that

$$G_t = \sum_{i=1}^{n} g_{i,t}\ for\ t = 1, \dots, T. \quad (4)$$

8. Assuming that the base year of the WB-CI is the first period (i.e. $\mathrm{WB-CI}_{t=1} = 100$) the level of the index is calculated recursively using equation (4) and the below symmetric percentage change formula,

$$WB - CI_t = WB - CI_{t-1} * \left(\frac{200 + G_t}{200 - G_t}\right)\ for\ t = 2, \dots, T \quad (5)$$

[12] The symmetric percentage change formula treats negative and positive changes symmetrically (with the same magnitude). For example, when a variable increases by one percent followed by a one percent decrease, the level of the variable would return to its initial value. This is would not be true with the standard change formula.

9. Finally the model is calibrated so that the final weights w_i satisfy equations (6) and (7) below:

$$\min_{w_i} \left\| Average \left[\left(\frac{WB - CI_y}{WB - CI_{y-1}} - 1 \right) - \left(\frac{GDP_y}{GDP_{y-1}} - 1 \right) \right] \right\| \; for\ y = 2006, \dots, 2011 \quad (6)$$

$$\min_{w_i} \left\| Standard\ deviation \left[\left(\frac{WB - CI_y}{WB - CI_{y-1}} - 1 \right) - \left(\frac{GDP_y}{GDP_{y-1}} - 1 \right) \right] \right\| \; for\ y = 2006, \dots, 2011 \quad (7)$$

After following the above steps and calibrating the model using the minimization problems in equations (6) and (7), the final data set (Table 5) used for the construction of the WB-CI is identified and consists of monthly observations for 13 variables covering most the sectors of the economy (real, external, monetary and fiscal) from December 2004 to December 2011 (85 observations).

3.2. World Bank Leading Indicator of Lebanon (WB-LI)

In a turbulent and volatile environment like Lebanon, a high-frequency leading indicator is a natural complement to a coincident indicator. A leading indicator for the Lebanese economy (WB-LI) would help to (i) detect early signs of turning points in the economic activity and (ii) forecast GDP growth during the next 12 months. To our knowledge, the designed WB-LI would be the only publicly available leading indicator for the Lebanese economy.

The WB-LI is constructed based on a methodology similar, but not identical, to the NBER-CB approach. The main difference resides in the choice of weights. While the NBER-CB methodology computes the weights of each variable as the inverse of its respective standard deviation, in the WB-LI the corresponding weights are chosen in order to minimize the difference between the growth rate of the leading indicator at time t and the growth rate of the coincident indicator at time $t + 12$. In other words, the weights are selected so that the growth rate of $WB - LI_t$ is as close as possible to the growth rate of $WB - CI_{t+12}$. The rationale for such an approach is to increase *(decrease)* the forecast confidence *(error)* of GDP growth for the forthcoming year.

3.2.1. Existing data and potential variables for the WB-LI

The next steps in constructing the WB-LI are to (i) choose an appropriate reference series, and (ii) determine the relevant components of the WB-LI. Given that the WB-CI is a reliable measure of the current state of the economy (Figure 2 and Table 7), it is used as the benchmark series. It should be noted that one of the two following conditions should be met in order that a certain variable be used in the construction of the WB-LI. The first condition is *economic significance*, implying that a certain variable has "expectational components that would (under some economic theory) respond rapidly to

some shocks to the economy" (Stock and Watson, 1989). The second is *statistical significance* which means that the correlation coefficient between a certain variable at time t and the reference series at time $t + 12$ should be larger than 0.5 in absolute value. Based on the above two conditions, 17 potential variables (Table 4) were used to construct the WB-LI.

While the choice of variables based on the statistical significance principle depends, solely, on having a correlation coefficient larger than 0.5, the variables that were selected according to the economic significance criteria would warrant a greater analysis (Table 3). For example, the Future economic index reflects the expectations of individuals regarding the future economic environment. On the other hand an increase in personnel costs[13] implies that workers have more money to save and spend today. And given the high Lebanese interest rates, a rational person would prefer to save today, earn a high return and then consume in the future. Meanwhile, freight incoming at the port of Beirut is a retail trade confidence indicator as businesses and industrialists import more goods in the present when expecting an improvement in the general business environment in the future. Finally, Stock Indices generally reflect investors' appetite to invest in the future.

[13] defined as the total remuneration to public sector employees

Table 3. Economic and statistical significance of the potential variables of the WB-LI

Variable	Statistical Significance /1	Economic Significance /2
Consumer Confidence Index	× (0.32)	✓
Cement Deliveries	✓ (0.72)	×
EMBIG spread	✓ (0.79)	✓
Custom Revenues	✓ (0.58)	✓
Airport Arrivals	✓ (0.84)	×
Freight Incoming at the Port of Beirut	× (0.37)	✓
Spread between local and Libor interest rate	✓ (0.89)	✓
Lending to the Private Sector	✓ (0.86)	✓
Personnel Cost	× (0.47)	✓
Capital expenditures	× (0.07)	✓
Change in dollarization rate	× (0.04)	✓
Public Debt	✓ (0.92)	✓
Blom Stock Index	× (0.04)	✓
Industrial Exports	✓ (0.68)	×
Construction permits	× (0.34)	✓
Construction in progress	× (0.015)	✓
Future Economic Index	× (0.08)	✓

Source: Own calculations

/1 ✓means that the correlation coefficient between the concerned variable at time t and the WB-CI at time t+12 is larger than 0.5 in absolute value.

/2 ✓ means that under some economic theory the concerned variable would respond rapidly to some shocks to the economy.

Table 4. Potential candidates for inclusion in the WB-LI

Variable	Unit	Source
Consumer Confidence Index	Index	ARA Research & Consultancy
Cement Deliveries	thousand tons	Banque du Liban
EMBIG spread	bps	JP Morgan; WB staff calculations
Custom Revenues	LBP bln	Ministry of Finance
Airport Arrivals	number	Banque du Liban
Freight Incoming at the Port of Beirut	tons	Banque du Liban
Spread between local and Libor interest rate	bps	Banque du Liban; WB staff calcualtions
Lending to the Private Sector	LBP bln	Banque du Liban
Personnel Cost	LBP bln	Ministry of Finance
Capital expenditures	LBP bln	Ministry of Finance
Change in dollarization rate	bps	BDL; WB staff calculations
Public Debt	LBP bln	Banque du Liban
Blom Stock Index	Index	BLOM Bank
Industrial Exports	mln USD	Ministry of Industry
Construction permits	m^2	Banque du Liban
Construction in progrees	LBP bln	Ministry of Finance
Future Economic Index	Index	ARA Research & Consultancy

3.2.2. Steps followed to construct the WB-LI

The WB-LI is computed and tested against the WB-CI for the period December 2006[14] to October 2012 (69 observations) using monthly data of the 17 potential variables listed in Table 4. To develop the WB-LI the same methodology followed in the construction of the WB-CI is used with the

[14] Our sample for the WB-LI starts from December 2006 and not December 2004 (as the WB-CI) given that 2006 was subject to an unexpected exogenous shock represented by the War with Israel. Hence, any attempt to estimate in 2005 the state of the Lebanese economy in 2006 would have been misleading.

exception of a different minimization problem (step 9). A prime ($'$) is used to represent the variables corresponding to the WB-LI. Equations (6) and (7) of Step 9 of methodology (M) become,

$$\min_{w_i'} \left\| Average\left[\left\{Geomean\left(\frac{WB-LI_y}{WB-LI_{y-12}} \times \ldots \times \frac{WB-LI_{y+11}}{WB-LI_{y-1}}\right)\right\} - \left\{Geomean\left(\frac{WB-CI_{y+12}}{WB-CI_y} \times \ldots \times \frac{WB-CI_{y+23}}{WB-CI_{y+11}}\right)\right\}\right] \right\| \; for\ y = Jan\ 2008, \ldots, Nov\ 2011 \quad (6')$$

$$\min_{w_i'} \left\| Standard\ deviation\left[\left\{Geomean\left(\frac{WB-LI_y}{WB-LI_{y-12}} \times \ldots \times \frac{WB-LI_{y+11}}{WB-LI_{y-1}}\right)\right\} - \left\{Geomean\left(\frac{WB-CI_{y+12}}{WB-CI_y} \times \ldots \times \frac{WB-CI_{y+23}}{WB-CI_{y+11}}\right)\right\}\right] \right\| \; for\ y = Jan\ 2008, \ldots, Nov\ 2011 \quad (7')$$

Table 5. Final set of variables used to construct the WB-CI.

Components of the WB-CI	Weight (%)
Net Exports of Goods without energy products /1	0.4
Taxes on real-estate	0.7
Tourist arrivals	3.4
Non-resident private sector deposits	3.7
Tobacco Excise	6.1
Cleared checks	6.2
Cement Deliveries	6.3
VAT revenues	13.0
Lending to the private sector	13.9
Primary spending	14.7
Administrative fees and charges	15.0
M3	16.6
Total	**100.0**

Source: Own calculations.
/1 Net Exports of Goods without energy products = Exports - Imports (excluding energy)

Table 6. Final set of variables used to construct the WB-LI.

Components of the WB-LI	Weights (%)
EMBIG spread	0.09
Custom Revenues	0.47
Spread between local and Libor interest rate	5.05
Capital expenditures	5.26
Lending to the Private Sector	10.85
Airport Arrivals	15.46
Cement Deliveries	15.66
Freight Incoming at the Port of Beirut	22.41
Personnel Cost	24.75
Total	**100.00**

Source: Own calculations.

The adjustment in the methodology and the ensuing calibration generates the final data set (Table 6) used for the construction of the WB-LI, which consists of monthly observations for 9 variables (real, external, monetary and fiscal) from December 2006 to October 2012 (61 observations).

4. Results of the WB-CI and the WB-LI

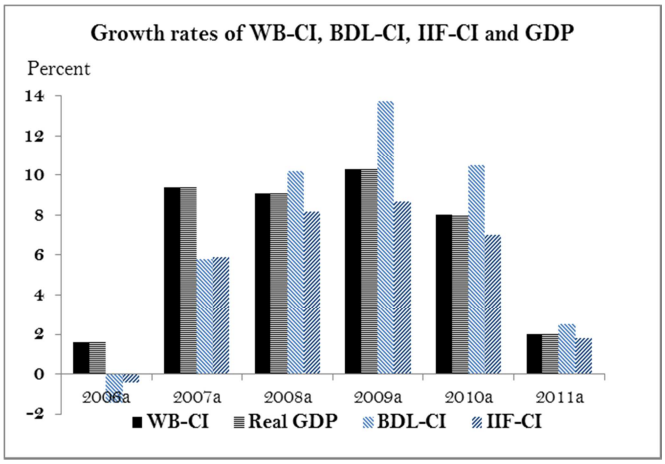
We find that the designed WB-CI measures the economic activity in Lebanon very accurately.[15] The criteria used to assess the effectiveness of the WB-CI in predicting Lebanese economic activity involves calculating *the absolute value of the error* between the yearly growth rate of the WB-CI and the actual (realized) annual GDP growth rate. *When this error tends, on average, to 0 and its standard deviation converges to 0 this implies that the WB-CI reflects accurately the dynamics of the Lebanese real economy.* Indeed, our results indicate that the average error and the standard deviation between 2006 and 2011 were both equal to 0.0 percent. This compares favorably to both the BdL and the IIF coincident indicators. For the BdL-CI *(IIF-CI)*, the average growth rate was 2.37(*1.53*) percent and the standard deviation was 1.29(*1.14*) percent during the same period (Table 7 and Figure 2).

Table 7. Error between GDP growth and each of WB-CI, BDL-CI and IIF-CI.

	WB-CI Growth (%)	BDL-CI Growth (%)	IIF-CI Growth (%)	GDP Growth (%)	Absolute value of error between WB-CI Growth and GDP Growth (%)	Absolute value of error between BDL-CI Growth and GDP Growth (%)	Absolute value of error between IIF-CI Growth and GDP Growth (%)
2006	1.6	-1.4	-0.4	1.6	0.0	3.0	2.0
2007	9.4	5.8	5.9	9.4	0.0	3.6	3.5
2008	9.1	10.2	8.2	9.1	0.0	1.1	0.9
2009	10.3	13.8	8.7	10.3	0.0	3.5	1.6
2010	8.0	10.5	7.0	8.0	0.0	2.5	1.0
2011	2.0	2.5	1.8	2.0	0.0	0.5	0.2
Memorandum items:							
Average of Error (2006-2011)					0.00	2.37	1.53
Standard deviation of Error (2006-2011)					0.00	1.29	1.14
Correlation Coefficient					1.00	0.88	0.96

Source: Lebanese authorities and own calculations.

Figure 2. Growth rate of the WB-CI is equal to the GDP growth.



Source: Lebanese authorities and own calculations.

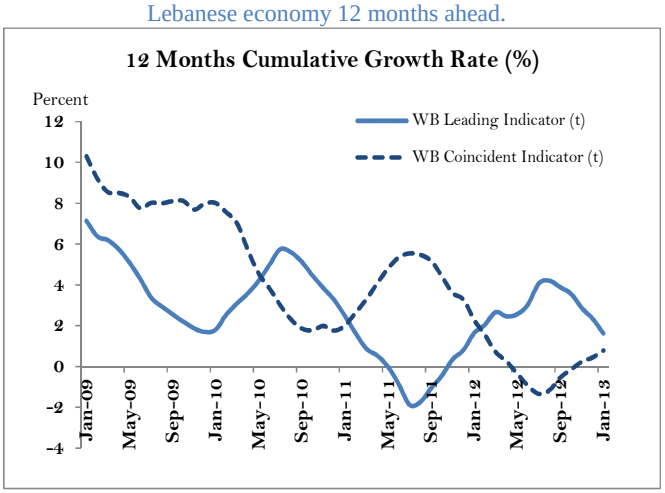
The one-year ahead forecasting performance of the constructed WB-LI[16] is encouraging. The yearly average growth rate of the WB-LI leads the yearly growth rate of the WB-CI by a year (Figure 3). Furthermore, the yearly growth rate of the leading indicator at time $t - 12$ follows almost the same pattern as the yearly growth rate of the WB-CI at time t, indicating that the WB-LI should be a useful forecasting tool (Figure 4). In fact, between December 2008 and December 2012, the average error

[15] The WB-CI series is available in Table 9 of Appendix 1.

[16] The components of the WB-LI with their respective weights are presented in Table 6.

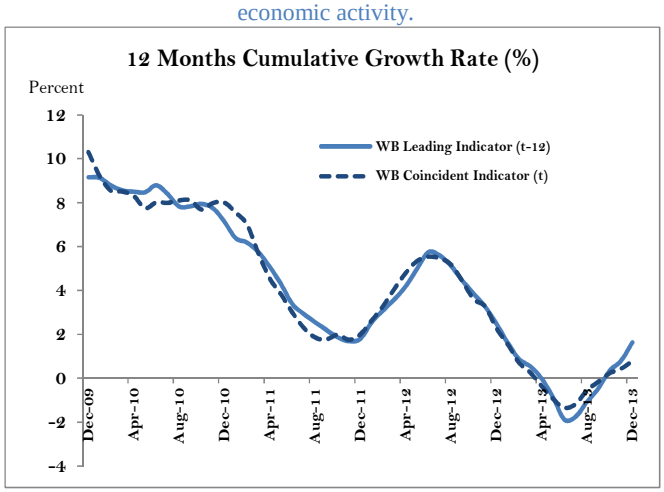
between the yearly growth rate of the WB-LI at time $t - 12$ and the yearly growth rate of the WB-CI at time t was only 0.37 percent, while the standard deviation of this error was 0.28 percent.

Figure 3. Using the WB-LI, we can detect the turning points in the Lebanese economy 12 months ahead.



Source: Own calculations.

Figure 4. The WB-LI is an accurate forecast tool for the Lebanese economic activity.



Source: Own calculations.

To illustrate the importance of having timely and accurate economic data, it is instructive to look at the monetary policy implications of the (new) WB-CI versus that of the existing BdL-CI. As detailed below, the latest reading from the BdL-CI points to an acceleration in economic activity in Lebanon. The WB-CI, however, is showing an economy that is decelerating. The growth rate of the BdL-CI increased from 0.3 percent during 2012 to 3.2 percent during 2013, suggesting that the Lebanese economy grew at faster rate in 2013. On the contrary, the WB-CI showed that the economy grew by only 0.8 percent (yoy) during 2013 compared to 2.2 percent during 2012, reflecting a deceleration in economic activity. A sustained period with such diverging trends would result in sharply different monetary policy decisions.

5. Some Policy Implications

Using the WB-CI decomposition, we can examine the impact of unexpected changes in macroeconomic variables on economic growth. We employ a Vector Autoregressive (VAR) model to examine the relationship between the variables forming the World Bank coincident indicator and real GDP growth as proxied for using the growth rate of the WB-CI. A necessary condition for VAR models to be econometrically valid is the stationarity of the variables. When used in log differences the variables WB-CI, tobacco excise (TE), cement deliveries (CD), VAT revenues (VAT), tourist arrivals (TA), taxes on real estate (TR), money supply (M3), primary spending (PS), cleared checks (CC) and administrative fees and charges (AC), are found to be stationary at the 10 percent level (Table 11) .[17] Let $\Delta\mathrm{WB}-\mathrm{CI}_t$ and $\Delta\mathrm{y}_{k;t}$ denote the one period growth rates of the WB-CI and variable k[18] at time (or month) $t = Dec - 2004, \dots, Oct - 2013$ respectively. The k VAR models are given by:

$$X_{t,k} = c + \beta_{1,k}X_{t-1,k} + \cdots + \beta_{L_k,k}X_{t-L_k,k} + \varepsilon_{t,k}\ ;\ ;\ t = Dec - 2004, \dots, Oct\ 2013 \quad (8)$$

where $\mathrm{X_{t,k}} = [\Delta\mathrm{WB}-\mathrm{CI_t}, \Delta\mathrm{y_{k;t}}]$ is the vector of endogenous variables and $\varepsilon_{\mathrm{t,k}}$ denotes the error vector of the k VAR models. In addition, L_k denotes the optimal lag length of each k VAR model as determined using the Akaike Information Criterion (AIC).

We proceed to generate, the *Impulse Response Functions* (IRFs) for the k VAR models. The results of the IRFs trace the response of real economic activity (proxied for by the WB-CI) to one standard deviation shocks in each variable k over a 24 months period. The IRFs presented in Figure 6 illustrate positive and significant responses for WB-CI to shocks in M3, TA, TE, CC, CD, AC and VAT.[19] In addition, we generate the *Forecast Error Variance Decomposition (FEVD)* to show the relative importance of the (statistically significant) shocks to the variation of the WB-CI. The FEVD analysis

[17] Stationarity tests are undertaken using the Augmented Dickey-Fuller test. Lending to the private sector and non-resident private sector deposits and Net exports (without energy) did not turn out to be stationary at the 10 percent level, hence we did not used them in the VAR. For more details check Table 11.

[18] k represents one of the following stationary variables: Tobacco Excise, Cement Deliveries, VAT Revenues, Tourist Arrivals, Taxes on Real Estate, M3, Primary Spending, Cleared Checks and Administrative Fees and Charges

[19] The response of WB-CI to a positive shock on primary spending and taxes on real estate is not statistically significant.

illustrated in Figure 7 reveal that all the k'[20] variables explain a large part of the variation in real economic activity in the short and long run.

In order to examine causality between the k' variables and the real economic activity, we apply the *Granger Causality* tests[21] to the k' VAR models of equation (8).The results obtained from the Granger causality tests (Table 12) show that there is a bi-directional Granger causality between WB-CI and each of tobacco excise, cleared checks, cement deliveries, administrative fees and charges and VAT revenues over current real economy. On the other hand, there is a uni-directional causality from with WB-CI Granger causing M3.

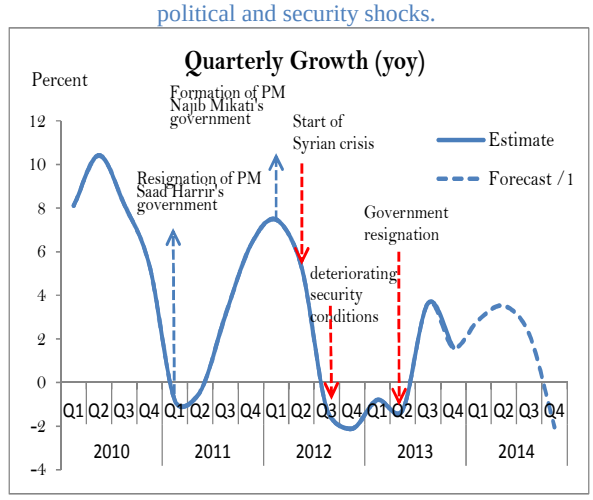
Finally, and based on the significant IRFs and the Granger causality tests, the economy would be expected to grow by 0.03, 0.2, 0.21, 0.21 and 0.32 percentage points next year if we observe a one percentage point increase in cement deliveries, cleared checks, tobacco excise, administrative fees and charges and VAT revenues respectively this year (Table 8).

Table 8. Impact of one percentage point shock of certain variables on the WB-CI growth rate.

	Value in 2012 (LL bln)	1 pp shock in Dec 2012 (LL bln)	Change in WB-CI Growth (%)	
			2013	2014
CD	5,299	53	0.03	-0.01
VAT	2,434	24	0.32	0.02
CC	79,159	792	0.15	0.00
TE	382	4	0.21	0.02
AC	434	4	0.21	-0.01

Source: Own calculations.

Figure 5. Economic activity is volatile and subject to political and security shocks.



Source: Own calculations
1/ Forecast based on the WB-LI

[20] k' includes all the k variables excluding TR and PS given that the IRFs of these two variables on WB-CI are not statistically significant.

[21] According to this approach, variable x_t is said to Granger causes y_t ($x_t \longrightarrow y_t$) "if we are better able to predict x_t, using all available information than if the information apart from y_t had been used" (Granger, 1969).

6. Caveats and Limitations

While the newly developed indicators reveal promising statistical properties in terms of estimating and forecasting real economic activity in Lebanon, analysts and policy makers should be aware of the following limitations of the model when interpreting the results:

- First, not all the sectors of the economy were adequately represented in the pool of potential variables due to data limitations. Most notably, good proxy variables were not available to accurately account for the agriculture and industry sectors, which combined accounted for 18.6 percent of GDP in 2011.
- Second, due to data limitations we deflated all the monetary variables into real terms using the CRI consumer price index that only account for the price dynamics in the greater capital area (greater Beirut). However, the Central Administration of Statistics (CAS) has recently (March, 2014) rebased Lebanon's inflation data to December 2013 and now provides (i) a much more comprehensive breakdown of prices (prices for rent are now collected on a monthly basis) and (ii) an updated weighting scheme to the inflation basket. As a result, this improved CAS CPI series could be preferable to the one currently used, once the old (2007) CPI index is rebased to the new (2014) index in order to have a continuous and comparable CPI series.
- Third, the lag period of the WB-CI and the WB-LI appeared to be larger (4-5 months) than initially expected due to the infrequent and lagged release of the fiscal data from the ministry of finance.
- Fourth, economic activity in Lebanon is highly volatile and subject to frequent exogenous shocks of political and security nature (Figure 5). However, this volatility is not captured by the WB-LI as it is hard to predict sudden changes in the political and/or security conditions. As a result, analysts should take into account any recent political developments rather than interpreting the results mechanically.
- Fifth and most importantly, the yearly growth rate of the newly constructed indicators were only tested against six actual GDP growth observations (2006-2011) because longer time series were not available. As a result, some non-negligible margin of error is expected to remain in the estimates and results. In order, to improve the efficiency of the estimates, the model will be recalibrated whenever new national accounts data are published by CAS.

7. Conclusion

This paper presents a new coincident indicator (WB-CI) and a 12-months leading indicator (WB-LI) for the Lebanese economy. These indicators, which can be used as monthly proxies for the evolution of real GDP, were constructed using a new methodology based on the NBER-CB approach. Notwithstanding the relatively small sample period, the results reveal promising statistical properties that should make these new indications valuable coincident and leading (one-year ahead) indicators for monitoring the Lebanese economy. However, given limitations on the length of time series in Lebanon, the accuracy and reliability of these indicators in tracking the business cycle of the Lebanese economy is expected to improve over time as more data points become available. To take into account the statistical value of these new data points, both indicators will be re-estimated periodically. It is therefore likely that the composition of the WB-CI and the WB-LI will change in the coming years and become more stable as actual GDP series from national authorities are published. Furthermore, and rather than analyzing the results of these indicators mechanically, analysts should incorporate into their assessment of economic activity historical, political and cultural factors that do not easily lend themselves to quantification. Finally, this new approach of adding a minimization problem to the original NEBR-CB methodology may provide a useful roadmap to analyze business cycles in countries that have weak economic statistics.

References

Anguyo. F (2011) "A Model to Estimate a Composite Indicator of Economic Activity (CIEA) for Uganda", Research Department , Bank of Uganda.

Burns. A, Mitchell. W (1946) "Measuring business cycles", NBER Studies in Business Cycles No. 2, New York.

Conference Board (2014) "Calculating the Composite Indexes", http://www.conference-board.org/data/bci/index.cfm?id=2154.

February (2012) "2011 Article IV Consultation", International Monetary Fund.

Granger C. J. (1969) "Investigating Causal Relationships by Econometrics Models and Cross Spectral Methods" Econometrica, Vol. 37, 1969, pp. 425-435.

Iradian. G, Zouk. N (2010) "Lebanon: New Estimates Reveal Exceptional Growth", Institute of International Finance, Washington DC.

Issler. J, Notini. H, Rodriguez. C, Soares. A, (2013) "Constructing Coincident Indices of Economic Activity for the Latin American Economy", Revista Brasileira de Economia.

July 2013, "Lebanese 2004-2011 National Accounts", Central Administration of Statistics.

Klucik. M, Haluska. Jan, (2008) "Construction of Composite Leading Indicator for the Slovak Economy", Alexandru Ioan Cuza University, Faculty of Economics and Business Administration.

Koopmans. C, (1947) "Measurement without theory", Review of Economics and Statistics 29, 161–179.

Marcellino. M (2005) "Leading Indicators", Centre for Economic Policy Research, Discussion Paper No. 4977.

Moore. G, Shiskin, J. (1967) "Indicators of Business Expansion and Contractions", NBER Occasional paper no 103.

Pereira. E (2012) "A Quarterly Coincident Indicator for the Cape Verdean Economy", Banco de Cabo Verde.

Saadi-Sedik. T and Mongardini. J (2003) "Estimating Indexes of Coincident and Leading Indicators: An application to Jordan", IMF, Working Paper No. 03/170, Washington DC.

Stock, J. H., & Watson, M. W. (1989) "New Indexes of Coincident and Leading Economic Indicators", Cambridge, Massachuseets: NBER Maroeconomic Annual Report, pp. 351-394.

Annex 1. Monthly data of World Bank Coincident and Leading Indicator of Lebanon

Table 9. World Bank Coincident Indicator for Lebanon /1

WB-CI					
Jan-05	98.1	Jan-08	112.8	Jan-11	141.7
Feb-05	93.7	Feb-08	116.1	Feb-11	141.8
Mar-05	93.6	Mar-08	115.5	Mar-11	142.2
Apr-05	95.2	Apr-08	115.2	Apr-11	144.4
May-05	97.0	May-08	116.1	May-11	144.6
Jun-05	101.4	Jun-08	121.6	Jun-11	147.8
Jul-05	103.0	Jul-08	122.6	Jul-11	149.0
Aug-05	104.6	Aug-08	126.1	Aug-11	147.4
Sep-05	107.2	Sep-08	124.1	Sep-11	152.3
Oct-05	101.7	Oct-08	125.8	Oct-11	153.2
Nov-05	100.8	Nov-08	130.1	Nov-11	148.7
Dec-05	104.4	Dec-08	130.6	Dec-11	156.0
Jan-06	103.6	Jan-09	134.1	Jan-12	152.2
Feb-06	108.7	Feb-09	133.0	Feb-12	153.0
Mar-06	110.4	Mar-09	130.3	Mar-12	150.9
Apr-06	114.0	Apr-09	131.6	Apr-12	153.9
May-06	114.8	May-09	133.9	May-12	153.2
Jun-06	109.8	Jun-09	131.5	Jun-12	152.5
Jul-06	77.0	Jul-09	134.8	Jul-12	149.3
Aug-06	78.7	Aug-09	134.1	Aug-12	145.4
Sep-06	99.3	Sep-09	133.2	Sep-12	148.4
Oct-06	97.1	Oct-09	137.5	Oct-12	148.7
Nov-06	108.6	Nov-09	134.2	Nov-12	149.1
Dec-06	106.5	Dec-09	137.2	Dec-12	150.2
Jan-07	105.3	Jan-10	141.4	Jan-13	150.6
Feb-07	110.4	Feb-10	141.6	Feb-13	150.1
Mar-07	111.1	Mar-10	146.5	Mar-13	152.2
Apr-07	110.8	Apr-10	147.0	Apr-13	152.6
May-07	111.9	May-10	144.9	May-13	151.4
Jun-07	110.5	Jun-10	146.1	Jun-13	150.1
Jul-07	111.1	Jul-10	147.5	Jul-13	152.9
Aug-07	112.9	Aug-10	144.3	Aug-13	154.5
Sep-07	113.3	Sep-10	143.1	Sep-13	151.3
Oct-07	110.2	Oct-10	143.4	Oct-13	151.5
Nov-07	113.9	Nov-10	143.4	Nov-13	153.3
Dec-07	112.4	Dec-10	144.3	Dec-13	150.3

Source: Own calculations.
/1 December 2004 is the base year.

Table 10. World Bank Leading Indicator for Lebanon /1

WB-LI			
Jan-07	101.7	Jan-11	129.9
Feb-07	106.2	Feb-11	128.5
Mar-07	105.5	Mar-11	127.2
Apr-07	104.5	Apr-11	128.3
May-07	104.8	May-11	129.9
Jun-07	106.6	Jun-11	129.5
Jul-07	101.7	Jul-11	125.4
Aug-07	98.7	Aug-11	122.1
Sep-07	100.9	Sep-11	124.1
Oct-07	104.6	Oct-11	123.3
Nov-07	103.7	Nov-11	127.3
Dec-07	107.6	Dec-11	124.8
Jan-08	110.5	Jan-12	127.8
Feb-08	114.0	Feb-12	126.6
Mar-08	113.8	Mar-12	129.7
Apr-08	112.8	Apr-12	128.0
May-08	113.4	May-12	126.4
Jun-08	112.5	Jun-12	122.7
Jul-08	114.2	Jul-12	127.8
Aug-08	112.9	Aug-12	129.5
Sep-08	110.6	Sep-12	129.9
Oct-08	112.0	Oct-12	132.2
Nov-08	114.0	Nov-12	132.4
Dec-08	119.5	Dec-12	132.1
Jan-09	119.8	Jan-13	132.0
Feb-09	118.0	Feb-13	134.0
Mar-09	119.7	Mar-13	129.3
Apr-09	121.1	Apr-13	129.2
May-09	122.4	May-13	130.3
Jun-09	122.8	Jun-13	131.0
Jul-09	122.7	Jul-13	132.5
Aug-09	121.4	Aug-13	132.5
Sep-09	121.3	Sep-13	130.5
Oct-09	121.5	Oct-13	129.5
Nov-09	122.7	Nov-13	128.2
Dec-09	123.9	Dec-13	127.1
Jan-10	119.4		
Feb-10	119.3		
Mar-10	119.9		
Apr-10	120.4		
May-10	120.5		
Jun-10	120.7		
Jul-10	125.1		
Aug-10	125.0		
Sep-10	127.6		
Oct-10	126.7		
Nov-10	129.3		
Dec-10	130.2		

Source: Own calculations.
/1 December 2006 is the base year.

Annex 2. Unit Root Tests

The following table (Table 11) presents the results of the Augmented Dickey-Fuller tests performed on the log differences of the WB-CI and the corresponding twelve variables forming it.

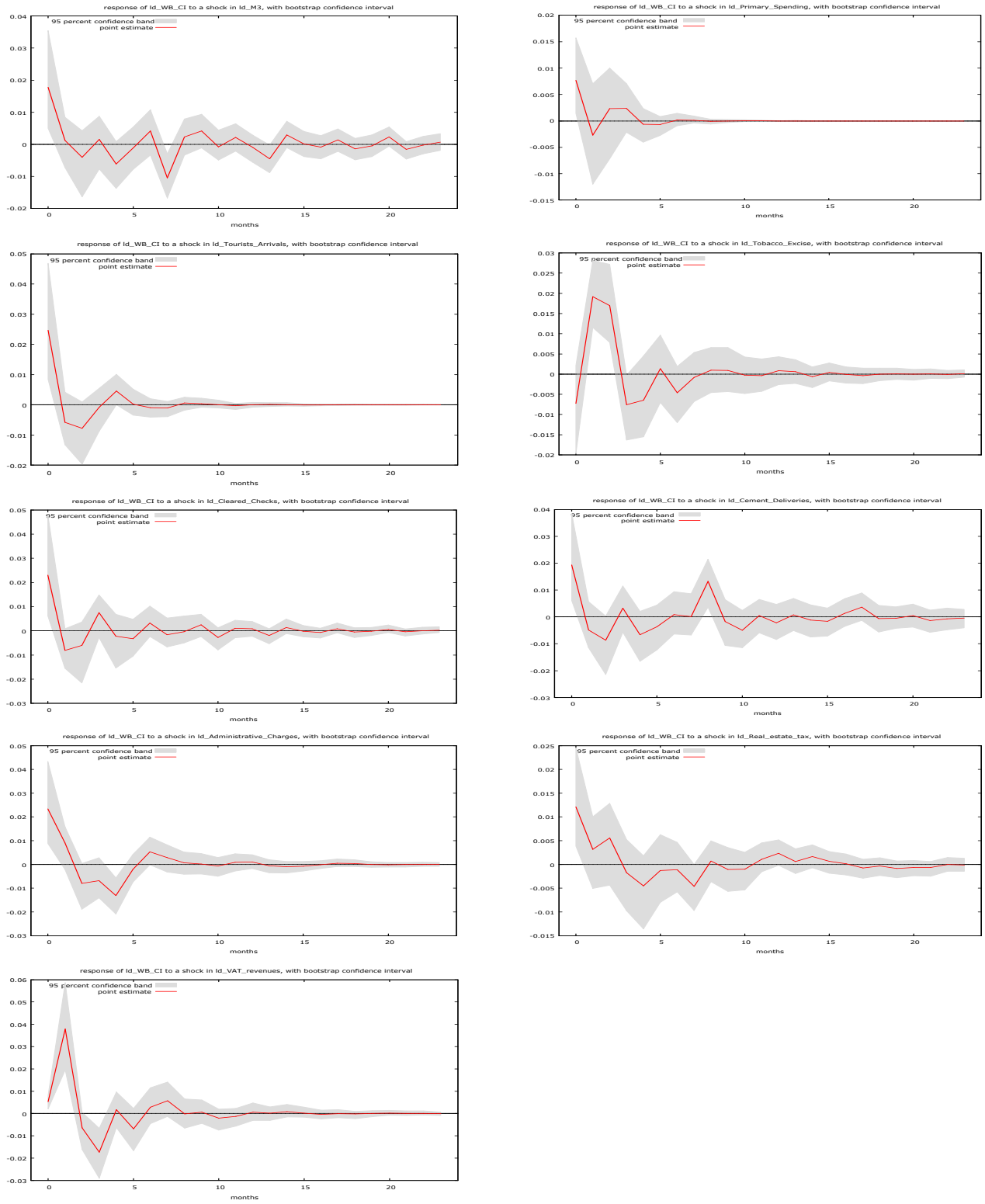
Table 11. Unit Root Test Results

Variable	ADF- Test (p-value) /1
ld_WB_CI	1.055e-017 ***
ld_Tobacco_Excise	2.7e-005 ***
ld_Cement_Deliveries	1.835e-023***
ld_VAT_revenues	6.573e-014 ***
ld_Tourists_Arrivals	1.068e-017***
ld_Real_estate_tax	9.575e-005***
ld_M3	0.07188*
ld_Lending_private	0.1726
ld_Administrative_Charges	5.18e-009***
ld_non-resid Deposits	0.1283
ld_Primary_Spending	0.009343***
ld_Cleared_Checks	2.29e-016***

Source: Own calculations
/1 Null: variable has unit root.
* indicates that the null hypothesis of a unit root is rejected at the 10 percent significance level.
** indicate that the null hypothesis of a unit root is rejected at the 5 percent significance level.
*** Indicate that the null hypothesis of a unit root is rejected at the 1 percent significance level.

Annex 3. Impulse Response Functions

Figure 6. Impulse response functions of WB-CI to each k variable

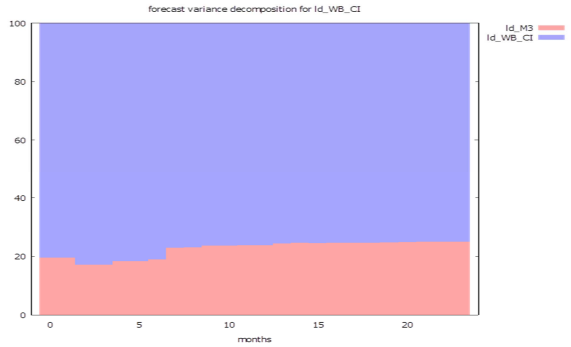


Source: Own calculations

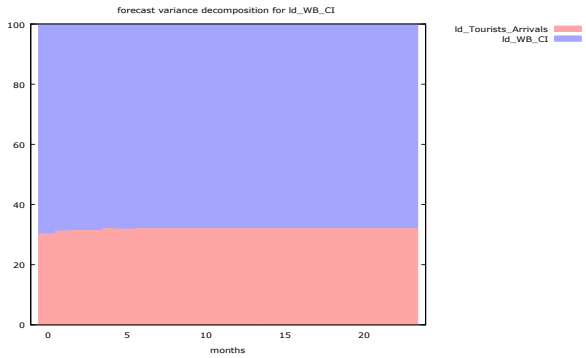
Annex 4. Contribution to WB-CI Variance Decomposition.

Figure 7. Contribution of a shock in variable k' on the variance decomposition of WB-CI growth rate (%)

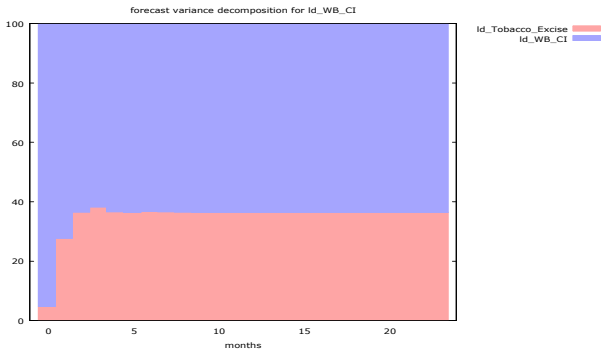
Contribution of M3 to the variance of WB-CI



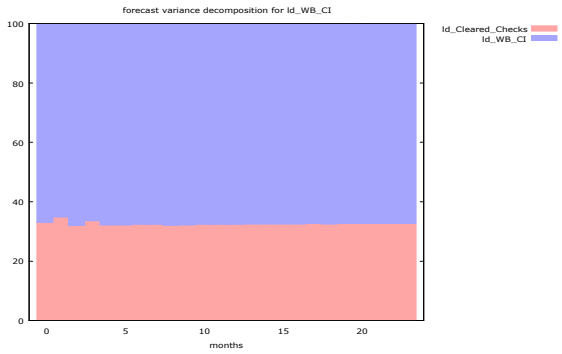
Contribution of TA to the variance of WB-CI



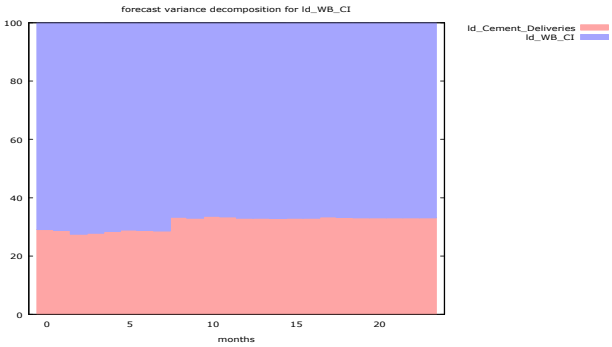
Contribution of TE to the variance of WB-CI



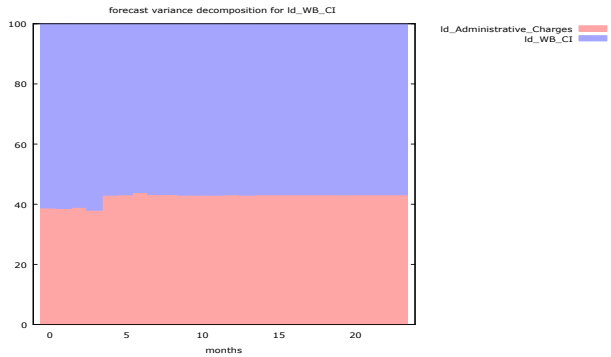
Contribution of CC to the variance of WB-CI



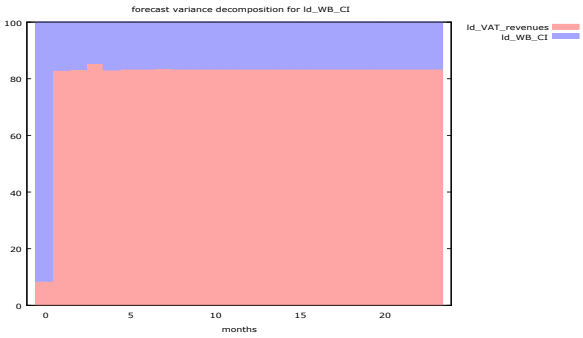
Contribution of CD to the variance of WB-CI



Contribution of AC to the variance of WB-CI



Contribution of VAT to the variance of WB-CI



Source: Own calculations

Annex 5. Causality between variables and real economic activity

Table 12. Granger Causality Test Results

Hypothesis /1	P-value	No. of Lags /2
M3 and WB-CI:		
M3 Granger causes WB-CI	0.1277	7
WB-CI Granger causes M3	0.0006***	7
TA and WB-CI:		
TA Granger causes WB-CI	0.246	3
WB-CI Granger causes TA	0.0000***	3
TE and WB-CI:		
TE Granger causes WB-CI	0.0000***	5
WB-CI Granger causes TE	0.0000***	5
CC and WB-CI:		
CC Granger causes WB-CI	0.015**	5
WB-CI Granger causes CC	0.0000***	5
CD and WB-CI:		
CD Granger causes WB-CI	0.0003***	8
WB-CI Granger causes CD	0.0000***	8
AC and WB-CI:		
AC Granger causes WB-CI	0.0000***	4
WB-CI Granger causes AC	0.0326**	4
VAT and WB-CI:		
VAT Granger causes WB-CI	0.0000***	4
WB-CI Granger causes VAT	0.0000***	4

Source: Own calculations

** indicate that the null hypothesis of no granger causality is rejected at the 5 percent significance level.

*** indicate that the null hypothesis of no granger causality is rejected at the 1 percent significance level.

/1 Null: No Granger Causality.

/2 The number of lags (months) is determined using the Akaike Information Criterion (AIC).