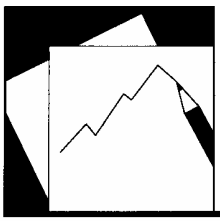
# Working Paper

INTERNATIONAL MONETARY FUND

WP/03/170



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# Estimating Indexes of Coincident and Leading Indicators: An Application to Jordan

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**IMF Working Paper**

Middle Eastern Department

# Estimating Indexes of Coincident and Leading Indicators: An Application to Jordan

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Authorized for distribution by Ahsan H. Mansur

August 2003

## Abstract



The analysis of coincident and leading indicators can help policymakers gauge the short-term direction of economic activity. While such analysis is well established in advanced economies, it has received relatively little attention in many emerging market and developing economies, reflecting in part the lack of sufficient historical data to determine the reliability of these indicators. This paper presents an econometric approach to deriving composite indexes of coincident and leading indicators for a small open economy, Jordan. The results show that, even with limited monthly observations, it is possible to establish meaningful economic and statistically significant relations between indicators from different sectors of the economy and the present and future direction of economic activity.

JEL Classification Numbers: E32, E37, F47

Keywords: Jordan; coincident indicators; leading indicators; economic activity

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[1] The authors are grateful to Mohammad Abu-Hammour, David Burton, Robert Flood, Ghassan Ifram, Ahsan Mansur, Udo Kock, Martin Petri, and Todd Schneider for helpful comments on earlier drafts. Natalie Baumer provided useful editorial comments. The usual disclaimers apply.

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## I. Introduction

A timely understanding of the direction of economic activity is essential for the formulation of macroeconomic policies. An unexpected weakening of output growth, for example, may suggest a need for relaxing macroeconomic policies to avoid an unduly contractionary stance. By the same token, an improvement in economic performance, especially following a recession, may justify a withdrawal of a policy-induced stimulus. Often, however, the relevant statistics to judge the direction of economic activity are only available with a considerable lag, delaying the appropriate policy response. This is particularly true in emerging markets where lags in the publication of relevant statistical data are longer on average than in advanced economies, and alternative sources for gauging economic activity (e.g., confidence indicators) are usually lacking.

Composite indexes of coincident and leading indicators of economic activity were first developed to respond to policymakers' needs for a reliable indication of economic activity in advance of the release of the relevant statistical data. A coincident indicator can be broadly defined as a variable that is correlated with the current level of economic activity (i.e., real GDP); a leading indicator instead is correlated with future economic activity. First pioneered by Burns and Mitchell (1946) in the context of the U.S. economy, these indicators are now widely used in all advanced economies to determine the stage of business cycle activity. Their availability in emerging markets is limited, however, owing in part to the lack of sufficient historical data to determine the reliability of the indicators.

This paper presents an estimation of coincident and leading indicators for Jordan, an emerging market economy where the statistical database is relatively comprehensive and sufficient observations are available to determine the reliability of the estimated indicators. While the case of Jordan is interesting as such, the paper is meant to provide a possible road map for the estimation of these indicators for other emerging markets as well. It is structured as follows. Section II discusses the literature on coincident and leading indicators and its implementation at the National Bureau of Economic Research (NBER) in Cambridge, Massachusetts for the United States, and the Organization for Economic Cooperation and Development (OECD) in Paris for other advanced economies. A description of Jordan's economic developments during the 1990s follows in Section III, together with a description of the available data. The estimation of a composite index of coincident indicators is then presented in Section IV, while Section V describes the estimation of a composite index of leading indicators. Section VI presents the conclusions.

## II. Literature on Coincident and Leading Indicators

The NBER first developed an approach to monitor economic variables that are sensitive to cyclical change in the 1930s. A research team at the NBER led by Burns and Mitchell studied a group of economic variables to see if fluctuations in those variables persistently led, coincided with, or lagged turning points in U.S. business cycles. Burns and Mitchell (1946) defined business cycles as follows:

> *Business cycles are types of fluctuations found in the aggregate economic activity of nations that organize their work mainly in business enterprises: a cycle consists of expansion 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; this sequence of changes is recurrent but not periodic...*(Burns and Mitchell, 1946, p. 3.)

In later research conducted in the 1950s and 1960s, NBER researchers combined the best series into composite indexes of leading, coincident, and lagging economic indicators. Moore and Shiskin (1967) first developed and applied a formal weighting scheme by scoring variables in terms of their economic significance, statistical adequacy, cyclical timing and business cycle conformity. The choice of variables and the weights associated with them, however, was purely subjective and did not involve a formal econometric analysis. In the early 1960s, the U.S. Department of Commerce took over the production of the composite indexes and in December 1995 ceded responsibility to the Conference Board (CB) in New York City.[2]

The popularity of the U.S. leading and coincident indexes has also spurred the development of similar indexes for other advanced economies. The OECD started publishing leading indicators in 1987 and now publishes such indexes on a monthly basis for all member countries and for six aggregate geographical zones. The NBER-CB and the OECD methods are very similar. Both methods are based on the analysis of turning points, namely the analysis of expansions (i.e., peaks) and recessions (i.e., troughs). The main difference is that the NBER-CB does not rely on trend adjustments, whereas the OECD method estimates long-term trends using a modified version of the Phase Average Trend method (PAT) first developed by the NBER (see Appendix II for a discussion on detrending). The difference between the two methods reflects a more fundamental difference in the definition of the business cycle.

Despite their popularity, two complaints that were originally directed at the analysis of Burns and Mitchell (Koopmans, 1947) continue to haunt the literature on leading and coincident indicators. First, little attention is paid to economic theory in determining the relationship between these indicators and economic activity (e.g., measurement without theory). Second, the methodology is not considered scientific, in so far as it relies on a subjective analysis rather than an econometric approach.

In response to these criticisms, Stock and Watson (1989) first introduced econometric analysis to derive new indexes of coincident and leading indicators for the United States. They first defined the composite index of coincident indicators as a single unobserved variable, "the state of the economy." They then estimated the index using dynamic factor analysis, where the parameters of the index are determined by maximum likelihood estimation. On the basis of this analysis, they derive a composite index of leading indicators

[2] Appendix I presents the variables currently used by the Conference Board to compile leading, coincident, and lagging indexes of economic activity in the United States.

by building a forecast of the index of coincident indicators using a vector autoregressive model. The authors chose seven leading indicators for the model after a search of over 250 candidate series. Despite the more sophisticated statistical procedure, the Stock and Watson indexes failed to predict the 1991 recession in the United States. In addition, the connection between movements in the individual indicators and the composite indexes are not easy to compute or explain, given the choice of a dynamic factor model.

### Coincident and Leading Indicators in Emerging Markets

Studies of coincident and leading indicators mostly relate to advanced economies. Only a few attempts have been made to apply the same methodology to emerging markets.[3] At least three factors may account for this. First, the predominance of agriculture in emerging markets makes the business cycle more dependent on weather than cyclical fluctuations in the production process (Mall, 1999). Second, limitations of the quality and frequency of data are often constraining factors. Third, emerging markets tend to be prone to sudden crises and market gyrations in macroeconomic variables, often making it difficult to discern any type of cycle or economic regularity (Agenor, McDermott, and Prasad, 2000). However, increasing examples in the literature have begun to analyze the stylized facts of business cycles for emerging markets and constructing coincident and leading indicators. The main contributions are Pallage and Robe (1998), Agenor, McDermott, and Prasad (2000), and Rand and Tarp (2001). These studies find that business cycles in emerging markets are different from those of industrial countries: the average duration of business cycles is shorter than in the industrial countries and the speed from peak to trough and vice versa is faster (Rand and Tarp, 2001). A few papers attempt to estimate coincident and leading indicators for specific countries: Mall (1999) studied the cyclical behavior of the Indian economy and proposed a composite index of leading indicators to forecast the cyclical movements in industrial production; and Simone (2000) estimates coincident and leading indicators for Argentina. Dua and Banerji (1999, 2001) construct coincident and leading indicators for India based on the NBER methodology. While these studies perform relatively well in the sample periods they consider, their methodology has not yet officially been adopted or tested to predict future business cycles. In the case of Jordan, the Economic Cycle Research Institute has been producing coincident and leading indicators for Jordan since 1998, but the results are not publicly available.[4]

## III. Jordan's Economic Performance Since the Late 1980s

Jordan is a low- to middle-income country with relatively few natural resources. In 2002, its per capita GDP averaged about $1,750, with over 70 percent of valued-added concentrated in the services sector, notably trade, tourism, and banking (Table 1). Manufacturing has

[3] The United Nations Economic and Social Committee for Asia and the Pacific (UNESCAP), in collaboration with the OECD and the Asian Development Bank, organized two workshops in 1999/2000 to encourage the use of leading indicators in emerging countries and harmonize their methodologies (http://www.unescap.org/stat/meet/libts/libts.htm).

[4] See http://www.businesscycle.com/data.php for further information.

traditionally concentrated in the mining of phosphates and potash, petroleum refining, and cement production, although light manufacturing—particularly textiles and apparel—have recently gained in importance. The economy is relatively open to international trade, with the tradable sector (defined here as exports plus imports of goods and nonfactor services) accounting for 106 percent of GDP in 2002. Jordan also receives a large amount of remittances from expatriates working in neighboring Arab countries.

In the late 1980s, Jordan faced a severe financial crisis, which, together with the Gulf war, forced the government to devalue the Jordanian dinar and reschedule its debts with bilateral and commercial creditors (Figure 1).[5] Large external imbalances and an increasingly unsustainable debt burden forced the Jordanian authorities in 1989 to devalue the Jordanian dinar (JD)—previously pegged to IMF Special Drawing Rights (SDRs) since 1973—by 21 percent in real effective terms. The financial collapse of the third largest bank in August 1989 and the onset of the Gulf war in 1990/91 further eroded market confidence. As a result, the economy contracted by 13 percent in real terms in 1989, and the JD lost another 10 percent of its value in real terms in 1990. By then, Jordan had become one of the most heavily indebted countries in the world, with external debt amounting to over 190 percent of GDP. As a result, the government of Jordan entered into negotiations to reschedule debt obligations to bilateral and commercial creditors that were completed in 1993/94.

The 1990s witnessed a process of macroeconomic adjustment and recovery from the financial crisis. Under a series of successive arrangements with the IMF, Jordan succeeded in reducing its external debt burden by more than half over a decade. External imbalances were reduced substantially, and the fiscal deficit was kept within the scope of available financing. Since October 1995, the Jordanian dinar was effectively pegged to the U.S. dollar. After a temporary boost in economic activity in the early 1990s, as a result of the forced repatriation of Jordanian workers from Kuwait, economic growth averaged 4 percent between 1993 and 1999. Inflation was quickly reduced to single digit levels by 1991 and averaged 3 percent thereafter. At the same time, structural reforms aimed at transforming Jordan into a dynamic market economy were implemented: a number of public enterprises were privatized, the trade regime was substantially liberalized, a system of generalized price subsidies was dismantled and replaced by direct income transfers to the poor, the civil service pension system was reformed, and financial supervision was strengthened.

The Jordanian dinar came again under speculative pressure in late 1998 and early 1999, as the uncertainty surrounding the deteriorating health of His Majesty King Hussein and his eventual death pushed investors to abandon the Jordanian dinar. The resulting drain on the international reserves of the Central Bank of Jordan (CBJ) encouraged the authorities to tighten policies and seek a new arrangement with the IMF. Interest rates were raised, fiscal policy was tightened, a currency crisis was averted, and confidence was restored with a relatively minor impact on economic activity. Economic growth has since been accelerating.

[5] For a detailed discussion of the financial crisis and its aftermath, see, for example, Maciejewski and Mansur (1996).

Table 1. Jordan: Selected Economic Indicators, 1993–2002

| | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | Prel. 2002 |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | (Annual percentage changes) | | | | | |
| Output and prices | | | | | | | | | | |
| Real GDP at market prices | 4.5 | 5.0 | 6.2 | 2.1 | 3.3 | 3.0 | 3.1 | 4.2 | 4.2 | 4.9 |
| GDP deflator at market prices | 2.8 | 6.9 | 1.9 | 2.1 | 1.2 | 6.0 | -0.2 | -0.1 | 0.0 | 0.5 |
| Nominal GDP at market prices | 7.4 | 12.2 | 8.2 | 4.2 | 4.6 | 9.2 | 2.8 | 4.1 | 4.3 | 5.3 |
| Consumer price index (annual average) | 3.3 | 3.6 | 2.3 | 6.5 | 3.0 | 3.1 | 0.6 | 0.7 | 1.8 | 1.8 |
| Consumer price index (end of period) | 1.6 | 5.1 | 4.1 | 2.6 | 6.3 | -0.8 | 2.8 | -1.9 | 3.8 | 0.5 |
| Nominal GDP at market prices (in millions of JD) | 3,925 | 4,401 | 4,774 | 4,982 | 5,138 | 5,610 | 5,767 | 6,002 | 6,260 | 6,594 |
| | | | | | (In percent of GDP) | | | | | |
| Inverstment and savings | | | | | | | | | | |
| Gross domestic investment | 36.6 | 33.3 | 33.0 | 30.5 | 25.7 | 21.8 | 21.6 | 22.1 | 22.4 | 23.0 |
| Government | 6.3 | 6.0 | 7.0 | 7.3 | 5.6 | 6.0 | 5.8 | 5.2 | 5.9 | 6.8 |
| Other | 30.4 | 27.3 | 25.9 | 23.2 | 20.1 | 15.8 | 15.9 | 16.9 | 16.5 | 16.3 |
| Gross national savings | 30.4 | 31.3 | 33.5 | 32.0 | 30.4 | 25.8 | 29.8 | 22.8 | 22.4 | 27.9 |
| Government | 5.7 | 4.6 | 3.1 | 4.4 | 3.1 | 0.1 | 2.2 | 0.5 | 2.2 | 1.7 |
| Other | 24.7 | 26.6 | 30.4 | 27.6 | 27.3 | 25.7 | 27.6 | 22.3 | 20.2 | 26.2 |
| Savings/investment balance | -11.5 | -6.4 | -3.8 | -3.2 | 0.4 | 0.3 | 5.0 | 0.7 | -0.1 | 4.9 |
| Government | -0.5 | -1.4 | -3.9 | -2.8 | -2.5 | -6.0 | -3.5 | -4.7 | -3.7 | -5.0 |
| Other | -10.9 | -5.0 | 0.1 | -0.4 | 2.9 | 6.2 | 8.5 | 5.4 | 3.6 | 10.0 |
| Fiscal operations | | | | | | | | | | |
| Revenue and grants | 34.8 | 32.6 | 34.4 | 33.6 | 31.5 | 30.4 | 31.0 | 30.0 | 30.8 | 30.5 |
| *Of which:* grants | 4.1 | 4.0 | 3.6 | 4.5 | 4.4 | 3.7 | 3.5 | 4.2 | 4.4 | 5.2 |
| Expenditure and net lending (incl. off-budget accounts) | 36.4 | 34.5 | 36.0 | 36.6 | 34.5 | 36.8 | 34.9 | 34.7 | 34.5 | 35.5 |
| Overall fiscal balance (after grants) | -0.5 | -1.4 | -3.9 | -2.8 | -2.5 | -6.0 | -3.5 | -4.7 | -3.7 | -5.0 |
| Government and government guaranteed debt 1/ | ... | ... | ... | ... | 94.3 | 104.5 | 111.3 | 99.7 | 97.8 | 101.4 |
| *Of which:* external | ... | ... | ... | ... | 89.2 | 89.3 | 95.5 | 84.0 | 79.4 | 81.2 |
| External sector | | | | | | | | | | |
| Current account balance (after grants) | -11.5 | -6.4 | -3.8 | -3.2 | 0.4 | 0.3 | 5.0 | 0.7 | -0.1 | 4.9 |
| | | | | | (Annual percentage changes in U.S. dollar terms) | | | | | |
| Domestic merchandise exports | 7.0 | 13.8 | 26.2 | 2.3 | 2.6 | -1.9 | 0.5 | 2.8 | 25.1 | 13.7 |
| Merchandise imports | -6.6 | -4.6 | 9.5 | 16.2 | -4.4 | -6.7 | -3.3 | 23.7 | 5.6 | 2.7 |
| | | | | | (Changes in percent of beginning of period broad money) | | | | | |
| Monetary sector | | | | | | | | | | |
| Net foreign assets | -1.7 | 2.8 | 2.5 | 0.4 | 8.1 | 1.9 | 10.4 | 12.6 | 1.8 | 5.4 |
| Broad money | 8.3 | 8.1 | 6.5 | 0.3 | 7.8 | 7.6 | 12.0 | 10.2 | 5.8 | 7.0 |
| Memorandum items: | | | | | | | | | | |
| Nominal per capita GDP (in U.S. dollars) | 1,404.1 | 1,506.7 | 1,568.6 | 1,559.0 | 1,575.3 | 1,663.8 | 1,660.1 | 1,679 | 1,703 | 1,746 |
| Gross usable international reserves (in U.S. dollar millions) 2/ 3/ | 595 | 411 | 407 | 678 | 1,673 | 1,149 | 1,970 | 2,742 | 2,565 | 3,474 |
| In months of prospective imports of GNFS 4/ | 1.9 | 1.2 | 1.1 | 1.8 | 4.6 | 3.3 | 4.8 | 6.4 | 6.1 | 7.5 |
| As percent of Jordanian dinar broad money | 10.6 | 6.8 | 6.6 | 11.1 | 25.0 | 16.9 | 25.6 | 33.2 | 30.1 | 38.1 |
| Net International Reserves (in millions of U.S. dollars) 2/ | 612 | 463 | 534 | 442 | 1,508 | 967 | 1,463 | 2,275 | 2,111 | 3,032 |
| U.S. dollar per Jordanian dinar (period average) | 1.44 | 1.43 | 1.43 | 1.41 | 1.41 | 1.41 | 1.41 | 1.41 | 1.41 | 1.41 |

Sources: Jordanian authorities; and IMF staff estimates and projections.

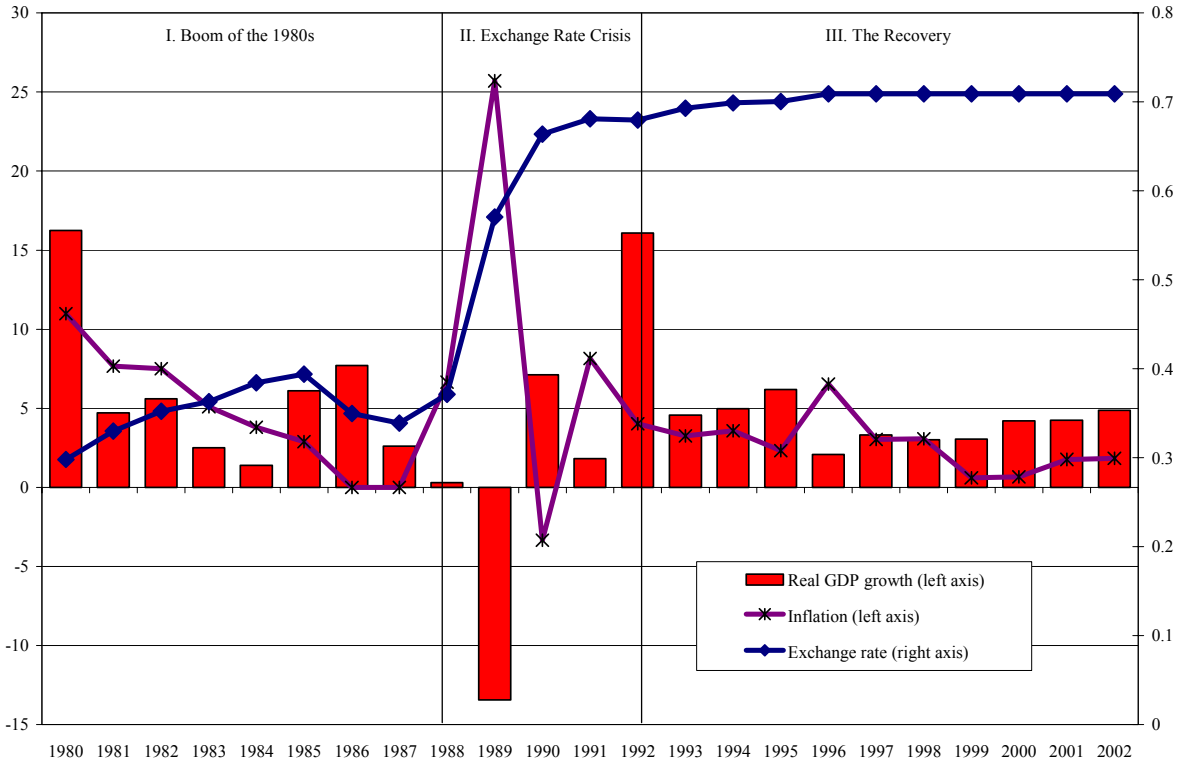
1/ Domestic debt is net of government deposits with the banking system, and external debt includes collateralized Brady bonds.

2/ Net of short-term foreign liabilities and excluding commercial banks' foreign currency deposits with the Central Bank of Jordan.

3/ Excludes pledged assets under the 1993 commercial debt rescheduling agreement and the yearly change in foreign currency swaps.

4/ Imports of goods and nonfactor services, excluding imports for re-export, in subsequent 12 months.

Figure 1. Economic Performance, 1980–2002




Source: IMF International Financial Statistics.

Notwithstanding the negative impact of the renewed Palestinian-Israeli conflict and the September 11, 2001 events, Jordan's economic growth accelerated to 4.2 percent in 2001 and 4.9 percent in 2002. This acceleration is mainly been driven by export growth, particularly to the United States. The surge in exports reflects accession to the WTO in 2000, duty- and quota-free access to U.S. markets, granted to specific Jordanian exports under the 1994 Peace Agreement with Israel,[6] and the 2001 Free Trade Agreement with the United States.

Overall, the business cycle in Jordan has been quite irregular. As shown in Figure 1, it has been dominated by the exchange rate crisis of the late 1980s, while the remainder of the period has been characterized by somewhat uneven growth. The pattern of regular booms and troughs typical of advanced economies cannot be discerned, as well as the amplitude and frequency of any cycle. However, periods of higher and slower growth seem to indicate some pattern of business cycle activity. This is in line with evidence from other emerging markets (Agenor, McDermott, and Prasad, 2000), where the business cycle is dominated by sudden macroeconomic crises, often making it difficult to discern any type of cycle or economic regularity.

[6] These exports require a minimum value added from both Israeli and Jordanian sources and are produced in so-called "Qualified Industrial Zones," that is, industrial parks with duty- and quota-free access to U.S. markets.

**Data Sample**

Jordan is a good candidate for the analysis of coincident and leading indicators. Despite being an emerging market, the economy is quite diversified and the financial sector is well developed. In addition, macroeconomic policy has been remarkably stable since the mid-1990s, and Jordan is not prone to the type of external shocks which are common to oil- or other commodity-producing countries. The Jordanian statistical database has also been substantially improved over the last decade.

The choice of the data sample for estimating composite indexes of coincident and leading indicators for Jordan is dictated by data availability and changes in the structure of the economy. The data sample analyzed in this paper comprises monthly observations of 40 variables from all sectors of the economy (namely real, fiscal, monetary, and external sectors) from January 1996 to December 2002 (84 observations).[7] Most of the variables prior to 1996 are only available on an annual or quarterly basis, thus unsuitable for the estimation of monthly composite indicators. In addition, the change in the exchange rate regime in October 1995 represents an additional obstacle in extending the sample further in the past, as the regime change affects the stability of the relationship between the variables considered. Exports and imports were deflated by their respective price indexes; all other nominal variables were deflated by the consumer price index.[8] Finally, the U.S. and Euro area producer price indexes and composite leading indicators, as estimated by the OECD, were included in the sample as potential coincident and leading indicators for Jordan, respectively. These variables represent the possible influence of the global business cycle on the Jordanian economy.

All variables were seasonally adjusted to take account of both the Gregorian calendar and Muslim holidays.[9] The U.S. Census Bureau X12 procedure was used for the seasonal adjustment of the variables according to the Gregorian calendar. The X12 procedure, however, leaves a residual seasonality in some of the variables associated with the two major Muslim holidays, the "Eid-ul-Fitr" corresponding to the end of Ramadan and the "Eid-ul-Adha," corresponding to the Day of Sacrifice. The Gregorian dates of these holidays shift

[7] See Appendix III for a list of the variables. The data were collected from various issues of the Monthly Statistical Bulletin of the Central Bank of Jordan and the Government Finance Bulletin of the Ministry of Finance of Jordan. For the price indexes of exports and imports, data were only available on a quarterly basis for 1996; the quarterly observations were therefore linearly interpolated for this period. Some earlier observations of some of the indexes were also rebased to conform to the base of later observations.

[8] The net usable reserves of the CBJ, denominated in U.S. dollars, were deflated by the U.S. CPI index.

[9] The Gregorian calendar is based on the revolution of the earth around the sun. The Gregorian year thus comprises 365¼ days, with 12 months averaging 30 days each. The Muslim calendar is based on motions of the moon with respect to the earth lasting 29.53 days. At 354.36 days, the Muslim year is therefore approximately 11 days shorter than the Gregorian year.

from year to year, as they follow the Muslim calendar based on a lunar year. Their effect is therefore not captured by the X12 procedure.

Following the approach of Alper and Aruoba (2001), two dummy variables were created to account for the Gregorian dates of the two major Muslim holidays. The following equation was then estimated for each X12-seasonally adjusted variable:[10]

$$V_t = \alpha + \beta_1 D_{Eid-ul-Fitr} + \beta_2 D_{Eid-ul-Adha} + U_t \quad (1)$$

The results of these regressions are summarized in Appendix IV. The results show that the coefficient for the Eid-ul-Fitr dummy is significant only for industrial production, construction activity, reserve money, real imports, and the trade balance. The coefficient on the second dummy variable for the Eil-ul-Adha holiday is insignificant for all variables. Based on these results, a further seasonal adjustment was made for those variables where the relevant coefficient was significant. Figure 2 presents the resulting seasonal adjustment for industrial production.

All seasonally adjusted variables were then tested in logarithmic form for nonstationarity using Phillips-Perron tests. As shown in Appendix V, the unit root hypothesis could not be rejected for some of the variables in logarithms; however, all variables in first differences (i.e., the growth rate) were found to be stationary. The regressions below are therefore expressed in first differences to avoid spurious correlations associated with non-stationary variables.

## IV. The Estimation of a Composite Index of Coincident Indicators

The first step in estimating a composite index of coincident economic indicators (CEI) is to determine a reference series for the state of the economy. In theory, real GDP would be best suited to represent the state of the economy, as it is the broadest statistical measure of economic activity. However, as in virtually all other countries, real GDP in Jordan is available only on a quarterly basis and with a substantial lag. One is therefore forced to fall back on the industrial production index as a reference series for the state of the economy, which is a common feature of the NBER and OECD methodologies and virtually all papers on this subject (see Mall, 1999). This choice is validated for Jordan by the positive correlation statistics (88 percent trended, 45 percent detrended) in the sample period between real GDP and the real index of production, but also by the fact that industrial production is the most volatile component of economic activity. A visual examination (see Figure 3) confirms the statistical similarities between the two series.

[10] All regressions in this paper were run using the Eviews 4.1 software package, see, for example, Lilien, (2002).

Figure 2. Seasonal Adjustment of Industrial Production

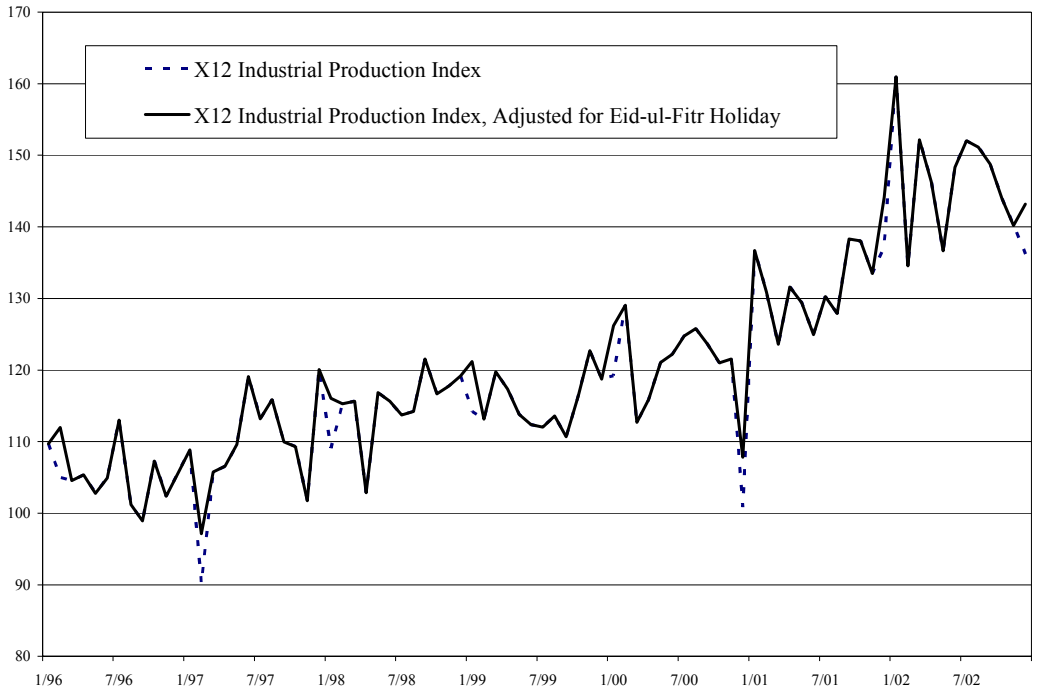
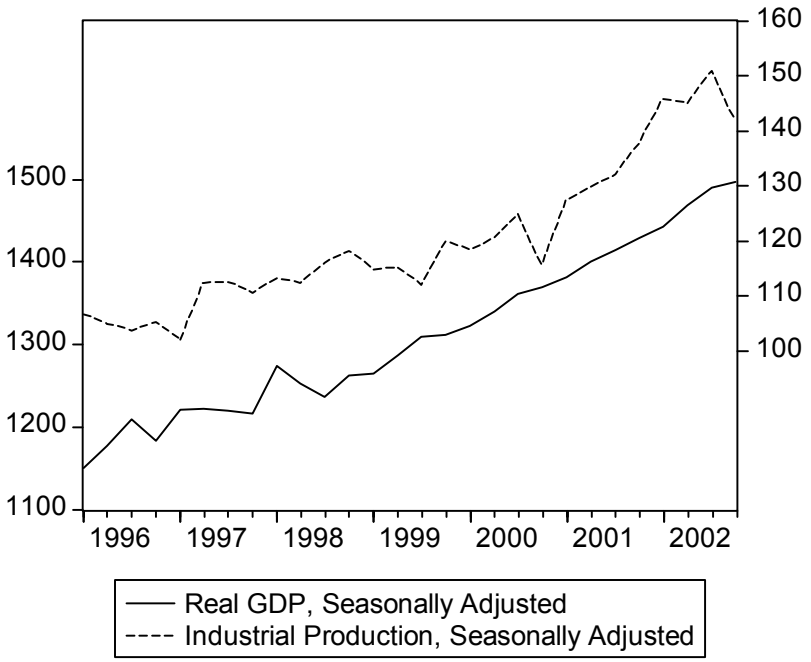



Figure 3. Real GDP and Index of Industrial Production (seasonally adjusted series; the index of industrial production is measured on the right-hand side axis)



It is important to note here that, while industrial production is a very good single coincident indicator, a composite index is preferable as an indication of economic activity. This is because a composite index reflects a broader spectrum of the economy, comprising real, monetary, fiscal, and external sector data. Moreover, the performance of an individual series may vary over different business cycles, making it a poor coincident indicator in some occasions (Dua and Banerji, 2001). In statistical terms, this implies that a composite index reduces the measurement error associated with a given cyclical indicator (Mall, 1999).

The second step is to identify an appropriate procedure for deriving the CEI. As discussed in Section II, both the NBER-CB and OECD methodologies follow an ad hoc procedure to determine the selection of variables that comprise a CEI, and the weights associated with them. While there is merit in a selection procedure based on the analysis of descriptive statistics, an econometric approach is likely to be superior, since it is purely based on statistical inference.

The estimation procedure used in this paper comprises a simple variable selection criterion and the regression of a linear reduced form equation. The selection of variables to be included in the regression is based on a principle of parsimony, also used in Stock and Watson (1989). From a generalized model using all potential indicators in the dataset, variables were recursively eliminated based on the variable with the lowest T-ratio. Attention was also paid to avoiding multicollinearity for variables that were close proxies. The paper though departs from the Stock and Watson methodology as the limited sample available for Jordan is insufficient to estimate a dynamic factor model. Instead, the following reduced form equation is estimated:

$$\Delta LRIIP_t = \alpha + \beta \Delta LCI_t + u_t \qquad (2)$$
$$u_t = \varepsilon_t + \theta \varepsilon_{t-1},$$

where $\Delta LRIIP$ is the growth rate of the seasonally adjusted industrial production index, $\Delta LCI$ is a vector of seasonally adjusted coincident indicators expressed in growth rates, $u_t$ is an error term with a moving average component *MA(1)*. As the error term is not normally distributed in the regressions that follow, the standard errors and covariance matrix are estimated below using the Newey-West heteroskedastic-consistent procedure.

The selection procedure outlined above identified five coincident indicators from all sectors of the economy (Table 2). These indicators are: the terms of trade (TOT), the trade balance (TB), the import of capital goods (IMPCG), employee payroll deductions (EMPTAX) and the number construction permits (COPERM). All these variables are significant at the 1 percent significance level. These variable explain about two thirds of the variation in the growth rate of industrial production.[11] As shown in Figure 4, the fitted value closely track the actual data.

[11] While θ is close to unity in absolute value, the null hypothesis (i.e., θ=1) can be rejected at the 5 percent confidence interval. In any case, even if θ were to be greater than unity (i.e., the MA process is noninvertible)

(continued…)

Table 2. Estimation of Coincident Economic Indicators

Dependent Variable: IIP
Method: Least Squares
Sample (adjusted): 1996:02 2002:12
Included observations: 83 after adjusting endpoints
Convergence achieved after 10 iterations
Newey-West HAC Standard Errors & Covariance (lag truncation=3)
Backcast: 1996:01

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| C | 0.004075 | 0.001332 | 3.058719 | 0.0031 |
| TOT | 0.506743 | 0.138262 | 3.665089 | 0.0005 |
| TB | 0.561191 | 0.173907 | 3.226965 | 0.0018 |
| IMPCG | 0.067893 | 0.024072 | 2.820390 | 0.0061 |
| EMPTAX | 0.053902 | 0.018522 | 2.910185 | 0.0047 |
| COPERM | 0.158926 | 0.024182 | 6.572115 | 0.0000 |
| MA(1) | -0.739768 | 0.062502 | -11.83591 | 0.0000 |

| | | | |
|---|---|---|---|
| R-squared | 0.667357 | Mean dependent var | 0.003213 |
| Adjusted R-squared | 0.641095 | S.D. dependent var | 0.065715 |
| S.E. of regression | 0.039369 | Akaike info criterion | -3.551120 |
| Sum squared resid | 0.117792 | Schwarz criterion | -3.347122 |
| Log likelihood | 154.3715 | F-statistic | 25.41216 |
| Durbin-Watson stat | 1.790883 | Prob(F-statistic) | 0.000000 |

Inverted MA Roots .74

The results are also intuitive from an economic point of view. Since the Jordanian economy is relatively open to international trade, external factors play an important role in determining the current state of the economy. As expected for a small open economy, improvements in the trade balance and the terms of trade signal increased economic activity. In a similar fashion, an increase in imports of capital goods—which can be considered a proxy here for overall investment in the economy—indicates an improvement in the state of the economy. However, the indicators for the global business cycle, the United States and Euro area industrial production indexes, were not significant, suggesting that the demand for Jordanian exports is mostly driven by market access and less by global demand. In the fiscal sector, higher economic activity would be expected to generate higher salaries; employee payroll deductions are therefore found to be a significant coincident indicator. Finally in the real sector, construction permits stand for investment in the construction sector, which has been shown in many countries to be highly procyclical.

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this poses no substantive problem, as noted by Hamilton (1994, p. 65); Plosser and Schwert (1977); and Enders (1995, p. 97).

Figure 4. Estimation of CEI: Actual, Fitted, and Residual Values

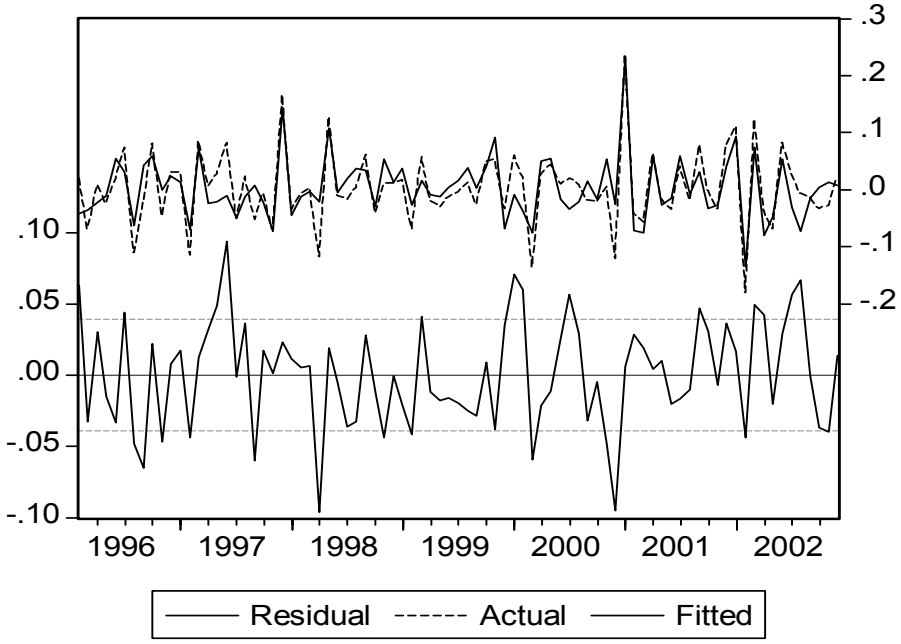
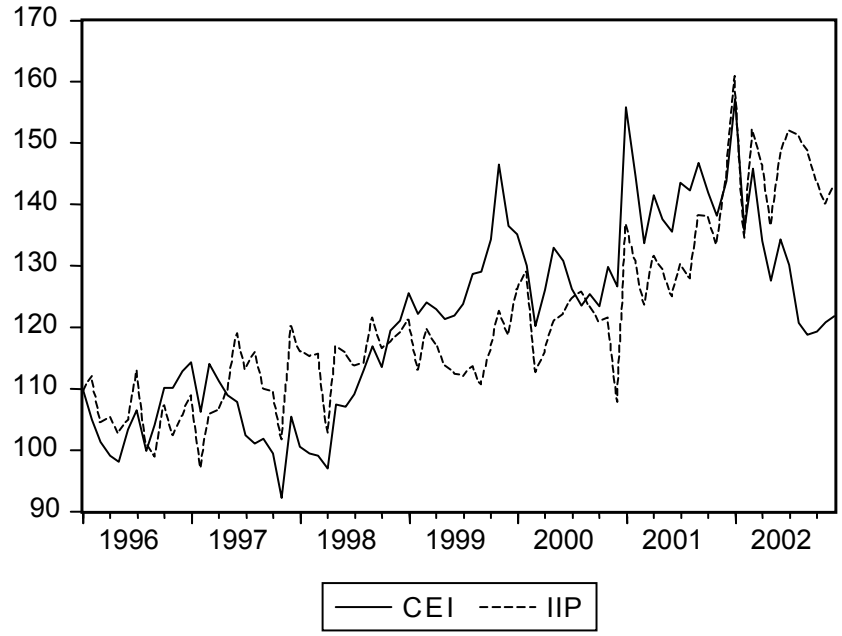



Figure 5. Jordan: Comparison of CEI and Index of Industrial Production



The final step is to derive the CEI from the regression results. The regression results determine statistically significant weights, namely the coefficients, for each coincident indicator. The fitted values of the regression can therefore be interpreted as the growth rates of the composite index. A simple procedure is then used to derive the index: the initial observation of the index is set equal to the equivalent observation for industrial production; subsequent observations are then derived by multiplying the previous observation by the fitted monthly growth rate. The CEI so derived is shown in Figure 5.

The performance of the CEI in gauging the current state of the economy seems relatively good. The CEI picks up most of the turning points in the cyclical behavior of industrial production. In some parts of the sample, the CEI tends to overstate the cyclical fluctuations, possibly as a result of the small sample period. However, as more observations become available, the statistical accuracy of the CEI is likely to improve. In the latter part of the sample, the CEI significantly understates economic activity, probably as a result of the uncertainty surrounding the impending war in Iraq.

## V. The Estimation of a Composite Index of Leading Economic Indicators

The estimation of a composite index of leading economic indicators (LEI) requires the determination of a "leading horizon" and of the statistical relationship that can forecast economic activity for that horizon. A leading horizon can be defined as the number of periods (i.e., months) for which LEI would predict economic activity. While in theory a leading horizon could be endogenously determined, namely through a search of the highest joint statistical significance for all combinations of indicators and leading horizons, in practice this is difficult to compute and may not be optimal in terms of providing a valuable indicator for policy decisions. In this paper, the leading horizon is set to six months, broadly in line with the NBER-CB and the OECD methodologies, so as to provide an appropriate lead time for policy formulation.

The second step is to determine the statistical relationship between leading indicators and economic activity six months hence. As in the estimation of the CEI, economic activity here is proxied by the index of industrial production, adjusted for seasonal fluctuations as described in Section III. The statistical relationship is then formulated in the form of the following reduced form equation:

$$\Delta LRIIP_{t+6} = \alpha + \beta \Delta LLI_t + u_t \qquad (3)$$
$$u_t = \varepsilon_t + \theta \varepsilon_{t-1},$$

where $\Delta LRIIP$ is the growth rate of the seasonally adjusted industrial production index, $\Delta LLI$ is a vector of seasonally adjusted leading indicators and $u_t$ is an error term with a moving average component *MA(1)*.

The procedure followed to estimate equation (3) is the same as the one used to estimate the CEI. From a generalized model using all potential indicators in the dataset, a selection procedure was used to reduce the number of indicators that were statistically significant by

eliminating the variables with the lowest t-ratio. Attention was also paid to avoiding multicollinearity for variables that are close proxies to other variables. In addition, as in the estimation of the CEI, a first order moving average term was included to capture the short-term endogenous dynamics of industrial production.

The estimation of equation (3) produces statistically significant and economically intuitive results. As shown in Table 3, the selection procedure described above identified the following variables: the growth rate in net credit to the private sector (CLAIMSPS), the interest rate spread between three-month Jordanian CD rates and the corresponding U.S. treasury bill rates (SPREAD3M), the growth rate in net usable reserves of the CBJ (RESERVUSD), the growth rate in the demand for domestic exports (DEXP), and the growth rate in the Amman stock exchange (ASTOCEXCH).[12] All of these variables are statistically significant at the 5 percent confidence interval, with the exception of Amman stock exchange which is significant at a 15 percent level. Together, these variables explain about 50 percent of the variation in the growth rate of industrial production.[13] As shown in Figure 6, actual and fitted values of the growth rate of industrial production are closely correlated, with only a few residuals outside the standard error bands.

Table 3. Estimation of Leading Economic Indicators

Dependent Variable: IIP(+6)
Method: Least Squares
Sample(adjusted): 1996:02 2002:06
Included observations: 77 after adjusting endpoints
Convergence achieved after 19 iterations
Newey-West HAC Standard Errors & Covariance (lag truncation=3)
Backcast: 1996:01

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| CLAIMSPS | 0.967311 | 0.156717 | 6.172354 | 0.0000 |
| SPREAD3M | -0.001210 | 0.000348 | -3.480252 | 0.0009 |
| RESERVUSD | 0.113004 | 0.023433 | 4.822525 | 0.0000 |
| DEXP | 0.176229 | 0.055984 | 3.147841 | 0.0024 |
| ASTOCEXCH | 0.084349 | 0.056545 | 1.491731 | 0.1402 |
| MA(1) | -0.980252 | 0.016004 | -61.24882 | 0.0000 |

| | | | |
|---|---|---|---|
| R-squared | 0.489537 | Mean dependent var | 0.003078 |
| Adjusted R-squared | 0.453589 | S.D. dependent var | 0.067135 |
| S.E. of regression | 0.049626 | Akaike info criterion | -3.093884 |
| Sum squared resid | 0.174855 | Schwarz criterion | -2.911250 |
| Log likelihood | 125.1145 | Durbin-Watson stat | 1.933549 |

| | |
|---|---|
| Inverted MA Roots | .98 |

[12] Unlike the CEI estimation, the coefficient on a constant was insignificant and was therefore dropped.

[13] This compares favorably with other econometric studies of coincident indicators, where $R^2$ of comparable regressions was *between .63 and .69. See, for example,* Stock and Watson (1989) and Phillips (1998).

The results of equation 3 are also intuitive from an economic point of view. In the monetary sector, an increase in real credit to the private sector (CLAIMSPS) or a reduction in the spread of interest rates (SPREAD3M) are forecast to increase economic activity six months ahead, as suggested by the theory of the monetary transmission mechanism. From the external sector, an accumulation in net usable reserves of the CBJ (RESERVUSD), which can be interpreted as proxying for capital inflows, or an increase in the real demand for domestic exports (DEXP) also have a positive impact on economic activity in the near future as expected. However, leading indicators for the United States and the Euro area were not significant, again suggesting that the global business cycle is not a significant determinant of future economic activity in Jordan. Finally, a rise in share prices (ASTOCEXCH)—usually an indication of increased confidence in the economy—also positively affects economic activity six months ahead. It is interesting to note here that these results resemble somewhat the composite index of leading indicators for the United States, in so far as the latter also includes a share price index (the S&P 500) and an interest rate spread (10-year treasury bond spread less the federal funds rate).

The LEI can easily be derived from the results of the estimation. The regression of equation 3 determines statistically significant weights, namely the coefficients, of a composite index. The resulting fitted values can therefore be used to derive the LEI in a simple procedure: the initial observation of the index is set equal to the equivalent observation of industrial production; subsequent observations are then derived by multiplying the previous observation by the fitted monthly growth rate. The LEI so derived is shown in Figure 7 and closely resembles the behavior of the seasonally adjusted industrial production index. Most importantly, it provides a relatively accurate forecast of most turning points in industrial production six months ahead of the actual observation.

The estimates for equation (3) also make it possible to forecast economic activity out of sample. This is done by constructing a forecast of the growth rate of industrial production from January to June 2003, based on the results of the regression and the full sample data. The LEI can then be extended for the forecast period by using the same recursive procedure outlined above: the forecast growth rates are used to extend the index into the future. In addition, it is also possible to calculate the standard error bands around the forecast by a similar procedure. The resulting forecast and confidence interval within the standard error bands are shown in Figure 8.

Based on these results, it is possible to provide an analysis of the direction of the economy that may be useful from a policy perspective. The projections shown in Figure 8 suggest a slowdown in economic growth (seasonally adjusted) for the first quarter of 2003. The actual data that became available after this out-of-sample forecast was produced (shown as dotted lines in Figure 8) indicate that indeed economic activity slowed down, with industrial production contracting by 14 percent and real GDP growth slowing to 2.8 percent in the first quarter of 2003, compared to 4.7 percent in the fourth quarter of 2002.[14] These results should therefore be taken with caution, mainly for two reasons. First, the confidence interval of the

[14] The contraction in industrial production in February 2003 was exacerbated by a snow storm, which halted production for about a week.

Figure 6. Estimation of LEI: Actual, Fitted, and Residual Values

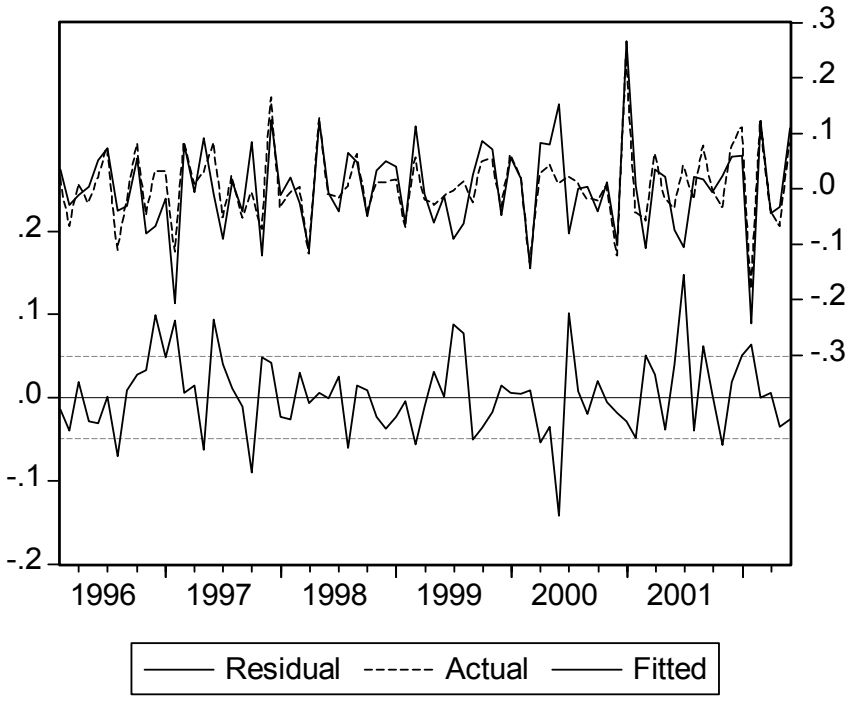



Figure 7. Industrial Production and Leading Economic Indicator
(LEI lagged six months forward)

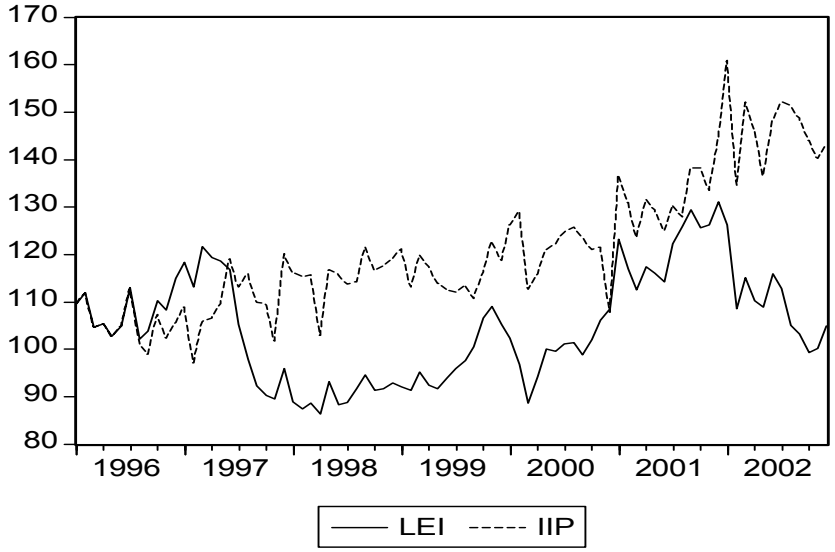


Figure 8. Forecast of Economic Activity and Confidence Interval


forecast is relatively wide and increasing as the forecast horizon increases. This is a reflection of the uncertainty arising from the 50 percent of variation in economic activity that is unexplained in the regression results. While it is possible that the confidence interval may narrow with the availability of additional observations, for the time being the LEI forecast should be taken to provide only a qualitative and not a quantitative indication of the short-term direction of economic activity. Second, some value judgment still needs to be used to assess the forecast of the LEI. In the case of Jordan, for example, the negative impact of the war in Iraq, which negatively affected the outturn for the first half of 2003, would have been hard to capture, as shown above, with a purely quantitative framework.

## VI. CONCLUSIONS

An assessment of the direction of economic activity is essential for the formulation of appropriate macroeconomic policies. In this regard, composite indexes of coincident and leading economic indicators provide useful summary statistics to analyze the current and future direction of economic activity. This paper has put forward an econometric approach to estimate such indexes for a small open economy, Jordan. Notwithstanding the relatively small sample period, the results of this approach seem to be both statistically significant and economically intuitive. However, a larger sample will probably be necessary before the composite indexes of coincident and leading economic indicators can be relied upon for more than a qualitative assessment of the direction of the Jordanian economy. The indexes proposed in this paper should therefore be considered experimental for the time being and

should be used operationally only after a testing period that can confirm their out-of-sample performance. In addition, a comprehensive assessment of future economic activity will always need to take account of other information that cannot easily be quantified, including the effects of geopolitical uncertainties and macroeconomic policy changes. Notwithstanding these caveats, a regular updating of these indexes could provide a useful tool to the Jordanian authorities for policy formulation. In addition, the econometric approach presented in this paper may provide a useful roadmap to analyze coincident and leading indicators in other emerging markets.

## Appendix I. U.S. Leading, Coincident, and Lagging Economic Indicators

The following is a list of leading, coincident, and lagging economic indicators for the U.S. economy used by the NBER-CB business cycle indicators project (standardization factors are shown in bracket). For more information on the NBER-CB methodology, please refer to Conference Board, Inc. (1997).

**Leading indicators**
BCI-1 Average weekly hours, manufacturing (.222)
BCI-5 Average weekly initial claims for unemployment insurance (.025)
BCI-8 Manufacturers' new orders, consumer goods and materials (.047)
BCI-32 Vendor performance, slower deliveries diffusion index (.026)
BCI-27 Manufacturers' new orders, nondefense capital goods (.012)
BCI-29 Building permits, new private housing units (.017)
BCI-19 Stock prices, 500 common stocks (.031)
BCI-106 Money supply, M2 (.293)
BCI-129 Interest rate spread, 10-year Treasury bonds less federal funds (.310)
BCI-83 Index of consumer expectations (.017)

**Coincident indicators**
BCI-41 Employees on nonagricultural payrolls (.487)
BCI-51 Personal income less transfer payments (.267)
BCI-47 Industrial production (.134)
BCI-57 Manufacturing and trade sales (.112)

**Lagging indicators**
BCI-91 Average duration of unemployment (.040)
BCI-77 Inventories to sales ratio, manufacturing and trade (.120)
BCI-62 Change in labor cost per unit of output, manufacturing (.067)
BCI-109 Average prime rate none (.250)
BCI-101 Commercial and industrial loans (.118)
BCI-95 Consumer installment credit to personal income ratio (.211)
BCI-120 Change in consumer price index for services (.194)

## Appendix II. Classical Business Cycle versus Growth Cycles Approaches to Estimating Coincident and Leading Indicators

The classical approach of macroeconomic fluctuations involves an analysis of booms and busts, as defined by Burns and Mitchell (1946), in output and or other indicators over a given time period independently of the underlying nature of change. In contrast, a competing approach in the business cycle literature has focused on the cyclical fluctuations in economic time series data around their long run trends, as in the seminal contribution by Lucas (1987). These short-term fluctuations are often referred to as growth cycles, and they are identified by filtering the relevant time series from its long run trend. Both these approaches have advantages and disadvantages, as discussed below. On the basis of this discussion, the benefits seem to weigh in favor of the classical approach for the analysis of small open economies like Jordan.

### What are business cycles?

The classical definition of business cycles, used by the NBER, refers to the determination of turning points in the level of economic activity. A single series $Y_t$ (or $y_t = \log(Y_t)$) might be regarded as summarizing the level of economic activity and its turning points would then be the local maxima and minima in its sample path (Harding and Pagan, 2001). A different view in the literature is that the same series can be decomposed into $Y_t = T_t + C_t + I_t$, where $T_t$ is the trend component, $C_t$ is the cycle component, and $I_t$ is the error term. Business cycles fluctuations are then identified as deviations from the trend of the process ($C_t$). Filters are then designed to remove the *permanen*t trend component ($T_t$) in a series.

Since business cycles relate to the turning points in the level of the economic activity, there is no need to remove any component from $y_t$. Burns and Mitchell (1946) argue against the use of such trend adjusted data. Detrending may involve the loss of critical information. Stock and Watson (1999) document that the focus on growth cycles (i.e., the cyclical component of macroeconomic change over time) has both advantages and disadvantages as compared to the classical attention to the aggregate change:

> *On the one hand, separation of the trend and the cyclical component is inconsistent with some modern macroeconomic models, in which productivity shocks (for example) determine both long-run growth and the fluctuations around that growth trend. From this perspective, the trend–cycle dichotomy is only justified if the factors determining long-run economic growth and those determining cyclical fluctuations are largely distinct. On the other hand, growth cycle chronologies are by construction less sensitive to the underlying trend growth rate in the economy, and in fact some economies which have had very high growth rates, such as postwar Japan, exhibit growth cycles but have few absolute declines and thus have few classical cycle*s (Stock and Watson, 1999, p. 9.)

Although there is little point in filtering the data, when measuring business cycles, there may be an independent interest in the filtered data. Initially, the impetus for filtering came from the fact that, with a strong deterministic trend in the data, it would be rare to find a case where $y_t$ declines, and so there would be no turning point in it. This situation describes Germany and Japan over the post-World War II period and was also true for some Asian economies prior to 1978. In those instances, it was clearly of more interest to study turning points in a series from which a deterministic growth path had been removed.

Zarnowitz and Ozyildirim (2002) develop two others arguments in favor of detrending. First, reasonably good trend estimates are required to study economic growth empirically and test related theories. This task cannot be accomplished without sufficiently long and reliable data and without confronting the question of how trends and cycles influence each other. Second, the appraisal of cyclical indicators can be substantially improved by considering their trends and the fluctuations in the deviations from trends. Leading indicators are much more sensitive to all types of disturbances, whether associated with business cycles or with fluctuations at shorter frequencies; hence they are generally much more volatile than coincident indicators. They also have as a group fewer and weaker upward trends, as some leading indicators in the United States, such as the average workweek, unemployment claims, or the diffusion index of slower deliveries are stationary or have only weak trends. Using deviations from trend or smoothed growth rates reduces these differences between the two sets of indicators.

**What is a trend and what is a cyclical component?**

Since $T_t + C_t + I_t$ are unobservable, numerous trend-cycle decomposition have been proposed in the literature. These efforts are devoted to extracting $Z_t = C_t + I_t$ or $T_t$ devolved into extensive discussions of what are appropriate "trend removal" filters—see the two filters used in the literature Hodrick and Prescott (1997), Baxter and King (1999); and see Canova (1998a, 1998b and 1999) and Burnside (1998) for a recent debate on filtering series.

Within the empirical literature, there are fundamental disagreements on the properties of the trend and on its relationship with cyclical component of a series. Since the issue of what is an "appropriate" statistical representation of the trend cannot be solved in small samples and since the choice of the relationship between the cyclical and secular components is arbitrary, statistical approaches to detrending raise questions about the robustness of certain "facts" (Canova, 1998a and 1998b).

Another problem rises from a standard "measurement without theory" concern. It is often argued that before variables can be selected and facts reported, a theory explaining the mechanism generating economic fluctuations is needed. Dynamic economic theory, however, does not indicate the type of economic trend that series may display nor the exact relationship between secular and cyclical components. In other words, without a set of statistical facts pinning down the properties of the secular component of a time series, the theoretical relationship between trend and cycle is unknown and the choice among various economic-based decompositions is arbitrary. Because of this circularity, all economic-based decompositions are, at best, attempts to approximate unknown features of a series and therefore subject to specification errors (Canova, 1998a and 1998b).

**Problems with filtering**

There are several reasons why the filtering approach seems inappropriate, especially for developing countries. First, different detrending methods extract different "types" of business cycle information from the original series, resulting in significant qualitative and quantitative

differences. Second, there is no independent criterion to choose filters (see Canova 1998a and 1998b). Third, the two methods of filtering most used in the literature, the Band-Pass filter (BP) and the Hodrick-Prescott filter (HP), can produce spurious relationship between variables and can generate business cycles dynamics even if none one is present in the original data. Benati (2001) shows that using the Band-Pass filter can produce a spurious correlation between the cyclical component of the variables of interest. For example, even if there is a negative relationship between GDP and another variable of interest, because of the cointegration relationship between these two variables, we can have a positive relationship. In other words, a countercyclical behavior can be estimated to be procyclical. Harvey and Jaeger (1993) and Cogley and Nason (1995) note that the Hodrick and Prescott (1997) (HP) filter, a commonly used univariate approach to trend removal, may induce business cycle periodicities and comovement in data series that do not contain cycles. Fourth, relying on the parameters of filters used in the context of industrial countries when studying developing countries is therefore at best ad hoc, and may lead to inappropriate conclusions as regards the summary statistics (or stylized facts) that characterize macroeconomic fluctuations. In the extreme, inappropriate numerical models might be validated and *vice versa*, depending on the choice of smoothing parameter (Rand and Tarp (2001). Finally, the classical analysis of coincident and leading indicators based on the business cycle approach uses simple unconditional correlation between the cyclical component of the variables of interest and the cyclical component of others variables supposed to lead or coincide with the variable of interest**.** Such correlations do not imply causal relationship (Agenor, McDermott, and Prasad, 2000).

## Appendix III. Definition and Sources of Variables

CBJ: Central Bank of Jordan, Monthly Statistical Bulletin, Various Issues
MFJ: Ministry of Finance of Jordan, Government Finance Bulletin, Various Issues
IFS: IMF International Finance Statistics Database

| Name | DEFINITION | SOURCES |
|---|---|---|
| AQABA | Aqaba port activity, thousand tons | CBJ |
| ASTOCKEXCH | Amman Stock Exchange Index | CBJ |
| BMON | Broad Money (JD Million) total | CBJ |
| BMONJD | Broad Money (JD Million) in JD | CBJ |
| CBYCAP | Registered Companies by Capital (JD Million) | CBJ |
| CEXP | Capital expenditures | MFJ |
| CLAIMSPS | Claims on private sector (resident) (JD Million) | CBJ |
| COAREA | Construction Area 1000 sq. Meters | CBJ |
| COPERM | No. of construction permits. | CBJ |
| CPIJ | Consumer Price index (Jordan) | CBJ |
| CPIUSA | Consumer Price index (USA) | IFS |
| CUREXP | CURRENT EXPENDITURES | MFJ |
| DEXP | Domestic Exports | CBJ |
| EIDSDUMMY | The variable takes the value 1 if the eid-ul-fitr or eid-ul-adha falls in the month and 0 otherwise. | |
| EIDULADHA | The variable takes the value 1 if the eid-ul-adha falls in the month and 0 otherwise. | |
| EIDULFITR | The variable takes the value 1 if the eid-ul-fitr falls in the month and 0 otherwise. | |
| ELECT | Electricity Millions of K.W.H. | CBJ |
| EMPTAX | Salaried Employees taxes | MFJ |
| EUROCLI | EU15 Composite Index of Leading Economic Indicators | OECD |
| EUROIIP | Euro Area Industrial Production Index | IFS |
| EUROPPI | Euro Area Producer Price Index | IFS |
| GDPDEF | GDP deflator (quarterly) | CBJ |
| IMP | Imports | CBJ |
| IMPCG | Imports of capital goods. | CBJ |
| IMPCMI | Imports of crude materials and intermediate goods | CBJ |
| IIP | General Industrial Production Index. | CBJ |
| IRJ3M | Interest rate on CBJ 3 month CD | CBJ |
| IRUS3M | US 3-month TB rate | IFS |
| MANUFAC | Manufacturing | CBJ |
| MINING | Mining and Quarrying | CBJ |
| NEER | Nominal effective exchange rate for Jordan | IMF Staff |
| NGDP | Nominal GDP at market prices (quarterly) | CBJ |
| PIEXP | Main export price index | CBJ |
| PIIMP | Main import price index | CBJ |
| RESERVUSD | Net usable reserves (i.e. readily available official reserves evaluated in millions of US dollars) | CBJ |
| RESMON | Reserve Money (JD Million) | CBJ |
| REXP | Re-exports | CBJ |
| RGDP | Real GDP at market prices (quarterly) | CBJ |
| SALTAX | General sales tax receipts | MFJ |
| SPREAD3M | IRJ3M-IRUS3M | |
| TOT | PIEXP/ PIIMP | CBJ |
| TOTDEP | Total deposits in the banking system (in millions of Jordanian dinar) | CBJ |
| TOTTAX | SALTAX + EMPTAX + TRADTAX | MFJ |
| TRADTAX | Taxes On Foreign Trade | MFJ |
| TB | Trade balance minus reexport activity | CBJ |
| USCLI | United States Composite Index of Leading Indicators | OECD |
| USIIP | United States Industrial Production Index (Seasonally adjusted) | IFS |
| USPPI | United States Producer Price Index | IFS |

## Appendix IV. Significance of Muslim Holidays Dummies

The Gregorian dates of the two main Muslim holidays, the Eid-ul-Fitr (end of Ramadan) and the Eid-ul-Adha (day of sacrifice), during the sample period are shown in Table 1. The actual dates may however vary by one or two days in different countries, as they are determined by the religious authorities in each country.

Table 1. Gregorian Dates of Main Muslim Holidays

| | Eid-ul-Fitr (End of Ramadan) | Eid-ul-Adha (Day of Sacrifice) |
|---|---|---|
| 1996 | 20 February | 28 April |
| 1997 | 9 February | 18 April |
| 1998 | 30 January | 8 April |
| 1999 | 19 January | 28 March |
| 2000 | 8 January and 27 December | 17 March |
| 2001 | 16 December | 6 March |
| 2002 | 6 December | 23 February |

Table 2 presents the significance tests on X12 seasonally adjusted variables in the dataset for residual seasonality associated with these Muslim holidays. The significance tests represent the statistical significance at 10 percent (*), 5 percent (**), and 1 percent (***) of the following dummy variables:

- EIDULFITR takes the value 1 if the eid-ul-fitr falls in the month, 0 otherwise.
- EIDULADHA takes the value 1 if the eid-ul-adha falls in the month, 0 otherwise.
- EIDSDUMMY takes the value 1 if the eid-ul-fitr or eid-ul-adha falls in the month and 0 otherwise.

Table 2. Significance Tests of Muslim Holidays

| | **EIDULFITR** | **EIDULADHA** | **EIDSDUMMY** |
|---|---|---|---|
| AQABA | -- | -- | -- |
| ASTOCEXCH | -- | -- | -- |
| BMON | -- | -- | -- |
| BMONJD | -- | -- | -- |
| CEXP | -- | -- | -- |
| CLAIMSPS | -- | -- | -- |
| COAREA | ** | -- | * |
| COPERM | *** | -- | *** |
| CUREXP | -- | -- | -- |
| DEXP | -- | -- | -- |
| ELEC | -- | -- | -- |
| EMPTAX | -- | -- | -- |
| IIP | ** | -- | ** |
| IMP | ** | -- | * |
| IMPCG | -- | -- | -- |
| IMPCMI | -- | -- | -- |
| IR3MJ | -- | -- | -- |
| IR3MUSA | -- | -- | -- |
| MANUFAC | -- | -- | -- |
| MINING | -- | -- | -- |
| PIEXP | -- | -- | -- |
| PIIMP | -- | -- | -- |
| RCBYCAP | -- | -- | -- |
| RESERVUSD | -- | -- | -- |
| RESMON | ** | -- | * |
| REXP | -- | -- | -- |
| SALTAX | -- | -- | -- |
| TOT | -- | -- | -- |
| TOTDEP | -- | -- | -- |
| TOTTAX | * | -- | -- |
| TRADTAX | -- | -- | -- |
| TB | ** | -- | * |
| CPIJ | -- | -- | -- |

## Appendix V. Unit Root Tests

The following table presents Phillips-Perron tests for unit roots for the variables in the dataset expressed in logarithms, both in levels and first differences (i.e. growth rates).[15] A single asterisk (*) indicates that the null hypothesis of a unit root is rejected at the 10 percent significance level; two asterisks (**) indicate a rejection at the 5 percent significance level; and three asterisks (***) a rejection at the 1 percent significance level.

Table 1. Unit Root Tests

| Variable | Test on levels (in logarithms) | Test on First Differences (in growth rates) |
|---|---|---|
| AQABA | -7.872*** | -101.101*** |
| ASTOCEXCH | -7.075*** | -9.917*** |
| BMON | -3.724*** | -29.532*** |
| BMONJD | -0.941 | -44.111*** |
| CBYCAP | -7.648*** | -155.049*** |
| CEXP | -13.311*** | -56.630*** |
| CLAIMSPS | -1.792 | -10.503*** |
| COAREA | -4.239*** | -72.566*** |
| COPERM | -6.504*** | -128.229*** |
| CPIJ | -1.927 | -10.438*** |
| CPIUSA | -1.317 | -6.539*** |
| CUREXP | -4.063*** | -54.965*** |
| DEXP | -2.162 | -25.897*** |
| ELEC | -0.865 | -26.199*** |
| EMPTAX | -4.202*** | -24.501*** |
| EUROCLI | -1.968 | -3.105** |
| EUROIIP | -1.527 | -12.534*** |
| EUROPPI | -1.371 | -3.812*** |
| IIP | -1.385 | -74.564*** |
| IMP | -7.830*** | -55.049*** |
| IMPCG | -6.489*** | -84.053*** |
| IMPCMI | -4.998*** | -13.524*** |
| IR3MJ | -0.804 | -8.508** |
| IR3MUSA | 2.221 | -3.764** |
| MANUFAC | -33.561*** | -156.707*** |
| MINING | -5.755*** | -83.967*** |
| PIEXP | -1.769 | -21.390*** |
| PIIMP | -5.366*** | -20.246*** |
| RESERVUSD | -1.471 | -6.596*** |
| RESMON | -3.820*** | -36.377*** |
| REXP | -7.350*** | -116.516*** |
| SALTAX | -3.089*** | -14.217*** |
| SPREAD3M | -3.140** | -12.203*** |
| TB | -8.753*** | -71.011*** |
| TOT | -2.114 | -24.581*** |
| TOTDEP | -3.546*** | -42.740*** |
| TOTTAX | -10.450*** | -162.243*** |
| TRADTAX | -2.733* | -14.652*** |
| USCLI | -2.248 | -3.609*** |
| USIIP | -2.360 | -6.095*** |
| USPPI | -2.323 | -7.964*** |

[15] The tests are performed with an autoregressive spectral-OLS procedure and a lag length of 9 months.

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