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A Composite Economic Performance Index for Trinidad and Tobago¹

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Abstract

We develop a Composite Economic Performance Index (LCI) for Trinidad and Tobago which is based on readily available high frequency data and therefore can be produced on a timely and consistent basis at lower cost. This index has lagging, coincident and leading component indices which can capture the full range of inter-temporal dynamics in the evolution of the local economy. This index is intended to provide policy makers and other agents in the market with information on the short-term dynamics of the economy. This would enable them to quickly adopt appropriate policy responses and strategies in a situation where high frequency GDP information may not be available or may be outdated and cannot provide timely signals for agents to respond to real time economic developments. The LCI could therefore not only help short-term economic analysis by providing insights into how the economy works on a more frequent basis but can also serve as an early warning system that signals changes in the macro-economy by providing short-term forecast of aggregate economic activity.

JEL Classification: *C43; C38; C53*

Keywords: *Composite Economic Indicators; Dynamic Factor Analysis; Forecasting*

¹Please note this is a preliminary draft and is not to be used for citation.

1.0 Introduction

Increasing international economic integration and complexity of economics and the related increased responsiveness of economies to a variety of international and local events means that policy makers today have to respond quickly to a range of emerging economic challenges which requires higher frequency information on economic dynamics. Indicators of short-term economic activity such as quarterly economic growth have long underpinned macroeconomic decision making in advanced economies. These indicators have been used to measure, as well as to increase our understanding of short-term aggregate economic activity. This has facilitated appropriate and timely policy responses to short-term fluctuations in these economies. The use of these indicators in developing countries has not been as prevalent because in many cases they were simply not available. In fact, even annual data on the national accounts are often outdated. If macroeconomic management is to be improved, understanding and effectively tracking the short-term direction of the economy is critical. When high-frequency GDP information is either unavailable or comes with a long lag it can be a major impediment to informed contemporaneous policymaking. In these situations a composite index of economic activity which is based on available high frequency economic indicators can help to improve the quality of macroeconomic management and deepen our understanding of the short-term dynamics of the economy.

There are sometimes conflicting views on the use of composite indicators, but they have remained relevant and widely used because of their ability to capture complex concepts that are most often poorly defined such as sustainability, confidence and welfare. The European Commission argues “*Our lives and societies are becoming more complex and bewildering. How can we measure and track the important factors that affect us all? Composite indicators are a way of distilling reality into manageable form.*”²

Composite indicators can be seen as elements of a wider analytical framework, once they are constructed according to proper standards. Composite leading indices are usually based on a set of indicators which are generally different across countries since each country has a different economic structure. Appendix I highlight the pros and cons of the composite indices as outlined by Staltelli et.

² Euro abstracts (2003) Mainstreaming Innovation. Published by the European Commission, Innovation Directorate, Vol. 41-1, February 2003.

al.(2004), the main advantage of using a composite index is the fact that is easy to interpret and provides the user with a snap shot of the situation without all the details. However a major critique of its use is the fact that it ignores the details, which can be misleading to users at times. A well designed composite indicator should be based on the best available evidence; be designed with transparent structures and assessed using appropriate multivariate and sensitivity analysis, Saisana and Cartwright (2007).

The literature on composite leading economic indicators can be traced back to a paper by Mitchell and Burns (1938) and business cycle research. Subsequent research by Moore and Shiskin (1967), Layton and Moore (1989), Zarnowitz (1996), Fabiano et. al. (2000), Lamy and Sabourin (2001) and Albu (2008) have added to a growing body of work on composite economic indices. There has not been many studies on composite indices in the Caribbean with Jordan and Howard (2005) being one of the few completed in recent years. A few organisations in the Caribbean have also sought to construct composite indicators, the majority using survey based consumer confidence indices and even fewer constructing composite economic indices using established methodologies . These studies represent efforts to fill the gap of inadequate high frequency indicators of aggregate economic activity in the Caribbean statistical architecture but in many cases have not been sustained. This studies aims to help fill this gap by developing a high frequency composite economic index for Trinidad and Tobago based on easily available data so that the index can be easily produced on a regular basis.

This paper is structured as follows. Sections 2 reviews the literature on composite economic indices, section 3 outlines the methodology used to construct the composite index, section 4 presents the proposed composite index for Trinidad and Tobago and section 5 concludes.

2.0 Literature Review of Leading Composite Indices

2.1 International

Numerous studies on composite indices exist on advanced economies, all of which have explored the various aspects of their derivation and composition. Early studies revealed that the economic variables were used to construct the index explained as much as 80 per cent of the variance of the index (Hymans

1970). Composite indices are at times discredited because of the choice of variables used to develop them. In Auerbach (1982) evaluated the statistical method of the NBER approach used to construct the composite index and investigated the predictability power of the index of leading indicators to cyclical variables. He concluded that the index serves is useful in predicting business cycles in the short run.

A review of the extensive research on composite indices reveals that there are certain models that are widely used to develop these indices around the world. Some of the early methods include (1) The NBER Business Cycle Dating Approach, (2) The OECD Methods of Composite Index, (3) GDP Rule of a Thumb, (4) Peaks and Through of the Commerce Department business cycle indicators, (5) Stock and Watson’s Business Cycle Indicators, and (6) Markov Switching Models. A study done by Boldin (1994) reviews and evaluates the methods used to date peaks and troughs of business cycles for period 1990-92. Table 1 outlines the findings of this study.

Table 1: Ranking of Business Cycles Dating Methods					
Criteria	NBER Committee	GDP Rules of Thumbs	Coincident Indicator Rules	Stock – Watson Procedure	Markov Switching Model for Unemployment
Performance	1	5	4	2	3
Replication	3	1	2	5	4
Clarity	1	3	2	5	4
Timeliness	5	4	3	2	1
Flexibility	1	5	4	3	2
Validity	3	5	4	2	1
Note: the orders are 1- best to 5- worst.					
Source: Michael Boldin (1994)					

Recent studies have proposed enhanced models to assess and develop composite indicators. These include Stock and Watson (2002a, 2006) – Principal Component Regression; Heij, Groenen and Van Dijk (2006) – Principal Covariate Index; Stock and Watson (1999, 2002a) - DI-AR-Lag Model which is based on the diffusion index and Forni et. al. (1999, 2000) - Dynamic factor Model. Heij, Groenen and Van Dijk (2011) look at the benefits of combining a range of indicators to forecast the Composite Coincident Index of the Conference Board. They use the three newer index methods in addition to the NBER Composite Leading Index. Comparisons of the three index methods are done using two data sets. To further test the predictability of the index models four coincident indicators – industrial production, employment, personal income and manufacturing and trade sales were also examined. In all scenarios

evaluated by Heij et. al. (2011) the Principal Covariate Index model was revealed to be the best performing index method.

The inclusion of expectations in the composite index while useful is not a strict requirement. The relevance of consumer and business sentiments is assessed in Curtin (2007), where it was noted that consumer expectations are largely formed from information on the standard array of variables that economists typically use in their forecasting models. Other economic variables often capture the information contained in consumer expectations and this data can be used to improve short-term forecasts.

2.2 Caribbean

In the Caribbean research on composite indicators is very scarce with a study by Jordan and Howard (2005) the only study of its kind which sought to identify the most potent indicators of a recession. Using the “Signal Approach” with in-sample and out-of-sample tests based on probit models to determine the predictive ability of specific indicators, they found that the most significant variables varied for each country and no single indicator exhibited predictive ability for all three countries – Barbados, Jamaica and Trinidad and Tobago. A notable finding of this study was the importance of financial variables such as stock prices to investors' expectations.

Gladys et. al. (2009) notes that in developing economies the examination of the short and very short-term movements of economic indicators play an important role in information flow to the general public. They argued that this practice was almost non-existent in the Caribbean and suggested that it is imperative for the Caribbean economies to develop leading composite indicators because of the prevalence of economic and financial crises in the global economy. They suggested that the absence of leading composite indices in the Caribbean was due to limited data and weaknesses in quantitative modeling.

In the CARICOM region the importance of composite indicators and confidence measures have led to the development of confidence and composite economic indicators by some organisations in the investment management and marketing sectors. They are the CARICOM Consumer Sentiment Report,

Composite Economic Indexes, Consumer Confidence Index, Business Confidence Index, Composite Leading Indicator, RBL-MFO Consumer Confidence Index and the Corporate Confidence Index³. These indices are in all cases constructed using established methodologies but the effort is often not sustained in terms of the production and coverage. Most of these indices are confidence indices based on survey information which is not a broad based economic performance index and may not capture the full range of influences affecting economic performance⁴.

The use of economic variables which drive overall economic performance to develop composite indicators however is relatively still unexplored in the Caribbean region. In an attempt to contribute to the sparse literature on composite economic indicators in the Caribbean we develop a leading composite index that uses an extensive set of indicators which attempt to capture the broad dynamics of the Trinidad and Tobago economy.

3.0 Data and Methodology

The proposed composite index is to be based on a series of monthly indicators that we believe to be reflective of the economy of Trinidad and Tobago. There were many data limitations issues in our study which we dealt with using the principles proposed by McGuckin et.al. (2007). They found that the failure to use the most current available data in the construction of the leading index is a major source of forecast errors; they proposed that the missing data problem encountered in the construction of the composite index be based on the following principles:

1. Use of the most recent complete monthly data for those components where they are available
2. Use the simplest uniform methods of forecasting that will produce acceptable estimates for those components where data for the most recent complete month are not available

³ Appendix II has a table of these indices .

⁴ Sergeant, Lugay and Dookie (2011) found mixed evidence of the correlation of consumer confidence indicator to GDP with a significant link in Trinidad and Tobago but not in Jamaica.

3.1 Identification and Justification of Leading Indicators and Time Period

Leading indicators once properly identified and compiled in an index can convey significant predictive information about the economy's change for the next several months (McGuckin et.al., 2007). In selecting appropriate indicators OECD (2012) suggest that the indicators chosen should be of economic relevance and practical considerations be given to the frequency, timeliness and length of time series. An extensive review of leading indices in a number of countries (Appendix III) revealed that each country is unique and the leading indicators of one country will not be the same for another.

The proposed variables in Table 4 are identified as possible leading and or coincident indicators for the LCI of Trinidad and Tobago. Given the dominance of the oil and gas sector we include forward looking indicators of these commodity prices, as well as information on production. We also include the production of some important commodities and financial indicators which have proven to be useful signals in previous research in this area. Last but by no means least is the impact of developments the global economy which we proxy by industrial production in important countries.

Economic Indicator	Frequency	Source
Exchange Rate per US dollar	Monthly	CBTT
Liquefied Natural Gas Production (cu m)	Monthly	CBTT
Crude Oil Production (000's Barrels)	Monthly	CBTT
Crude Oil Refinery Throughput (000's Barrels)	Monthly	CBTT
Production of Motor Gasoline (000's Barrels)	Monthly	CBTT
Production of Gas and Fuel Oil (000's Barrels)	Monthly	CBTT
Future Gas Price (US\$ per Million BTU)	Monthly	EIA
Spot Gas Price – Henry Hub (US\$/MMBTU)	Monthly	EIA
Future Oil Price – WTI (US\$per barrel)	Monthly	EIA
Spot Oil Prices WTI (US\$ per barrel)	Monthly	EIA
Production of Cement (tonnes)	Monthly	CBTT
Production of Direct Reduced Iron (000's tonnes)	Monthly	CBTT
Production of Billets (000's tonnes)	Monthly	CBTT
Inflation (Consumer Price Index per cent change)	Monthly	CBTT
Net Official Reserves (US\$M)	Monthly	CBTT
Government Debt Outstanding (US\$M)	Monthly	CBTT
Central Government Overall Fiscal Balance (TT\$000's)	Monthly	CBTT
Financial System: Loans Outstanding Consumers (TT\$M)	Monthly	CBTT
Financial System : Loans Outstanding Incorporated Businesses (TT\$M)	Monthly	CBTT
Commercial Banks : Real Estate Mortgage Loans (TT\$M)	Monthly	CBTT
Commercial Bank Ordinary Savings Deposit Rate (%)	Monthly	CBTT
Commercial Bank Basic Prime Lending Rate (%)	Monthly	CBTT
Commercial Bank Real Estate Mortgage Loan Rate (%)	Monthly	CBTT
Composite Stock price Index	Monthly	CBTT/ TTSE
Balance of Trade (US\$M)	Monthly	CBTT
Money Supply (M2) (TT\$M)	Monthly	CBTT
Index of Retail Sales	Quarterly	CBTT
Unemployment Rate (%)	Quarterly	CBTT
Index of Industrial Production – Brazil, India and USA	Monthly	IFS

As discussed above one of the desirable properties of the component indicators is that they must be underpinned by economic theory. In what follows below we outline in very summary terms the economic rationale for choosing these variables.

Exchange Rates

The exchange rate is probably the most important price in a small open economy like Trinidad and Tobago. In many cases events and news which drive economic performance is often embedded in this price before it is reflected in GDP growth. Economic agents who often base their current decisions of how they expect the economy to perform in the future also makes decisions that impact on the foreign exchange market and the exchange rate again, often before a distinct trend in GDP emerges. This rate is therefore likely to be a good leading indicator of economic performance in Trinidad and Tobago. The

average monthly price of the TT dollar relative to the US dollar is used since the foreign exchange market is dominated by US dollar trades.

Production and Prices of Minerals and Fuels

Oil and Gas is the mainstay of Trinidad and Tobago's economy, the production and prices of these commodities has a great impact on the performance of the economy. The economy has transformed in recent times, from being oil to a gas driven economy. In order to capture the performance of this sector the production of oil, gas and LNG, as well as prices for oil and gas are considered as component indicators for the LCI. We also use future prices of these commodities to try to build in a forward looking emphasis in the LCI.

Production of Industrial Products

The Industrial Production Index is also an important driver of the economy but this information is only available quarterly. Since we are interested in indicators on a monthly frequency we use some of the components this Index such as the production of cement, direct reduced iron, billets and wire rods as proxies for industrial production. These indicators are also important drivers for the construction sector which is one of the dominant sectors in the economy.

Inflation

The price level of all goods and services is a significant factor since high inflation has a negative impact on the economy as the cost to both consumers and businesses eventually reduces the demand for goods and services and by extension the output of the economy. The change in the Consumer Price Index is used as the measure for inflation.

Net Official Reserves

A high and increasing level of reserves is an indication that the country's foreign exchange earning sectors are doing well and since a good supply of foreign exchange is so critical to the Trinidad and Tobago economy this is a good indicator not only of the performance of the economy but also of its resilience to negative shocks which helps bolster confidence. This is therefore likely to be positively correlated with growth and a good coincident indicator in the LCI.

Central Government Debt

Debt is the entire stock of direct government fixed-term contractual obligations to others outstanding on a particular date. It includes domestic and foreign liabilities such as currency and money deposits, securities other than shares, and loans. It is the gross amount of government liabilities reduced by the amount of equity and financial derivatives held by the government.

Overall Fiscal Surplus/Deficit

The government's expenditure contributes to the growth of the economy, and the ability of the government to cover their expenditure is also important. The difference between government revenue and expenditure is the fiscal surplus deficit, a fiscal surplus is always a good indicator that the country is doing well economically.

Loans to Business and Consumers

The loans to business and consumers were included as possible indicators since loan demand is believed to reflect the level of confidence of these important agents in the economy with rising confidence associated with higher growth and lower confidence with lower economic growth. These indicators are therefore likely to be good leading indicators of economic activity, signaling when economic activity is likely to increase as well as when it is likely to fall off.

Mortgage Loan

Mortgage loans are used to purchase the major asset of most consumers and is often based on their expected income in the long-term⁵. A change in the expectations of future income of the consumer affects current consumption and therefore mortgage loans are a good indicator of their perception of future economic performance. It is also a good measure of their confidence in the economy. In this context, increasing mortgage loans is an indication that they expect economic growth to be robust while declines suggests that they expect growth to be weak. This indicator is therefore likely to be a good coincident indicator.

⁵ The Permanent Income Hypothesis

Composite Stock Price Index

Increasing stock prices are generally associated with rising economic growth and is seen as positive signs of increased confidence in the future of the economy. This indicator has also been shown to be a good leading indicator in previous research on composite economic indices. In this study the composite stock market price index is used.

Balance of Trade

The highly open nature of the Trinidad and Tobago economy means that trade balance is a good indicator of the performance of the economy as it reflects the competitiveness of the tradable sector. An increase in the trade balance is generally associated with increased growth and is therefore likely to be a good component of the LCI trying to capture economic performance.

Money Supply

The money supply is the total amount of money in circulation and is an important economic variable as it is closely linked to the exchange and inflation rates. It is a good indicator of a central bank's monetary and interest rate policy stance. Additionally, since in small open economies such as Trinidad and Tobago, the money supply is significantly affected by the external accounts, it is generally a good indicator of current economic performance.

Employment Data

The unemployment rate of a country is one of the most important economic indicators in a country because it impacts directly on consumer demand and sentiment. If unemployment rates are high it generally means that the economy is weak and consumer confidence low and the opposite dynamic operates if unemployment is low. Since consumer demand is central to economic performance and consumer confidence is increasingly an important determinant of current growth this is expected to be a good component indicator for the LCI.

Index of Retail Sales

The index of retail sales for Trinidad and Tobago measures the change in the monetary value of retail sales for a fixed sample of retail establishments. Retail sales is another indicator which captures

consumer demand and sentiment which as we have argued above is central to the performance of the local economy.

Index of Industrial Production – Brazil, India, UK and USA

Trinidad and Tobago is a small open developing nation and its economic fortunes are in large part driven by global developments in commodity prices and foreign demand. Global demand, especially from large industrial and emerging economies has a major impact on commodity prices and aggregate demand generally in the local economy. Industrial production of these important economies is a good indicator of the current and future trajectory of the global economy and industrial production from a number of important economies is used as a proxy for external demand.

These variables are examined for the period January 2000 to the most recent period for which data is available, that is September 2012. Appendix III shows the descriptive statistics for each proposed indicators. This time period was chosen for several reasons. We wanted to include the most recent time period since if the data is too long we run the risk of the indicator being overly influenced by economic structures and outcomes from the past and not reflective of current and future dynamics. The period chosen also included both a boom and a bust cycle and therefore contains regimes which may be driven by different variables and turning points which presents an opportunity to test the effectiveness of the LCI since the accurate identification of turning points is an important basis on which LCIs are judged.

3.2 Data Transformation and Indexation Model

Current and past economic events are reflected in the business cycles of the economy. The most widely cited definition of business cycle is from Burns and Mitchell (1946), they state a that “*Business cycles are a type of fluctuation found in aggregate economic activity of nations that organize their work mainly in business enterprise: a cycle consists of expansions occurring at about the same time in many economic activities, followed by similarly general recessions, contractions, and revivals which merge into the expansion phase of the next cycle; this sequence is recurrent but not periodic; in duration business cycles vary from more than one year to ten to twelve years; they are not divisible into shorter cycles of similar character with amplitudes approximating their own*”. These economic fluctuations are of interest to everyone, as the current economic situation and future economic prospects have implications for revenue and economic welfare. For this reason, the pre-selected indicators are examined and evaluated for their cyclical performance to validate their classification as a leading indicator.

Each proposed indicatorwastested using TRAMO⁶ to remove any outliers and seasonal factors that may be in the data. This TRAMO module which is found in EVIEWS 7 was applied to all variables since it identifies and removes the outliers of the series as well as fill in the missing data points in the time series. In keeping with the suggestions of McGuckin et al (2007) the missing data points are simply inputted by TRAMO. After the outliers have been detected and removed there is a need to de-trend and smooth the series to ensure that any irregularities are removed. The Hodrick-Prescott filter is then applied to get the filtered times series of the various indicators. The HP filter method is preferred and most widely used because it is a simple and flexible tool that can be used with no restrictions on the length of the series.

Once the de-trending and smoothing phase has been completed the next step would be the standardization and normalization of the indicators, to allow for comparisons across indicators.

Normalization formula: $X_n = \left[\frac{X^* - \bar{X}}{X^{**}} \right] + 100$

⁶ TRAMO ("Time Series Regression with Arima Noise, Missing Observations and Outliers") is a program for estimation, forecasting, and interpolation of regression models with missing observations and ARIMA errors, in the possible presence of several types of outliers (no restriction is imposed on the location of the missing observations in the series).

Where X_n = Normalized value of the indicator

X^* = Filtered Series

\bar{X} = Mean of Original Series

X^{**} = Mean Absolute Deviation of the Original Series

The other important step in the development of the leading composite index is the evaluation phase which is done with the use of the BUSY program. The filtered series are used in the BUSY program which identifies the lagging, coincident and leading indicators for Trinidad and Tobago.

Various indexing methods were reviewed from the literature, but the Dynamic Factor Analysis method was considered to be the most appropriate model to compute the Composite Index for Trinidad and Tobago. This method was chosen because it has been proven to be most suited for data sets with a large number of variables for a relatively short time series, as is the case for this study. Dynamic Factor Models⁷ were originally proposed by Geweke (1977) as a time series extension of factor models which were developed for cross-sectional data. The main thrust of the model was that a few factors could explain a large fraction of the variance of many macroeconomic time series.

Once the indicators are chosen on their statistical relevance, the normalized series for each variable is then used to compute the composite index. We use the equal weighting scheme for each indicator in keeping with major composite indices. That is, OECD stance on weights is adopted which is the view that equal weights implies by default, a judgment on appropriate weights, and the normalization process is itself a weighting system in reverse. After weighting and aggregating the indicators the Composite indicator is complete.

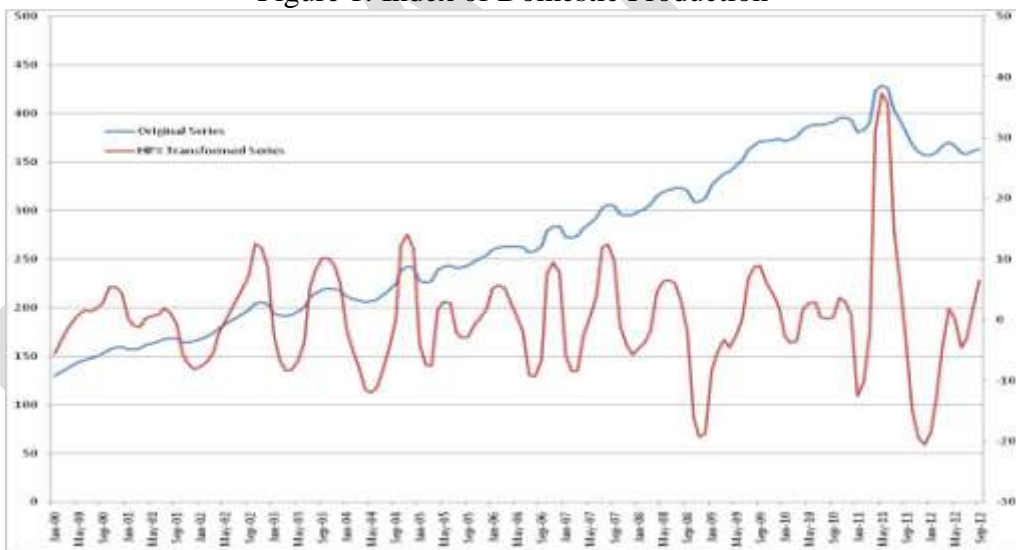
⁷See Appendix V for the methodology

4.0 The Composite Index of Trinidad and Tobago

4.1 Turning points Identification and Variable Identification

The turning points in an economy's business cycle are important as the identification process for the causes of the boom or recession can be found. We utilise the BUSY⁸ programme which is based on the Bry-Boschan method⁹ for turning point identification in the Trinidad and Tobago economy for the period January 2000 to September 2012. Using the index of domestic production as a proxy measure for the country's performance we evaluate whether the composite index accurately picks up the turning points. Figure 1 illustrates the actual index of domestic production and the de-trended and smoothed series with the missing data points imputed by TRAMO.

Figure 1: Index of Domestic Production



Trinidad and Tobago's proxy business cycle for the period under review consisted of five peaks and five troughs. These are outlined below:

⁸ The BUSY program makes available a selection of statistical techniques designed for conducting business cycle analysis on a possibly large set of time series. Two types of statistical procedures are offered. The first is an NBER-type of analysis that is based on descriptive statistics such as cross-correlations, coherences and phases of the cross spectra and Bry and Boschan dating procedure (see Bry and Boschan, 1971). The second is based on dynamic factor models, following the work by Forni et al. (1999, 2000). Both are aimed at building composite indices that are leading, coincident or lagging with respect to a reference series.

⁹ See Appendix VI for the methodology

Peaks :	Sept 2000	Sept 2002	March 2006	May 2008	April 2011
Troughs :	October 2001	April 2004	Dec 2006	Dec 2008	Dec 2011

There were several memorable events that occurred in review period both locally and internationally that may have had a significant impact on the cyclical behavior of the Trinidad and Tobago economy. These include:

- ❖ September 11th 2001 - Two hijacked passenger airlines plunged into the twin towers of the World Trade Centre in New York. The Pentagon in Washington was also partly destroyed by another hijacked airline.
- ❖ January 1st 2002 – Euro enters circulation
- ❖ July 31st 2003 - This date marked the end of an era for a large segment of the population as operations ground to a halt at Caroni (1975) Ltd leading to the layoff of 6000? workers.
- ❖ 2007 – The international financial crisis marks the beginning of a worldwide recession that many economies are still trying to overcome.
- ❖ July 23rd 2008 - The Hindu Credit Union was taken over by liquidator R.D. Rampersad & Company.
- ❖ January 30th 2009 - The Government structured an agreement with the CL Financial Limited Group for the provision of a package of financial support for the group's financial services companies.

If these turning points are replicated by the LCI then it would be an indication that it meets an important standard of an effective LCI - that is, it accurately tracks the turning points in economic cycles. An initial assessment of which variables are leading or lagging can be done using information Appendix VII which shows the lead and lags in months of the various indicators when compared to the turning points in our reference series the Index of Domestic Production.

4.2 The Composite Index Development

The Composite Index is a grouping of economic indicators standardized to provide a useful statistical measure of the country's economy. Three types of component indicators make up this composite index: lagging, coincident and leading; and there is a cause and chain effect that links them all. In determining

the relevant variables for the index, the ratio common component variance over series variance is examined and a value 0.3¹⁰ and below suggests that there is not strong commonalty and the indicator is idiosyncratic in nature. Table6 shows that the ratio common component variance over series variance for all indicators and the revised and improved ratios after the idiosyncratic variables are removed.

Indicator	All	Revised
Index of Domestic Production	0.475	0.572
Balance of Trade	0.453	0.506
Billets Production	0.411	0.461
Brazil Industrial Production Index	0.432	0.424
Cement Production	0.571	0.569
Composite Stock Price Index	0.450	0.491
Commercial Banks and NFIs – Business Deposits	0.574	0.607
Commercial Banks and NFIs – Consumer Deposits	0.358	-
Exchange Rate per US\$	0.513	0.440
Gas Fuel Production	0.466	0.487
Gas Future Price	0.673	0.711
Gas Price	0.642	0.692
Central Government Debt	0.385	-
Government Fiscal Balance	0.706	0.715
India Industrial Production Index	0.696	0.703
Inflation Rate	0.606	0.671
Iron Rod Production	0.451	0.478
Commercial Banks and NFIs – Business Loans	0.370	-
Commercial Banks and NFIs – Consumer Loans	0.648	0.660
Commercial Banks – Mortgage Loans	0.575	0.581
Commercial Banks Interest Rate on Loans	0.659	0.683
Methanol Production	0.472	0.499
Money Supply	0.463	0.499
Commercial Bank- Mortgage Interest Rate	0.530	0.552
Motor Gas Production	0.550	0.561
Oil Future Price	0.727	0.731
Oil Price	0.675	0.672
Oil Production	0.365	-
Refinery Oil Production	0.501	0.520
Net International reserves	0.413	0.408
Retail Sales Index	0.686	0.675
Commercial Bank – Ordinary Saving Interest Rate	0.301	-
United Kingdome Index of Industrial Production	0.607	0.634
Unemployment Rate	0.711	0.711
USA Index of Industrial Production	0.547	0.534

The relevant variables for the composite index are then evaluated to determine their properties, that is, whether they are lagging, coincident or leading variables. In a multi-country setting, each country is different in nature and as a result the variables will be classified differently across countries.

¹⁰ We experiment by increasing this benchmark to determine the robustness of the variable selected to the selection criterion and there is little change in variables selected.

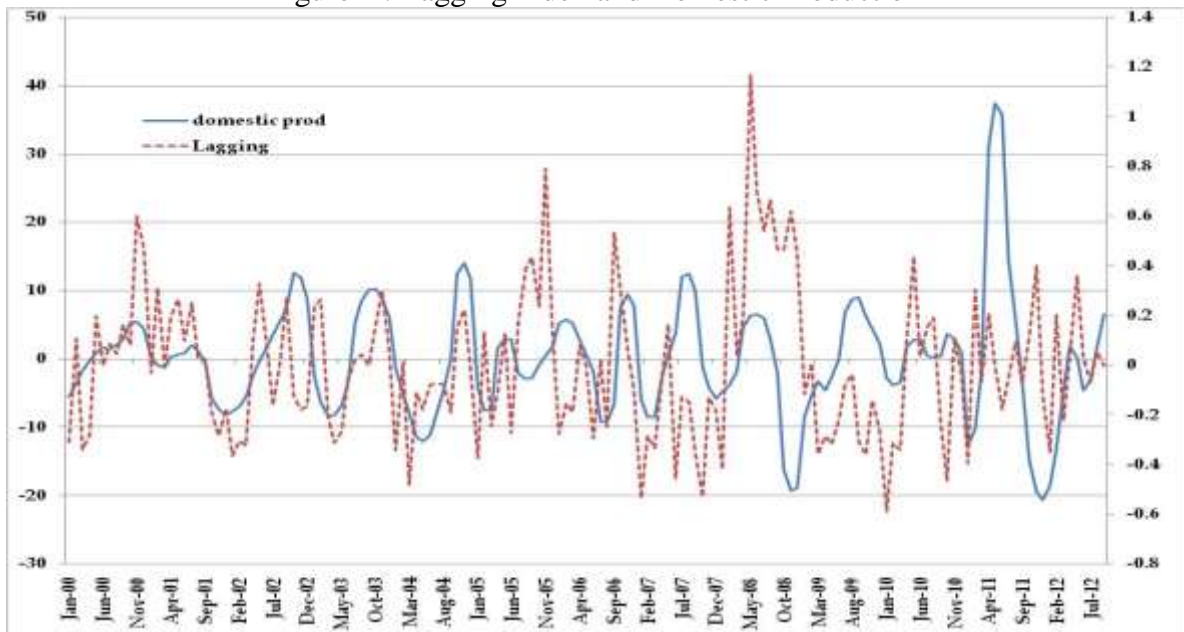
Classifications of the proposed economic variables are based on the correlation behavior of the common parts of each variable with respect to that common part of the reference series. High cross-correlation at positive (negative) lag is an evidence of a leading (lagging) behaviour with respect to the reference series.¹¹ Table 7 shows the indicators and their classification based on the Dynamic Factor Analysis.

Table 7 : Classification of variables based on the Dynamic Factor Analysis		
Leading Series	Coincident Series	Lagging Series
Balance of Trade	Billets Production	Industrial Production Index – Brazil
Composite Stock Price Index	Cement Production	Commercial Banks and NFIs – Business Deposits
Commercial Banks and NFIs – Consumer Deposits	Exchange Rate – per US\$	Future Gas Price
Gas and Fuel Production	Iron Production	Gas Price
Central Government Debt Outstanding	Future Price of Oil	Central Government Fiscal Balance
Industrial Production Index of India	Oil Price	Inflation
LNG Production	Oil Production	Commercial Banks and NFIs – BusinessLoans
Commercial Banks and NFIs – Consumer Loans		Commercial Banks – Loan Interest Rate
Commercial Banks – Mortgage Loans		Methanol Production
Money Supply		Motor Gas Production
Interest Rate – Mortgage Loans		Oil Refinery Production
Retail Sale Index		Net International Reserves
Industrial Production – UK		Commercial Banks – Ordinary Savings Rate
Unemployment Rate		Industrial Production Index – USA

An indicator is considered to be lagging when it confirms long term trends instead of predicting them. They are considered to be good indicators of measuring performance of the economy as oppose to predicting its performance. In the context of the Trinidad and Tobago economy¹⁴ lagging indicators were identified; lagging indicators while important for historical analysis, helps to clarify and confirm the underlying pattern of economic activity. The Lagging index is expected to have a delayed relationship to the business cycle of the country as can be seen in Figure 2 which shows the Lagging index for Trinidad and Tobago. Lagging economic indicators provide the final and conclusive evidence that peaks and troughs did occur, making it possible to direct attention to the next phase of the business cycle.

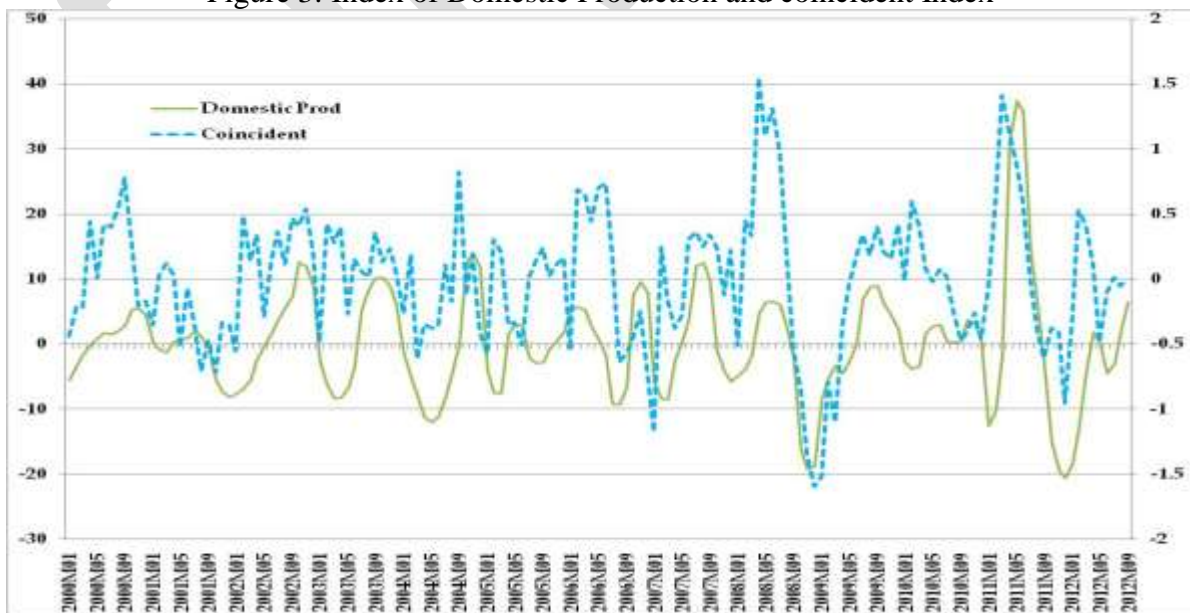
¹¹ See Appendix V for the table of correlation between common parts of the series and reference series.

Figure 2 : Lagging Index and Domestic Production



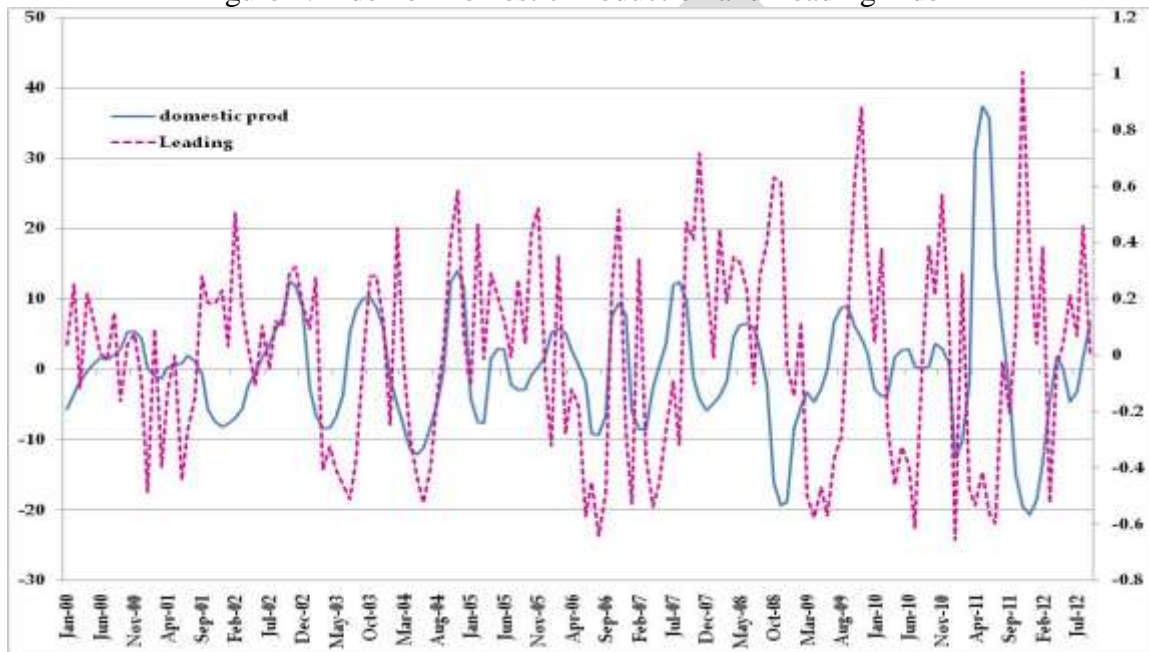
The second type of indicators is the coincident which reflects the current economic performance of the country and is a primary source of information used to determine business-cycle turning points. Coincident indicators tend to move in tandem to the business cycle of the country as its name implies it “coincides” with the aggregated business cycles events. In the case in Trinidad and Tobago seven of the 35 variables proposed were identified as coincident variables. Figure 3 shows the coincident index and the business cycle for Trinidad and Tobago.

Figure 3: Index of Domestic Production and coincident Index



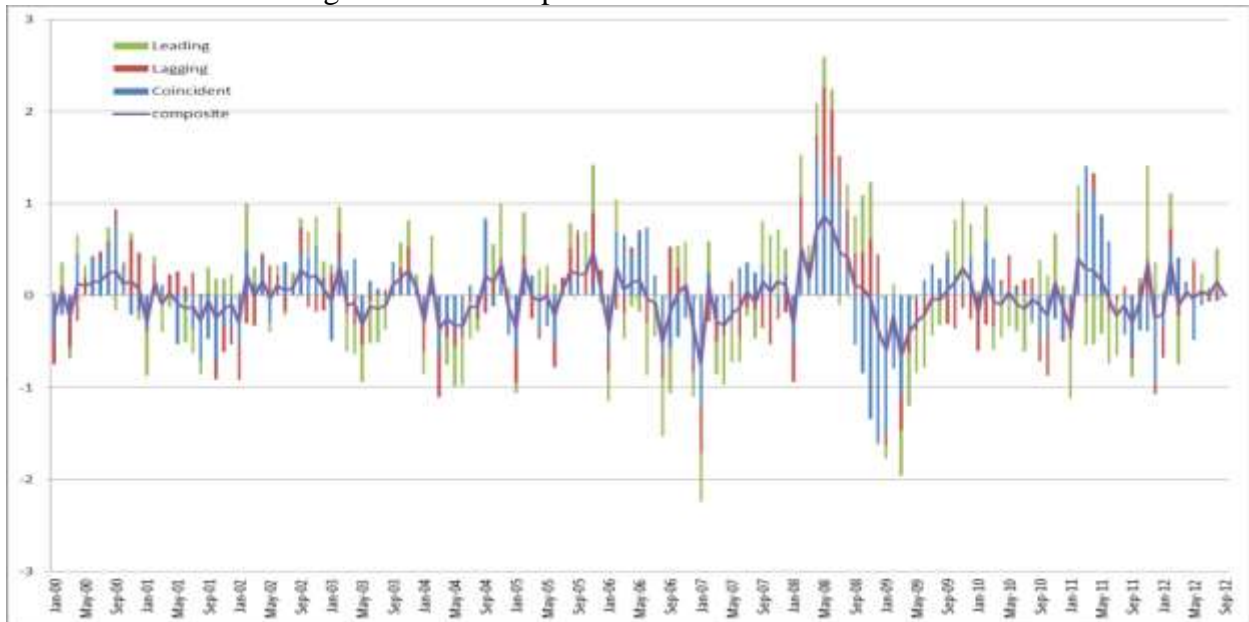
The final component of the composite index is its leading segment; the leading indicators are important to the business cycle analysis as they allow you to make pre-emptive moves to improve your chances of achieving strategic goals. They can be used to predict where the economy is headed in the near future. Leading indicators are based on variables that are believed to signal in advance the changes and performance of the economy thereby giving a preview of what is going to happen before it actually happens. Figure 4 shows the leading index of the Trinidad and Tobago.

Figure 4: Index of Domestic Production and Leading Index



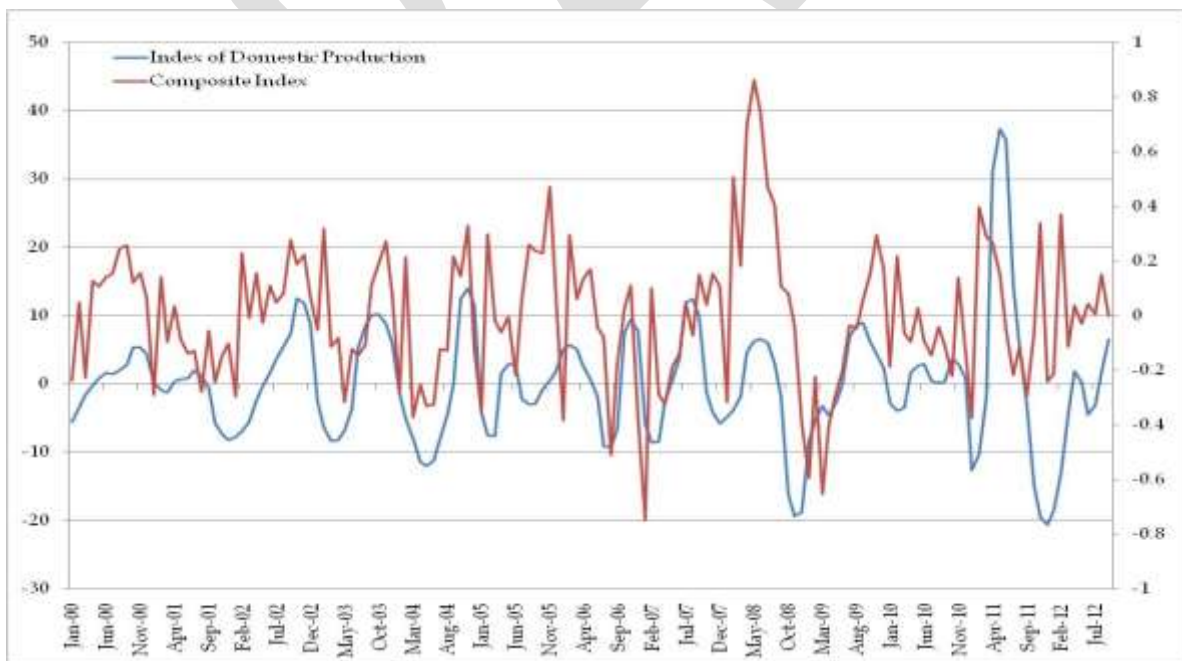
The composite index combines the lagging, coincident and leading indicators into a single number, using an equal weighting scale to create a reliable, single index of economic performance. Figure 5 below shows the lagging, coincident, leading and composite indices.

Figure 5: The Composite Index and its Sub-Indices



The composite index should be able to mimic the index of domestic production, and we see in Figure 6, it does a fairly good job from a visual inspection.

Figure 6: The Index of Domestic Production and Composite Index



4.3 Evaluation of the Composite Index

Initial graphical analysis indicates that the indices have been able to pick up and represent the peaks and troughs of the business cycle of Trinidad and Tobago. However more empirical testing of the indices should be done to evaluate the model and its ability to accurately forecast the composite index and sub indices. This is usually evaluated on the basis of how well the composite index tracks the reference series in terms of picking up the turning points, as well as on the basis of in-sample forecasting of the reference series. The summary statics of the forecast for the index of domestic production using the composite index resulted in a root meansquare error of 7.710 and the root mean square error for the leading index was 0.242¹².

Another way to evaluate if the indices are accurately portraying the economic activities of the country is comparing the turning points of the Index of domestic production to the turning points of the three indices – lagging, coincident and leading. The turning points of the various indices seem to support the fact that the composite index does accurately replicate the economic activities of Trinidad and Tobago. They all have displayed turning points that are desirous of them, that is the lagging index has turning points that are a month or more ahead of the actual index indicating that these variables are delayed. The only exception was for the third identified through at December 2006; at this point the lagging index reported the same turning point as the index of domestic production. Similarly the coincident index turning points are exact for most of the turning points of the reference series – index of domestic production. The Leading index turning points are also a number of months ahead of the actual turning point of the economic activities in Trinidad and Tobago.

¹² This is can be taken as a good value since for Barbados the mean square error for the leading index with the dynamic factor method was 18.1.

Table 8: Turning Points of Indices with respect to the Index of Domestic production (DFM)				
Index of Domestic Production	Composite Index	Lagging Index	Coincident Index	Leading Index
P: 10-2000	P: 7-2000	P: 10- 2000	P: 8-2000	P: 1-2003
T: 11-2001	T: 12-2001	T:12-2001	T: 10-2001	T: 7-2004
P: 9-2002	P-8-2002	P: 1-2003	P: 8-2001	P: 10-2005
T: 4- 2004	T:2-2004	T: 5-2004	T: 2-2004	T: 12-2006
P: 3-2006	P: 10-2005	P:10-2005	P: 7-2005	P: 7-2008
T: 12:2006	T: 12-2006	T: 12-2006	T:12-2006	T: 2-2009
P: 5-2008	P: 4-2008	P: 7-2008	P: 2-2008	
T: 12-2008	T: 12-2008	T: 2-2009	T: 12-2008	
P: 4-2011	P: 3-2011	P:4-2011	P: 3-2011	
T: 12-2011	T: 11-2011	T: 12-2011	T: 11-2011	

5.0 Conclusions and Recommendations

This is only the first attempt at the leading economic composite index for Trinidad and Tobago, but this index derived has potential to be a good summary indicator of the economy. It has been able to accurately track the changes of the economy to date. The use of leading composite indices is an ancient tool for economic analysis in industrialized countries and this paper was able to add to spares literature on the Caribbean on economic composite indices.

The Leading composite index also helps to give an indicator of where the economy is headed based on real economic data. However its ability to track confidence is a shortfall of the index, which we plan to address by incorporating a proposed measure of expectations using economic news as a variable in the index. A recurring problem in the Caribbean region is data limitations there were other identified variables that could have been used but because they were not available monthly or not available for the entire time period of the study, they had to be left out.

Appendix I

Pros and Cons of Composite Indicators

Pros:

- Composite Indicators can be used to summarize complex or multi-dimensional issues, in view of supporting decision makers.
- Composite Indicators provide the big picture. They can be easier to interpret than trying to find a trend in many separate indicators; they facilitate the task of ranking countries in complex issues.
- Composite Indicators can help attiring public interest by providing a summary figure with which to compare the performance across countries and their progress over time.
- Composite indicators could help to reduce the size of a list of indicators or to include more information within the existing size limit.

Cons:

- Composite indicators may send misleading, non-robust policy messages if they are poorly constructed or misinterpreted. Sensitivity analysis can be used to test composite indicators for robustness.
- The simple “big picture” results which the composite indicator shows may invite politicians to draw simplistic policy conclusions. Composite indicator should be used in combination with the sub-indicators to draw sophisticated policy conclusions.
- The construction of the composite indicator involves stages where judgment has to be made: the selection of sub0indicators, choice of model, weighting indicators and treatment of missing values etc. These judgments should be transparent and based on sound statistical principles.
- There could be more scope for disagreement among member states about composite indicators than on individual indicators. The sub-indicators and weights could be target of political challenge.
- The Composite Indicator increase the quantity of data needed because data are required for all the sub-indicators and for a statistically significant analysis.

Source: Composite Indicators – The Controversy and the way forward, Staltelli et al (2004)

Appendix II

Table 2: Composite Index and Confidence Indices of the CARICOM Region						
Country	Organisation	Name of Index	Series	Date of Inception	Methodology	Availability to public
CARICOM countries – Antigua, Barbados, Dominica, Grenada, Guyana, Jamaica, St. Lucia, Suriname, St. Vincent and Grenadines, St. Kitts and Nevis and Trinidad and Tobago	Caribbean Investments and Wealth Management (Barbados)	CARICOM Consumer Sentiment Report	Quarterly	April 2011	University of Michigan	Available to public for free on website
Barbados	Ministry of Economic Affairs (Barbados)	Composite Economic Indexes	Quarterly	2005	NBER	Available to public for free on website
Jamaica	Jamaica Chamber of Commerce	Consumer Confidence Index	Quarterly	2001	University of Michigan	
Jamaica	Jamaica Chamber of Commerce	Business Confidence Index	Quarterly	2001	University of Michigan	
Trinidad and Tobago	CMMB	Composite Leading Indicator	Quarterly	2006		No longer produced
Trinidad and Tobago	Republic Bank Ltd. and Market Fact and Opinion	RBL-MFO Consumer Confidence Index	Quarterly	Not sure	University of Michigan	No longer produced – but a subscription had to be paid to get the report.
Trinidad and Tobago	Lok Jack GSB,UWI	Corporate Confidence Index	Quarterly	2001	World Economic Forum	A subscription has to be paid.

APPENDIX III

Table 1: Composite Indices of Selected Economies.			
Country	Organisation	Name of Index	Variables Used
United States	NBER	Composite Index of Leading Indicators	<ul style="list-style-type: none"> - Length of weekly work in the industry - Demand for unemployment benefits - Orders to industry - Delivery times - New construction permits - Stock Market - Variation in Money Supply - Interest Rates - Prices of Raw Materials - Consumer Expectations
	OECD	Composite Leading Indicator	<ul style="list-style-type: none"> - Dwellings started (number) - Net new orders for durable goods (USD) - Share prices: NYSE composite (2005=100) - Consumer sentiment indicator (normal = 100) - Weekly hours of work : manufacturing (hours) - Purchasing managers index (BS) (% balance) - Spread of interest rates (% per annum).
	Conference Board	The Conference Board Leading Economic Index for US	<ul style="list-style-type: none"> - Average Weekly hours (Manufacturing) - Average weekly initial claims for unemployment insurance - Manufacturing new orders, consumer goods and materials - Building permits, new private housing units - Stock prices, 500 common stocks - Leading Credit Index - Interest Rates Spread – Treasury Bond (10yr) less Federal Funds - Average Consumer Expectations for Business and Economic conditions
Canada	Statistics Canada	Canadian Composite Leading Indicator	<ul style="list-style-type: none"> - Housing Index - Business and personal service employment - Stock Exchange Index - Money Supply - US Composite Leading Indicator - Average Work Week - New Orders of durables - Shipments/Inventories of finished goods - Furniture and Appliance Sales - Other durable goods sale
	OECD	Composite Leading Indicator	<ul style="list-style-type: none"> - Deflated money supply (m1) sa (1995 cad) - Housing starts large cities sa (number) - USA business climate indicator (pmi) sa (normal=50)

			<ul style="list-style-type: none"> - Consumer confidence sa (2000y) - Spread of interest rates (% a.r.) - Ratio of inventories to shipments (ratio) inverted - Share prices (S&O/TSX composite index) (2005y)
Japan	Economic and Social Institute of Japan	Leading Economic Index of Japan	<ul style="list-style-type: none"> - SNA - Orders received for Machinery - New Buildings started - Index of Industrial Production - Labour Force Survey of employment situation - Non-Scheduled hours worked - Compensation of Employees - Retail Sales
	Conference Board	The Conference Board Leading Economic Index for Japan	<ul style="list-style-type: none"> - Operating Profits - Dwelling Units Started - Business Failures - Index of Overtime Worked - Number of employed persons - Industrial Production - Stock Prices - Six month growth of Labour Productivity - Tankan Business Conditions Survey - Money Supply - Yield Spread - New orders for Machinery and Construction - Wage and Salary Income - Real Retail, Wholesale and Manufacturing Sales
	OECD	Composite Leading Indicator	<ul style="list-style-type: none"> - Inventories to shipments ratio (mining and manufacturing) - Ratio imports to exports - Ratio loans to deposits - Monthly overtime hours (manufacturing) - Construction: dwellings started - Share price index (TOPIX) Tokyo - Spread of interest rates - Small business survey: Sales tendency
Philippine	Bersales et al (2004)	Philippine Leading Economic Indicator System	<ul style="list-style-type: none"> - CPI - Electric Energy Consumption - Exchange Rate - Hotel Occupancy Rate - Money Supply - Number of new business incorporations - Stock Price Index - Terms of Trade Index - Total Imports

			<ul style="list-style-type: none"> - Tourist/Visitor Arrivals - Whole Sale Price Index
India	OECD		<ul style="list-style-type: none"> - Industrial production of durable goods (2005=100) - Production of manufactured non metallic mineral products (2005=100) - Passenger car sales (number) - Monetary aggregate m1 (inr) - Share prices: BSE dollex (2005=100) - Call money rate (% per annum) inverted
Turkey	Aslıhan Atabek, Evren Erdoğan Coşar and Saygın Şahinöz (2005) : Central Bank of the Republic of Turkey)	A composite leading indicator for the Turkish economic activity	<ul style="list-style-type: none"> - Industrial Production Index - Production Amount of Durable Consumption Goods - Production Amount of Electricity - Interest Rate on Three Months Time Deposit - Interest Rate on Six Months Time Deposit - Interest Rate on Twelve Months Time Deposit - Discounted Treasury Auctions Interest Rate - Imports of Intermediate Goods - Employment (number of employees) - CBRT Business Tendency Survey Question Related to the Stocks of Finished Goods - CBRT Business Tendency Survey Question Related to the Amount of New Orders Received From Domestic Market - CBRT Business Tendency Survey Question Related to the Investment Expenditure - CBRT Business Tendency Survey Question Related to the Volume of Output - CBRT Business Tendency Survey Question Related to the Export Possibilities - CBRT Business Tendency Survey Question Related to the Employment.
South Africa	OECD	Composite Leading Indicator	<ul style="list-style-type: none"> - Orders inflow (manufacturing): tendency (% balance) - Industrial confidence indicator (% balance) - Permits issued: dwellings (2005=100) - Sales of motor cars (2005=100) - Share prices: ftse/jse index (2005=100) - Spread of interest rate (% per annum)
	South Africa Reserve Bank	Composite Leading Index	<ul style="list-style-type: none"> - Opinion survey of volume of orders in manufacturing - Opinion survey of stocks in relation to demand: Manufacturing and trade - Opinion survey of business confidence: Manufacturing, construction and trade - Composite leading business cycle indicator of major trading-partner countries: Percentage change over twelve months - Commodity prices in US dollars for a basket of South Africa's export commodities: Six-month smoothed growth rate - Real M1 money supply (deflated with the CPI): Six-month smoothed growth rate - Prices of all classes of shares: Six-month smoothed growth rate - Number of residential building plans passed for flats, townhouses and houses larger than 80m - Interest rate spread: 10-year bonds less 91-day

			<ul style="list-style-type: none"> - Treasury bills - Gross operating surplus as a percentage of gross domestic product - Labour productivity in manufacturing: Six-month smoothed growth rate - Job advertisements in the Sunday Times newspaper: Six-month smoothed growth rate - Opinion survey of the average hours worked per factory worker in the manufacturing sector
Barbados	Ministry of Economic Affairs Barbados	Composite Leading Index	<ul style="list-style-type: none"> - Average Lending Rate (%) - Durable Consumer Imports (BDS\$ 000) - Labour Force (000 persons) - Long-Stay Arrivals (persons) - Long-Stay Arrivals from Canada (persons) - Long-Stay Arrivals from CARICOM (persons) - Money Supply (BDS) - Non-Durable Consumer Imports (BDS\$ 000) - Oil Prices (US\$ per barrel) - Real GDP UK (2000=100) - Real GDP US (2000=100) - Treasury Bill Rate (%) - Average Length of Stay (Days) - Domestic Exports (BDS\$ 000) - Inflation Rate (%) - Long-Stay Arrivals from UK (persons) - Long-Stay Arrivals from US (persons) - Minimum Deposit Rate (%) - Prime Lending Rate (%) - Total Reserves less Gold (US\$ Million) - Weighted Average Deposit Rate (%) - Capital Goods Imports (BDS\$ 000) - Construction Materials (BDS\$ 000) - Cruise-Ship Passenger Arrivals (persons) - Employment (000 persons) - Fuel Imports (BDS\$ 000) - Hotel Bed Occupancy (%) - Hotel Room Occupancy (%) - Index of Industrial Production (2005=100) - Intermediate Goods Imports (BDS\$ 000) - Machinery Goods Imports (BDS\$ 000) - Real GDP Canada (2000=100) - Retail Price Index (2005=100) - Retained Imports (BDS\$ 000) - Total Consumer Imports (BDS\$ 000)
Trinidad and Tobago	FCIB (formerly CMMB)	The CMMB Composite Leading Index	<ul style="list-style-type: none"> - WTI Closing Price - Production of Methanol (000's Barrels) - TT Stock Exchange All items - Production of Cement (000's Tonnes) - Interest Rate Spread 90-DAY and 10-YR

APPENDIX IV

Indicator	Mean	Median	Maximum	Minimum	Std. Dev.	Skewness	Kurtosis	Jarque-Bera	Probability	Sum	Sum Sq. Dev.	Observations
BAL_TRADE	630.31	633.82	1095.11	-42.87	235.13	-0.14	2.34	3.23	0.20	93916.23	8182402.00	149
BILLETS_PROD	55.92	57.30	83.40	16.30	15.02	-0.40	2.50	5.40	0.07	8219.60	32946.73	147
BRAZIL_IIP	101.05	101.06	117.45	82.24	10.90	-0.05	1.60	12.32	0.00	15258.32	17806.96	151
CEMENT_PROD	65783.98	66865.50	95156.00	7679.00	11672.71	-1.12	7.51	158.57	0.00	9867597.00	20300000000.00	150
COM_STK_PRICE	187.25	200.30	284.05	97.21	54.68	-0.36	1.84	11.82	0.00	28462.52	451477.70	152
DEPOSIT_BUSINESS	10742.01	11455.20	18458.80	3061.91	4780.96	-0.23	1.52	15.13	0.00	1622043.00	3430000000.00	151
DEPOSIT_CONSUMER	23008.50	19436.10	42322.60	14246.50	8513.26	0.88	2.31	22.39	0.00	3474284.00	10900000000.00	151
DOMESTIC_PROD	263.90	258.55	422.83	129.71	80.29	0.18	1.83	9.25	0.01	38793.30	941212.10	147
ER_US	6.32	6.30	6.45	6.14	0.06	-0.10	3.96	6.07	0.05	966.69	0.59	153
GAS_FPRICE	5.48	5.13	13.45	2.05	2.35	1.09	4.44	43.83	0.00	838.31	838.32	153
GAS_PRICE	5.38	5.06	13.42	1.95	2.30	1.08	4.41	42.51	0.00	823.81	807.32	153
GASFUEL_PROD	1577.90	1575.39	2537.20	842.79	332.58	0.42	3.34	5.19	0.07	236685.30	16480397.00	150
GOVT_DEBT	22719.61	20158.90	33718.70	17341.30	4748.38	1.13	2.79	32.69	0.00	3430661.00	3380000000.00	151
GOVT_FISCAL_BAL	159746.20	-22016.00	7904310.00	-3629160.00	1429458.00	1.32	8.44	230.32	0.00	24121679.00	30700000000000.00	151
INDIA_IIP	111.74	108.18	180.58	71.38	29.98	0.38	1.91	11.10	0.00	16761.12	133894.20	150
INFLATION	6.74	6.41	16.20	0.60	3.45	0.65	2.69	11.37	0.00	1024.44	1799.39	152
IRON_PROD	160.06	165.90	241.60	0.00	45.31	-0.84	3.92	22.49	0.00	23528.60	299755.90	147
LNG_PROD	1996320.00	2238430.00	3140920.00	362400.00	901862.40	-0.67	1.98	17.81	0.00	301000000.00	12200000000000.00	151
LOAN_INTRATE	11.33	11.50	16.50	7.75	2.58	0.58	2.54	9.93	0.01	1721.78	1001.33	152
LOANS_BUSINESS	16445.32	16385.20	25443.10	6746.57	6265.38	-0.07	1.33	17.68	0.00	2483244.00	5890000000.00	151
LOANS_CONSUMER	13665.74	13105.70	21176.80	7495.12	4911.66	0.11	1.36	17.29	0.00	2063527.00	3620000000.00	151
LOANS_MORT	5127.96	4720.51	12501.40	592.78	4113.11	0.35	1.61	15.25	0.00	774322.10	2540000000.00	151
METH_PROD	383.69	405.67	588.43	153.22	131.16	-0.16	1.47	15.38	0.00	57937.57	2580273.00	151
MONEY_SUP	32004.07	28043.20	65018.20	12813.60	16457.95	0.57	1.94	15.16	0.00	4832614.00	40600000000.00	151
MORTG_INTRATE	11.52	11.50	17.50	7.75	2.83	0.80	2.85	16.39	0.00	1740.02	1201.61	151
MOTORGAS_PROD	895.69	929.41	1416.80	364.55	203.88	-0.37	3.01	3.47	0.18	135248.60	6235333.00	151
OIL_FPRICE	59.45	59.21	134.02	19.40	28.23	0.43	2.22	8.56	0.01	9095.56	121141.00	153
OIL_PRICE	59.40	59.03	133.88	19.39	28.18	0.43	2.22	8.60	0.01	9088.47	120671.30	153
OIL_PROD	3599.31	3582.82	4834.23	2328.06	573.47	0.04	2.50	1.60	0.45	543496.50	49329338.00	151
REFIN_OIL_PROD	4481.49	4587.47	5351.03	1527.18	603.30	-1.99	9.62	376.08	0.00	676704.30	54596490.00	151
RESERVES	5242.13	5139.82	9903.10	901.67	3206.48	0.13	1.37	17.25	0.00	791562.00	1540000000.00	151
RSI	172.97	168.46	306.93	95.43	58.25	0.29	1.96	8.68	0.01	25426.80	495454.00	147
SAV_INTRATE	1.68	1.63	5.56	0.20	0.98	0.47	3.89	10.55	0.01	252.96	145.29	151
UK_IIP	97.50	98.05	114.96	79.19	6.58	-0.08	2.74	0.59	0.74	14722.89	6484.92	151
UNEMPLOY	7.70	7.00	12.50	3.90	2.57	0.29	1.65	12.41	0.00	1062.60	907.92	138
USA_IIP	97.59	96.77	107.36	88.63	4.37	0.22	2.19	5.38	0.07	14833.55	2881.34	152

APPENDIX V

Dynamic Factor Model Methodology - BUSY Program Manual (2003)

The approach BUSY bases its Dynamic Factor Model is the non-parametric version of factor models proposed by Forni et al. (1999 and 2000). The dynamic version allows the classification of the series with respect to the reference one is a by-product of the decomposition procedure. An important feature of dynamic factor models is that they provide a statistical framework for business cycle analysis in large-scale data sets where all the different steps of the analysis are nested into a unified theoretical setting.

As described by Forni et al. (1999,2000) , the generalized dynamic factor model assumes that N second-order stationary variables denoted $Z_{it}, i = 1, \dots, N$ observed at time t share q orthogonal common factors y_{1t}, \dots, y_{qt} . Let z_t and Y_t denote the $N \times 1$ vector of observations and the $q \times 1$ vector of unobservable factors, respectively. Writing $C_q(L)Y_t$ the linear projection of Z_t on the space generated by $\{y_{1t}, \dots, y_{qt}\}$, the vector of observations verifies:

$$Z_t = C_q(L)Y_t + \zeta_t = \chi_t^q + \zeta_t \quad (4.1)$$

Where ζ_t is a $N \times 1$ vector of possibly cross-correlated idiosyncratic components and the $N \times 1$ vector χ_t^q contains the common part of the series. Orthogonality between common factors and idiosyncratic parts implies the spectral density matrix (sdm) relationship

$$\Sigma(\omega) = \Sigma_{\chi}^q(\omega) + \Sigma_{\zeta}(\omega) \quad (4.2)$$

where $\omega \in [-\pi, \pi]$ is a frequency and $\Sigma(\omega), \Sigma_{\chi}^q(\omega), \Sigma_{\zeta}(\omega)$ are the sdm of the series, of the common and of the idiosyncratic parts respectively. The vector of common parts, χ_t^q , can be estimated using the dynamic principal components developed in Forni et al. (1999, 2000) as summarized below.

Let us denote $p_j(\omega) = \{p_{j1}(\omega)\} \dots, p_{jN}(\omega)$ the j -th eigenvector of the $N \times N$ sdm matrix $\Sigma(\omega)$ associated with the j -th eigenvalue $\lambda_j(\omega)$, the eigenvalues being classified in descending order. The N vectors $p_j(\omega), j = 1, \dots, N$, represents an orthonormal system of eigenvectors for I_N . It can be checked that the projection of Z_t on the first q eigenvectors verifies

$$\chi_t^{q*} = K^q(L)Z_t \quad (4.3)$$

Where the $N \times N$ matrix of filters is such that

$$K^q(L) = p_1(L^{-1})' p_1(L) + \dots + p_q(L^{-1})' p_q(L)$$

Under certain assumptions, Forni et al. (2000) showed that χ_t^{q*} is a consistent estimator of χ_t^q .

The $N \times N$ matrix of polynomials $K^q(L)$ is computed first in the frequency domain as:

$$K^q(\omega) = p_1(\omega)' p_1(\omega) + \dots + p_q(\omega)' p_q(\omega)$$

For instance the ij -th entry in the matrix $K^q(\omega)$ is

$$K_{ij}^q(\omega) = p_{1i}(\omega)' p_{1j}(\omega) + \dots + p_{qi}(\omega)' p_{qj}(\omega)$$

In practice, $K^q(\omega)$ must be evaluated over a finite number of frequencies. Following Forni et al. (1999, 2000), M is denoted, the number of frequencies in $(0, \pi)$ where the spectral density matrix is computed, so over $[0, 2\pi]$ the following $2M+1$ frequencies are considered:

$$\omega_1 = 0, \omega_2 = \frac{2\pi}{2M+1}, \dots, \omega_{2M+1} = 2M \frac{2\pi}{2M+1}$$

By computing the matrix $K^q(\omega)$ at the $2M+1$ frequencies above, the weights of the polynomial

$$K_{ij}^q(L) = \sum_{k=-M}^M K_{ijk}^q L^k$$

that loads the j -th variable for the estimation of i -th common component can be removed by inverse Fourier Transform as in :

$$K_{ijk}^q = \frac{1}{2M+1} \sum_{k=0}^{2M+1} K_{ij}^q(\omega_k) e^{ik\omega_k}$$

(4.4)

Using this methodology the BUSY program estimates the common component and the idiosyncratic part in every series, the decomposition being such that:

$$Z_t = \chi_t^{q*} + \zeta_t^*$$

The common component obtained can be saved in output.

The classification of all series according to the behavior the common parts with respect to that of the reference series is performed by computing the mean delays in the first row of the common components spectral density matrix, namely $\sum_x^q(\omega_1)/\omega_1$. For example, if the mean delay is between -1 and 1 , meaning between one period lead and one period lag, then the series can be classified as leading (lagging) by more than one period. The building of composite indexes is based on the common parts of all series, similar to the NBER-type of approach. Also, because the common component of every series is cleaned of idiosyncratic short-term noise, the dating of turns can be improved when performed directly on the common components.

APPENDIX VI

Bry-Boschan Methodology - BUSY Manual (2003)

The turning point detection procedure is based on the one built by Bry and Boschan (1971), with some updates and adaptation to the case of quarterly series. The procedure can be described as follows.

1. The original Bry and Boschan procedure starts with a detrending moving average. As our series have already been detrended either via first-order difference, Hodrick-Prescott or Baxter-King filtering, that first stage is skipped as irrelevant.
2. On the transformed series, a Spencer moving average is applied in order to obtain the so called Spencer curve. The Spencer moving average is defined as:

$$v(L) = \frac{1}{320} \left[\begin{aligned} &74 + 67(L + L^{-1}) + (46(L^2 + L^{-2}) + 21(L^3 + L^{-3}) + 3(L^4 + L^{-4}) - 5(L^5 + L^{-5})) \\ &- 6(L^6 + L^{-6}) - 3(L^7 + L^{-7}) \end{aligned} \right]$$

At both ends of the series, following the original procedure, the data are extended assuming that the growth rate of the first (last) 4 observations is constant in the previous (next) seven periods.

3. The stationary series is corrected for outliers. Outliers are identified as the points that lie outside the range $[\bar{z}_{it} - \alpha\sigma(z_{it}), \bar{z}_{it} + \alpha\sigma(z_{it})]$, where \bar{z}_{it} denotes the sample mean of the i -th series and $\sigma(z_{it})$ the sample standard deviation. Outlying points are replaced by their equivalent on the Spencer curve. Passing the Spencer moving average on the outlier corrected series yields an outlier-corrected Spencer curve.
4. For monthly data, a 2x12 centered Moving Average (MA) is applied on the outlier-corrected data in order to obtain the "first cycle" curve. For quarterly series, 2x4MA are used instead. The use of 2x12 or 2x4 MA instead of 4-term or 12-term is recommended as both are symmetric and hence do not cause any phase shift in output.
5. A first set of potential turning points are searched for in the MA12 or 2x12MA filtered series, and it is used to look for the corresponding turning points on the Spencer curve. The turning points are looked for in the interval $[t-n\text{term}, t+n\text{term}]$ where the default is $n\text{ term}=5$.
6. A minimum phase length of $1.25 \cdot \text{MQ}$ periods, MQ denoting data periodicity - i.e. 4 or 12 for quarterly or for monthly series, from a peak (trough) to a peak (trough) is imposed. The succession peak-trough is checked and imposed if necessary.

7. The Months for Cyclical Dominance (MCD), i.e. the minimum month-delay for which the average of absolute deviations of growth in Spencer cycle is larger than that in the irregular component is computed. Then, the outlier-corrected series is passed through a moving average of length MCD. A new set of turning points is looked for on the basis of the complementary turning points that have been found on the Spencer curve. Again the succession of turns and minimum distance of $1.25*MQ$ from peak to peak or from trough to trough are imposed.
8. These last set of turning points are cleaned by removing the turns found in the first six or last six observations, and by imposing a minimum phase length - i.e. distance peak (trough) to trough (peak) of 5 observations.

DRAFT

APPENDIX VII

<i>Dynamic Factor Turning point analysis: leads and lags with respect to the reference series :Index of Domestic Production</i>										
	Peak	Trough	Peak	Trough	Peak	Trough	Peak	Trough	Peak	Trough
Reference Series	Sep-00	Feb-03	Sep-03	Feb-05	Apr-06	Feb-07	Jul-07	Dec-08	Apr-11	Dec-11
BAL_TRADE	3	-20	-9	4	-4	8	10	9	-16	-
BILLETS_PROD	3	-15	-5	2	-2	-3	2	0	-12	-
BRAZIL_IIP	0	2	-12	-	-5	1	11	3	0	0
CEMENT_PROD	9	-14	-	-	-	9	-5	12	10	-
COM_STK_PRICE	14	-1	-1	3	-	-	1	-6	-5	-4
DEPOSIT_BUSINESS	3	-11	-3	0	3	0	11	10	-10	-4
ER_US	15	-	-	-9	-2	-6	5	-5	2	3
GASFUEL_PROD	4	-1	0	-	-	-	-	-	-1	-13
GAS_FPRICE	0	6	-8	2	-7	5	10	5	-16	-15
GAS_PRICE	1	6	-8	-	-7	4	10	3	-16	-15
GOVT_FISCAL_BAL	-2	3	-11	-	-	-	-	14	-21	-
INDIA_IIP	-	-	-	-	-2	-5	7	-5	-2	3
INFLATION	17	4	14	-	-	-6	-6	-3	3	1
IRON_PROD	3	-15	-	-	-5	-5	12	3	-	-
LNG_PROD	10	9	-1	-	-8	5	13	-	6	-12
LOANS_CONSUMER	5	-3	-4	5	-	10	-2	-	-	-13
LOANS_MORT	-	-17	4	7	1	-	-	-3	-4	-3
LOAN_INTRATE	0	3	-	-	-5	-6	4	2	-15	-
METH_PROD	3	-11	-2	4	-	-	12	3	0	3
MONEY_SUP	14	-	-	-7	-5	-7	4	6	-17	-
MORTG_INTRATE	-2	2	15	-	-	-3	4	1	-13	-
MOTORGAS_PROD	-2	-11	13	4	6	-	-	-9	-	-17
OIL_FPRICE	0	-15	-9	-1	-7	-2	10	1	-1	-
OIL_PRICE	0	6	-9	-	-7	-1	10	1	-1	-
REFIN_OIL_PROD	5	11	-12	-	-12	11	-	-	-16	-14
RESERVES	16	-2	-	-	-6	-5	3	-3	-18	3
RSI	4	-17	-2	8	2	7	-	-	10	-14
UK_IIP	-2	-12	-	-	-	-	0	2	11	-10
UNEMPLOY	6	-15	-6	9	-	9	-4	11	-1	-1
USA_IIP	-2	4	-14	-	-9	2	10	3	-	-

Note : + (-) denotes a lag (lead) with respect to the reference series

APPENDIX VIII

TURNING POINTS OF INDICATORS (DYNAMIC FACTOR ANALYSIS)												
BAL_TRADE	P:12-2000	T:6-2001	P:12-2002	T:8-2004	P:2-2006	T:8-2007	P:5-2008	T:5-2009	P:12-2009			
BILLETS_PROD	P:9-2000	T:5-2001	P:2-2002	T:1-2003	P:8-2003	T:6-2005	P:2-2006	T:11-2006	P:4-2008	T:12-2008	P:2-2010	
BRAZIL_IIP	P:9-2000	T:8-2001	P:9-2002	T:4-2003	P:9-2004	T:12-2006	P:6-2008	T:3-2009	P:2-2010	T:12-2011		
CEMENT_PROD	T:12-2001	P:6-2003	T:11-2005	P:4-2009	T:12-2009							
COM_STK_PRICE	T:4-2001	P:11-2001	T:1-2003	P:8-2003	T:9-2005	P:9-2006	T:6-2008	P:5-2010	T:10-2011			
DEPOSIT_BUSINESS	T:9-2000	P:2-2002	T:6-2003	P:8-2005	T:6-2008	P:10-2009	T:6-2010	P:8-2011	T:3-2012			
DEPOSIT_CONSUMER	P:7-2000	T:7-2001	P:2-2002	T:12-2002	P:6-2003	T:4-2005	P:7-2007	T:10-2008	P:2-2010			
DOMESTIC_PROD	P:10-2000	T:5-2001	P:5-2002	T:4-2003	P:11-2003	T:12-2008	P:5-2011	T:12-2011				
ER_US	T:5-2003	P:12-2004	T:8-2006	P:12-2007	T:7-2008	P:12-2009	T:9-2010					
GASFUEL_PROD	T:1-2003	P:1-2004	T:8-2005	P:7-2007	T:10-2008	P:1-2010	T:12-2011					
GAS_FPRICE	P:9-2000	T:1-2002	P:1-2003	T:8-2003	P:9-2005	T:7-2007	P:5-2008	T:4-2009	P:11-2009			
GAS_PRICE	P:9-2000	T:10-2001	P:12-2002	T:8-2003	P:9-2005	T:6-2007	P:5-2008	T:4-2009	P:12-2009	T:10-2010	P:8-2011	T:3-2012
GOVT_DEBT	T:2-2001	P:11-2001	T:4-2003	P:7-2005	T:8-2006	P:11-2007	T:10-2008	P:12-2010				
GOVT_FISCAL_BAL	P:7-2000	T:5-2001	P:1-2002	T:5-2003	P:10-2004	T:8-2006	P:7-2009	T:2-2010				
INDIA_IIP	P:2-2002	T:7-2003	P:2-2006	T:10-2006	P:2-2011	T:3-2012						
INFLATION	T:7-2001	P:2-2002	T:9-2003	P:9-2005	T:10-2008	P:10-2009	T:7-2010	P:7-2011	T:1-2012			
IRON_PROD	P:8-2000	T:6-2001	P:7-2002	T:6-2005	P:7-2010							
LNG_PROD	P:8-2001	T:6-2002	P:8-2003	T:11-2004	P:8-2005	T:7-2007	P:5-2008	T:12-2010	P:9-2011			
LOANS_BUSINESS	P:12-2000	T:8-2001	P:1-2004	T:10-2005	P:12-2007	T:10-2008	P:2-2010	T:10-2011				
LOANS_CONSUMER	T:11-2002	P:5-2003	T:7-2005	P:5-2007	T:12-2007	P:5-2009	T:11-2010					
LOANS_MORT	T:9-2001	P:1-2004	T:9-2005	P:5-2006	T:9-2008	P:12-2010	T:9-2011					
LOAN_INTRATE	T:5-2001	P:2-2002	T:5-2003	P:9-2005	T:8-2006	P:11-2007	T:12-2008	P:1-2010				
METH_PROD	P:11-2003	T:7-2005	P:7-2010	T:12-2011								
MONEY_SUP	T:6-2001	P:11-2005	T:7-2006	P:11-2007								
MORTG_INTRATE	T:8-2001	P:3-2002	T:4-2003	P:3-2005	T:8-2006	P:12-2007	T:2-2009	P:3-2010				
MOTORGAS_PROD	P:4-2001	T:7-2002	P:2-2004	T:2-2005	P:10-2006	T:7-2010						
OIL_FPRICE	P:9-2000	T:11-2001	P:12-2002	T:1-2005	P:9-2005	T:12-2006	P:5-2008	T:1-2009	P:3-2011			
OIL_PRICE	P:9-2000	T:1-2002	P:12-2002	T:1-2005	P:9-2005	T:12-2006	P:5-2008	T:1-2009	P:3-2011			
OIL_PROD	P:2-2001	T:1-2002	P:2-2003	T:1-2005	P:2-2006	T:1-2012						
REFIN_OIL_PROD	P:4-2005	T:6-2006	P:2-2008	T:1-2009	P:12-2009	T:1-2011						
RESERVES	T:5-2001	P:2-2002	T:12-2002	P:1-2005	T:9-2006	P:10-2007	T:9-2008	P:10-2009	T:3-2012			
RSI	T:9-2001	P:7-2003	T:9-2005	P:6-2006	T:10-2010	P:2-2012						
SAV_INTRATE	P:11-2000	T:6-2001	P:2-2002	T:6-2003	P:2-2005	T:7-2006	P:4-2008	T:6-2009	P:12-2009	T:1-2012		
UK_IIP	P:2-2002	T:7-2004	P:2-2005	T:7-2007	P:2-2008	T:7-2009	P:2-2011	T:12-2011				
UNEMPLOY	P:12-2000	T:11-2001	P:3-2003	T:11-2007	P:3-2009	T:11-2011						
USA_IIP	T:6-2004	P:5-2005	T:4-2007	P:5-2008	T:4-2009							

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