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Early Warning Indicator of Economic Vulnerability

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Abstract

The initiative to capture the information content behind the rise and fall of the business cycle has popularized the study of leading indicators. Many of the foreign experiences shared by economically advanced countries reveal that the leading indicator approach works well as a short-term forecasting tool. Thus, exploring an indicator-based forecasting tool for business cycle analysis and economic risk monitoring would provide insight into the Malaysian economy as well as that of other emerging countries. By extending the ideology of indicator construction from the US National Bureau of Economic Research (NBER), the present study demonstrated the strong potential of the leading indicator approach to be a good gauge of the business cycle movement in addition to being a practical and functional early warning indicator for economic vulnerability prediction.

***Keywords*:** Business Cycle, Composite Leading Indicator, Early Warning Indicator

***JEL Classification Code*:** C82, E32, E37

1.0 INTRODUCTION

Malaysia stands well-off as one of the emerging countries while making significant headway toward a globalized and liberalized world, and its economy is unsurprisingly open to historic external influences and, consequently, conveys immense risk and uncertainty to the domestic market. Since economic risk and uncertainty are intrinsic and ever present, attempts to stop their inbursts are not feasible in reality. However, failure to foresee their arrival and make all attempts to minimize their potential danger may significantly depress the health of the economy. Also, the adverse impact and the cost of economic contraction, if not properly addressed and minimized, will likely deepen and spillover to other neighboring markets. In this regard, the Asian financial crisis of 1997-1998 and the sub-prime mortgage crisis of 2008-2009, on top of other unpleasant economic phenomena, have provided a down-to-earth lesson to the world, especially to those countries with the most seriously affected economies.

The harshness of the past crises, especially the two mentioned above, has created awareness among all countries of the importance of enhancing economic risk management. As a result, cyclical analysis in the tradition of Mitchell and Burns (1938) and Burns and Mitchell (1946) has been expanding rapidly with the aim of shedding light on the underlying facts behind economy-wide fluctuations. Studies of this nature are commonly referred to as business cycle forecasting, and indicator approaches commenced by the US National Bureau of Economic Research (NBER) have been in the forefront of business cycle forecasting for decades. The popularity and credibility of the leading indicator approach is attributable particularly to the ability of the indicator to foreshadow the changing economic scenario in the near future due to its inherent leading nature against the business cycle.[1]

In a real economic setting, it makes great sense to interpret the implicit facts behind the movement of a set of leading economic indicators to obtain insightful information on the current performance of the economy in addition to permitting notable projections regarding the future economic direction. Phillips (1998) agreed that monitoring the economic variables that tend to be sensitive to cyclical changes no matter what their causes is a viable forecasting approach to predicting recessions and expansions. In this instance, the intrinsic leading feature makes the leading indicator a functional early warning tool to signal forthcoming economic vulnerability. As such, the indicator-based forecasting tool is not merely used to forecast movement in the general economic activity, but also serves as a crisis alarm given the ability of the indicator to signal vulnerable episodes in advance. Attempts to build a resilient forecasting system will be of value to all economic agents, including policymakers, business players, investors, and the general public. Consequently, development of an early warning indicator (EWI) capable of assessing impending economic dangers is of great interest in macroeconomic and business cycle forecasting because it would provide an opportunity to moderate the severity of any unwelcome economic event.

[1] See De Leeuw (1991) for arguments that preserve the use of the indicator-based approach to business cycle forecasting. Moreover, three important bases that motivated the popularity of the leading indicator approach have been outlined by Zhang and Zhuang (2002).

Accordingly, the present study sought to establish an empirically and practically useful EWI capable of offering early signals of critical turning points in the business cycle. The results are intended to aid economic agents in staying alert to the future direction of an economy and to respond promptly to changing economic scenarios and upcoming economic dangers. The practical implementation of the EWI is especially important to national policymakers and central banks because economic policy by its nature requires a high degree of foresight to be effective. The rationale is that policy typically plays its role after a certain lag time. Hence, the key policy objective of macroeconomic stabilization may not be achievable if the policy action is not implemented in a timely manner to ensure that a weakening economic position does not translate into a serious crisis or downturn. Thus, closely scrutinizing the rise and fall in economic activity through an EWI is important in creating and implementing responsive stabilization and adjustment policies.

Seeing that the development of EWI provides a sizable benefit to its potential users with respect to macroeconomic risk management and vulnerability anticipation, we perceived a vital role of EWI in the Malaysian economy in the contemporary and dynamic economic environment. Therefore, the exploration into a resilient early signal tool to identify economic vulnerability is an important endeavor for the Malaysian economy because the ability to monitor and manage arising risks and uncertainties in the economy is yet to be enhanced despite currently available practices.[2] In addition, building a sound forecasting tool for accurate short-term prediction is worthwhile in confronting the

[2] Samuelson (1976) argued that the standard macroeconomic models based on quantitative forecasting procedure are not appropriate to predict turning points if the prediction involves regime shifts.

diminishing capability of existing economic indicators as early signaling tools due to false signals and lead times, as reported by Yap (2009). Also, a study presented by Wong, Abu Mansor, Puah, and Liew (2012) provided evidence of the diminishing lead time offered by the existing composite leading indicator (CLI).

All in all, the main objective of this study was to construct a novel EWI for the Malaysian economy with the aim of providing notable future projections of any vulnerable economic situation and a macroeconomic risk-monitoring tool. The constructed EWI was expected to outperform the currently available indicator-based forecasting instruments in terms of ability to lead the business cycle and predictive power in directional accuracy.

This paper is organized into sections, as follows. The next section provides a review of related literature followed by a brief description of the data and reference series selection. The subsequent section covers methodological aspects of the study and presentation of empirical findings with interpretations, while the final section provides the conclusion.

2.0 REVIEW OF LITERATURE

Despite the challenging task of analyzing and predicting the business cycle under an intrinsically dynamic economic environment, continuous evolution in business cycle forecasting is taking place over time. Endless research on this agenda has contributed countless articles to sustain the practical significance of business cycle forecasting in economic settings. After the first inspiration of the US NBER to develop an indicator-based forecasting tool for business cycle analysis became reality, the practice diffused promptly into other economies. However, most of the empirical study of this nature has concentrated on industrialized or economically advanced economies (see, for example, Herrera & Garcia (1999); Bodart, Kholodilin, & Shadman-Mehta (2003); Kholodilin & Siliverstovs (2005), and Schirwitz (2009)). Literature in this domain is fairly scarce for emerging economies where the construction and application of indicator-based forecasting is quite a recent practice in macroeconomics forecasting.

As far as this study is concerned, the noteworthy research on business cycle analysis carried out specifically for emerging economies includes Everhart and Duval-Hernandez (2001), Zhang and Zhung (2002), Jaya, Bhupal, and Rajeev (2003), Atabek, Coşar, and Şahinöz (2005), Bascos-Deveza (2006), Bordoloi and Rajesh (2007), Zalewski (2009), and Issler, Notini, and Rodrigues (2011). For the Mexican economy, Everhart and Duval-Hernandez (2001) constructed a CLI following the Organization for Economic Cooperation and Development's (OECD's) indicator compilation procedure. They concluded that the Hodrick-Prescott (HP) filter developed by Hodrick and Prescott (1980) contributed fairly well in cycle extraction and that the constructed indicator met their research objective of building an indicator of economic activity for business cycle forecasting. Alternatively, Jaya, Bhupal, and Rajeev (2003) used the band pass (BP) filter to construct a business cycle indicator under the growth cycle approach for the Indian economy. That study showed that the constructed indicator could predict the cyclical turning points six months ahead of the reference series - the Index of Industrial Production (IIP).

Meanwhile, Zhang and Zhuang (2002) employed the sequential probability model proposed by Neftci (1982) to build up a system of leading indicators for Malaysia and the Philippines. The predictive power evaluation based on the Quadratic Probability Score (QPS) proposed by Diebold and Rudebusch (1989) indicated that the constructed indicator performed better than non-indicator-based forecasting models, suggesting that the composite indicator could be a useful predictor of economic activity. Then, Bascos-Deveza (2006) added to the literature on indicator construction and business cycle analysis for the Philippines. Following a rules-based approach proposed by Artis, Bladen-Hovell, and Zhang (1995) in turning points detection, both studies by Zhang and Zhuang (2002) and Bascos-Deveza (2006) consistently illustrated that the leading indicator works well in tracing the turning points in the business cycle for the Philippines. Using a combination of QPS evaluation and the Granger causality test as an approach to component series selection, Issler, Notini, and Rodrigues (2011) computed a CLI for the Brazilian economy. The proposed CLI forecasts correctly the economic activity represented by the coincident index up to 90% of the time.

Moreover, Atabek, Coşar, and Şahinöz (2005) constructed a CLI for the Turkish economy based on the growth cycle approach, taking the IIP as the reference series. The study showed that the constructed CLI leads IIP and movements in IIP were predicted correctly with no false turning point. Both in-sample and out-sample forecast evaluations demonstrated that the constructed CLI has significant power to predict the IIP. Taking a different approach, Bordoloi and Rajesh (2007) applied the probit model to forecast the movement of Indian economic activity with leading indicators. The authors concluded that the model-based leading indicator is capable of predicting all the turning points in IIP and satisfactorily portrays forecasting performance as shown by recursive probabilities estimation. Furthermore, the yield on Treasury bills was found to be a best potential leading indicator for business cycle forecasting.

3.0 DESCRIPTION OF DATA AND REFERENCE SERIES SELECTION

For the purpose of EWI construction, a bundle of macroeconomic and financial series that has certain desirable properties of a business cycle indicator as documented by the Conference Board (2000, p. 14) and OECD (2001, p. 3) was selected for empirical examination.[3] This was to ascertain the inherent nature of each series in relation to the business cycle. To reach the goal of building an early warning tool to signal critical turning points in the Malaysian business cycle, only economic series with leading characteristics were selected for inclusion in construction of the EWI. Correlation analysis and visual inspection were utilized to facilitate the selection of the component series. It was crucial to have a component series highly correlated with the business cycle because evidence of correlation denotes that the selected component series possesses a significant interrelationship with the business cycle. This was a necessary condition to ensure the likelihood of the EWI working well in tracing the business cycle. Hence, series that did not show significant correlation were dropped from the analysis, and ultimately only six component series (domestic share price, share price in US, total exportation,

[3] The selection of the leading indicator of business cycle is subject to the nature, characteristics, and other country-specific background of the investigated economy. However, some economic and statistical criteria as documented by de Leeuw (1991) and Yap (2001) and Jones and Ferris (1993) can be considered in selecting a set of representative component series for the business cycle of a specific economy.

money supply, number of new companies registered, and number of tourists' arriving) made up the EWI construction in this study.

Given that the selection of business cycle representation does not tie to a universal proposition (European Central Bank, 2001), appropriate selection accounts for the common practice in business cycle literature as well as the nature of the economy and the representativeness of the selected proxy. In this study, we adopted the real gross domestic product (GDP) as a representation of business cycle or general economic activity in Malaysia. The rationale was that the real GDP is a broad-based and ideal representation of the Malaysian business cycle as it covers a wide range of economy activity and sufficiently reflects each of the real economic sectors in the country. This is consistent with the NBER routine but distinct from the OECD's and the Department of Statistics Malaysia's (DOSM's) approaches of using IIP and the self-built coincident index (CCI), respectively, as the reference series in their business cycle analysis. Du Plessis (2006), who analyzed the business cycle for a group of emerging markets consisting of Hong Kong, Israel, Korea, Mexico, Peru, the Philippines, and South Africa, also employed the real GDP as the reference series.

To obtain series with higher frequency, the interpolation technique proposed by Gandolfo (1981) was applied and the ratio of GDP to consumer price index (CPI) was calculated to transform the GDP series into its real term. The monthly series of CPI and quarterly series of GDP were extracted from various issues of the *International Financial Statistics (IFS) Yearbook* published by the International Monetary Fund (IMF). Furthermore, the currently available monthly data of CLI from 1981 through 2009 were compiled from various issues of *Malaysian Economic Indicators* published by the DOSM. The CLI functioned as a competing model in the evaluation of predictive accuracy and forecasting performance of the constructed EWI.

4.0 METHODOLOGY AND EMPIRICAL DISCUSSION

The EWI construction involved a step-by-step procedure of indicator-based ideology first introduced by the US NBER during 1930s. The composite indicator compilation procedure outlined by the Conference Board (2000) was applied to construct the EWI for the Malaysian economy. After the construction of the EWI, the index was then transformed into a growth cycle based on the procedure proposed by Moore and Zarnowitz (1986). The rationale behind using the growth cycle approach was that we intended to study the growth rate of the Malaysian business cycle instead of the classical business cycle or business cycle in its level form.[4] The justification was that the level form of the business cycle conception is less applicable to the Malaysian scenario as the economy does not suffer from major oscillation in the level of general economic activity, but experiences fluctuations in the growth rates of economic activity (Ahmad, 2003, p. 3). Therefore, measuring the business cycle by estimating the deviation of economic activity from its long-term trend was more appropriate for the Malaysian context.[5]

[4] The business cycle conception of growth cycle and classical cycle has different interpretations. For the former, contraction means a slowdown or an absolute decline in economic activity in the growth cycle approach. However, for the latter, contraction involves only absolute decline or recession.
[5] See Niemira and Klein (1994) for further argument on choosing the growth cycle approach in business cycle conception.

To obtain a smoothed cyclical component of the reference series for turning point analysis, this study followed the procedure suggested by Moore and Zarnowitz (1986). First, seasonal adjustment using Tramo/Seats methods were applied to eliminate the seasonal factor. Then, the seasonally adjusted series was subjected to detrending using the HP filter to obtain a smooth estimate of the long-run trend components of real GDP. The HP filter is a widely applied detrending framework used to decompose the seasonally adjusted time series into trends and to provide smoothed trends to minimize problems. The HP filter was first employed by Hodrick and Prescott in the early 1980s to study the business cycle for the US during the postwar period. The HP filter is a commonly applied technique for extracting the cyclical component in business cycle analysis. Recent studies in business cycles, including Everhart and Duval-Hernandez (2000), Kranendonk, Bonenkamp, and Verbruggen (2005), Bascos-Deveza (2006), Klucik and Haluska (2008), Zalewski (2009), Polasek (2010), and many more, have opted for the HP filter for cycle extraction.

Next, we applied the method of simple centered moving average to smooth out irregularities. This is one of the smoothing techniques adopted and suggested by Zhang and Zhuang (2002). According to those authors, a moving average length of seven months is appropriate for the case of Malaysia. However, the present study employed a moving average length of five months since this was empirically sufficient to smooth out the irregularities within the sample period. Finally, following most of the non-parametric business cycle studies reported in the literature, the Bry-Boschan technique was used to identify the turning points from the deseasonalized, detrended, and smoothed reference series. To ensure consistency, a similar procedure was applied to yield a smoothed cyclical component of the EWI. The performance of the EWI in predicting critical scenarios in the Malaysian business cycle from 1991 through 2009 is presented in Figure 1. The important episodes that resulted from the outbreak of critical economic downturns and crises are indicated by the shaded area.

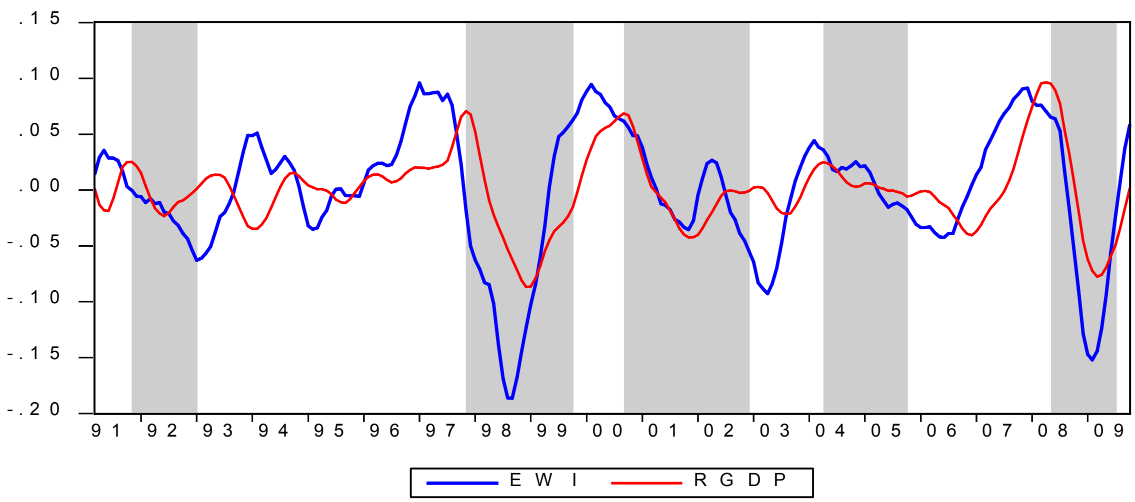

Figure 1: EWI versus RGDP, January 1991 through December 2009

On the whole, Figure 1 shows that the movement of the EWI is relatively consistent with the movement of the business cycle represented by real GDP. The traced peaks and troughs from turning point analysis are fairly consistent with the historical profile of the Malaysian business cycle. Moreover, from Figure 1, it is obvious that the EWI moves in advance of real GDP most of the time and that the turning points in EWI frequently appear a few months earlier than the turning points in real GDP. The visual evidence presented in Figure 1 suggests that the constructed EWI successfully traced most of the historical economic downturns and crises that occurred in Malaysia from 1991 through

2009. Furthermore, the remarkable lead times shown by the EWI fulfilled the aim of building an EWI to signal vulnerable turning points in the Malaysian business cycle.

In recent years, testing the directional accuracy of macroeconomic forecasts has received increased attention in the field of forecasting because unreliable forecasts make no sense to users. In addition, only large predicted change is useful to forecast users (Greer, 2003). Hence, we applied directional accuracy testing in the present study to investigate whether the EWI accurately predicted the direction of changes in the business cycle. We trichotomized the forecasts into trichotomous scenarios, namely, large predicted increases, no significant changes, and large predicted decreases. To distinguish small from large changes, a relevant threshold or cutoff was required. We adopted a 5% cutoff following Greer (2003). The directional accuracy rate was first calculated as Cs/Ns x 100%, where Cs was the number of correct predictions for significant large changes, and Ns referred to the total number of significant large changes in the actual business cycle variable. Then, the comparative finding for directional accuracy and binomial testing up to 6 months was tabulated collectively, as shown in Table 1. This was to evaluate the predictive accuracy of the constructed EWI against the competing indicator-based mode (i.e., the publicly available CLI).

In this context, the binomial test was incorporated to examine the robustness of the EWI as a forecasting tool. The aim of the test was to statistically verify that the EWI itself has compelling predictive power and that the success of the prediction is independent from wild guess or mere chance. The null hypothesis for the binomial testing was that the probability of correctly predicting the direction of change in the forecasting model is 50%. In other words, the null hypothesis implied that the forecasting model performs no differently than the wild guess. If the null hypothesis is rejected, then we could expect two possible outcomes. In the case where the directional accuracy rate is more than 50%, the forecasting model proved to statistically outperform the wild guess. Conversely, if the directional accuracy rate is lower than 50%, the wild guess will dominate the source for obtaining correct predictions. If this is the case, then the forecasting model cannot beat the wild guess in predicting the direction of change in the business cycle.

Table 1: Directional Accuracy and Binomial Testing Results

Lag (month)	**Directional Accuracy (%)**		**P(Binomial)**	
	EWI	CLI	EWI	CLI
1	86.49%	8.11%	0.000	0.000
2	91.89%	10.81%	0.000	0.000
3	94.59%	13.51%	0.000	0.000
4	94.59%	13.51%	0.000	0.000
5	89.19%	13.51%	0.000	0.000
6	83.78%	10.81%	0.000	0.000

The direction accuracy test results in Table 1 reveal that the constructed EWI can predict with up to 94.6% accuracy Malaysia's major business cycle turning points. In sharp contrast, the directional accuracy rate of the existing CLI was at best 13.5%. Furthermore, binomial test results called for a rejection of the null hypothesis at the 1% level of significance, indicating that the EWI performs better than the wild guess. This is an important inference to justify that the source of success or correct prediction offered by the EWI is owing to the predictive power of the indicator per se, and not to mere chance. The empirical assessment of predictive accuracy is apparently favorable to support the robustness of the EWI in business cycle forecasting given the strong evidence of directional accuracy. This again suggests that EWI holds compelling predictive power to foreshadow the changing phases in the business cycle and offers a reliable signal of economic vulnerability.

5.0 CONCLUSION

With the aim of providing the Malaysian economy with a practically and empirically sound indicator-based forecasting tool, an EWI was constructed using a set of macroeconomic series. The EWI was found to work well in tracing the business cycle in Malaysia with some lead time. Most of the critical turning points that translated into unpleasant economic experiences from 1991 through 2009 were predicted in advance by the EWI. The remarkable lead time of about 6 months on average enables the EWI to work as a responsive short-term forecasting tool in macroeconomic analysis and policy building. In addition, the statistical tests on the model's predictive accuracy suggest that the constructed EWI outperforms the currently available CLI in forecasting the Malaysian business cycle. This finding again strengthens Yap's (2009) argument regarding the diminishing capability of the CLI as an early signaling tool. One significant possibility that leads to a weakened CLI is the diminishing capability of the component series to reflect the contemporary economic environment. In other words, such phenomenon implicitly suggests that continuous updating and revising of the composite indicator is crucial to sustain the accuracy and competency of the indicator-based forecasting tool in the face of the dynamic economic environment.

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