

Research Study of Business Cycle and Early Warning Indicators for the Economy of Hong Kong – Challenges of Forecasting Work amid the COVID-19 Pandemic

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Abstract

Timely indication of current and near-term economic situation is important. In particular, early warning signal ahead of economic downturn / crisis is vital for policy makers to prepare timely responses. The Organisation for Economic Cooperation and Development (OECD) has developed a system of leading indicators called Composite Leading Indicators (CLIs) for business cycle analysis and to provide effective and accurate early warning signal. CLI is an aggregate time series which aims to show a leading relationship with the growth cycles of key macro-economic indicators such as Gross Domestic Product (GDP). It is calculated by combining component series which cover a wide range of short-term indicators, such as opinions about economic activity, housing permits, financial and monetary data, etc.

This paper discusses the methods to effectively identify early warning indicators and build up a CLI on economic growth of Hong Kong based on the OECD's framework and simple forecasting model through the Vector Autoregressive model (VAR). In particular, the COVID-19 pandemic has caused serious disruptions to economic activities, both locally and globally. Further studies have recently been attempted to assess the performance of the CLI and short-term forecast, which were built on pre-COVID-19 parameters, under such abrupt economic situations and identify further adjustments to enhance the forecasting models.

Keywords: leading indicators, GDP, forecasting, short-term forecast, COVID-19

I. Introduction

With a view to predicting the turning points of the economy after the outbreak of the global financial crisis in 2008, the Census and Statistics Department (C&SD) conducted the study on the trial compilation of the CLI for Hong Kong (Ng, Kwok and Tam, 2010), which was discussed at the International Seminar on Early Warning and Business Cycle Indicators organised by the United Nations Statistics Division in 2010. Subsequently, internal reviews had been carried out over time to assess the performance of the CLI and the forecasting model.

Starting from early 2020, the outbreak of COVID-19 pandemic has caused serious disruptions to economic activities. Given such abrupt changes, the production of some early warning and business cycle indicators has become even more important. However, producing early warning indicators becomes more challenging as the empirical relationships between the pre-COVID-19 parameters and the business cycle will very likely be changed drastically in the midst of the pandemic. Thus, the performance of the early warning indicators has to be reviewed critically and the formation of the CLI and forecasting models has to be adjusted, which is the aim of this present research.

II. Analytical Framework

CLI of Hong Kong

In the present research study, the method employed mostly follows the OECD's framework (OECD, 2012), which is based on various landmark work on business cycle, such as Bry and Boschan (1971), Hodrick and Prescott (1997) and Christiano-Fitzgerald (1999). The first step involves the selection of reference indicator and component indicators. The choice depends on the economic relevance and empirical relationship between the potential component and reference indicators. For reference indicator, real GDP, seasonally adjusted, is chosen in both the present study and previous work in 2010. The Denton method is applied to generate the monthly series of real GDP when compiling the CLI.

After selection of indicators, the data series are seasonally adjusted by the X-12-ARIMA method to remove possible seasonal patterns. A double Hodrick-Prescott (HP) filter is adopted to extract cyclical component of the series. The various component series that are used in the construction of CLI are first normalised in order to express various indicators (which are originally measured in different units) in a common scale. This normalisation process is achieved by subtracting from filtered observations the mean of the series, and dividing this by the mean absolute deviation of the series, and, finally, by adding 100 to each observation.

Short-term forecast of real GDP of Hong Kong

While CLI is useful in providing an early qualitative reference on turning points of the economy, it does not contain explanatory power in predicting output growth. For predicting short-run output growth, we attempt to make use of the potential high frequency component indicators identified in the above study of the CLI to form a monthly VAR model so as to forecast the real GDP growth.

An unrestricted VAR (Sims, 1980) is given below in Equation (1):

$$\text{VAR}(p) \text{ model for } y_t \text{ in level form: } y_t = \mu + \sum_{k=1}^p B_k y_{t-k} + \varepsilon_t \quad (1)$$

where y_t refers to vector of variables; μ refers to vector of constants; B_k refers to matrix of estimated coefficients; p refers to lag; and ε refers to vector of error terms.

Each equation in the unrestricted VAR can be estimated efficiently using ordinary least squares. Assuming the relationship identified in the past continues to hold in the forecast period, the period ahead forecasts can be obtained by simply substituting the estimated coefficients and their past values in the equations. In other words, the one-quarter ahead forecast can be produced when the data of component indicators in the last quarter are available. The model can also produce forecasts of current quarter real GDP growth with partial data of that quarter. To achieve this, recursive estimation, in which parameters are estimated recursively by constantly updating the information set when the forecast moves forward in time, is performed.

III. Empirical Results

CLI of real GDP of Hong Kong

The CLI of Hong Kong for the pre-COVID-19 period included component indicators that are selected based on the cross correlation analysis and graphical analysis, and taking into account the economic interpretation of potential indicators. These component indicators are retail sales, Hong Kong's Purchasing Managers' Index (PMI), Hang Seng Index, price of private domestic premises, transactions of the property market, M1, total merchandise trade, visitor arrivals and China's manufacturing PMI. Details of the cross correlation analysis are given in Table 1.

After the outbreak of the COVID-19 pandemic, tourism was virtually halted and visitor arrivals was no longer relevant to predicting GDP movement. Thus, it is taken out of the component indicator set.

On the other hand, having further reviewed the indicator set and conducted several trials using relevant indicators that can potentially better correlate with the ups and downs in local economic activities along with changing COVID-19 situation, the number of passenger journey by taxis is chosen to replace the visitor arrivals after Q4 2019.

Table 1: Summary of cross correlation results for selection of component indicators

Variables	Cross correlation of cyclical properties between real GDP and CLI components											
	Pre-COVID-19 parameters [quarterly data from Q1 2009 to Q4 2019]						COVID-19 adjusted parameters [quarterly data from Q1 2009 to Q1 2021]					
	<i>SD</i>	$\gamma(-2)$	$\gamma(-1)$	$\gamma(0)$	$\gamma(1)$	$\gamma(2)$	<i>SD</i>	$\gamma(-2)$	$\gamma(-1)$	$\gamma(0)$	$\gamma(1)$	$\gamma(2)$
Real GDP	0.02	0.60	0.76	1.00	0.76	0.60	0.02	0.52	0.72	1.00	0.72	0.52
	<i>Rapidly responsive</i>											
Retail sales, volume index	0.07	0.32	0.54	0.79	0.75	0.63	0.08	0.38	0.64	0.83	0.71	0.55
Hong Kong's PMI	0.06	0.47	0.49	0.57	0.16	-0.21	0.06	0.61	0.63	0.59	0.09	-0.23
Passenger journey by taxis	0.03	0.20	0.36	0.54	0.65	0.54	0.05	0.15	0.48	0.69	0.67	0.52
		[not included in pre-COVID-19 parameters]										
	<i>Expectation-sensitive</i>											
Hang Seng Index	0.10	0.44	0.53	0.67	0.35	0.15	0.10	0.35	0.49	0.66	0.39	0.17
Price of private domestic premises	0.06	0.33	0.47	0.70	0.57	0.41	0.06	0.23	0.40	0.63	0.60	0.46
Transactions of the property market	0.26	0.20	0.19	0.21	-0.14	-0.31	0.26	0.26	0.26	0.26	-0.10	-0.30
	<i>Prime movers</i>											
Visitor arrivals	0.68	0.23	0.34	0.50	0.63	0.70	0.97	-0.06	0.17	0.49	0.75	0.72
							[dropped in COVID-19 adjusted parameters]					
M1	0.05	0.22	0.16	0.06	-0.26	-0.58	0.06	0.51	0.37	0.19	-0.28	-0.60
Total merchandise trade	0.06	0.50	0.61	0.81	0.58	0.38	0.06	0.46	0.60	0.80	0.47	0.26
	<i>External factor</i>											
China's manufacturing PMI	0.02	0.32	0.23	0.17	-0.27	-0.38	0.03	0.38	0.38	0.26	-0.24	-0.34

Sources: C&SD, Transport Department and Land Registry of the Government of the HKSAR, Hong Kong Monetary Authority, Hang Seng Indexes Company Limited, Hong Kong Tourism Board, National Bureau of Statistics of China, IHS Markit and Centaline Property Agency Limited

Table 2: Cross correlation between the reference series and CLI, January 2009 – March 2021

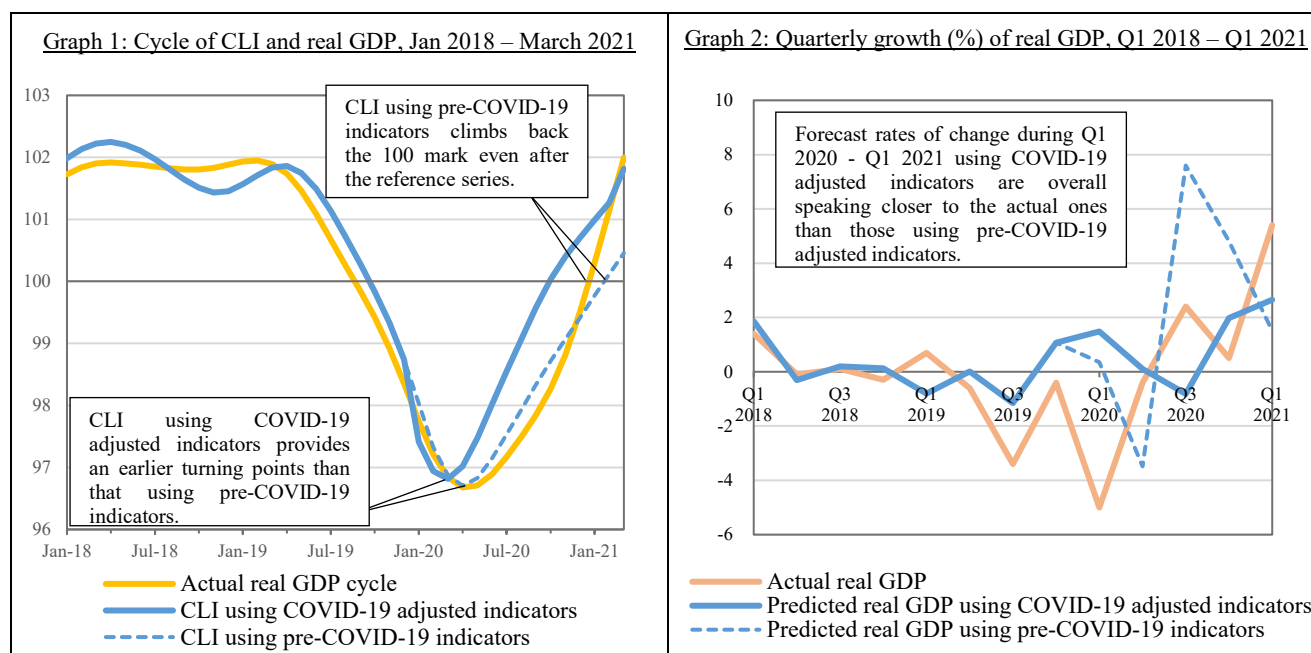
	Cross correlation between the reference series (i.e. monthly de-trended, smoothed and normalised seasonally adjusted real GDP) and CLI							
	<i>SD</i>	$\gamma(-3)$	$\gamma(-2)$	$\gamma(-1)$	$\gamma(0)$	$\gamma(1)$	$\gamma(2)$	$\gamma(3)$
CLI of pre-COVID-19 indicators	1.30	0.76	0.82	0.86	0.88	0.82	0.75	0.66
CLI of COVID-19 adjusted indicators	1.16	0.80	0.83	0.84	0.83	0.72	0.60	0.47

Statistically, the cyclical properties of CLI and real GDP can also be confirmed by the cross correlation analysis. As shown in Table 2, strong leading correlation between CLI and real GDP is identified in both CLIs, with the CLI formed by the COVID-19 adjusted indicators showing lower standard deviation when compared with the CLI using pre-COVID-19 indicators. On the other hand, in Graph 1 the CLI using the COVID-19 adjusted indicators exhibits a much better leading property of real GDP than the CLI using pre-COVID-19 indicators since the latter is heavily dragged by the halt in inbound tourism after Q4 2019.

VAR model for short-term real GDP forecasting

Regarding the forecasting of quarter-to-quarter percentage change of real GDP growth using the unrestricted VAR, all indicator series used in constructing CLI have been applied in the model. The results of current quarter model forecasts with two months' actual data are shown in Graph 2. Given the higher volatility of GDP growth since Q1 2020, the forecast results are generally not as accurate as

before. Still, the forecast results using the COVID-19 adjusted indicators are overall speaking closer to the actual ones compared to the forecast results using the pre-COVID-19 indicators, with the absolute difference between the actual and predicted growth lowered by 1.5 percentage points on average during the five quarters from Q1 2020 to Q1 2021.



IV. Concluding Remark

In this present research, we have reviewed the statistical indicators used in the 2010 research and updated the set of relevant statistical indicators amid COVID-19 pandemic that exhibit good leading properties for real GDP in Hong Kong to form the CLI and the forecasting model using VAR.

There is no guarantee that the model will still be valid in the future along with the evolving situation of the COVID-19 pandemic. Indeed, it should be noted that the forecasting ability of CLI and VAR model is based on past relationship between the occurrence of crises and relevant data. The historical patterns may not hold in future if an economy is impacted significantly by external shocks which have no historic references. This is particularly true for economies like Hong Kong that are small and open and can be heavily influenced by external shocks. The composition of the component indicators may need to be reviewed periodically to ensure their relevance. On the other hand, with the rapidly changing economic condition in the foreseeable future, further development and enhancement in the study of early warning indicators can be expected.

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