China’s New Normal Economy and World Business Cycle Synchronization

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Abstract: This paper aims to study the transmission of business cycle synchronization between China’s economy and world economy for policy implications, under globalization background and “New Normal”, as China is gradually integrating into the world. Starting from macroeconomic data, the study combines the traditional international economic cycle theory, the world economic cycle theory with latest new framework of business cycle model.

Considering the characteristics of “New Normal” in China from macroeconomic level to industrial level, the external and internal impact on China's economy and world economy through international trade, international finance or international policy coordination will be one of the concern to do analysis and reveal the importance of the research on the new features of the world economic cycle fluctuations for the coordination of China’s economy and the world economic development. Under the circumstance of sustainable growth in China and world economy, the study of international trade and international financial interdependence will be timely and promising. Accordingly, the research analysis will put forward policy recommendations for China’s response to the new characteristics of world economic cycle fluctuations, which has important theoretical significance and practical application value. International economic policy cooperation is promoted greatly. This paper will also discuss China’s economic relationship with other emerging Asian countries and with major industrial countries, since it would be interesting to investigate the direction and magnitude of growth spillovers and business cycle synchronization between China and other major players in the world economy for policy implications.

Key words: economic transformation; international trade; international finance; policy implications; business cycle synchronization

JEL codes: E32, F15, F42

1. Introduction

Is there “China Effect” in the transmission of world business cycle? China’s economy and United States’ economy are the two engines of world economic growth. As China is gradually integrating into the world economy and has become the second largest economy in the world since 2010, ranking second only to the United States, the research on the transmission mechanism and policy implications of China’s economy and world business cycle synchronization catches great concern. Especially under the background of establishing the new...
international normal for economic growth in China and the world: the imperative for sustainable global development, the theme of this study is important.

Since the 1978, the reform and opening-up policy promotes China’s rapid economic development. In 2014, China’s GDP reached 63.591 trillion yuan with the annual growth rate of 7.27%, the first time to become the world’s second-largest economy whose GDP exceeds $10 trillion US dollars (Figure 1). In 2015, China’s GDP kept grew to 67.6708 trillion yuan, although the GDP growth rate fell to 6.9%\(^1\), which fell below 7% for the first time since 1990. The decrease from 2010 till now implies the appearance of “New Normal”. There are some debate about China's economic growth rate and its impact on the global economy, such as whether it is good for the rest of the world if China’s economic growth rate falls below 7%, especially for the countries whose GDP growth are heavily relied on China’s economy. The continuous decrease of GDP growth rate from 2010 signals China and the world economy has entered the “New Normal” economy in the post-crisis period (Figure 2). At this stage, “stabilizing growth, adjusting structure and improving quality” has become the standpoint for reform in economic development. In 2013, Chinese President Xi Jinping put forward the strategic conception of “the Silk Road Economic Belt” and “the 21st Century Maritime Silk Road” — “One Belt And One Road”, or “OBAOR” for short, as important national economic development strategy, redistricting the world economic pattern.

![Figure 1](image)

**Figure 1  China’s Nominal GDP and GDP Growth Rate**

Source: National Bureau of Statistics of People’s Republic of China

As the interdependence between China and the world economy is increasing, through the transmission of international trade, international investment and international financial channels, the macro economic variables between China and other economies have obvious synchronization in fluctuations, further driving the international relevance of related policies. China, as the center of the global value chain (GVC) and the world’s second largest economy, plays an important role in promoting sustainable development of the global economy. China’s economy and the interaction with the world economy has been significantly strengthened and enter the stage of two-way feedback period. On the one hand, China is accepting the challenge of international rules so as to enhance the level of internationalization; on the other, China is influencing the world economy and increasing the share of Chinese elements, through the growing economic strength (Figure 3). In this sense, it is meaningful to study the business cycle synchronization and transmission mechanism between China and the world for reasonable policy implications.

The concept of world business cycle originates from the exploration of international business cycle. If the world business cycle theory is the highly abstraction and generalization of global transnational economic synchronization phenomenon, the international business cycle theory is the logical starting point and theoretical basis to study this international synchronization phenomenon (Yu-hua Song, 2007). The co-movement or synchronization refers to the convergence of the various countries’ business cycles on the direction and amplitude, due to the interaction and mutual influence of different countries’ economic fluctuations, in a specific period of time. Non-synchronization refers to the performance of the inconsistency. The synchronization and non-synchronization of the world business cycles coexists and at the same time has certain complexity and uncertainty.
Till now, the theoretical and empirical study of China’s economy and world business cycle synchronization can be divided into the following three categories. The first one is about correlation analysis. The major concern of correlation analysis include the sustainability, volatility, the degree of correlations between China and the world economy, as well as the evolutionary path of business cycle synchronization and lead-lag relationships. The second category focuses on causal relationship. That is, economic fluctuations between China and the world is a one-way or two-way causality, whether there is a spurious correlation question and so on. The third category concerns the transmission mechanism of China's economy and the world business cycle. That is, through a transmission mechanism, how do China and the world economic fluctuations realize resonance, dynamic path, and the explanatory parts measured by the various decomposition of innovations in their respective economic fluctuations. Based on the previous studies, generally speaking, the major transmission channels cover international trade, international finance and policy cooperation. In the channel of international trade, inter-industry trade and intra-industry trade are classified, and intra-industry trade can be further divided into horizontal-commodity trade and vertical-fragmentation trade.

In the theoretical literature, Gerlach (1988) is the first one using frequency band to measure the world business cycle which is defined as the existence of high correlations of a multinational industrial production index changes in a certain frequency band. Backus, Kehoe, and Kydland (BKK) (1992a, 1992b), was the first to set up a perfect financial market of the international business cycle model (International Business Cycle) to study the impact of international trade on the international business cycle synchronization. Due to the free transfer of production across different countries, external shocks make trade intensity stronger, however, the business cycle synchronization between countries become lower instead. Kose and Yi (2001) introduce the production of vertical specialization in BKK model (1992a) and find that the impact of trade scale on business cycle synchronization depends on the type of trade and shocks, that is, when the trade promotes industry specialization, the closer trade ties, the lower the business cycle synchronization of the two countries; however, when the trade promotes the development of intra-industry trade between two countries, the closer trade ties, the higher the business cycle synchronization of the two countries. Based on the study of Anderson and Wincoop (2003) whose finding is that the degree of trade between the two countries may be associated with the trade barriers between the two countries, Kose and Yi (2006) expand the BKK model from two countries to three countries and introduce trade transaction costs. They find that the impact of trade on business cycle synchronization is strengthened, after adding these factors. Baxter and Farr (2005) introduce variable capital utilization to BKK model and find that the inflow of FDI could increase the degree of two countries’ economic structure, further enhancing the impact of trade on business cycle synchronization. Garcia-Herrero and Ruiz (2008) also get similar conclusion. Thus, the above studies have recognized trade intensity is one of the important factors affecting business cycle synchronization, and analyzes how do the different forms of trade influence the business cycle synchronization from the perspective of trade pattern and trade type. It is worth noting that whether the “heterogeneity” of today’s foreign trade across countries in different categories of traded goods will affect the business cycle synchronization between the two countries.

The outbreak of global financial crisis in 2008 made more and more scholars have realized that financial market integration and the incompleteness of financial market play important role in the transmission of business cycle synchronization, at the same time, traditional static models are not able to catch the effects of lag variable, so the dynamic models develop gradually. Among them, the dynamic stochastic general equilibrium (DSGE) model is widely used by scholars. Faia (2007) introduces the variable describing the difference of financial market into a two-country DSGE model and find that the greater the difference of the financial market structure in two
countries, the lower the business cycle synchronization is. Gourinchas et al. (2007) establish a two-country DSGE model and do systematic analysis of the role of “Valuation Effect” from bilateral asset holding across countries in the current account adjustment. Devereux and Sutherland (2010) use higher order method after introducing characteristics of bilateral asset holding into the two countries DSGE model, and consider adding financial friction in the model to explore the transmission channels of external shocks. Dong-zhou Mei et al. (2012, 2014) introduce intermediate goods trade in a standard DSGE model and discuss current account adjustment with the existence of intermediate goods trade and international business cycle synchronization, etc. The expansion of DSGE models are widely used in the academic study of business cycle synchronization. At the same time, to overcome the limitation of samples and measuring methods, such as bilateral correlation studies and etc., Kose et al. (2008) put forward multiple dynamic factor model based on the Bayesian analysis framework which has the advantage of fitting the multinational sample data at the same time, therefore quickly becoming the international mainstream econometric model of this field. Zi-hui Yang and Lei Tian (2013) apply the classical model to construct three levels of static factors to study China's economy and world business cycle synchronization.

In the empirical literature, there are many milestones. Frankel and Rose (1998) study the bilateral trade intensity and business cycle correlation of 20 developed countries and find that the closer trade ties between two countries, the higher the business cycle synchronization is. However, because this model is unable to separate common shocks from influencing factors, the result triggers controversy on the conclusion of articles. Calderon et al. expand sample size of Frankel-Rose (1998) model by adding developing countries and find that the positive relationship between trade intensity and business cycle synchronization, but the relationship in developed countries are stronger than that in developing countries. Kose and Yi (2006) explore the factors influencing international business cycle synchronization from the perspective of industrial structure similarity and discover that intra-industry trade is more likely to contribute the GDP synchronization than inter-industry trade, considering that different industrial structure in the two countries will make both parties respond in different cycles when facing the same industry shock. The research on the relationship between industrial structure and business cycle synchronization has become a relatively new research field. Some scholars (Imbs, 2004) argue that the higher degree of industrial structure similarity, the higher the business cycle synchronization is. However, other scholars (Cerqueira & Martins, 2009) do not support the conclusion of significant relationship between the similarity of industrial structure and business cycle synchronization. Di Giovanni (2010) uses trade data and industrial level data to analysis the influencing mechanism of bilateral trade on business cycle synchronization. The conclusion of Giovanni (2010) indicates that the more important the vertical specialization in a certain section, the stronger effect of that section’s corresponding industrial trade on business cycle synchronization is. Wu et al. (2009) do research on the impact of FDI on business cycle synchronization and find positive effect of FDI which is more powerful in explaining the changing patterns of business cycle synchronization than the similarity of industrial structure. Hui-fang Chen and Li-jun Cen (2010) develop relatively completed models and do analysis by taking FDI and industrial structure into consideration.

1997-1998 Asian crisis and 2008 global financial crisis make the business cycle synchronization between developing countries and developed countries increases, and at the same time, the impact of financial integration on business cycle synchronization catches great concern. Imbs (2004, 2006) develops system of simultaneous equations to find that the increasing degree of financial integration plays an important role in the transmission of business cycles. But Dees and N. Zorell (2012) conclude that there is no direct impact of financial integration on business cycle synchronization. The studies of Kim et al. (2012), Imbs (2006), and Moneta and Ruffer (2009)
conclude that East Asian economies become closer after Asian financial crisis, and the business cycle synchronization increases significantly, which is creating a reasonable background for currency and exchange rate cooperation. The study of Dong-zhou Mei and Xiao-jun Zhao (2015) indicates that the asymmetric transmission of China-US business cycle resulting from incomplete financial market and bilateral asset holding is the crucial factor causing huge negative impact from 2008 global financial crisis. Yu-hua Song et al. (2007) develop systematic research methods and indices to discuss business cycle synchronization between China and major regional economies and emphasize bi-direction influence of China's economy and world business cycle.

To sum up, the existing studies focusing on China and world business cycle synchronization are mainly from macro level and industrial level. Few of them do further in-depth research from relatively micro level, as possible as they can, to explore the effect from “regional heterogeneity” or “firm heterogeneity”. In addition, most of the previous research on China and world business cycle synchronization take developed countries’ research methodologies as reference and hard to avoid missing “Chinese characteristics”. Based on the above analysis, this paper will try the best to cover the gap in research.

The rest of the paper is organized as the following. Section I describes the changing patterns of China and world business cycle synchronization. Section II discovers the causal relationship between China’s economy and world business cycles. Section III develops models to analyze transmission mechanism of China and world business cycle synchronization through different channels. Section IV explores empirical implications and finally concludes.

2. The Patterns of China and World Business Cycle Synchronization

The empirical study of China’s economy and world business cycle synchronization usually starts with a series of correlation coefficients. The range of GDP data and trade data is from 1978, the year of implementing the reform and opening-up policy in China, to 2014, the year for latest data available. The selection of sub-periods takes the important events into consideration as criterion. The aim of correlation analysis is to investigate the correlation relationship of economy fluctuations between China and world, and between China and major economies in the world, further exploring the evolution path of China and world business cycle synchronization.

Based on the correlation results, China’s economy and world economy, as well as China’s economy and major economies in the world have experienced the process of from-strong-to-weak and then from-weak-to-strong (Figure 4), which implies China’s response to the world economy since 1978. As China is gradually integrating with world economy, China entered the world market at the beginning. And now, China is influencing the world economy, making difference to the world. Especially after China’s entry to WTO in 2001, business cycle synchronization of China and other Asian countries has increased significantly, except South Korea and Thailand (Table 1), to a large extent, promoting Asian countries’ economic growth. Thus, “China Effect” emerges.

On the whole, from 1978 to 2014, business cycle synchronization of China and other major economies in the world appears increasing at the beginning, followed by decreasing trend and then increasing alternatively. “China Effect” benefits other Asian economies first. For example, Japan’s recent economy recovery is highly related to China’s rapid economic growth. As China’s economy open the window to the world since 2001, the correlations of China and the world, China and other major economies in the world has increased substantially in the sub-period of 2002-2007.
China’s New Normal Economy and World Business Cycle Synchronization

One the one hand, as European Union become China’s first largest trading partner, China’s strategic position is growing and mutual business cycle synchronization is also increasing, especially for France, Germany and Italy. On the other, although the trade between China and United States is asymmetric with trade friction constantly, the correlations of China and United States are significantly high than that of China and other economies. United States is China’s second largest trading partner for a long time, and China is also United States’ second largest trading partner in 2014 and the first largest trading partner in 2015. In the past 10 years, China-US bilateral trade has increased 198%. Additionally, China is one of the major holders of US treasury bills. With the development of China’s technology and value-added products contributing to the world economy, in the future, China and United States have great potential to cooperation in the field of trade, investment and etc.

However, after 2008 global financial crisis, the correlations of China and other major economies in the world decrease a lot, while other economies keep high correlations with the world economy (Table 2), indicating that China’s economy has entered new normal period. The decreased business cycle synchronization of China and world could provide some evidence to support the argument that China’s economy was not hit fairly hard by the global recession generated by the financial crisis, contrary to much popular discussion (Li et al., 2012). Although China suffered huge drop in exports and these effects on the economy were only partially offset by the financial crisis, China’s economic growth remained well above international averages and the drop of China’s economic growth was of the same order of magnitude as for the United States (Li et al., 2012). Decoupling hypothesis has emerged and become popular again.

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2 Data source: Ministry of Commerce of the People’s Republic of China (MOFCOM).
4 Generally speaking, there are two versions of decoupling hypothesis. One version is that emerging markets, such as China, India, and Malaysia, could be decoupled from the advanced economies, such as the United States, the EU and Japan. The other is that Asian economies including Japan could be decoupled from the United States.
## Table 1  The Correlation Coefficients of GDP Growth Rate for China and World as well as Other Major Economies

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Data Source: World databank, World Development Indicators (WDI).

## Table 2  The Correlation Coefficients of GDP Growth Rate for World and Other Major Economies

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Data Source: World databank, World Development Indicators (WDI).

Linear de-trended correlations and Hodrick-Prescott filtered de-trended correlations are also widely used to
analyze business cycle synchronization. Considering that the growth rate of natural log of GDP is not stationary (Figure 5), Hodrick-Prescott filter provides a non-linear method to decompose a time series \( \{y_t\}_{t=1} \) to growth component \( \{y^g_t\}_{t=1} \) and cyclical component \( \{y^c_t\}_{t=1} \).

\[
y_t = y^g_t + y^c_t
\]

Where the growth component \( \{y^g_t\}_{t=1} \) will be decided by minimizing the following:

\[
\min \sum_{t=1}^{T} (y_t - y^g_t)^2 + \lambda \sum_{t=2}^{T-1} \left[ (y^g_{t+1} - y^g_t) - (y^g_t - y^g_{t-1}) \right]^2
\]

\( \lambda \geq 0 \) is given and \( \lambda \) is a penalty. The idea \( \lambda \) let time trend smooth without too much fluctuations. For annual data, it is recommended to choose \( \lambda = 400 \), while for quarterly data, \( \lambda = 1600 \) is recommended, because quarterly data is usually more smooth than annual data. As \( \lambda \) increases, the requirement of smooth time trend also increases. Hodrick-Prescott filtered de-trended correlations are also used and the results are consistent with that of correlations.

However, business cycle correlations are heavily influenced by the patterns of shocks which can vary a great deal over time and then affect the correlations again through various channels of transmissions. Therefore, it is not reliable to place a great deal of weight on using correlations over short periods to either support or reject the decoupling hypothesis (Willett et al., 2011). Besides being variable, short run correlations are generally not statistically significant. Theoretically, the increased globalization and economic interdependence will facilitate the growth of international trade flows and substantial increase of international capital mobility. However, the high variability in correlations over time suggests that the expected results have been muted by the variability in patterns of shocks (Willett et al., 2011).

![Figure 5 Hodrick-Prescott Filter Results of LNCHINAGDP, LNWORLDGDP, LNUSAGDP and LNEUROGDP](source)

Data source: World databank, World Development Indicators (WDI).
Pearson and Spearman correlation coefficients could be used to measure whether the two data sets on a line and the distance linear relationship between the two variables. The difference between Pearson correlation coefficients and Spearman correlation coefficients is the scope of application. Pearson correlation coefficients can be used wider than Spearman correlation coefficients method. The p-value in the brackets indicates the significance of Pearson correlation coefficients and Spearman correlation coefficients (Table 3). The results of Pearson and Spearman correlation coefficients are consistent. In most cases, China's relatively low correlation coefficients with world economy and with other major economies in the world are insignificant; while the world’s relatively high correlation coefficients with other major economies in the world are significant. China’s low correlations with world economy reflect inconsistent policy with the world economy at the beginning of 1978 and for a long time. Due to the relatively low degree of openness and limited impact on the world economy, the business cycle synchronization of China and the world economy appears weak for most of the time.

| Table 3  Pearson and Spearman Correlation Coefficients with p-value |
|-----------------|-----------------|-----------------|-----------------|-----------------|
|                 | Pearson corr   | Spearman corr   | Pearson corr   | Spearman corr   |
| Australia       | 0.013 (0.940)  | -0.042 (0.806)  | 0.411** (0.011) | 0.343** (0.038) |
| China           | 1               | 1               | 0.286* (0.087)  | 0.205 (0.223)   |
| Euro area       | 0.007 (0.966)  | -0.013 (0.941)  | 0.697*** (0.000) | 0.794*** (0.000) |
| France          | -0.062 (0.715) | -0.115 (0.499)  | 0.646*** (0.000) | 0.726*** (0.000) |
| Germany         | 0.033 (0.848)  | -0.039 (0.817)  | 0.572*** (0.000) | 0.690*** (0.000) |
| Hong Kong       | 0.273 (0.103)  | 0.248 (0.138)   | 0.487*** (0.002) | 0.485*** (0.002) |
| India           | 0.180 (0.287)  | 0.181 (0.284)   | 0.237 (0.159)   | 0.066 (0.699)   |
| South Korea     | 0.192 (0.256)  | 0.189 (0.262)   | 0.406** (0.013) | 0.392** (0.017) |
| Japan           | 0.033 (0.848)  | 0.000 (1.000)   | 0.504*** (0.001) | 0.632*** (0.000) |
| Italy           | 0.073 (0.666)  | 0.067 (0.695)   | 0.684*** (0.000) | 0.741*** (0.000) |
| Indonesia       | 0.110 (0.516)  | 0.088 (0.604)   | 0.083 (0.625)   | 0.111 (0.512)   |
| Malaysia        | 0.122 (0.474)  | 0.071 (0.677)   | 0.264 (0.114)   | 0.315* (0.058)  |
| Singapore       | 0.213 (0.206)  | 0.135 (0.424)   | 0.435*** (0.007) | 0.449*** (0.005) |
| United Kingdom  | 0.262 (0.117)  | 0.277* (0.097)  | 0.547*** (0.000) | 0.700*** (0.000) |
| United States   | 0.293* (0.078) | 0.291* (0.081)  | 0.669*** (0.000) | 0.803*** (0.000) |
| World           | 0.286* (0.087) | 0.205 (0.223)   | 1               | 1               |
| Thailand        | 0.243 (0.148)  | 0.109 (0.523)   | 0.192 (0.254)   | 0.290* (0.072)  |
| Philippines     | -0.124 (0.465) | -0.342** (0.039) | 0.410* (0.012)  | 0.135 (0.424)   |
| Mexico          | -0.131 (0.439) | -0.123 (0.468)  | 0.337* (0.042)  | 0.384** (0.019) |
| North America   | 0.276* (0.099) | 0.285* (0.088)  | 0.678*** (0.000) | 0.814*** (0.000) |
| OECD members    | 0.199 (0.238)  | 0.167 (0.324)   | 0.902*** (0.000) | 0.947*** (0.000) |
| East Asia & Pacific | 0.250 (0.135) | 0.205 (0.223)   | 0.758*** (0.000) | 0.683*** (0.000) |

Note: The values in bracket are p-value. *, ** and *** denote the significance at 10%, 5% and 1% of the estimated correlation coefficients, respectively.
Data source: World databank, World Development Indicators (WDI).

First-order autocorrelations can be used to measure the persistence of the country’s economy and the standard deviation can be used to measure the fluctuation of business cycle. The higher the value of first-order autocorrelation, the more persistent the economy is. Empirical data show that the persistence of China’s economy
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is almost as well as that of United States, but lower than that of United Kingdom and Japan. For the stability of China’s economy measured by the standard deviation, China’s economy experienced big fluctuations and adjustment which will have negative effect on the stability of the economy on the whole period5.

Furthermore, gross regional product, which is the value of GDP for different provinces or cities in China is also used to calculate the correlations with China’s economy and the correlations with world economy, using similar method. Generally speaking, most of the high correlation coefficients appear in the provinces or cities which have relatively high value of gross regional product, such as Beijing, Tianjin, Guangzhou and etc. Regions with high growth rate of gross regional product, such as Guiyang also have high correlation with China's economy.

5 Table of first-order autocorrelations and standard deviations of different economies is omitted here for limited space. Readers can email the author to get the results.
3. The Causality of China and World Business Cycle Synchronization

In order to examine the causality of China’s economy and world business cycle synchronization, stationary data are required. Taking natural log of China’s GDP (LNCHINAGDP) and world’s GDP (LNWORLDGDP), the increasing trend of the two time series exists (Figure 7), indicating that LNCHINAGDP and LNWORLDGDP are not stationary data. First-order difference of LNCHINAGDP and LNWORLDGDP or second-order difference of the two variables can transfer them to stationary series.

![Figure 7 Trend of Natural Log of China's GDP and Natural Log of World's GDP](image)

Augmented-Dickey-Fuller (ADF) test is used to examine whether there is a unit-root. Because the first-order difference of LNWORLDGDP and LNCHINAGDP still cannot refuse the null hypothesis at 99% confidence interval, 1% significance level, second-order difference of the two series are calculated and ADF test shows that second-order difference of LNWORLDGDP and LNCHINAGDP are stationary, denoted by I (2), at 99% confidence interval.

**Table 4 Augmented-Dickey-Fuller Test for 2nd Difference of LNWORLDGDP and LNCHINAGDP**

<table>
<thead>
<tr>
<th></th>
<th>ADF Unit-root Test</th>
<th>Test Statistic $z(t) = -7.611$</th>
<th>1% critical value***</th>
<th>5% critical value**</th>
<th>10% critical value*</th>
</tr>
</thead>
<tbody>
<tr>
<td>LNWORLDGDP</td>
<td></td>
<td>p-value = 0.0000</td>
<td>-3.689</td>
<td>-2.975</td>
<td>-2.619</td>
</tr>
<tr>
<td>2nd-order Diff</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LNCHINAGDP</td>
<td></td>
<td>Test Statistic $z(t) = -5.083$</td>
<td>1% critical value***</td>
<td>5% critical value**</td>
<td>10% critical value*</td>
</tr>
<tr>
<td>2nd-order Diff</td>
<td></td>
<td>p-value = 0.0000</td>
<td>-3.689</td>
<td>-2.975</td>
<td>-2.619</td>
</tr>
</tbody>
</table>

Considering the cointegration of LNWORLDGDP and LNCHINAGDP, traditional regression method is not allowed. Johansen cointegration and EG two stage methods can be applied. Here, E-G two stage method is used.

Based on the result of ADF test, LNWORLDGDP and LNCHINAGDP are stationary at second-order difference. Next step is to regress LNWORLD on LNCHINAGDP to get the following estimates.

$$\begin{align*}
\text{LNWORLDGDP} &= 0.301487 \times \text{LNCHINAGDP} + 22.88004 \\
(90.73165)*** & \quad (249.1185)***
\end{align*}$$

Note: The values in parentheses are t-statistics. *, ** and *** are the significance at 10%, 5% and 1% of the estimated coefficients, respectively.
After that, residual of regression need to be examine to justify the above result. The graph of residual series (Figure 8) shows no trend and no intercept. Then, ADF unit-root test is used to prove that residuals of the regression model are stationary, statistically (Table 5). The value of test statistic -2.992394 is less than 1% critical value, -2.632688, meaning that the residuals series is stationary at 99% confidence interval.

![Figure 8  Residual Series](image)

**Table 5  Augmented-Dickey-Fuller Test Residual**

<table>
<thead>
<tr>
<th>ADF Unit-root Test</th>
<th>Test Statistic $z(t) = -2.992394$</th>
<th>1% critical value ***</th>
<th>-2.632688</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>p-value = 0.0039</td>
<td>5% critical value **</td>
<td>-1.950687</td>
</tr>
<tr>
<td></td>
<td></td>
<td>10% critical value *</td>
<td>-1.611059</td>
</tr>
</tbody>
</table>

Through ADF test, LNCHINAGDP and LNWORLDGDP are both stationary at second-order difference, I (2). Granger causality test can be used to test the causality of LNWORLDGDP and LNCHINAGDP for stationary series. Based on the following results, from 1978 to 2014, for the null hypothesis of China’s GDP growth does not Granger Cause world’s GDP growth, at 90% confidence interval, the null hypothesis is refused, meaning that China’s GDP growth does Granger cause world’s GDP growth, at 10% significance level.

**Table 6  Granger Causality Test of China and World GDP Growth**

<table>
<thead>
<tr>
<th>Null Hypothesis</th>
<th>Obs</th>
<th>F-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>LNCHINAGDP does not Granger Cause LNWORLDGDP</td>
<td>35</td>
<td>2.92421</td>
<td>0.0691</td>
</tr>
<tr>
<td>LNWORLDGDP does not Granger Cause LNCHINAGDP</td>
<td>35</td>
<td>3.45462</td>
<td>0.0446</td>
</tr>
</tbody>
</table>

For the null hypothesis of world’s GDP growth does not Granger cause China’s GDP growth, at 95% confidence interval, the null hypothesis is refused, meaning that world’s GDP growth Granger cause China’s GDP growth. However, the effect of granger causality is asymmetric. China’s influence to the world is relatively weak, compared with world’s influence to China’s economy. The null hypothesis of China’s GDP growth does not Granger cause World’s GDP growth can only pass 10% significance level, but cannot pass 5% significance level test.
4. The Transmission of China and World Business Cycle Synchronization

Long term relationship of China’s economy and world business cycle can be examined through Granger Causality test. To explore the transmission mechanism and dynamic reaction of China’s economy and world economy, VAR, impulse response function and variance decomposition method can be used.

Three stationary series are used to construct the VAR model. They are LNCHINAGDP at second-order difference, LNWORLDGDP at second-order difference and the natural log of China’s gross exports and imports (LNCTRADE) at second-order difference.

\[
\begin{bmatrix}
\text{LNWORLDGDP} \\
\text{LNCHINAGDP} \\
\text{LNCTRADE}
\end{bmatrix}_t = 
\begin{bmatrix}
C_1 \\
C_2 \\
C_3
\end{bmatrix} + 
\sum_{i=1}^{p} 
\begin{bmatrix}
\beta_{11i} & \beta_{12i} & \beta_{13i} \\
\beta_{21i} & \beta_{22i} & \beta_{23i} \\
\beta_{31i} & \beta_{32i} & \beta_{33i}
\end{bmatrix} 
\begin{bmatrix}
\text{LNWORLDGDP} \\
\text{LNCHINAGDP} \\
\text{LNCTRADE}
\end{bmatrix}_{t-i} + 
\begin{bmatrix}
\varepsilon_1 \\
\varepsilon_2 \\
\varepsilon_3
\end{bmatrix}_t
\]

Where \( C_i \) is constant terms, \( \beta_{jk} \) denotes the estimation coefficients, \( \varepsilon_i \) denotes residuals. According to AIC and SC criterions, second-order difference I (2) of LNWORLD, LNCHINAGDP and LNCTRADE are stationary and can be used in VAR. After establishing the VAR model, impulse response function and variance decomposition can be used to analyze the dynamic response of different variables.

Based on the figures of impulse response function for different variables (Figure 9), on the whole, each variable has significant response to one standard deviation of its own as the impulse and the effect from impulse decrease from second or third year. LNCHINAGDP has strong response to its own impulse, compared with world’s GDP and China’s gross exports and imports.

Variance decomposition of LNCHINAGDP, LNWORLDGDP and LNCTRADE (Figure 9) shows that the explanatory power of each variable become stable after three years. For world’s GDP growth and China’s GDP growth, most of the variance can be explained by its own and a relatively small part of variance will be explained by other factors. However, for China’s gross exports and imports, the explanatory power of each variable is equally distributed, around 33% for each.

Foreign direct investment (FDI) inflow is also an important transmission channel of business cycle synchronization between China’s economy and the world economy. Two stationary time series VAR of second-order difference of LNCHINAGDP and second-order difference of LNFDI is constructed for impulse response function and variance decomposition. For the results of impulse response and variance decomposition, China’s GDP has large response to its one standard deviation innovation as impulse with relatively weak response to FDI, which is consistent to the result of variance decomposition, that is, most of the variance decomposition is explained by its own variance. At the same time, the response of FDI to China’s GDP and its own is relatively stronger than the response of China’s GDP. After three years, the level of variance decomposition become constant. For the variance of FDI, China’s GDP growth could explain about 40% of FDI variance, while FDI growth could explain about 60% of its own variance.
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Figure 9  Impulse Response Function and Variance Decomposition for D2LNWORLD_D2LNCHINA_D2LNCTRADE Model
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5. Policy Implications and Conclusion

As China’s economy is further integrating with the world economy, “China Effect” has emerged significantly through the transmission channel of international trade, international finance and international economic cooperation. Although the effects of world on China and the effects of China’s economy on the world are not symmetric, China is playing a more and more important role in the world economy.

Compared with the world economy and other major economies in the world, China’s business cycle has relatively strong persistence and large fluctuations, which lag behind the world economic cycles. However, China’s economy and the world economy have long term equilibrium relationship from Granger Causality test results. Furthermore, world’s economic growth has significant impact on China’s gross exports and imports, while China’s gross exports and imports have limited influence on world economic growth. In addition, FDI inflow also has significant impact on China’s GDP growth, but there is around two year lag effect.

As the degree of openness increases, the interdependence of China’s economy and world economy is increasing, especially after “China Effects” emerges under the background of new normal. China will make more and more contributions to the world economy for sustainable global development.
Acknowledgements

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References:


