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A STUDY ON THE DYNAMIC RELATIONSHIP BETEWEEN B2B E-COMMERCE AND ECONOMIC GROWTH

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ABSTRACT

As the increasing focus of new economy, the e-Commerce is leading the fundamental transformation in the economic field. Setting trading object as a standard, the e-Commerce can be categorized into B2B, B2C, B2G, C2G, C2C, ABC, C2B2S and P2D. In this paper, most attention will be drawn to the dynamic relationship between B2B e-Commerce and economic growth. In order to make operating mechanism between them mostly understood, the time series from 2000 to 2016 is applied to conduct an empirical analysis under the vector error correction model. The B2B e-Commerce is treated as an independent variable; the GDP is treated as a dependent variable. Via the co-integration test, there is a long-run relationship between B2B e-Commerce and economic growth. Meanwhile, the Granger causality test also indicates that the B2B e-Commerce is one of the most major reasons that promote economic growth. More importantly, even though their relation is deviate from the long-run equilibrium, the B2B e-Commerce has a positive effect on economic growth. In summary, in the short run, 1% increase in B2B e-commerce will result in 0.075% increase in economic growth; in the long run, 1% increase in the B2B e-Commerce can lead to 0.376% increase in the economic growth. The long-run positive effect of B2B e-Commerce on economic growth is greater than that of the short-run positive effect. However, their relation will return to long-run equilibrium by 0.017% (opposite direction).

INTRODUCTION

The Business-to-Business (B2B) refers to a situation where one business makes a commercial transaction with another. It is a kind of business mode that is mainly processed by the exchange and transition of information. Meanwhile, it can connect the intranet with its product and service via B2B sites, mobile client and costumers. Due to the timely manner, it can provide better service for the costumers and also can accelerate the company development. The B2B e-Commerce typically occurs when A business is souring materials for their production process. A business needs the services of another for operational reasons. A business re-sells goods and services produced by others. The B2B e-Commerce is often contrasted with business-to-consumer (B2C). In B2B e-Commerce, it is often the case that the parties to the relationship have comparable negotiating power, and even when they do not, each party typically involves professional staff and legal counsel in the negotiation of terms, whereas B2C e-Commerce is shaped to a far greater degree by economic implications of information asymmetry. However, within a B2B e-Commerce context, large companies may have many commercial, resource and information advantages over smaller businesses. The United Kingdom government, for example, created the post of Small Business Commissioner under the Enterprise Act 2016 to "enable small businesses to resolve disputes" and "consider complaints by small business suppliers about payment issues with larger businesses that they supply". In order to have a best understanding of B2B e-Commerce, Figure 1 shows the transaction process of B2B e-Commerce. It demonstrates full process from a business start to a business end between two companies.

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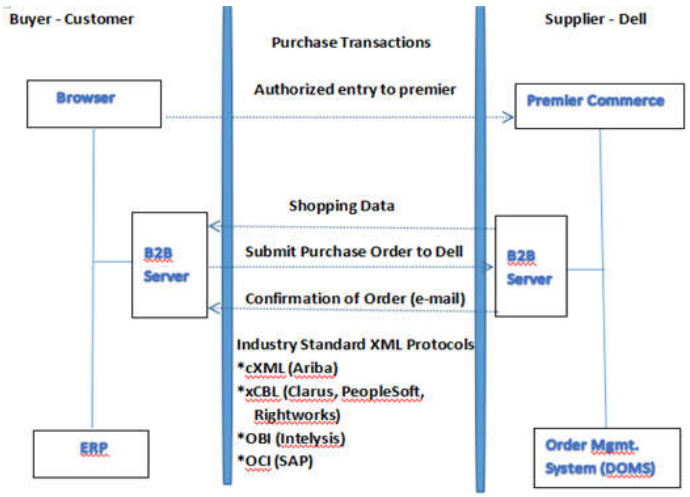

Figure 1 Transaction Process of B2B e-Commerce

Owing to the economic globalization and network generalization, a large number of companies have been started up in the world. Especially in China, the most well-know representatives are the Alibaba Group and HUAWEI TECHNOLOGIES CO. LTD. More importantly, their impact on a country's economic growth also become more and more significant. Due to this, this paper tries to explore the dynamic relationship between B2B e-Commerce and economic growth. The B2B e-Commerce is treated as an independent variable; the GDP is treated as a dependent variable. Based on this two variables, an empirical analysis will be conducted under the vector error correction model. The empirical analysis results find that whenever in the long run or short run, the B2B e-Commerce has a positive effect on economic growth. This idea may provide an evidence for China's government to take measures so as to keep high-speed economic growth.

The whole structure of this paper will be organized as following: Section Ⅰ gives overall concept of this paper. Sector Ⅱ focuses on the difference and similarity when compared with the previous researches. Sector Ⅲ discusses the methodology. Sector Ⅵ provides the empirical analysis. Sector Ⅴ presents the conclusion.

LITERATURE REVIEW

With the rapid development of e-Commerce, the traditional bidding model will be replaced by e-Commerce bidding model. It has greatly changed and challenged the traditional business model. Due to its huge impact on economic growth, a large number of scholars and experts have tried their best to study the dynamic relationship between both of them. This paper mainly focuses on the relationship between B2B e-Commerce and Economic Growth. This part will present the selected research sources by various authors that deal with the association between B2B e-Commerce and economic growth in many countries in the world.

Hop, Kamal and Chowdhury (2005) also conduct a research about B2B e-Commerce. They find that B2B e-Commerce has a significant impact on business costs and productivity. The B2B e-Commerce has a chance to be widely adopted due to its simple applications. Thus it has a large economic impact. It gives the opportunity for "boundary crossing" as new entrants, business models, and changes in technology erode the barriers that used to separate one industry from another. This increases competition and innovation, which are likely to boost overall economic efficiency.

Hei and Prieger (2009) find that the e-Commerce will have a growing impact on the macroeconomy. The B2B e-Commerce will continue to expand into existing and future industries. The growth in B2B e-Commerce will further increase productivity, reduce cost, and enhance competition. Consequently, The B2B e-Commerce will continue to stimulate the aggregate economic activity across the world. Similarly, cost reductions and the disciplining of monetary authorities will continue to exert deflationary pressures in the near future. While the economic gains from B2B e-Commerce are certainly welcome, policymakers will face challenges in managing the monetary and fiscal impacts of B2B e-Commerce. Meeting these challenges as they evolve will require deepening our understanding of the theoretical and empirical effects B2B e-Commerce has on the overall economy.

Zhang (2012) studies the relationship between B2B e-Commerce and GDP by using co-integration test and Engel-Granger test methods. His finding shows that the long-run stable co-integration relationship does not exist: The B2B e-Commerce causes the growth of GDP, but GDP is not reason for the increase of B2B e-Commerce, which reflects the development status of China's B2B e-Commerce transactions at the initial stage to some extent. Lu, Jia, Yao and Zhao (2012) find that with the proliferation of computer technology and networking, the e-Commerce in China has entered a stage of large scale development. As the number of Internet users, growth and the steady improvement of the national economy, the B2B e-Commerce industry as the representative of China has made a substantial contribution to the GDP. Their achievements show that the B2B e-Commerce can promote the economic growth.

Zhao (2014) performs a study on the economic efficiency of B2B e-Commerce. Via his analysis, he finds that the B2B e-Commerce has a negative effect on economic growth in the short run. In the long run, however, the B2B e-Commerce has a positive effect on economic growth. As time goes by, its impact on economic growth will be weakened. Huirong (2014) established the vector auto-regressive model about the B2B e-Commerce, logistics and the economic output, adopts the Chinese annual data from 2000 to 2012. It is studied that the relationships of dynamic effects between the B2B e-Commerce, logistics development and the economic growth through the Granger causality test and the variance decomposition. It is found that, in the long term the B2B e-commerce development is the reasons of the Chinese logistics development and the economic growth, while the economic growth is not the reasons for the development of B2B e-Commerce and the logistics. The development of logistics is not the B2B e-Commerce development and the economic growth. The relationships of dynamic effect between the B2B e-Commerce, logistics and the economic growth are as follows, the development of B2B e-Commerce not only leads to the development of next logistics industry, it also effectively pulls the next phase economic growth. The development of B2B e-Commerce and the logistic industry together drive the China's next phase economic growth, the development's inertia of China's economy can also stimulate next period economic

growth. At the same time, the China's economic growth is also strong let the next phase development of B2B e-Commerce and logistics industry.

Wang (2016) conducts a study on the B2B e-Commerce mode Via an empirical analysis. His results indicate that the B2B e-Commerce has a long-run relationship between B2B e-Commerce and Economic Growth. However, the impact of B2B e-Commerce on economic growth is not very significant in the short run.

Zhang (2017) finds that the B2B e-Commerce has a very large room for development. However, at present, there still exists some problems that limit development of B2B e-Commerce such as platform construction, information confirmation and credit system. Therefore, his research results provide some ideas for government to improve B2B e-Commerce so as to promote economic growth. Zhao (2017) also performs a research about this topic and he finds the same results.

In the previous researches, it can be concluded that many scholars and exports mainly focus on the impact of B2B e-Commerce on economic growth. In order to make this research different from previous, Most attention will be paid to the dynamic movement between B2B e-Commerce and economic growth in China.

METHODOLOGY

This paper sets two variables as the object of study. There are the B2B e-Commerce and economic growth. The B2B e-Commerce is suorced from the Chinese Ecommerce Research Centre and the GDP is searched from the National Bureau of Statistic of the People's Republic of China, which is dealt with GDP deflator. Due to that the e-Commerce develops only in past two decades, the arrangement of time series is from 2000 to 2016. In order to remove the heteroscedasticity, the B2B e-Commerce and economic growth will be in the form of logarithm.

Based on the datum mentioned above, this paper will employ the vector error correction model to analyze the long-run and short-run dynamic relationship between B2B e-Commerce and economic growth based on B2B mode. A book, called "Applied Econometric Time Series", is written by Walter Enders from Unviversity of Alabama. In his book, He proposes a new scope that only if the cointegration among variables exists, the vector error correction model can be generated from the auto regressive model. It is often used to established a model with non-stationary time series that exist cointegration. y_t can be defined as $y_t = f(\log B2B, \log GDP)$. Therefore, an auto regressive model can be obtained with two variables whose lagged period is k. The model gives:

$$y_t = \alpha_t + \sum_{j=1}^{k} \Pi_j y_{t-j} + \mu_t \tag{1}$$

Where $\alpha_t = \alpha_1, \alpha_2$; $\mu_t = \mu_{1t}, \mu_{2t}$; y_t is the vector with order 2×1 time series; μ_t is the vector of constant series with order 2×1 time series. It is also the white noise whose mean is zero; Π_j is the parameter matrix with 2×2. The difference of equation (1) gives:

$$\Delta y_t = \sum_{j=1}^{k-1} \Gamma_j \Delta y_{t-j} + \Pi y_{t-1} + \varepsilon_t \tag{2}$$

Where $\Pi = \sum_{j=1}^{k} \Pi_j - I$; $\Gamma_j = -\sum_{i=j+1}^{k} \Pi_j$; ε_t is the white noise whose mean is zero.

If equation (1) is the process of $I(1)$, the first difference of y_t and y_{t-1} is stationary. Namely, Δy_t and Δy_{t-1} are stationary. If y_t represents two variables which exist the cointegration in equation (1). Therefore, equation (2) can be expressed by vector error correction model. The model gives:

$$\Delta y_t = \sum_{j=1}^{k-1} \Gamma_j \Delta y_{t-j} + \beta ecm_{t-1} + \varepsilon_t \tag{3}$$

Where ecm is determined by the long-run equilibrium relationship between $\log B2B$ and $\log GDP$. The magnitude of absolute value of β reflects the returning speed to the long-run equilibrium when the time series suffers from the short-run shock. More specifically, the larger the absolute value of β is, the faster the adjusting speed will be.

Empirical Analysis

Unit root test

As a matter of fact, a large number of time series are not stationary. Therefore, if these are directly used to conduct a regression analysis, it will be easy to lead to a spurious regression. Of course, the regression analysis will make no sense. Hence, in order to avoid the spurious regression, the time series which will be applied to conduct an empirical analysis needs to test the stationarity. In this paper, the Augmented Dicky-Fuller test is performed to test whether a variable has the unit root or not. The testing models give:

Model 1:

$$\Delta X_t = \delta X_{t-1} + \sum_{i=1}^{m} \beta_i \Delta X_{t-1} + \varepsilon_{1t} \tag{4}$$

Model 2:

$$\Delta X_t = \alpha + \delta X_{t-1} + \sum_{i=1}^{m} \beta_i \Delta X_{t-1} + \varepsilon_{2t} \tag{5}$$

Model 3:

$$\Delta X_t = \alpha + \beta t + \delta X_{t-1} + \sum_{i=1}^{m} \beta_i \Delta X_{t-1} + \varepsilon_{3t} \tag{6}$$

The null hypothesis, $H_0: \delta = 0$, one unit root exists; An alternative hypothesis, $H_1: \delta = 0$, a unit root does not exist.

The difference between model 1 and the other two models is that the other two models have a constant and trend term or

only have a constant. Actually, the proper order to test the sequence is from model 3, then Model 2, to Model 1. Any test that rejects the null hypothesis means that its original sequence does not have a unit root. As long as one of the results from any of the models rejects the null hypothesis, the original hypothesis can be considered stationary. When all of testing results of the three models do not reject the null hypothesis, the original sequence can be considered non-stationary. Then, the first order difference sequence should be tested, and the procedures above should be repeated.

The results of unit root test will be shown in Table 1.

Table 1 Results of unit root test.

Variable	t-Statistic	Test critical value	Prob.*	Result
$\log GDP$	-1.744	-3.081	0.391	Non-rejection
$\log B2B$	-1.343	-3.145	0.573	Non-rejection
$\Delta \log GDP$	-3.690	-3.120	0.019	Rejection
$\Delta \log B2B$	-8.245	-3.120	0.000	Rejection

Note: Δ represents the difference operator.

Table 1 reveals that the original hypotheses (time series has a unit root) are accepted under 5% significant level. It verifies that two of them are non-stationary. But since the time series are conducted the first difference, the original hypotheses are rejected under 5% significant level. It proves that both of them are non-stationary. According to the Granger representation theorem (this states that a cointegrated vector autoregressive process can be decomposed into four components: a random walk, a stationary process, a deterministic part, and a term that depends on the initial values), cointegration can be conducted further.

Engle-Granger two-step-approach

Engle and Granger (1987) suggest a cointegration test, which consists of estimating the cointegration regression by the ordinary least squares, obtaining the residual $\breve{\mu}_t$ and applying unit root test for $\breve{\mu}_t$. To test an equilibrium assertion, they propose to test the null hypothesis that $\breve{\mu}_t$ has a unit root against the alternative that it has a root less than unity. Since $\breve{\mu}_t$ are themselves estimates, new critical values need to be tabulated. Thus one has to use the corrected MacKinnon critical values.

We have the equation $\breve{\mu}_t = y_t - \breve{\alpha} x_t$, where $\breve{\mu}_t$ follows an autoregressive progress:

$$\breve{\mu}_t = \breve{\rho}\mu_{t-1} + \breve{\varepsilon}_t \tag{7}$$

Where $\breve{\varepsilon}_t$ is the white noise whose mean is zero. One could assume three possibilities, that $\breve{\rho}$ is smaller, equal or higher than one:

If $|\breve{\rho}| > 1 : y_t \sim I(1)$ and $x_t \sim I(1)$ then $\mu_t \sim I(2)$.

If $|\breve{\rho}| = 1 : y_t \sim I(1)$ and $x_t \sim I(1)$ then $\mu_t \sim I(1)$.

If $|\breve{\rho}| < 1 : y_t \sim I(1)$ and $x_t \sim I(1)$ then $\mu_t \sim I(0)$.

Only if $|\breve{\rho}| > 1 : y_t \sim I(1)$, a cointegration relationship exists.

If one wants to derive more information about the dynamic behaviour of the variables, he will have to apply an error correction model. Engle and Weiß (1983) demonstrated that if a set of cointegrated variables exist, they can be regarded as being generated by an error correction model, which is called the Granger representation theorem.

The ordinary least squares will be used to conduct a regression. The result will be shown in Table 2.

Table 2 Result of ordinary least squares

Variable	Coefficient	Std. Error	t-Statistic	Prob.
$\log B2B$	0.376	0.013	29.736	0.000
C	3.274	0.041	79.507	0.000
$R-squared = 0.983$		$Adjusted-R-squared = 0.982$		$D.W. = 2.680$

Table 2 shows the result of ordinary least squares. It can be seen that all original hypotheses are rejected. Namely, $\log B2B$ and C get through the significant test under 5% level. $R-squared = 0.983$ indicates that the explanatory variable has a excellent ability to address the explained variable. $D.W. = 2.680$ reveals that there is no auto correlation in the sequence. Even through the conditions mentioned above also cannot guarantee the long-run equilibrium relationship between both of them. If the long-run equilibrium relationship between both of them, the residual of the model should be stationary. Namely, It should satisfy $\mu_m \sim iid.(0, \sigma^2)$. The testing result shows in **Table 3**.

Table 3 Result of unit root of residual

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.340	0.023
Test critical values	1%	-2.728	
	5%	-1.966	
	10%	-1.605	

Note: *MacKinnon (1996) one-sided p-values.

Table 3 recaps that the null hypothesis that residual has a unit root is rejected under 5% significant level. In other word, the residual of model satisfies $\mu_m \sim iid.(0, \sigma^2)$. This verifies that there is a long-run relationship between two of them.
The long-run estimated equation gives:

$$\log GDP = 0.367 \log B2B + 3.274 + \varepsilon_t \tag{8}$$

Equation (8) demonstrate the long-run relationship between B2B e-Commerce and economic growth. Specifically speaking, 1% increase in the B2B electronic commerce trade can lead to 0.376% increase in the economic growth in the long run.

Granger causality test

The Granger causality test is a statistical hypothesis test for determining whether one time series is useful in forecasting another. A time series X is said to Granger-cause Y if it can be shown, usually through a series of T-tests and F-tests on lagged values of X (and with lagged values of Y also

included), that those X values provide statistically significant information about future values of Y.

Granger defined the causality relationship based on two principles: ① The cause happens prior to its effect. ② The cause has unique information about the future values of its effect. Given these two assumptions about causality, Granger proposed to test the following hypothesis for identification of a causal effect of X on Y:

$$P\left[Y_{t+1} \in A\middle|I(t)\right] \neq P\left[Y_{t+1} \in A\middle|I_{X_t}\right] \quad (9)$$

where P refers to the probability, A is an arbitrary non-empty set, and $I(t)$ and I_{X_t} respectively denote the information available as the time t in the entire universe, and that in the modified universe in which X is excluded. If the above hypothesis is accepted, we say that X Granger causes Y.

The results of Granger causality test show in Table 4.

Table 4 Pairwise Granger causality test

Lags	Null Hypothesis	Obs	F-Statistic	Prob.
1	$\log B2B$ does not Granger Cause $\log GDP$	16	6.968	0.020
	$\log GDP$ does not Granger Cause $\log B2B$		0.067	0.800

Table 4 suggests under 5% significant level, the hypothesis that $\log B2B$ does not Granger Cause $\log GDP$ is rejected. Namely, $\log B2B$ is a reason which can give rise to an increase in $\log GDP$. Meanwhile, the hypothesis that $\log GDP$ does not Granger Cause $\log B2B$ is accepted under 5% significant level. In other word, is not a reason which can lead to an increase in. In summary, $\log B2B$ has a positive effect on $\log GDP$.

Vector error correction estimation

According to the previous cointegration test, it can be known that $\log B2B$ and $\log GDP$ are the process of $I(1)$. And there is a cointegration relationship between both of them. Their ADL (1, 1) model gives:

$$\log GDP_t = \alpha \log B2B_t + \beta \log B2B_{t-1} + \gamma \log GDP_{t-1} + \varepsilon_t \quad (10)$$

Rewriting equation (10) gives:

$$\Delta \log GDP_t = \alpha \Delta \log B2B_t - \lambda(\log GDP_{t-1} - \delta \log B2B_{t-1}) + \varepsilon_t \quad (11)$$

Combining and computing equation (10) and equation (11) gives:

$$\lambda = 1 - \gamma \quad (12)$$

$$\delta = \frac{\beta}{\lambda} \quad (13)$$

Combining equation (10), equation (11), equation (12) and equation (13), the model can be rewritten:

$$\Delta \log GDP_t = \alpha \Delta \log B2B - \lambda ecm_{t-1} + \varepsilon_t \quad (14)$$

Where ecm is the error correction term.
Via estimating, the coefficients of estimated function will be shown in **Table 5**.

Table 5 Pairwise Granger causality test

Coefficient	α	β	γ	λ	δ
Value	0.075	-0.085	1.017	-0.017	0.200

Therefore, the function of vector error correction model gives:

$$\Delta \log GDP_t = 0.075 \Delta \log B2B_t - 0.017 ecm_{t-1} + \varepsilon_t \quad (15)$$

Equation (15) indicates the short-run relationship between $\log GDP_t$ and $\log B2B_t$. The coefficient of $\Delta \log B2B_t$ is 0.075, which means that $\log B2B_t$ has a positive effect on $\log GDP_t$ in the short run. 1% increase in $\log B2B_t$ can result in 0.075% increase in $\log GDP_t$. The coefficient of ecm_{t-1} is -0.017, which is in keeping with the opposite correction mechanism. More specifically, ecm_{t-1} can lead to an increase in the short run. As a matter of fact, the magnitude of coefficient of ecm_{t-1} illustrates the ability of returning to the long-run equilibrium when $\log GDP_t$ is deviate from the long-run equilibrium in the short run. Equation (15) shows that the ability of returning to the long-run equilibrium is 0.017% from the short-run fluctuation to the long-run equilibrium of $\log GDP_t$.

CONCLUSION

For the present, the e-Commerce has become the new growth point of the globe economy and the target of the enterprise's innovation. It is reported that even someone said "no e-Commerce, no business". B2B e-Commerce which impacts economic growth on a company, community and national level is one of the most important modes. As B2B companies grow, new jobs are created, new solutions are discovered and new opportunities are developed. This paper focuses on the dynamic relationship between B2B e-Commerce and economic growth. In order to make operating mechanism between both of them mostly understood, an empirical analysis has been conducted under the vector error correction model. The result of cointegration test shows that there is a long-run relationship between B2B e-Commerce and economic growth. Specifically, 1% increase in the B2B e-Commerce can lead to 0.376% increase in the economic growth in the long run. Meanwhile, the result of Granger Causality test also indicates that the B2B e-Commerce is one of the most major reasons that promote economic growth. More importantly, the empirical analysis results also show that the B2B e-Commerce has positive effect on economic growth. 1% increase in B2B e-commerce will result in 0.075% increase in economic growth in the short run. The long-run positive effect of B2B e-commerce on economic growth is greater than that of short-run effect. The adjustment degree of their relation from short-run derivation to long-run

balance is 0.017% (opposite direction). In summary, whenever in the long run or short run, the B2B e-Commerce has a positive effect on economic growth in China. Therefore, the China's government should take measures to improve the circumstance of B2B e-Commerce so as to promote economic growth.

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