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AASRI Procedia 2 (2012) 39 – 43

AASRI Procedia

www.elsevier.com/locate/procedia

2012 AASRI Conference on Power and Energy Systems

An Empirical Analysis on U.S. Foreign Trade and Economic Growth

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Abstract

This study used data ranging from 1960-2010 in order to test the relationship between U.S. foreign trade and its economic growth. The Granger Causality Tests show that there exists a bi-directional relationship between American exports and its GDP, while exists only a single-directional relationship between American imports and its GDP. It indicates that American imports didn't Granger cause American GDP growth. That is to say, even if taking several measures to protect and reduce its imports, U.S. can not achieve the goal of promoting its economic growth.

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Keywords: U.S.; Foreign trade; Economic growth; Granger causality test

1. Introduction

Since the financial crisis, the United States launched anti-dumping, anti-subsidy and other special safeguard clauses to limit its imports and reduce trade deficit in order to recover its economy. This kind of practice has seriously harmed its partners' legitimate interests. Moreover, whether American imports have restrained its economic growth still needs a further inspection.

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This study focuses on the study of the relationship between American foreign trade and its economic growth so as to analyze whether America's protective policy is appropriate or not. The variables we choose are U.S. imports, exports and GDP.

2. Method and Data

2.1. Research method

Generally, when explaining the relationship among several variables, one of the traditional methods is to establish a structured simultaneous equation model. The shortcoming of this method is that this model must be established strictly on economics theory. However, because the economic theory has its limitation in explaining the dynamic relationship between variables, a better solution is to establish a Vector Regression Model (VAR). VAR model is a kind of non-structured equation model, whose biggest advantage is that we can establish the model directly regardless of the economic theory. After several tests, it's convenient to judge the dynamic relationship among variables accurately.

The specific analysis is as follows: step one, we conduct the unit root test on the time series data to explore its stationary; step two, we establish the VAR model to determine the maximum lag and to further explore the Johansen co-integration relationship; step three, we conduct the Granger causality test to find the causal relationship between variables.

2.2 Data source

The study used data ranging from 1960-2010. The time series variables selected are U.S. gross domestic product (GDP), exports (EX) and imports (IM). All data are collected from U.S. Bureau of Economic Analysis (BEA).The data processing software for this empirical analysis is Eviews 6.0.

Considering the influence of price fluctuation, we need to process on the original data in order to eliminate the influence of price change. Then, we take natural logarithm sequence on these variables, namely into LGDP, LEX and LIM.

3. Empirical analysis

3.1 The unit root test

When establishing a time series model, OLS models require the time series to be stationary to avoid spurious regression. A standard method to test the stationarity of the time series variables is to conduct unit root test. We choose the ADF unit root test. Test results see table 1.

The result of ADF unit root test shows that variables LGDP, LEX, and LIM are all non-stationary series, after an order difference, they are single time series of the order. Because the multivariable system has already held the condition of establishing VAR model, we establish the VAR model directly. In order to determine the biggest lag order, we do test on the model's lagging structure. There exist 5 test methods, AIC (Akaike) information criterion inspection, SC (Schwarz) information criterion, LR (Sequential modified LR test statistic) information criterion, FPE (Final prediction error) information criterion and the HQ (Harman-Quinn) information criterion. We specifically examine these five methods. (See table 2)

Test results show that the maximum lag order number is 2 under the 5 information criterion. Therefore, we can build Vector Autoregression Models VAR (2) acco rdingly. From the perspective of the fitting effect of the model, we can see the coefficient R_2 is 0.998454, which reflects the model fitting well. From the

perspective of the stationarity of the model, all unit roots are located in the unit circle, which reflects that model is stationary in structure. It can be concluded that the optimal lag order number in the following Johansen co-integration test is 1.

Table 1. ADF unit root test results

variables	**Test form (C、T、K)**	**ADF t-Statistics**	**prob.**
LGDP	(C、N、0)	-2.522563	0.1163
△LGDP	(C、N、0)	-0.5030486	0.0001
LEX	(C、N、0)	-1.012592	0.7419
△LEX	(N、N、0)	-4.007381	0.0002
LIM	(C、N、O)	-1.357853	0.5953
△LIM	(N、N、0)	-5.291156	0

Note: (C, T, K) represents the intercept, trend and lags;
△(X) represents the 1 difference of X; * represents significance level is 5%.

Table 2. Information criterion on lag order of VAR model

Lag	LogL	LR	FPE	AIC	SC	HQ
0	55.12806	NA	2.18E-05	-2.218215	-2.100121	-2.173776
1	254.341	364.5173	6.68E-09	-10.31238	-9.840006	-10.13462
2	272.545	30.98543*	4.54e-09*	-10.70404*	-9.877379*	-10.39296*
3	276.6739	6.500912	5.66E-09	-10.49676	-9.315817	-10.05236
4	282.6476	8.642793	6.59E-09	-10.36798	-8.832755	-9.790267

Note: * represents maximum lag order number for each criteri

3.2 Johensen co-integration test

Johansen co-integration test is also called JJ inspection, a method of regression coefficients testing based on VAR model, which is suitable for co-integration test towards multivariable systems. It includes two test methods, namely eigenvalue trace test and maximum eigenvalue test. We test the 5 possible co-integration relationship, which conclude that only the last form, namely the sequence and co-integration equation with both trend term and intercept pass the test. The test results show that there exists only one co-integration relationship among variables. Table 3 and 4 reflects the test results for eigenvalue trace test and maximum eigenvalue test.

Table 3. Unrestricted cointegration rant test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.36259	29.33124	24.27596	0.0106
At most 1	0.144356	7.714776	12.3209	0.2596
At most 2	0.004812	0.231512	4.129906	0.6884

Table 4. Unrestricted cointegration rank test (Maximum eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.36259	21.61646	17.7973	0.0127
At most 1	0.144356	7.483264	11.2248	0.2104
At most 2	0.004812	0.231512	4.129906	0.6884

Note：*represents significance level is 5%, ** represents Critical values based on MacKinnon-Haug-Michelis (1999)

3.3 Granger causality test

The tests above can only draw one conclusion that there exists the long-term equilibrium relationship among variables LGDP, LEX and LIM. However, we need to further analyze the Granger causality relationship through the Granger causality test. The precondition of testing the Granger causality relationship on VAR model is that the series must be stationary. The series are proved to be non-stationary, the only way to solve this problem is to establish Vector Error Correction Model (VECM).Table 5 shows the Granger causality results based on VECM.

Granger causality test could draw the following conclusions:

Firstly, the relationship between America's GDP (LGDP) and its exports (LEX). At 5% level, the test result rejects the null hypothesis that "LGDP does not Granger Cause LEX" with a concomitant probability of 0.0144. That is to say, LGDP is the Granger reason of LEX. At meanwhile, the hypothesis that "LEX does not Granger Cause LGDP" with a concomitant probability of 0.0026 is rejected at 5% level, which indicates that LEX is also LGDP's Granger reason. In all, there exist a bi-directional relationship between American GDP and exports. On the one hand, exports, as one of the three carriages to drive a country's economy, have a positive effect on a country's GDP; on the other hand, exports will expand with a country's growth in GDP.

Secondly, the relationship between America's GDP (LGDP) and its imports (LIM). At 5% level, LGDP is LIM's Granger reason, while LIM is not LGDP's Granger reason. It shows that the increase in GDP will expand a country's national income, which will increase the demand for goods and services including the demand from outside the country.

Thirdly, the relationship between America's exports (LEX) and its imports (LIM). In 5% of the level of significance, LEX is not LIM's Granger reason, while LIM is neither LEX's Granger reason, which indicates that there exist no direct Granger causality relationship between American exports and imports.

Table 5. Granger causality test based on VECM

Null Hypothesis	Chi-sq	df	Prob.
LGDP does not Granger Cause LEX	5.994528	1	0.0144*
LEX does not Granger Cause LGDP	9.074817	1	0.0026*
LGDP does not Granger Cause LIM	9.553536	1	0.0020*
LIM does not Granger Cause LNGDP	0.035366	1	0.8508
LEX does not Granger Cause LIM	0.035724	1	0.8501
LIM does not Granger Cause LEX	3.350274	1	0.0672

Note：*represents significance level is 5%,

4. Conclusion

According to the empirical results, we can see that there exists bi-directional relationship between American exports and its GDP; while there exists only one-way relationship between America's imports and its GDP, America's imports is not its GDP's Granger causality reason; there exists no Granger causality relationship between America's imports and its exports. Therefore, in order to promote its economy, America's foreign trade policy is not valid until now that a new trade policy is needed. A new policy should aim at expanding its export but not restricting its imports.

Acknowledgements

This work is supported by grant 09JZD00037 from Ministry of Education of China, grant "Education, Science and Culture" Cooperation [2010] No.272 from Department of Education of Jilin Province, and grant 2012BS22 from Jilin Provincial Social Science Fund, China.

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