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EVALUATION OF TRADE INFLUENCE ON ECONOMIC GROWTH IN CHINA: A TIME SERIES ANALYSIS

SAYEF BAKARI

Faculty of Economic Sciences and Management of Tunis (FSEGT), University of Tunis El Manar, Tunisia.

Email: bakari.sayef@yahoo.fr

FATMA SAAIDIA

Faculty of Economic Sciences and Management of Sfax (FSEGS), University of Sfax, Tunisia.

Email: fatma.saaidia@gmail.com

AHLEM SOUALHIA

Faculty of Economic Sciences and Management of Sfax (FSEGS), University of Sfax, Tunisia.

Email: ahlem.swalhia@gmail.com

Abstract

This paper investigates the relationship between exports, imports, and economic growth in China. In order to achieve this purpose, annual data were collected from the reports of World Bank for the periods between 1960 and 2015, was tested by using Augmented Dickey-Fuller (ADF) and Phillip-Perron (PP) stationary test, cointegration analysis of Vector Error Correction Model and the Granger-Causality tests. According to the result of the analysis, unit root tests show that economic growth, exports and imports series become stationary when first difference is considered. Also, it was determined by using co integration analysis that there is relationship between the three variables in Chine in the long run term only. Also, and according to the Vector Error Correction Model, exports have a positive effect on economic growth. However, imports have a negative effect on economic growth. These results provide evidence that exports are seen as the source of economic growth in China.

Key words: Exports, Imports, Economic Growth, Chine, Cointegration, Vector Error Correction Model and Causality.

I. Introduction

It has been theoretically argued that both export and import may play a crucial role in economic development. The theoretical and empirical studies mainly concentrate on either the relationship between export and growth or between import and growth or the association between export, import and economic growth. China is the second largest country in the world in terms of its nominal gross domestic product (GDP), behind the United States. In 2014, according to the latest estimates by the World Bank, it has become the first country in the world for purchasing power parity (PPP). Since 1979, it has done everything it can to successfully modernize its economy: it has abandoned the plan for the market, mobilized its immense labor resources and taken advantage of globalization by becoming the world's factory. China has become a great power before being rich: rural exodus and urbanization are still in their infancy. Trade accounts for more than 45% of China's GDP (average 2012-2014). With enormous trade surpluses, China has become the world's largest exporter and ranks second importer in the world. The aim of this paper, therefore, is to econometrically investigate the direct linkages between trade and economic growth of China, through employing yearly data for the period 1960-2015. In particular, this work tries to empirically find an answer for the question of whether exports lead economic growth or imports lead economic growth or economic growth leads exports and imports to achieve this objective the paper is structured as follows. In section 2, we present the review literature concerning the nexus between trade and economic growth. Secondly, we discuss the Methodology Model Specification and data used in this study in Section 3. Thirdly, Section 4 presents the empirical results as well as the analysis of the findings. Finally, Section 5 is dedicated to our conclusion.

II. Literature Survey

Many research works exist that examines the causal interaction of export, import and economic growth.

Francisco and Ramos (2001) investigated the Granger-causality between exports, imports and economic growth in Portugal over the period 1865-1998. The empirical results of the study didn’t confirm a unidirectional causality between the variables considered. There is a feedback effect between exports-output growth and import-output growth.

Uğur (2008) using multivariate cointegrated VAR methods and Granger Causality test found that there is a bidirectional relationship between GDP and investment goods import and raw materials import, there is a unidirectional relationship between GDP and consumption goods import and other goods import of Turkey.

Çetintaş and Barişik (2009) analyzed the relationships between export, import and economic growth for the 13 transition economies. The study used quarterly data of 13 transition economies from 1995 to 2006, by using Panel Unit Root Test Panel Cointegration Test and Panel Causality Test. The empirical results showed that there is a unidirectional causality from economic growth to export. Empirical findings showed that the growth-led export hypothesis is valid in those countries and growth is rather shaped by increase in import demand.

Muhammad Adnan Hye (2012) provided an investigation on export, import and GDP of China over the period 1978-2009. Using unit root tests to examine the level of integration and the autoregressive distributed lag (ARDL) approach they found the existence of bidirectional long run relationship between the economic growth and exports and between the economic growth and imports.

Achchuthan (2013) examined the relationship between exports, imports and economic growth in Sri Lanka over the period 1970-2010. The study applied the Time series analysis and Regression analysis. The findings of this study confirmed that export and import have the significant positive relationship, and also, both export and import have the significant impact on the economic growth. Further, the export and import have been associated by 98 percent, which denotes that, there is a strong positive association between export and import.

Uddin, Khan and Ozturk (2013) investigated the relationship between exports, imports and GDP by applying cointegration and error correction models using annual time series from 1971 to 2009 in Bangladesh. The results reveal bidirectional causality between exports and economic growth in Bangladesh. However, unidirectional causality running from imports to exports and income to imports also in the case for Bangladesh. The results of the error correction model (ECM) suggest that there is a long run unidirectional causality from exports to growth.

Alhowaish (2014) using Saudi-Arabia data over the period 1968-2011 found that Saudi Arabia followed an export-led growth path and that economic growth has a significant effect on the import growth process via export growth channels. Empirical results also suggest that imports do not play a role in output or export growth in either the short or long term. The overall findings of this study suggest that export growth positively affects output growth in the Saudi economy, which in turn supports increased demand for imports, when all things are considered equal.

Shihab, Soufan and Abdul-Khaliq (2014) investigated the link between export and growth in Jordan over the period 2000-2012. The empirical results indicated a unidirectional causality between export and economic growth in Jordan and the direction of causality runs strictly from economic growth to exports.

Ajmi, Aye, Balcilar and Gupta (2015) analyzed the relationship between exports, imports and economic growth. They applied linear granger causality tests, in a cointegration framework, to time series data on exports and GDP of South Africa. The results showed no evidence of significant causality between exports and GDP. Accordingly they turn to the nonlinear methods to evaluate Granger causality between exports and GDP, and unidirectional causality from GDP to exports and find evidence of significant bi-directional causality.

Andrews (2015) examined the relationship between export, import and GDP for Liberia, using historical data from 1970 to 2011. The study confirmed the existence of bidirectional causation between GDP and imports and uni-directional causation between exports and GDP and exports and imports. The results showed that Liberia is not driven by exports alone but rather a mixture of exports and imports, with the latter having a long-run impact.

Saaed and Hussain (2015) found unidirectional causality between exports and imports and between exports and economic growth in Tunisia for the period from 1977 to 2012. According to them growth in Tunisia was propelled by a growth -led import strategy. Imports are thus seen as the source of economic growth in Tunisia.

Trošt and Bojnec (2016) investigated the dynamic causal link between exports and economic growth using both Cointegration test Granger causality test. The study used quarterly Slovenia and Estonia data from 2000-2014. The results confirmed the existence of cointegration connections among the tested time series variables for Slovenia and Estonia. The Granger causality test showed that exports significantly cause economic growth and imports in Slovenia and Estonia.

III. Data, methodology and model specification:

1. The Data:

Our investigation starts by studying the integration properties of the data, conducting a systems cointegrating analysis, and checking Granger causality tests. The data are annual Chine observations uttered and expressed by natural logarithms for the sample period running from 1960 to 2015. Data were sources from World Development Indicators (WDI), which includes logarithm of real GDP measure of economic growth, logarithm of exports of goods and services (Current US$) and logarithm of imports of goods and services (Current US$).

2. Methodology

We will use the most appropriate method which consists firstly of determining the degree of integration of each variable. If the variables are all integrated in level, we apply an estimate based on a linear regression. On the other hand, if the variables are all integrated into the first difference, our estimates are based on an estimate of the VAR model. When the variables are integrated in the first difference we will examine and determine the cointegration between the variables, if the cointegration test indicates the absence of cointegration relation, we will use the model VAR. If the cointegration test indicates the presence of a cointegration relation between the different variables studied, the model VECM will be used.

3. Model specification:

Early empirical formulations tried to capture the causal link between exports and GDP growth by incorporating exports into the aggregate production function (Balassa, 1978; Sheehey, 1992; Güngör Turan, 2014; Rummana Zaheer, 2014; Afaf Abdull J. Saaed, 2015). The augmented production function including both exports and imports is expressed as:

$$\boldsymbol{GDP_t = f(exports, imports)} \qquad \textbf{(1)}$$

The function can also be represented in a log-linear econometric format thus:

$$\boldsymbol{\log(GDP)_t = \beta_0 + \beta_1 \log(exports)_t + \beta_2 \log(imports)_t + \varepsilon_t} \qquad \textbf{(2)}$$

Where:

- β_0 : The constant term.

- β_1: coefficient of variable (exports)
- β_2: coefficient of variables (imports)
- t: The time trend.
- ε: The random error term assumed to be normally, identically and independently distributed.

IV. EMPIRICAL ANALYSIS

1. Descriptive Statistics

Table 1: Descriptive Statistics

	LOG(GDP)	LOG(EXPORTS)	LOG(IMPORTS)
Mean	26.83012	24.61155	24.53207
Median	26.45692	24.49115	24.59476
Maximum	30.01670	28.48215	28.30357
Minimum	24.56669	21.37206	21.04024
Std. Dev.	1.606765	2.361676	2.347487
Kurtosis	2.136985	1.738096	1.762010
Jarque-Bera	4.070337	3.962804	3.622094
Probability	0.130658	0.137876	0.163483
Sum	1502.487	1378.247	1373.796
Sum Sq. Dev.	141.9931	306.7633	303.0883
Observations	56	56	56

2. Test of Correlation

In order to determine how strong the relationship is between two variables, a formula must be followed to produce what is referred to as the coefficient value. The coefficient value can range between -1.00 and 1.00. If the coefficient value is in the negative range, then that means the relationship between the variables is negatively correlated, or as one value increases, the other decreases. If the value is in the positive range, then that means the relationship between the variables is positively correlated, or both values increase or decrease together. Let's look at the formula for conducting the Pearson correlation coefficient value.

$$\boldsymbol{r} = \frac{N\sum XY - (\sum X)(\sum Y)}{\sqrt{[N\sum X^2 - (\sum X)^2][N\sum Y^2 - (\sum Y)^2]}} \quad (3)$$

Where:

- $N = Number\ of\ pairs\ of\ scores$
- $\sum XY = Sum\ of\ the\ products\ of\ paired\ scores$
- $\sum X = Sum\ of\ X\ scores$
- $\sum Y = Sum\ of\ Y\ scores$
- $\sum X^2 = Sum\ of\ squared\ X\ scores$
- $\sum Y^2 = Sum\ of\ squared\ Y\ scores$

Table 2: Test of Correlation

	LOG(GDP)	LOG(EXPORTS)	LOG(IMPORTS)
LOG(GDP)	1	0.9855517347891966	0.9802998412319626
LOG(EXPORTS)	0.9855517347891966	1	0.9978975303963841
LOG(IMPORTS)	0.9802998412319626	0.9978975303963841	1

The results of the test of correlation show the relationship between the variables is positively correlated. According to the correlation matrix of the variables, it is found that the dependent variable (PIB) and the independent variable (exports) are positively correlated with a correlation coefficient equal to (0.9855517347891966). Thus, if exports increase by 1%, gross domestic product (GDP) increases by 0.9855517347891966%. Otherwise, the dependent variable (GDP) and the independent variable (imports) are positively correlated with a correlation coefficient equal to (0.9802998412319626). Thus, if imports increase by 1%, the gross domestic product (GDP) increases by 0.9802998412319626%.

3. Tests for Unit Root: ADF

In the econometric literature several statistical tests are used to determine the degree of integration of a variable. The test that will be used as part of this study is testing Augmented Dickey-Fuller (ADF). The general form of ADF test is estimated by the following regression:

$$\Delta Y_1 = \alpha + \beta Y_{t-1} + \sum_{i=1}^{n} \beta_1 \Delta Y_i + \varepsilon_t \quad (4)$$

Where:

- *Δ: is the first difference operator*
- *Y : is a time series*
- *t : is a linear time trend*
- *α: is a constant*
- *n: is the optimum number of lags in the dependent variable*
- *ε: is the random error term.*

Table 3: Tests for Unit Root: ADF "en level"

Null Hypothesis: LOG(GDP) has a unit root			
Exogenous: Constant			
Lag Length: 0 (Automatic - based on SIC, max-lag=10)			
Augmented Dickey-Fuller test statistic		t-Statistic	Prob.*
		2.769408	1.0000
Test critical values:	1% level	-3.555023	
	5% level	-2.915522	
	10% level	-2.595565	
Null Hypothesis: LOG(EXPORTS) has a unit root			
Exogenous: Constant			
Lag Length: 0 (Automatic - based on SIC, max-lag=10)			
Augmented Dickey-Fuller test statistic		t-Statistic	Prob.*
		1.115144	0.9972
Test critical values:	1% level	-3.555023	
	5% level	-2.915522	
	10% level	-2.595565	
Null Hypothesis: LOG(IMPORTS) has a unit root			
Exogenous: Constant			
Lag Length: 2 (Automatic - based on SIC, max-lag=10)			
Augmented Dickey-Fuller test statistic		t-Statistic	Prob.*
		-0.137510	0.9395
Test critical values:	1% level	-3.560019	
	5% level	-2.917650	
	10% level	-2.596689	

Table 4: Tests for Unit Root: ADF "en first difference"

Null Hypothesis: D(LOG(GDP)) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, max-lag=10)

Augmented Dickey-Fuller test statistic		t-Statistic	Prob.*
		-5.964217	0.0000
Test critical values:	1% level	-3.557472	
	5% level	-2.916566	
	10% level	-2.596116	
Null Hypothesis: D(LOG(EXPORTS)) has a unit root			
Exogenous: Constant			
Lag Length: 0 (Automatic - based on SIC, max-lag=10)			
Augmented Dickey-Fuller test statistic		t-Statistic	Prob.*
		-5.496033	0.0000
Test critical values:	1% level	-3.557472	
	5% level	-2.916566	
	10% level	-2.596116	
Null Hypothesis: D(LOG(IMPORTS)) has a unit root			
Exogenous: Constant			
Lag Length: 1 (Automatic - based on SIC, max-lag=10)			
Augmented Dickey-Fuller test statistic		t-Statistic	Prob.*
		-6.421485	0.0000
Test critical values:	1% level	-3.560019	
	5% level	-2.917650	
	10% level	-2.596689	

4. Lag order Selection Criteria

Most VAR models are estimated using symmetric lags, he same lag length is used for all variables in all equations of the model. This lag length is frequently selected using an explicit statistical criterion such as the AIC or SIC.

$$\boldsymbol{AIC = 2k - 2\ln(L)} \qquad \textbf{(5)}$$

$$\boldsymbol{SIC = -2\ln(L) + k.\ln(n)} \qquad \textbf{(6)}$$

Where:

- L: The maximum values of the likelihood function for the model.
- K: the number of estimated parameters in the model.
- n: the number of observation.

Table 5: VAR Lag Order Selection Criteria

VAR Lag Order Selection Criteria						
Endogenous variables: LOG(GDP) LOG(EXPORTS) LOG(IMPORTS)						
Exogenous variables: C						
Sample: 1960 2015						
Included observations: 51						
Lag	LogL	LR	FPE	AIC	SC	HQ
0	-90.29940	NA	0.007791	3.658800	3.772437	3.702224
1	139.7086	423.9363*	1.34e-06*	-5.008180*	-4.553633*	-4.834484*
2	147.4765	13.40353	1.42e-06	-4.959864	-4.164407	-4.655896
3	151.4503	6.389117	1.74e-06	-4.762755	-3.626387	-4.328515
4	154.9498	5.215059	2.20e-06	-4.547052	-3.069774	-3.982541
5	160.1254	7.103673	2.64e-06	-4.397073	-2.578884	-3.702289
* indicates lag order selected by the criterion						
LR: sequential modified LR test statistic (each test at 5% level)						
FPE: Final prediction error						
AIC: Akaike information criterion						
SC: Schwarz information criterion						
HQ: Hannan-Quinn information criterion						

It is clear from Table 3 that LR, FPE, AIC, SC, HQ and HQ statistics are chosen lag 1 for each endogenous variable in their autoregressive and distributed lag structures in the estimable VAR model. Therefore, lag of 1is used for estimation purpose.

5. Cointegration Test

The Johansen test can be seen as a multivariate generalization of the augmented DickeyFuller test. The generalization is the examination of linear combinations of variables for unit roots. The Johansen test and estimation strategy – maximum likelihood – makes it possible to estimate all cointegrating vectors when there are more than two variables.

$$J_{trace} = -T \sum_{i=r+1}^{n} ln(1 - \lambda_i) \quad (7)$$

$$J_{max} = -T\, ln(1 - \lambda_{r+1}) \quad (8)$$

Where λ_i denotes the estimated values of the characteristic roots obtained from the estimated π, and T is the number of observations.

Table 5: Cointegration Test: Johansen Test

Sample (adjusted): 1962 2015				
Included observations: 54 after adjustments				
Trend assumption: Linear deterministic trend				
Series: LOG(GDP) LOG(EXPORTS) LOG(IMPORTS)				
Lags interval (in first differences): 1 to 1				
Unrestricted Cointegration Rank Test (Trace)				
Hypothesized		Trace	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.364220	31.87833	29.79707	0.0284
At most 1	0.128062	7.421620	15.49471	0.5291
At most 2	0.000400	0.021623	3.841466	0.8830
Trace test indicates 1 cointegrating eqn(s) at the 0.05 level				
* denotes rejection of the hypothesis at the 0.05 level				
**MacKinnon-Haug-Michelis (1999) p-values				
Unrestricted Cointegration Rank Test (Maximum Eigenvalue)				
Hypothesized		Max-Eigen	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.364220	24.45671	21.13162	0.0164
At most 1	0.128062	7.399997	14.26460	0.4430
At most 2	0.000400	0.021623	3.841466	0.8830
Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level				
* denotes rejection of the hypothesis at the 0.05 level				
**MacKinnon-Haug-Michelis (1999) p-values				
1 Cointegrating Equation(s):		Log likelihood	154.5980	
Normalized cointegrating coefficients (standard error in parentheses)				

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LOG(GDP)	LOG(EXPORTS)	LOG(IMPORTS)
1.000000	-5.828671	5.125702
	(0.93974)	(0.93541)

The results of the cointegration test indicates one cointegrating equation at the 0.05 level, and provide the existence of long run equation between GDP, exports and imports, which can be written as:

$$\mathbf{log}(\boldsymbol{GDP}) = \mathbf{5.828671\,log}(\boldsymbol{exports}) - \mathbf{5.125702log}(\mathbf{imports}) \quad \mathbf{(9)}$$

According to this equation a 1% increase in exports leads to an increase of 5.828671% of GDP. On the other hand, a 1% increase in imports leads to a decrease of 5.125702% of GDP. Otherwise, the three variables are cointegrated, which obliges us to use the VECM model to test the significance of this model.

6. Estimation VECM

As, GDP, exports and imports are cointegrated, a VECM (vector error correction model) representation would have the following form, in equation

$$\Delta \mathbf{GDP}_t = \sum_{i-1}^{k} \alpha_0\, \Delta \mathbf{GDP}_{t-i} + \sum_{i-1}^{k} \alpha_1\, \Delta \mathbf{export}_{\mathbf{t-i}} + \sum_{i=1}^{n} \alpha_2\, \Delta \mathbf{Imp}_{t-i} + Z_1 EC1_{t-1} + \varepsilon_{1t} \quad \mathbf{(10)}$$

Where:

- Δ: The difference operator.
- k : The number of lags
- $\alpha_0, \alpha_1 and\ \alpha_2$: Short run coefficients to be estimated.
- $EC1_{t-1}$: The error correction term derived from the long-run co integration relationship.
- Z_1 : The error correction coefficients of $EC1_{t-1}$.
- ε_{1t}: The serially uncorrelated error terms in equation

Table 6: Estimation of the Long Run Equation

Dependent Variable: D(LOG(GDP))
Method: Least Squares (Gauss-Newton / Marquardt steps)
Sample (adjusted): 1962 2015
Included observations: 54 after adjustments

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	-0.060400	0.015984	-3.778858	0.0004
C(2)	0.015808	0.131382	0.120322	0.9047
C(3)	0.031655	0.121209	0.261157	0.7951
C(4)	0.171256	0.101677	1.684309	0.0985
C(5)	0.073363	0.015957	4.597593	0.0000
Diagnostic Tests				
R-squared	0.833786	Mean dependent var		0.099821
Adjusted R-squared	0.779401	S.D. dependent var		0.087765
S.E. of regression	0.074502	Akaike info criterion		-2.267948
Sum squared resid	0.271980	Schwarz criterion		-2.083782
Log likelihood	66.23459	Hannan-Quinn criter.		-2.196922
F-statistic	6.137473	Durbin-Watson stat		2.062602
Prob(F-statistic)	0.000438			

C (1) must be significant, and the coefficient of C (1) should be negative for the VECM. In our case, the correction error term is significant and has a negative coefficient. These prove that in the long run, 1% increase in exports leads to an increase of 5.828671% of GDP. On the other hand, a 1% increase in imports leads to a decrease of 5.125702% of GDP.

Diagnostic tests indicate that the overall specification adopted is satisfactory. The R-squared is greater than 60%, which agrees that our estimate is acceptable. Otherwise the probability of Fisher is less than 5%, which indicates that our model is well treated. Finally, Durbin-Watson shows that our model is very satisfactory.

V. CONCLUSION

This paper investigates the relationship between exports, imports, and economic growth in China. In order to achieve this purpose, annual data were collected from the reports of World Bank for the periods between 1960 and 2015, was tested by using correlation matrix test, Augmented Dickey-Fuller (ADF) stationary test and co integration analysis of Vector Error Correction Model (VECM). According to the result of the analysis, the test of correlation show the relationship between the variables is positively correlated. Also, unit root tests show that economic growth, exports and imports series become stationary when first difference is considered. Also, it was determined by using co integration analysis that there is relationship between the three variables in China. Also, and according to the Vector Error Correction Model, exports have a positive effect on economic growth. However, imports have a negative effect on economic growth. These results provide evidence that exports are seen as the source of economic growth in China. The analysis in this paper demonstrates that exports have always been and will continue to be a major contributor to China's economic growth.

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