Trade and Economic Growth in Germany

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Abstract:

The nexus between trade and economic growth in Germany has been widely debated given to the high economic status compared to most countries in the world. This paper investigates the relationship between exports, imports, and economic growth in Germany. In order to achieve this purpose, annual data were collected from the reports of World Bank for the periods between 1985 and 2015, was tested by using Augmented Dickey-Fuller (ADF) and Phillip-Perron (PP) stationary test, co integration analysis of Vector Auto Regression 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 of Vector Auto Regression Model that there is no relationship between the three variables in Germany. On the other hand, and according to the Granger-Causality tests, we defined that there is unidirectional causality between exports and imports and between exports and economic growth. In addition, we found that there is a strong evidence of bidirectional causality from import to economic growth. These results provide evidence that exports and imports, thus, are seen as the source of economic growth in Germany.

Key words: export, import, economic growth, Germany, Cointegration and Causality.

JEL Codes: D53

1. 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. Germany's economy is one of the largest economies of the world, where it occupies the fourth place in terms of GDP after the United States, China, and Japan. Furthermore it is ranked fifth in terms of purchasing power since it is the most populous country in Europe, where the population is roughly 82 million people. Additionally, Germany's booming economy attracted millions of immigrants from around the world as it is the third largest country in terms of the number of immigrants. Germany maintained a high standard of living. In other words, Germany is the largest economy in the European Union. They benefit from a large group of talented labor force that enabled Germany to be one of the most industrious states in terms for cars, machinery, chemicals, equipments, and appliances all over the world. In 2014, Germany exports reached $ 1.41 trillion making it the 3rd largest exporter in the world. During the last five years the exports of Germany have increased to an annual rate of 6.3%, from $ 1.04 trillion in 2009 to $ 1.41 trillion in 2014. The most recent exports are led by cars which represent 116% of the total exports of Germany, followed by vehicle's spare parts that reach the level of 4.49%. In 2014, Germany imported $ 1.13 billion, which makes it the third largest importer in the world. During the last five years the imports of Germany have increased to reach an annual rate of 6.1%, from $ 842 billion in 2009 to $ 1.13 trillion in 2014. The most recent imports are led by crude oil. Its production represents 4.7% of the total imports of Germany, followed by cars, which account for 4.17%.The aim of this paper, therefore, is to econometrically investigate the direct linkages between trade and economic growth of Germany, through employing yearly data for the period 1985-2015. 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.

2. REVIEWLITERATURE:

The relationship between import, export and economic, has been a subject matter for a substantial body of empirical work. Their nexus is usually investigated in the empirical literature in

two different lines: The first line of the existing empirical research attempt to separately examine the importance of export or import on economic growth, the second line of the empirical works examines the relationship between export and import collectively. With regard to methods haven used to determine the importance of export and/or import to economic growth, there are two main methods. The first one employs simple or multiple regressions, while the second method employs the causality technique. Recently, most of studies have attended to focus on VAR and VEC models and cointegration approach. Our review of literature is limited to studies that focus on the joint impact of both export and import on economic growth, which are emphasized on the table below.

Table 1: Studies related to the relationship between exports, imports and economic growth

Study	Data	Method	Keys findings
Hadi Salehi Esfahani (1989)	1960 – 1973 (annual): 31 countries	OLS and Granger causality tests	The major contribution of exports to the GDP growth rate is to relieve the import shortage that many semi-industrialized country confront.
Frederik Sjôholom (1999)	1980 – 1991 (annual): Indonesia	OLS	Exports have shown comparable high productivity growth. The larger the share of an establishment's output that is exported, the higher its productivity growth. The effects of imports on productivity growth are mixed.
Johan Asafu-Adjaye and Debasish Chakraborty (1999)	1960 – 1994 (annual): India, Nigeria, Fiji and Papua New Guinea	Cointegration analysis and VECM	There is no evidence of the existence of a causal relationship between export, import, and economic growth.
Francisco F. Ribeiro Ramos (2000)	1865 – 1998 (annual): Portugal	Cointegration analysis, VECM and Granger causality	There is a feedback effect between exports output growth and imports output growth. There is no kind of significant causality between import export growths.

		tests	
Rubina Vohra (2001)	1973 – 1993 (annual): India, Pakistan, the Philippines, Malaysia and Thailand	OLS	Exports have a positive and significant impact on economic growth when a country has achieved some level of economic development.
Leo Michelis and George K. Zestos (2004)	1950 – 1990 (annual): Belgium, France, Germany, Greece, Italy and the Netherlands	Cointegration analysis, VECM and Granger causality tests	Strong evidence of Granger causality from the foreign sector to GDP. Strong evidence of bi-directional causality from GDP to exports and, imports.
Titus O. Awokuse (2006)	For Bulgaria: 1994 – 2004 (quarterly) For Czech Republic: 1993 – 2002 (quarterly) For Poland: 1995 – 2004 (quarterly)	Cointegration analysis, ECM, and Granger causality tests	Trade stimulates economic growth.
Ullah et al (2009)	1970 – 2008 (annual): Pakistan	Cointegration analysis, VECM and	Exports expansion lead to economic growth. Unidirectional causality between economic growth, exports, and imports.

		Granger causality tests	
Yuhong Li and all (2010)	1981 – 2008 (annual): China	Cointegration analysis, VECM and Granger causality tests	Existence of long term and short term causality between GDP, exports, and imports. Strong development of foreign trade greatly benefits the economic development. No existence of causality between exports, imports, and economic growth.
Barbara Pistoresi and Alberto Rinaldi (2011)	1863 – 2004 (annual): Italy	Cointegration analysis and Granger causality tests	Strong bidirectionality between imports and exports resulted in the increase in intra-industry trade. Weak support of exports led growth and growth-led imports. Exports were not the only or the main driver of economic growth.
Dilawar Khan and al (2012)	1972 – 2009 (annual): Pakistan	Cointegration analysis, VECM and Granger causality tests	The existence of long-run correlation among exports, imports, and economic growth. Exports and imports are considered an essential part for economic growth of Pakistan. Economic growth has an important impact on exports and imports.
Aleksandra Parteka and Massimo Tamberi (2013)	1988- 2010 (annual): 163 countries	OLS	Trade between countries stimulates economic growth.
SK Kamal Ahmed and al (2013)	1972 – 2006 (annual): Bangladesh	OLS	Exports and imports are moderately related to the growth of GDP. Exports contribute positively to GDP where imports' contribution is unenthusiastic.

Velnampy.T and Achchuthan. S (2013)	1970 – 2010 (annual): Sri Lanka	Correlation analysis and regression analysis	Exports and imports have the significant positive relationship with each other. Also the result shows that exports and imports have a significant impact on the economic growth.
Rummana Zaheer and al (2014)	2000 – 2010 (annual): Pakistan	VECM	Exports and imports have significant relationship with growth rate. Government should move towards more exchange rate liberalization policy in order to increase its economic growth.
Auro Kumar Sahoo, Dukhabandhu Sahoo and Naresh Chandra Sahu (2014)	1981 – 2010 (annual): India	Cointegration analysis, VECM, ARCH and Granger causality tests	Mineral exports, industrial production, and economic growth are cointegrated, indicating an existence of a long run equilibrium relationship among variables. There is a long-run Granger causality relationship running from economic growth and industrial production to the mineral export.
Hussain M and Saaed A.(2014)	1977 – 2012 (annual): Tunisia	Cointegration analysis, VECM and Granger causality tests	There is unidirectional causality from imports to GDP. As imports do lead GDP.
Güngör Turan and Bernard Karamanaj (2014)	1984 – 2012 (annual): Albania	OLS	Exports have a positive impact on the economic growth, however imports have a negative impact on the economic growth.
Afaf Abdull J. Saaed and Majeed Ali Hussain (2015)	1977 – 2012 (annual): Jordan	Cointegration analysis, VECM and Granger causality tests	There is unidirectional causality between exports and imports and between exports and economic growth. Imports are seen as the source of economic growth in Tunisia.

Sachin N. Mehta (2015)	1976 – 2014 (annual): India	Engle Granger Cointegration analysis, VECM and Granger causality tests	There is a long run co-integrating relationship between Gross Domestic Products (GDP), Export, and Import in India. In long term the results of Granger causality tests show that GDP leads to Exports but Exports does not lead to GDP, also GDP does not lead to Import and Import do not lead to GDP. Finally Export lead to Imports but Imports do not lead to Exports.
Serhat Yüksel and Sinemis Zengin (2016)	1961- 2014 (annual): Argentina, Brazil, China, Malaysia, Mexico and Turkey	Engle Granger Cointegration analysis, VECM and Granger causality tests	The increase in exports causes higher growth rate in Argentina. There is also a causal relationship between import to export in China and Turkey. Then, exports cause higher imports in Malaysia. Finally, the relationship between import, export and growth rate is not same for all developing countries.
Masoud Albiman Md and Suleiman NN (2016)	1967 – 2010 (annual): Malaysia	Cointegration analysis, VAR and Granger causality tests	There is a causal relationship from exports to economic growth and from exports to imports.

3. DATA AND METHODOLOG

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 Germany observations uttered and expressed by natural logarithms for the sample period running from 1985 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$) and logarithm of imports of goods and services (Current US$).

The empirical model used to test the relationship between GDP, exports and imports. Can be specified by the following form:

$$\boldsymbol{GDP_t = f(Exports, Imports)(1.1)}$$

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

$$\boldsymbol{Ln(GDP_t) = \alpha + \beta_0 Ln(Exports_t) + \beta_1 Ln(Imports_t) + \varepsilon_t\ (1.2)}$$

Where: α is the constant term,'t' is the time trend, and 'ε' is the random error term assumed to be normally, identically and independently distributed. The empirical methodology used in this study is in two stages and is to determine the degree of integration of each variable. 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) and Phillips-Perron test (PP).

The general form of ADF test is estimated by the following regression:

$$\boldsymbol{\Delta Y_1 = \alpha + \beta Y_{t-1} + \sum_{i=1}^{n} \beta_1 \Delta Y_i + \varepsilon_t\ (1.3)}$$

$$\boldsymbol{\Delta y_t = \Delta y_{t-1} + \varepsilon_t (1.4)}$$

Once the order of integration of the known series is determinate, the next step is to review the possible presence of cointegration relationships that can long exist between the variables. This analysis will be following the cointegration test procedure of Johansen (1988) more effective than the two-step strategy of Engle and Granger (1987) when the sample is small and the high number of variables (before the cointegration test, we look for the number of delays from the optimum choice criterion of use SC). If there are cointegrating relationships we will use the VECM model, if no one applies the VAR model.

The VAR-based cointegration test using the methodology developed in Johansen (1991, 1995) is described below:

Consider a VAR of order p

$$Y_t = \mu + \Delta_t Y_{t-1} + \Delta_p Y_{t-p} + \varepsilon_t (1.5)$$

If the economic variables are not cointegrated, we can proceed to use the Vector Auto-regression (VAR) representation. This VAR can be rewritten as follows:

$$\Delta Y_t = \mu + \eta_{Yt-1} + \sum_{i=1}^{p-1} \tau_1 \Delta Y_{t-1} (1.6)$$

Finally, we apply Granger causality test. In the absence of cointegration, the unrestricted VAR in first difference is estimated, which takes the following form:

$$\Delta GDP_t = \sum_{i=1}^{n} \beta_{1t} \Delta GDP_{t-1} + \sum_{i=1}^{n} C_1 \Delta e^{t-1} + \sum_{i=1}^{n} d_{1t} \Delta Imp_{t-1} + \varepsilon_{2t} (1.7)$$

$$\Delta e^t = \sum_{i=1}^{n} \beta_{3t} \Delta GDP_{t-1} + \sum_{i=1}^{n} C_{3t} \Delta e^{t-1} + \sum_{i=1}^{n} d_{3t} \Delta Imp_{t-1} + \varepsilon_{3t} (1.8)$$

$$\Delta \text{ Im p}_t = \sum_{i=1}^{n} \beta_{3t} \Delta GDP_{t-1} + \sum_{i=1}^{n} C_{3t} \Delta e^{t-1} + \sum_{i=1}^{n} d_{3t} \Delta Imp_{t-1} + \varepsilon_{3t} (1.9)$$

4. EMPIRICAL ANALYSIS

Tables 2 and 3 show that all the variables (GDP, exports and imports) were differenced once the ADF and PP test were conducted on them; the result reveals that all the variables became stationary at first difference. The table 5 shows the result of the cointegration test. In the table, both trace statistic and maximum Eigenvalue statistic indicate no cointegration at the 5 percent level of significance, meaning that the null hypothesis cannot be rejected at the 5% significance level. This means that there is no cointegrating relation between the variables so tested; this implies that exports, imports and economic growth have no long-run relationship. Also, the table 8 justifies the efficiency and the quality of the estimation of VAR model in the tables 6 and 7. And finally, the table 9 presents the Granger Causality tests.

Table 2: Tests for Unit Root: ADF

Variable	ADF Level with constant only			ADF First Difference with constant only		
	Test critical values	test statistic	Probability	Test critical values	test statistic	Probability
LGDP 1% level LGDP 5% level LGDP 10% level	-3.670170 -2.963972 -2.621007	-4.431395	0.0015	-3.679322 -2.967767 -2.622989	-4.000355	0.0044
LEXPORT 1% level LEXPORT 5% level LEXPORT10% level	-3.670170 -2.963972 -2.621007	-2.399173	0.1504	-3.679322 -2.967767 -2.622989	-4.567129	0.0011
LIMPORT 1% level LIMPORT 5% level LIMPORT 10% level	-3.670170 -2.963972 -2.621007	-2.294967	0.1800	-3.679322 -2.967767 -2.622989	-4.591160	0.0010

Table 3: Tests for Unit root (PP)

Variable	PP Level with constant only			PP First Difference with constant only		
	Test critical values	test statistic	Probability	Test critical values	test statistic	Probability
LGDP 1% level LGDP 5% level LGDP 10% level	-3.670170 -2.963972 -2.621007	-3.781078	0.0076	-3.679322 -2.967767 -2.622989	-4.424404	0.0016
LEXPORT 1% level LEXPORT 5% level LEXPORT10% level	-3.670170 -2.963972 -2.621007	-2.399173	0.1504	-3.679322 -2.967767 -2.622989	-4.556735	0.0011
LIMPORT 1% level LIMPORT 5% level LIMPORT 10% level	-3.670170 -2.963972 -2.621007	-2.294967	0.1800	-3.679322 -2.967767 -2.622989	-4.591160	0.0010

Table 4: Lag order Selection Criteria

VAR Lag Order Selection Criteria						
Endogenous variables: LOG(GDP) LOG(EXPORTS) LOG(IMPORTS)						
Exogenous variables: C						
Sample: 1985 2015						
Included observations: 27						
Lag	**LogL**	**LR**	**FPE**	**AIC**	**SC**	**HQ**
0	67.14017	NA	1.73e-06	-4.751124	-4.607142	-4.708310
1	135.7616	116.9106*	2.11e-08*	-9.167528*	-8.591600*	-8.996274*
2	139.2914	5.229290	3.26e-08	-8.762325	-7.754452	-8.462632
3	145.5216	7.845418	4.31e-08	-8.557154	-7.117335	-8.129020
4	154.9904	9.819489	4.83e-08	-8.591879	-6.720115	-8.035306

Table 5: Cointegration Test

Included observations: 29 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			0.05	
No. of CE(s)	Eigen value	Trace Statistic	Critical Value	Prob. **
None	0.397656	22.34260	29.79707	0.2798
At most 1	0.229549	7.641743	15.49471	0.5045
At most 2	0.002726	0.079148	3.841466	0.7784
Trace test indicates no cointegration 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 Eigen value)				
Hypothesized		Max-Eigen	0.05	
No. of CE(s)	Eigen value	Statistic	Critical Value	Prob. **
None	0.397656	14.70085	21.13162	0.3104
At most 1	0.229549	7.562596	14.26460	0.4249
At most 2	0.002726	0.079148	3.841466	0.7784
Max-Eigen value test indicates no cointegration 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	148.1779	
Normalized cointegrating coefficients (standard error in parentheses)				
LOG(GDP)	LOG(EXPORT)	LOG(IMPORT)		
1.000000	14.09609	-16.70118		
	(3.74100)	(4.20642)		

Table 6: Vector Auto-regression Estimates

Vector Autoregression Estimates			
Sample (adjusted): 1986 2015			
Included observations: 30 after adjustments			
Standard errors in ( ) & t-statistics in [ ]			
	LOG(GDP)	LOG(EXPORTS)	LOG(IMPORTS)
LOG(GDP(-1))	0.552440 (0.14394) [3.83787]	-0.251130 (0.15893) [-1.58017]	-0.144682 (0.15913) [-0.90919]
LOG(EXPORTS(-1))	0.830564 (0.48321) [1.71885]	2.306040 (0.53350) [4.32247]	1.602537 (0.53420) [2.99991]
LOG(IMPORTS(-1))	-0.725396 (0.56237) [-1.28990]	-1.372324 (0.62090) [-2.21023]	-0.765968 (0.62170) [-1.23205]
C	9.876544 (2.06530) [4.78214]	8.941271 (2.28025) [3.92118]	8.525268 (2.28322) [3.73388]
R-squared	0.950852	0.981353	0.976623
Adj. R-squared	0.945181	0.979201	0.973926
Sum sq. resids	0.175994	0.214535	0.215094
S.E. equation	0.082274	0.090837	0.090955
F-statistic	167.6710	456.0995	362.0716
Log likelihood	34.50939	31.53906	31.50003
Akaike AIC	-2.033959	-1.835937	-1.833335
Schwarz SC	-1.847133	-1.649111	-1.646509
Mean dependent	28.50933	27.32250	27.25073
S.D. dependent	0.351396	0.629856	0.563278
Determinant resid covariance (dof adj.)		1.12E-08	
Determinant resid covariance		7.26E-09	
Log likelihood		153.4118	
Akaike information criterion		-9.427452	
Schwarz criterion		-8.866973	

Table 7: Least Squares (Gauss-Newton/Marquardt steps)

Dependent Variable: LOG(GDP)				
Method: Least Squares (Gauss-Newton / Marquardt steps)				
Sample (adjusted): 1986 2015				
Included observations: 30 after adjustments				
LOG(GDP) = C(1)*LOG(GDP(-1)) + C(2)*LOG(EXPORTS(-1)) + C(3)*LOG(IMPORTS(-1)) + C(4)				
	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	0.552440	0.143944	3.837868	0.0007
C(2)	0.830564	0.483209	1.718852	0.0975
C(3)	-0.725396	0.562365	-1.289902	0.2084
C(4)	9.876544	2.065298	4.782139	0.0001
R-squared	0.950852	Mean dependent var		28.50933
Adjusted R-squared	0.945181	S.D. dependent var		0.351396
S.E. of regression	0.082274	Akaike info criterion		-2.033959
Sum squared resid	0.175994	Schwarz criterion		-1.847133
Log likelihood	34.50939	Hannan-Quinn criter.		-1.974192
F-statistic	167.6710	Durbin-Watson stat		1.648025
Prob(F-statistic)	0.000000			

Table 8: Residual Diagnostics Tests

R-squared	0.950852
Adjusted R-squared	0.945181
F-statistic	167.6710
Prob(F-statistic)	0.000000
Breusch-Godfrey Serial Correlation LM Test:	0.4517
Heteroskedasticity Test: Breusch-Pagan-Godfrey	0.8321
Jarque-Bera	0.830316

To investigate the causality between GDP and exports, on the one hand, and GDP and imports, on the other, a simple Granger causality test has been performed, by estimating the vector autoregressive processes for GDP, exports, and imports. The objective of this exercise is to test the

GDP, exports and imports hypothesis for Germany empirically. The results of causality between economic growth (GDP), exports and imports are contained in the table 9.The Granger Causality Tests shows that there is unidirectional causality between exports and imports and between exports and economic growth. In addition, we found that there is a strong evidence of bidirectional causality from import to economic growth.

Table 9: Pairwise Granger Causality Tests

Pairwise Granger Causality Tests			
Sample: 1985 2015			
Lags: 1			
Null Hypothesis:	**Obs**	**F-Statistic**	**Prob.**
LOG(EXPORTS) does not Granger Cause LOG(GDP)	30	6.62366	0.0159
LOG(GDP) does not Granger Cause LOG(EXPORTS)	30	5.13643	0.0317
LOG(IMPORTS) does not Granger Cause LOG(GDP)	30	5.12493	0.0318
LOG(GDP) does not Granger Cause LOG(IMPORTS)	30	1.53946	0.2254
LOG(IMPORTS) does not Granger Cause LOG(EXPORTS)	30	7.82963	0.0094
LOG(EXPORTS) does not Granger Cause LOG(IMPORTS)	30	10.2341	0.0035

5. CONCLUSION

The aim of this study was to explain the nexus between exports, imports and economic growth of Germany during the period 1985-2015. The cointegration, VAR model and Granger's causality tests are applied to investigate the relationship between these three variables. The unit root properties of the data were examined using the Augmented Dickey Fuller test (ADF) and Philips-Perron (PP) after that the cointegration and causality tests were conducted. The result shows that there is no relationship between the three variables in Germany. On the other hand, we defined that there is unidirectional causality between exports and imports and between exports and economic growth. In addition, we found that there is a strong evidence of bidirectional causality from import to economic growth. These results provide evidence that growth in Germany was propelled by a growth-led import and growth-led export strategy. Therefore, we can affirm that exports and imports are thus seen as the source of economic growth in Germany

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