Linear adjustment of the bilateral exchange Tunisia Fundamental to its value

Abstract: This article we analyze the bilateral trade in Tunisia. For this, we will refer us to the main previous empirical work. Also, we will try to empirically validate this Tunisian bilateral exchange from a database extracted from the Tunisian Central Bank, the IMF and the World Bank. We will use statistical techniques and sophisticated econometric models to study the linear fit of Tunisian bilateral trade from its fundamental value.

Keywords:Bilateral Exchange, Exchange Rate Volatility, Cointegration, Vector Error-Correction, ARCH, GARCH, VEC-GARCH.

JEL Codes: F3, F36, G12, G18

Introduction

Since the last two decades, the consequences of volatile trade on exchange rates have been the focus of debate on the optimality of alternative exchange rate regimes. Adherents of fixed exchange rates argue that since the advent of flexible exchange rates, exchange rates have been subject to an unreasonable volatility and deviation from the equilibrium values that have persisted for periods of time frozen.

The changes in the international economy in a contradictory manner could affect the impact of changes in exchange rates on international trade. Therefore, it seems very difficult to understand their impact without recourse to extensive empirical research. The instability of exchange rates can influence trade instantly by uncertainty and adjustment costs and indirectly through its effect on the structure of production and investment and political government.

From a theoretical point of view, the link between the variability of exchange rates and trade flows remain very ambiguous to the end. The assumption that the variability of exchange rates has a negative effect on trade is based on aversion against risk. In fact, Ethier (1973), Clark (1973), Baron (1976), Cushman (1986), Perée and Steinherr (1989) showed the existence of a negative relationship between exchange rate volatility and trade. While Viaene and De Vries (1992), Franke (1991),Vanhulle and Sercu (1992) had an opposite view. The idea is also worth mentioning that the literature is largely based on a partial equilibrium approach that excludes conclusions on the well-being.

From an empirical point of view, the study of the impact of volatility in exchange rates on the trade volume was largely devoted to the G7 and extended regularly to members when the IMF data became available. It also studied the impact of the volatility of exchange rates on trade at the global level by also focusing on differentiated and homogeneous products. Finally, waste estimation methods have fully played a crucial role in optics is to evaluate the effect of the variability of exchange rates on trade.

On 1 January1995, the World Trade Organization (WTO) was established to help develop and multilateral trade agreements and facilitate trade liberalization. This organization currently has 153 members among them there is also Tunisia. Specifically, Tunisia became a member of the WTO since 1995 after the signing of a treaty in 15 April 1994. This agreement was approved 29 March1995. The cohesion of Tunisia as one WTO member has led him to a successful strategy of openness and integration of the national economy (Tunisian) on the global economy, to promote exports and provide new opportunities to access new markets.

In this article we will try to study the impact of the volatility of the Tunisian dinar on the trade balance through the import demand and export supply. To achieve this purpose, we consider the bilateral trade relationship between Tunisia with its main trading partner is France. We subdivide this article into two sections. In the first section we will use the main previous empirical work that dealt with the impact of the volatility of exchange rates on international trade and bilateral particular. In the second part, we will study the volatility of import-export functions and we will analyze the linear fit of the Tunisian bilateral exchange in the VECM model.

I- The main previous empirical work

To judge the conventional assumption that exchange rate volatility has a negative effect on the volume of trade, and Kohlhagen Hooper (1978) studied the relationship on a global and bilateral level in the G7 countries during the period 1965-1975. In fact, they estimated reduced form equations for the price and the volume of trade flows in the United States and Germany. Based on this model and kohlhogen Hooper (1978) used the absolute difference between the current exchange rate (spot) for the current period and the forward exchange rate (3 months early) for the term expired whose purpose is to measure the currency risk. Their results suggested that the volatility of the exchange rate has a negative and statistically significant impact on market prices if importers assume currency risk. Currency risk of resurgence reduced demand for imported goods and therefore the market price will aggravated.In addition, both economists have demonstrated a significant impact on the price of exports if the exporters required coping with currency risk. Conversely, kohlhagn and Hooper (1978) found that there is no influence of any significant currency risk on quantities of traded goods.

Cushman (1983) examined the impact of currency risk on the level of trade by reference to a model similar to that adopted by Hooper and Kohlhagen (1978) but replaced the nominal exchange rates by exchange rate real. In fact, Cushman (1983) tried to apply his model on industrial country in which there were fourteen cases of bilateral trade flows during the period 1965-1977, of these fourteen cases, there are six cases where the variability of rates Real Exchange has a negative and statistically significant impact. In reality, the existence of a negative effect of the variability of the exchange rate appeared more specifically on US trade

with Canada, Germany with France and Japan with France in order to justify that 'there is a negative impact of currency risk on the level of world trade. Contrary to what was stated by the previous model (Model Koholhagen and Hooper (1978)) where the currency risk could not affect prices, Cushman (1983) justified the change in exchange rates affects both prices and quantities of goods exchanged, but this is due to a study adopting a long-term period and not short term.
Moreover, what the difference between resurfaced this study with other empirical work is that its theoretical resource supports on the classic design of proportional inelastic in the short term and is partially elastic in the long run.

A study by Brada & Mendez (1988) differs from previous studies presented by De Grauwe and Verfaille (1988). This study used a gravity model of bilateral trade flows, including national and foreign income, population, distance between countries and even the dummy variables for the system of the exchange rate and trade arrangements. The model is estimated on advanced and developing countries 30 for each year from 1973 to 1977. Actually, the coefficients on the exchange rate regime are significant at 5%. In all cases, trade flows are larger between countries with varying rates between countries with fixes.All rate reduction in the trade as a fixed-rate regime varies from 27% to 61% .The authors found that although the variability of the exchange rate may mitigate the exchange between countries, its impacts are lower than restrictive trade policies often imposed under the system of fixed exchange rates. In this sense, instead of relying on the movements of exchange rates to break even fixed exchange payments, countries must rely on the evolution of revenues and domestic prices, or impose trade restrictions. Also, import demand is controlled by tariff and non tariff barriers in the currencies are overvalued.

Frankel and Wei (1993), Wei (1999), Dell'Ariccia (1999), Rose (2000), Tenreyo (2003) McCallum (1995) and Coe, Subramanian and Tamirisa (2002), Deardorff (1998), Anderson and Van Wincoop (2003) used a gravity model to identify the existence of a negative relationship between exchange rate volatility and trade. In this model of gravity, all bilateral trade flows between the countries are under a positive way to their gross domestic products (GDP) and negatively, to the physical distance which separates them. In a very precise way, the advanced countries still share in absolute terms, while the distance can be seen as a proxy for transport costs, which proceed as a hindrance to trade. In addition, the population is often introduced as an explanatory variable, as an additional measure of the size of a country. Also, a series of dummies has been introduced in the gravity equation in order to take account of shared characteristics that increase the likelihood of bilateral trade, such as the appearance of a border or a collective language or contribution to the same free trade agreement.

Perée and Steinherr (1989) estimated the equations for the export volume of five industrialized countries during the period 1960-1985. In this context, the two researchers showed that the uncertainty variables are never significant in the case of the United States while in industrialized countries, their impact is often negative and significant (important). Similarly, they attributed the asymmetry in the results to the fact that US exports are largely denominated in US dollars and US companies are more diversified, benefiting from a large domestic market that allows them to offset most commonly the uncertainty of exchange rates. Also, Perée and Steinherr (1989) also reported regression results for bilateral exports to the

United States, with the exception of Japan; the amplification of the uncertainty seems to worsen the trade volume.

Feenstra and Kendall (1991) founded a hypothesis about the relationship between the estimated risk premium and exchange rate variability effect on prices. The regressions for the prices of US imports from the United Kingdom, Japan and Germany were presented. The difference in the exchange rate is estimated by the GARCH model. A significant risk premium is negative time-variant was found for the Japanese Yen but not for the book and the brand. Also, these authors found that the variance is insignificant in the equation of the Japanese export prices, while there is a negative and significant impact in the equations concerning the United Kingdom and Germany. In general, it may be noted that there are four empirical studies that make use of cross-sectional regressions.

In addition, other authors namely Asseery and Peel (1991) attempted to examine the impact of volatility on the volume of multilateral export of five industrialized countries. They tried to use a framework of error correction. It should be noted that non-robust results in previous empirical studies may be explained by the fact that the export variable and certain built-in variables of these determinants are potentially stationary. In this sense, the measure of volatility is based on residue from an ARIMA process for the real exchange rate, for all countries except the UK, they found that the variability has a positive impact increased export during the period 1973-1987. Although, we note that the measurement of Williamson (1985) assumes that "the rate of Fundamental Equilibrium Exchange" is considered as the real exchange rate leads to a balance allowing it to support the current account, taking into account the long-term capital movements.

In addition, Lastrapes kroner (1993) have fully investigated the effect of the instability on the volume of multilateral exports and prices by using the joint estimation technique as part of a parametric model of the conditional variance (a GARCH multivariate). This model is opposed to conventional estimation procedures in two steps. On the one hand, this model requires rationality forecast variance. The terminal model variance which bends exchanges to be the same as generated by the data. Therefore, the conditional variance is a statistically significant impact on the reduced form of equations for all countries (based on likelihood ratio tests).Otherboth as regards individual coefficients of variability impact the volume is estimated with the utmost precision to the United States. The sign of the scale of the impact varies depending on the country properlythe scale was more powerful for full price. In a very precise manner, the impact of volatility discovered is only a temporary effect in the case of Japan, France and the United States. In this context, one can note the existence of negative impact on the volume of trade outright for the UK and the US, as opposed to other countries where it is found that the coefficient is positive. Moreover, by also focusing on export prices, volatility has a negative impact in the US, while for other countriesthis instability has a strictly positive.

Rose (2000) presented a gravity model using a large sample of 186 countries during the period 1970-1990. This study was based on the optical is to measure the impact of currency unions on trade in member countries. She practiced more specifically the standard deviation

of the first difference of the logarithm of the monthly bilateral nominal exchange rate, which is calculated over the five years preceding the year of the estimate. It found that there is a small but significant negative effect: The decline in the variability of the standard deviation of 7% from the average of 5% results in an amplification of the level of bilateral trade by 13%, which coincides with the results generated by Dell'Ariccia (1999) when using three different measures other than the standard deviation. However, when stochastic effects are associated in the assessment, the extent of the Trade variability impact is mitigated to a third compared to the first estimate. According to what was mentioned by the latter two analyzes, we find that Dell'Ariccia (1999) and Rose (2000) found harmonious results.

Cermeno et al (2009) studied the effects of the volatility of fundamental determinants (relative prices and real incomes) on trade flows in Mexico during the period 1991-2008. The two functions of exports and imports are based on the model of the product of imperfect substitution of trade. They focus their analysis on the effects of the real exchange rate as well as relative price measures, real income and their conditional volatility associated to the flow of imports and exports. Based on a vector error correction model with conditional heteroskedasticity (VECMGARCH). Their results suggest that the model of imperfect substitutes is a reasonable empirical specification that there is a cointegration relationship and get income and price elasticity in line with those of previous empirical studies. In fact, they found that the effects of income are the main determinants of trade flows. In the long term, there are the effects of significant volatility in the foreign trade.

Finally, Yussoff and Sbit (2015) examined the impact of volatility in the exchange rate, real GDP of China and the real exchange rate on bilateral exports of member countries of ASEAN (Brunei Darussalam, Indonesia, Malaysia, Philippine, Singapore and Thailand) to China using the generalized method of moments. Their results suggest that all the coefficients of these variables have the expected signs and are statistically significant. Specifically, if the volatility of exchange rate increases by 1%, exports decreased by approximately 0.21%, if the real exchange rate depreciates by 1%, the ASEAN exports to China increased by 186%. The results show that members of ASEAN nations should maintain the stability of their bilateral exchange rates with the Chinese Yuan as a way to boost their exports to China.

Empirical Validation

We will try to verify the effects of Tunisian bilateral exchanges during a study period from 2000 to 2015 on monthly frequency in this article. For this, we will use the function of imports and exports as endogenous variables in relation to relative prices of exports & imports and the Tunisian national income in real terms. We will refer to the Tunisian Central Bank (BCT), the International Monetary Fund (IMF) and World Bank (WB) to collect our database. We will model the import-export duties by a non-linear model Yussoff and Sbit (2015), which takes the following form:

$$Y_t = A(PR)_t^{\alpha} (RN)_t^{\beta} \exp(\varepsilon_t) \qquad \forall \, t = 2000:01 \rightarrow 2015:08$$

With Y_t: corresponds imports or exports Tunisian volumes, PR: represents the relative price either imports or exports, RN: means the national income in real term: the error term and A: means the means of effects omitted variables. We will use the natural logarithmic operator to reconcile figures increases the values for all variables and linearize our basic model. After a logarithmic transformation our reference model is written as follows:

$$Log(Y_t) = Log(A) + \alpha Log(PR)_t + \beta Log(RN)_t + \varepsilon_t \qquad \forall t = 2000:01 \rightarrow 2015:08$$

II-1Test unit roots

We will use the unit root test to study the stationarity of the variables of the basic model (Yussoff and Sbit (2015)). The size of observations is very high. For this, we will refer us to the test Philips &Perron (1988), which takes into account the existence of a problem than heteroscedasticity autocorrelation. The table below corresponds to this is to these variables.

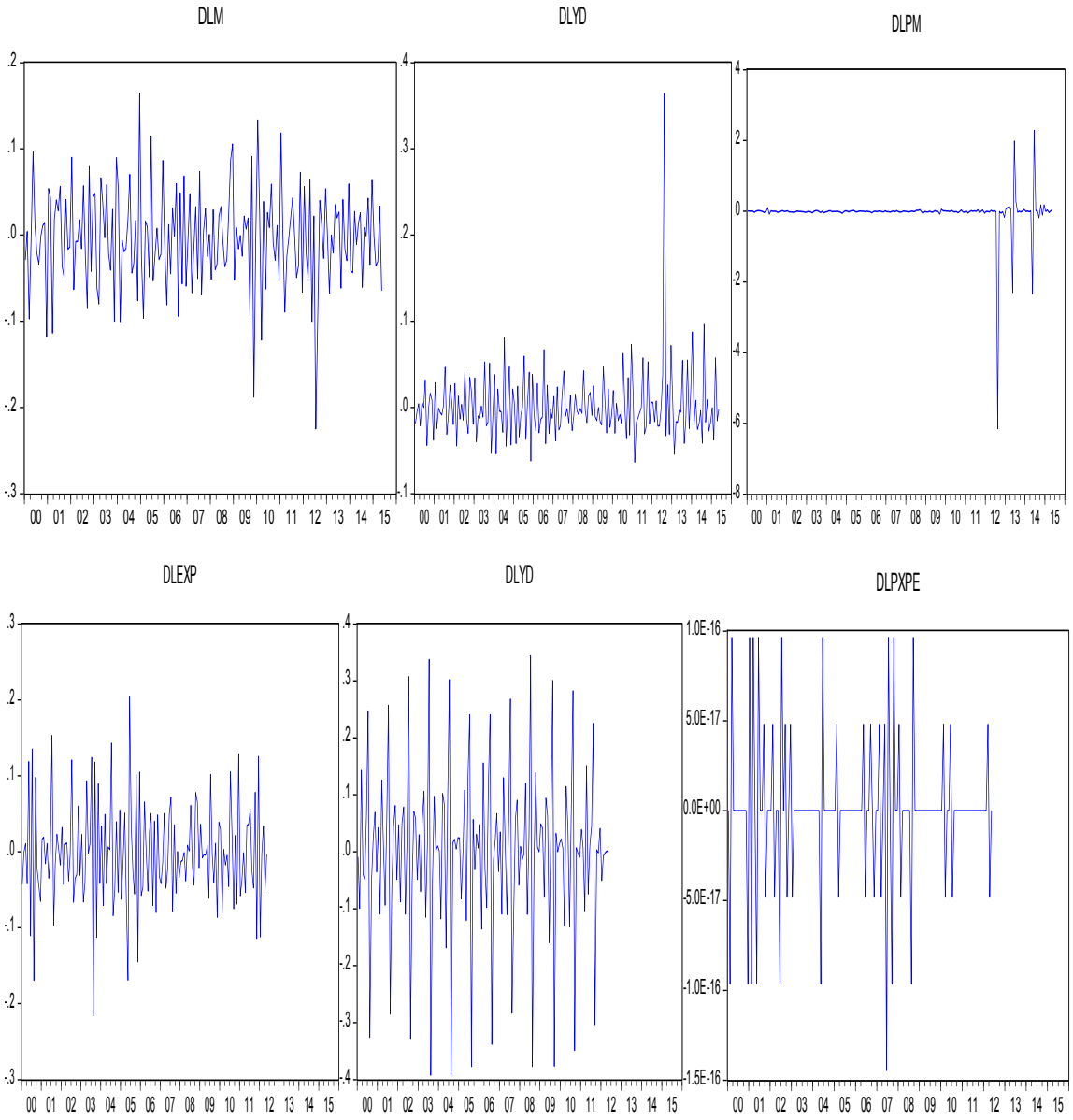
Table 1:Philips et Perron test (1988)

Variables	In level			In firstdifference		
	T-stat	Model	CV	T-stat	Model	CV
Log(M)	-3.266771	M3	-3.434299	-44.67425	M3	-3.434433
Log(Exp)	1.493588	M1	-1.942982	-34.76890	M1	-1.942996
Log(PM)	-1.923293	M3	-3.434299	-16.03362	M3	-3.434433
Log(PE)	-1.41116	M2	-1.942982	-3.65768	M2	-1.942996
Log(YDM)	-0.709010	M1	-1.942555	-17.33962	M1	-1.942564
Log(YDE)	-0.143922	M1	-1.942982	-30.95326	M1	-1.942996

We model each variable by its adequate model. We find that the T-statistics are larger than the critical value (CV) the threshold of 5% risk. Hence, these variables are non-stationary in levels. Imports and relative prices are modeled by a random walk with trend and constant. By cons, real national income is specified by a random walk without drift and without trend. Also, we noticed that the Student calculated values are higher than the theoretical values of Mackinnon (1996) at risk of 5% for the function of exports. The variables of these exports are specified by a model without constant and without trend. After only one difference, the variables of the functions of exports and imports are stationary. Hence, these variables are integrated of order one.

II-2 Geometric Analysis

We will discuss the existence or absence of a problem of heteroscedasticity by a graphic representation for the variables of our basic model (Yussoff and Sbit (2015)) in first differences. The graphs below correspond to the variables of the functions of imports and exports.



We note that a problem exists heteroscedasticity for these variables because there is a risk of disturbance for them. These variables are volatile from average and we try to model these variables two export-import functions from the ARIMA models (autoregressive integrated moving average). The tables below show the exact specificity of each variable with the ARIMA model (p, 1, q).

Table 2:Modelling imports variables ARIMA (p, 1, q)			
Variables	Log(M)	Log(PM)	Log(YD)
Constant	-0.003635**	-0.037813	0.001508
AR(1)	0.162427	-0.165657	-0.228930
AR(2)	-0.068474		
MA(1)	-0.577985		
DW	1.973876	2.014416	2.029631
Specificity	ARIMA(2,1,1)	ARIMA(1,1,0)	ARIMA(1,1,0)

Modelling exports variables ARIMA (p, 1, q)			
Variables	Log(Exp)	Log(PE)	Log(YD)
Constant	-0.002341	0.01258	0.000670
AR(1)	-0.143734	0.482182	0.044246
MA(1)	-0.646159	-0.502026	-0.985315
DW	1.985644	1.991862	1.977862
Specificity	ARIMA(1,1,1)	ARIMA(1,1,0)	ARIMA(1,1,1)

The Tunisian imports specify an ARIMA (2,1,1), but real income and relative prices are modeled by each ARIMA (1,1,0). We used the OLS techniques to estimate these models we conclude that residues are bleached from the Durbin & Watson. Also, all the variables of the function of exports can be modeled by the ARIMA (1,1,1).

II-3 Volatility of the bilateral exchange

We will study the volatility of the bilateral exchange Tunisian from the linear ARCH models. The tables below represent the volatility for the relative prices, real national income, exports and imports.

Table 3:Volatility function imports			
Variables	Log(M)	Log(PM)	Log(YDM)
Constant	0.001433	0.270070	0.000612
ARCH(-1)	0.203648	0.181252	1.366754
GARCH (-1)	0.254509		0.558679

Volatility function imports			
Variables	Log(Exp)	Log(PE)	Log(YDE)
Constant	0.002726	9.92E-34	0.011986
ARCH(-1)	0.011961	0.171429	-0.082257
GARCH (-1)	1.046826	0.600000	0.467397

We treat the volatility of the model of Tunisian imports by linear ARCH models. We note that there is a problem of asymmetry and volatility in real income and imports. For this, we specify these two variables by ARCH and GARCH models. But for the Tunisian relative price, we note that there is an asymmetry of information and the coefficient of the ARCH model is significant and non-significant GARCH. Also, we detect the presence of a volatile issue for all variables of the function of Tunisian exports. We note that there are asymmetries in the variables of this function and trunks entering the money market for the Tunisian bilateral exchange.

II-4- Linear fit Tunisian bilateral exchange

Philips & Perron test (1988) showed that all variables in the model Yussoff and Sbit (2015) are integrated of the same order, that is to say an order. We will use the cointegration theory to estimate the long relationship that connects the Tunisian bilateral trade based on the value and the Tunisian real national income. We will use the method of Engle & Granger (1987) to

estimate the long-term relationships and we will test the residue stationarity to accept or reject these cointegration relationships. In the first stage of Engle & Granger (1987), we will estimate the import-export relationships by OLS technique.

Table 4:Bilateral relations of exchange		
	Imports	Exports
Variables	Coefficients	Coefficients
Constant	0.747879	2.867339
Log(P)	0.127847	-1.124613
Log(YD)	1.040736	0.005369

The bilateral trade relations will be accepted ex-post because under the restriction of the stationary residue of Tunisian exports-imports. We will test this stationarity from the Philips-Perron test (1988). The table below corresponds to the stationarity of these residues.

Table 5:Stationarity of the residue		
Philips-Perron	Imports	Exports
T-Statistics	-8.968440	-3.467898
Critical Values	-1.942555	-1.942982

The calculated value of T-statistics is less than the critical value of MacKinnon (1996). We accept the alternative hypothesis of stationary of the import residue, and we retain the cointegration relationship above. Also T-StatisticsPhilips &Perron (1988) residue of export is less than the tabulated value, we accept long-term relationship that connects the Tunisian exports to the ratio of export price and real income. The import elasticity relative price is very low and significant. This means that the relative price does not ensure the increase in import values. By cons, real income is very sensitive to Tunisian imports. The average effect of positive and significant omitted variables, that is to say the positive impacts of non-explanatory variables dominate the negative effects of hidden variables. Export prices are highly elastic in relation to exports and any increases in these prices generate a reduction in export volumes. This statement is very logical because all depressions dinars lead to a reduction in export volumes. This result conforms to international trade theory. By cons, disposable income is not sensitive to exports.

We will study the linear fit of the relationship to its core values. The table below shows the error correction model (ECM) estimated by the OLS procedure.

Table 5:Linear adjustment of bilateral trade from its fundamental value		
Variables	Imports	Exports
Constant	-0.003914	-0.003369
dLog(M)	-0.132990**	
dLog(Exp)		-0.449245*
dLog(PM)	0.036714*	
dLog(PExp)		-1.411324
dLog(YD)	0.544317*	0.161215*
ResidueM(-1)	-0.431427*	
ResidueExp(-1)		0.137111*

The estimated error correction model by OLS procedure gives the look and significant results. The speed of adjustment takes a negative and significant sign. Hence, there is an adjustment mechanism adopted by the monetary authority which brings the imbalance of imports to a long-term balancing status. By cons, there is no adjustment mechanism for the function of exports since the force of the report takes a significant and positive sign. Depression of the National Tunisian currency direct cause of the deterioration in the trade balance since it generates higher imports and lower exports. This interpretation justifies the curve "J".

We will use the method of Johansen (1991) to estimate the cointegration space. We will refer to the trace tests and maximum values to determine the number of cointegration vectors. The table below corresponds to the track of tests and maximum values problems.

Table 6: Number of CointegrationVectors								
	Test λ_{trace}				Test $\lambda_{\max}$			
X1t = (Log(Mt,), Log(PMt,), Log(YDt)								
Nullhypothesis	r=0	$r \leq 1$	$r \leq 2$		r=0	r=1	r=2	
Alternativehypothesis	$r \geq 1$	$r \geq 2$	$r \geq 3$		r=1	r=2	r=3	
Statistics value	41.39	8.27	0.37		33.12	7.90	0.37	
Critical value at 5%	29.80	15.49	3.84		21.13	14.26	3.84	
			Log(M)	Log(PM)	Log(YD)			
Cointegrating vector normalized by Log (M)			1	-0.141703	-1.272476			

X1t = (Log(Expt,), Log(PEt,), Log(YDt)								
Nullhypothesis	r=0	$r \leq 1$	$r \leq 2$		r=0	r=1	r=2	
Alternativehypothesis	$r \geq 1$	$r \geq 2$	$r \geq 3$		r=1	r=2	r=3	
Statistics value	87.99	38.90	1.58		49.09	37.32	1.580	
Critical value at 5%	29.79	15.49	3.84		21.13	14.26	3.84	
			Log(Exp)	Log(PE)	Log(YD)			
Cointegrating vector normalized by Log (Exp)			1	7.478565	-0.210066			

Tests traces and maximum values prove that there is one cointegration relationship for the function imports. And, Johansen test (1991) indicates that there are two long-term relationships for the function of Tunisian exports. We will estimate Vectors in Error Correction (VECM) by the maximum likelihood method.

Table 6:Estimation VECM				
	Imports		Exports	
Variables	Matrix β	Matrix α	Matrix β	Matrix α
Log(M)	1,000	-0.112183		
Log(Exp)			1,000	-0.033527
Log(PM)	-0.141703	3.501542		
Log(PE)			7.478565	-0.122639
Log(YD)	-1.272476	-0.069587	-0.210066	-0.205489

The estimate of the maximum likelihood technique provides results only significant discount for long-term relationship imports. We find that imports are highly sensitive to real income, as higher import elasticity-income unit. By cons, those imports are less elastic to import prices. Also, Tunisian exports are heavily unreacted reporting of prices for those exports. However, real income is not involved in increasing these exports.

The weak exogeneity test shows that there is a corrective adjustment that reduces the offset of imports to target a long-term equilibrium. We discuss the long-term causal relationship

between relative prices and imports and between actual income and imports since the strength of the report takes a negative and significant sign. By cons, there is not a long-term causal direction between the explanatory variables and Tunisian exports because the adjustments of the coefficients are very low. The weak exogeneity test retains a single long-term relationship for exports.

Conclusion

In our article we studied the bilateral exchanges with a summary of major past empirical studies that have addressed these exchanges. We generated from this work the main variables and the base model. Also, we validated empirical bilateral exchange in Tunisia by the import-export functions during a study period from 2000 to 2015 on monthly frequencies. We found that the variables of the reference model and YussoffSbit (2015) are integrated of order one. Also, we detected the existence of the problem of heteroskedasticity for these variables after the modeling them by ARIMA models. Also, we have specified the variables in our model by the linear ARCH specification.

We studied the linear fit of the bilateral trade in Tunisian from the cointegration theory and we identified that the function of long-term imports converges towards a situation of balance. By cons, exports do not provide the balance since the correction term of these positive and significant.

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