The effect of terms of trade on economic growth in Maghreb countries: Harberger-Laursen-Metzler effect for the period 1990-2017.

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Summary: This study investigates the direct impact of terms of trade on economic growth in Maghreb countries from 1990 to 2017, so as to be able to test the Harberger-Laursen-Metzler effect, using various econometric techniques for panel data analysis as the modern unit root test PSCADF (2006), the Pedroni and Kao tests for co-integration in addition to Westerlund (2007, 2008) test with bootstrap technique, and finally the Dumitrescu-Hurlin (2012) non-causality test, the results shows that there is no evidence of any co-integration relationship between the variables, and there is a small effect from the TOT index to economic growth whereas any increase in the TOT index by 10% causes an increase in GDP by 0.217%, the results also shows that there is no evidence of any causality from terms of trade to economic growth in contrast of a uni-directional causality running from terms of trade to trade openness, and for the Harberger-Laursen-Metzler effect (HLM effect) the results reveal a weak effect with economic growth and trade openness in Maghreb countries.

Keywords: Terms of Trade; HLM effect; Co-Integration; Causality.
Jel Classification Codes : C23 ; F14 ; F41.

I- Introduction :

Back into 1950, we find two important studies, Harberger (1950) and Laursen and Metzler (1950), according to this studies, a decrease in current income arising from and adverse Terms of Trade (TOT) would decrease both the private savings and the current account balance[1], for example, the TOT index can affect the current account balance by three different ways, at first, according to the consumption tilting effect, it means that the current price of imports relative to their future price decreases owing to a favorable transitory terms of trade shock, secondly, the exchange rate can affect the current account balance according to the prices of tradable decreases relative to the price of non-tradable, finally, we find what called the consumption smoothing effect, known as the HLM effect (Harberger-Laursen-Metzler effect) when induces current income to increase relative to future income.[2]

In this case many studies reexamine the HLM effect as Medoza (1995), Hadass and Williamson (2001), Kose (2002), Cashin and McDermott (2002), Otto (2003), Chen and Hsu (2006), Bouakez and Kano (2008), Aquino and Espino (2013) Wang (2015), Lee (2017), Erauskin (2017), Jebran et.al (2018), Muntasir (2018) and many others.

On the other hand, Obstfeld (1982a) revisited the HLM effect and found that it's failed to hold when there was a permanent deterioration in TOT index, and he declared that a temporary worsening of TOT index led a current account deficit, but that when the TOT index reverted to

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their original level, the current account balance would move into surplus and ultimately back to it's initial steady-state level.[3]

According to the Fig.1, any change in the TOT index affects the foreign trade balance basically thorough three different ways, by the savings, savings-investment and the public spending channels.[4]

The terms of trade (a proxy for the real exchange rate) is a major determinant of the current account balance and economic growth in all economies especially the smaller ones, where the negative shocks to the TOT index can affect strongly the CAB (Current Account Balance), in addition, the terms of trade are the indicators that cover both the short-run and long-run commercial movements in all countries, [5] and in the economic world which is affect by globalization, the relationship between terms of trade and exchange rate, economic growth, foreign trade balance and CAB can be detected by many hypothesis as J and S curves, PS hypothesis (Prebisch and Singer hypothesis) and the HLM effect hypothesis.

In this case, the terms of trade can be calculated via different variations as follows:[6]

1. Definition of the terms of trade in consideration of barter:
1.1. Net barter terms of trade (N): obtained by equating export prices to describe the sale and purchase of goods and services.

$$N = Px/Pm$$

Where: Px is the export price index and Pm is the import price index.
1.2. Gross barter terms of trade (G): is the ratio of import quantity index to export quantity index.

$$G = Qm/Qx$$

Where: Qm is the import quantity and Qx is the export quantity.
1.3. Income terms of trade (I): to indicate the purchasing power of exports since the importing capacity of the country is explained regarding exports.

$$I = Dx/Px = (Px/Pm)Qx$$

Where: Dx is the export value index.

2. Definition of terms of trade considering factor exchange:
2.1. Single factorial terms of trade (S): it shows the gains from foreign trade as a sign of economic prosperity.

$$S = (Px/Pm)\,Vx$$

Where: Vx is the index of export productivity.
2.2. Double factorial terms of trade (D): to show the amount of imports will be imported despite the change in exports.

$$D = (Px\,/\,(Pm)(Vx)/Vm)$$

Where: Vm is the index of import productivity.

3. Definition of terms of trade considering utility:
3.1. Real cost terms of trade (R): the increase in the index of disutility of exports indicates that real cost of each unit for import increases.

$$R = S.E$$

Where: E is the index of the amount of disutility per unit productive resource used in producing exports.
3.2. Utility terms of trade (F): to measure technical and utility coefficients of imports and exports.

$$F = R(U_0^m/U_0^a)$$

Where: (U_0^m / U_0^a) is the index of relative utility of import and domestic goods foregone to produce exports.

In addition, and to get the distinct dimension of terms of trade, the most important wisdom in this case is that terms of trade changes and shocks represent a major source of business cycles in emerging and poor countries based on the analysis of calibrated business-cycle models, essentially this result is obtained by first estimating a process for the terms of trade and then feeding it to an equilibrium business cycle model to compute the variance of macroeconomic indicators of interest induced by this type of disturbance, then this variance is compared to the observed unconditional variance of the corresponding macroeconomic indicator to obtain the share of variance explained by terms-of-trade shocks, consistently, the most important distinct dimension is that more than 30% of the variance of output and other macroeconomic indicators is attributable to terms-of-trade shocks.[7]

This paper specifically focuses on analyzing the co-integration and causality relationships between economic growth, terms of trade, gross fixed capital formation, labor force and trade openness for the period 1990-2017 in the case of Maghreb countries (Algeria, Mauritania, Morocco and Tunisia) except Libya according to the absence of data, by using many econometric techniques for panel estimations as unit root tests (Levin, Lin and Chu test , Breitung test, Im, Pesaran and Shin test, ADF Fisher test, PP Fisher test the modern PSCADF Pesaran (2006) test), Pedroni (2004), Kao (1999) and Westerlund (2007, 2008) tests to examine the co-integration relationships, then the panel techniques estimation methods (Fixed and Random effects model and the Hausman test), and finally, causality test according Dumitrescu-Hurlin non-causality test (2012) (HNC), on the other hand, the paper makes a contribution to existing literature by fill the gap of scarcity of the studies on TOT effect on the economic growth in Arabic countries, this paper we try to bridge this gap by using an econometric examination for the period 1990-2017, the remainder of this paper is structured as follows, section 2 is for literature review on terms of trade and economic growth relationship and the HLM effect, the relationship between TOT and economic growth in section 3, while methodology and data are discussed in section 4, section 5 presents the results of the econometric study, and finally section 6 concludes the paper.

II– Literature review :

Arize (1996), this paper examines the impact of TOT index on the trade balance in 16 countries (Canada, France, Germany, Italy, Japan, UK, USA, Finland, Switzerland, Denmark, Netherlands, India, Korea, Malaysia, Mexico and Sri Lanka) using quarterly data for the period 1973-1992, by applying the Johansen-Juseluis (1990) and Engel Granger (1987) co-integration techniques, the results indicate that for the majority of countries there exists a positive and significant long run relationship between trade balance and TOT (except Denmark and Finland), and there is a significant affect from TOT to trade balance in 10 countries[8]. Mendoza (1997), this study examines a stochastic endogenous growth model in which TOT uncertainly affects savings and economic growth across 40 developed and developing countries over the period 1971-1991, using panel estimations (Fixed effects model, random effects model and between means model), the results indicate a positive association of TOT and economic growth[9]. Bleaney and Greenaway (2001), this study examines the impact of TOT and real exchange rate volatility on investment and economic growth in 14 Sub-Saharan Africa countries over the period 1980-1995 using fixed effects panel regressions, the results show that growth is negatively affected by TOT instability, and investment by real exchange rate instability, and both of growth and investment increase when TOT improve.[10]

Hadass and Willialson (2001), this paper aims to examine the effect of TOT on economic growth and to test the PS hypothesis (Prebisch and Singer hypothesis) which was instead that the TOT for primary products has deteriorated up to the 1950s in 19 countries classify as core and periphery for the period 1870-1940, and using panel estimations to estimate the price shocks on long run economic performance, and the results show also that the impact have been asymmetric between center and periphery, and the TOT changes the favor exports but declines the growth so the association between TOT and economic growth was found very weak[11]. Otto (2003), this paper examines the HLM effect by estimating the TOT effect in small open economies on the trade balance using the structural vector auto-regression techniques (SVAR model) for the period 1960-1997 in 15 developed countries and 40 developing countries (including Algeria and Morocco), the results indicate a strong support of an HLM effect and the response of the trade balance and real income to TOT shock are strongly consistent with those reported by Mendoza (1995)[12].

Chinn and Prasad (2003) according to a study on about 18 developed countries and 71 developing countries for the period 1971-1985 and to provide an empirical investigation of the medium-term determinants of current accounts found that terms of trade volatility is positively associated whit current accounts for the full sample, on the other hand[13], Agenor and Aizeman (2004) examined the extent to which permanent terms of trade shocks have an asymmetric effect on private savings for the period 1980-1996 on the non-oil exporters Sub-Saharan Africa countries, the results indicate that periods of increase in the permanent component of terms of trade indeed be associated with higher rates of private savings.[14]

Cakir (2009), this study considers annual data for 18 emerging market economies for the period 1990-2004, using dynamic panel data estimation (GMM) to examine the elasticities between TOT, economic growth, education, financial depth, government expenditure and inflation, the results provide evidence that TOT positively affecting economic growth,[15] Mistzal (2010), by using a VAR model for the period 1995-2009 in the context of Poland, revealed that temporary improvement of terms of trade led to the current account improvement but the permanent terms of trade improvement led to deteriorate the current account balance. Islam et al (2013) used the autoregressive distributed lag model (ARDL model) to test the HLM effect in the context if Bangladesh for the period 1985-2011, the findings of the paper confirmed the existence of a long run relationship between terms of trade and current account balance with an unidirectional Granger causality running from terms of trade to current account balance[16]. Jawaid and Waheed (2011), this paper examines the effect of TOT and it's volatility on economic growth for 94 developed and developing countries over the period 2004-2008 using the cross country ordinary least square (OLS), the results indicate significant positive effect of TOT on economic growth and volatility of TOT has significant positive effect on economic growth[17]. Erauskin and Gardeazabal (2017), this paper examines the effect of TOT on external balance for 37 countries (21 developed and 16 developing) using dynamic panel estimations (GMM), the results show that there is an impact of a shock in TOT on the external balance and the HLM effect holds for all the sample[18].

Szomolanyi et al (2016) using Slovak and Czech data according to SVAR model concluded that both countries have an Obstfeld-Svensson-Razin effect (OSR effect) of terms of trade on current account balance which means that trade balance negatively reacts on the changes in terms of trade. In Turkey,[19] Ucan and Unal (2018) aimed to test the relationship between foreign trade balance and terms of trade for the period 2005-2017 with quarterly data depending on co-integration and causality analysis, and they concluded that there is a long run relationship between the two variables and any increase in the terms of trade by 1 unit would cause an average increase of 321,335 dollar in the foreign trade balance, in addition to a short-term unilateral causality from foreign trade balance to terms of trade.[20]

Muntasir (2018), this paper aims to investigate the HLM effect in 14 countries from South and Southeast Asia for the period 2000-2016, in addition to examine the Dutch Disease hypothesis using panel fixed effects estimation techniques, panel co-integration tests (Pedroni and Johansen-Fisher tests), VECM model (Vector Error Correction Model) and Granger causality, according to the findings, a non-linear relationship between TOT and CAB is identified, and the HLM effect depends on the persistent nature of TOT shock, moreover, shocks in TOT are found to be ineffective in stimulating the Dutch Disease problem[21]. Shafiullah et.al (2018). [22]This study aims to examine the HLM effect in SAARC countries (South Asian Association for Regional Cooperation) for the period 1980-2015 by applying both time series and panel methods (ARDL approach, Granger causality, Pedroni test, PMG-ARDL approach and Dumitrescu-Hurlin causality), the results show that the HLM effect is hold for Bangladesh, Pakistan, Nepal and Sri Lanka but not in India as a large economy, Ayad (2019), The contribution of this paper is investigating the Harberger-Laursen-Metzler effect in the context of 18 Arabic countries since it's the first time to test it Arabic countries over the period 2000-2017, and was tested by using the Westerlund (2007) co-integration and Dumitrescu-Hurlin (2012) causality analysis in addition to the random effects model, empirical analysis show that there is no evidence of HLM effect for all the samples in short run term and there is no long-run relationship between the variables, but there is bi-directional causal relationship between terms of trade and current account balance in the middle incom countries in the long run term.[23]

The main contribution of this paper in the literature review is the first attempts to test the HLM effect in the case of Maghreb countries because there is no previous studies in this area in the Arabic countries whether individual country study nor panel study (except Ayad study in 2019 on 18 Arabic countries) especially is this years after 2014 with the collapse of the oil prices in the world and it's great effect on Arabic countries especially the oil exporter countries as Algeria, on other hand, we aim to make a contribution on Arabic studies especially Algerian studies in the case of Panel analysis with the using of cross section independence test which is one of the most important step in this kind of methodologies.

III– relationship between terms of trade and economic growth :

As we mentioned before the terms of trade is the ratio of domestic export price relative to import price, by using other words, TOT is the ratio of exports and imports in any country, for this reason the relationship between TOT and economic growth is still an issue of debate for most of researchers, in this case we have two different effects running from TOT to economic growth, at first, the positive impact, this case is realized when exports price relatively greater than imports price, this will increase the revenue of exports relative the cheap imports, for the reason, the trade output will affect the economic growth positively and the GDP will rise, on the other hand, if the imports price increase and will be higher than the exports price this will make the TOT index negatively affect the economic growth, for example when demand for domestic goods of foreign goods increases it leads to decrease the TOT index and effect negatively the GDP because the exports revenue is not enough to cover this demand which force the government to allocate expenses outside the trade sector to meet this demand, and it's clear that in this case the trade sector is a burden on the overall economy.

Batra and Pattanaik (1971) argue that TOT deterioration may elevate national welfare of a country when there is significant differentiation in inter-sectorial wage rate.[24] Similarly, Bhagwati and Brecher (1980) and Anam (1988) argue that decline in TOT may enhance national welfare by diminishing social cost of imports and hence is favorable for economic growth,[25] on the other hand, changes in terms of trade are twice large as in developing countries as in developed countries by account roughly half of output volatility in developing countries, all of this make the relationship

between TOT and GDP getting critical during world episodes of global integration or disintegration when export prices converge or diverge particularly worldwide, in addition to this, developing countries export commodities that generally have higher degree of openness to international trade, therefore, any shock in TOT will lead to a large impact in their economies especially with the fluctuation of exports prices of this commodity products and the inelastic price of the commodity products.

IV- Data and Methodology :

IV.1.Data

We use in this paper annual panel data series covering the period 1990-2017 in Maghreb Countries (Algeria, Mauritania, Morocco and Tunisia) collected from the World Bank Database (2018), the dependent variable is the economic growth measured as log of Gross Domestic Product (GDP), while the explanatory variable is the terms of trade (TOT) index measuring as the net barter terms of trade (N) , and the control variables are gross fixed capital formation (CAP) represents capital, the log of labor force (LF) and the trade openness (exports plus imports as a percentage of GDP) represents international trade (TRA).

IV.2.Methodology
IV. 2.1. Westerlund panel co-integration test:

Westerlund (2007) and Persyn and Westerlund (2008) developed four new panel co-integration tests that are based on structural rather than residual dynamics and, therefore, do not impose any common-factor restriction, this procedure tries to test the null hypothesis of no co-integration by inferring whether the error-correction term in a conditional panel error-correction model is equal to zero, in addition the new tests are all normally distributed and are general enough to accommodate unit-specific short-run dynamics, unit-specific trend and slope parameters, and cross-sectional dependence, two tests are designed to test the alternative hypothesis that the panel is co-integrated as a whole, while the other two test the alternative that at least one unit is co-integrated, so, the rationale here is to test for the absence of co-integration by determining whether Error Correction exists for individual panel members or for the panel as a whole, for this reason we estimate the following equation:[26]

$$\Delta GDP_{i,t} = \alpha_i^{GDP} + \lambda_i^{GDP}(GDP_{i,t-1} - \beta_i^{GDP}TOT_{i,t-1} - \gamma_i^{GDP}CAP_{i,t-1} - \vartheta_i^{GDP}LF_{i,t-1} - \omega_i^{GDP}TRA_{i,t-1} + \sum_{j=1}^{n}\theta_{i,j}^{GDP}\Delta GDP_{i,t-j} + \sum_{j=1}^{n}\varphi_{i,j}^{GDP}\Delta TOT_{i,t-j} + \sum_{j=1}^{n}\rho_{i,j}^{GDP}\Delta CAP_{i,t-j}$$
$$+ \sum_{j=1}^{n}\tau_{i,j}^{GDP}\Delta LF_{i,t-j} + \sum_{j=1}^{n}\zeta_{i,j}^{GDP}\Delta TRA_{i,t-j} + \mu_{i,j}$$

Where λ is the error correction term (ECT) and μ is the white noise, here we have four test statistics (G_a, G_t, P_a and P_t), the two tests G_t and P_t are computed with the standard errors of λ estimated in a standard way, while G_a and P_a are based on Newey and West (1994) standard errors, to run this tests all variables are assumed to be I(1), this test (Westerlund 2007, 2008) examine co-integration is present by determining whether ECT (λ) is present for individual panel members and for the panel as a whole.[27]

IV. 2.2. Dumitrescu-Hurlin Panel non-causality test (2012):[28]

The general pair of panel Granger causality models is given by:

$$y_{i,t} = \alpha_{0,i} + \alpha_{1,i}y_{i,t-1} + \cdots + \alpha_{l,i}y_{i,t-1} + \beta_{1,i}x_{i,t-1} + \beta_{l,i}x_{i,t-1} + \varepsilon_{i,t}$$

$$x_{i,t} = \alpha_{0,j} + \alpha_{1,j}x_{j,t-1} + \cdots + \alpha_{l,j}x_{j,t-1} + \beta_{1,j}y_{j,t-1} + \beta_{l,j}y_{j,t-1} + \varepsilon_{j,t}$$

While Granger causality tests the following hypothesis:

$$\alpha_{0,i} = \alpha_{0,j}, \alpha_{1,i} = \alpha_{1,j}, \ldots, \alpha_{l,i} = \alpha_{l,j}, \forall i, j$$

$$\beta_{1,i} = \beta_{1,j}, \ldots, \beta_{l,i} = \beta_{l,j}, \forall i, j$$

But the Dumitrescu-Hurlin (2012) tests the causality for this hypothesis:

$$\alpha_{0,i} \neq \alpha_{0,j}, \alpha_{1,i} \neq \alpha_{1,j}, \ldots, \alpha_{l,i} \neq \alpha_{l,j}, \forall i, j$$

$$\beta_{1,i} \neq \beta_{1,j}, \ldots, \beta_{l,i} \neq \beta_{l,j}, \forall i, j$$

And the pair of Homogeneous Non-Causality (HNC) null and alternative hypothesis are:

$$H_0: \beta_i = 0 \; \forall i \text{ with } (\beta_i = \beta_{1,i} = \beta_{1,j} = \cdots = \beta_{l,i} = \beta_{l,j}$$

$$H_1: \begin{cases} \beta i \neq 0 \; \forall i = 1, \ldots, N1 \\ \beta i \neq 0 \; \forall i = N1+1, N1+2, \ldots, N \end{cases}$$

The average statistic $W_{N,T}^{HNC}$ hypothesis can be written as follows:

$$W_{N,T}^{HNC} = \frac{1}{N} \sum_{i=1}^{N} W_{i,t}$$

Where $W_{i,t}$ is the individual Wald statistic values for cross section units.

V- Results and Discussion:

V.1 Cross section independence test

In the case of unit root tests in panel data Maddala and Wu (1999), Hadri (2000), Breitung (2000), Choi (2001), Levin et al. (2002) and Im et al. (2003) claim that the cross section independence should be hold to run the panel unit root tests, but if there is a cross section dependence in the sample this tests fail to test the unit roots and should apply SURADF, CADF, PESCADF and CIPS unit root tests, so, before checking the unit roots we must apply the cross

section independence tests, and from the results obtain from table (1) there is no evidence of any cross section dependence for all series according to Pesaran CD test.

V. 2. Unit root test:

To investigate the stationary of the series used, we use the unit root tests on panel data (Levin, Lin and Chin (LLC) ; Breitung t-test (BRE) ; Im, Pesaran and Chin W-test (IPS) ; MW-ADF Fisher ; MW-PP Fisher and (PSCADF) Pesaran test), the results of the tests are presented in table (2), It can be inferred from the Table that the unit root hypothesis cannot be rejected when the variables are taken in levels. However, when the first differences are used, the hypothesis of unit root non-stationary is rejected. These results enable to test the co-integration among variables in I(1) level.

V. 3. Co-integration tests:

As second step in the study, we examine the co-integration relationship between the variables when the GDP is the dependent variable using three different tests as mentioned before allow us to deal with non-stationary data in a heterogeneous panel, which yield substantial benefits by exploiting data from a cross-section[29], the results obtained from table (3) is that there is no evidence of any long run relationship between the variables both for the Pedroni test (all the probabilities of the 11 statistics are greater than 0.05 at the 5% significance level) and the Kao test (all the probabilities of the 5 statistics are greater than 0.05 at 5% significance level), and in order to promote this results, the Westerlund test is applied, and the same result is obtained from table (4), because the four tests (G_a, G_t, P_a and P_t) prove that the null hypothesis of no co-integration is not rejected both with normal test or bootstrapping test with 1000 repetitions and the same result is obtained with the Westerlund (2008) procedure both for the first alternative hypothesis (all the panels are co-integrated) and the second alternative hypothesis (some panels are co-integrated), so, we conclude that there is no evidence of co-integration relationship among the variables.

V. 4. Panel estimations:

To estimate the elasticities between the variables it must now determine which model is appropriate (fixed effect or random effect), using the Hausman test in table (5), the optimal model is the fixed effect model (the p-value of the test is 0.0076 smaller than 0.05), and from table (6) we perceive a significant effect from TOT to GDP (p-value is 0.006 smaller than 0.05) but with small positive manner, so, any increase in the TOT index by 10% causes an increase in GDP by 0.217%, which means there is a weak effect of TOT to economic growth in the Maghreb countries in the period of study, and there is a small evidence of HLM effect in the model, in addition, the table (7) shows us the cross-section dependence testing for serial correlation presented by Pesaran 2004 and there is no problem of serial correlation in the model (p-value 0.607 bigger than 0.05).

V. 5. Causality test:

Finally and as the final step, we use the modern Dumitrescu-Hurlin (2012) panel causality test to determine causality relationship between variables, it is also possible utilize from test when $T>N$ or $T<N$ situations, another advantage of this test, is it considers cross section dependence and provides efficient result even in cases where we have unbalanced panel data, and it proposes Homogeneous Non Causality (HNC) hypothesis by taking into account both the heterogeneity of the regression model and that of the causal relation.

The results obtained from table (8) is that there is no evidence of causality between TOT and economic growth both for W or Z statistics (the p-value higher than 0.05), but there is a uni-directional causality running from TOT to trade openness which means an HLM effect in the sample, but in the case of economic growth and trade openness there is no causality between the two variables.

VI- Conclusion:

This paper examined the co-integration and causality relationships between terms of trade (TOT) and economic growth, trade openness, gross fixed capital formation and labor force in Maghreb countries (Algeria, Mauritania, Morocco and Tunisia) for the period 1990-2017, using various econometric techniques for panel data analysis as the modern unit root test PSCADF (2006), the Pedroni and Kao tests for co-integration in addition to Westerlund (2007, 2008) test with bootstrap technique, and finally the Dumitrescu-Hurlin non-causality test.

The results obtained from the study and the econometric procedures, is that there is a weak HLM effect in the sample because of the small effect from TOT to economic growth though the absence of the causality relationship between the two variables, in other hand there is an evidence of an effect of the TOT on trade openness which means another kind of HLM effect, but generally, the TOT effect is negligible on the economic growth in the Maghreb countries which means an independence of the real economic sector (but not the trade sector) on the variations of the prices of exports and imports.

According to this results, we have two major observations, the first is the small effect from terms of trade on economic growth, and the second is the absence of the effect from trade openness on economic growth in Maghreb countries for the period 1990-2017, whereas, in the four countries in the sample (Algeria, Morocco, Tunisia and Mauritania) there is no diversification in the export basket like oil and gas in Algeria with 97% of global exports, and semi finished products, consumer goods and raw materials in Morocco with 77% of global exports, in addition to this, the main similarly between them is the absence of an industrial base with outputs oriented to export which means that there is no products with high comparative advantages, for this two reasons, the changes in TOT index are almost non-existent for long periods, on the other hand, the exports revenue is used basically to meet the demand of domestic goods of foreign goods, and this what explain the causal relationship running from TOT to trade openness, finally, the trade sector in Maghreb countries still very limited to impulse the economic growth because of the non-diversification of exports especially when it is limited to raw materials and hydrocarbons, and we can also explain the absence of the effect from trade openness and TOT on GDP by the bad use of trade revenues in low yielding investments (white elephant projects[30]).

- Appendices:

Figure 1: Transmission Mechanism for the Terms of Trade.
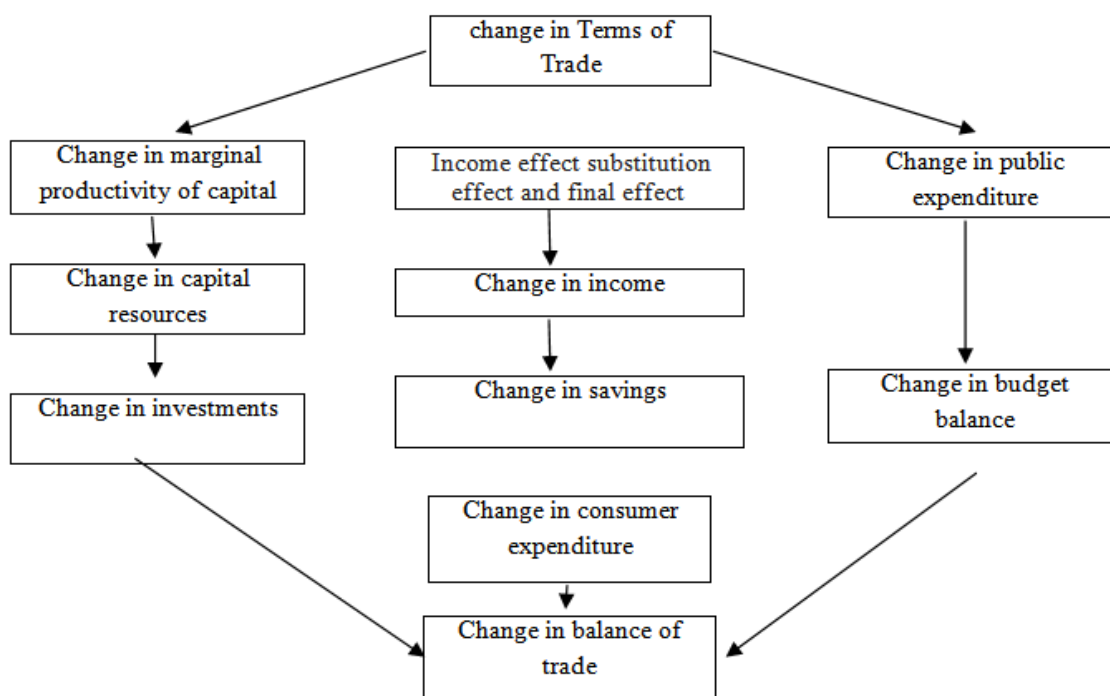
Source: Misztal, P. (2009). **The Harberger-Laursen-Metzler Effect: Theory and Practice in Poland**. The Romanian Economic Journal. 38: 129-146.

Table (1) : Cross section independence test results

Variables	Statistic	Probability
TOT	4.92	0.000
GDP	5.12	0.000
CAP	4.78	0.000
LF	5.98	0.000
TRA	7.20	0.000

The source : Calculated by the authors using Eviews 10.

Table (2) : Unit root tests results

variables	LLC*	BR*	IPS*	ADF-F*	PP-F*	PSCADF*
TOT	0.064	-1.254	-0.791	10.43	12.87	-1.191
D(TOT)	-3.862	-2.247	-3.817	28.12	67.83	-2.523
GDP	1.603	-0.621	0.0758	6.761	6.251	-1.256
D(GDP)	-3.823	-3.034	-3.518	26.077	48.405	-2.779
CAP	-0.991	-1.318	-2.028	17.051	11.047	-0.705
D(CAP)	-4.102	-0.369	-4.235	31.092	64.315	-2.113
LF	-1.545	0.064	0.475	6.684	1.927	-1.305
D(LF)	-0.182	-2.700	-2.456	20.743	59.896	-2.658
TRA	-1.142	-1.864	-1.623	15.958	14.324	-1.804
D(TRA)	-5.886	-3.514	-5.823	43.037	65.587	-2.831

D: the first differences, (.): the probability of tests.

The source : Calculated *using Eviews 10 and ** using Stata15.

Table (3) : Pedroni and Kao co-integration tests results

	Pedroni (2004) test*				
tests	statistic	prob	Weighed		
			statistic	prob	
Panel v-statistic	0.661	0.254	0.415	0.338	
Panel rho-statistic	0.066	0.526	0.159	0.563	
Panel pp-statistic	-1.286	0.099	-1.367	0.085	
Panel ADF-statistic	-0.699	0.242	-1.133	0.128	
Group rho-statistic	0.709	0.706			
Group PP-statistic	-1.343	0.089			
Group ADF-statistic	-1.223	0.110			
Kao (1999) test**					
Modified DF t	-0.817	0.207			
DF t	-0.832	0.202			
ADF t	-0.915	0.180			
Unadjusted modified DF t	-1.225	0.110			
Unadjusted DF t	-1.038	0.149			

The source : Calculated *using Eviews 10 and ** using Stata15.

Table (4) : Westerlund (2007, 2008) tests results

	Westerlund (2007) test					
tests	Without bootstrapping			With bootstrapping (100)		
	statistic	Z-value	prob	statistic	Z-value	Robust prob
G_t	-1.481	0.969	0.834	-1.481	0.969	0.700
G_a	-2.352	2.117	0.983	-2.317	2.127	0.790
P_t	-2.686	0.432	0.667	-2.603	0.497	0.820
P_a	-3.077	0.831	0.797	-3.061	0.835	0.820
Westerlund (2008) test						
Alternative hypothesis	Statistic			prob		
All panels are co-integrated	-0.6304			0.2642		
Some panels are co-integrated	-0.9876			0.1617		

The source : Calculated by the authors using Stata15.

Table (5) : Hausman test results

Statistic	Probability
13.92	0.0076

The source : Calculated by the authors using Stata15.

Table (6) : Fixed effect model results

Variables	coefficients	T-statistic	probabilty
TOT	0.00217	2.81	0.006
CAP	-0.00461	-2.89	0.005
LF	2.67733	11.75	0.000
TRA	0.00201	1.61	0.111
Constant	-7.40714	-5.18	0.000
Fisher statistic	124.42		0.000
Within R-square		0.8327	
Between R-square		0.0353	
Overall R-square		0.0561	

The source : Calculated by the authors using Stata15.

Table (7) : Cross sectional independence test results

Statistic	Probability
0.513	0.6079

The source : Calculated by the authors using Stata15.

Table (8) : Dumitrescu-Hurlin causality test results

The null hypothesis	W-bar	Z-bar	probability
TOT does homogeneously Granger cause GDP	1.6196	-0.4772	0.6332
GDP does homogeneously Granger cause TOT	2.9174	0.5899	0.5552
TOT does homogeneously Granger cause TRA	4.7026	2.0579	0.0396
TRA does homogeneously Granger cause TOT	1.9137	-0.2354	0.8139
GDP does homogeneously Granger cause TRA	3.1760	0.8179	0.4134
TRA does homogeneously Granger cause GDP	2.2703	0.0662	0.9472

The source : Calculated by the authors using Gretl 2018c.

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[29] A "white elephant project" is a phrase which is used in reference to a financial endeavor which fails to live up to its expectations. A "white elephant project" can be used in reference to a completed project or one whose undertaking is still ongoing. The phrase has its origins in Southeast Asia which is home to Asian elephants known as white elephants due to their unusual pigmentation, which instead of being grey, have a pink pigmentation.