Empirical Evidence of Elasticity of Export and Import Towards the Change of Prices and Income - The case of Republic of Macedonia

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Abstract

The imbalance of balance of payments and the presence of continued growing current account deficit are significant value for the stability of external equilibrium for different time prospects especially for long-term periods. A growth of global prices reflects immediately at the imbalance of the external equilibrium, reflecting as a value for having a balanced stability. The purpose of this paper is to analyze the sensitivity and the changes of trade, export and import from one side and the change of prices and income on the other side. The aim of this paper is to use the Thirlwall and ARDL model as most used models for quantifying the elasticity of these categories. The results for the case of Macedonia show that there is a significant elasticity of imports from the change of domestic income, and relative elasticity of exports from the change of global income. Variables that are used in this paper are: export, import, GDP, price ratio, ratio of domestic export prices to world prices, and ratio of foreign prices of imported goods and domestic prices for the period of 1990-2012.

Keywords: Prices, Income, Export and import, Thirlwal model, Republic of Macedonia.

Introduction

The relationship between elasticity of Income, price and economic growth has been extensively discussed in economic literature. Most studies show a strong correlation between such variables. Developments of financial and economic integrations in recent years have escalated larger pushing the process of trade cooperation towards liberalization which in some cases results in the deterioration of the deficits as high in countries insufficiently developed. The developments in foreign trade flows could have large implications for small open economies. The prediction of income and price elasticity are useful for policy makers who need to advance the position of foreign trade with the rest of the world.

The conventional economic theory on international trade links the long run quantity demand for imports or exports to domestic (foreign) income growth, developments of domestic and foreign prices and changes of local currency[39].

Houthakker and Magee (1969)[c] estimate empirical evidence for income and price elasticity for a number of developed countries, so they conclude that if their production and prices increased at the same rate the trade balance improvement or deterioration in some countries was influenced by disparities in income elasticity of their demand for imports.

Also Abdelhak, Senhadji and Claudio (1999) [ci] mentioned that higher the income elasticity of the export demand, the more powerful exports will be as an engine of growth.

By Nilsson (2005)[cii], countries that try to improve competitiveness of non-price characteristics of export[40] create an environment for higher economic growth. Thus, as higher income elasticity of exports is it will have as greater role in achieving economic growth.

According to everything mentioned above, it is important to conclude that the estimation of the export and import sensitivity to the price and income changes is an important feature for macroeconomic policy to limiting the country's trade deficits and to advance the position of foreign trade.

Republic of Macedonia is characterized as a small country with an open economy and dependent on the global market, which is characterized with concentrated exports in a few countries in the region and within the European Union. The balance of payments and trade balance permanently are showing deficit from year to year. Therefore the motivation for the reduction of this deficit in most cases requires structural improvement and changes in the export sector and changes to the country's macroeconomic policies.

Thus, beside the primary goal of this analysis – the estimation of prices and income elasticities of the Macedonian export and import, the estimated elasticities will be used in Thirlwall's model by using Error Correction Model technique. Thus, the economic growth of the Republic of Macedonia will be estimated through the export growth rate and the income elasticity of the import.

[39]The success of devaluation depends of the fulfillment of Marshall-Lerner condition, which can be expressed as $(M/X)\,|e_m| + |e_x| > 1$, where M and X are the values for the import and export, and e_m and e_x are the price elasticity of the import and of the export

[40] captured through the income elasticity of the export demand

The structure of this analysis is the following: the second section gives a literature review on the Thirlwall's law and ECM technique. Section three lay out the method applied in this study. In section four the results of the study are presented and analysed followed by the conclusions.

2. Model for Economic Growth - Thirlwall Model

Thirlwall model is detected since 1979 and is one of the most important models that explains the difference between the developed countries and countries on development. A relationship between growth rate and balance of payments of a country is as an economic rule for economic development. Therefore, for long term periods growth is assumed that a balanced trade balance is important for economic growth in an economy.

Thirlwal model is based on sustainable capital, nominal flows, fixed deficit and debt levels expressed as a percentage of GDP. The rule of Thirlwall model is based on the trade multiplier founded by Harrodi 1993 and focuses aggregate demand. According to this model the driving force of economic growth is the rate of growth of effective demand when in the other side we have an offer that reacts passively. Thirlwall model for economic growth states that in long term growth of national income is determined by the ratio of export and import elasticity. (π, $y = x / \pi$). This model can also be expressed as: In the long term periods any country can't grow faster than the rate of compliance with the balance of the balance of payments, only if they found the deficit, that grows continuously.

Also by this economic model is stated that different countries have different growth level due to various aggregate demand growth. Due to this if demand grows faster than the growth of local capacity that leads up to disoriented balance of payments (an increase of imports), and the offer is not fully used, local investments will decline, technological development will come down, which will cause a decline in competitiveness and domestic export . In opposite if demand grows up to the level of local capacity, without causing problems in the balance of payments then demand will determine the increase of capacity which means that we will have new investment in stock market and technology development.

Thirlwall's model is based on the fact that economic growth is based on the assumption that the expansion of exports stimulates the economic growth of the state without affecting the balance of payments .But the same export levels in different countries do not produce the same levels of economic growth due to the existence of different elasticity of import (Moudud, 2000).

Thirlwall's model consists of two basic equations such as:

$X = (Pd / Pf)\ \eta Z\xi$ and $M = (Pd / Pf)\ \varphi Y\pi$ where if the parameters $\xi, \pi, \varphi > 0$ and $\eta < 0$ then X, M, Y, Z are imports, exports, domestic income, respectively ratio (Pd / Pf) presents the local prices to foreign prices measured in a common currency, η and φ are price elasticities and ξ, π are income elasticities for imports and exports. If we take natural logarithm equations we have: $x = \eta\ (pd\text{-}pf) + \xi z$ and $m = \varphi\ (pd\text{-}pf) + \pi y$ If we have an import-export balance then

$\eta\ (pd\text{-}pf) + \xi z = \eta\ (pd\text{-}pf) + \xi z$

Then we can calculate the growth of the country's balance of payments and $y^* = [(\eta - \varphi) / \pi]\ (pd\text{-}pf) + (\xi / \pi)\ z$ Combining the above equations $y^* = -(\varphi / \pi)\ (pd\text{-}pf) + (1 / \pi)\ x$

Based on Thirlwall model is assumed that relative prices measured in a common currency are constant $(pd\text{-}pf) = 0$ And then the growth rate will be $y = y^* = (\xi / \pi)\ z = (1 / \pi)\ x$

Based on the equation above results that the growth rate is determined by economic multiplier $(1 / \pi)$ and the growth rate of exports based x. Due to this, the income elasticity reflects the competitive aspects that do not depend on prices, and thus states that are more competitive in foreign trade will have a ξ with a higher value and π with lower value.

3. Methodology, model specification and data

The empirical analysis of this study was done through the error correction method (ECM). It is very crucial for times series to select the right estimation methodology (Harris, 1995). The most disturbing fact is non stationarity of the data as it may cause a spurious regression. To avoid this, it is necessary to be used the co integration methodology. For this reason, the stationarity of series was first tested and after the regression equations are estimated by the Engel- Granger procedure in two steps (Engel and Granger, 1987). The first step is to estimate a long run relationship equation using ordinary least squares (OLS) with variables which are integrated of order *I(1)*. In order to avoid spurious regression, residual based co integration test can be used, where the stationarity of the residual implies a co integrating relationship among the variables in the long run equation. The second step of the E-G procedure is to estimate the corresponding error correction model based on the long run cointegrating relationship to observe the short run dynamics (Engel and Granger, 1987). One can estimate an ECM using the residual from the long run equation. The ECM is based on stationary data as all the I(1) regressors are in first difference form and includes the lagged residuals of the long run equation, which is also I(0) when the variables have cointegrating relationship.

The specification of both the export and import models, respectively, using the ECM methodolgy can be shown as in the following:

$$\Delta EXP_t = \theta_0 + \theta_1 \mu_{t-1} + \delta_1 \Delta WGDP_t + \delta_2 \Delta DEP_t + \varepsilon_t \quad \ldots\ldots\ldots (1)$$

where: $\mu_{t-1} = EXP_{t-1} - \eta_0 - \eta_1 WGDP_{t-1} - \eta_2 DEP_{t-1} - \eta_3 T$

$$\Delta IMP_t = \theta'_0 + \theta'_1 \mu_{t-1} + \delta'_1 \Delta GDP_t + \delta'_2 \Delta DIP_t + \varepsilon'_t \quad \ldots\ldots\ldots (2)$$

where: $\mu_{t-1} = IMP_{t-1} - \eta'_0 - \eta'_1 GDP_{t-1} - \eta'_2 DIP_{t-1} - \eta'_3 T$

In the first equation, EXP_{t-1}, $WGDP_{t-1}$ and DEP_{t-1} are regressors with one period lagged for EXP, WGDP and DEP, respectively. *T* is the trend variable, whereas μ_{t-1} is the one period lagged value of the error from the cointegration equation. The above model states that ΔEXP_t depends upon both μ_{t-1} and regressors ΔGDP_t and ΔDEP_t. If μ_{t-1} is different from zero then there will be disequlibrium.

The same logic is also for the second model, IMP_{t-1}, GDP_{t-1} and DIP_{t-1} are regressors with one period lagged for IMP, GDP and DIP, respectively. *T* is the trend variable, whereas μ_{t-1} is the one period lagged value of the error from the co integration equation. The above model states that ΔIMP_t depends upon μ_{t-1} and ΔGDP_t and ΔDIP_t.

We equalize the price elasticity and income to the function based on the demand for export and import:

$$lnXt = \alpha 0 + \alpha 1 lnWGDPt + \alpha 2 lnRPXt + \mu t \;\; function\ of\ supply\ for\ export$$

$$lnMt = \beta 0 + \beta 1 lnDGDPt + \beta 2 lnRPMt + Vt \;\; import\ demand\ function$$

The model includes the following variables: X and M are exports and imports, real goods and services of the Republic of Macedonia, DGDP and GDP are Real GDP national GDP real world in dollars (as a proxy for national income and world) , RPX and RPM are the relative prices of exports and imports (RPX is the ratio of domestic export prices to world prices, while RPM is the ratio of foreign prices of imported goods to domestic prices). All variables are in logarithmic form and on quarterly basis, while the remains of the demand for export and import, respectively. α1 and β1 are the income elasticity of exports and imports, while the α2 and β2 are the price elasticity of exports and imports.

Exports and real imports are calculated by the reduction of export and import values (in millions of dollars) prices of export and import. Domestic GDP are calculated as the ratio of nominal GDP to the GDP deflator (2005 = 100), using the same deflator of GDP for all four quarters of last year. Source of data for export and import data (values), the domestic export and import prices, CPI, GDP (in pence) and the deflator of GDP is the State Statistical Office of the Republic of Macedonia, world prices export are calculated in the Research Department in NBRM, GDP and GDP deflator trade partner countries involved in the global calculation of income are taken from World Bank Reports. The description of the data is given in the following table:

Table 1. Description of the data

Variable	Abbreviation	Description	Source
Economic growth	GDPG	Level of growth of real GDP	SSO
Real GDP	RGDP	GDP with constant prices 2005=100	SSO
Domestic Export Prices	DEP	The difference of logarithm of export relative prices with one quarter time lag)	NBRM
Domestic Import Prices	DIP	The difference of logarithm of import relative prices with one quarter time lag)	NBRM, SSO
Consumer Price Index	CPI	Consumer price index 2005=100	SSO, NBRM
Exports	EXP	Real export of goods and services of Macedonia on dollars	SSO, NBRM
Imports	IMP	Real import of goods and services of Macedonia	SSO, NBRM

In accordance with available data, the model is based on 31 observations for the period from Q1.2003 up Q1.2014.

The calculation of GDP based on the amount of the arithmetic average of the seven most important trade partners with the Republic of Macedonia (countries in which the Republic of Macedonia exports more), expressed by the following formula:

$$WGDP = \sum_{j=1}^{n=7} a_{ij}\, Y_{jt}$$

Where a_ij is part j normalized trade partner in export country, namely the Republic of Macedonia, Y_jt is real GDP of country j. Weight structure is based on the average share in the export trade partners of Macedonia in the period 2003-2014, and as the most important partners of trade were selected: Germany, Serbia and Montenegro[41] Greece, Italy, USA, Netherlands, and Croatia, of which common share are about 75% of total exports. World real GDP (WGDP) calculated based on the data of the GDP of each country (at constant prices expressed in respect of the national currency).

Resources for GDP data of countries are International Financial Statistics (IFS) and national statistics and values of GDP in national converted to dollars and the deflator of GDP (2005 = 100) for each country respectively, and used the same deflator GDP for all quartiles of the respective year.

Relative export prices are calculated as a ratio of the country's export prices to world prices. World prices are calculated in the NBRM, WXPI Republic of Macedonia Index weighted price that includes world prices Stock Exchange (transformed into indicator) of raw materials and products with the largest share structure in Macedonian export : cotton, tobacco, lamb, iron ore, nickel, steel products and zinc. Normalized weight structure is arranged for the entire period and it is derived from the portion of these raw materials and export of Macedonian products in 2005.

Both series of price (domestic and foreign) are re-based to the base year 2005 = 100, and quarterly data are calculated as an average of the months in the corresponding quarter.

Relative prices of imports are the ratio of import prices to domestic prices, Index of Consumer Prices (CPI through which domestic inflation is measured), while indexes chained CPI are based on 2005 = 100, and Quarterly data are calculated as an average of the months in the corresponding quarter, while import price series is re-based with base year 2005 = 100.

[41] Serbia and Montenegro are taken together because we didn't have separated data for all the period of time just from 2007.

Besides the fact that the procedure does not require testing ECM prior to stationary time series, Dickey Fuller test (ADF test) was conducted to determine the order of integration of variables (variables). ADF test was applied to all time series included in the level and change their first or trend continued, with interruptions, and disruption and trend. Tests show that many of the series are on non stationary level, and change the first stationary or except for the series of export earnings and domestic.

4.Empirical estimation

Table 2

ADF Test first difference

Variables	T-Statistic	Level of significance		Order of integration
LX	-3.005	5%	No const and trend	I(1)
LM	-2.971	5%	No const and trend	I(0)
LGDP	-2.418	5%	No const with trend	I(0)
CPI	-2.426	5%	No const with trend	I(1)
NGDP	-5.126	5%	No const with trend	I(0)
LSUMWGDP	-5.876	5%	No const and trend	I(0)
DEP	-5.281	5%	No const no trend	I(1)
DIP	-6.653	5%	No trend no const	I(1)

The method in analyzing the long run equilibrium relationship between Macedonian's exports and imports, requires the determination of the integration order of each variable. This shall be accomplished by unit root testing of the macro time series variables. The unit root test provides the information about the presence/absence of stationarity of the time series variables in levels or first difference If the time series variables, exports and imports, are not stationary in levels, then the series contain unit root. The estimates of economic relationships based on OLS method in the presence of unit root in the levels. The non stationary time series data on exports and imports require to be differenced until stationarity has emerged. The popular methods to detect the presence/absence of unit root and for determining the order of integration of each variable, exports and imports are the Augmented Dicky Fuller test and Phillips-Perron test. The order of integration of each time series variable needs to be established first.

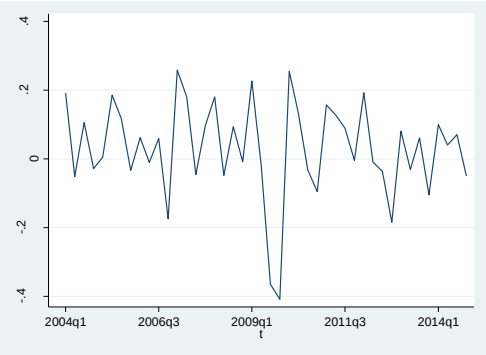
With a view to find the degree of integration of the residuals from the cointegration regression of exports on imports and imports on exports, ADF and PP test statistics have once again been estimated for residuals. Table-3 reports the calculated ADF and PP test statistics for the level of the residuals.

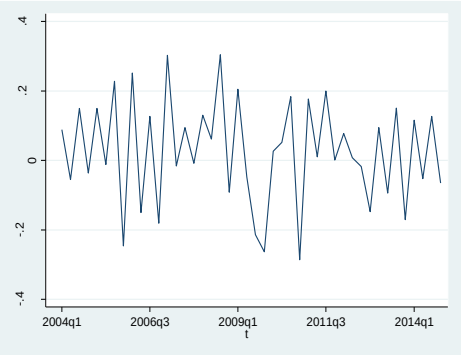
The calculated ADF and PP test statistics are higher than the MacKinnon critical values showing that the residuals in level form are on a stationary process i.e., they are U~ I(0). The exports and imports series have unit root in levels while the residuals from co integrated regression have no unit root in levels. Therefore, though the exports and imports series are non stationary in log level form, their linear is stationary in level form evincing the fact that Macedonia's exports and imports are co integrated in the long run. This empirical content [through the Engel - Granger Representation] leads to conclude that there is a long run equilibrium relationship between exports and imports in Macedonia during the period under consideration.Further, the regression coefficients on log imports and log exports in two cointegration regressions, constant elasticities, are close to unity with trifling difference, which can be expected in the long run, indicating that in the long run one percent of Macedonian's imports is synchronized by one percent of Macedonian's exports and vice-versa resulting long run trade balance in Macedonia.

There is the ECM model where is shown the effectiveness of trade policies in correcting the disequilibrium has been scanned on the basis of ECM. The effective trade policies in correcting the disequilibrium reflects the responsiveness of the changes in exports or imports to previous deviations of actual exports or imports from long run equilibrium. In other words the equilibrium term that entered the ECM as explanatory variable allows to examine the effectiveness of the trade policies to move toward a new equilibrium. With a view to provide

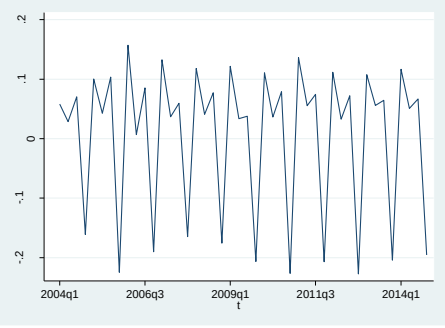
an empirical content to this an error correction modeling [ECM] which combines a long run co integration relationship and short run corrections/adjustments of co integrated variables toward the long run equilibrium has also been attempted to first differenced variables and error correction variable, which are stationary. An interaction variable is also inducted in the model to scan whether the economic reforms helped in reducing the disequilibrium between short run dynamics and long run values.

Graphs

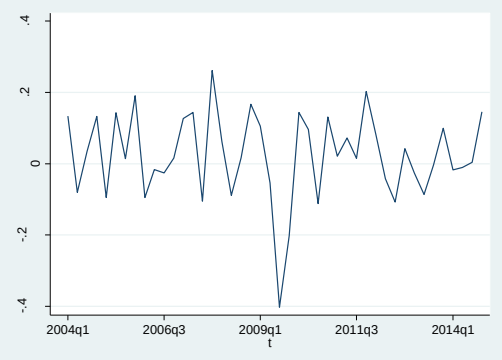


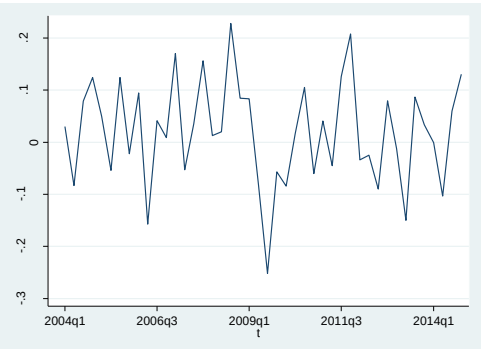


Graph of domestic exports in first difference Graph of domestic imports in first difference



Graph of Domestic GDP Graph of World Gdp





Graph of foreign exports Graph of foreign imports

Table 3. Results of co integration test

H0 : $\lambda_1 = \lambda_2 = \lambda_3 = 0$	
Statistics	probability
F(3,14)=5.57244 CHSQ(3)=21.63616	0.001 0.000
Pesaran critical values	
Intercept and no trend k=2 Level of significance 0,05	
I(0) 3.97	I(1) 4.78

From the table we see that there is a normal distribution of the trend and no autocorrelation.

Table 4

Long run coefficients based on model for import demand

Depended variable DLRM(difference of logarithm of import

Regressor	Coefficients	Standard Error	Tstatistic
LGDP	3.5674	0.6907	4.9789
LM	-1.6148	0.3895	-4.1464
con	-17.5905	4.5787	-3.0606

- The results show that the import income and price elasticities are 3.57 and -1.62, that t hey are statistical significant (at 1%) and have the right signs of the coefficients.
- It means that in the long run, if domestic income (GDP) rises by 1%, then the import demand will increase for 3.57%, while if relative import prices rises for 1%, than the i mport will decrease for 1.62% (higher foreign prices than domestic prices determine i mport fall, or lower domestic than foreign prices lead to import decrease).

- Namely, the results illustrate that the Macedonian import is highly sensitive to the do mestic income changes, which means that if the domestic income grows, than the dom estic economic subjects increase their demand, which determine import growth.

Table5. Long run coefficients based on export supply

Depended variable LX(logarithm of export)

Regressor	Coefficients	Standard Error	Tstatistic
LSUMWGDP	1.5232	0.3565	4.1235
LX	-0.8172	0.3103	-2.3156
con	-14.3533	4.8389	-2.9412

- The results show that income and price elasticity of the export are 1.52 and -0.82, resp ectively, they are statistical significant (at 1% and 5% level of significance, respective ly) and have the expected signs. That means that on long term, if the world income ris es 1%, than the Macedonian export demand will increase 1.52%, while if relative expo rt prices rise 1%, the export will decrease 0.82% (higher domestic prices than foreign prices determine export fall).
- This points out that the Macedonian export is more sensitive to the world income chan ges than to the relative prices changes. It indicates that price characteristics of the Mac edonian export are not the main determinant of the foreign demand, which depends m ore on non-price (qualitative) aspects of the export. Thus, in order for the domestic ex porters to increase their export to world markets, it is necessary for them to improve th e non-price aspects of the export (quality, distribution, marketing etc.) for which it wa s determined that there is a sensitive international capital.

Table 6. Short run dynamic and ECM

Difference of logarithm of import

Regressor	Coefficients	Standard Error	Tstatistic
dLDGDP	2.4012	0.3265	7.1235
dLM	-1.4021	0.3213	-4.3012
dLM1	0.5493	0.3413	1.6017
con	-12.1023	2.3324	-5.1902
ECM(-1)	-0.6902	0.1042	-6.5102

Rsquared 0.85351

- The results show that only the variable dLM1 (the difference of logarithm of import relative prices with one quarter time lag) is not statistical significant (at 10% level of significance). On the other hand, short run changes in domestic income (dLDGDP) and in the relative import prices (dLM) are statistical significant (at 1% level of significance), which points out that they significantly influence the short run import change.
- That means that import reacts immediately to changes in domestic GDP and to the changes of relative prices. The coefficient in front of the error correction term (ECM), which is speed of adjustment, is significant and shows fast adjustment to the long run equilibrium. Namely, around 69% of the disequilibrium in the previous period (quarter) is adjusted back to the long run equilibrium in the current period. In other words, in absence of changes in other variables, the high coefficient indicates fast adjustment to the long run equilibrium between the variables.

Table 7. Short run dynamic and ECM

Depended variable DLX(Difference of export logarithm)

Regressor	Coefficients	Standard Error	Tstatistic
dLX1	0.3012	0.2014	0.1601
dLSUMWGDP	2.6132	0.6691	3.9313
dLSUMWGDP1	0.5595	0.7692	0.7301
dLSUMWGDP2	1.5794	0.8541	1.8703
dLRPX	-0.1234	0.3203	-0.3904
dLRPX1	0.1382	0.2910	0.4732
dLRPX2	-0.0299	0.2734	-0.1101
dLRPX3	0.7403	0.2534	2.9202
DCon	-9.7002	4.7710	-2.0330
Ecm(-1)	-0.6702	0.1911	-3.4903
Rsquared 0.75012			

- The results show that only short run change in world income (dLSUMWGDP) has an influence on the short run dynamics of the export at the 1% level of significance. The other short run changes (including those with time lags) do not have effects to the export on short term.

- The error term coefficient is significant and shows fast adjustment back to the long run equilibrium. Thus, almost 67% of the disequilibrium in the previous period, derived b y the short run changes, adjusts back to the long run equilibrium in the actual quarter.
- This empirical content [through the Engel - Granger Representation] leads to conclude that there is a long run equilibrium relationship between exports and imports in Maced onia during the period under consideration.
- Further, the regression coefficients on log imports and log exports in two cointegration regressions, constant elasticities, are close to unity with trifling difference, which can b e expected in the long run, indicating that in the long run one percent of Macedonian's imports is synchronized by one percent of Macedonian's exports and vice-versa resulti ng long run trade balance in Macedonia.

5. Conclusion

The main purpose of this paper is in detail to clarify the influence of elasticity of import and export elasticities on economic growth. The practical application of elasticity highlights the determinats of economic growth of Republic of Macedonia. Therefore we used Thirwal model here as a suggested model and with more accurate determinations.

The results showed a sensitivity of imports to the changes of income in Macedonia, but a lower sensitivity to changes of relative prices.

The elasticity of exports also represents sensitivity to the changes of income but no sensitivity of changes in relative prices.

These results indicate that the country's economic entities are more sensitive to changing economic price than non-resident entities (foreign).

The analysis shows that the elasticity of import is higher than export elasticity ($\pi > \xi$) which brings to imbalance of trade balance.

Most of domestic products determined for export from Macedonia are represented by agricultural products.

Macedonian export products must compete with the world products in the quality of the products based on world standards with successful promotion and good distribution .Just in this way can be contributed to increase exports and decrease imports.

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Appendix

varsoc dlog_imp dlog_gdp dlog_dip

```
Selection-order criteria
Sample:  2004q2 - 2014q1                        Number of obs      =        40
+---------------------------------------------------------------------------+
|lag |    LL      LR      df    p      FPE       AIC      HQIC      SBIC    |
|----+----------------------------------------------------------------------|
|  0 |  133.913                      2.9e-07  -6.54567  -6.49987  -6.41901  |
|  1 |  147.465  27.104    9  0.001  2.3e-07  -6.77327  -6.59008  -6.26661  |
|  2 |  161.011  27.091    9  0.001  1.8e-07  -7.00056  -6.67997   -6.1139  |
|  3 |  231.849  141.67    9  0.000  8.6e-09* -10.0924  -9.63445* -8.82577* |
|  4 |  240.866  18.035*   9  0.035  8.9e-09  -10.0933* -9.49793  -8.44665  |
+---------------------------------------------------------------------------+
Endogenous:  dlog_imp dlog_gdp dlog_dip
Exogenous:  _cons
varsoc dlog_exp
```

```
Selection-order criteria
Sample:  2004q2 - 2014q1                        Number of obs      =        40
+---------------------------------------------------------------------------+
|lag |    LL      LR      df    p      FPE       AIC      HQIC      SBIC    |
|----+----------------------------------------------------------------------|
|  0 |  21.0352                      .021502* -1.00176* -.986493* -.959537* |
|  1 |  21.0662  .06209    1  0.803  .022571  -.953311  -.922779  -.868867  |
|  2 |  22.7455  3.3586    1  0.067  .021821  -.987277  -.941478  -.860611  |
|  3 |  23.2423  .99348    1  0.319  .022386  -.962114  -.901049  -.793226  |
```

```
  |  4 |  24.7373  2.9901    1  0.084  .021853  -.986866  -.910535  -.775756  |
  +--------------------------------------------------------------------------+
Endogenous:  dlog_exp
    Exogenous:  _cons
. varsoc log_exp
   Selection-order criteria
   Sample:  2004q1 - 2014q1                     Number of obs      =        41
  +--------------------------------------------------------------------------+
  |lag |    LL      LR      df    p      FPE       AIC      HQIC      SBIC    |
  |----+---------------------------------------------------------------------|
  |  0 | -14.1066                     .122339   .736908   .752127   .778703  |
  |  1 |  23.7437  75.701*   1  0.000  .020273* -1.06067* -1.03023* -.977081* |
  |  2 |   23.834  .18057    1  0.671  .021197  -1.01629  -.970635   -.89091  |
  |  3 |   25.163   2.658    1  0.103  .020867  -1.03234  -.971465  -.865164  |
  |  4 |  25.8467  1.3674    1  0.242  .021204  -1.01691  -.940816   -.80794  |
  +--------------------------------------------------------------------------+
   Endogenous:  log_exp
    Exogenous:  _cons
```

Based on this we order the optimal level of exports and we see that the optimal level is the first level.

```
varsoc  log_imp
dfuller r
```

```
Dickey-Fuller test for unit root                   Number of obs = 43

                                 ---------- Interpolated Dickey-Fuller ---------
                 Test         1% Critical       5% Critical      10% Critical
               Statistic           Value             Value             Value
------------------------------------------------------------------------------
 Z(t)             -8.046            -3.628            -2.950            -2.608
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.0000

. reg  dlog_exp dlog_dep log_sumwgdp

      Source |       SS       df       MS              Number of obs =      34
-------------+------------------------------           F(  2,    31) =   10.41
       Model |  .209233316     2  .104616658           Prob > F      =  0.0003
    Residual |  .311599372    31  .010051593           R-squared     =  0.4017
-------------+------------------------------           Adj R-squared =  0.3631
       Total |  .520832687    33  .015782809           Root MSE      =  .10026

------------------------------------------------------------------------------
    dlog_exp |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
dlog_dep |   1.820087   .4001312     4.55   0.000     1.004014     2.63616
```

```
 log_sumwgdp |  -.0054654   .0069798    -0.78   0.440    -.0197009      .00877
       _cons |   .0870585   .0865397     1.01   0.322    -.0894404    .2635575
------------------------------------------------------------------------------
```

```
reg  dlog_exp dlog_dep dlog_sumwgdp
```

```
      Source |       SS       df       MS              Number of obs =      32
-------------+------------------------------           F(  2,    29) =    9.00
       Model |  .191911743     2  .095955872           Prob > F      =  0.0009
    Residual |  .309215148    29  .010662591           R-squared     =  0.3830
-------------+------------------------------           Adj R-squared =  0.3404
       Total |  .501126891    31  .016165384           Root MSE      =  .10326

------------------------------------------------------------------------------
    dlog_exp |   Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
    dlog_dep |   1.734321   .4088455     4.24   0.000     .8981385    2.570504
dlog_sumwgdp |  -.0025883   .0048837    -0.53   0.600    -.0125766    .0073999
       _cons |   .0222217   .0192016     1.16   0.257      -.01705    .0614933
------------------------------------------------------------------------------
```

```
reg  dlog_exp dlog_dep
```

```
      Source |       SS       df       MS              Number of obs =      44
-------------+------------------------------           F(  1,    42) =   28.15
       Model |  .345184034     1  .345184034           Prob > F      =  0.0000
    Residual |  .515043683    42  .012262945           R-squared     =  0.4013
-------------+------------------------------           Adj R-squared =  0.3870
       Total |  .860227718    43  .020005296           Root MSE      =  .11074

------------------------------------------------------------------------------
    dlog_exp |   Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
    dlog_dep |   1.960578   .3695355     5.31   0.000     1.214825    2.706331
       _cons |   .0111014   .0170809     0.65   0.519    -.0233693     .045572
------------------------------------------------------------------------------

vec  dlog_imp dlog_gdp dlog_dip, lags(3)

Vector error-correction model

Sample:  2004q1 - 2014q1                        No. of obs      =        41
                                                AIC             = -9.205531
Log likelihood =  214.7134                      HQIC            = -8.809831
Det(Sigma_ml)  =  5.67e-09                      SBIC            = -8.118875

Equation           Parms      RMSE     R-sq      chi2     P>chi2
```

```
------------------------------------------------------------

D_dlog_imp            8     .117826   0.8390   171.9269   0.0000

D_dlog_gdp            8     .023123   0.9909   3591.208   0.0000

D_dlog_dip            8     .064265   0.3173   15.33507   0.0529

------------------------------------------------------------

------------------------------------------------------------------------------

             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]

-------------+----------------------------------------------------------------

D_dlog_imp   |

        _ce1 |

         L1. |   .3720895   .0745603     4.99   0.000     .2259539    .5182251

    dlog_imp |

         LD. |  -1.000411   .2028384    -4.93   0.000    -1.397967   -.6028552

        L2D. |  -.4385567   .2104022    -2.08   0.037    -.8509374   -.0261761

    dlog_gdp |

         LD. |   1.857992   .4069419     4.57   0.000       1.0604    2.655583

        L2D. |   1.118463   .2987899     3.74   0.000     .5328458    1.704081

    dlog_dip |

         LD. |   .6606132    .347693     1.90   0.057    -.0208526    1.342079

        L2D. |   .5440858   .3452564     1.58   0.115    -.1326044    1.220776

       _cons |   .0007556   .0184175     0.04   0.967    -.0353419    .0368532

-------------+----------------------------------------------------------------
```

```
D_dlog_gdp   |
        _ce1 |
         L1. |   .5388981   .0146319    36.83   0.000       .51022    .5675761
    dlog_imp |
         LD. |  -.3590226   .0398056    -9.02   0.000    -.4370401    -.281005
        L2D. |  -.1684689   .0412899    -4.08   0.000    -.2493957   -.0875422
    dlog_gdp |
         LD. |   2.239057   .0798594    28.04   0.000     2.082536    2.395579
        L2D. |   1.142497   .0586354    19.48   0.000     1.027574     1.25742
    dlog_dip |
         LD. |   .2253227   .0682323     3.30   0.001     .0915899    .3590555
        L2D. |   .1008947   .0677541     1.49   0.136    -.0319009    .2336903
       _cons |  -.0003988   .0036143    -0.11   0.912    -.0074827     .006685
-------------+----------------------------------------------------------------
D_dlog_dip   |
        _ce1 |
```