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INVESTIGATING CAUSALITY BETWEEN INTERNATIONAL TRADE INFLOWS AND OUTFLOWS: ROMANIA'S CASE

Abstract. *Public finance theory states that, related to the causality relationship between budgetary revenues and expenditures, it could be investigated if revenues adjust due to changes in expenditures, or otherwise, depending on the sense of the causality. This theory could, also, be applied to the components of current account in order to analyze the synchronization between inflows and outflows of international trade. In the case where the two time series are cointegrated, classical Granger causality test could reveal distorted results. Consequently, it can be used an adjusted Granger test based on cointegration equation between the two variables. The aim of this paper is to investigate the causal relationship between exports and imports of Romanian current account, according to the methodology of Engle and Granger. The results could reveal some insights related to the formation of current account deficit, based on the adjustments of inflows caused by changes in outflows, or, otherwise.*

Keywords*: Granger causality, cointegration, international trade, current account deficit, synchronization hypothesis.*

JEL classification: C22, F10, F32

1. INTRODUCTION

There are many studies related to the relationship between fiscal balance and current account deficit, considered as being "twin deficit" or "twin divergence" (Kim, Roubini, 2008). This relation was investigated, mostly, using the following approaches: (i) Mundell–Fleming–Dornbusch model (Bryant et al., 1988; and Taylor, 1993); (ii) dynamic stochastic general equilibrium models (for example, Baxter, 1995; Kollmann, 1998; Betts and Devereux, 2000b; and McKibbin and Sachs, 1991); (iii) equation with government spending and the current account as variables in order to examine the long run relationship between fiscal balance and current account deficit in different exchange rate regimes; (iv) Global Economic Model for US, Japan, Germany and UK (Peeters, 1999); (v) standard neoclassical

growth model extended to open economy (Mariano and Villanueva, 2005); (vi) cointegration (Bagnai and Carlucci, 2003); (vii) VAR, Granger causality tests, ECM (Bachman,1992; Aqeel, and Nishat, 2000; Corsetti, and Müller, 2006; Marinheiro, 2008). These techniques where used in order to: (i) if fiscal balance has a significant impact on external imbalances which is called "twin deficits"; (ii) if external imbalances influences fiscal balance, called by Summers (1988) current account targeting; (iii) if these variables are determined simultaneously; (iv) if the two variables are independent.

The relationship between fiscal balance and current account deficit has also been tested taking into consideration other variables such as exchange rates, interest rate, government saving, money supply, government employment, the average tax and social security contribution rates, imports, export for different countries. The results conduct to conflicting conclusions such as: (i) evidence for twin deficits in the case of US (Bachman, 1992; Rosenweigh and Tallman, 1993; Dibooğlu, 1997; Bartolini and Lahiri, 2006), in the case of Greece (Vamvoukas, 1999), in the case of Indonesia, Malaysia, Philippines and Thailand (Baharumshah, Lau and Khalid, 2006); (ii) evidence for current account targeting in the case of OECD countries (Kearney and Monadjemi, 1990), in the case of Philippines, India, Indonesia and Korea (Anoruo and Ramchander, 1998), in the case of Indonesia and Pakistan (Khalid and Teo, 1999); (iii) by-directional causality between fiscal balance and external imbalances for US data (Darrat, 1988); (iv) no relationship between fiscal deficit and external imbalances in Australia (Winner, 1993).

The aim of this paper is not concerned with the relationship between fiscal and external balance, but with the relationship between international trade inflows and outflows within the current account. Based on *fiscal synchronization hypothesis* we shall investigate the causal relationship between exports and imports according to the methodology proposed by Engle and Granger (1987). The results could reveal some insights related to the formation of current account deficit, based on the adjustments of inflows caused by changes in outflows, or, otherwise. This analysis is, also, helpful, to show the adjustment reaction of current account components to different stimuli. We shall use Romania's case in order to formulate our conclusions.

This paper is structured as follows. Following a brief review of literature, it will be presented methodology of investigation (Section 2). Section 3 presents the results of the empirical investigation based on causality relationship between international trade inflows and outflows on Romania's case in order to measure their degree of dependency. Section 4 highlights the main findings of this study.

2. THEORETICAL BACKGROUND

Public finance theory states that, related to the causality relationship between budgetary revenues and expenditures, it could be investigated if revenues adjust due to changes in expenditures, or otherwise, depending on the sense of the causality. This theory could, also, be applied to the components of current account in order to analyze the synchronization between inflows and outflows of international trade.

The main stream of literature, mostly, investigates the effectiveness of macroeconomic policy based on causal relationships between export, import and growth or income (see in that sense, Jung and Marshall, 1985; Chow, 1987; Bahmani-Oskooee and Alse, 1993; Howard, 2002; Jordaan and Eita, 2007; Doraisami, 1996; Chang et al., 2000), using Granger causality tests or cointegration tests.

We focus our analysis only on the relationship between imports and export in order to reveal some insights related to the formation of current account deficit, based on the adjustments of inflows caused by changes in outflows, or, otherwise. We follow the *fiscal synchronization hypothesis*, which, generally, states that: (i) when the causality relationship between the two variables is bidirectional, on long term, the decisions regarding the amount of outflows should depend on the size and evolution of inflows; (ii) when the causality relationship runs from inflows to outflows, then outflows should be influenced by the amount of inflows; (iii) when the causality relationship runs from outflows to inflows, then outflows should be influence by the amount of inflows (see in that sense, Fassano and Wang, 2002).

The main method of investigating synchronization hypothesis is based on classical causality Granger test (for instance, Manage and Marlow, 1986; Anderson, Wallace, Myles and Warner, 1986; Ram, 1988). A *causality test* reveals if lagged values of one variable could improve the estimation of other variable. For instance, variable X_t Granger causes variable Y_t, if past values of variable X goes to a better estimation of variable Y. In fact, Granger causality test represents a weak test for establishing if one variable is exogenous or not (see Enders, 1995).

But, Engle and Granger (1987) showed that in the case of coinregrated time series, Granger causality test is not so relevant and could give some distorted results. Therefore, they suggested an adjusted causality test which takes into consideration the cointegration relationship between two variables.

When two variables X and Y are integrated of order d, the cointegration relation between X and Y is represented by the following equation:

$$Y_t = \beta \cdot X_t + \varepsilon_t \quad (1)$$

where:
β = parameter;
ε_t = error term which has to be stationary (integrated of order 0).

The cointegration relation between two variables could be tested according to (1), but it could be taken into account an intercept according to equations (2) and (3):

$$X_t = \alpha_0 + \beta_0 \cdot Y_t + \varepsilon_t \quad (2)$$

$$Y_t = \alpha_1 + \beta_1 \cdot X_t + \mu_t \quad (3)$$

Using Johansen cointegration test, it could be revealed the existence of a long run equilibrium relation between the two variables, as it follows from the equations below:

$$X_t - \beta_0 \cdot R_t - \alpha_0 = \varepsilon_t \quad (2 \text{ bis})$$

$$Y_t - \beta_1 \cdot R_t + \alpha_1 = \mu_t \quad (3 \text{ bis})$$

The error term of each of previous equation will be used in the adjusted Granger causality test. A classical causality test investigates if past values of a variable could improve the estimation of other variable, according to the following equations:

$$\begin{aligned} \Delta Y_t &= C_0 + \alpha_0 \cdot \Delta X_t + \sum_{i=1}^{n} \alpha_i \cdot \Delta X_{t-i} + \sum_{j=1}^{n} \beta_j \cdot \Delta Y_{t-j} + u_t \\ \Delta X_t &= C_1 + \delta_0 \cdot \Delta Y_t + \sum_{i=1}^{n} \delta_i \cdot Y_{t-i} + \sum_{j=1}^{n} \rho_j \cdot \Delta X_{t-j} + v_t \end{aligned} \quad (4)$$

where:
α_i, β_i =capture the influence of current and past values of variable *X/ Y* on variable *Y*;
δ_j, ρ_j = capture the influence of current and past values of variable *X/ Y* on variable *X*.

If α_i and δ_j are zero, it means that there is no causality relation between the two variables and, consequently, past values of them could be used to estimate the current value. If α_i is different from zero, then it could be used past values of *X* in order to improve the estimation of *Y*, and if δ_j is different from zero, then it could be used past values of *Y,* in order to improve the estimation of *X*. In the case when both α_i and δ_j are different from zero, then, there is a bi-directional causality and both of the variables could be estimated using past values of each other. The last case is consistent with synchronization hypothesis.

Engle and Granger (1987) suggested that for cointegrated variables, the causality between them should be investigated using a modified standard test based on (4) and on error terms estimated from (2) and (3), as follows:

$$\Delta Y_t = C_0 + \alpha_0 \cdot \Delta X_t + \sum_{i=1}^{n} \alpha_i \cdot \Delta X_{t-i} + \sum_{j=1}^{n} \beta_j \cdot \Delta Y_{t-j} + \lambda_0 \cdot ECT_1 + u_t$$
$$\Delta X_t = C_1 + \delta_0 \cdot \Delta Y_t + \sum_{i=1}^{n} \delta_i \cdot \Delta Y_{t-i} + \sum_{j=1}^{n} \rho_j \cdot \Delta X_{t-j} + \lambda_1 \cdot ECT_2 + v_t \quad \text{(4 bis)}$$

where: ECT_1 represents ε, from equation (2 bis), and ECT_2 represents μ_t from equation (3 bis).

This supplementary term represents the error correction mechanism based on which it is re-established the long term equilibrium relationship between the two variables. According to (4 bis), it is tested the null hypothesis, H_0: α_i and/or $\lambda_0 = 0$, against H_1: α_i and/or $\lambda_0 \neq 0$, which could confirm one of the three hypothesis mentioned at the beginning of this study.

This methodology was successfully applied for budgetary expenditures and revenues by Miller and Russek, (1990), Owoye (1995), Fasano and Wang (2002), and, also, could be applied on exports and imports if they are cointegrated like in Romania's case.

3. EMPIRICAL RESULTS: ROMANIA'S CASE

In order to investigate the relationship between international trade inflows and outflows within Romanian current account based on adjusted causality test presented in the previous section, we used available quarterly data on exports and imports spanned on 1998 and 2005. The information was provided by National Bank of Romania. The tests were applied on real level of the variables. The results of ADF stationarity test are presented in the table below:

Table 1

Integration order for imports and exports[*)]

Variable	ADF Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value
IMP_fx [i)]	-3.39	-4.29	-3.56	-3.21
EXP_fx [i)]	-2.41	-4.29	-3.56	-3.21
Δ IMP_fx [ii)]	-3.74	-2.64	-1.95	-1.62
Δ EXP_fx [ii)]	-4.05	-2.64	-1.95	-1.62

[*)]Critical values for 1%, 5%, and 10% depends on the option choose: intercept or trend and intercept.
[i)]It was considered intercept and. [ii)]No intercept and no trend.
Number of observations: 32
IMP_fx: natural logarithm for imports in 1991: 1-st quarter prices
EXP_fx: natural logarithm for exports in 1991: 1-st quarter prices
ΔIMP_fx: first difference on imports
ΔEXP_fx: first difference on exports

Based on the previous results, it could be noticed that the two variables are integrated of order I. Using Johansen cointegration test, it was revealed the existence of a long run equilibrium relation between imports (*IMP*) and exports (*EXP*), and error correction terms from 2 and 3 bis result from the equations below:

$$IMP_t - 1.05 \cdot EXP_t + 0.04 = \varepsilon_t \quad (5)$$

$$EXP_t + 0.95 \cdot IMP_t + 0.04 = \mu_t \quad (6)$$

Following Engle and Granger (1987), we will estimate (4 bis) using error correction terms from equations (5) and (6) and OLS method. The results are presented in the table below:

Table 2

Adjusted causality test between exports and imports

Explanatory variables	Regression 1: Dependent variable ΔIMP_t	Regression 2: Dependent variable ΔEXP_t
C	0.01 [1.39] (0.17)	0.33 [1.71] (0.09)
ΔIMP_t		0.34 [3.72] (0.00)
ΔEXP_t	0.60 [3.37] (0.02)	
ΔIMP_{t-1}	-0.54 [-3.75] (0.00)	0.26 [1.94] (0.06)
ΔEXP_{t-1}	0.43 [1.40] (0.17)	-0.36 [-2.38] (0.02)
ECT_{1t-1}	-0.52 [-1.87] (0.07)	
ECT_{2t-1}		-0.03 [-1.64] (0.11)
Statistics	R-sq: 0.74 F-stat: 17.87 Prob: 0.00	R-sq: 0.29 F-stat: 2.57 Prob: 0.06

[ ]: t-statistic ( ): probability

The results from the table above show that there is no synchronization between Romanian international trade inflows and outflows, nor a causal relationship between the two variables. From the estimations of the 1-th regression, it could be easily seen that imports are influenced by current values of exports (positive relation) and by past values of imports (negative relation). There is no clear distinction how inflows or outflows influences one on another.

The existence of a cointegration relationship between exports and imports reveals there, on long run, there is an error correction mechanism which conducts to

equilibrium. If it is about how to estimate the amount of imports, it will be taken into consideration current values of exports and past values of imports.
Compared to fiscal balance which is constrained by the regulation imposed by European Union, trade balance runs under no restriction. Consequently, there are many cases where fiscal balance remains under 3% of GDP, but current account has large deficits. Using causality tests, we investigated the existence of any mechanism which is able to adjust the size of current account deficit in Romania's case. The tests revealed the forces that driven the size of imports and exports are others than ones which have been investigated under this study.

4. CONCLUDING REMARKS

There are many studies related to the relationship between fiscal balance and current account deficit. The aim of this paper was not related to the relationship between fiscal and external balance, but with the relationship between international trade inflows and outflows within the current account. Based on *fiscal synchronization hypothesis* we investigated the causal relationship between exports and imports for Romania's case, according to the methodology proposed by Engle and Granger (1987). The results reveled that there is no synchronization between Romanian international trade inflows and outflows, nor a causal relationship between the two variables and the driven forces which influenced the size of imports and exports are others than the ones investigated within this study.

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