The link between international trade flows of "*Machinery and transport equipment*" and foreign direct investment in Romania

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Abstract

The paper investigates the causal relationship between the Romania's exports and imports of "Machinery and transport equipment", the group of goods with the largest percentage share in the international trade and foreign direct investments, using annual data series for the period 1990-2016. The developed econometric model has demonstrated the strong connection between these indicators, showing that exports of machinery and transport equipment are 85% influenced by imports of similar goods and by foreign direct investments. In the long run, the study reveals a direct link between foreign direct investments and growth in exports, as confirmed by other empirical studies on exports and imports at national and international level, too. The VECM analysis was performed using EViews 10 statistical software and it is based on data extracted from the United Nation statistical database (UNCTAD database).

Keywords*: export, import, foreign direct investment, Johansen cointegration test, Granger causality test, vector correction error*

1. Introduction

The evolution of international trade during the period 1990-2016 has made Romania's economy relatively open to the outside, which implies not only opportunities for external exchanges but also concerns for increasing the economic resilience to possible external shocks and vulnerabilities. If at the beginning of the EU pre-accession period in 1990goods exports were about 5.8 billion USD, by the end of 2016 they had more than 11 times increased, to around 64 billion USD. Also, the imports of goods have increased by about 8.2 times in 2016 compared to 1990. Although in the year 2016 compared to 1990 export dynamics is higher than that of imports, the volume of imports steadily exceeded that of exports, generating a trade deficit with an upward trend over the period under review. A 60-70% proportion of Romania's external trade is dominated by companies with foreign capital (foreign direct investment), mostly subsidiaries of multinational companies, which implies certain structural peculiarities and challenges. The causal relationship between FDI, exports, imports and even GDP remains an open question for research as regards the mutual influences between explained and explanatory variables.

At a macroeconomic level, in the period 2008-2016, FDI companies have had an unfavorable effect on the trade balance, mainly in the trade and services sectors. Industry, especially manufacturing, has generated a trade surplus (since 2009) helping to reduce the negative sold of the overall trade balance. In this context, given that the most of the national exports and imports belong to the manufacturing industries of transport machinery and equipment, the present paper aims to answer, on the basis of empirical analyzes, the question of the research "*How can evaluate the link between international trade flows of cars and transport equipment and foreign direct investments in Romania?* "

The paper is organized as follows: section 2 summarizes the role of exports, imports and foreign direct investments in the economic evolution of Romania; section 3 provides a brief review of the literature on this subject, followed, in section 4, by the econometric methodology used to examine the relationship between variables; section 5 analyzes empirical results. The conclusions are presented in section 6.

Role of international trade with "Machinery and transport equipment" and of the foreign direct investment in evolution of Romania's economy

The Standard International Trade Classification (SITC) developed by the United Nations Statistics Division (UNSD) is recommended to be used for analytical purposes. International trade statistics are originally based on the Combined Nomenclature but, using conversion tables, statistical data can be aggregated by different characteristics, according to other classifications and nomenclatures, including the SITC.

International trade with "Machinery and transport equipment"

According to the statistical data presented in Table 1, SITC 7 *"Machinery and transport equipment"* account for the largest share of Romania's total exports and imports (46.9% and respectively 38.0%, in 2016).

Table 1 Exports and imports of Romania according to SITC in 2016

SITC group	*2016*	Export		Import	
		Bil.USD	share in total (%)	Bil.USD	share in total (%)
	Total	**63.6**	**100.0**	**74.6**	**100.0**
0	Food and live animals	4.4	6.9	6.1	8.1
1	Beverages and tobacco	1.0	1.5	0.7	0.9
2	Crude materials, inedible, except fuels	2.5	4.0	2.2	2.9
3	Mineral fuels, lubrifiants and related materials	2.3	3.6	4.2	5.7
4	Animal and vegetable oils, fats and waxes	0.2	0.3	0.2	0.2
5	Chemicals and related products,n.e.s.	2.8	4.3	10.0	13.4
6	Manufactured goods classified chiefly by material	10.2	16.1	15.1	20.2
7	**Machinery and transport equipment**	**29.9**	**46.9**	**28.3**	**38.0**
8	Miscellaneous manufactured articles	10.1	15.9	7.9	10.6
9	Good not classified in other section	0.2	0.4	0.0	0.0

Source: Own calculations based on UNCTAD data (http://unctadstat.unctad.org/wds/ReportFolders/reportFolders.aspx) available in April 2018

The products covered of the SITC 7 *"Machinery and transport equipment"* are presented in Table 2, which contains data broken down by SITC 2 digits level. For even more analytical purposes, the breakdown can be done by SITC codes up to the level maximum 5 digits.

Table 2 Exports and imports of "Machinery and transport equipment", by product subgroups, in 2016

Codes SITC Rev.4	SITC description	billion USD - 2016	
		Export	Import
Total SITC 7, from which:		**29.9**	**28.3**
71	Power-generating machinery and equipment	1.7	2.0
72	Machinery specialized for particular industries	0.9	2.1
73	Metalworking machinery	0.2	0.5
74	General industrial machinery and equipment, n.e.s., and machine parts	4.0	3.9
75	Office machines and automatic data-processing machines	0.3	1.1
76	Telecommunications and sound-recording and reproducing apparatus and equipment	1.6	2.8
77	Electrical machinery, apparatus and appliances and electrical parts thereof	10.1	8.6
78	Road vehicles (including air-cushion vehicles)	9.8	6.9
79	Other transport equipment	1.4	0.4

Source: Own calculations based on UNCTAD data (http://unctadstat.unctad.org/wds/ReportFolders/reportFolders.aspx) available in April 2018

The profile of specialization, usually measured by the *revealed comparative advantage indicator*, has a major importance in studying the trade performance.

The indicator of the revealed comparative advantage reflects the extent to which Romania has exploited its relative cost advantages. On the basis of this indicator, conclusions can be drawn regarding the apparent capacity to capitalize the national advantages compared to other sectors, but also on the contribution of the main product groups in generating the trade deficit.

Romania's revealed comparative advantages obtained for the SITC group 7 "*Machinery and transport equipment*", in the years 2006 (preceding the EU accession of Romania) to 2016 (the 10th year after EU accession) are presented in the table 3.

Table 3 Revealed comparative advantages in the period 2006 - 2016 for SITC group 7, *Machinery and transport equipment"*

SITC Code	SITC description	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	the difference between 2016 and 2006	Comments RCA-Revealed Comparative Advantage
71	Power generating machinery and equipment	0.889	0.933	0.833	0.825	0.687	0.692	0.854	1.150	1.050	1.068	1.081	0.193	RCA kept, in growing
72	Specialised machinery	0.537	0.488	0.573	0.576	0.436	0.396	0.468	0.461	0.538	0.568	0.575	0.039	RCA kept, relatively constant
73	Metal working machinery	1.274	1.128	1.098	0.973	0.637	0.738	0.620	0.728	0.651	0.650	0.592	-0.681	RCA lost
74	Other industrial machinery and parts	1.050	1.314	1.239	1.226	1.403	1.509	1.558	1.574	1.610	1.537	1.548	0.498	RCA kept, significant growth
75	Office machines and automatic data processing machines	0.214	0.236	0.467	0.222	0.209	0.214	0.219	0.176	0.150	0.145	0.155	-0.058	RCA lost
76	Telecommunication and sound recording apparatus	0.227	0.238	0.564	1.380	1.758	1.786	0.998	0.788	0.727	0.591	0.512	0.285	RCA kept, significant growth
77	Electrical machinery, apparatus and appliances	1.237	1.357	1.514	1.411	1.343	1.509	1.586	1.481	1.557	1.589	1.724	0.487	RCA kept, significant growth
78	Road vehicles	0.748	0.965	1.090	1.829	1.768	1.734	1.820	1.997	1.915	1.799	1.807	1.058	RCA kept, significant growth
79	Other transport equipment	1.599	1.620	1.661	1.914	1.304	1.175	1.185	1.430	1.114	0.971	0.964	-0.635	RCA lost

Source: Own calculations based on UNCTAD data (http://unctadstat.unctad.org/wds/ReportFolders/reportFolders.aspx) available in April 2018

The indicator of the apparent / revealed comparative advantage (Bella Balassa, 1965) was calculated on the basis of the formula:

$$RCA = \frac{x_j^i / \sum_{j=1}^{n} x_j^i}{x_j^{wi} / \sum_{j=1}^{n} x_j^{wi}} \quad (1)$$

where:

x_j^i - represents the exports of product j from the country i, and

x_j^{Wi} - represents the world export of product j.

The revealed comparative advantage in 2016 compared to 2006 for the SITC group 7 "Machinery and transport equipment" (Table 3) emphasizes different situations, depending on the each different product groups. We found product groups that, in the 10 years after the EU accession of Romania:

- have significantly increased their comparative advantage, for example: road vehicles, other industrial machinery and parts, telecommunication and sound recording apparatus and electrical machinery, apparatus and appliances;
- have relatively constant the comparative advantage: specialised machinery;

- have lost their comparative advantage: metal working machinery, office machines and automatic data processing machines and other transport equipment.

Foreign Direct Investments (FDIs)

Foreign direct investment, according to the economic literature, has an advantage over the external credit because the investors, usually represented by multinational companies, contribute to the consolidation of an investment project not only with capital flows but also with technological know-how and managerial experience, technical and organizational innovation, highly skilled workforce and increased access to sales markets.

The link between foreign direct investments and foreign trade may be bivalent. On the one hand, trade policy measures can generate and influence investment flows received by a country, and on the other hand, foreign capital affects the trade of the host (receiver) country. From historical point of view, a producing company firstly has foreign trade transactions with other country and, later on, starts foreign direct investment in that country.

The influences of FDIs on the economy of the host country vary from one country to another. The analysis of these influences requires particular attention given the diversity of both positive and negative effects that can be generated by the characteristics of FDI flows and by the particularities of the host country's economic environment, as for example: local infrastructure, labor market, communications systems, economic policies and general macroeconomic climate.

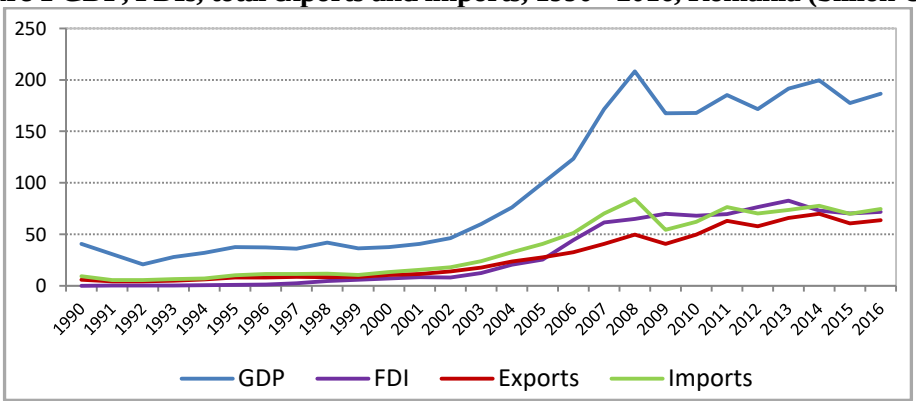
The practice has shown that developed countries, as main FDI receivers, obtain significantly higher benefits than developing countries, which justifies the reserve of economists in judging the negative or positive nature of FDIs flows received by a certain country. Opinions on the influence of FDIs on foreign trade and on the economies of host countries, with a relatively low level of development, can be divided into three main categories, namely:

a. The FDIs has a favorable influence on economic growth (Albu, 2013, Damijan, 2003, De Mello, 1997);
b. The influence of FDIs on the economy of the host country is both positive and negative (Agosin 2010, Borensztein, 1998);
c. There is still no clear conclusion as to the impact of FDIs on the economies of host countries (Cole, 2008).

Many economic studies identified that, for a given country, periods of intense economic growth are characterized by attracting important foreign direct investment flows. In Romania, although high rates of economic growth were recorded, this was not supported by foreign direct investments. At the level of 2016 year, the share of foreign direct investments in GDP was 39.8%, below the EU28 average rate (47.1%).

Comparative evolution between GDP, FDIs and international trade flows as well as between GDP, FDI and trade with *"Machinery and transport equipment"* are shown by the Figure 1, respectively by the Figure 2.

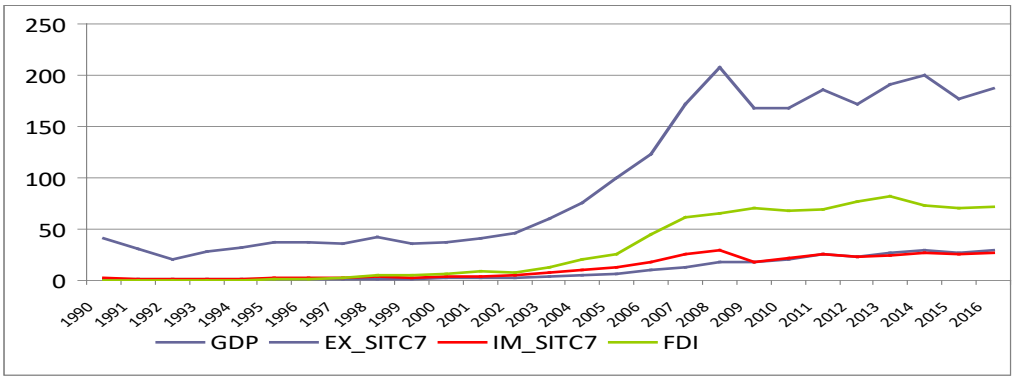
Figure 1 GDP, FDIs, total exports and imports, 1990 - 2016, Romania (billion USD)



Source: Own calculations based on UNCTAD data (http://unctadstat.unctad.org/wds/ReportFolders/reportFolders.aspx) available in April 2018

While the effects of the 2008 global economic crisis have had a significant impact on GDP and on total trade flows, the impact on the exports of SITC group 7 *"Machinery and transport equipment"* was insignificant, with reductions having lower amplitudes than the country's overall level.

Figure 2 GDP, FDIs, exports and imports of "*Machinery and transport equipment*" (SITC 7), 1990-2016, Romania (USD billion)



Source: Own calculations based on UNCTAD data (http://unctadstat.unctad.org/wds/ReportFolders/reportFolders.aspx) available in April 2018

Since 1990, the Romania's current account has deficit. Throughout this period, FDIs has managed to fully fund this deficit only in three years - 2004, 2013 and 2014.

The level of amounts brought by foreign investors in Romania fluctuated over time, most of them being in line with the trend of the economy. As economic analysts say, in the years of crisis, the decline in foreign investment took place in the context of corporations adopting a more conservative attitude towards growth through acquisitions, focusing more on preserving or reducing activity which they already have at international level and the use of excess liquidity in order to lower the indebtedness.

Romania's Export Strategy horizon 2020 is aimed at promoting export-oriented foreign direct investment. According to this Strategy, the activity of foreign investors, as well as the increase of investments in the domestic market, contributed significantly to the implementation of previous strategies and to the current performances of exports, especially in the industries producing transport equipment, industrial equipment and components, IT and electronics. The presence of large investors was a determining factor in changing the export structure and increasing the share of the mentioned industries in total export. Also, in other strategic industries such as furniture, clothing, footwear, the presence of FDIs has been significant in exports, as shown by Romania's Export Strategy.

As well as exports, foreign investments experienced a rebound during the crisis. Foreign direct investments has “returned” to Romania after the recovery of the global economy and overcoming the crisis.

The link between FDIs and economic growth is achieved through exports and imports. The balance of foreign direct investment amounted to around 72 billion USD in 2016, a third of GDP. The activity of foreign direct investment companies contributes to exports by 74.0% and to imports by 66.3%.

Table 5 Exports, imports and trade balance of FDIs companies in Romania in 2016

2016	Exports (FOB)			Imports (CIF)			Trade balance FOB-CIF (USD million)
	FDI companies (USD million)	(%) FDI companies		FDI companies (USD million)	(%) FDI companies		
		in total economy *)	in total sector		in total economy *)	in total sector	
TOTAL, of which:	**50631**	**74.0**	**74.0**	**53384**	**66.3**	**66.3**	**-2752**
Industry, of which:	45792	69.9	82.0	35110	43.6	81.4	10682
Mining	512	0.7	87.4	417	0.5	93.5	96
Manufacturing, of which:	44794	65.5	82.1	34360	42.7	82.0	10433
– manufacture of computer, electronic, optical and electrical products	5356	7.8	89.4	4700	5.8	89.6	656
– machinery and equipment	2791	4.1	92.0	1626	2.0	90.9	1165
– metallurgy	4212	6.1	84.1	2219	2.8	79.4	1993
– transport equipment	18173	26.6	88.6	12708	15.8	89.7	5465

SOURCE: own calculations based on NBR data, "Foreign direct investments in Romania in 2016"*) Exports and imports related to activities of NACE Rev.2 divisions 84 - Public administration, 94 - Associative activities, 97/98 - Activities of households and 99 - Extraterritorial activities, are not included: Note: Exports and imports of goods are aggregated according to the basic activity of FDI enterprises, according to NACE Rev. 2.

As regards the trade balance of the FDIs companies in various economic sectors, it is found that the manufacturing industry is the main sector registering trade surplus (about 10.4 billion USD).

3. Literature review

No studies and analyzes on exports and imports of goods from the SITC group 7 *"Machinery and transport equipment"* have been identified. Therefore, inventory of specialized literature has been extended to all trade flows and FDIs respectively. Existing practical approaches at international and national levels can be categorized according to the level of aggregation of statistical data used in modeling. There are studies conducted at a high level of aggregation - at country level, as well as at sector level, company level and product level. Most studies are based on annual data series and only few used data series with a lower frequency (quarterly, monthly).

Country-level analysis shows a strong relationship between international trade flows and FDIs. In his analysis, Pfaffermayr (1994, 1996) uses the causality of Granger for the link between Austrian FDIs and exports, obtaining a positive, significant causality link in both directions. The same type of analysis was made by Bajo-Rubio and Montero-Munoz in 1999 and Alguacil in 2002 for Spain, the conclusion leading to the identification of a long-term causality between FDI and export. In 1997, Pajot uses the panel method for 21 countries, identifying a positive effect of FDI on exports, with different magnitudes depending on the country under review. Wong and Tang in 2007, demonstrates, in the case of Malaysia, the existence of a unique, long-term causal link between FDI, exports and imports. They also identified the existence of a two-way causal relationship between exports and imports. In contrast, Sultan in 2013 has studied India's case by showing that there is a stable long-term bilateral equilibrium between FDI and export growth but not vice versa (FDI does not influence exports). In addition, it has shown that, on the short term, there is no mutual influence between FDIs and exports to India. In 2014, Sithikun analyzed the case of Cambodia, concluding that there is a positive link between FDI, export and import. Anagaw and Demissie in July 2015 identified a strong relationship between FDI and export growth in Ethiopia.

Empirical studies on sector level have mixed results. Lipsey and Weiss (1981) show a positive relationship between US exports and FDIs for 40 countries in 1970. They believe that an additional dollar affiliate sales lead to an increase from 2 to 78 cents of additional exports to the corresponding market. Marchant et al. (2002) also demonstrates a complementarity relationship between FDI and trade for the US food industry. Graham's findings (1996) generally support the complementary relationship between FDI outward flows and US exports. Falke and Hake in 2008 concluded that exports are influencing FDI but not vice versa. There is a significant long-term elasticity of FDI relative to exports.

Using data at the ***company level***, Lipsey and Weiss (1981) determined strong complementary effects between US production of intermediate goods in the host country and US exports to the same region in 1970. Their results showed that a dollar of additional production in the host country induce 9 to 25 cents of additional exports.

At ***the product level***, in 2001 Blonigen analyzed the data for the "car parts" group for Japan and concluded that there was a complementary effect in the case of vertical production relations. Türkan in 2006 also identified a strong complementary relationship between US trade and FDI stocks of intermediate goods exports, while there is a slight negative relationship between FDIs and end-use trade transactions.

Table 6 Relevant empirical studies on the link between FDIs, Export and Import

Author (s), years	*Aggregation level*	*Reference data*	*Analysis method*	*Results*
Acaravici, Ozturk (2012)	Data at country level (Bulgaria, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovak Republic and Slovenia)	1994-2008 quarterly data, 10 new Member States	ARDL model, cointegration analysis	FDI influences GDP more strongly than exports. There is no single or long-term balance between FDI, export and GDP in BG, EE, HU, LT, RO and SI.
Alguacil si al. (2002)	Data at country level (Spain)	1970-1992, quarterly data	Time series, VAR with Granger causality test	Long-term Granger Positive Causality between FDI and Exports
Ahmadi, Ghanbarzadeh (2011)	Data at country level	1970 - 2008, MENA countries	VAR panel model	There is a bidirectional causality relationship between the FDI, export and GDP variables
Anagaw, Demissie (2015)	Data at country level (Ethiopia)	1971-2011	VAR model, Johansen cointegration analysis	Strong relationship between investment and growth in exports
Bajo-Rubio, Montero-Munoz (1999)	Data at country level (Spain)	1977-1992, quarterly data	Cointegration, Granger causality tests	Long-term Granger Causality between FDI vs. Export (without short-term effects)
Blonigen (2001)	Product-level data (car parts), Japan	1978-1994	Time series, regression	Complementarity effect on vertical production relationships, otherwise substitution effect ISD - Export
Chakrabartya, Chakravartyb (2012)	Product data - crude oil (India)	1971-2010	VECM model	There is a causal link between oil exports and economic growth. There is no immediate econometric link between exports and imports, but exports positively influence imports with a lag of 7 years
Falk, Hake (2008)	Branch / sector data and 7 EU member states	1973-2004	Panel analysis, GMM estimation	Export affects FDI but not vice versa. There is a significant long-term elasticity of FDI relative to exports
Fontagné, Pajot (1997)	Data at country level (21 countries)	panel data	Time Fixed Effects	Positive effect of FDI on exports, different magnitudes for different countries
Graham (1996)	Branch / sector data - USA and Japan	1983, 1988, 1991	The gravitational model	The predominant complementarity relationship between FDI - export
Lipsey, Weiss (1981)	Branch / sector data (14 countries)	1970	OLS	Complementarity between FDI - export
Lipsey,Weiss (1984)	Company-level data	1970	OLS	High complementarity between FDI - export for intermediate goods; poor for end-use goods; possible substitution effect for end-use goods
Marchant si al. (2002)	Branch / sector data (US food processing industry)	1989-1998	Time series, cross-section. Full-information maximum likelihood (FIML) method	Complementarity between FDI - export
Oberhofer si Pfaffermayr (2007)	Company-level data	19,079 companies, 10 countries, Amadeus database	Bivariate Probit Model with Maximum Likelihood approach	Complementarity between FDI - export
Pfaffermayr (1994)	Data at country level (Austria)	1969-1991	Time series, OLS, VAR with Granger causality	Complementarity between FDI - export
Pffafermayr (1996)	Data at country level (Austria)	1980-1994, Time series, cross-section data	Dynamic fixed effects model, GMM estimation	Complementarity between FDI - export
Sithikun (2014)	Data at country level (Cambodia)	1995-2010, 25 partner countries	The gravitational model	Positive link between FDI, export and import
Sultan (2013)	Data at country level (India)	1998-2010	VECM model, Granger causality	There is a stable long-term relationship between FDI and export growth. In the long term, exports influence inflows of FDI and not vice versa. In the short term, there is no mutual influence between FDI and exports to India.
Türkan (2006)	Date la nivel de produs (US)	1989-2003, panel data	Gravitational Model, Fixed Effects, Random Effects	Complementarity of FDI-exports for intermediate goods; easy to substitute FDI-exports for end-use goods
Wong, Tang (2007)	Data at country level (Malaysia)	1999-2006, quarterly data	VECM model, Granger causality	There is a unique, long-term causalilty link between FDI, exports and imports. There is a two-way causality relationship between exports and imports. However, FDI does not cause long-term exports.

Source: personal research on the Internet

4. Methodological considerations

The methodology of research is based on the econometric methods of the time series. The Augmented Dickey-Fuller (ADF) root test, the Johansen co-integration test, the Granger causality test in the context of auto-regression models were used to examine the relationship between the dynamics of the export and import of *"Machinery and transport equipment"* and FDIs stocks of Romania, both on the short and long term, with the assessment of causality and its direction.

Selection and description of variables

The analysis is based on time series for FDI stock and exports, respectively imports of *"Machinery and transport equipment"*. The statistical data used have annual frequency, covering the period 1990-2016; for comparability, statistical data were downloaded from the UNCTAD website.

In terms of international trade in goods statistics, depending on the reference period, they have different but comparable data sources and compilation methods. Between 1990 and 2006, data are exhaustively collected and processed on the basis of customs declarations. Since 2007, after Romania's accession to the EU, international trade statistics are established based on the Intrastat system for intra-EU trade (goods exchanges between Romania and the other EU Member States) and Extrastat system for extra-EU trade (goods exchanged between Romania and non-EU countries).

Values are expressed in FOB prices for exports and CIF prices for imports. FOB price (Free on Board) represents the price at the border of exporting country, and includes the value of the commodity, all transport expenditures to the shipping point, as well as all the fees for the commodity to be loaded on board. CIF price (Cost, Insurance and Freight) represents the price at the border of the importing country and includes both the components of the FOB price and the cost of the insurance, as well as the cost of the international transport.

Theoretical presentation of the proposed analysis

In order to verify if there is a relationship between FDIs, exports and imports of *"Machinery and transport equipment"* (EX_SITC7) we considered the following hypotheses (theoretical model):

$$H1: FDI = f(EX\_SITC7, IM\_SITC7) \quad (2)$$

$$H2: EX\_SITC7 = f(FDI, IM\_SITC7) \quad (3)$$

$$H3: IM\_SITC7 = f(FDI, EX\_SITC7) \quad (4)$$

For all three data series (EX_SITC7, IM_SITC7 and FDI) were tested:

- stationarity - root unit test - Dickey-Fuller Augmented,
- cointegration - Johansen cointegration test.

Given the nature of the series - stationary and cointegrated - the VEC model was used; the "white noise" properties of the residual terms (normal distribution, lack of autocorrelation and heterodasticity) were tested and the Granger causality between the three variables considered was assessed.

5. Data analysis

Basic statistics

Table 7 shows the basic statistics (average, median, maximum, minimum, standard deviation, etc.) for each of the three variables analyzed: foreign direct investment (FDI), exports of *"Machinery and transport equipment"* (EX_SITC7) and imports of *"Machinery and transport equipment"* (IM_SITC7).

Table 7 – Descriptive statistic

	EX_SITC7	IM_SITC7	ISD
Mean	10.15660	12.28252	31.44291
Median	3.792184	7.080112	12.20247
Maximum	29.40139	29.14783	82.68803
Minimum	0.836000	0.943000	0.000010
Std. Dev.	10.72424	10.58349	32.32307
Skewness	0.693354	0.350597	0.382016
Kurtosis	1.824285	1.390200	1.329684
Jarque-Bera	3.718423	3.468519	3.795414
Probability	0.155795	0.176531	0.149912
Sum	274.2281	331.6280	848.9585
Sum Sq. Dev.	2990.243	2912.268	27164.31
Observations	27	27	27

Source: Data processed with Eviews 10

Based on these statistics, we can establish that the value of exports of *"Machinery and transport equipment"* ranges between 0.8 billion USD in 1993 and 29.4 billion USD in 2016. The average value of this indicator for the period 1990-2016 is 10.2 billion USD. The values of the Skewness and Kurtosis tests indicate that the distribution of the series is not perfectly symmetrical, predominantly between the minimum and average of the data series (the median of the series is less than the average of the series).

In terms of imports, the value of imports of *"Machinery and transport equipment"* ranged between 0.9 billion USD in 1991 and 29.1 billion USD in 2008, before the start of the global economic crisis. The average value of this indicator for the period 1990 - 2016 is 12.3 billion USD. Also, the values of the Skewness and Kurtosis tests show that the considered distribution is not a perfectly symmetrical one, predominantly between the minimum and the average of the series of data (the median of the series is less than the average of the series).

Stationary series tests

The evolution of a stationary series is not affected by the time; the media, the dispersion and the covariance of such a series are constant over time. The time series are often non-static, so the first step in this time series economic modeling is to establish the stationary relationship between the variables to avoid false regressions. Also, Granger causality can only be tested for stationary variables; therefore unit root tests must be performed on all variables considered in order to ensure the validity of common statistical tests (F-statistic, t-statistic, R-square).

From economic point of view, a series is stationary if a shock on the series has a temporary effect (it is absorbed over time) and not permanently. Unit root detection for a series indicates that the shocks on that series will be permanent and not transient.

To test the stationarity of the export, import and FDIs series, the Augmented Dickey Fuller - ADF test was used (Dickey and Fuller, 1981). The ADF test also highlights the degree of integration of the series, knowing that many macroeconomic series are unstable, leading to false results when applying the Ordinary Least Squares method (OLS). The non-stationary series transforms into stationary series by differentiating them, after which they can be used in regression analyzes.

For each of the three series, the stationary test (Augmented Dickey-Fuller Test) was performed on both the initial series and the differentiated series (order 1 and order 2).

Hypotheses:

H0: series is non-stationary (p-value <0.05 - H0 rejected and H1 is accepted),

H1: the series is stationary (p-value> 0.05 - H0 is accepted and the H1 is rejected).

The root unit test results for the level and for the first and second difference:

Table 8 - The results of stationary test on the given series

	Level series (initial)			series 1st differentiated			2nd order differentiated series		
	$EX7_t$	$IM7_t$	ISD	$\Delta EX7_t$	$\Delta IM7_t$	ΔISD_t	$\Delta(\Delta EX7_t)$	$\Delta(\Delta IM7_t)$	$\Delta(\Delta ISD_t)$
t -statistic	-1,9926	-0,4341	-0,6364	-1,2478	-4,8290	-2,9245	-12,8908	-7,9361	-5,6688
p value	0,2877	0,8890	0,8451	0,6353	0,0008	0,0567	0,0000	0,0000	0,0001
critical value (5%)	-2,9981	-2,9810	-2,9862	-2,9981	-2,9919	-2,9862	-2,9981	-2,9981	-2,9919

Source: Data processed with Eviews 10

In the table 8, for the series and series 1st differentiated export and FDI series, the p-value associated with the t-statistical test is greater than 0.05, H0 is accepted (the series is non-stationary) and the H1 alternative is rejected (the series is stationary).

P-value ≈ 0.000 associated with the t-static 2nd order differentiated series indicates a clear rejection of the non-stationarity hypothesis for the three time series, FDI, export and import of *"Machinery and transport equipment"*; thus, we can state that the three series of data are stationary after the 2nd order differentiated.

The time series Cointegration Test (Johansen Test)

Cointegration means that, despite the fact that the series are non-stationary, a linear combination with the same degree of integration of two or more time series can be stationary. The cointegration of more than two time series suggests a long-term relationship or equilibrium between them.

In general, two series are cointegrated if two conditions are met:

- the series are affected by a random trend with the same degree of integration ***d***;
- the linear combination of these series allows for a series with a lower integration order.
- Since our series are integrated by the same order I (2), we can verify whether the data series are cointegrated by applying the Johansen procedure.

The cointegration test of the FDI, EX_SITC7, IM_SITC7 series indicates the presence of at least one and not more than 2 long-term cointegration equations between FDI, export and import of *"Machinery and transport equipment"* (Trace test, respectively Maximum Eigenvalue test).

Because the time series is relatively short (27 years) we choose a single cointegration equation.

Table 9 Cointegration test of the series (Johansen Test)

Test Type	No Intercept	Intercept	Intercept	Intercept	Intercept
	No Trend	No Trend	No Trend	Trend	Trend
Trace	2	2	2	2	2
Max-Eig	2	2	2	2	2

Source: Data processed with Eviews 10

Lag order selection (Schwarz criterion)

Lag order selection is based on the Schwarz criterion (SC): the lowest SC coefficient indicates the lag order - in this case the selected lag order is 1.

Table 10 VAR Lag Order Selection Criteria

Lag	0	1	2
SC	19.73844	14.57454*	18.23568

Source: Data processed with Eviews 10

Based on the above-mentioned analyzes we decided to analyze the long-term relationship between FDI and export and import of *"Machinery and transport equipment"*, using the VEC model with the 1st order differentiated data, 1st lag order and one cointegration equation.

Estimation of the model parameters

The VEC model was performed by using the facilities offered by Eviews 10 application. The resulted regression equation is the following:

$$\Delta^2(EX\_SITC7)=C_{(1)}*(\Delta(EX\_SITC7_{(-1)})+1.1809*\Delta(IM\_SITC7_{(-1)})-0.5748*\Delta(ISD_{(-1)}) - 0.5670) +\Delta^2(EX\_SITC7_{(-1)}) + C_{(3)}* \Delta^2(IM\_SITC7_{(-1)}) +C_{(4)}* \Delta^2(ISD_{(-1)}) + C_{(5)} \quad (5)$$

According to the ANOVA test results, the selected model is valid (F-statistic = 33.2 and Prob (F-statistic) = 0.000000 <0.05). Most of the coefficients of the equation are significant, indicating that imports of *"Machinery and transport equipment"* and FDI influence the exports of *"Machinery and transport equipment"*, both in the short and long term (the coefficient of the cointegration equation is negative and significant).

The adjusted R^2 indicates that the simultaneous action of imports of *"Machinery and transport equipment"* and FDI determines 85.0% of the variation in the export of *"Machinery and transport equipment"*.

In the short term, the results show that the evolution of imports of *"Machinery and transport equipment"* from the previous period has a major impact on the exports of *"Machinery and transport equipment"* in the current period (an increase of imports with 1 million USD generate an increase of exports with 0.57 million USD). In the long run, exports of *"Machinery and transport equipment"* are negatively affected by similar imports (-0.59 * 1.18 = -0.70) and positive by FDI (+0.34).

It should be noted, however, that in the model considered, the influence of the free term, as a picture of factors not included in the model, is significant. Thus, we can say that factors, which were not taken into account at the time of the construction of the econometric model, determine an increase (not very significant) in the value of exports.

Tests diagnosis for residues

- ❖ Autocorrelation of errors

The Residue Correlation Test (Breusch-Godfrey test) shows that errors are not correlated (does not reject the null hypothesis: there is no correlation of errors – Chi-Square Probability = 0.14> 0.05)

- ❖ Homoscedasticity of random errors

The Breusch-Pagan-Godfrey and ARCH tests show that the errors are not heteroscedastic (do not reject the null hypothesis: errors are homoscedastic):

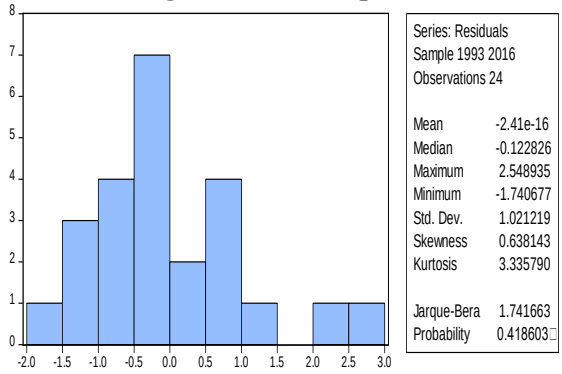
- Breusch-Pagan-Godfrey test (Prob. Chi-Square = 0.48> 0.05)
- ARCH test (Prob. Chi-Square(1)=0.75>0.05)

- ❖ Random errors have normal distribution

The Jarque-Bera test and the histogram indicate a normal distribution of residues – Figure 3 (Jarque-Bera = 1.74 and probability = 0.42> 0.05 – does not reject the null hypothesis that residues are normally distributed)

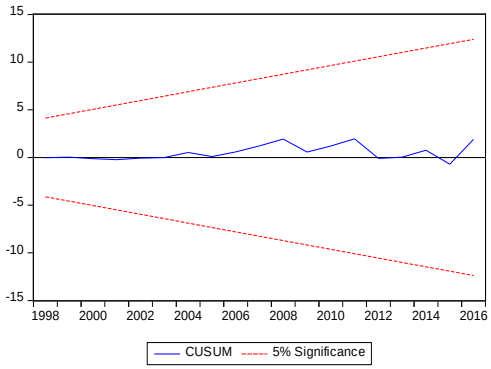
CUSUM test indicates the stability of the regression coefficients, as shown in the Figure 4.

Figure 3. The Jarque-Bera test and the histogram



Source: Eviews 10 output on the Jarque-Bera test and the histogram

Figure 4. The CUSUM test



Source: Eviews 10 output on CUSUM test

The previously generated regression function (export of SITC 7 depending on import of SITC 7 and FDI) has the following characteristics:

- the R-adjusted is close to 1 (0.85), which means that import of *SITC 7* and FDI determine for 85% of export of *SITC 7* and are very close to 1; it results that there is a strong link between variables;
- The ANOVA test indicates the validity of the model (F-statistic = 33.2 and Prob (F-statistic) = 0.000000 <0.05);
- Most of the coefficients are significant, indicating import of *SITC 7* and FDI influence export of *SITC 7*, both in the short and long term (coefficient of cointegration is negative and significant);
- Residues are not autocorrelated, have a normal distribution and are homoscedastic.

In conclusion, the previously VEC model can be considered representative to describe autoregressive links between export of *SITC group 7* as the dependent variable and import of *SITC group 7* and FDI as independent variables.

6. Conclusions

As a whole, the exports of "*Machinery and transport equipment*" are 85% influenced by imports of "*Machinery and transport equipment*" and FDIs. In the long run, the study reveals a direct link to FDIs and the growth of exports. Also, in the long run, the results show a reverse link between exports of machinery and transport equipment and imports of similar products (the decrease in imports by 1 currency unit determines the increase of exports by 0.70 monetary units). The result is not always supported by the economic reality and requires further investigation.

A reliable conclusion on the characteristics of the link between the FDIs, export and import of "*Machinery and transport equipment*" requires further investigations, taking into account other aspects of the national macroeconomic context – the total trade balance, trade balance of SITC group 7 "*Machinery and transport equipment*", trade balance by types of technologies, the dynamics of trade flows and FDI, GDP, etc.

Regarding the evolution of exports and imports of FDIs companies (aggregated data by main activities) it is observed that the manufacturing industry is the main export sector (over 80% of the total). In turn, the manufacturing industry includes an important part of the SITC 7 "*Machinery and transport equipment*", which should facilitate the image of a strong link between FDIs and the export and import of goods from the SITC 7.

Taking into account the determining contribution of the FDIs companies to Romania's foreign trade, it can be said that many foreign investments were attracted by the comparative advantages of our country in the competition of globalization (especially in the case of producing branches for groups presented in Tables 2 and 3 in Section 2 of this paper), either by export-oriented production or by exports with a significant import content (including processing and assembling).

References

[1] Alguacil M., Orts V., "A Multivariate Cointegrated Model Testing for Temporal Causality between Exports and Outward Foreign Investment: the Spanish Case", Applied Economics, 34, 119-132, 2002.

[2] Andrei T., Bourbonnais R., "Econometrie", Ed. Economică, Bucureşti, 2008.

[3] Acaravci A., Ozturk I., "Foreign direct investment, export and economic growth: empirical evidence from new EU countries", Romanian Journal of Economic Forecasting, no. 2, pp. 52-67, 2012.

[4] Bajo-Rubio O., Montero-Munoz M., "Foreign Direct Investment and Trade: A Causality Analysis", Working Paper of the University of Navarra, No. 9902, 1999.

[5] Blonigen B., "In search of substitution between foreign production and exports", Journal of International Economics, 53, 81-104, 2001.

[6] Dickey D.A., Fuller W.A., "Distribution of the Estimator for Autoregressive Time Series with Unit Root", Journal of the American Statistical Association, vol.74, 427-431, 1979.

[7] Engle R.F., Granger C. W. J., "Co-integration and Error Correction: Representation, Estimation and Testing", Econometrica, vol. 55, 251-276, 1987.

[8] Helpman E. et al, "Export vs FDI", NBER Working paper, No.9439, Cambridge, Mass, 2003.

[9] Johansen S., "Statistical analysis of Co-integration vectors", Journal of Economic Dynamics and Control, vol. 12, 231-54, 1988.

[10] Liu X. et al, "Relationship between economic growth, foreign direct investment and trade: evidence from China", Applied Economics, 34, pp. 1433- 1440, 2002.

[11] Marchant M.A. et al, "International Trade and Foreign Direct Investment: A Focus on the Free Trade Area of the Americas", Journal of Agricultural and Applied Economics, 34, 289-302, 2002.

[12] Oberhofer H., Pfaffermayr M., "FDI versus Exports, Substitutes or Complements? A Three Nations Model and Empirical Evidence", Paper presented on the ETSG, 2007.

[13] Pacheco-Lopez P., "Foreign Direct Investment, Exports and Imports in Mexico", the World Economy, 28(8), pp. 1157-1172, 2005.

[14] Pfaffermayr, M., "Foreign Direct Investment and Exports: A Time Series Approach", Applied Economics, 26 (4), 337- 351, 1994.

[15] Phillips P.C.B., Perron P., "Testing for a Unit Root in Time Series Regression", Biometrica, vol.75, 335-346, 1988.

[16] Rahman A., "Determinants of Foreign Direct Investment in the Kingdom of Saudi Arabia", http://faculty.ksu.edu.sa/ammar/Publications/Determinants%20of%20 Foreign%20 Diredct%20Investment%.

[17] Toda, H.Y.,Yamamoto,T., "Statistical inference in vector autoregressions with possibly integrated processes" Journal of Econometrics, 66, 225-250, 1995.

[18] Türkan, K., " Foreign Outward Direct Investment and Intermediate Goods Exports: Evidence from USA", Paper presented on the ETSG 2006, ,http://www.etsg.org/ ETSG2006/papers/Turkcan.pdf.

[19] Wong K.N., Tang,T.C., "Foreign direct investment and electronics exports: exploratory empirical evidence from Malaysia …", Economics Bulletin, Vol. 6, No. 14, 1-8, 2007.

[20] Zaman Gh., et al, "Aspecte ale impactului ISD din România asupra exporturilor si dezvoltarii durabile", Romanian Journal of Economics, IEN, Volum 33, Pages: 130-190, 2011.

[21] Zaman Gh.,"Ways of improving foreign direct investment Contribution to Romania's sustainable development", Annales Universitatis Apulensis Series Oeconomica,vol.2,issue 24, 2012.

[22] Zhang, Honglin K., Song, Shunfeng, "Promoting Exports: the Role of Inward FDI in China",China Economic Review, 11, 385-396, 2000.