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THE MACRO DETERMINANTS OF THE ROMANIAN PHARMACEUTICAL IMPORTS AND EXPORTS IN 2001-2018 PERIOD USING THE GRAVITY MODEL

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Abstract:

The aim of this paper is to identify the macroeconomic determinants of Romanian pharmaceutical imports and exports from 2001 to 2018. A gravity model and panel data analysis were used, with EViews 10 as the software tool, and the data were collected from the World Bank and the International Trade Centre databases. The results show that the gravity model exhibits high explanatory power for Romanian pharmaceutical imports and exports. Market size, health expenditures of partner countries, sharing a common border, EU membership, as well as former CMEA (Council for Mutual Economic Assistance) ties, have a positive impact on import and export flows, while geographical and economic distance have a negative impact on Romanian pharmaceutical trade. The profiles of the major suppliers of Romanian pharmaceutical imports and the major destination countries for Romanian pharmaceutical exports are identified. The paper provides valuable insight into Romanian pharmaceutical trade, showing that the main macroeconomic determinants of imports are the share of pharmaceutical exports in total exports and the export market penetration index for the partner country, while the main determinants of exports are the share of pharmaceutical imports in total imports and the trade openness of the partner country. The paper addresses only macroeconomic determinants of Romanian pharmaceutical trade flows; therefore, further research on micro-level determinants is needed.

Keywords:

gravity model, macro determinants, Romania, pharmaceutical products, imports, exports

JEL Classification: F14, C33

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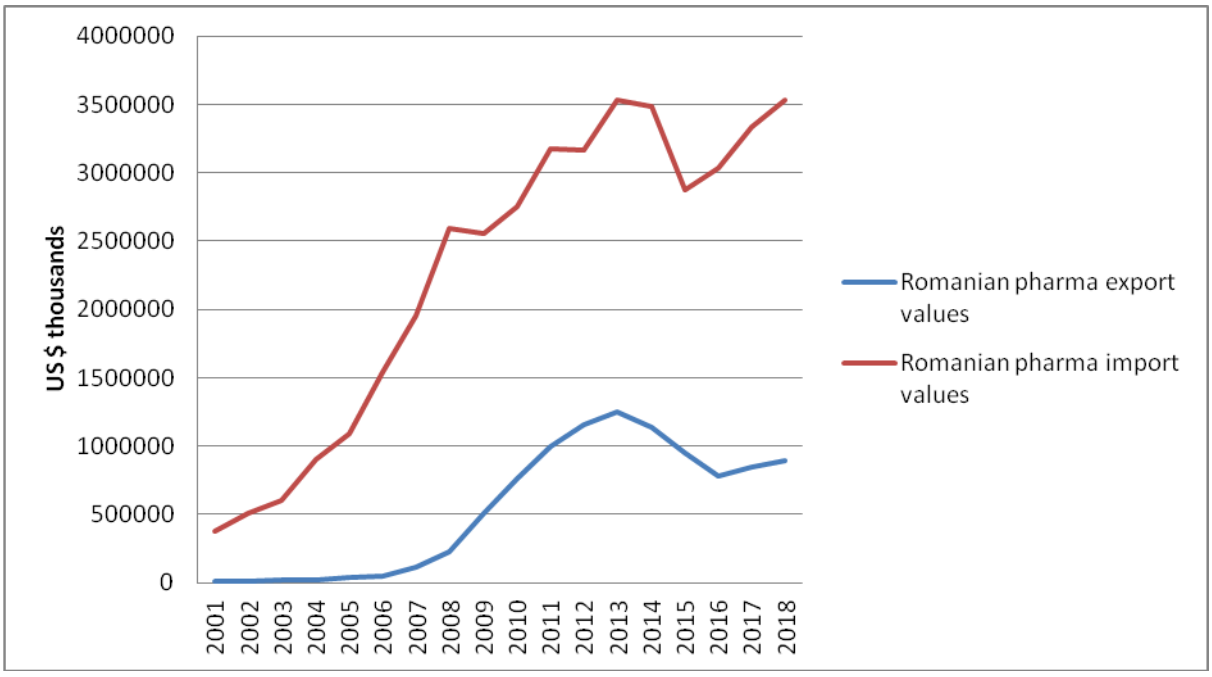
Introduction

The aim of this paper is to find out the macro determinants of the Romanian pharmaceutical imports and exports from 2001 to 2018. The paper is organized as follows: an overview of the Romanian pharmaceutical exports in the considered period, the theoretical background – literature review, the methodology, the results and discussions, the conclusions.

Overview of the Romanian pharmaceutical imports and exports in the 2001-2018 period

The value of the Romanian pharmaceutical imports increased 9 times in 2018 compared to 2001, with relative peaks in 2013, 2014 and 2018. The value of Romanian exports increased 90 times in 2018 compared to 2001, with a 2013 peak. The Romanian pharmaceutical trade was not balanced, the import values outpaced the export values by different rates, from over 32 times in 2006 to over 2 times in 2012 and there was a descending trend starting 2007, the year when Romania became an EU member. In the considered period, the value of the pharmaceutical imports in all Romanian imports was between 2.45% in 2001 to 4.81% in 2013, while the value of the pharmaceutical exports in all Romanian exports was 1.99% at the best in 2012. Over 81% of the pharmaceutical imports and over 90% of the pharmaceutical exports were medicine for prophylactic or therapeutical use. This shows that there is not a large variety of pharmaceutical exports, therefore the magnitude of exports is rather small, which is consistent with the results of Andersson (2007). [1]

Figure 1: The values of the Romanian pharmaceutical imports and exports in the 2001-2018 period



[1] Andersson, M. (2007). *Disentangling Trade Flows: Firms, Geography and Technology*. Jönköping International Business School (JIBS) Dissertation Series No. 036.

Source: Author's figure based on data from the International Trade Center, http://www.intracen.org/itc/market-info-tools/trade-statistics

The top three areas for Romanian pharmaceutical imports were the EU, Germany and the UK. The top countries for Romanian pharmaceutical exports were Germany, Russia, Bulgaria, Ukraine, UK, Poland, Hungary, Moldavia, therefore most of them were former CMEA countries, thus with similar industrial structures as background, so they should trade more according to Baxter and Kouparitsas (2006). [2]

Table 1: Top three countries for Romanian pharmaceutical imports in 2001-2018

2001 2002 2003 2004 2005	2006	2007 2008	2009	2010 2011 2012	2013	2014	2015	2016	2017 2018
France	France	Germany	Germany	Hungary	Germany	Hungary	Germany	Germany	Germany
Germany	Germany	France	France	Germany	Hungary	Germany	Hungary	Netherlands	Hungary
UK	Swizerland	Hungary	Swizerland	Swizerland	Swizerland	Switzerland	Italy	Hungary	Netherlands

Source: Author's table based on data from the International Trade Center, http://www.intracen.org/itc/market-info-tools/trade-statistics

Table 2: Top three countries for Romanian pharmaceutical exports in 2001-2018

2001	2002 2003 2004	2005	2006	2007	2008	2009 2010 2011	2012	2013 2014 2015 2016 2017 2018
Bulgaria	Bulgaria	Bulgaria	Bulgaria	Russia	Russia	Germany	Germany	Germany
Moldavia	Russia	Russia	Russia	Bulgaria	Ukraine	Russia	UK	Russia
Russia	Ukraine	Poland	Hungary	Hungary	Bulgaria	UK	Russia	UK

Source: Author's table based on data from the International Trade Center, http://www.intracen.org/itc/market-info-tools/trade-statistics

Literature review

In 1962, Jan Tinbergen presented the first gravity model for trade flows based on Newton's gravity law and proved that trade flows between two countries are positively influenced by their market size and negatively influenced by the distance between them. [3] The first gravity model

[2] Baxter, M. and Kouparitsas, M. (2006), *What determines bilateral trade flows?*, NBER Working Paper 12188, National Bureau of Economic Research, Inc.

[3] Tinbergen, J. (1962). *Shaping the World Economy; Suggestions for an International Economic Policy*. Twentieth Century Fund, New York.

studies were based on intuitive trade models and not on standard trade theories (Poyhonen, 1963; Leamer and Stern, 1970).

At micro level, the determinants of the imports could be the import demand and the export capacities, but at macro level, the determinants could be the GDP, the population and the geografical distance (Evenett and Hutchinson, 2002), the income of the importer (Martinez-Zarzoso and Nowak-Lehmann, 2003) or the GDP per capita and the common border (Achay, 2006). Cipollina and Salvataci proved in 2011 that EU membership matters and it has a positive impact on developing countries, while Baldwin and Taglioni proved in 2006 that being an EU member will boost the trade of a country by 25% and, in about the same time, Baier and Bergstrand showed that a FTA between two countries can double the trade in 15 years. For pharmaceutical exports, one of the major drivers was the membership in the former CMEA (Council for Mutual Economic Assistance), sustaining Bussière et al. (2005) findings. The coefficients for GDP should be between 0.2 and 1 (Head, 2003). For the exporter countries, GDP measures the productive capacities and for the importer countries, it measures the market size. According to Anderson (2011), the estimated coefficients of the mass variables, such is GDP, should be close to 1, while the distance coefficients should be close to -1. The distance between two countries is considered a proxy for transportation costs. The mean effect of the distance on the trade flows is -0.9, with 90% of the estimates between -1.55 and -0.28 (Disdier and Head, 2008). For developed countries, the distance impact on the trade flows have weakened in time (Brun et al, 2005; Prasada, 2009). The border effect is larger between small countries (Anderson and van Wincoop, 2003). Trade openness, considered as the share of imports or exports or bilateral trade in a country GDP, is positively correlated with the trade flows (Alotaibi and Mishra, 2014; Lane and Milesi-Ferretti, 2008).

Panel data methodology should be used because significant relationship among independent variables over time could be considered and unobserved individual effects could be revealed (Alam, Uddin and Taufique, 2009).

A panel based approach should better deal with the heterogeneity issues by considering the country pair individual effects. Panel analysis with fixed effects would provide many correct specified models (Kandogan, 2009; De Benedictics and Taglioni, 2011).

Although the mainstream literature regarding the gravity model continues to explore different nonlinear methodologies, none of them being widely accepted, the traditional OLS loglinear specification is still mostly used in empirical studies (Khan and Kalirajan, 2011). According to Kepaptsoglou et al. (2010), 83% of the researchers used OLS and more than a third of them the fixed effects.

The literature regarding finding the determinants of the pharmaceutical imports and exports using the gravity model is scarce. Iran, for example, would trade more pharmaceuticals with countries with similar market size and with common language and religion, revealed the study of Khodamoradi et al (2018).

According to Baldwin (1994), when using the gravity model for imports and exports, one would accept the assumption that countries tend to monitor their imports more carefully than their exports.

There is a robust positive influence of language similarity on trade flows (Siliverstovs and Schumacher, 2009), although including the common language variable is not rooted in theory (Thursby and Thursby, 1987).

The protection of the intellectual property rights has a positive impact on the USA pharmaceutical imports, yet it does not significantly increase the trade of USA pharmaceutical products (Boring, 2015).

The determinants of the EU pharmaceutical exports are the economic size and the importance of the health sector, the quality of infrastructure and the protection of the intellectual property of the receiving countries (Blanc, 2015).

The Swedish pharmaceutical exports can be explained in a similar manner to other exports (Wilkman, 2012). The size of the receiving market is important (Andersson, 2007). Sharing the same religion, as well as the cultural similarity matters for pharma exports, according to Adolfsson (2007), although Wilkman (2012) disagrees this finding. Adolfsson (2007) found EU membership as a negative driver of the pharma exports.

Boring (2015) found out that the implementation of minimum standard of pattern protection positively influences the US pharmaceutical exports.

Methodology

The aim of this paper is to find out the macrodeterminants of the Romanian pharmaceutical import and export flows in 2001-2018 period using the gravity model.

The research hypothesis are:

H1: The macro determinants of the Romanian pharmaceutical import and export flows are the trade openness, the share of the pharmaceutical trade and the importance of the health sector of the partner countries.

H2: The market size of Romania and of the partner country positively influences the import and the export flows.

H3: The geographical distance between Romania and the partner country would negatively influence the import and the export flows, but the effect would be limited.

H4: Sharing a common border or a common language or a common trade union membership positively influences the import and export flows.

H5: The landlocked characteristic of the partner country would negatively influence the import flows.

H6: The former CMEA (Council of Mutual Economic Assistance) membership positively influences the export flows.

For import flows the equation is:

$LnImpVal_t = c_0 + c_1LnESGDP_t + c_2LnIEMP_t + c_3LNPESAE_t + c_4LnGDPT_t + c_5LnHESHDP_t + c_6LnDistt + c_7CB + c_8CL + c_9EU + c_{10}LL + \varepsilon$

The dependent variable is $LnImpVal_t$ (Ln - the logarithm of), the Romanian Import Value in year t of the partner countries. The data were collected from ITC (International Trade Center). The independent variables are:

$LnESGDP_t$ is (Ln - the logaritm of) the exports share of GDP of the partner country in year t, it shows the degree in which the economy of the partner country is oriented to exports.

$LnIEMP_t$ is (Ln - the logarith of) the Index of Export Market Penetration of the partner country in year t, it measures the degree of a country's exports reached on the international markets.

The data for the above independent variables were collected from WITS (World Integrated Trade Solution).

$LNPESAE_t$ is (Ln - the logarithm of) the Pharmaceutical exports as share of all exports of the partner country in year t. It measures the importance of the pharmaceutical exports of the partner country.

This independent variable was computed using the exports data from ITC.

$LNGDPT_t$ is (Ln - the logarithm of) the sum of the Romanian GDP and the GDP of the partner country in year t, it measures the size of the economy.

$LnHESHDP_t$ is (Ln - the logaritm of) the health expenditures share of GDP of the partner country in year t.

The data for GDP and HESGDP were collected from World Bank database.

All the above independent variables are expected to have a positive sign.

LnDist is (Ln - the logaritm of) the distance between the capital cities of Romanian and the partner country. The data were computed using the Distance Calculator from https://www.distance.to/. The distance is expected to have a negative sign.

The dichotomic dummy variables considered were:

CB (common border), it takes the value 1 if Romania and the partner country share a common border and 0 otherwise.

CL (common language), it takes the value 1 if Romania and the partner country share a common language and 0 otherwise.

EU, it takes the value 1 if Romania and the partner country are European Union members and 0 otherwise.

All the above dummy variables are expected to have positive signs.

LL, it takes the value 1 if the partner country is a landlocked country, with no access to the sea or the ocean and 0 otherwise. The LL dummy variable is expected to have a negative sign.

t indicates the year and it will take the whole values between 2001 and 2018.

ε is the error term.

For export flows, the equation is:

$LnExpVal_t = c_0 + c_1LnGDPP_t + c_2LnDist + c_3LnHEPC_t + c_4LnSPharmImp_t + c_5LnSImpGDP_t + c_6LnEcdist_t + CB + EU + EXCC + \varepsilon$

$LnExpVal_t$ is the dependent variable (Ln - the logarithm of), the Romanian pharmaceutical export values in year t. The data were collected from the International Trade Center (ITC). The independent variables are:

LnGDPPt (Ln - the logarithm of) is the GDP of the partner country in year t. It measures the size of the receiving country.

$LnHEPC_t$ (Ln - the logarithm of) represents the health expenditures per capita of the partner country in year t.

LnSPharmImp (Ln - the logarithm of) is the share of the pharmaceutical imports of all imports of the partner country in year t, it measures the size of pharmaceutical products' demand.

$LnImpGDP_t$ (Ln - the logarithm of) is the share of the imports in the GDP of the partner country in year t, it measures the openness to trade.

The data for GDP were collected from the World Bank database and the last two were computed. The above mentioned independent variables are expected to have positive signs.

$LnEcdist_t$ (Ln - the logarithm of) is the absolute value of the difference between the Romanian GDP and the partner country GDP in year t, the logarithm is multiplied with -1 if the Romanian GDP is smaller than the partner country GDP, it measures the economic distance between Romania and the partner country.

LnDist (Ln - the logarithm of) is the distance between Romania and the partner country. It is considered as a proxy for the transportation costs.

These two distances are expected to have negative signs.

The dichotomic dummy variables considered are:

CB (common border), it takes the value 1 if Romania and the partner country share a common border and 0 otherwise.

EU, it takes the value 1 if Romania and the partner country are European Union members and 0 otherwise.

EXCC, it takes the value 1 if Romania and the partner country are members of the Council for Mutual Economic Assistance (CMEA) and 0 otherwise. CMEA was a kind of economic treaty for former communist countries between 1949 and 1991. Although the CMEA is long time gone, the trade relashionships are longlasting, similar to colonial ties.

All the above dummy variables are expected to have positive signs.

t indicates the year and will take the whole values between 2001 and 2018.

ε is the error term.

EViews10 was used for regression. The Hausman Test was applied to decide between the options Fixed Effects or Random Effects. The p value was 0.0000 for exports, therefore the Fixed Effects should be applied for exports and the p value was 0.4576 for imports, therefore the Random Effects should be applied for imports. The multicolinearity test was applied. For exports and for imports as well, the Variance Inflation Factor (VIF) is less than 10 for all the variables, so there is no multicolinearity. The Durbin-Watson coefficient for exports is 1.59 and the Durbin-Watson coefficient for imports is 2.10, so there is a positive, but low autocorrelation for exports and there is no autocorrelation for imports. The Panel Least Squares with the option Cross Sections Fixed Effects and Robust Least Squares were used to deal with the heteroskedasticity issues, according to Alam, Uddin and Taufique (2009) [4], Kandogan (2009) [5], Khan and Kalirajan (2011). [6] The White Test was applied to check for heteroskedasticity and due to the fact that the p value is greater than 0.05, there is no heteroskedasticity in any of the models.

The results

An unbalanced panel data was used with 10 cross-sections for imports and 9 cross-sections for exports and 18 years in both cases.

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Table 3: The regression results for import flows

Coefficients	Panel Least Squares Cross Sections random effects	Std. Error	Prob.	Robust Least Squares	Std. Error	Prob.
c	-3.704	3.39	0.27	-5.13***	2.74	0.06
LnGDPTt	0.44*	0.12	0.0005	0.46*	0.09	0.0000
LnDist	-0.04*	0.01	0.0002	-0.05*	0.01	0.0003
LnESGDPt	0.47**	0.19	0.01	1.002*	0.14	0.0000
LnHESGDPt	0.59**	0.25	0.02	0.15	0.21	0.47
LnIEMPt	1.08*	0.23	0.0000	1.16*	0.18	0.0000
LnPESAEt	1.16*	0.08	0.0000	1.29*	0.05	0.0000
EU	1.07*	0.19	0.0000	0.79*	0.15	0.0000
CB	1.06*	0.28	0.0002	1.2*	0.27	0.0000
CL	0.404***	0.2	0.04	0.34	0.26	0.18
LL	0.98*	0.19	0.0000	0.62*	0.2	0.0002
R squared	0.67			0.58		

Legend: * significant at 1%; ** significant at 5%; *** significant at 10%

Source: Author's table based on EViews outputs

Table 4: The regression results for export flows

Coefficients	Panel Least Squares Cross Sections fixed effects	Std. Error	Prob.	Robust Least Squares	Std. Error	Prob.
C	-4.18***	2.55	0.1	-13.87*	2.47	0.0000
CB	2.33*	0.18	0.0000	2.2*	0.27	0.0000
EU	0.82*	0.36	0.02	1.74*	0.13	0.0000
EXCC	2.3*	0.14	0.0000	1.73*	0.17	0.0000
LnHEPC	0.12**	0.06	0.03	0.07	0.05	0.2
LnSPharmImp	0.79*	0.11	0.0000	0.91*	0.12	0.0000
LnSImpGDP	0.7*	0.17	0.0001	0.94*	0.16	0.0000
LnGDPP	0.46*	0.08	0.0000	0.8*	0.08	0.0000
LnDist	-0.03***	0.01	0.07	-0.04***	0.02	0.05
LnEcdist	-0.01**	0.004	0.01	0.005	0.004	0.17
R squared	0.60*			0.43		

Legend: * significant at 1%; ** significant at 5%; *** significant at 10%

Source: Author's table based on EViews outputs

Discussions

The GDPT, the total of the GDP of Romania and of the partner country has a positive impact on the Romanian pharmaceutical import flows, though the value is lower compared to other goods. The distance between the two countries has a negative, yet very small influence on the Romanian pharmaceutical import flows. The exports share of GDP of the partner country has a positive impact, about the same size with the partner country GDP in the first model and twice in the second model. The health expenditures as percent of the GDP of the partner country have a positive impact on the Romanian import flows in the first model and it is not significant in the second one. The index of export market penetration has a strong positive influence on the imports and so does the percent of the pharmaceutical exports out of all exports, both with coefficients over 1. As expected, the EU membership and the common border have a strong positive impact on the Romanian pharmaceutical imports. Sharing a common language has a small positive influence in the first model and is not significant in the second one. Being a landlocked country hasn't a negative influence on the Romanian imports as it was expected, on the contrary, the influence is positive and important.

The GDP of the partner country has a positive influence on Romanian pharmaceutical export flows, the greater the GDP is, the larger is the size of the imports of the partner countries, including for pharmaceutical products, including for Romanian ones. The geographical distance, considered as a proxy for transportation costs, has a negative, yet small impact on pharmaceutical exports and it is significant in both models. The economic distance also has a negative and even smaller influence on export flows in the first model and it's not significant in the second one. The main drivers for Romanian pharmaceutical exports are the common border, which also explains the small values for distance impact, followed by the former CMEA membership and the actual EU membership. The share of imports in the receiving countries GDP, as well as the share of pharmaceutical imports in all imports for the partner countries, representing the demand for foreign medicine, have a significant strong influence on the export flows. The health expenditures per capita in the receiving countries have a small positive impact in the first model and it is not significant in the second one.

Conclusions

For imports, the first research hypothesis is sustained, the share of the pharmaceutical exports in all exports for the partner country, represented in the model by LnPESAEt, has the highest value for its coefficient, followed by the export market penetration index, represented in the model by LnIEMPt, both of them with values over 1. Their predictive power is even higher than the EU membership and the common border, which in the classical gravity model have the highest predictive power. The results are sustained by the analysis of the Romanian pharmaceutical trade, most Romanian pharmaceutical imports are from top pharmaceutical exporters, with high index of export market penetration (see Table 1).

The other two macro determinants, the share of the health expenditures, represented in the model by LnHESGDPt and the export orientation of the partner country, represented by LnESGDPt, have higher coefficients than the combined size of the economies of Romania and of the partner country, represented by $LnGDPT_t$ (0.59 and 0.47 respectively in the first model and

even more than 1 for LnESGDPt in the second model). The results regarding the trade openness of the partner countries for imports, as well as for exports, are in line with the results of Mishra (2007) and Lane and Milesi-Ferretti (2008).

For exports, the share of pharmaceutical imports in all imports for the partner country, represented in the model by LnSPharmImp, has the highest value among the independent variables, followed by the openness to trade of the receiving country, represented by LnSImpGDP. For both predictors, the values in the second model are closed to 1. The importance of the health sector in the partner country has a positive impact on the Romanian pharmaceutical exports, but the amplitude of this determinant is almost five times smaller than for import flows, the results are in line with those of Blanc (2015).

The second research hypothesis is sustained, the coefficient for the sum of GDP is low, but still in range according to Disdier and Head (2008). The market size of the partner country has a positive impact on export flows, sustaining the results of Martinez-Zarzoso and Nowak-Lehmann (2003). The GDP remains a significant predictor for both pharmaceutical imports and exports, similar with the findings of Andersson (2007).

The geographical distance influence is negative, for import flows and export flows alike, as the third research hypothesis stated, yet the amplitude of the effect is smaller than the ones found by Disdier and Head (2008), Anderson (2011) and Khan and Kalirajan (2011) and this extended the results of Brun et al (2005) and Prasada (2009) regarding the weakeness of the distance impact even for a developing country like Romania. The distance results are consistent with Anderson and Wincoop ones, Romania being larger than its neighbours. The economic distance has a small negative impact on the export flows, for Romania is easier to export pharmaceutical products in countries with GDP less than Romania compared to countries with GDP at least as the Romanian one.

The fourth research hypothesis is partially sustained, the results for EU membership are in line with those of Cipollina and Salvataci (2011), most of the Romanian pharmaceutical trade has EU partner countries and in contradiction with the findings of Adolfsson (2007). The results for common border sustain the findings of Achay (2006) and they are higher compared to those of Head (2003), for exports even higher than for imports, which sustains the statistical analysis that most of the exports are in the proximity of Romania. The common language is statistically significant at 10% for panel least squares and not statistically significant for robust least squares in the case of imports and it is not significant for Romanian pharmaceutical exports in either models. These results are in contradiction with those of Siliverstovs and Schumacher (2009) and Khodamoradi et al (2018).

The fifth research hypothesis is not sustained, the sign is not negative as expected. This could be explained together with the distance and the common border, for instance, a landlocked country with a convenient distance, like Switzerland, would trade more with Romania and so would do a landlocked country sharing a common border with Romania, like Hungary.

The last research hypothesis is supported, for pharmaceutical exports one of the major drivers is the membership in the former CMEA, sustaining Bussière et al. (2005) findings [7], in line with the statistical results in Table 2.

Based on this study results, the profile of the major suppliers for the Romanian pharmaceutical imports is as follows: countries with significant pharmaceutical exports and a high index of export market penetration, with important health expenditures, with an export orientated economy, situated at a convenient distance from Romania, EU members or associated EU countries. The profile of the major receiving countries for the Romanian pharmaceutical exports is as follows: countries with significant pharmaceutical imports, with a high openness to trade, situated close to Romania, members of EU or former members of CMEA.

Further research should be conducted to discover the determinants at the micro level for the Romanian pharmaceutical trade.

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