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A HYBRID MODEL APPROACH OF ANALYZING THE DYNAMICS OF FDI INFLOWS, EXPORTS AND GDP IN ALBANIA

PRISTUP ANALIZI DINAMIKE HIBRIDNOG MODELA PRILJEVA IZRAVNIH STRANIH ULAGANJA, IZVOZA I BDP-A U ALBANIJI

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Abstract: *This study focuses on the relationship between FDI inflows, exports, together with Gross Domestic Product, for the past 20 years in Albania. A Hybrid model Approach is used while combining the standard vector error correction model (VECM) and Granger causality tests, with Machine Learning models using quarterly time series data to research in both the short-run dynamics and the long-run trends.*

Based on the VECM model with quarterly data, both variables are expected to rise within the next five periods. The impulse exercise reveals that FDI inflows will show more pronounced volatility compared with exports, which will continue with a gradual increasing trend.

The impulse analysis reveals that FDI inflows cause an almost negligible (positive) fluctuation in exports and a (negative) fluctuation in GDP in the long run. Conversely, exports, after a short-term negative impact, lead to an increase in FDI inflows in the long run and a slight increase in the GDP level. Finally, GDP has a positive effect on both variables. The result, therefore, is very important as it suggests that the government should focus on openness, growth and exports—devaluating thus the role of FDI inflows.

Keywords: *Economic integration, FDI; Exports, GDP, time series; causality*

Sažetak*: Ova se studija fokusira na odnos između priljeva izravnih stranih ulaganja, izvoza, zajedno s bruto domaćim proizvodom, u posljednjih 20 godina u Albaniji. Pristup hibridnog modela koristi se uz kombiniranje standardnog vektorskog modela ispravljanja pogrešaka (VECM) i Grangerovih testova uzročnosti, s modelima strojnog učenja koji koriste tromjesečne podatke vremenskih serija za istraživanje kratkoročne dinamike i dugoročnih trendova.*

Na temelju VECM modela s tromjesečnim podacima, očekuje se rast obje varijable u sljedećih pet razdoblja. Impulsna vježba otkriva da će priljevi izravnih stranih ulaganja pokazivati izraženiju volatilnost u usporedbi s izvozom, koji će se nastaviti s postupnim rastućim trendom.

Impulsna analiza otkriva da priljevi izravnih stranih ulaganja dugoročno uzrokuju gotovo zanemarivu (pozitivnu) fluktuaciju izvoza i (negativnu) fluktuaciju BDP-a. Nasuprot tome, izvoz nakon kratkotrajnog negativnog utjecaja dugoročno dovodi do povećanja priljeva izravnih stranih ulaganja i blagog povećanja razine BDP-a. Konačno, BDP ima pozitivan učinak na obje varijable. Rezultat je stoga vrlo važan jer sugerira da bi se vlada trebala usredotočiti na otvorenost, rast i izvoz—devalvirajući tako ulogu priljeva izravnih stranih ulaganja.

Ključne riječi*: Ekonomska integracija, FDI; Izvoz, BDP, vremenske serije; uzročnost*

1. Introduction

Foreign direct investment (FDI) is considered a significant determinant of the economy of any host country, and therefore, many studies have focused on the role of foreign direct investment in these economies. Of particular interest have been the transition economies, although in different stages of

development, all countries are characterized by similar economic situations and similar mechanisms for post-communist economic recovery. FDI plays a very important role for these countries since these foreign investments add knowledge and capital that the host country lacks, they also create new jobs. Regading to the albanian economy, foreign investors have shown an ever-increasing interest in these foreign direct investments, mainly because they are attracted to its potentials in terms of natural resources, geographical position, climate, labor force, etc. In this context, Albania is constantly trying to establish development policies and other important measures to create the most suitable business environment and the most favorable investment climate.

The aim of the study is to empirically assess the short-term and long-term relationship among the variables taken into consideration to arrive at some causal conclusions regarding the impact that Foreign Direct Investments may have on domestic exports and vice versa.

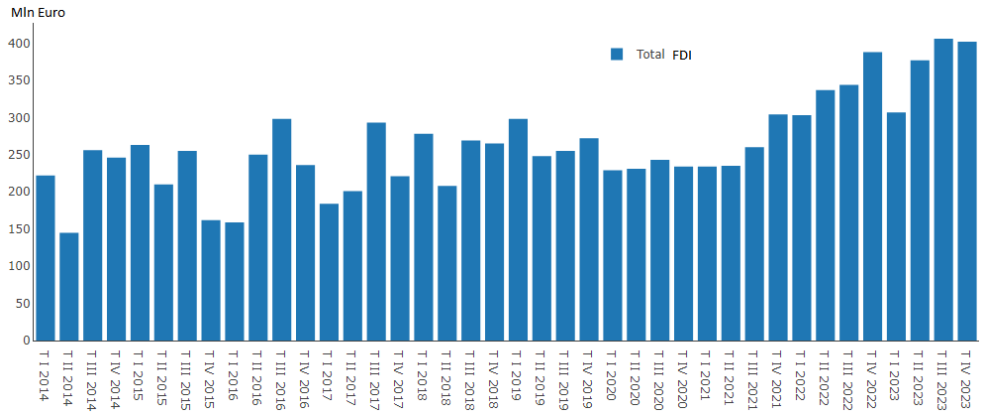
In the case of Albania, particularly, the decisive role played by FDI in the economies of countries in transition, empirical data, made available by institutions like Bank of Albania, Albanian Investment Development Agency-AIDA, INSTAT, etc., are fragmented and not sufficiently stable in the methodology of their collection. One of the most important economic indicators, such as the Gross Domestic Product, turns out to be published in a quarterly series only after 2008. Up to the previous year, the GDP results are published only in an annual interval.

This article consists of seven sections. The first section introduces the reader to the Albanian environment of foreign investments. The second section presents a general framework about previous literature and studies. While in the third section, the methodology used in this study is presented, followed by the fourth section, which details the econometric analysis along with the presentation of data and the empirical implementation and testing of hypotheses. The fifth section presents the results, followed by the limitations of the sixth section. The last section summarizes the conclusion of the study.

1.1 FDI background in Albania

Albania has a good geographical position to benefit from the implementation of international projects and to attract new investors. Referring to data from the Bank of Albania, energy and mining constitute the vast majority of the total stock of FDI, followed by the information and communication sector 16% and financial services 14%. Less than 10% of all FDI in the country is in the field of manufacturing. According to AIDA, (Albanian Investment Development Agency), EU countries remain the main source of foreign direct investments in Albania which in the end of 2020 account for 54.2% of the total FDI stock. The main source countries of foreign direct investment include Switzerland (18.9% of the stock), the Netherlands (16.2%), Canada (12.8%), Italy (9.6%) and Turkey (7.2%).

Figure 1: FDI quarterly flow from 2014-2023 (in million Euro)



Source: Bank of Albania

Through the data provided by INSTAT, it is evident that the pandemic during the year 2020 also impacted the inflow of foreign investments, bringing the investments flow in the Albanian economy to the level of the year 2016. Thus, according to the data, the decline in FDI was by 140 million Euros or 13% less than in the year 2019. It was particularly in the second quarter of 2020 when the closure of economic activity resulted in the greatest fall. Foreign direct investment started the recovery process in the end of 2020 with a total value of 940 million Euro. The industry of mineral extraction and fuel faced the greatest impact during the second the period of 2020, due to the importance that raw materials and especially fuels have on global markets.

The FDI in Albania increased by 37 % that is 1.37 billion Euro in 2022, the previous year.

According to the Bank of Albania, the highest volume of foreign investments in the fourth quarter of 2022 comes from Netherlands—71.8 million Euro—followed by Italy with 37.7 million Euro and Austria with 27.4 million Euro.

The largest volume of investments from non-residents in the fourth quarter of 2022 attracted to the sectors of mining and quarrying, real estate, and finance and insurance, with 66.4 million Euro, 66 million Euro, and 65.8 million Euro, respectively.

2. Literature Review

Previous studies concerning the factors determining FDI in countries in transition have majorly assessed factors such as market size, which are essential for Foreign Direct Investment in economies in transition (Botrić and Škuflić, 2006) and factors of gravity that explain the pattern of FDI in Southeast European countries (Mateev, 2008).

Others are proximity, trade barriers, tax policy and tax incentives, labor costs, and regional integration. Demekas et al. (2005) showed that gravity factors explain a large part of the flows of FDI in transition economies, including Southeast European countries, not being at all forgetful of the business environment and the political environment, which are of great importance for foreign direct investments. Janicki and Wunnava (2004) suggest that international trade is perhaps the most important and determining factor of FDI in countries with economies in transition.

The FDI literature on Albania during the transition period is characterized by some unclear conclusions:

Boriçi and Osmani (2015) investigated the link of FDI on economic growth in Albania. Applying the cointegration analysis of time-series data, they discovered a significant long-run relationship between FDI and GDP growth. They recommended that Albania should invest more in its economy in order to attract more FDI.

Hysa and Hodo (2016) investigated the real effects of FDI on economic growth in Albania through the cointegration method with quarterly data from 1991 to 2012. Empirical findings reveal a great correlation between GDP growth and the ratio of FDI to GDP, thus proving significant support for economic growth.

Beyond these results, Golitsis et al. (2018) tested the effect of remittances and FDI on economic growth, using quarterly data between 1996 and 2014 from the World Bank. Using the Granger causality test and the VAR test, they found that remittances cause economic growth in both the short and long term while FDI appeared to be unrelated to economic growth. This would indeed indicate that transfers from emigration to support their families are much more significant than FDI.

Also, Demeti and Rebi (2014) maintained the argument that FDI does not support the promotion of economic development in Albania. The study used data from the period between 2002 and 2013

and used Pearson's correlation coefficient and Granger's causality test. This study, however, found a positive relationship between FDI and labor productivity, which is the main indicator of economic development. The reasoning for this was that the most productive sectors of Albania have attracted more FDI during this period, bringing as an example the hydropower sector, which occupied a substantial part in Albania's FDI stock during this period.

Recently, Hobbs, S., Dimitrios P., and Mostafa E. A. (2021), evaluated the case of Albania with annual data collected from 1992 to 2016 and proved the existence of long-run relationships between trade, economic growth, and FDI. They proved that exports were more effective in stimulating economic growth than FDI, because, according to VECM tests, the dependence of exports and GDP growth was more significant. In conclusion, while their study failed to establish causality from FDI inflows to exports, support for reverse causality from exports to FDI inflows is strong. This result seems to corroborate the assertion that Albania's increasingly open trade policies have been attractive to foreign investors. This is most likely because trade liberalization is simultaneously associated with higher exports and FDI inflows.

In general, in the case of Albania, the empirical results are unclear and the role of FDI inflows in economic growth or development as well as in the impact on the host country's exports is not clearly predicted. On the other hand, most findings suggest that economic growth and development cause increased FDI inflows.

Albania's commercial policies can be characterized as promoting exports. As the trend in most transition economies show, when FDI increases, so do exports. Therefore, research on the relationship between FDI, trade, and GDP will help to understand the effectiveness of Albania's open trade policies more appropriately than the narrow research between FDI and GDP.

The limitations associated with previous studies are due to the fact that the time series span is relatively small since these research are mostly based on annual data, which results only in a few observations. Such small data does not allow to put in the model a sufficient number of variables that would help in better explanations of how macroeconomic variables interact with each other, as well as provide more reliable results from econometric tests.

3. Methodology

Although many studies have investigated the link between FDI, economic growth, and exports, there have been very many difficulties in quantifying this relationship due to the use of various econometric methods and explanatory variables, which are often unique for new studies, and as a result, this leads to biased results and controversy over the interpretation (Sapienza, 2010).

Since studies on the case of Albania have provided ambiguous results for the relationship of the above variables, and there are still few studies that found that there may be a bidirectional or endogenous relationship of FDI, the interest in deepening these relations in more details and up to date data is used to test the relationship and impact between FDI, exports and economic growth using the same econometric methods, which will lead to a better understanding of the causal influences between the variables.

The following research questions can shed more light on a better understanding of the impact between FDI, exports and economic growth for this particular economy:

- H1: What is the impact of FDI inflows and economic growth in GDP on Albanian exports?
- H2: And what are the effects of exports and GDP on FDI inflows?

We will answer the above questions using a general macroeconomic model with the above variables.

$$\text{Exports} = f(\text{Exports}-k, \text{IHDt}-k, \text{GDPt}-k)$$

$$\text{IHDt} = f(\text{IHDt}-k, \text{Exports}-k, \text{GDPt}-k)$$

Where FDI represents the incoming flows of Foreign Direct Investments measured in millions of Euro; Exports represent economic openness; GDP is Gross Domestic Product, measured by time unit t.

Firstly, the time series data will be tested for unit roots, then Granger causality will be tested between the variables, as well as co-integration and the Error Correction Model (VECM) to investigate the short- and long-run relationships between FDI- ves, exports and economic growth. Secondly, Machine Learning models such as Decision Tree Regression and recurrent neural networks (RNNs), will be carried out on the same variables.

The general VECM model can be written as follows:

$$\Delta Y_t = \alpha_0 + \sum_{j=1}^{k} \beta_j \Delta Y_{t-j} + \sum_{j=1}^{k} \delta_j \Delta X_{t-j} + \phi_1 Z_{t-1} + \varepsilon_t$$

where Z is the error correction term (ECT) and represents the OLS residuals from the long run cointegration regression. This model can be expressed in two equations according to the two hypotheses presented above:

$$\Delta \ln Exp_t = \alpha_1 + \sum_{j=1}^{k} \beta_{11j} \Delta \ln Eksp_{t-j} + \sum_{j=1}^{k} \beta_{12j} \Delta \ln IHD_{t-j} + \sum_{j=1}^{k} \beta_{13j} \Delta \ln PBB_{t-j} + \phi_1 ECT_{t-1} + U_{1t} \quad (1.1)$$

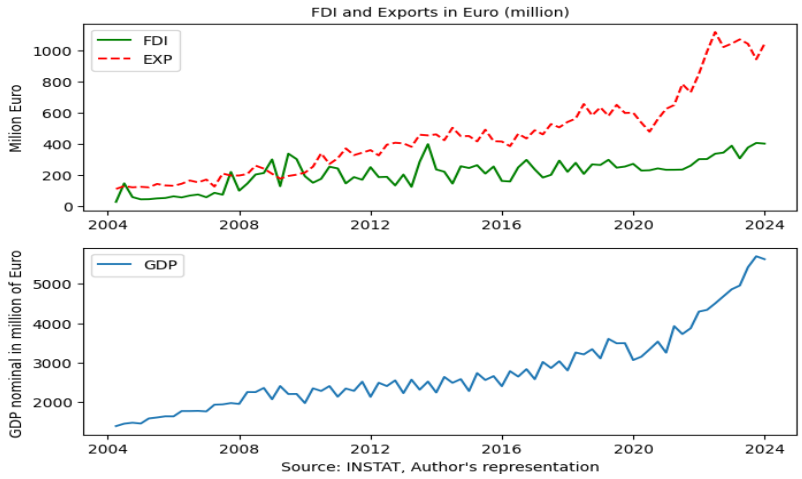
$$\Delta \ln IHD_t = \alpha_2 + \sum_{j=1}^{k} \beta_{21j} \Delta \ln IHD_{t-j} + \sum_{j=1}^{k} B_{22j} \Delta \ln Eksp_{t-j} + \sum_{j=1}^{k} \beta_{23j} \Delta \ln PBB_{t-j} + \phi_2 ECT_{t-1} + U_{2t} \quad (2.1)$$

Where α_1 and α_2 are the constants of the two equations and ECT_{t-1} is the error correction term with a delay period, where *k* denotes the length of the delay, while βj and ϕj are the coefficients to be estimated and *Ut* represents the uncorrelated disturbance terms. Note that the error correction term is related to the fact that the deviation of the last period from the long-run equilibrium affects the short-run dynamics of the dependent variable. Thus, the ECT coefficient, ϕ, measures the speed at which the dependent variable returns to equilibrium following a change in the independent variable.

3.1. Data Description

The analysis in this study is conducted using secondary data, made available from the Bank of Albania, INSTAT, and AIDA. The data used are quarterly (n = 80) starting from the first quarter of 2004 to the fourth quarter of 2023. This means that, unlike previous studies, which were based on annual data of the two post-communist decades, we can add more detailed and qualitative information thus enabling statistically more reliable results due to the higher number of observations used. The time-series data for GDP are presented in millions of the national currency and are not seasonally adjusted. For the period 2004-2007, the data have uniform distribution, as quarterly measurements of the GDP in Albania started to be available from 2008 onwards. The other variables employed include FDI and total quarterly exports given in millions of Euro from the first quarter of 2004 to the last quarter of 2023 as shown in Figure 2, below.

Figure 2: Quarterly Flows of FDI, GDP, and Exports.



Source: Bank of Albania, INSTAT, Author's representation

4. Empirical Analysis

To assess whether the variables are stationary or not, the Augmented Test Dickey and Fuller (1979) is used. Meanwhile, to see if the variables are co-integrated, that is, if there is a long-term relationship between the variables, Johansen's test (1988) and Stock and Watson's test (1988) were used. Using the VECM model, the long-term equilibrium after a shock to the independent variables is studied, and finally, the short-term dynamics between the variables under study are evaluated using the Granger test of causality to determine the direction of causality between them.

4.1.1 The ADF test for stationarity

The variables need to be stationary, which means that each variable needs to be tested for the existence of a unit root, and this is done by the Augmented Dickey–Fuller test.

The null hypothesis is based on the fact that for any series, the series is non-stationary because it has a unit root. The alternative hypothesis states that the series is stationary, so it does not have a unit root. Therefore, in order to reject the main hypothesis, one should have that the ADF t-statistic is less negative than the critical value for any chosen level of significance.

We can see in the Table 1 below that for the data at the current level of significance, the null hypothesis cannot be rejected since the t-statistic is greater than the critical values (5%) for all the three variables tested. These variables can be stationary in their first order difference.

Table 1. ADF Test for of unit root for FDI, Exports, GDP.

Dependent Variable	Null Hypothesis	t-Statistic	Prob.	Result
EXP_EUR at level	Unit root	0.522534	0.9865	yes
D(EXP_EUR) first difference	Unit root	-11.34246	0.0001	no
GDP_EUR at level	Unit root	2.682207	1.0000	yes
D(GDP_EUR) first difference	Unit root	-4.676948	0.0000	no
FDI_EUR at level	Unit root	-3.492889	0.0107	yes
D(FDI_EUR) first difference	Unit root	-8.916650	0.0000	no

Source: Author

4.1.2 Cointegration test

From the above fact that our time series are first-order integrated, the cointegration test by Johansen has been applied to check whether there is a long-run relationship between the variables. In this regard, the following two tests have been carried out: the *trace rank test* and the *maximum eigen value* test.

The null hypothesis is that cointegration does not exist, so r = 0. The alternative hypothesis says that at least one cointegrating relationship is present.

The second basic null hypothesis is that there is at most one cointegrating equation: r = 1. Its alternative hypothesis would be that there is more than one cointegrating equation. The basic null hypothesis will be rejected if the trace statistic would be less than its critical value. On the other hand, if the trace statistic is greater than its critical value, then the basic null hypothesis is rejected.

Table 2, shows the result of a test of the three first-order series for cointegration in the third rank between them. Since the t-statistic values exceed the critical values under the alternative hypothesis of more than one cointegrating equation, this alternative is accepted, showing that there are three cointegrating first-differencing equations of one lag.

Table 2. Cointegration Rank Test

Unrestricted Cointegration Rank Test (Trace)				
Hypothesized		**Trace**	**0.05**	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.506561	103.5160	29.79707	0.0000
At most 1 *	0.359202	49.83293	15.49471	0.0000
At most 2 *	0.189946	16.00978	3.841466	0.0001
Trace test indicates 3 cointegrating eqn(s) at the 0.05 level				
Unrestricted Cointegration Rank Test (Maximum Eigenvalue)				
Hypothesized		**Max-Eigen**	**0.05**	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.506561	53.68305	21.13162	0.0000
At most 1 *	0.359202	33.82316	14.26460	0.0000
At most 2 *	0.189946	16.00978	3.841466	0.0001
Max-eigenvalue test indicates 3 cointegrating eqn(s) at the 0.05 level				
** denotes rejection of the hypothesis at the 0.05 level*				
***MacKinnon-Haug-Michelis (1999) p-values*				

4.1.3 VECM Model

According to Johansen's testing, there exists cointegration between FDI, exports, and GDP. It is possible to come up with an estimate of the speed of adjustment in the long-run equilibrium of variables after a shock through error correction (ECT), which should be negative and have a value higher than 5% of critical value of significance.

The VECM's coefficient estimations between FDI, exports, and GDP when applied on equations 1.1 and 2.1 can be reformulated in:

$$D(LOG\_EXP)=(-0.003764)(LOGEXP(-1)-5.326LOGFDI(-1)+6.952LOGGDP(-1)-32.7837)+(-0.247951)D(LOGEXP(-1))+(0.003)D(LOGFDI(-1))+(0.729D(LOGGDP(-1))+(0.020213) \quad (1.2)$$

D(LOG_FDI)=(0.060407)
(LOGEXP(−1)−5.326LOGFDI(−1)+6.952LOGGDP(−1)−32.783)+(0.766264)
D(LOGEXP(−1))+(−0.284814)*D*(LOGFDI(−1))+(0.4626)*D*(LOGGDP(−1))+(−0.006729) (2.2)

From the test results, the error correction term when FDI inflow is the dependent variable is negative (-0.341541) and statistically significant [t=-3.18074< -1.96] indicating a long-term impact of exports to FDI. A shock to exports causes FDI to recover by approximately 34% per quarter, reaching the equilibrium after three periods. On the other hand, the error correction term when the dependent variable is the flow of exports, is positive and statistically insignificant, which shows that there is no long-term impact of FDI towards exports.

The same case is observed for the relationship between FDI inflows and GDP where the error correction term when the dependent variable is FDI inflow is negative −0.295145 and statistically significant [t= −3.71067< -1.96] and indicating a long-term impact of GDP towards FDI. A shock in GDP causes FDI to recover by approximately 30% per quarter, reaching equilibrium after three periods. On the other hand, the error correction term when GDP is the dependent variable, although it is negative, results statistically less insignificant, indicating that there is a weaker (4%) long-term impact of FDI towards GDP.

So, from the analysis of the used model-VECM, it results that FDI inflows do not have a long-term impact either on the level of exports or on economic growth-GDP. On the contrary, both exports and Albanian economic growth have a long-term impact on FDI inflows.

4.1.4 Granger Causality Test

Through Granger causality tests we can investigate the existence of causality in the short term between FDI, exports and GDP.

From Table 3, the null hypothesis stating that FDI does not cause Exports, cannot be rejected, since the F statistic is below the critical value and the probability is above 0.05. On the contrary, the null hypothesis stating that Exports do not cause FDI, can be rejected, since the F statistic is above the critical value and the probability is below 0.05.

Table 3. Granger causality test for Exports and FDI

Null Hypothesis:	Obs	F-Statistic	Prob.
LOGEXP does not Granger Cause LOGFDI	78	7.98156	0.0007
LOGFDI does not Granger Cause LOGEXP		0.00253	0.9975

Source: Author

From Table 4, below, the causality relationship remains as in the case of GDP and FDI, only in contrast, the causality relationship from FDI to GDP is not very important relative to the second hypothesis rejected convincingly.

Table 4 Granger causality test for GDP and FDI.

Null Hypothesis:	Obs	F-Statistic	Prob.
LOGFDI does not Granger Cause LOGGDP	78	3.10285	0.0509
LOGGDP does not Granger Cause LOGFDI		6.30378	0.0030

Source: Author

As for the short-term relationship between Exports and GDP, in Table 5, the causality relationship from economic growth, GDP, to exports is very strong, but this does not reverse the direction since the basic hypothesis that Exports cannot be rejected do not cause GDP.

Table 5. Granger causality test for GDP and exports

Null Hypothesis:	Obs	F-Statistic	Prob.
LOGEXP does not Granger Cause LOGGDP	78	0.22025	0.8028
LOGGDP does not Granger Cause LOGEXP		13.5835	1.E-05

Source: Author

Thus, from the above, there exists a one-way flow of causality from Exports to FDI and from GDP to exports. However, bi-directional causality has been established only in the combination between GDP and FDI inflows, which, is not very strong.

4.2 Machine Learning: Random Forest Regression and Recurrent Neural Networks (RNN)

Random Forest Regression is a popular machine learning algorithm that works well with cross-sectional data and holds robustness against outliers and over-fitting and may not be the best-fit model to apply to time series data; however, it can still be applied to time series data that exhibit simple patterns and when the other models fail to perform well. Applying this model to the actual data, we can conclude that it performs quite well with the test data, thus it remains a good estimator.

Table 5. Random Forest Regression Test for FDI, Exports, GDP.

Dependent Variable	Independent Variable	Accuracy on test train data	Accuracy on test data (R2 score)
EXP at level	FDI, GDP	0,99	0.85
FDI at level EXP, GDP		0.96	0.84

Source: author

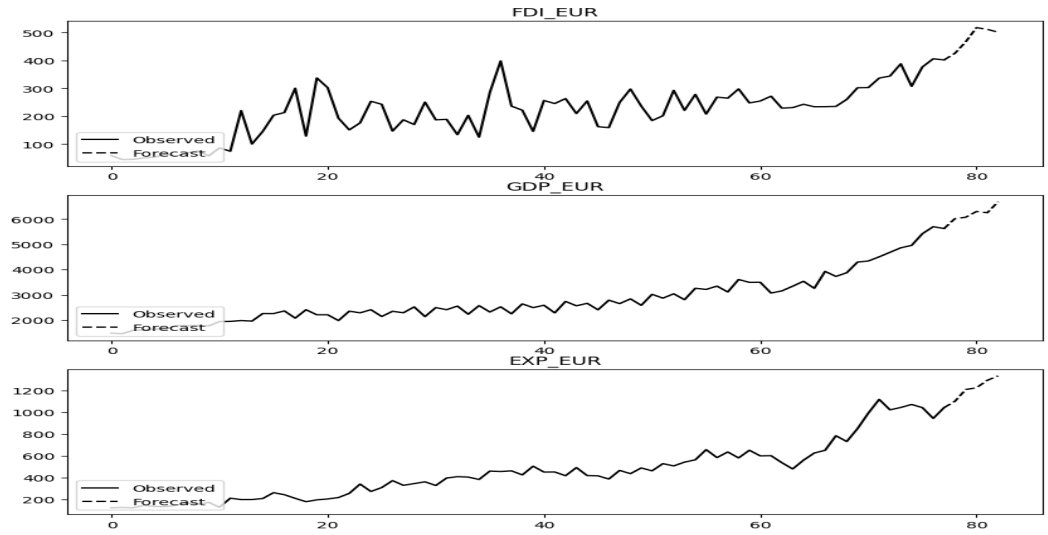
A drawback of Random forest is that it does not explicitly model temporal dependencies that characterize time series data, so it may not capture the sequential patterns in the data very effectively.

Recently, a powerful tool of deep learning used for time series forecasting is the Recurrent Neural Networks (RNN). It models the temporal dependencies present in the data as it contains an implicit memory of previous inputs. Hence, it can handle sequential data of varying lengths, capturing long-term dependencies and temporal patterns effectively. Surprisingly the test outcome (negative R2) of RNN suggests that this model is performing very poorly and is worse than the basic linear model. This could be due to incorrect specification of the model, insufficient or noisy data.

5. Results

The VECM model for quarterly data predicts an upward trend for all three variables in the next 5 periods; however, FDI inflows are characterized by greater fluctuation compared to exports that are also expected to continue growing.

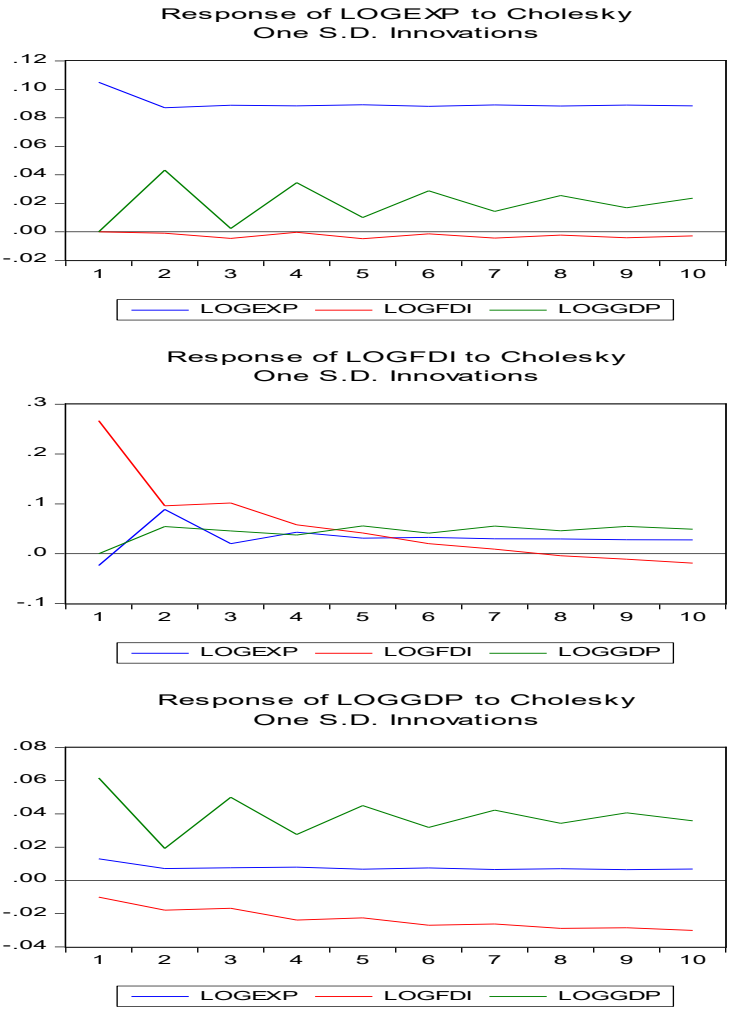
Figure 3. VECM forecast for the next 5 periods of each time series:



Source: INSTAT, author's calculation

Finally, in Figure 4, we see how the effect caused by the change of one variable on other variables will be in the long term (10 periods).

Figure 4. Response of the variables to the impulse changes in each of them in the next 10 periods.



Source: Author

The impulse analysis reveals that FDI inflows (in red line) cause an almost negligible fluctuation in exports in the top graph and a (negative) fluctuation in GDP in the long run as shown in the bottom graph. Conversely, exports (in blue), after a short-term negative impact, lead to an increase in FDI inflows in the long run (shown in the middle graph) and a slight increase in the GDP level. Finally, GDP (shown in green line), has a positive effect on both variables. The result, therefore, is very important as it suggests that the government should focus more on trade openness, growth and exports—devaluating thus the role of FDI inflows.

6. Limitations

A problem encountered with studies that have used different secondary data for different countries is their instability as a result of different methods of data collection. Data quality from countries under transition is also not guaranteed. This leads to the fact that the same studies carried on the same countries to result in controversial conclusions.

The fact that the analysis of the model used (VECM) indicates that the FDI inflows do not have a long-term impact either on the level of exports or on economic growth (GDP) is probably related to the content of these investments. In fact, most of the FDI stock is invested in the energy sector (while the domestic demand for energy is steadily increasing) and in hydrocarbon-mining sector which is focused on mineral extraction rather than in investing in the processing tecnology of these minerals.

7. Conclusion

In contrast to prior studies, which relied on truncated annual data, this study uses more detailed and better quality information with quaterly data, thus enabling statistically more reliable results from the higher number of observations used.

The analysis with the VECM model indicates that FDI inflows do not have a long-term impact either on the level of exports or on economic growth (GDP). On the contrary, both exports and economic growth have a long-term impact on FDI inflows. This relationship is also verified by Granger causality tests for the short term which showed causality in only one direction.

When applying the same data to machine learning models such as Random Forest Regression, we can still obtain high accuracy in data prediction even though, a more appropriate model such as the Recurrent Neural Networks (RNN) fails to perform well on the same data.

These results constitute an important information for policy-making as it supports the idea that the focus of government policies have been oriented towards economic opening and export growth, thereby undervaluing the role of FDI inflows.

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