MACROECONOMICS

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FORECASTING THE INVESTMENT ENVIRONMENT

Assessment and forecasting of the investment environment are of great importance for both the country and the investors. Investments are used for the creation of new value in different sectors not only to start productions, but also upgrade the existing ones. If the country's investment environment is attractive and predictable for the investors, the risks are less for the investors who may face them during their investment activities. To control and ensure investment activities in place, different countries adopt several laws to make it happen. In the Republic of Armenia to control the investment activities the RA Law "On Investment Fund" was adopted in 2010. By different economists and researchers over 500 factors have been found which can affect the investment environment, but for the investors first of all it is important to understand the trend of the investments in the country and the future of it. That gives lots of information about the country's investment environment. In this article, ARIMA time series forecasting model has been used to forecast the volume of investments in the Republic of Armenia until 2027. The results have shown that with the current dynamics, the volume of investments can reach up to 2.5 billion US dollars.

Keywords: *investment, forecasting, investment environment, ARIMA, seasonality*
JEL: E22, C23
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INTRODUCTION. In recent years, various analyzes have been carried out with great momentum, in which different types of models have been used: regression, classification, decision-making and time series evaluation. In this

work, an attempt is made to apply ARIMA model but due to finding seasonality in time series, SARIMA time series forecasting model has been estimated, which makes it possible to forecast the volume of investments in the RA until 2027. There hasn't been any reseach in Armenia yet, in which an attempt is made, using these models, to predict the volume of investments in the future. After the coronavirus crisis, the volume of investments in Armenia registered a sharp increase and even at the end of 2022 it recorded the historical maximum in the amount of 998 million US dollars. The forecast of this macroeconomic indicator has become more urgent, which will enable various specialists and investors to get information about the volume of investments in the RA in a more transparent way and make a choice of investment strategy.

LITERATURE REVIEW. Forecasts of the volume of investments using the ARIMA type models can be found in the works of a number of foreign analysts and economists. This study has been developed using these works, but some additions or changes have been made, which will be more descriptive on the example of the Republic of Armenia.

J.Du Preez and S.F. Witt's work entitled "Univariate and Multivariate Time Series Forecasting: An Application to Tourism Demand", published in 2003, played a huge role in the creation of this paper. That was one of the first articles where an attempt to forecast FDI flows using ARIMA models was made. It gave detailed information about the specifics of forecasting FDI and what parameters to use.

The article – "Foreign Direct Investment (FDI) Dynamics in India" (2019), written by T. Nyoni and L. Muchingami used both previous and some other works to modify the forecast of FDI by ARIMA models. Another article written by P.W.L. Prasanna in 2015 entitled "Modeling and Forecasting Foreign Direct Investment (FDI) into SAARC for the Period of 2013-2037 with ARIMA" gave theoretical and practical explanations to forecast by up to 20 years. But in this study we have tried to forecast only till 2027.

The paper "The Analysis of Investment Environment and Foreign Direct Investment Prognostication: Lithuanian Case", which was published in November 2015 aimed to forecast the FDI inflows in Lithuania. The author L.Gaspareniene tried to forecast the FDI inflows by creating a linear function of the FDI trend. That can be a good start for the linear regression analysis which can be applied to the results of this article too.

In 2004 Investment Climate Research Team in the World Bank was created and afterwards each year numerous works and articles which cover global, territorial or country-wise analyses have been published. Numerous surveys such as Foreign Investor Pulse, FDI Watch or Global Pulse surveys provide each year, on a monthly or quarterly basis, enourmous information about the changes happening in global and territorial investment climates and the factors which affect it.

RESEARCH METHODOLOGY. The data on the volume of investments in the Republic of Armenia have been collected from the World Bank database. It includes information from 1990-2022. The data could not remain on an annual basis, as 33 rows of data were not enough to make a quality forecast, so an artificial increase of the data series was carried out by means of exponential interpolation. This method was chosen to minimize autoregression and autocorrelation with respect to previous lags. The scikit-learn and statsmodels statistical libraries of the Python programming language and their sub-indicators were used, which made it possible not only to carry out a forecast, but also to evaluate the quality of the forecasted model, in particular, full and partial autocorrelation detection testing was implemented, as well as time series decomposition was carried out, thanks to which seasonality was revealed in the time series and also a lot of collected data were not considered as an outlier. Afterwards an ARIMA model was estimated but as seasonality was found in the data as a result, the SARIMA model was evaluated. After the evaluation of the model, a visualization of the obtained results has been carried out, in which the dynamics of the volume of investments in the RA until 2027 can be seen.

ANALYSIS. As we have mentioned, in this work, forecasting has been carried out using the ARIMA time series forecasting model.

The ARIMA time series forecasting model simultaneously estimates both the autoregressive (AR) and moving average (MA) components of the time series. And after combining both of the estimates, the final results are being shown. Before running the ARIMA model, there is a need to perform some analytical tests to better understand the pattern of the data and what is hidden under it. Those tests will help to discover whether there is a seasonality in the time series or correlation between the following years or lags. The greater the connection, the more useless the results are, as they become too predictable from the previous years' results and thus other variables will affect them in a more «chaotic» way, which is too risky for the investors. To reveal whether there is any seasonality in time series or not a decomposition test has been carried out and shown in the 3rd graph.

From Figure 1, it can be assumed that changes in investment volumes in Armenia have a seasonal nature. There will be no seasonality in time series, if in the third graph we have a horizontal line which refers to 0 value. The trend of the time series is shown in the second graph. As we can see, it is like an actual series. After the exclusion of the trends and seasonality, the results can be seen in the fourth graph which represents the time series without the outliers. Outliers can play a huge role in the approximation of the results and thus make them useless. They can sparse the results from reality and the results can be unrealistic. As it can be seen, the high values of 1999 and 2008 were preserved, but the record value of 2022 was not preserved. Then, autocorrelation and

partial autocorrelation graphs have been drawn, which will enable to understand the degree of connection of each year with the previous periods.

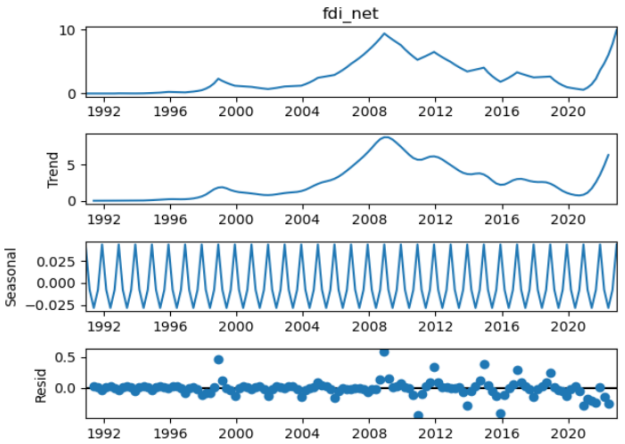

Figure 1. ***Time series decomposition (author's calculations with Python)***

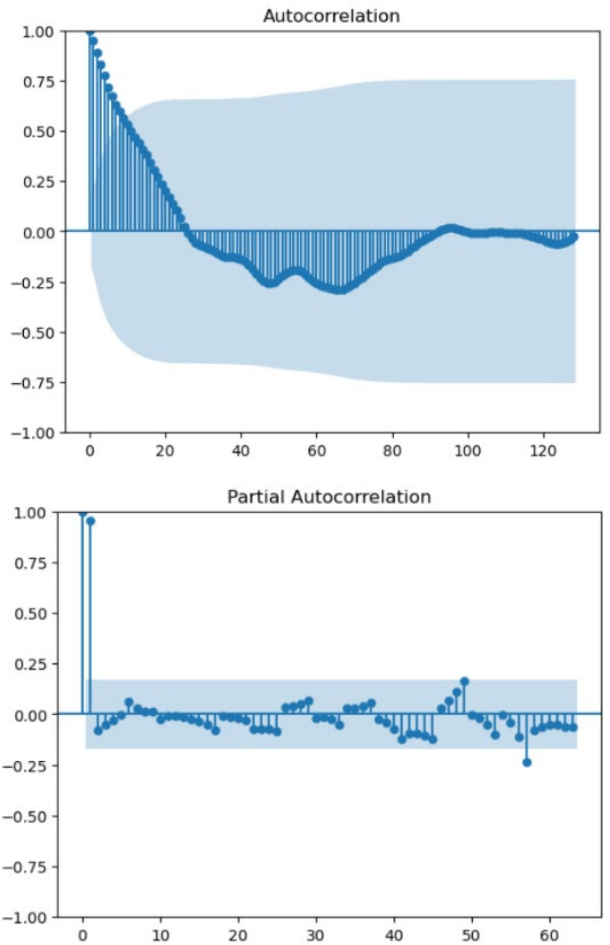

Figure 2. ***Autocorrelation and partial autocorrelation graphs***

Autocorrelation shows the relationship of each period to all previous periods, and partial autocorrelation shows the same, but excludes different effects in previous lags. From the estimation it can be understood that from the first lag a sharp decline is happening as the first lag's correlation always equals to 1. The estimation process of the ARIMA model should be started from the lag after which the sharp decline happened. Looking at the results of the autocorrelation and partial autocorrelation tests, the correlation between the previous years' results and the actual results is low or does not occur at all. It can be both a good and a bad sign. On the positive side, there is no need to worry about having overfitting data, which can lead us not to continue with the estimation of the final model because of having sparse and unrealistic results. The negative side is that there may be non-linear relationships in different time periods, which require the evaluation of more complex models and a test, which can be carried out by such models, as Gradient Boosting, XGboost, etc. These models give the importance levels of different affecting factors on the dependent variable.

Looking at the results, the ARIMA model can be estimated. It is necessary to remember that seasonality has been found in the time series which leads us to estimate SARIMA model instead, which is a specialized model to work with the seasonal time series.

When working with ARIMA or SARIMA models, it is crucial to make appointments. An Auto-ARIMA test has been performed where the model itself will generate the optimal p,d and q values which will be suitable for the data set to provide better forecasting.

Table 1

Results of the Auto-ARIMA testing

```
Performing stepwise search to minimize aic
 ARIMA(2,2,3)(0,0,0)[0]             : AIC=14.446, Time=0.13 sec
 ARIMA(0,2,0)(0,0,0)[0]             : AIC=13.045, Time=0.02 sec
 ARIMA(1,2,0)(0,0,0)[0]             : AIC=15.044, Time=0.02 sec
 ARIMA(0,2,1)(0,0,0)[0]             : AIC=15.044, Time=0.03 sec
 ARIMA(1,2,1)(0,0,0)[0]             : AIC=17.044, Time=0.04 sec
 ARIMA(0,2,0)(0,0,0)[0] intercept   : AIC=14.441, Time=0.04 sec
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If we take out the options with p and q values being 0 which are not significant to observe, the best remaining option is to estimate the model with (2,2,3) order.

There are three meanings:

- p, which is the order of the AR component. In our model, it will be 2, because after the 2nd lag there is a decline,
- d, which indicates the degree of differentiation made in the dataset, it will be 2,
- q, which is the order of the MA component, this one will be 3.

Thus, a SARIMA type model with (2,2,3) designations has been evaluated.

Table 2

Results of the SARIMA model

Dep. Variable:		fdi_net	No. Observations:			129
Model:		ARIMA(2, 2, 3)	Log Likelihood			-1.223
Date:		Thu, 02 May 2024	AIC			14.446
Time:		12:07:41	BIC			31.511
Sample:		12-01-1990	HQIC			21.379
		- 12-01-2022				
Covariance Type:		opg				
	coef	std err	z	P>|z|	[0.025	0.975]
ar.L1	-0.9136	0.335	-2.724	0.006	-1.571	-0.256
ar.L2	-0.5482	0.271	-2.025	0.043	-1.079	-0.018
ma.L1	0.9921	0.326	3.044	0.002	0.353	1.631
ma.L2	0.7306	0.295	2.480	0.013	0.153	1.308
ma.L3	0.2862	0.071	4.051	0.000	0.148	0.425
sigma2	0.0595	0.003	18.497	0.000	0.053	0.066
Ljung-Box (L1) (Q):		0.05	Jarque-Bera (JB):			655.31
Prob(Q):		0.82	Prob(JB):			0.00
Heteroskedasticity (H):		2.17	Skew:			-2.25
Prob(H) (two-sided):		0.01	Kurtosis:			13.17

Looking at the results of estimated model, we can see that the ar.L1, ar.L2 indicators are respectively equal to -0.9136 and -0.5482, from which it can be concluded that if the volume of investments increases then in the next time period the investments will decrease and vice versa, and the size of the indicator's volume is in direct ratio with its effect. The positive values of the ma.L1 and ma.L2 indicators show a positive deviation from the expected value in the previous period to a positive increase in the current value. The components of the autoregression (AR) do not exceed the confidence interval, thus they can be used but the moving averages are greater than 0.05. The Ljung-Box coefficient exceeds 0.05 threshold and is equal to 0.05 which means that the null hypothesis of not having autocorrelation in the time series is being accepted.

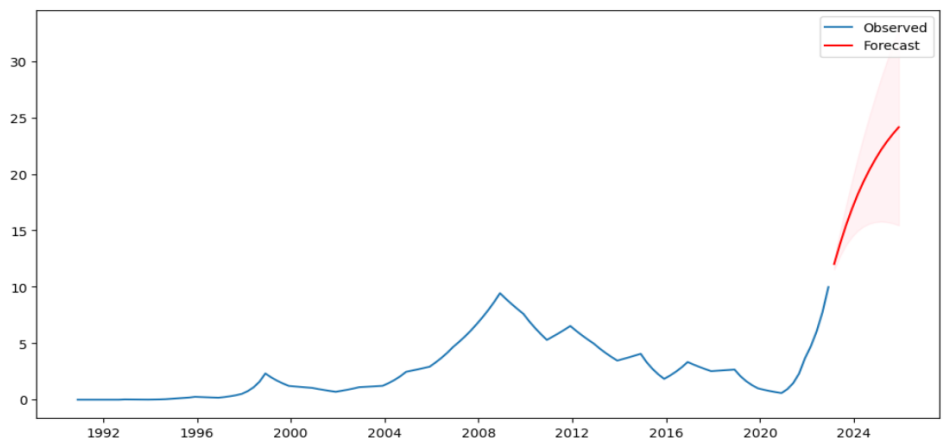

Figure 3. ***Forecasting the volume of the RA investments until 2027 using the SARIMA model***

Having these values, the final result can be visualized, which will show the future values of the volume of investments and their direction. It will depict the volume of future investments until 2027. If depicted further, the values will be unmanageable and unapplicable for study, as ARIMA models are not programmed to show results for more than 5 years. It can be seen that the forecasted part has a ratio which shows the situational range of the forecasted values. The range of the forecasted results are from 1.5 bilion to 3.2 billion US dollars. This gives an opportunity to be more ready for the upcoming developments.

Taking into account the sharp growth that started in 2021 and the record indicator recorded in 2022, such a picture becomes conceivable. This figure shows the trend of the data already available until 2027, but it needs to be redrawn when the 2023 and 2024 values are available, which, given the seasonality in the data, will try to give a more realistic picture, but now it predicts growth at a similar rate in 2027 up to 2.5 billion US dollars but as we have mentioned above the range of the forecasted results are from 1.5 billion to 3.2 billion US dollars which also indicates a record value for the FDI inflows in the Republic of Armenia.

CONCLUSION. Summarizing the results, we can say that it was quite interesting to reveal the fact that the investments in the RA have a seasonal nature. It couldn't be seen just by looking at the time series, but the test with the time series decomposition was able to show it. Thus, there is a need to work out different strategies for different time periods to attract investments. The war and crisis situations at the beginning of the 90s of the previous century can be considered exceptions, because it was impossible to provide such an investment environment in the Republic of Armenia under these conditions. The RA Law "On Banks and Banking Activities" was adopted in 1995, and until November 1993, the Soviet ruble was in circulation. All this could not remain without consequences and creating and providing an investment environment at that time was simply next to impossible. In 2008, the volume of investments crossed the threshold of 900 million US dollars, which was the highest of all the previous indicators. That figure was surpassed only in 2023, when the volume of investments was 998 million US dollars. After 2020 coronavirus crisis, the volume of investments in the Republic of Armenia increased sharply, but in order to give a more precise forecast, it is necessary to have the next time period's result of the sharp increase to be able to present the trend of the investments and to forecast the dynamics. In this case, if the dynamics in 2024 continues like it was before 2023, the volume of investments in the Republic of Armenia can confidently reach the figure of 2.5 billion USD in 2027.

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