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MEASURING THE MACROECONOMIC IMPACT OF ECONOMIC DIPLOMACY USING VARFIMA MODEL FOR CROATIA 1990-2018

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ABSTRACT. Solving economic issues in international relations has historically become an inseparable part of diplomatic theory and practice. The consequence of the latest speed-up in trade globalization and liberalization is the increased competition on both domestic and foreign markets. Thus, the states which do not have a built-up concept of economic diplomacy cannot have a proactive role in their relationship with other countries, but become the object of other countries' economic diplomacies. Given the importance of economic diplomacy's action in solving economic issues in international relations, we empirically measure its impact on the most important macroeconomic indicators in the Republic of Croatia by means of applying the MLE (maximum likelihood estimation) method. As the primary macroeconomic aggregates are by their nature fractionally integrated, this assumption was the threshold for applying the empirical VARFIMA model based on fractionally integrated data. The primary dependent variables in the VARFIMA model were different macroeconomic indicators – industrial production, unemployment, inflation, export. We find a positive link between economic diplomacy and macroeconomic performance of Croatia during 1990-2018.

JEL Classification: FO2, F47, F55, C14

Keywords: economic diplomacy, macroeconomic aggregates, VARFIMA modeling, long memory, Croatia.

Introduction

Previous research studies on economic diplomacy were based on the qualitative approach, i.e., theoretical research concepts, while the quantitative research aspect was neglected, primarily due to the lack of data for quantitative measurements in this area. Due to this reason, in this paper, the research will be based on quantitative methods of economic diplomacy research, primarily on the econometric model, which will try to measure the impact of economic diplomacy on a particular country's economics.

The empirical part of the research will be conducted by means of applying MLE (maximum likelihood estimation) method, while the impact of economic diplomacy on the most

important macroeconomic indicators in the Republic of Croatia will be observed. Structural relations will measure the causality between Croatian economic diplomacy intensity and the fundamental macroeconomic indicators. The assumption that the primary macroeconomic aggregates are by their nature fractionally integrated will be the threshold for the application of the empirical model based on fractionally integrated data. The empirical part of the research will thus simultaneously encompass the structural relation and the fractionally integrated relation, which automatically selects the models which can be applied to the suggested empirical research, this being the VARFIMA model. Through such an empirical research the H_1 hypothesis will be tested: Is it possible to measure the impact of economic diplomacy on the movement of fundamental macroeconomic indicators by means of VARFIMA model.

Being directly linked to the research problem, research object and the set hypothesis, the objective of this research is to provide theoretical and practical contribution to understanding the model of conduction and action of the economic diplomacy model and its effect on macroeconomic indicators' movement. Due to the lack of empirical research on this topic, a contribution to economic diplomacy as a wide-range topic is expected. Among a rather limited number of empirical research we should mention though Ruel and Zuidema (2012), Rose (2007), Yakop and Bergeijk (2009), Moons and Bergeijk (2013) as they provide evidence on the positive impact of economic diplomacy on macroeconomic performance. Our study advances a new state-of-the-art model to study economic diplomacy's impact on macroeconomic performance based on long memory and the fractional integration approach.

After introducing the study's topic, we present a theoretical background behind economic diplomacy and macroeconomic performance. In section two, we present data and methodological framework we have been using for this study. The next section discusses the study results and empirical evidence we provide on the link between economic diplomacy and the country's macroeconomic performance. The conclusion section presents the main findings of our research and the limitations of the study along with the guidelines for further research on this topic.

1. Literature review

Ruel and Zuidema (2012) conducted empirical research on the effect of economic diplomacy on the example of Dutch embassies and consulates. Their concluded shows that the most effective embassies and consulates are those in which the structure/network of economic diplomacy is clearly established and well organized. Where the most significant number of employees have a multiple-year experience, i.e., they are teams of people performing an established work for a more extended time.

Rose (2007), Yakop and Bergeijk (2009), Moons and Bergeijk (2013) conducted empirical research on the impact diplomatic missions abroad have on the range of international trade, export and attracting investments, and they proved the causal link of “more active” diplomatic missions and the increase in international trade and export (Chi-Wei et al., 2019). Namely, Rose proved a statistical increase in export of 6 to 8% on export markets where the diplomatic missions were above the average effective. In contrast, Moons and Bergeijk (2013) proved that embassies have a significantly higher contribution to the increase of international trade and investments than consulates and other foreign missions.

Previous research on reaching legal suggestions and their causation to macroeconomic aggregates and quantitative research on the impact of economic diplomacy on economic growth are practically non-existent. In this sense, the threshold for the establishment of the model was the research studies on the causation between economic expectations and enforcement of laws in parliaments (research by Durr et al. (1997), Box-Steffensmeier and Tomlinson (2000).). In

order to form the dataset of macroeconomic aggregates we employ the basic methodological approaches of economic policy making, particularly, multifactor productivity and labour productivity evaluation (Bilan et al., 2020), labour market analysis (Okuneviciute Neverauskiene and Rakauskiene, 2018), investments regulation (Awad, 2020).

The causality between economic diplomacy movements in Croatia and fundamental macroeconomic indicators will be measured in the paper by structural relations, i.e., the VARFIMA model used in similar former research. A similar model was used to analyze people's expectations about the adoption of laws in the U.S. Congress (Durr et al., 1997).

The VARFIMA models are part of econometric structural vector autoregressive fractionally integrated and movable averages and were developed earlier in the works by Sowell (1989) and Dueker and Startz (1998), Box-Steffensmeier and Tomlinson (2000), and Clarke and Lebo (2003).

2. Data and methodological approach

Macroeconomic aggregates we use in this study are:

- industrial production (iip),
- export (izvoz),
- foreign exchange movement (eur),
- inflation (cpi),
- unemployment (nez),
- labor costs (nad).

The economic diplomacy index (dipl - a proxy for economic diplomacy level) is constructed as an average index following economic diplomacy activities:

- investment variables,
- lists of implemented laws,
- ordinances,
- other legal regulations linked to economic diplomacy from 1995 to 2018 in Croatia.

Data are from the Croatian statistical office (www.dzs.hr) and Eurostat (https://ec.europa.eu/eurostat/home?) and for the economic diplomacy index data from the Croatian national parliament (https://www.sabor.hr/en/home).

The primary independent variable in the VARFIMA model will be different macroeconomic indicators – industrial production, unemployment, inflation, export (the accessibility of data limits the variables coverage in terms of monthly and quarterly time series). The structural relation will define the link between the fundamental macroeconomic indicators as a dependent variable and independent variables affecting them. Regarding independent variables, various measures of economic diplomacy activity will be used (investments, list of adopted laws, and regulations from 1990 to 2018). The proxy for the overall economic activity is the industrial production index as one of the most critical macroeconomic aggregates because the monthly G.D.P. time series for Croatia is not available.

On the path of research conducted by Sowell (1989; 1992), Dueker and Starz (1998), Tsay (2010), Clarke and Lebo (2003), the structural VARFIMA model of the following form

was used to study the impact of economic diplomacy on more important macroeconomic aggregates in Croatia (Tsay, W. J., 2012)

$$\begin{cases} Y_t = \alpha_1^{\top} D_t + \beta^{\top} X_t + u_t, \\ X_t = \alpha_2^{\top} D_t + \gamma^{\top} X_{t-1} + V_t, \end{cases} \quad (1)$$

or

$$\begin{bmatrix} Y_t - \alpha_1^{\top} D_t - \beta^{\top} X_t \\ X_t - \alpha_2 D_t - \gamma^{\top} X_{t-1} \end{bmatrix} = \begin{bmatrix} u_t \\ V_t \end{bmatrix} = W_t \quad (2)$$

where Dt is the determinant functions' vector, α1 is the parameter vector, while α2 is the parameter matrix linked to Dt. *Vt* is the time series of dimensions *r-l* with *r-l* potential parameters of fractional integration d, while *ut* is the univariate fractionally integrated process d. Since the interest is set on economic diplomacy's impact on more important macroeconomic aggregates in Croatia, one of the most important is certainly the industrial production index as a proxy for the overall economic activity because of the monthly GDP time series for the Republic of Croatia is not available. The VARFIMA model of the analysis of the impact which economic diplomacy has on industrial production in Croatia is of the form

$$\begin{bmatrix} \nabla^{d_1} & 0 \\ 0 & \nabla^{d_2} \end{bmatrix} \begin{bmatrix} 1 - \Phi_{11,1} B & 0 \\ 0 & 1 - \Phi_{22,1} B \end{bmatrix} \times \begin{bmatrix} IP_t - \beta_1 DIPL - \alpha_1 \\ DIPL_t - \gamma_1 DIPL_{t-1} - \alpha_2 \end{bmatrix} = \widetilde{W_t} \quad (3)$$

The graphic representations and impulse responses of variable movements were created by the Seasonal Adjustment Programme – Time Series Modelling 4.48.

3. Results of measuring the impact of economic diplomacy using VARFIMA modeling

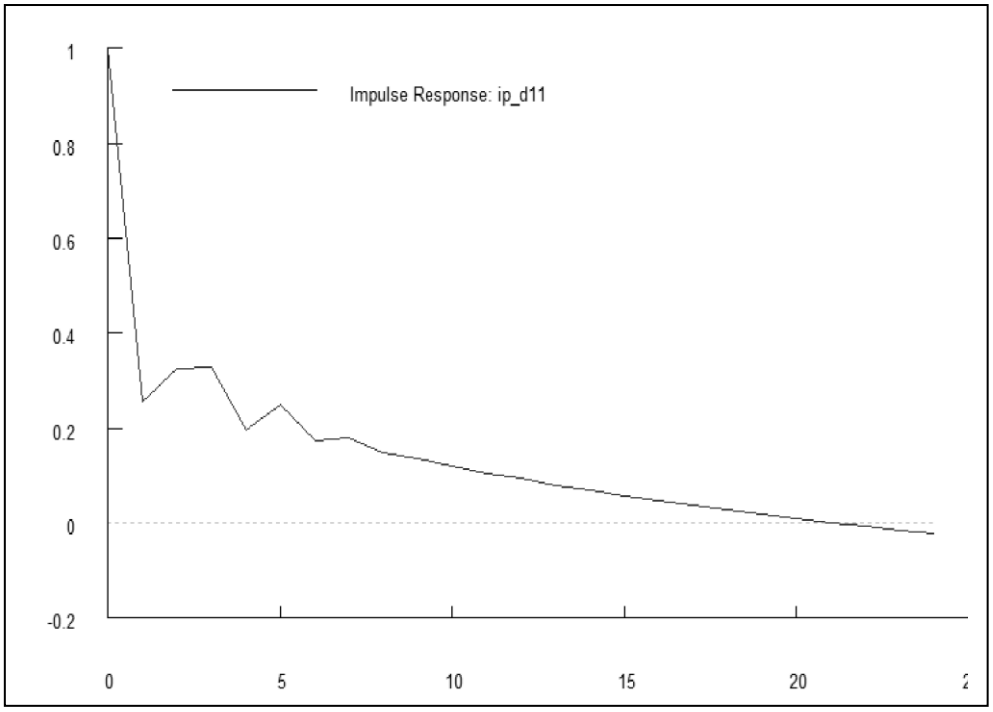
What follows is the representation of the calculation of the parameters by the VARFIMA model for each of the series of macroeconomic aggregates and economic diplomacy, whereas standard tests of series movement dependence (Q tests of the level of movement dependence (Box – Pierce, 1970) determine the movement dependence in a series of a certain macroeconomic aggregate and economic diplomacy.

Table 1. VARFIMA model for a series of economic diplomacy and industrial production

Parameters	Estimate	Std. errors	t-values	p-values
Intercept	0.65457	0.07818	8.373	0
ARFIMA d	0.66194	0.04248	15.582	0
AR1(2,1)	2.8233	0.0955	29.563	0
AR1(2,2)	-0.21969	0.07184	-3.058	0.003
MA1(2,1)	2.7511	0.0273	100.773	0
MA1(2,2)	1.1848	0.00061	1942.29	0
R^2 0.95				

Source: *own compilation*

The parameter values for the series industrial production and economic diplomacy calculated by the VARFIMA model show causation. In contrast, the value in the standard test of the series dependence of industrial production on economic diplomacy expressed by the Q test on the level of dependence Box – Pierce (1970) shows a dependence on the series's movement. That can also be seen in the graphic representation of the impulse response of series, i.e., the decrease in the level of economic diplomacy activity causes a decrease in industrial production (see *Table 1* and *Graph 1*).



Graph 1. Impulse response economic diplomacy and industrial production
Source: *own data*

The VARFIMA model of the analysis of the economic diplomacy impact on the consumer prices index in Croatia is of the following form:

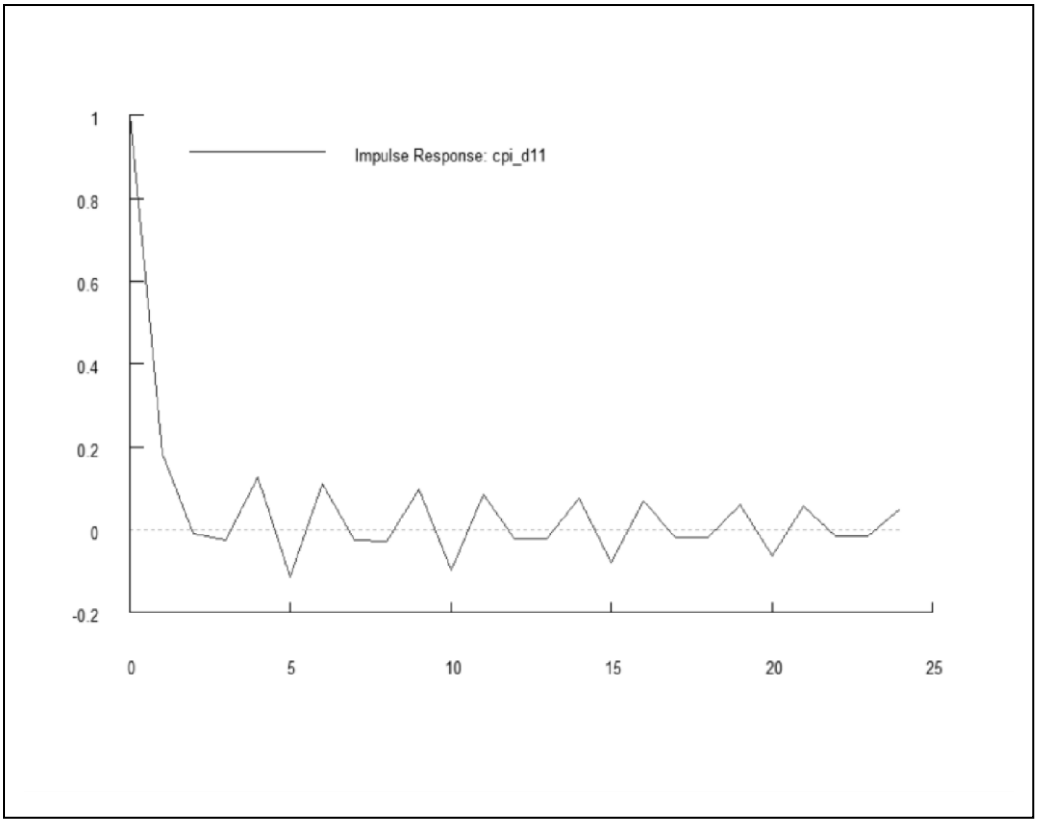
$$\begin{bmatrix} \nabla^{d_1} & 0 \\ 0 & \nabla^{d_2} \end{bmatrix} \begin{bmatrix} 1-\Phi_{11,1}B & 0 \\ 0 & 1-\Phi_{22,1}B \end{bmatrix} \times \begin{bmatrix} CPI_t - \beta_1 DIPL - \alpha_1 \\ DIPL_t - \gamma_1 DIPL_{t-1} - \alpha_2 \end{bmatrix} = \widehat{W_t} \quad (4)$$

The parameter values of the consumer prices index and economic diplomacy series calculated by the VARFIMA model show a low level of causation, which can also be seen in the graphic representation of the consumer prices index and economic diplomacy series movement. The value in the standard test of series dependence of the consumer prices index on economic diplomacy expressed by the Q test on the level of dependence Box – Pierce shows a low dependence, so it is not possible to determine the impulse response between series (see *Table 2* and *Graph 2*).

Table 2. The VARFIMA model for the series of economic diplomacy and consumer prices index

Parameters	Estimate	Std. errors	t-values	p-values
Intercept	0.00545	0.06142	0.089	0.929
ARFIMA d	-0.94341	0.05279	-17.871	0
AR1(1,1)	-0.59022	0.01574	37.498	0
AR1(1,2)	-0.79091	0.00715	-110.616	0
MA1(1,1)	-0.71786	0.00088	-815.755	0
MA1(1,2)	-0.81365	0.00145	-561.139	0
R^2 0.13				

Source: *own compilation*



Graph 2. Impulse response economic diplomacy and consumer price index
Source: *own data*

The VARFIMA model of the analysis of the economic diplomacy impact on Croatia's currency exchange rate is of the following form:

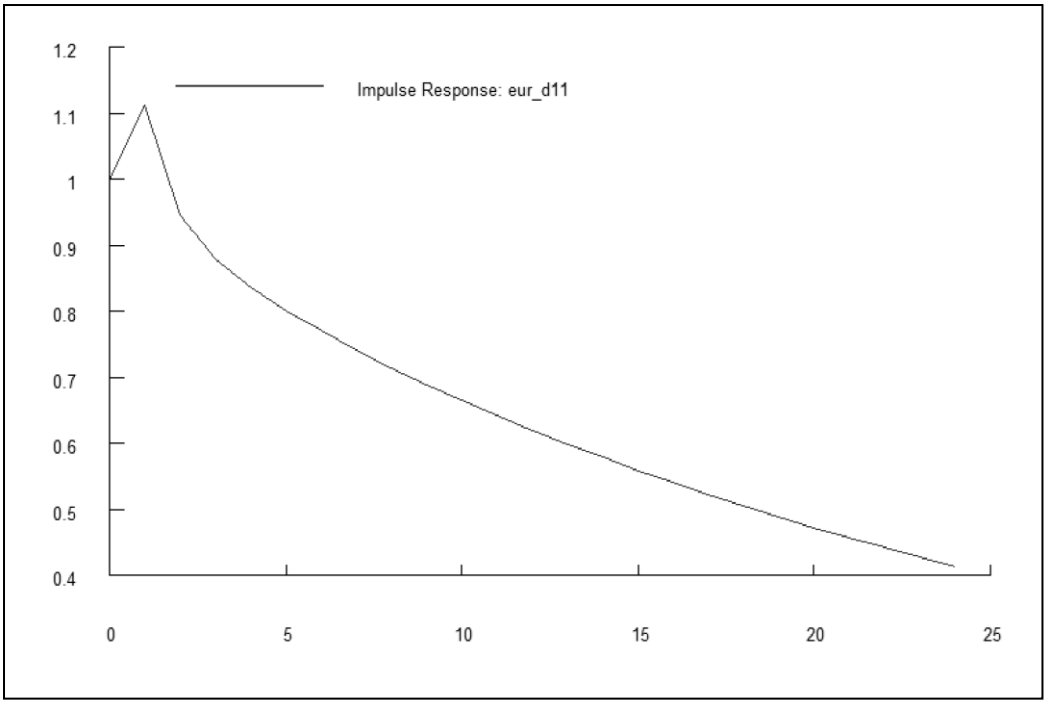
$$\begin{bmatrix} \nabla^{d_1} & 0 \\ 0 & \nabla^{d_2} \end{bmatrix} \begin{bmatrix} 1-\Phi_{11,1}B & 0 \\ 0 & 1-\Phi_{22,1}B \end{bmatrix} \times \begin{bmatrix} EUR_t - \beta_1 DIPL - \alpha_1 \\ DIPL_t - \gamma_1 DIPL_{t-1} - \alpha_2 \end{bmatrix} = \widetilde{W_t} \quad (5)$$

The parameter values of the currency exchange rate and economic diplomacy series calculated by the VARFIMA model show causation. In contrast, the value in the standard test of series dependence of the currency exchange rate on economic diplomacy series expressed by the Q test on the level of dependence Box – Pierce shows dependence in the movement of series (see *Table 3* and *Graph 3*).

Table 3. The VARFIMA model for the series of economic diplomacy and currency exchange rate movement

Parameters	Estimate	Std. errors	t-values	p-values
Intercept	-1.36146	0.66052	-2.061	0.04
ARFIMA d	-1.05548	0.09295	-11.355	0
AR1(2,1)	-15.2928	4.13325	-3.7	0
AR1(2,2)	-4.16094	1.06751	-3.898	0.003
MA1(2,1)	-15.2944	4.13411	-3.7	0
MA1(2,2)	-5.32755	1.10503	-4.821	0
R^2 0.96				

Source: *own compilation*



Graph 3. Impulse response economic diplomacy and currency exchange rate
Source: *own data*

The VARFIMA model of the analysis of the economic diplomacy impact on vacancies in Croatia is of the following form:

$$\begin{bmatrix} \nabla^{d_1} & 0 \\ 0 & \nabla^{d_2} \end{bmatrix} \begin{bmatrix} 1-\Phi_{11,1}B & 0 \\ 0 & 1-\Phi_{22,1}B \end{bmatrix} \times \begin{bmatrix} SLR_t - \beta_1 DIPL - \alpha_1 \\ DIPL_t - \gamma_1 DIPL_{t-1} - \alpha_2 \end{bmatrix} = \widetilde{W_t} \quad (6)$$

The parameter values of vacancies and economic diplomacy series calculated by the VARFIMA model show causation. In contrast, the value in the standard test of series dependence of vacancies on economic diplomacy series expressed by the Q test on the level of dependence Box – Pierce shows dependence in the movement of series, but insufficient for the representation of impulse response of series (see *Table 4*).

Table 4. The VARFIMA model for the series of economic diplomacy and vacancies movement

Parameters	Estimate	Std. errors	t-values	p-values
Intercept	7195.95	0.91265	7884.67	0
ARFIMA d	-0.4192	0.0202	-20.753	0
AR1(2,1)	278.437	0.59554	467.537	0
AR1(2,2)	350.914	0.00216	162460	0
MA1(2,1)	292.767	0.00252	116177	0
MA1(2,2)	350.914	0.00203	172864	0
R^2 0.67				

Source: *own compilation*

The VARFIMA model of the analysis of the economic diplomacy impact on export in Croatia is of the following form:

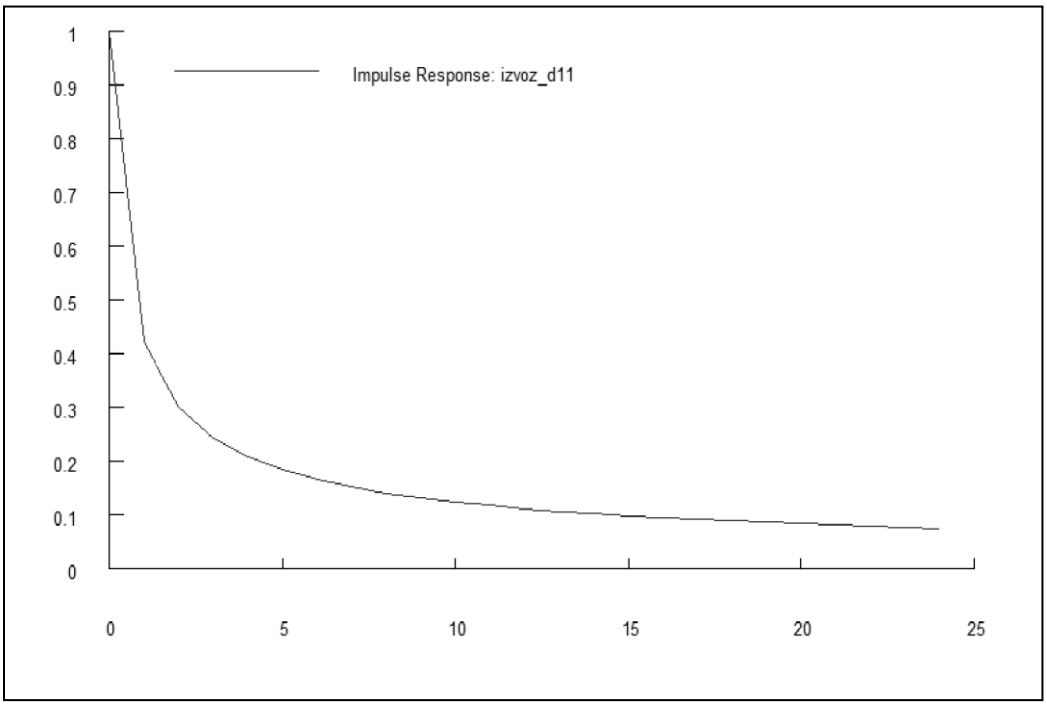
$$\begin{bmatrix} \nabla^{d_1} & 0 \\ 0 & \nabla^{d_2} \end{bmatrix} \begin{bmatrix} 1-\Phi_{11,1}B & 0 \\ 0 & 1-\Phi_{22,1}B \end{bmatrix} \times \begin{bmatrix} IZVOZ_t - \beta_1 DIPL - \alpha_1 \\ DIPL_t - \gamma_1 DIPL_{t-1} - \alpha_2 \end{bmatrix} = \widetilde{W_t} \quad (7)$$

The parameter values for the series export and economic diplomacy calculated by the VARFIMA model show causation, while the value in the standard test of series dependence of export on economic diplomacy expressed by the Q test on the level of dependence Box – Pierce shows a dependence in the movement of series. That can be seen in the graphic representation of the parameters export and economic diplomacy, as well as the impulse response of series. The dependence of series and the impulse response is highly conspicuous, as is for industrial production and economic diplomacy, i.e., the decrease of the level of economic diplomacy activity causes a decrease in exports, like for industrial production, too (see *Table 5* and *Graph 4*).

Table 5. The VARFIMA model for the series of economic diplomacy and export movement

Parameters	Estimate	Std. errors	t-values	p-values
Intercept	7195.95	0.91265	7884.67	0
ARFIMA d	-0.4192	0.0202	-20.753	0
AR1(2,1)	278.437	0.59554	467.537	0
AR1(2,2)	350.914	0.00216	162460	0
MA1(2,1)	292.767	0.00252	116177	0
MA1(2,2)	350.914	0.00203	172864	0
R^2 0.67				

Source: *own compilation*



Graph 4. Impulse response economic diplomacy and export
Source: *own data*

The VARFIMA model of the analysis of the economic diplomacy impact on labor costs in Croatia is of the following form:

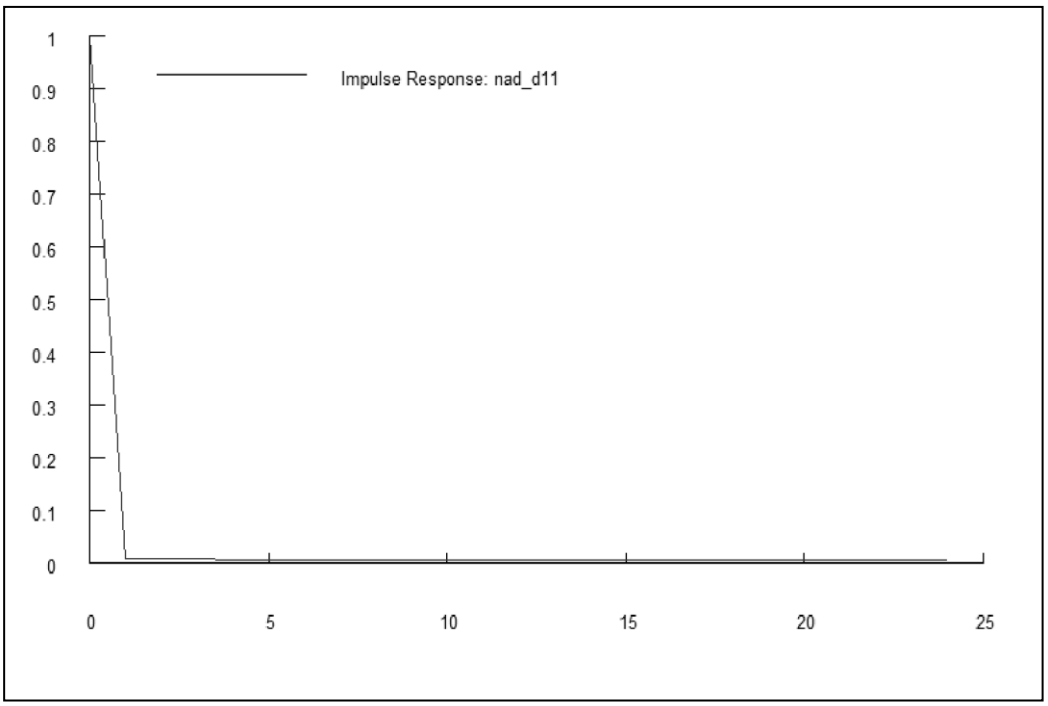
$$\begin{bmatrix} \nabla^{d_1} & 0 \\ 0 & \nabla^{d_2} \end{bmatrix} \begin{bmatrix} 1-\Phi_{11,1}B & 0 \\ 0 & 1-\Phi_{22,1}B \end{bmatrix} \times \begin{bmatrix} NAD_t - \beta_1 DIPL - \alpha_1 \\ DIPL_t - \gamma_1 DIPL_{t-1} - \alpha_2 \end{bmatrix} = \widetilde{W_t} \quad (8)$$

The parameter values for the series labor costs and economic diplomacy calculated by the VARFIMA model do not show causation, which can be seen in the graphic representation of the parameters labor costs and economic diplomacy movement. Moreover, the value in the standard test of series dependence of labor costs on economic diplomacy expressed by the Q test on the level of dependence Box – Pierce does not show a dependence in the series, which can be seen in the impulse response between series (see *Table 6* and *Graph 5*).

Table 6. The VARFIMA model for the series of economic diplomacy and labour costs movement

Parameters	Estimate	Std. errors	t-values	p-values
Intercept	-352.496	0.93401	-377.401	0
ARFIMA d	0.00397	0.00212	1.873	0.062
AR1(2,1)	0.14472	0.00256	56.531	0
AR1(2,2)	4.5151	0.03351	134.739	0
MA1(2,1)	0.17881	0.00123	145.373	0
MA1(2,2)	4.50892	0.03193	141.213	0
R^2 0.03				

Source: *own compilation*



Graph 5. Impulse response economic diplomacy and labor costs
Source: *own data*

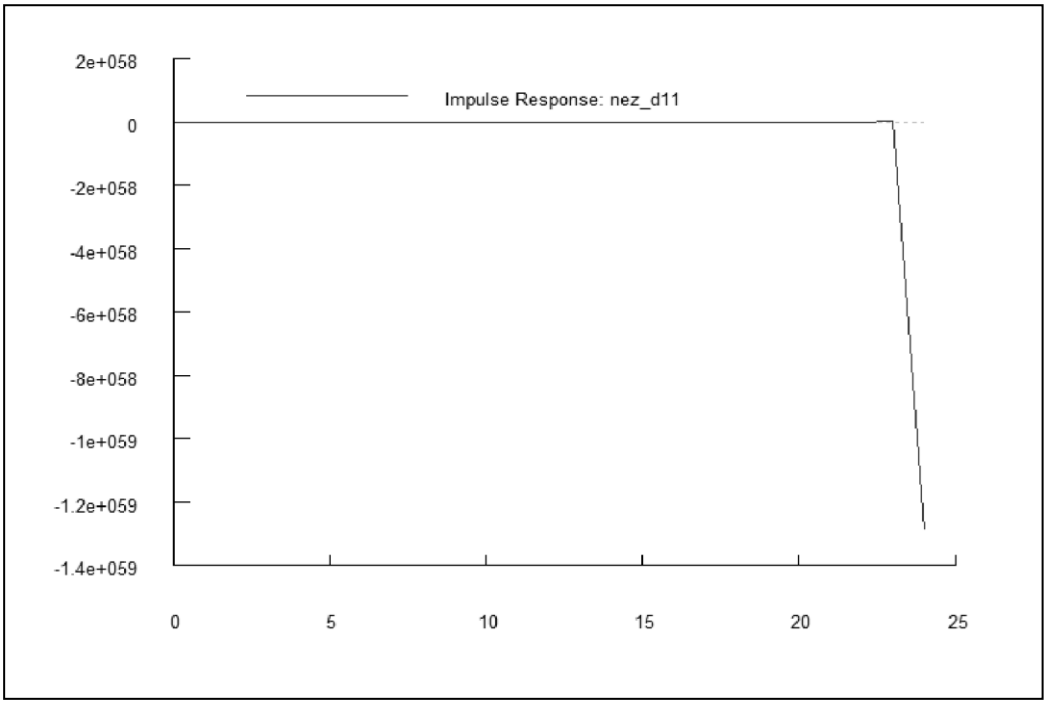
The VARFIMA model of the analysis of the economic diplomacy impact on unemployment in Croatia is of the following form:

$$\begin{bmatrix} \nabla^{d_1} & 0 \\ 0 & \nabla^{d_2} \end{bmatrix} \begin{bmatrix} 1-\Phi_{11,1}B & 0 \\ 0 & 1-\Phi_{22,1}B \end{bmatrix} \times \begin{bmatrix} NEZ_t - \beta_1 DIPL - \alpha_1 \\ DIPL_t - \gamma_1 DIPL_{t-1} - \alpha_2 \end{bmatrix} = \widetilde{W_t} \quad (9)$$

Table 7. The VARFIMA model for the series of economic diplomacy and unemployment movement

Parameters	Estimate	Std. errors	t-values	p-values
[2]Intercept	51437.9	33.2526	1546.88	0
ARFIMA d	1.03192	0.02935	35.159	0.062
AR1(2,1)	-1014.91	0.75094	-1351.51	0
AR1(2,2)	182.639	0.09787	1866.14	0
MA1(2,1)	-307.809	0.20581	-1495.6	0
MA1(2,2)	182.577	0.11168	1634.82	0
R^2 0.99				

Source: *own compilation*



Graph 6. Impulse response economic diplomacy and unemployment
Source: *own data*

The parameter values for the series unemployment and economic diplomacy calculated by the VARFIMA model do not show causation, which can be seen in the graphic representation of the parameters unemployment and economic diplomacy movement. Moreover, the value in the standard test of series dependence of unemployment on economic diplomacy expressed by the Q test on the level of dependence Box – Pierce does not show a dependence in the series, which can be seen in the impulse response between series, as is for the impulse response of labor costs and economic diplomacy.

Conclusion

Our study shows that economic diplomacy has a positive impact on the country's macroeconomic performances in the long run. Results are in line with the study of Peres et al. (2018), Jaworski and Czerwonka (2019), Buturac et al. (2019).

The starting assumption for the conducted empirical research is that economic diplomacy activities analyzed through variables Law and legal regulations adopted in the

Croatian parliament in the domain of economic diplomacy as proxy variables for economic diplomacy activities in Croatia are fractionally integrated.

The VARFIMA models belong to the class of econometric structural vector autoregressive fractionally integrated and movable averages, so VARFIMA models for a series of macroeconomic aggregates and economic diplomacy were created to prove the primary hypothesis in the paper – H_1: by the VARFIMA model, it is possible to measure the impact of economic diplomacy on the movement of fundamental macroeconomic indicators.

The lowest impact, i.e., the lack of causation of the impact of economic diplomacy activities on the economic diplomacy movement in series of economic diplomacy and consumer price index, unemployment, vacancies, and labor costs were calculated by the econometric.

VARFIMA model, while by calculating and testing data by the VARFIMA model it was proved that industrial production and export as macroeconomic aggregates show a high level of causation and dependence of movement concerning the level of economic diplomacy activity, which means that when the economic diplomacy activity level is low, industrial production and export diminish, and vice versa.

Testing data by the VARFIMA model led to the conclusion that the lowest impact, i.e., the lack of causation of the economic diplomacy activity's impact on economic diplomacy movement, is characteristic for series of economic diplomacy and consumer price index, unemployment, vacancies, and labor costs. It is nevertheless necessary to emphasize that the variables above are affected by various social changes and activities outside the sphere of economic diplomacy activity.

On the other hand, results showed that an increase in economic diplomacy activities led to an evident increase in industrial production and export, as is the other way round. That is exceptionally significant for the Croatian economy's economic growth and development due to its multiplicative effects. Namely, industrial production encompasses variability and a range of national production, and enables the competitiveness of domestic products on the European and world market, but also serves to calculate the visible domestic consumption (production + export-import) as a constituent part of G.D.P. According to the National Bureau of Statistics, although there are only 13% of Croatian companies exporting their products, at the same time they employ half of the employed in all companies, reach 65% of the overall sale profit, and even 70% of the overall means invested in development come from them. Therefore, the growth of such healthy and advanced companies makes the overall Croatian economy more powerful, and since export is a component of aggregate demand, its growth also implies G.D.P. growth, which means that it also influences the economic growth. Furthermore, due to financial and other limitations of the internal market, only an export-oriented economy can guarantee a long-term sustainable development to a small country such as Croatia, advance the competitive advantages of the country by acquiring new knowledge and technologies, and thus strengthen the overall competitiveness of the country and create a positive perception on the functioning of the economy.

Consequently, the conducted empirical research on testing data by the VARFIMA econometric model belongs to the class of econometric structural vector autoregressive fractionally integrated and movable averages; the primary hypothesis in the paper was proved. We can use the VARFIMA model to measure economic diplomacy's impact on the movement of fundamental macroeconomic indicators, and economic diplomacy has a positive long-run impact on the country's macroeconomic performances.

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