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CAUSALITY ANALYSIS BETWEEN GDP, DEFENCE EXPENDITURE AND THE NUMBER OF ARMED FORCES PERSONNEL: THE CASE OF CROATIA

Croatia's national defence has experienced dramatic evolution since its creation, during the Homeland War in Croatia, at the beginning of the 1990s, and its subsequent transformation. Political and economic circumstances have the most significant impact on defence expenditure (DEFEXP) and the size of the armed forces. The aim of this research is to analyse a potential causality between DEFEXP and Croatia's gross domestic product (GDP), as well as between DEFEXP and the number of Croatian Armed Forces personnel (AFP). The main data sources are from the World Bank and Stockholm International Peace Research Institute (SIPRI). The research is based on the use of the Granger causality test followed by procedures proposed by Toda and Yammamoto (1995) and the impulse response function with data from 1995 to 2014. The results show that there is no short-run or long-run causality between GDP and DEFEXP. The results obtained show one-way causality from DEFEXP to AFP, with AFP responding to shock from DEFEXP after three years.[1]

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1. Introduction

The relationship between defence expenditure (hereafter DEFEXP) and economic growth has attracted the interest of many economists and policy decision makers. Emile Benoit (1973, 1978) was the first to explore the impact of DEFEXP on GDP. Since then, many researchers have carried out studies and tests to explore the presence and direction of causality between these two variables, either at the individual country level or within a group of countries.

In the empirical literature, Croatia has not received considerable attention regarding the examination of the causal relationship between DEFEXP and economic growth. There has been only one study so far in which the Republic of Croatia was analysed but only as part of a panel test (Korkmaz, 2015). Consequently, the conclusion of that research applies to all countries together.[2] The aim of this research is therefore to fill the gap in Korkmaz's research and determine, in an individual analysis, what the causal relationship of DEFEXP and GDP is.

The original scientific contribution of this research lies in the following facts: despite the popularity of the subject (causality between GDP and DEFEXP), Croatia's case has not been analysed individually before this study. In addition, a comprehensive analysis of Croatia's DEFEXP that incorporates security-related as well as economic and political factors is missing in the literature.

The first research goal was to analyse the short-run and long-run causal relationship of DEFEXP to GDP in Croatia within the time interval 1995–2015. The second research goal was to analyse the causal relationship between DEFEXP and the number of armed forces personnel (AFP) in Croatia (the total active military manpower) within the time interval 1995-2014.

The next section provides an overview of Croatia's defence spending profile. Section 3 presents an analysis of earlier research in this domain. Section 4 reports the results of the econometric analysis that tests the causality of Croatian GDP and DEFEXP, as well as DEFEXP and AFP in Croatia. Finally, section 5 provides some conclusions.

[2] Suna Korkmaz (2015) conducted research on a sample of 10 Mediterranean countries (Bosnia-Herzegovina, Croatia, Egypt, France, Greece, Israel, Italy, Slovenia, Spain and Turkey) in the timeframe 2005 to 2012.

2. Croatia's defence spending profile

Croatia declared independence and the dissolution of its association with Yugoslavia on 25 June 1991. This decision, however, was not realised easily. Although internationally recognised as an independent state in 1992, the conflicts began escalating into armed incidents in the majority-Serb populated areas already in the second part of 1991. The conflicts evolved into the four years of fighting against pro-Yugoslav forces (represented by the Serb-controlled Yugoslav National Army) and the local Serb forces (represented by the Army of the self-proclaimed Republic of Serb Krajina) that took control over one-third of the Croatian territory with a substantial Serb population.

During the war that lasted from 1991 to 1996,[3] also called the Croatian War for Independence or the Homeland War, Croatia underwent the processes of international recognition, creating credible armed forces, and political and economic reforms which included the privatisation of state-owned assets in Croatia.

Concerning the economy, Alex J. Bellamy (2003), for example, used different official reports to assess that in 1992 alone "industrial output decreased by around 39 per cent, and that provision for more than a million refugees cost an additional $1.3 billion or around one-fifth of the GDP in 1992. As a result of war damage on the industry, the GDP in 1992 was less than half the 1989 GDP" (p.105).

After the war, the Republic of Croatia started to rebuild the destroyed parts of the country, facilitated a return of refugees and displaced persons, and provided landmine clearance, among many other activities undertaken along with recovering its economy. The total direct war damage Croatia suffered from 1990 to 1999 amounted to around 33 billion EUR (Perković and Puljiz, 2001). Although the direct damages were large, Croatia also suffered a loss related to the foregone economic activity (opportunity cost) for a longer period. The economic effects of the conflict were disastrous not only for the constituent parts of the former Yugoslavia but also for the entire region (Braddon, Bradley and Dowdall, 2011).

In the areas of foreign and security policies, Croatia started intensifying the process of joining NATO and the EU in the early 2000s. As declared in Croatia's first National Security Strategy, "entering both integrations is one of the most important national goals" (Croatian Parliament, 2002). The main paradigm change in that period was in shifting the orientation of the security policy from pure territorial defence towards contributing to international peace and stability.[4] Croatia began

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[3] According to the *Act on the Rights of Croatian Defenders of the Homeland War and Members of their Families* (*Zakon o pravima hrvatskih branitelja iz Domovinskog rata i članova njihovih obitelji*), the Croatian Homeland War lasted from 5 August 1990 until 30 June 1996.

[4] "An increasingly active approach to this segment of international cooperation will represent, in line with the country's possibilities, a significant element of Croatia's security policy" (Croatian Parliament, 2002).

contributing with its armed forces in various UN-, NATO- (in the Partnership for Peace framework) and EU-led missions and operations, changing its role from an international security consumer to a security provider. This fact also affected requirements for the development of defence capability.[5] The armament and equipment used during the Homeland War needed to be either modernised (those identified as necessary) or disposed of as obsolete. More importantly, some new capabilities had to be developed. The early 2000s were also a period of establishing the long-term development defence planning. The first Croatian Armed Forces Long-Term Development Plan (CAF LTDP) 2006–2015[6] set ambitious goals for the capability development, including the acquisition of some major equipment, such as armoured personnel carriers, a new combat aircraft, a new patrol ship and a modern radar system, to mention only the major programmes.

The accession of Croatia to NATO took place in 2009, at a time when the economic crisis that erupted in 2008 and 2009 had already influenced all members of NATO. The economic conditions had further delayed reforms (IISS, 2017:p. 98) and negatively affected the financing of the projects laid out in the CAF LTDP 2006–2015. Namely, the projection[7] of the defence budget had been to increase it gradually from around 5 billion HRK, in 2005, to more than 9 billion HRK, in 2015. The defence budget decreased continuously during that period towards 4 billion HRK. Consequently, some major acquisition programmes, such as the combat aircraft and the patrol ship, had to be postponed for the next LTDP cycle (i.e. 2015–2024).

Due to the economic crisis, the defence sector had faced a reduced defence budget, along with the imperative to adapt to financing under the conditions of fiscal rationalisation and savings. The latest CAF LTDP[8], for the period from 2015 to 2024, represents a more realistic approach regarding the available funding, emanating from the macroeconomic reality that is not capable of producing reliable medium- and long-term forecasts of GDP dynamics. The document was based on the assumption that the defence budget for the period 2015–2017 would remain

[5] "The Armed Forces must develop capabilities for active contribution to the creation of a favourable environment with the development and strengthening of international cooperation, confidence, partnership and alliance, and with its involvement in international peacekeeping operations, crisis management, humanitarian operations and collective military exercises" (Croatian Parliament, 2002).

[6] Published on 19 July 2006, in the Official Gazette of the Republic of Croatia, 81/2006. Available from: https://www.files.ethz.ch/isn/154936/Croatia_English-2006-2015.pdf

[7] Ministry of Finance in its document "Guidelines of Economic and Fiscal Policy for the 2006–2008 Period" anticipated the GDP growth to be 2% annually. The CAF LTDP presupposed the growth of GDP after 2008 not to be lower than 2%.

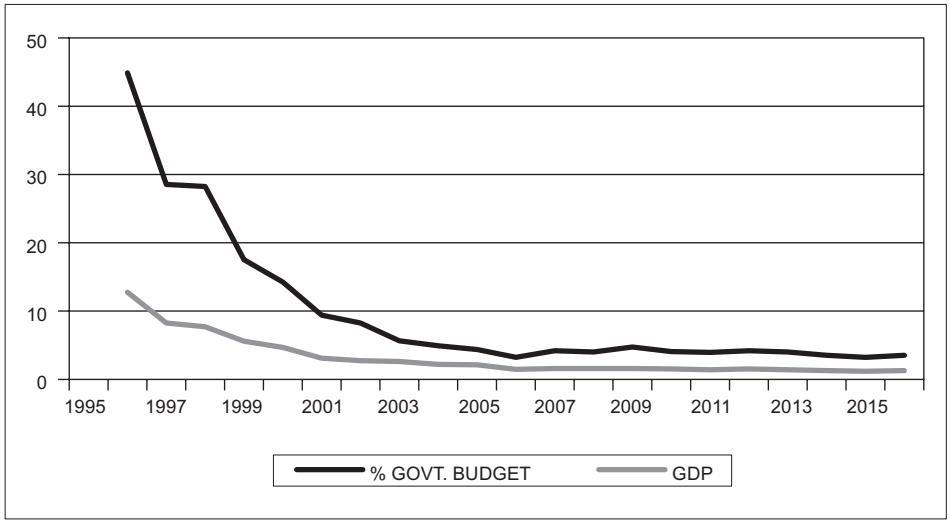
[8] Published on 12 December 2014, in the Official Gazette of the Republic of Croatia, 151/2014. Available from: https://www.morh.hr/images/stories/morh_2015/pdf/dpr/ltdp_en_2015.pdf

at the level of the fiscal year 2014, that is, the total defence budget would be 4.3 billion HRK which would put an end to its years-long continuous decrease. The document optimistically counts on the recovery of the economy and the growth of GDP in the coming years. It also anticipates, in accordance with the European Union procedures related to the excessive deficit, that conditions will be favourable for a gradual increase in the defence budget, which is the prerequisite for a progressive accomplishment of the long-term goal to meet the NATO guideline of 2% of GDP for DEFEXP.

The illustration in Figure 1 clearly shows that five years after the Homeland War, in 2001, the defence budget dropped to less than 2% of GDP.

Figure 1.

DEFEXP AS A SHARE OF GOVERNMENTAL BUDGET AND GDP



Source: own, adapted from the Croatian MoD's website (www.morh.hr)

In general, the investments in defence, including the development of the national defence industrial and technological base (DITB) have not been a high priority for the Croatian government since the end of the Homeland War. The Croatian defence industry, established in the 1990s, along with the creation of Croatian statehood during the Homeland War, represents in the 2010s a reputable and constantly growing sector regarding export revenues, innovativeness and agility. As the demands of the national defence started to decrease in the 2000s, the Croatian

defence industry began to orient production increasingly towards the international arena. Lacking a national industrial policy that would increase survivability in a highly competitive international market (top-down approach), the Croatian defence industry, represented by the most prominent producers of arms and equipment for the military, adopted a bottom-up approach, which has proved to be successful so far.

3. Relationship between military expenditure and economic growth

The empirical analyses have identified various ways by which military spending can influence the economy positively or negatively. Regarding skills, it can attract skilled labour away from civil production but, on the other hand, it can train experts and workers, introducing them to advanced skills and attitudes, particularly in developing economies in which investments in defence may represent incentives for developing valuable skills. It can take significant capital expenditures from civil industry to produce a strong defence industry sector. On the other hand, the military's capital expenditures can have alternative civilian value. Finally, it can stimulate demand in a stagnant economy and lead to growth by strengthening the country's economic infrastructure but may create bottlenecks in a constrained economy. Military spending may also result in mild inflation and, in turn, encourage fuller utilisation of the existing production facilities. The net effects arguably may be positive or negative, which is an empirical question and it likely differs across countries (Dunne, Nikolaidou & Smith, 2002). Alternatively, there may not be any relationship between military expenditure and economic growth.

The empirical estimates give conflicting results depending on the country or group of countries in question, the period covered or the estimation technique used, providing support to each hypothesis. Some previous research and approaches in this area failed to include relevant variables. Furthermore, others have not been soundly based on theory, but rather on an *ad hoc* justification of their choice of explanatory variables. Moreover, it is difficult to develop a general theory or a standard empirical approach for the determination of the demand for military expenditure, due to many variables that contribute to its size and scope (see, for example, Sezgin & Yildirim, 2002).[9]

[9] Sezgin and Yildirim's findings suggest that Turkish defence spending is determined by NATO's defence spending, Greece's defence spending and some security considerations.

4. Empirical research

4.1. Data

Data used in this study are annual, from the period 1995–2014.

Data sources, descriptions and descriptive statistics of variables are shown in Table A1 and Table A2.

4.2. Methodology

The paper uses the Granger causality test to check the hypothesis by using the vector autoregression (VAR) model:

$$\begin{aligned} y_0 &= \alpha_1 + \sum_{i=1}^{ly_1} \beta_{1,i} y_{1,t-i} + \sum_{i=1}^{lx_1} \delta_{1,i} x_{1,t-i} + \varepsilon_{1,t} \\ x_0 &= \alpha_2 + \sum_{i=1}^{ly_1} \beta_{2,i} y_{1,t-i} + \sum_{i=1}^{lx_1} \delta_{2,i} x_{1,t-i} + \varepsilon_{2,t} \end{aligned} \quad (1)$$

where i = 1,…, N, t = 1,…, T.

We test the hypothesis $H_0 = \delta_{1,i} = \beta_{2,i} = 0$ which says that there is no Granger causality between x and y. By testing the VAR model, there are four possible results: (1) $\delta_{1,i} = 0$, $\beta_{2,i} \neq 0 \rightarrow$ Granger causality in one direction from x to y; (2) $\delta_{1,i} \neq 0$, $\beta_{2,i} = 0 \rightarrow$ Granger causality in one direction from y to x; (3) $\delta_{1,i} = 0$, $\beta_{2,i} = 0 \rightarrow$ No Granger causality between x and y; (4) $\delta_{1,i} \neq 0$, $\beta_{2,i} \neq 0 \rightarrow$ Granger causality in both directions between x and y.

If the variables are non-stationary (regardless of cointegration), usually the Wald test for this kind of testing will have an asymptotic χ^2 distribution. Therefore, the procedure will be carried out as Toda and Yamamoto (1995) proposed.

Stationarity is determined using the augmented Dickey-Fuller (ADF) test (Dickey and Fuller, 1979) which is based on two functions:

$$\Delta y_t = \alpha_0 + \gamma y_{t-1} + \alpha_2 t + \sum \beta_i \Delta y_{t-1} + \varepsilon_t \quad (2)$$

$$\Delta y_t = \alpha_0 + \gamma y_{t-1} + \sum \beta_i \Delta y_{t-1} + \varepsilon_t, \quad (3)$$

where ε_t is an error term with the arithmetic mean equal to zero and constant variance. The null hypothesis is that there is no unit root. If the variable still has a unit root after testing, then the variable is differentiated.

If two variables have the same rank of integration, then Johansen's (1988) approach will be used for testing cointegration.

There are several criteria for determining the optimum number of lags, such as the Akaike Information Criterion (AIC), Schwarz Bayesian Information Criterion (SC) and Hannan-Quinn Criterion (HQC). For the purpose of this study, the VAR model is tested on all three criteria.

Granger causality (Granger, 1969; Granger, 1988) forms an important part of the VAR program. Edward Leamer (1985:p.5) suggests that this concept should be called "precedence." Actually, what is tested under the heading of Granger causality is whether one variable regularly precedes another. In practice, we can consider contexts in which precedence is suggestive of causation and also contexts in which it is not.

The importance of the order of variables i.e. whether one variable precedes the other is crucial for determining what is being tested. To use a useful analogy, "Christmas cards may Granger-cause Christmas, but they are hardly a real cause of Christmas" (Atukeren, 2008:p.836). In fact, Granger had a particular definition of causality in mind, the one in which one variable could improve the forecasts of another. Therefore, Granger's "method of testing made sense in such context" (Ouliaris, Pagan and Restrepo, 2016:p.42).

4.3. Empirical results

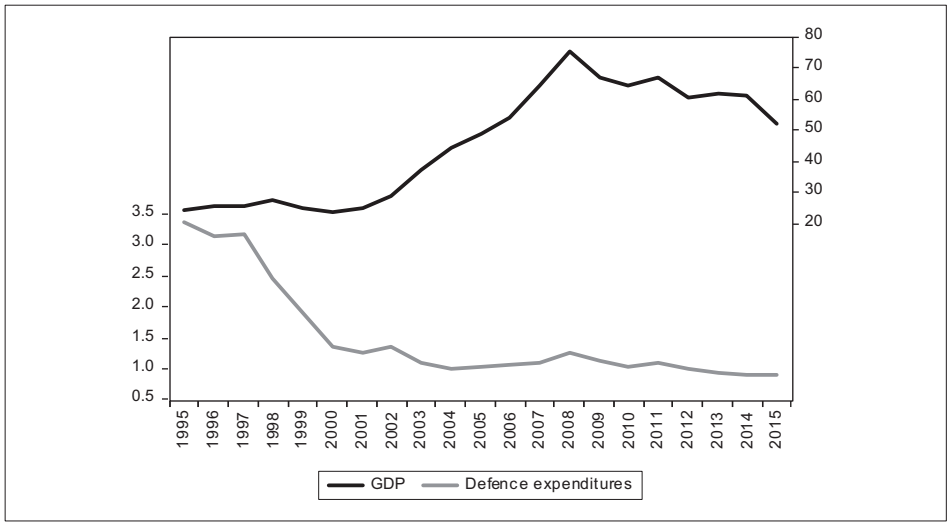
We tested two models: the first model was Granger causality between civilian GDP and DEFEXP – VAR(1), and the second model was Granger causality between the AFP and DEFEXP – VAR(2).

4.3.1. GDP and DEFEXP – VAR(1)

Croatian GDP in the period between 1995 and 2015 increased 118% whereas the DEFEXP, during the same period, decreased 73% (Figure 2).

Figure 2.

GDP AND DEFEXP



Note: billions USD and constant 2014 prices

The breakpoint unit root test and common unit root test were made with the ADF test based on the SC. We concluded that both variables are integrated I(2), GDP had a break point in 2010, DEFEXP has no breakpoint and the result is obtained with the trend included (Table B1). Based on this result, for both VAR models, we conclude that m = 2.

Using VAR lag order selection criteria, we determined the optimal number of lags with the AIC, SC and HQ. The result based on all criteria was one lag, which means that p = 1. Johansen's cointegration test was made because the rank of integration had been the same (Table B2). The result shows no cointegration at the 0.05 level.

After the VAR model had been made, we performed the Breusch-Godfrey serial correlation LM test for testing autocorrelation in the errors of the VAR model. The results show that the VAR model is stable (Table B3).

If it is known that p = 1 and m = 2, then the VAR models are made with one lag where the third extra lag was added, VAR (1):

$$\begin{aligned} GDP_{1,t} &= c_1 + \beta_{1,1}GDP_{1,t-1} + \delta_{1,1}DEFEXP_{1,t-1} + \varepsilon_{1,t} + \beta_{1,2}GDP_{1,t-3} + \delta_{1,2}DEFEXP_{1,t-3} \\ DEFEXP_{1,t} &= c_2 + \beta_{2,1}DEFEXP_{1,t-1} + \delta_{2,1}GDP_{1,t-1} + \varepsilon_{2,t} + \beta_{2,2}DEFEXP_{1,t-3} + \delta_{2,2}GDP_{1,t-3} \end{aligned} \quad (4)$$

where GDP represents Croatia's gross domestic product and DEFEXP represents defence expenditures. After VAR models were made, we obtained the results as presented in Table 1.

Table 1.

RESULTS OF VAR GRANGER CAUSALITY/BLOCK EXOGENEITY WALD TESTS

	Dependent variable	χ^2	**df**	**Probability**
VAR(1)	GDP	0.858654	1	0.3541
	DEFEXP	1.298593	1	0.2545

Neither probability is smaller than 0.05, meaning that on 5% significance we cannot reject the null hypothesis that says there is no Granger causality.

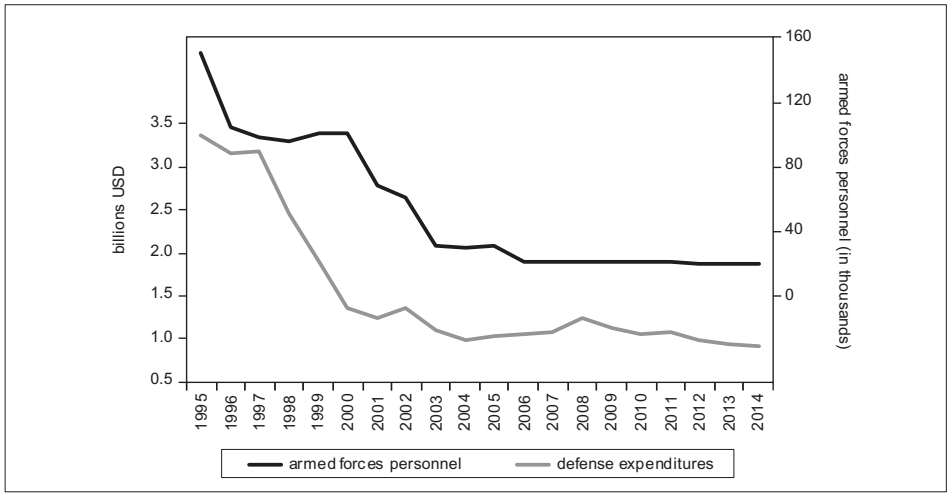
We concluded that, in both the short run and long run, based on VAR(1), there is no one-way or two-way causality between DEFEXP and GDP in the Granger sense, in the case of Croatia, during the period between 1995 and 2015.

4.3.2. DEFEXP and AFP – VAR(2)

AFP, in the time 1995–2014, decreased 87% and DEFEXP decreased 73% (Figure 3).

Figure 3.

AFP AND DEFEXP



Note: DEFEXP constant 2014 prices

A unit root test was made with the ADF test based on SC with included constant, and the results are shown in Table B1. From the results, we conclude that DEFEXP is integrated I(2), and AFP is integrated I(1). Based on these results, we conclude that m = 2.

Johansen's cointegration test was not made because the rank of integration is not the same. We have determined the optimal number of lags with the AIC, SC and HQ and the result based on all criteria is three lags, which means that p = 3. After the VAR model had been made, we used the Breusch-Godfrey serial correlation LM test for testing autocorrelation in the errors of the VAR model, with the results showing that the VAR model is stable (Table B3).

If it is known that p = 3 and m = 2, then the VAR model is made with three lags, where the fifth extra lag is added:

$$\begin{aligned} AFP_{1,t} &= c_1 + \beta_{1,1}AFP_{1,t-1} + \delta_{1,1}DEFEXP_{1,t-1} + \beta_{1,1}AFP_{1,t-2} + \delta_{1,1}DEFEXP_{1,t-2} + \beta_{1,1}AFP_{1,t-3} + \\ &\quad \delta_{1,1}DEFEXP_{1,t-3} + \varepsilon_{1,t} + \beta_{1,2}AFP_{1,t-3} + \delta_{1,2}DEFEXP_{1,t-5} \\ DEFEXP_{1,t} &= c_2 + \beta_{2,1}DEFEXP_{1,t-1} + \delta_{2,1}AFP_{1,t-1} + \beta_{2,1}DEFEXP_{1,t-2} + \delta_{2,1}AFP_{1,t-2} \\ &\quad + \beta_{2,1}DEFEXP_{1,t-3} + \delta_{2,1}AFP_{1,t-3} + \varepsilon_{2,t} + \beta_{2,2}DEFEXP_{1,t-3} + \delta_{2,2}AFP_{1,t-5} \end{aligned} \quad (5)$$

where AFP represents the number of the armed forces personnel, and DEFEXP represents the defence expenditure. The VAR(2) model was applied and the results obtained are shown in Table 2.

Table 2.

RESULTS OF VAR GRANGER CAUSALITY/BLOCK EXOGENEITY WALD TESTS

	Dependent variable	χ^2	**df**	**Probability**
VAR(2)	AFP	5.322195	3	0.0000*
	DEFEXP	1.441970	3	0.6957

The probability of the dependent AFP is smaller than 0.05, so we rejected the null hypothesis that says there is no Granger causality between variables AFP and DEFEXP. We therefore concluded that there is causality in the short run from DEFEXP to AFP in the case of Croatia in the period between 1995 and 2015.

An important conclusion is that this result is made after three lagged values, which means that the full causality relationship is seen after three years. To get a more detailed view, the impulse response function (Lütkepohl, 2010) was used, and the results are shown in Figure B1. As we can see, the biggest response was made in the third year, and later there has not been a significant response.

5. Conclusion

In this paper, we analysed causality between DEFEXP and GDP for the period 1995–2015. The results show that in the short run and long run the Granger causality does not exist. The amount of the Defence Budget, as well as investments in defence-related industry, in Croatia, is closely connected with the threat perception. The budget decreased rapidly in the years after the Homeland War and stayed relatively low (less than the 2% of GDP) as the imminent threats to sovereignty and territorial integrity disappeared[10] (Croatian Parliament, 2002).

[10] Serbia, seen internationally as the principal protagonist behind the conflicts in the former Yugoslavia, weakened as the result of reprisal in the form of economic sanctions and intervention of NATO military forces, in 1999.

When causality of DEFEXP and AFP was analysed, we found that there is one-way causality from DEFEXP to AFP, with the response of three years. This result can be attributed to the known *dinosaur effect*. The results are not surprising since the largest share of Croatia's DEFEXP belongs to personnel expenditures (Figure B2). Evidently, when financial resources are scarce, it is less controversial to cut investments in equipment, infrastructure or other expenditures (for instance R&D) than to make cuts in salaries or the number of personnel.

Investigating the potential causality between DEFEXP and Croatia's GDP might provide relevant arguments for governmental policy development, particularly related to the defence-related industry. For instance, Croatia's Industrial Strategy 2014–2020 does not recognise existing production of military goods and defence-based services as sub-activity of the national industry with significant potential for development, growth and employment.[11] On the other hand, Croatia's Smart Specialisation Strategy has recognised the Croatian defence industry as representing the critical element of the Thematic Priority Area (TPA) dedicated to security. This strategy argues that the producers in this industrial sector represent a solid industrial base oriented towards high-tech products that provide high added values and are export-oriented and supported by skilled and experienced human resources in technical sciences and fields of expertise related to technologies in this TPA segment.[12]

Differing views, even at the national level, suggest that the careful analysis of the impact of different variables and circumstances (geopolitical and economic, among others) is needed to shape and develop optimal national policies that will balance the security–economic nexus. An attempt to connect the results of the research with the overall historical, national security and macroeconomic context of the Republic of Croatia may also be a good way to overcome potential limitations of the utility of the Granger causality test. While many researchers have used Granger causality tests to examine the relationship between defence expenditures and the economy, a critique of this literature argued that parameters may not be stable over different time periods or different countries. Moreover, "Granger causality test statistics are uninformative about the size and direction of the predicted effects and Granger causality measures incremental predictability and not economic causality" (Dunne and Smith, 2010:p. 440).

Arguably, the success of an effort to minimise the "guns or butter" dilemma and to increase the efficiency of DEFEXP depends highly on measures of the political and strategic determinants such as economic policy as well as the threat

[11] Croatian Parliament (2014) *Industrijska strategija RH 2014–2020. [Croatia's industrial strategy 2014–2020].* The Official Gazette of the Republic of Croatia 126/2014.

[12] Government of the Republic of Croatia (2016) *Strategija pametne specijalizacije [Croatia's smart specialisation strategy].* The Official Gazette of the Republic of Croatia 33/2016.

assessment of a country. While the method may credibly show the causality between the variables, it is neutral regarding interpretability of results, with regards to factors that shape economic policy. To properly analyse the DEFEXP–economic growth nexus it is therefore valuable to combine methods such as the Granger causality test with a keen understanding of trends in a country's security environment as well as with a solid knowledge of national economic policy and the key strategic documents.

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Appendix A: Data source and descriptive statistics

Table A1.

DATA SOURCE AND DESCRIPTION

Variable	Description	Data source
Defence expenditures	SIPRI definition of defence (military) expenditure includes all current and capital expenditure on the (1) armed forces, including peace-keeping forces, (2) defence ministries and other government agencies engaged in defence projects, (3) paramilitary forces when judged to be trained, equipped and available for military operations and (4) military space activities (SIPRI, 2017a). The data from SIPRI Military Expenditure Database are shown in billions USD in constant 2014 prices (SIPRI, 2017b).	SIPRI (2017b)
Armed forces personnel	Armed forces personnel are active duty military personnel, including paramilitary forces if the training, organisation, equipment and control suggest they may be used to support or replace regular military forces (The World Bank, 2016). Data are shown in thousands.	The World Bank (2016)
GDP	GDP at purchaser's prices is the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products. It is calculated without making deductions for depreciation of fabricated assets or for depletion and degradation of natural resources (The World Bank, 2016). Data are shown in billions USD in constant 2014 prices.	The World Bank (2016)

Table A2.

DESCRIPTIVE STATISTICS

Variable	observations	mean	median	sd	min	max
DEFEXP	21	1,500.316	1,096.556	805.2496	904.3706	3,355.608
AFP	20	52.9715	30.4	40.85076	19.55	150
GDP	21	45.91774	48.76324	18.29584	23.37904	75.67594

Appendix B: Additional analysis

Table B1.

UNIT ROOT TEST (NOTES: * TREND INCLUDED)

Variable	rank	breakpoint (year)	t - statistic	probability
GDP	I(2)	2010	-7.045076	< 0.01
DEFEXP	I(2)	-	-7.233819	< 0.02
AFP*	I(1)	-	-5.285127	< 0.01

Table B2.

JOHANSEN'S COINTEGRATION TEST VAR(1)

VAR(1)				
Unrestricted Cointegration Rank Test (Trace)				
Hypothesised No. of CE(s)	**Eigenvalue**	**Trace Statistic**	**0.05 Critical Value**	**Prob.****
None	0.412666	1.456968	1.549471	0.0686
At most 1 *	0.178252	3.926437	3.841466	0.0475
Trace test indicates no cointegration at the 0.05 level				
* denotes rejection of the hypothesis at the 0.05 level				
** MacKinnon-Haug-Michelis (1999) p-values				

Table B3.

LM TEST

	VAR(1)		VAR(2)	
Lags	**LM – st**	**probability**	**LM - st**	**probability**
1	2.794.784	0.5927	8.967828	0.0619
2	4.383.265	0.3566	5.850725	0.2106
3	2.226.984	0.6941	4.045856	0.3998
4	2.539.386	0.6376	11.88780	0.0182
5	1.534.825	0.8205	2.512603	0.6424
6	1.694.639	0.7917	1.482641	0.8297
7	6.031.219	0.1968	4.030487	0.4019
8	7.455.194	0.1137	2.174207	0.7038

Figure B1.

IMPULSE RESPONSE FUNCTIONS OF THE NUMBER OF AFP TO DEFEXP

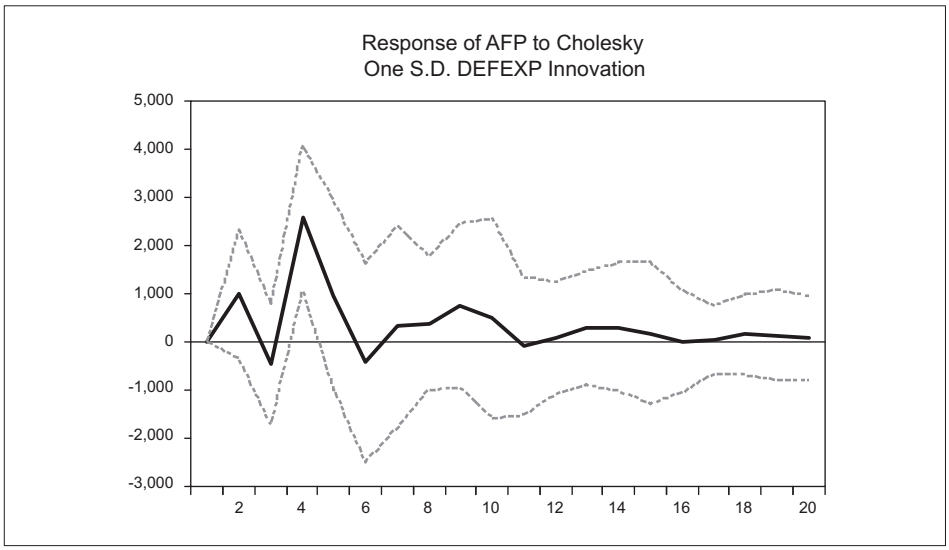
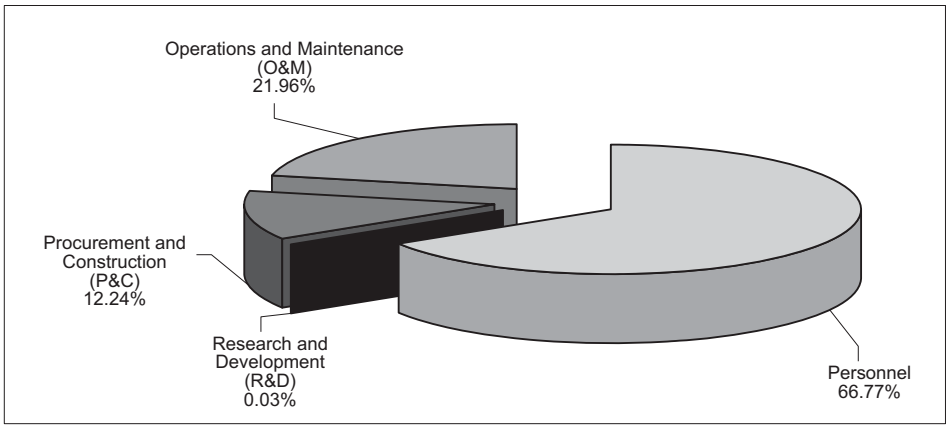


Figure B2.

THE STRUCTURE OF DEFEXP OF THE CROATIAN MOD IN 2016



Source: own, adapted from the Croatian government's report "Annual Report on National Defence for 2016"

KAUZALNA ANALIZA IZMEĐU BDP-A, RASHODA ZA OBRANU I BROJA PRIPADNIKA ORUŽANIH SNAGA: SLUČAJ REPUBLIKE HRVATSKE

Sažetak

Oružane snage Republike Hrvatske prošle su kroz dramatične promjene od vremena svojeg stvaranja, tijekom Domovinskog rata, početkom 1990-ih te transformacije koja je uslijedila nakon njega. Političke i ekonomske okolnosti najznačajnije utječu na rashode za obranu (DEFEXP) i veličinu oružanih snaga. Cilj ovoga istraživanja je analizirati moguću kauzalnu vezu između DEFEXP-a i bruto domaćeg proizvoda (GDP), te kauzalnu vezu između DEFEXP-a i broja pripadnika Oružanih snaga (AFP). Glavni izvor podataka u istraživanju su Svjetska Banka (The World Bank) i Stockholmski međunarodni institut za mirovna istraživanja (SIPRI). Istraživanje je temeljeno na korištenju Grangerovog testa uzročnosti u skladu s procedurama koje su predložili Toda i Yammamoto (1995) te na korištenju funkcije impulsnog odziva, za razdoblje od 1995. do 2014. Rezultati su pokazali da na kratki rok i dugi rok ne postoji uzročnost između DEFEXP i GDP-a. Analiza je također pokazala da promjene DEFEXP-a uzrokuju promjenu AFP-a nakon tri godine.

Ključne riječi: izdatci za obranu, BDP, pripadnici oružanih snaga, Grangerova uzročnost, Republika Hrvatska