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The Relationship of Private Savings and Economic Growth: Case of Croatia

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***Abstract*—**The main objective of the research in this paper is to empirically assess the causal relationship of private savings and economic growth in the Republic of Croatia. Households' savings are approximated by household deposits in banks, while domestic income is approximated by industrial production volume indices. Vector Autoregression model and Granger causality tests are used to in order to analyse the relationship among private savings and economic growth. Since ADF unit root tests have shown that both mentioned series are non stationary at levels, series are first differenced in order to become stationary. Therefore, VAR model is estimated with percentage change in private savings and percentage change in domestic income, which can be interpreted as economic growth in case of positive percentage change in domestic income. The Granger causality test has shown that there is no causal relationship among private savings and economic growth in Croatia. The impulse response functions have shown that the impact of shock in domestic income on private savings change is stronger than the impact of private saving on growth. Variance decompositions show that both economic growth and private saving change explain the largest part of its own forecast variance. The research has shown that the link between private savings economic and growth in Croatia is weak, what is in line with relevant empirical research in small open economies.

***Keywords*—**Economic growth, Granger causality, innovation analysis, private savings, Vector Autoregression model.

I. Introduction

STANDARD macroeconomic theories have little to say about the impact of domestic saving on growth. Growth models emphasizing capital accumulation imply that higher savings rates should foster growth because higher savings are related to higher capital investment. But these are closed economy models, and extending them to the case of small open economies with international capital markets would eliminate the effect of local saving on growth. More recent models emphasizing innovation as the main engine of growth either ignore capital accumulation, in which case there is no role for saving even in a closed economy, or they emphasize the complementarity between capital accumulation and innovation in which case the equilibrium growth rate depends positively upon domestic saving. But even in the latter case the theory does not apply to the case of an open economy with capital mobility [20].

According to [17] national savings, which include private savings, equals to the investment in the country and abroad. Although all the savings do not necessarily turn into productive investment, the role of personal savings in capital formation for economic development is strong. Furthermore, the household decisions regarding savings have an impact on aggregate demand. Household decisions can be the causes of economic shocks [19]. Regarding Croatia, household consumption accounts for notable part of GDP. Fig. 1 shows consumption to BDP ratio in Croatia from 2002 to 2013 year according to the [6]. Although slightly decreasing trend can be noted, for the observed period it is obvious that consumption has considerable share of economic activity in Croatia. In period from 2002 to 2013, household consumption covers 58.97% of gross domestic product on average, with very low coefficient of variation of 1.26%. Therefore, the deviation of the mentioned ratio values from the mean is very low for the observed period. Concerning the observed period, the lowest value of consumption to BDP ratio of 57.54% is recorded in 2013, and the highest value of 60.40% is recorded in 2002 [6]. Therefore, the decisions on consumption, and at the same time on savings, represent important decisions since they might affect economic growth as they have important share of BDP in Croatia.

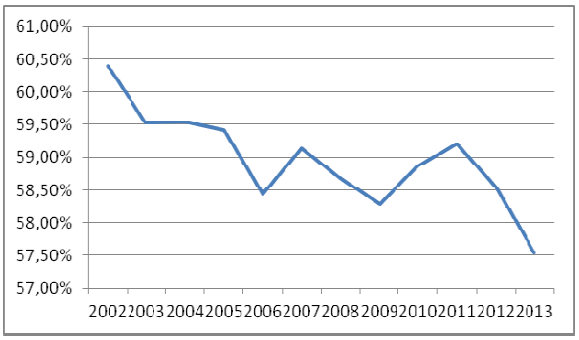

Fig. 1 Private consumption to GDP ratio in Republic of Croatia (Source: Author's calculation according to [6])

This research concerns the relationship of consumer savings and economic growth in the Republic of Croatia. Private savings, by definition, is equal to disposable income of consumers reduced by their spending. Reviewing the relevant literature indicates that in the countries of Southeast Europe there exists relatively small number of research in this field. Since the economic growth is the key policy issue in each country, the results of this research are important for decision making regarding economic policy. The main objective of the research in this paper is to empirically assess the causal relationship of private savings and economic growth in the Republic of Croatia. The research is limited by data

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availability regarding national savings in Croatia. Since national savings data is not available, authors use households' savings which are approximated by household deposits in banks. Although real savings, which represent future investments are different from financial savings of households, which will not certainly end up as investments [10], microeconomic data provide a unique source of information to check whether the possible macroeconomic explanations regarding savings apply at the level of the individual [22].

The cause and effect relationship between economic growth and savings in advanced economies and in emerging and developing countries using cointegration models and Granger's causality test is analysed in [21]. The results of mentioned research show the existence of one-way casual relationship between gross domestic savings and gross domestic product in the case of developed countries as well as in developing and transition countries. However, the absence of causal relationship between gross domestic product and gross domestic savings both in developed economies and developing and transition countries is revealed. Reference [16] investigates savings and growth relationship in seventeen African countries using an annual data spanning 1960 to 2000. The findings from the impulse response functions reveal that most impulse responses are negative in all the countries investigated, indicating an inverse relationship between savings and real gross domestic products in the African countries. The findings also show that while savings are sensitive to real GDP in the short run, it is insensitive to it in the long run. The variance decomposition results reveal that the predominant sources of savings fluctuations are due largely to "own shocks" and they vary from country to country. Research of [2] analyzes growth and savings relationship in Morocco and Tunisia. In the case of Morocco a long-run relationship exists between the variables, while no evidence of long-run relationship to exist in the case of Tunisia. The Granger causality test supports bidirectional causality between economic growth and saving growth in Morocco. However, in the case of Tunisia, the results suggest that there is a unidirectional Granger causality between real GDP and real GDS and runs from saving growth to economic growth. Research by [3] estimates bivariate vector autoregressive or vector error-correction models of saving and GDP for Sweden, UK, and USA, and performs Granger causality tests within the estimated systems. The mentioned research shows that the causal chains linking saving and output differ across countries, and also that causality associated with adjustments to long-run relations might go in different directions than causality associated with short-term disturbances. According to [11], while theory predicts that increased total saving (from domestic or foreign savers) will lead to higher investment and higher growth, the empirical link whether higher domestic saving causes growth or growth causes saving is less clear. In an open economy with access to foreign capital, domestic saving and investment can diverge without necessarily impeding growth. Reference [20] conducts cross-country regression which shows that lagged savings is positively associated with productivity growth in poor countries but not in rich countries. The same result is found when the regression is run on data generated by a calibrated version of their theoretical model.

II. Data and Methods

Since the main objective of the paper is the analysis of the relationship of private savings and economic growth in Croatia, firstly private savings and economic activity indicators, namely gross domestic product and industrial production volume indices in Croatia are explained and their dynamics is graphically analysed in this section. After that, Vector Autoregression (VAR) modeling which will be used to assess the relationship of private savings and growth is presented. Furthermore, stationarity analysis which is part of VAR modeling is explained.

Private savings in this research are approximated household deposits in banks. Regarding savings rates in transition countries in general, it is interesting to note that before the nineties they were quite high, even exceeded 30%. It was the result of "planned savings" in the system of central planning, as well as of saving for the purchase of durable goods and savings arising from the lack of choice in consumer goods [18]. Fig. 2 shows increasing trend of household deposits in Croatia according to data from [7]. Foreign currency savings represent most of the savings and foreign currency time deposits represent the largest share of all types of deposits. While other foreign currency deposits stagnated after 2006, the foreign currency time deposits recorded strong growth. Dominant share of foreign currency savings deposits in spite of the fact that interest rates on kuna deposits are higher, indicate that households are characterized by scepticism regarding the macroeconomic stability [12] and it is related to high euroisation of Croatian economy.

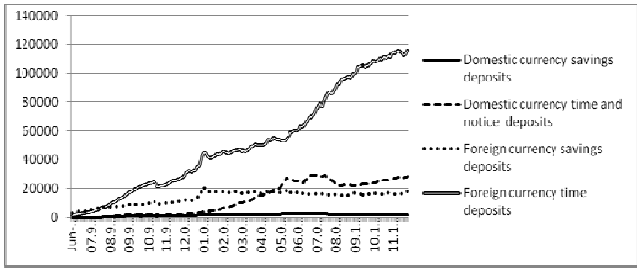

Fig. 2 Household deposits in banks in Republic of Croatiafrom January 1995 to September 2009, in million kuna [7]

Economic activity in Croatia is analysed using two indicators: Gross domestic product (GDP) and industrial production volume indices. The [6] revised data series on GDP is available for the period from the first quarter of 2000 to the third quarter of 2013 for the Republic of Croatia by major categories of expenditure and economic activities of the National Classification of Activities. The data are presented at constant prices of referent year (2005 = 100). Fig. 3 shows GDP in constant prices with base year 2010 in Croatia from

first quarter 1997 to first quarter 2013. GDP values at constant prices for 1997, 1998 and 1999 are authors calculations calculated from GDP at constant prices using chain indices.

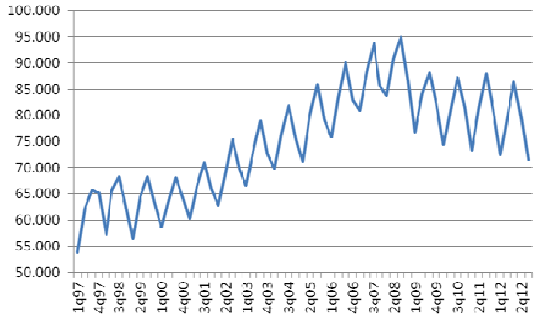

Fig. 3 Gross domestic product in Republic of Croatia from first quarter 1997 to first quarter 2013 in constant process, 2010=100, in million kuna [6]

The GDP in Croatia is increasing from 1997 up to 2008. With the financial crisis and recession GDP decreased after 2008 and is stagnating up to 2013. Since GDP values are announced quarterly, the industrial production volume indices which are announced monthly are also included in this research in order to approximate monthly domestic economic activity. According to Indices of industrial production volume are chain indices of finished industrial products defined by the Nomenclature of Industrial Products, as defined by the [6]. The domestic income in Croatia is also approximated by volume index of industrial production in [10] and [14]. Fig. 4 shows the time series of industrial production volume indices in Croatia. It can also be noted that indices gradually increased up to 2008 and that in the aftermath of financial crisis industrial production started deceasing. Figs. 3 and 4 show that both GDP and industrial production volume indices time series indicate seasonality, what is important for further econometric analysis. In order to extract seasonal component form time series, seasonal adjustment methods are used [10]. The concept of seasonal adjustment is developed in the early 20th century, starting from the division of time series into components. In various time series a trend component and seasonal component are noticed, which could not be described by explicit mathematical functions of time and that created a need to use methods of seasonal adjustment [24]. Seasonally adjusted time series is obtained by removing seasonal component from the original time series. Seasonal adjustment in practice is widely used so often it is impossible to get the original or seasonally unadjusted data [13]. Furthermore, Figs. 3 and 4 show that gross domestic product and indices of industrial production volume exhibit similar dynamics, in other words both show increasing trend up to 2008 and after that start decreasing. Moreover, both of them have similar seasonal path. Therefore, industrial production in Croatia follows gross domestic product and both indicators can be used in analysis of economic activity in Croatia.

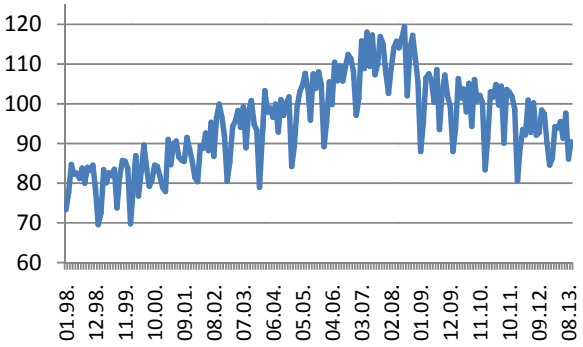

Fig. 4 Industrial production indices in Republic of Croatia from January 1998 to September 2013 [7]

In order to assess the relationship between private saving and economic growth in Croatia, vector Autoregression methodology will be used. For analysis of the relationship of economic variables Sims [5] first proposed Vector Autoregression model (VAR). VAR model is based on models that contain two or more equations that describe the mutual impacts of variables. VAR models are dynamic models of a group of time series, i.e. the generalization of dynamic models defined on the basis of a single equation. VAR models are used in the analysis of Granger causality analysis and innovation. The basic VAR model treats all variables symmetrically, regardless of whether endogenous or exogenous in the model. In the VAR model, the time path of each variable is influenced by current and past realization of the variables and other variables in the model [23]. The basic form of the VAR model in the case of *n* variables and lag k is given by:

$$Z_t = \mu + A_1 Z_{t-1} + \ldots + A_k Z_{t-k} + \psi D_t + e_t \qquad (1)$$

where is n-dimensional vector of potentially endogenous variables of order(n x 1), A1,…,Ak are square matrices of autoregressive parameters of order (n x n), Dt is the vector of non stohastic exogenous variables with matrix of parameters,is the vector of constant terms for each variable etis the vector of innovations, i.e. residuals.

In estimating VAR models, question of time series stationarity arises. Time series is considered to be stationary in a broader sense if the expected value and variance of the population does not depend on time t and if the covariance of two members of the series $Y_t$andY_{t+s} which are separated by one period depends on the distance *s*, but not on time *t* [4].

Most economic time series are characterized by the presence of the trend component, i.e., the expected value of series is changing over time, which means that most economic variables are not stationary. Estimation of regression equations using non-stationary time series could lead to wrong conclusions and spurious regression. Since the non-stationary time series have infinite variance, using the least squares method is not valid [15]. It may be wrong to conclude that there is a relationship between variables when it actually does

not exist. For most economic time series stationarity can be removed by adequate differencing *d* times [8]. Variable is integrated of order d, or I (d), if it should be differentiated *d* times to become stationary. It is usual to take the logarithmic values of the original series to remove heteroscedasticity or volatility of the variance of error terms. For the explanation of the problem of heteroscedasticity see, for example, [9]. To test the stationarity of the variables in the model, or the order of integration of the variables, unit root tests are used. The most common test is Dickey-Fuller test which can be modified Augmented Dickey Fuller test by the inclusion of an additional shift of the dependent variables in order to eliminate autocorrelation of error terms.

III. Empirical Analysis of the Relationship of Private Savings and Economic Growth in Croatia

The main objective of the vector autoregression methodology is the analysis of the relationship among variables [23], for which innovation analysis is used. Innovation analysis includes analysis of the impulse response function and variance decomposition. The advantage of conducting innovation analysis is suitable interpretation of parameters and simplicity of drawing conclusions about the dynamics of group of economic variables.

In order to empirically assess mutual relationship of private savings and economic growth in Croatia, previously explained bivariate VAR model is used. Private savings are approximated by deposits in banks. Nominal values of bank deposits are deflated using Consumer Price Indices (CPI) with base year 2010, which are published monthly by [6]. Since the VAR methodology requires a relatively long time series in order to avoid a quick erosion of degrees of freedom, economic activity is approximated by monthly industrial production volume indices (2010=100) in order to have more observations in comparison to quarterly gross domestic product data. Industrial production volume indices are also deflated using CPI.

Original values of deflated household deposits in banks and values of real monthly industrial production volume indices (2010=100) are given in logarithms, what is common practice in order to eliminate heteroscedasticity of residuals. Moreover, since seasonality of monthly industrial production volume indices (2010=100), which will be denoted by *Y* in further analysis, is detected (see Fig. 4), logarithmic values of Y are seasonally adjusted using X12 seasonal adjustment method. The raw values of logarithms of *Y* (*LY*) and seasonally adjusted values of logarithms of *Y* (*LY_sa*) are shown in Fig. 5.

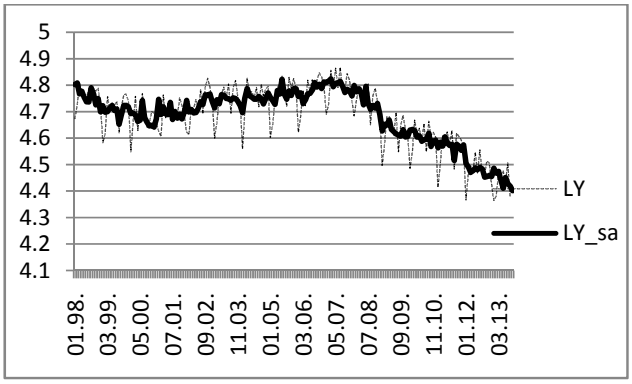

Fig. 5 Raw values (*LY*) and seasonally adjusted values (*LY_sa*) of logarithms of monthly industrial production volume indices (2010=100) (Source: Author's calculations (Demetra +XL software is used for X12 seasonal adjustment))

Furthermore, the inspection of variable private savings which is approximated by household deposits did not show the existence of seasonal component, and therefore this variable is given in logarithmic values. The time span for both variables is from January 1998 to September 2013, what is the longest available data series. Hence, the empirical analysis is conducted using following variables:

- *Domestic income,* which is approximated by *LY_SA*-seasonally adjusted logarithmic real values of industrial production volume indices (the original series is given in index points),
- *Private savings,* which are approximated by *LS*-logarithmic values of real savings and time deposits in banks (the original series is given in millions of kuna).

Initial step before estimation of VAR model is testing the stationarity of the series. Therefore, ADF unit root test is conducted and the results are given in Table I. Both trend and intercept are included in test equations for testing the stationarity of series. The null hypothesis of unit root is tested. Firstly, ADF test is conducted for series in levels, namely LS and LY_SA. Since for both variables p-values are higher than any reasonable significance level, it can be concluded that both time series are not stationary. Therefore, in order to use stationary time series for VAR model estimations, first differences of both series are calculated. D(LS) and D(LY_SA) denote first differences of variables LS and LY_SA, respectively. The ADF unit root test of both series in first differences has shown that differenced time series D(LS) and D(LY_SA) are stationary at 1% significance level. Therefore, first differences of log-values of variables will be used in further analysis. First differences of log logarithmic are approximations of percentage changes in the value of the variable [1]. Therefore, D(LS) denotes percentage change in private savings while D(LY_SA) denotes percentage change in domestic income (approximated by industrial production volume indices).

The results of Pairwise Granger Causality Test are given in Table II. Since both p-values are higher than any reasonable significance level, it can be concluded that variables do not

Granger cause each other. In the research of [2] similar empirical result is obtained for Tunisia.

TABLE I
ADF UNIT ROOT TEST FOR SELECTED VARIABLES IN LEVELS AND FIRST DIFFERENCES (EVIEWS7)

Variable	ADF t-Statistic	p-value
LS	-1.53	0.815
LY_SA	0.28	0.998
D(LS)	-9.59*	0.000*
D(LY_SA)	-11.24*	0.000*

Source: Author's calculation
* denotes stationarity of time series at 1% significance level

After that, the estimation of VAR model is done in order to conduct innovation analysis, i.e. to analyze the impact of shocks in two mentioned variables on each other. Within innovation analysis, impulse response functions and forecast error variance decomposition are analyzed. VAR model is estimated with k=2 lags. White heteroscedasticity test with χ^2 test statistic equal 30.39 and corresponding *p-value=0.*1721 has shown that the problem of heteroscedasticity is not present at any reasonable significance level. Moreover, Autocorrelation *LM* test with all *p-values* (up to the tested lag *k=12*) higher than 0.01 has shown that problem of autocorrelation is not present at 1% significance level. At 1% significance level null hypothesis of no autocorrelation of residuals cannot be rejected up to lag length k=10, since all corresponding empirical significance levels are more than 0.01. Furthermore, estimated VAR model satisfies the stability condition since no inverse root of AR characteristic polynomial lies outside the unit circle. Therefore, stated VAR model diagnostic tests show that stated model is appropriate.

TABLE II
RESULTS OF PAIRWISE GRANGER CAUSALITY TEST (EVIEWS7)

Null Hypothesis:	F-Statistic	Prob.
DLY_SA does not Granger Cause DLS	0.67158	0.7766
DLS does not Granger Cause DLY_SA	105.027	0.4064

Source: Author's calculation

Impulse response function shows the effects of increase of one standard deviation of variables in the VAR model on the observed variable. Fig. 6 shows the impulse response, i.e. the effect of one standard deviation shock in domestic income on change in private savings. The shock of domestic income initially affects change in private savings positively. After approximately six months, the effect of shock vanishes. Positive impact of income on savings is in line with economic theory and relevant empirical research. However, this impact is fading out after only six months, indicating that the impact of economic growth on private savings in Croatia is short term.

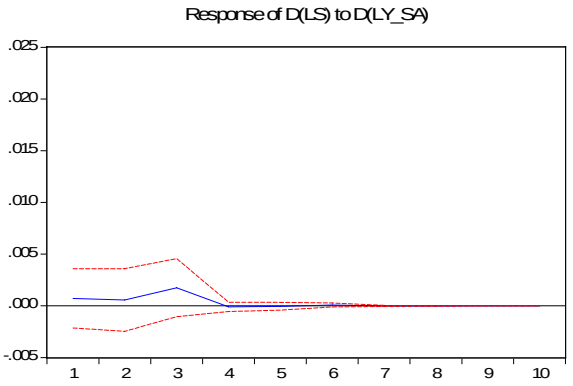

Fig. 6 Impulse response of change in private savings to shock in domestic income change (EViews7) (Source: Author's calculations)

The effect of one standard deviation shock in private savings change on domestic income is shown in Fig. 7. After one month the impact is slightly positive, but the effect of shock vanishes after approximately 4 months. The impact of private savings change on economic growth, although positive, is short term and very low. If we compare these two impulse responses, we might conclude that the impact of economic growth on savings is stronger than the impact of saving on growth.

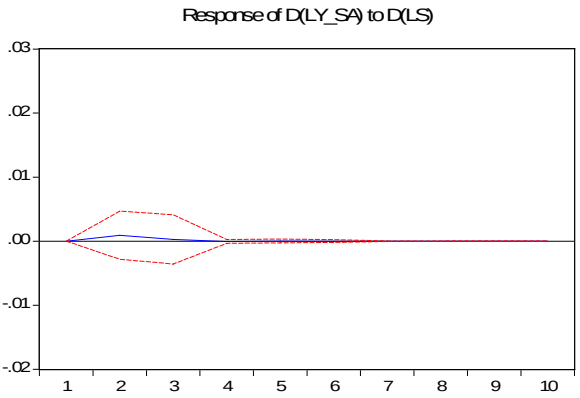

Fig. 7 Impulse response of change in domestic income to shock in private savings change (Source: Author's calculations)

Variance decomposition shows the percentage of variance of the forecasting error in observed variable explained by each variable in the system. Variance decomposition gives the similar information as the impulse response function, but the information is presented in a different form. Variance decomposition of domestic income change is given in Table III. The shock of one standard deviation in variable D(LY_SA) equals 0.025418%. After a month variable D(LY_SA) is 0.027584 % above the average level. After 5 months rate of change of domestic income is 0.027642% above the average level and that percentage persists up to the end of the observed period, i.e. 24 months after. Moreover, two months after the shock domestic income change explains 99.8862% of its own forecast error. After six months this percentage equals 99.8785% and remains the same up to the

end of observed period. On the other hand, change in private savings explains only 0.121502% of forecast error variance seven months after the shock and it does not change up to the end of the observed period

The variance decomposition of change in private savings in Table IV shows that one month after the shock in domestic income change, private savings change is 0.019492% above its average. After five months it is 0.020858% above the average and it remains the same up to the end of observed period. Private savings change explains 99.86322% of its own forecast error one month after the shock. This percentage decreases slightly to 99.10367% after eight months and remains on that level. Furthermore, change in domestic income explains only 0.896331% of forecast error variance seven months after the shock and it remains on that level.

TABLE III
VARIANCE DECOMPOSITION OF CHANGE IN DOMESTIC INCOME (EVIEWS7)

Period	S.E.	D(LY_SA)	D(LS)
1	0.025418	100.0000	0.000000
2	0.027584	99.88862	0.111377
3	0.027591	99.87863	0.121368
4	0.027633	99.87855	0.121447
5	0.027642	99.87851	0.121491
6	0.027642	99.87850	0.121499
7	0.027642	99.87850	0.121502
8	0.027642	99.87850	0.121502
…	0.027642	99.87850	0.121502
24	0.027642	99.87850	0.121502

Source: (Author's calculation)

Analysed variance decompositions from Tables III and IV show that both economic growth and private saving change explain the largest part of its own forecast variance, while the other variable, even after 2 years after the shock, explains very small portion of the forecast error variance. It should be noted here that the expression economic growth is equivalent to positive percentage change in national income. The research by [14] of determinants of private savings in Croatia has also shown that variable private savings in Croatia is self-explanatory. Reference [14] shows that with five included variables that might determine private savings in Croatia (including domestic income approximated by industrial production volume indices); household savings explain the largest part of variation by itself. Reference [16] also shows that the predominant sources of savings fluctuations are due largely to "own shocks". Another interesting result of empirical analysis is that economic growth is not strongly influenced by private savings. This is also shown in empirical research by [21] for African countries. According to [11] empirical research of saving, investment and growth conducted for New Zealand shows that New Zealand has been able to access foreign saving to meet investment demands and that domestic saving does not appear to have constrained investment and hence growth.

TABLE IV
VARIANCE DECOMPOSITION OF CHANGE IN PRIVATE SAVINGS (EVIEWS7)

Period	S.E.	D(LY_SA)	D(LS)
1	0.019492	0.136779	99.86322
2	0.020707	0.194264	99.80574
3	0.020853	0.892093	99.10791
4	0.020857	0.894273	99.10573
5	0.020858	0.894831	99.10517
6	0.020858	0.896264	99.10374
7	0.020858	0.896323	99.10368
8	0.020858	0.896326	99.10367
9	0.020858	0.896331	99.10367
…	0.020858	0.896331	99.10367
24	0.020858	0.896331	99.10367

Source: Author's calculation

IV. CONCLUSION

The relationship of consumer savings and economic growth in the Republic of Croatia is analysed in this paper. Private savings in this research are approximated household deposits in banks. Economic activity in Croatia is firstly analysed using two indicators: gross domestic product (GDP) and industrial production volume indices. Since both indicators exhibit similar trend and seasonality pattern, national income is approximated by industrial production volume indices due to the fact that monthly data are available for mentioned indices while GDP data is published quarterly. Vector Autoregression model is used to assess relationship among private savings and economic growth, for which innovation analysis is used. Innovation analysis includes analysis of the impulse response function and variance decomposition. Domestic income is approximated by seasonally adjusted logarithmic real values of industrial production volume indices. The series is seasonally adjusted since seasonal component is present in original industrial production volume indices data. Private savings are approximated by logarithmic values of real savings and time deposits in banks. Since ADF unit root tests have shown that both mentioned series are non stationary at levels, series are first differenced in order to become stationary.

Therefore, VAR model is estimated with percentage change in private savings and percentage change in domestic income, which can be interpreted as economic growth in case of positive percentage change in domestic income. The Granger causality test has shown that there is no causal relationship among private savings and economic growth in Croatia. Furthermore, impulse response functions are analysed. The shock of domestic income initially affects change in private savings positively, but it fades outafter approximately six months. The impact of private savings change on economic growth, although positive, is short term and very low. The initial impact of economic growth on savings is stronger than the impact of saving on growth. Variance decompositions show that both economic growth and private saving change explain the largest part of its own forecast variance, while the other variable, even after 2 years after the shock, explains very small portion of the forecast error variance. In conclusion, it should be stated that in the case of Croatian small open

economy the link between private savings and growth is weak. However, it should be emphasized that the research is limited by data availability regarding national savings in Croatia. Since national savings data is not available, authors use households' savings which are approximated by household deposits in banks. Microeconomic data provide a unique source of information and author uses households' deposits as approximation of private savings to check whether the possible macroeconomic explanations regarding savings and growth apply at the level of the individual.

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