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Economic Research-Ekonomska Istraživanja

ISSN: 1331-677X (Print) 1848-9664 (Online) Journal homepage: http://www.tandfonline.com/loi/rero20

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To cite this article: Marijana Bađun & Josip Franić (2015) The importance of government incentives for housing savings in Croatia, Economic Research-Ekonomska Istraživanja, 28:1, 331-353, DOI: 10.1080/1331677X.2015.1043777

To link to this article: http://dx.doi.org/10.1080/1331677X.2015.1043777

Published online: 26 May 2015.

Economic Research-Ekonomska Istraživanja, 2015
Vol. 28, No. 1, 331–353, http://dx.doi.org/10.1080/1331677X.2015.1043777

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The importance of government incentives for housing savings in Croatia

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(*Received 29 October 2013; accepted 5 March 2015*)

This article analyses the determinants of housing savings (the contractual saving scheme) in Croatia by applying Vector Autoregression (VAR) methodology on monthly data for the period 2000–2013. The results show that the selected macroeconomic indicators (wages, interest rate, stock exchange index-CROBEX, availability of loans and unemployment rate) do not influence the housing savings market dynamics. Moreover, the housing savings system proves to be resilient to economic downturn. On the other hand, the findings are that the system primarily depends on government incentives (GI) (premiums), as confirmed by the intervention analysis. Each of the three interventions in the structure of incentives (reductions in 2005 and 2013 and the decision to freeze the payment of premiums for 2014) resulted in a significant decline in the number of new housing savings contracts. Since the findings differ from empirical research on determinants of private savings, this article emphasises that housing savings are a specific financial product, very sensitive to institutional changes. Therefore, frequent regulatory modifications, especially regarding government incentives, can easily destabilise the whole system.

Keywords: housing savings; Croatia; government; institutions; government incentives

JEL classification: E21; D14.

1. Introduction

The housing savings system is an organised scheme for the collection of monetary funds-deposits from natural and legal persons, with the purpose of satisfying savers' housing needs by granting them housing loans with the government's financial support (premium). The main rationale behind this type of government intervention is to provide every household with the possibility of obtaining adequate housing, raising the housing quality, and at the same time encouraging saving with a defined purpose. Croatian citizens and natural persons residing in Croatia, as well as Croatian municipalities and cities, are eligible to take up the scheme. However, the latter must use these funds for the construction of residential buildings which meet the housing needs of the low-income population.

The housing savings scheme was introduced in the Croatian legal system in 1998 under the Act on Housing Savings and Government Incentive to Housing Savings (Official Gazette 109/97, 117/97, 76/99, 10/01, 92/05, 21/10, 15/13 and 139/13). During the saving period, users are entitled to both interest on deposits and government incentives

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(GI) approved to housing savings banks from the public budget. The base on which a GI is added is limited by law to HRK 5000. After a five-year period, savers can either withdraw their savings increased by the GI, or enter into a home loan contract with a fixed interest rate during the whole repayment period.

Although a significant number of countries have a long tradition of supporting the acquisition of property, no research has been done on the determinants of this type of saving. Apart from the lack of previous studies, an additional obstacle to analyse determinants of housing savings in Croatia is the limited availability of macroeconomic data. Moreover, the observed period (2000–2013) is relatively short and marked by many regulatory changes and the setting up of new housing savings banks.

Before conducting a statistical analysis, we present data on the housing savings dynamics in Croatia and describe changes in the structure of GIs (the main characteristic of the system), followed by a literature review on the determinants of private saving. The purpose of the literature review is to find potential determinants of housing savings, which will then be expanded with additional variables, specific for the housing savings scheme in Croatia.

2. An overview of government incentives and housing savings data for Croatia

There were five housing savings institutions operating in Croatia, with a total of 703,929 active saving accounts in December 2013. This represents a housing savings take-up by 16% of the total population. The savings reached their peak at the end of 2013 with HRK 6.36 billion. The only year with a negative annual percentage change was 2009 (–9.3%), which was a consequence of a decrease in new savings contracts, a relatively large number of contracts terminated by clients and an increase in expired contracts. Still, it seems that the economic crisis did not have any significant long-term effect on housing savings, because they have been growing since 2009.

The dynamics of the number of savings accounts during the period 2000–2013 is shown in Figure 1. Given that the expected duration of a contract is five years, a clearer picture emerges from Figure 2 showing the number of new housing savings contracts.

The largest number of new contracts was signed in 2004 (154,096) and 2003 (148,194), followed by 2008 (146,068) and 2007 (144,147). With the exception of the

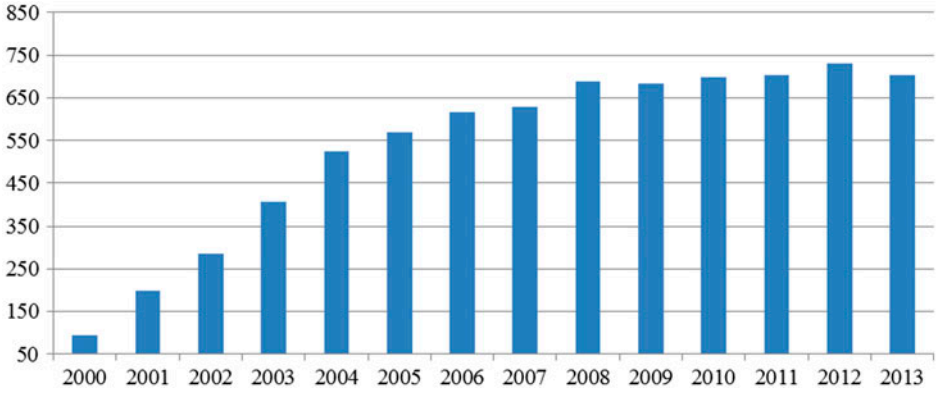

Figure 1. Total number of housing savings accounts (31 December, in thousands).
Source: Housing savings banks' data and authors' calculations.

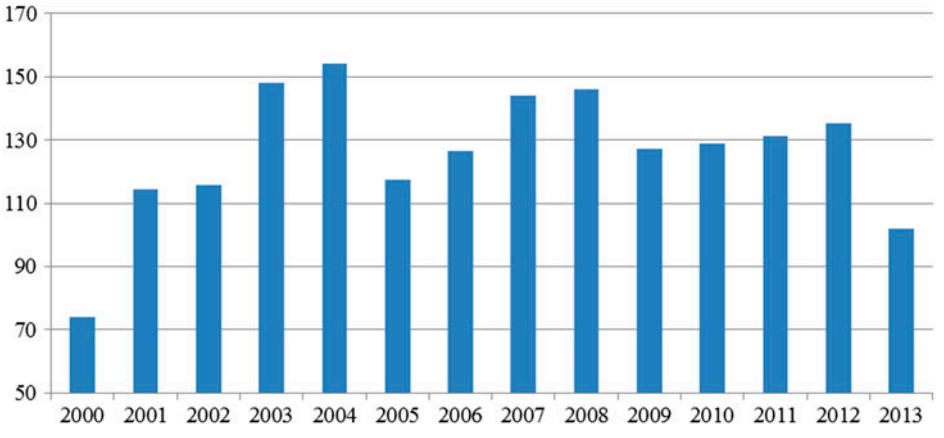

Figure 2. Number of new housing savings contracts (in thousands).
Source: Housing savings banks' data and authors' calculations.

period when the housing savings banks had just begun operating, the lowest interest in housing saving was recorded in 2013 (Figure 2). This is not surprising given that the government first reduced GI from 15% to 10% in January 2013 (legal changes came into force the following month – Official Gazette 15/13), and then decided to suspend the GI payments (in November 2013) for the following year (Official Gazette 139/13). A similar drop is noticeable for 2005, after a decrease in GI in July (starting from August) from 25% to 15% (Official Gazette 92/05). The largest number of contracts expired in 2009, mainly due to the fact that most contracts had been agreed in 2004 and matured five years later.

The first decrease in GI (July 2005) was justified by the fact that housing savings banks did not provide enough loans, i.e. that the fiscal cost of GI was larger than the amount of loans (almost three times in the period 1998–2004). This means that, from the government's perspective, housing savings banks failed to fulfil their purpose (Ministry of Finance, 2005). In addition, according to the Ministry of Finance (MFIN), GIs were larger in Croatia than in other countries implementing housing savings schemes (Czech Republic, Slovakia and Austria).

Regarding the second reduction of GI (January 2013), the MFIN again stated that the primary purpose of the housing savings system was not to satisfy housing needs, but that it rather represented a lucrative form of savings for citizens who did not eventually intend to take a housing loan (Ministry of Finance, 2012). According to the housing savings banks' data, the ratio of loans to deposits at the end of 2012 was 0.54, but varied significantly among individual savings banks. As with the first decrease in GI in 2005, the state of public finances was an additional reason to reduce GI in 2013. However, the decision to freeze GI payments in 2014 was not explained by public budget problems (Ministry of Finance, 2013). Instead, the MFIN reiterated that the system failed to fulfil its purpose. Three central problems with the scheme were highlighted: (1) housing loans issued by housing savings banks accounted for only 5.5% of total housing loans in Croatia; (2) housing savings were primarily used for other purposes rather than solving housing problems; and (3) the number of residential units exceeded the number of families in Croatia by 30%.

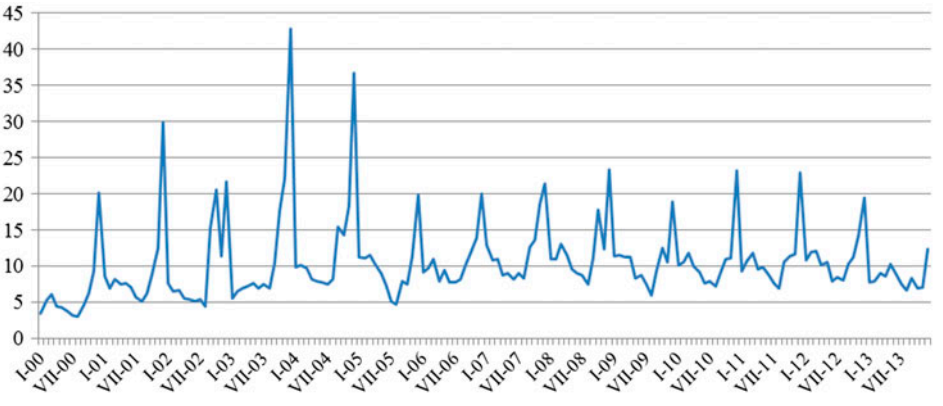

Figure 3. Number of new housing savings contracts (in thousands, monthly data).
Source: Housing savings banks' data.

Figure 3 shows monthly data on new housing savings contracts for the period 2000–2013. The most pronounced characteristic of this time series is seasonality, i.e. strong fluctuations within years. The largest number of new contracts is seen at the end of a year, especially in December, while new contracts are low at the beginning of a year. The year-end increase in the number of new contracts can be explained by the fact that a person can pay in the whole amount of housing savings to get the full GI for a given year, but also by stronger marketing campaigns of housing savings banks.

3. Determinants of private savings: literature review

There are two dominant theories on determinants of private savings: the permanent income theory (Friedman, 1957) and the life-cycle theory (Ando & Modigliani, 1963). Both theories rely on the assumption that individuals plan their savings in the long run, i.e. based on lifelong income expectations. The permanent income theory differentiates between permanent and transitory income as determinants of savings. The former refers to the present value of lifetime income, and the latter represents the difference between current income and permanent income. When a person faces an increase in income that they see as temporary, they are supposed to save that money. However, when an increase in income is regarded to be permanent, the person is supposed to spend it. According to the life-cycle theory, economic agents have negative savings (i.e. the difference between disposable income and consumption is negative) when they are young and have low earnings, then the savings are positive during their most prolific age and eventually negative when they are elderly and retired.

Apart from: (1) income and income growth rate; (2) demographic variables, which are apparent determinants of private savings stemming from these theories, several other variables stand out as determinants of savings in empirical papers, such as: (3) government consumption; (4) financial system development; (5) uncertainty; (6) foreign exchange; and (7) institutions.

The relationship between savings and income is at the centre of the discussion on economic growth. More developed countries usually have higher savings rates, while research results on the causality between savings and economic growth rates are not

unanimous: savings influence economic growth via investment and capital accumulation, and then growth influences savings through these exact channels. Empirical research confirms that income and income growth rate increase private savings (see Appendix 1).

Savings are also influenced by demographic variables, such as the age structure of the population and the share of urban population (see Appendix 1). The older the population, the lower the savings rates. In addition, a larger share of urban population entails lower savings rates, since the urban population has lower precautionary savings, which is high in rural areas with high income volatility. Curtis, Lugauer, and Mark (2011) explicitly check the capability of classic life-cycle studies to explain the transformation of household savings in China over almost five decades. They find, by using the overlapping generations model, that 'the currently observed high saving rate is driven primarily by the reduction in family size resulting from population control policies and the relatively large size of the today's working population' (p. 13).

When it comes to government consumption, there are three different views. The first view suggests that a decrease in government savings can increase consumption and demotivate private savings by transferring the tax burden from current to future generations. In other words, a decrease in government savings results in a decline in total national savings. According to the second view, larger national savings is a consequence of a momentary cutback in public savings. The third view, known as the Ricardian equivalence concept, explains that a decrease in government savings has no effect on national savings, because it increases private savings by the same amount. Empirical research mostly shows that public saving is a partial substitute for private saving (see Appendix 1). Social security can also influence savings; large social benefits decrease motivation to save.

As a proxy for financial system development, empirical models usually contain real interest rate. However, the effect of real interest rates on savings is theoretically ambiguous due to the simultaneous income and substitutions effects. Empirical results also differ, but still there is a weak interest rate elasticity of private savings (see Appendix 1). Scholars also observe financial market depth, measured by the share of M2 monetary aggregate (money and quasi-money) in GDP. The link with private savings is usually positive (Edwards, 1996). The effect of financial liberalisation in empirical research is usually negative (Bandiera, Caprio, Honohan, & Schiantarelli, 2000; Edwards, 1996; Loayza, Schmidt-Hebbel, & Servén, 2000), which means that, in order to increase savings with a goal of achieving higher economic growth rates, it is not recommended to rely on financial liberalisation (decrease of liquidity constraints).

Savings are also influenced by uncertainty, which is a consequence of political and macroeconomic instability. Inflation has a positive impact on savings rates, given that people use savings to protect themselves from future risks. The effect of political instability is positive as well. Moreover, terms of trade and current account deficit also proved to be important determinants of private savings (De Serres & Pelgrin, 2003; Jongwanich, 2010; Masson, Bayoumi, & Samiei, 1998; Ozcan, Gunay, & Ertac, 2003; Schrooten & Stephan, 2005). Positive terms of trade shocks boost savings through a positive impact on wealth and income. An increase in current account deficit reduces savings, because foreign savings partly substitute domestic ones. Several scholarly papers confirm the persistency of private savings rates, i.e. the fact that they are strongly autocorrelated (Dumičić & Čibarić, 2010; Loayza et al., 2000; Ozcan et al., 2003; Schrooten & Stephan, 2005). Therefore, the lagged values of private savings can explain the savings rate in a given year.

In addition to these variables, authors also observe institutional determinants of private savings. Beverly and Sherraden (1999) theoretically point out the importance of financial literacy, institutionalised saving mechanisms, saving incentives, and facilitation in promoting saving. De Castro Campos, Kool, and Muysken (2013) show the importance of informal institutions (thrift, trust, religion), while Schrooten and Stephan (2005) could not prove the significance of the European Bank for Reconstruction and Development (EBRD) institutional reform indicator for the new European Union countries.

Several authors analysed the importance of tax incentives (institutional variable) but mostly in terms of saving for retirement. Vidor (2005) finds that tax exemption of voluntary supplementary pension fund contributions increases household and national savings in Hungary. In other words, tax-deferred savings do not crowd out other types of savings. The findings of Pfarr and Schneider (2013) validate the positive impact of governmental subsidies on private pension programmes. Furthermore, these subsidies provide a stronger motive to save than does the sole rationale to prepare for old age. However, it is not clear whether the higher demand for subsidised pension plans in fact raises private saving rates. Instead, there is a possible substitution of unsubsidised through subsidised products.

Corneo, Keese, and Schröder (2011) also show that special allowances and tax exemptions, set out to stimulate private retirement savings in Germany, have almost no effect on private savings. In the case of Italy, Paiella and Tiseno (2014) find that the pension fund legislation has a great impact on the allocation of savings and causes considerable substitution of non-tax-favoured non-retirement wealth for tax-favoured pension funds. In contrast, it has a weak effect on household saving flows. Engelhardt (1996) concludes that tax subsidies for savings produce a large amount of new household and national savings. His conclusions are based on an analysis of the Registered Home Ownership Savings Plan, a Canadian tax-subsidised savings plan.

There is only one paper on determinants of private savings in Croatia. The authors themselves (Dumičić & Čibarić, 2010) emphasise the paper's shortcomings, mainly in two aspects. Firstly, the 'household bank deposits' and not the 'total private savings' are the dependent variable. Secondly, the industrial production index is used as a proxy for income, since there are no monthly data on the latter. The authors found that the industrial production index, real interest rate and gross foreign debt have a negative impact on savings, while money supply and loans given to households have a positive influence.

4. Potential determinants of housing savings in Croatia

In the above literature review on determinants of private savings, one can find several variables that should be taken into account when analysing housing savings in Croatia. The first among them is income. However, since there is no monthly data on disposable income per capita in Croatia, we use real net wages per employee in legal entities as a proxy. The next potentially important indicator is real interest rate on bank deposits. Financial market development/liberalisation is presumably also important, and the same holds for uncertainty (which can be represented by unemployment). We proxy financial development by: (1) real loans to households by credit institutions; and (2) the shareholder index of the Zagreb Stock Exchange. These two also represent substitutes for housing savings. The inflation rate is excluded due to stable prices in Croatia. Furthermore, it is assumed that government consumption and foreign exchange are not relevant variables, since housing savings are a specific financial product, independent of these

two indicators. Finally, demographic variables are not included in the analysis, as there is no monthly data available.

The main assumption is that changes in institutional variables are of utmost importance, primarily when it comes to GIs and their reductions during the observed period. Finally, we expect inertia in housing savings, i.e. a strong influence of savings in past periods on savings in a current period. Even though it would be useful to include payments to the third pension pillar in our analysis (since they are also linked to GI), this is not possible, given that these data are not available for the whole observed period.

In sum, the following variables are taken into consideration in the rest of the article (the signs in brackets indicate a potential association with housing savings, as one would expect according to the literature on private savings):

- real net wages (*wages*, +)
- unemployment (*unemployment*, –)
- real interest rate on long-term foreign currency deposits (*int_rate*, –)
- Zagreb stock exchange index (*CROBEX*, –)
- real loans (*loans*, –)
- dummy variables for changes in government incentives (*GI*, –)
- dummy variable for the economic crisis (*crisis*, –)
- dummy variables for appearance of new housing savings institutions (*new_hsb*, +)

The following indicators are used as dependent variables: (1) total real housing savings; and (2) the number of new housing savings contracts. We obtain real values by Consumer Price Index (CPI) deflation. All variables, their definitions and data sources are given in the Appendix 1.

5. An analysis of housing savings determinants: vector autoregression models

The goal of this section is to analyse the link between housing savings and the selected set of economic indicators by using the Vector Autoregression (VAR) methodology. The most important advantages of VAR modelling are simplicity of use and simplicity of estimation, since each of the equations in the model can be independently estimated by the ordinary least squares (OLS) method. Unlike in standard multivariate models, in VAR models variables of interest do not necessarily need to be pre-classified as strictly exogenous or endogenous. Instead, mutual interdependence of variables is assumed. A general form of a VAR model with n variables and lag length k is:

$$\boldsymbol{Z_t} = \mu + \mathbf{A}_1\boldsymbol{Z_{t-1}} + \ldots + \mathbf{A}_k\boldsymbol{Z_{t-k}} + \psi\boldsymbol{D_t} + \boldsymbol{e_t} \quad (1)$$

where $Z_t = \begin{bmatrix} Z_{1t} \\ Z_{2t} \\ \vdots \\ Z_{nt} \end{bmatrix}$ is an n-dimensional vector of variables interacting with each other, $\mathbf{A_1},\ldots,\mathbf{A_k}$ are square matrices of parameters of the order n, and $\boldsymbol{D}_t$ is a vector of non-stochastic exogenous indicators with the accompanying matrix of parameters ψ.

The variable of key interest for this part of the analysis is the amount of housing savings. More precisely, we are focused only on the subset of the VAR model in which the amount of housing savings in Croatia is a response variable. To solve the issue of non-constant variance, logarithmic values are used (*lsavings*). Other variables in the

model, in accordance with the above-discussed literature, are the Zagreb Stock Exchange index (*CROBEX*), real net wages (*wages*), the number of unemployed persons (*unemployment*), real interest rate on long-term foreign currency deposits (*int_rate*) and loans to households by credit institutions (*loans*). Since seasonal variations are present, the TRAMO/SEATS procedure is used to obtain seasonally adjusted variables (for *wages, loans, int_rate* and *unemployment*). The extension *_sa* denotes seasonally adjusted variables. All data used are given on a monthly basis for the period January 2000 to December 2013.

Before checking interdependence in a given model, we perform an Augmented Dickey-Fuller test on all variables to check for stationarity. The test results suggest that all variables are integrated of order 1. Given this, the Johansen test of cointegration is performed to test for a long-term equilibrium in the model. The test does not show the presence of long-term equilibrium.

Following this, a VAR model with a constant is constructed, with no exogenous variables and with the vector of endogenous variables $\boldsymbol{Z}_t$ given by:

$$\boldsymbol{Z_t} = \begin{bmatrix} \Delta lsavings_t \\ \Delta CROBEX_t \\ \Delta wages\_sa_t \\ \Delta loans\_sa_t \\ \Delta int\_rate\_sa_t \\ \Delta unemployment\_sa_t \end{bmatrix}.$$

Even though most information criteria (AIC, SC, HQ, FPE) show that the optimal number of lags is $k = 1$, the model with four lags is chosen since it is the first to give satisfactory characteristics of residuals. The results of a Granger causality test based on a given VAR model, with Δ*lsavings* as a response variable, are shown in Table 1.

As can be seen from Table 1, the null hypothesis that each individual macroeconomic indicator in the model does not Granger-cause the dynamics of housing savings cannot be rejected for any of the five conducted tests, since the p-values of test statistics are very high. Likewise, we cannot reject the null hypothesis that variables altogether do not Granger-cause the housing savings amounts (p-value = 0.84). Therefore, there is no evidence that the dynamics of the housing savings market depends on the given macroeconomic variable trends.

The same conclusion comes from a variance decomposition given in Table 2, which shows that after one month the variable Δ*lsavings* itself fully explains its variations, while after 12 months, that share is 92.21%. At the same time, other variables do not have any significant influence. Since the outcome of the variance decomposition depends on the variable ordering in Cholesky factorisation, additional analyses with

Table 1. Results of a Granger causality test in a VAR model, response variable Δ*lsavings*.

Null hypotheses	χ^2 test statistics	p-value
Δ*CROBEX* does not Granger-cause Δ*lsavings*	0.84	0.94
Δ*wages_sa* does not Granger-cause Δ*lsavings*	4.11	0.39
Δ*loans_sa* does not Granger-cause Δ*lsavings*	4.16	0.38
Δ*int_rate_sa* does not Granger-cause Δ*lsavings*	5.59	0.23
Δ*unemployment_sa* does not Granger-cause Δ*lsavings*	0.43	0.98
Variables altogether do not Granger-cause Δ*lsavings*	13.80	0.84

Source: Housing savings banks' data and authors' calculations.

Table 2. Variance decomposition for variable Δ*lsavings*.

Period	S.E.	Δ *lsavings*	Δ *CROBEX*	Δ *wages_sa*	Δ *loans_sa*	Δ *int_rate_sa*	Δ *unemployment_sa*
1	0.037	100.00	0.00	0.00	0.00	0.00	0.00
2	0.040	96.67	0.72	0.25	2.07	0.17	0.12
3	0.040	96.16	0.71	0.25	2.31	0.43	0.14
4	0.041	93.55	0.80	0.59	2.33	2.58	0.15
5	0.043	92.92	0.74	1.04	2.37	2.54	0.39
6	0.044	92.66	0.74	1.32	2.33	2.51	0.44
7	0.044	92.52	0.73	1.41	2.33	2.55	0.46
8	0.045	92.47	0.77	1.40	2.27	2.61	0.48
9	0.045	92.43	0.76	1.45	2.25	2.58	0.53
10	0.045	92.35	0.76	1.53	2.23	2.55	0.58
11	0.046	92.26	0.77	1.57	2.21	2.59	0.60
12	0.046	92.21	0.77	1.59	2.20	2.61	0.62

Cholesky ordering: Δ*lsavings*, Δ*CROBEX*, Δ*wages_sa*, Δ*loans_sa*, Δ*int_rate_sa*, Δ*unemployment_sa*

Source: Housing savings banks' data and authors' calculations.

modified order are performed. Differences in results are negligible and the conclusion is the same.

These findings are not surprising, given that the expected period for housing savings is five years. More specifically, after they start to save, GIs motivate savers to save for five years, thus neutralising the possible effects of changes in other macroeconomic indicators on housing savings.

6. Sensitivity analysis

In this section, we replace the amount of housing savings in the VAR model with the number of new housing saving contracts. All other variables remain the same and are, as before, given on a monthly basis for the period 2000–2013. The goal is to find out to what extent the selected macroeconomic indicators influence an individual's decision to open a housing savings account.

In order to solve the issue of a non-constant variance in the newly included variable (the number of new housing saving contracts), log values are used in the analysis. The next step is to address the problem of seasonality, which remains persistent after taking log values. The analysis of autocorrelation and partial autocorrelation functions indicates that seasonality can be efficiently removed by seasonal differencing with period $s = 12$. When compared with the results of the TRAMO/SEATS procedure, seasonal differencing gives better results and will therefore be applied. Following this, the response variable of interest in VAR modelling is given by:

$$\Delta_{12} lnew\_contracts_t = \log(new\_contracts_t) - \log(new\_contracts_{t-12}) \qquad (2)$$

An augmented Dickey-Fuller test shows that the variable obtained in this way does not contain a unit root. We next perform a VAR analysis without exogenous variables, where the vector $\boldsymbol{Z}_t$ of potentially inter-related variables is:

Table 3. The Granger causality test results for a given VAR model, response variable $\Delta_{12}lnew\_contracts$.

Hypotheses	χ^2 test statistics	*p*-value
$\Delta CROBEX$ does not Granger-cause $\Delta_{12}lnew\_contracts$	0.64	0.89
$\Delta wages\_sa$ does not Granger-cause $\Delta_{12}lnew\_contracts$	1.37	0.71
$\Delta loans\_sa$ does not Granger-cause $\Delta_{12}lnew\_contracts$	5.34	0.15
Δint_rate_sa does not Granger-cause $\Delta_{12}lnew\_contracts$	0.58	0.90
$\Delta unemployment\_sa$ does not Granger-cause $\Delta_{12}lnew\_contracts$	1.14	0.77
Variables altogether do not Granger-cause $\Delta_{12}lnew\_contracts$	12.74	0.62

Source: Housing savings banks' data and authors' calculations.

$$Z_t = \begin{bmatrix} \Delta_{12}lnew\_contracts_t \\ \Delta CROBEX_t \\ \Delta wages\_sa_t \\ \Delta loans\_sa_t \\ \Delta int\_rate\_sa_t \\ \Delta unemployment\_sa_t \end{bmatrix}$$

The optimal number of lags is $k = 3$. Granger causality tests for a given VAR model are shown in Table 3.

None of the five conducted tests reject the null hypothesis (5% significance level) that each individual indicator in the model does not Granger-cause changes in the dynamics of new housing savings contracts. Equally, we cannot reject the null hypothesis of the joint test that all variables together do not Granger-cause changes in the dynamics of new housing savings contracts. Hence, there is no evidence that selected macroeconomic indicators influence the housing savings market.

7. Intervention analysis

Since no dependency of housing savings on the selected set of macroeconomic variables is found, the next step is to examine the sensitivity of the system to both internal and external shocks that emerged during the observed period. We therefore apply the intervention analysis, which is a macroeconomic analysis used to evaluate the long-term effect of various events (such as economic shocks, political decisions, structural changes, etc.) on the observed time series, or, more precisely, on its expected value and trend (Box & Tiao, 1975).

There were six events in the observed period for which it is realistic to expect that they could have influenced individuals' decisions about commencing housing savings. Namely, after 2000, two housing savings institutions have started operating in Croatia (PBZ stambena štedionica in February 2003 and HPB stambena štedionica in May 2006). The assumption is that these two events increased the number of savers. On the other hand, and as described earlier, GIs were decreased from 25% to 15% in July 2005, and further decreased to 10% in January 2013. Finally, in November 2013 the government decided not to subsidise housing savings in 2014. These three changes presumably reduced the attractiveness of housing savings. In addition to this, one should not neglect the role of the economic crisis which started in 2009 and continued throughout the observed period.

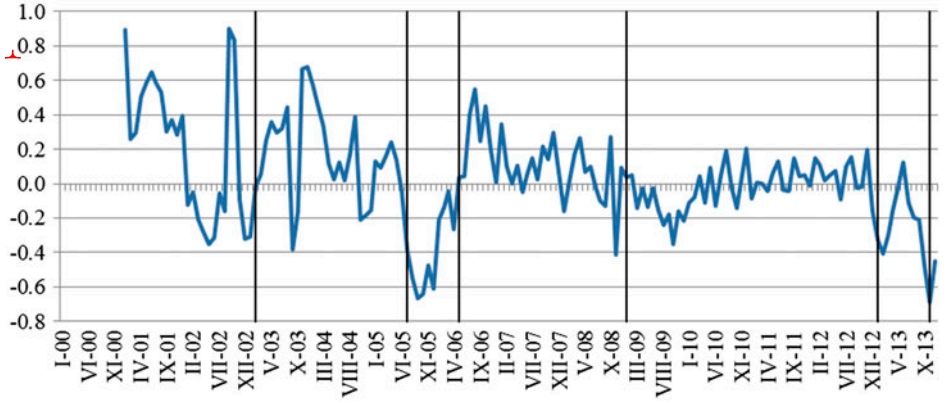

Figure 4. Changes in the number of new housing savings contracts compared to the same month in the previous year (log values).
Source: Housing savings banks' data and authors' calculations.

Figure 4 shows changes in the number of new housing savings contracts per month, compared to the same month in the previous year for the period 2000–2013. Vertical lines represent the occurrence of the six shocks. The figure suggests the susceptibility of the housing savings market to these interventions, which particularly holds for the period after the second shock (the first reduction in GI), during which a strong fall on a monthly level is noticeable compared to the period before the intervention. Similarly, the second decrease in GI in 2013 and the decision to freeze the payment of incentives for 2014 also seems to have a negative impact. As a matter of fact, a drop in the number of new contracts is evident even before each of these three interventions in the system of incentives, probably as a result of a public debate preceding them. However, for the sake of simplicity, it will be assumed later in the analysis that each shock occurred exactly at the moment of intervention. On the other hand, things are not apparent when it comes to the long-term effect of the economic crisis and the emergence of the two new housing savings institutions.

The dependent variable in the model is the number of new savers. As in the previously described VAR model, the analysis is based on log values, which are seasonally adjusted by differencing with period 12. Alongside the afore-discussed satisfactory characteristics of the time series transformed in this way, the analysis conducted on differenced log data has an additional advantage. Specifically, for a general time series x_t it holds that:

$$\Delta_{12}\ln x_t = \ln x_t - \ln x_{t-12} \approx (x_t - x_{t-12})/x_{t-12} \tag{3}$$

For that reason, coefficients in the intervention analysis can be interpreted as average percentage changes of the dependent variable following the shock compared to the same month in previous years.

The assumption is that interventions result in an instant and long-term shift of the expected value of the dependent variable. Hence these shifts are modelled with the following equations:

$$m_{it} = \beta_i S_{it}^T, \quad i = 1, \ldots, 6 \tag{4}$$

where m_{it} represents the change in the expected value due to i^{th} intervention, β_i denotes the magnitude of the change due to *ith* intervention and

$$S_{it}^{T} = \begin{cases} 1, T_i \le t < T_{i+1} \\ 0, \text{otherwise} \end{cases}, \quad i = 1, ..., 5$$
$$S_{6t}^{T} = \begin{cases} 1, T_6 \le t \\ 0, \text{otherwise} \end{cases}$$

are step-functions, representing the occurrence of the six modelled interventions.

Since the autocorrelation and partial autocorrelation functions of the variable $\Delta_{12} lnew\_contracts$ suggest that we are dealing with an autoregressive process of order one (AR (1)), the observed model is as follows:

$$\Delta_{12} lnew\_contracts_t = \phi \Delta_{12} lnew\_contracts_{t-1} + \beta_1 new\_hsb1_t + \beta_2 GI1_t + \beta_3 new\_hsb2_t + \beta_4 crisis_t + \beta_5 GI2_t + \beta_6 GI3_t + \varepsilon_t \tag{5}$$

where

$\Delta_{12} lnew\_contracts$- new contracts per month (log values, seasonally adjusted)

$$new\_hsb1_t = \begin{cases} 1, T_1 \le t < T_2 \\ 0, otherwise \end{cases} \quad T_1 = \text{February 2003}, \quad T_2 = \text{July 2005}$$

$$GI1_t = \begin{cases} 1, T_2 \le t < T_3 \\ 0, \text{otherwise} \end{cases} \quad T_3 = \text{May 2006}$$

$$new\_hsb2_t = \begin{cases} 1, T_3 \le t < T_4 \\ 0, \text{otherwise} \end{cases} \quad T_4 = \text{January 2009}$$

$$crisis_t = \begin{cases} 1, T_4 \le t < T_5 \\ 0, \text{otherwise} \end{cases} \quad T_5 = \text{January 2013}$$

$$GI2_t = \begin{cases} 1, T_5 \le t < T_6 \\ 0, \text{otherwise} \end{cases} \quad T_6 = \text{November 2013}$$

$$GI3_t = \begin{cases} 1, T_6 \le t \\ 0, \text{otherwise} \end{cases}$$

The results shown in Table 4 suggest that the onset of the economic crisis had no significant long-term influence on the number of new housing savings contracts. Thus, the housing savings system seems to be generally resilient to crisis, which is also confirmed by the small number of non-performing loans (only 0.9% in 2012).

On the other hand, all the three changes in GI and the entry of 'PBZ stambena štedionica' into the market are significant (p-values < 0.1), while no significant long-term influence of the entry of 'HPB stambena štedionica' into the market has been found. The estimated coefficient for the variable GI1 shows that the number of new contracts

Table 4. Results of an intervention analysis, dependent variable Δlog (*new_contracts*).

Variable	Coefficient	Standard error	*t*-statistics	*p*-value
AR(1)	0.52	0.07	7.74	0.000
new_hsb1	0.16	0.07	2.21	0.029
GI1	−0.33	0.11	−2.88	0.005
new_hsb2	0.09	0.07	1.36	0.175
crisis	−0.01	0.06	−0.23	0.816
GI2	−0.21	0.12	−1.82	0.071
GI3	−0.49	0.19	−2.50	0.013
$\overline{R^2}$ = 0.50	Standard error = 0.21			

Source: Housing savings banks' data and authors' calculations.

fell by 33% following the first reduction of GI. A slightly less severe drop occurred after GI was reduced to 10% in 2013 (accounting for 21%), while the government's decision not to subsidise housing savings in 2014 almost halved the number of new contracts.

8. Conclusion

The analysis of determinants of housing savings in Croatia based on the VAR methodology for the period 2000–2013 (monthly data) shows that macroeconomic variables (wages, interest rate, CROBEX, availability of loans and unemployment) do not influence the size of housing savings, nor the dynamics of new contracts. The housing savings system primarily depends on GIs, which is confirmed by the intervention analysis. Additionally, housing savings are characterised by strong inertia, i.e. they depend on savings from previous periods. This is not surprising, since people are motivated to save until the end of the contract period in order to get GI. This neutralises the possible effects of changes in other macroeconomic indicators on the housing savings market. The analysis also shows that the housing savings system is resilient to economic crisis.

Since the results differ from empirical research on determinants of private savings, we can conclude that housing savings are a specific financial product, very sensitive to institutional changes. This is why it is necessary that changes in the regulatory environment should not be frequent, in order to prevent uncertainty from being brought into the system, and that they should be well thought-out and reasoned. This especially holds for reductions or any other measure relating to GIs. It should be noted that a fall in the total amount of housing savings automatically reduces the ability of housing savings banks to give loans to citizens, which can destabilise the whole system of housing savings supported by the government.

Acknowledgements

The authors would like to thank two anonymous reviewers for their very helpful comments and suggestions. This article is based upon the research project 'Analysis of Housing Savings System in Croatia' commissioned from the Institute of Public Finance by the Croatian Banking Association and all housing savings banks operating in Croatia (HPB stambena štedionica, PBZ stambena štedionica, Prva stambena štedionica, Raiffeisen stambena štedionica, Wüstenrot stambena štedionica), which also funded the project.

Disclosure statement

No potential conflict of interest was reported by the authors.

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Appendix 1.

Table A1. Determinants of private savings: a review of empirical research.

Authors	Sample	Period	Methodology	Dependent variable	Independent variables	Main conclusions
Athukorala and Sen (2004)	India	1954–1998	General to specific modelling	Share of private savings in gross national disposable income	Real national disposable income (GNDI) per capita growth rate, population growth rate, real interest rate, real wealth (share of M3 in GNDI), inflation rate, terms of trade, share of public savings in GNDI, number of inhabitants per bank branch, share of remittances from abroad in GNDI	Real interest rate, level and growth rate of income per capita, expansion of bank branches and inflation rate have a positive impact on private savings. Terms of trade and remittances from abroad negatively influence the private savings rate. Public savings partially substitute for private savings.
Athukorala and Tsai (2003)	Taiwan	1952–1999	Time series analysis (UECM method)	Share of household savings in household disposable income	Real household disposable income growth rate, real household disposable income, share of population < 15 in working-age population, share of population > 65 in working-age population, unemployment rate, real interest rate on bank deposits, inflation rate, share of loans to households in household disposable income, dummy variable for financial liberalisation, share of social security contributions in household disposable income, share of corporate savings and public savings in disposable household savings, share of household financial wealth in disposable household income	Income and income growth rate positively influence the household savings rate. Social insurance, availability of loans and population ageing decrease the household savings rate. Corporate savings do not influence household savings, while public savings only partially crowd them out. Real interest rate increases household savings, and inflation decreases them, but the effects are insignificant.

Bandiera et al. (2000)	8 developing countries	1970–1994	Time series and panel analysis	Share of private savings in gross national disposable income	Real interest rate, financial liberalisation index, inflation rate, public savings, income	The effect of real interest rate on private savings is positive, but small. The influence of financial liberalisation in panel analysis is negative, and the results differ across countries.
De Castro Campos et al. (2013)	30 OECD countries	1990–2010	Panel analysis	Share of private savings (difference between total and public savings) in GDP	Share of government budget (difference between current revenues and expenditures) in GDP, GDP growth rate, inflation rate, share of net financial wealth in GDP, real disposable income per capita, share of young (<15) and old (>65) population in working-age population, thrift, trust, religiosity	Thrift and trust affect private savings positively and religiosity decreases them.
Cohn and Kolluri (2003)	G7 countries	1960–1999	Time series analysis (ECM)	Real household savings per capita	Real disposable household income, real public savings per capita, real social contributions per capita, real interest rate, inflation rate	Real interest rate increases household savings. Public savings decrease household savings. A decrease in social contributions increases savings.
De Serres and Pelgrin (2003)	15 OECD countries	1970–2000	Dynamic panel analysis	Share of private savings in gross national savings	Share of population > 65 in working-age population, ratio of real GDP and total employment (labour productivity), terms of trade, real interest rate, inflation rate, gross public sector savings rate	Private savings rates in OECD countries are affected by public sector savings rates, demographic structure of population, productivity growth rate, changes in terms of trade and real interest rate.
Dumičić and Čibarić (2010)	Croatia	1998–2008 (monthly data)	Time series analysis (VAR model)	Real household deposits with banks	Real industrial production index (instead of income), real interest rate on foreign currency deposits, real money supply,	Industrial production negatively influences private savings, and so do real interest rate and gross foreign debt.

(*Continued*)

Table A1. (*Continued*).

Authors	Sample	Period	Methodology	Dependent variable	Independent variables	Main conclusions
					real gross national debt, real loans to households	Loans to households and money supply positively influence private savings. There is strong persistency of bank deposits, i.e. savings from previous periods are an important determinant of savings in the current period.
Edwards (1996)	36 countries	1970–1992	IV panel analysis	Share of private savings in GDP	Share of sum of young (<15) and old (>65) population in working-age population, share of urban population in total population, share of public savings in GDP, 3-year average of real GDP per capita growth rate, share of public savings in GDP, GDP per capita, share of M2 in GDP, share of loans to private sector in total loans, share of social insurance expenditures in total public expenditures, real interest rate on saving deposits, share of current account deficit in GDP, inflation, income ratio between the poorest 40% and the richest 10%, political stability	Private savings can be increased by larger financial market depth, decrease in social insurance and decrease in public savings. Share of urban population decreases savings as well as sum of young and old population. GDP per capita and GDP per capita growth rate increase private savings and the availability of loans decreases them.
Horioka and Wan (2007)	China (31 provinces)	1995–2004	Dynamic panel analysis	Share of household savings in household disposable income	Real disposable income per household growth rate, share of population < 15 in working-age population, share of population > 65 in working-age	The main determinants of household savings rate in China are: lagged savings rate, income growth rate, real interest rate and inflation rate.

					population, previous periods' savings rate, real interest rate, inflation rate, dummy variable for rural households	
Hüfner and Koske (2010)	G7 countries	1970–2008	Panel cointegration	Share of household savings (minus fixed capital consumption) in household disposable income	Real disposable income per household member, real interest rate, inflation rate, share of population > 65 in working-age population, share of current liabilities of banks and other financial intermediaries in GDP, share of net financial liabilities of general government in GDP, real stock prices, real real-estate prices, difference between actual unemployment rate and NAIRU (non-accelerating inflation rate of unemployment)	Disposable income, real interest rate and inflation rate are important determinants of household savings in most countries. Demographics, country debt, financial system depth, stock prices and real-estate prices are important in a few countries.
Jongwanich (2010)	Thailand	1960–2004	Time series analysis (ARDL model)	Share of household savings in gross national disposable income and share of private savings in gross national disposable income	Real national disposable income (GNDI) per capita growth rate, real GNDI per capita, real interest rate on bank deposits, share of public savings in GNDI, share of population < 15 in working-age population, share of population > 65 in working-age population, inflation, terms of trade (price ratio of exports and imports), liquidity constraint (share of private loans in GNDI), share of corporate savings in GNDI	Increases in economic growth rate, inflation and terms of trade increase the private savings rate and household savings rate. Availability of loans decreases the savings rate. Corporate savings decrease household savings, as do the shares of young and old population. Public savings crowd out private savings but less than proportionally.
	150 countries	1965–1994				

(*Continued*)

Table A1. (*Continued*).

Authors	Sample	Period	Methodology	Dependent variable	Independent variables	Main conclusions
Loayza et al. (2000)			Dynamic panel analysis	Share of private savings in gross national disposable income	Dependent variable in previous period, share of public savings in real national disposable income (GNDI), share of M2 in GNDI, real interest rate on saving deposits, share of loans to private sector in GNDI, share of young (<15) and old (>65) population in total population, share of urban population in total population, terms of trade (ratio of nominal export/import to real export/import), share of difference between import and export in GNDI, level and growth rate of real GNDI per capita, inflation rate, share of public investment in GNDI, dummy variable for oil crisis	Private savings rates are strongly correlated, i.e. characterised by strong inertia. Real income per capita and real income per capita growth rate positively influence the private savings rate. Share of old population reduces the private savings rate, as does larger loans availability, while inflation increases it. There is no evidence for the existence of full Ricardian equivalence.
Masson et al. (1998)	21 industrialised countries and 40 developing countries	1971–1993 for industrialised countries and 1982–1993 for developing countries	Panel analysis	Share of private savings in GDP	Share of budget balance in GDP, share of current government expenditures in GDP, share of government investment in GDP, GDP growth rate, share of financial wealth in GDP, inflation rate, percentage change in terms of trade, GDP per capita relative to USA GDP per capita, current account balance in GDP, demographic dependency rate	Decreases in public savings (government consumption growth) increase private savings. Demographic determinants are statistically significant but the effect is not strong. Beyond a certain threshold, income does not play an important role. Real interest rate and terms of trade positively influence private savings, but the latter does so

						only in industrialised countries.
Ozcan et al. (2003)	Turkey	1968–1994	Time series analysis (AR model)	Share of private savings in gross national disposable income	Dependent variable in previous period, share of public savings in gross national disposable income (GNDI), share of M2 in GNDI, real interest rate on saving deposits, share of loans to private sector in GNDI, share of young (<15) and old (>65) population in total population, share of urban population in total population, life expectancy at birth, terms of trade, share of difference between import and export in GNDI, level and growth rate of GNDI per capita, inflation rate, dummy variable for political stability (changes in government) and dummy variable for economic crisis	Private savings rates are strongly correlated, i.e. characterised by inertia. Public savings partially crowd out private savings. Income level, financial system development, inflation and terms of trade positively influence the private savings rate, while the influence of life expectancy and economic crisis is negative.
Schrooten and Stephan (2005)	EU-10 and EU-15 member states	1992–2000 for EU-10 and 1993–2000 plus 1973–1994 for EU-15	Dynamic panel analysis	Share of private savings in GDP (difference between total national and public savings)	Dependent variable in previous period, real GDP per capita growth rate, inflation rate, unemployment rate, real interest rate, share of loans to private sector in GDP, share of M2 in GDP, share of social insurance contributions in current revenues, share of sum of young (<15) and old (>65) population in working-age population, share of current	Determinants of private savings rates in EU-10 and EU-15 member states are very similar. Private savings are highly persistent. Income growth increases private savings. Public savings crowd out private savings. The share of M2 in GDP is significant only in EU-10 countries and it decreases private savings, and so does share of young and

(*Continued*)

Table A1. (*Continued*).

Authors	Sample	Period	Methodology	Dependent variable	Independent variables	Main conclusions
					account balance in GDP, share of direct foreign investment in gross fixed capital formation, EBRD indicator of institutional development, public savings rate, dummy variable for initial transition shock	old population in working-age population. Loan availability, real interest rate, inflation, unemployment rate, social contributions, foreign investment and institutional development are not significant. Current account deficit decreases private savings.

Table A2. Variables in the analysis of housing savings determinants.

Variable	Description	Data source
Real housing savings	Housing savings, with CPI deflation	Croatian National Bank, and authors' calculations
New housing savers	Number of new housing savings contracts	Housing savings banks' data
Real net wages	Monthly net wage per employee in legal entities, with CPI deflation	Croatian Bureau of Statistics, authors' calculations
Unemployment	Number of unemployed persons	Croatian Employment Service
Real interest rate	Interest rate on long-term foreign currency deposits minus inflation rate	Croatian National Bank and authors' calculations
CROBEX	Shareholder index of Zagreb Stock Exchange	Zagreb Stock Exchange
Real loans	Loans to households by credit institutions, with CPI deflation	Croatian National Bank, and authors' calculations
Government incentives (GI)	Dummy variables for decreases in GI	Official Gazette of the Republic of Croatia
Economic crisis	Dummy variable for economic crisis (quarterly negative GDP growth rates)	Croatian Bureau of Statistics