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MACROECONOMIC DETERMINANTS OF HOUSEHOLD SAVINGS IN UKRAINE

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ABSTRACT. The article elaborates on the issue of household savings in Ukraine and investigates the most significant macroeconomic indicators that influence their formation. The research also focuses on testing the hypothesis of structural breaks in formation of household savings in Ukraine after the World financial crisis. Formation process of household savings was studied with using the econometric modeling, particularly a multiple linear regression model with an error correction term. Estimated model demonstrated adequacy, stability as well as good performance and could be used for forecasting. Our results showed that household consumption expenditures and gross national income were the most significant macroeconomic determinants of household savings in Ukraine. In contrast to expectations, hypothesis testing indicated structural break in formation of household savings in Ukraine only in 2010.

JEL Classification: C22, E21 ***Keywords***: household savings, gross domestic savings, Ukraine, error correction model, unit root.

Introduction

Saving is one of the most important types of household‘s economic activities. Its significance can be seen from the point of view of both microeconomics as well as macroeconomics. First of all, household savings ensure stable level of consumption for households at microeconomic level during time of income reduction, for example, due to job loss, disability or retirement. Undoubtedly, savings provide safety for a household in sense of future uncertainty. Secondly, aggregated household savings at macroeconomic level can be used as a source of investments.

There is a variety of articles, which elaborate on importance of savings for economy. For example, Ramsey (1928) was one of the first who tried to solve the problem of how much a nation should save with the help of mathematical modeling. Nevertheless, his study was not accepted by scientific society of his time due to serious mathematical tools. However, it was used as a basis for investigations of Koopmans (1963) and Cass (1965) in the 1960s. More recent work of Ramskyi (2013) elaborated on the influence of household savings on development of gross domestic product and found out that household savings had great potential to impact financial resources formation. In addition, Krupa (2013) allocated economic, social and political significance of savings for Ukrainian economy. Household

savings were also considered as important source of investments in Ukraine by Ramskyi (2007), Stepanova and Udod (2012) as well as many other Ukrainian scholars.

Generally, Ukrainian economists believe that household savings can become alternative to foreign capital, bank loans and budget funding as a source of real economy sector financing in Ukraine and have considerable potential. Therefore, policy makers should take into account household savings, sustainable growth of which will induce economic development of the country. Moreover, it is important for policy makers to understand which macroeconomic factors have the most significant influence on household savings in order to understand processes of their formation as well as to be able to manage them. Likewise, policy makers should be able to forecast values of household savings at macroeconomic level and use the results of forecasts in decision making processes.

Aforementioned indicates topicality of household savings investigation at macroeconomic level. Admittedly, econometric modeling gives us suitable virtues for this research. The goal of the study is to determine the most significant factors that influence the formation of household savings in Ukraine at macroeconomic level. The object of research is one of the household economic activities, particularly – households` system saving at macroeconomic level. In addition, we would like to test the hypothesis whether there was structural break in formation of household savings in Ukraine after world financial crisis.

Article consists of eight parts: Introduction, Literature Review, Methodology, Data Diagnostic, Model Estimation, Model Diagnostic, Structural Breaks Testing and Conclusions. In Literature Review section we have analyzed theoretical as well as recent empirical studies. Further, we have briefly described methods used for research. In particular, we have mentioned applied modeling technique in Methodology chapter. Data Diagnostic section includes unit roots testing of our data. In next section (Model Estimation) we have estimated error correction model as well as provided information about its econometric properties and interpretation of its parameters. Model Diagnostic part provides postdiagnostic tests of developed model. In the following Structural Breaks Testing chapter we have tested the hypothesis of household savings structural breaks in financial crisis years. Final section elaborates on conclusions and policy implications stemming from our research.

1. Literature Review

In general, household savings are the difference between household income and expenditures. From our point of view such definition of household savings is too limiting. Particularly, household savings should also include household expenditures on durables. Especially the price of which may increase over time depending on market conditions. Experience shows that in times of economic instability the safest way not to lose savings is to purchase real estate, although it lacks liquidity. Moreover, the most reliable and efficient way of savings according to Becker (1962) is investment in children.

Keynes (1936) highlights eight main motives that encourage household saving. He believes that households save in order to:

1) create money reserve in case of unexpected negative events in the future;
2) ensure stable expenditures in retirement when income decreases;
3) receive interest payments;
4) be able to increase expenditures;
5) have the feeling of independence and free opportunities, although without clear ideas and specific intentions or needs;
6) have the possibility to participate in potential business project;
7) leave bequest;
8) satisfy their greediness, which is the reason for unwillingness to spend.

In like manner, Wärneryd (1999) identifies motives that have influence on household saving, namely:

1) saving as a habit;
2) saving for precaution reasons;
3) saving to leave bequest;
4) saving for profit.

Moreover, he notes that households usually have more than one motive to save at the same time.

Relative income hypothesis was one of the first attempts to explain relationship of household savings and income. Duesenberry (1952) formulated his theory in two versions: intertempolar and cross-sectional. The common basis of both of them was that household consumption and saving depended on current income, which was compared to some income standard. This theory was successful in explaining Kuznets paradox (Kuznets, 1946) and was very popular in 50s.

Furthermore, permanent income theory and life-cycle hypothesis, introduced respectively by Friedman (1957) and Modigliani (1966), successfully explained household income allocation between consumption and saving.

One of numerous empirical works that revealed cross-country evidence about household saving in developing countries was conducted by Schmidt-Hebbel, Webb and Corsetti (1992). Their article used household panel data available from the U.N. System of National Accounts to investigate relationship between savings and income, its growth, rates of return, monetary wealth, foreign saving as well as demographic variables. They identified that income and wealth factors affected saving significantly. Inflation and the interest rate did not show clear impact on saving, which was consistent with their theoretical ambiguity. Foreign saving and monetary assets had high negative influences on household saving, which demonstrated the relevance of liquidity constraints and monetary wealth in developing countries. Similarly, Muradoglu and Taskin (1996) followed the same framework and tried to distinguish differences of household saving behavior in industrial and developing countries. Their main conclusion was that determinants of household savings behavior for industrial countries were not valid for developing countries and vice versa.

Additionally, Callen and Thimann (1997) investigated factors affecting household saving based on panel dataset of 21 OECD countries. They have used fixed-effects model specification to show that public and corporate saving, growth and demographics were the most significant determinants of saving, whereas inflation, unemployment, financial deregulation and real interest rate were less important factors. Moreover, variables capturing structure of tax, social security and welfare systems also appeared to be essential for household saving behavior.

As for empirical studies of savings in individual countries, we can point out the article of Cohn and Kolluri (2003), where authors analyzed determinants of household saving in G-7 countries based on individually estimated error correction models for each county. Generally, effects of changes in the real interest rate, real disposable per capita income, real per capita government saving, real per capita social security contributions, and inflation significantly affected per capita household savings. In addition, interest rate, government saving and social security contributions determined household savings of G-7 countries in long run.

Next, Athukorala and Tsai (2003) used unrestricted error correction modeling methodology in order to parcel out determinants of household savings in Taiwan. Authors concluded that household saving rate rose with both the level and the rate of growth of household disposable income. The real deposit rate had a significant positive impact, while increased availability of social security provisions and enhanced credit availability as well as old- and young-dependency in population had a negative impact on the saving rate in Taiwan.

Further, Narayan and Narayan (2006) estimated error correction model to investigate factors influencing the savings rate in Fiji. They found out that in the short run growth rate and real interest rate had positive impact on saving, while current account deficit had negative effect. In the long run saving rate in Fiji was positively affected by growth rate, whereas real interest rate and current account deficit had negative influence. Alike, Nwanchukwu and Egwaikhide (2007) dealt with determinants of private saving in Nigeria using error correction model. They suggested that income, external terms of trade, inflation, external debt service ratio and public saving increased private saving. In contrast interest rate as well as growth of income reduced Nigerian private saving.

The following study of Jongwanich (2010) covered determinants of household savings in Thailand. Author constructed error correction model to examine a broad set of macroeconomic factors. He concluded that economic growth, inflation and terms of trade positively affected savings. On the contrary public and corporate savings, elderly and young dependencies as well as availability of credit decreased household savings in Thailand. Likewise, Chaudhry, Faridi, Abbas and Bashir (2010) investigated determinants of national savings of Pakistan with the help of error correction methodology. They showed that in long run consumer price index, exports, workers remittances, public loans, government spending and interest rate turned out to be significant factors in determining the savings.

Empirical research pursued by Zhuk and Zdrok (2014a) studied structure of main Ukrainian household economic activities in general and saving in particular as well as dynamics of interrelationships between them with the help of vector autoregressive (VAR) modeling. Based on estimated VAR model, authors studied individual and aggregated influence of lagged values of indicators upon their current values and system`s reaction on main indicators impulses. They also conducted two types of forecasts that reflected general tendency of development of economic activity of households in Ukraine. In addition, Zhuk and Zdrok (2014b) carried out univariate analysis of gross domestic savings dynamics in Ukraine as well as estimated autoregressive integrated moving average model, based on Box and Jenkins (1979) methodology, suitable for univariate forecasting of gross domestic savings in Ukraine.

Finally, Kolasa and Liberda (2015) analyzed formation of private and household saving in Poland using GMM (generalized method of moments) dynamic system approach. Authors demonstrated that the most essential factors driving saving in Poland were income and its growth, interest rate, government and corporate saving.

2. Methodology

In order to investigate the most influential factors that determine household savings formation in Ukraine a tool of econometric modeling is used. Particularly, we have constructed multiple linear regression model with error correction term or error correction model (ECM). This approach was firstly applied by Sargan (1964). Such type of econometric model is usually used in macroeconomic data analysis because it can help to avoid estimation of spurious regression based on non-stationary datasets. As usual most of macroeconomic indicators time-series are non-stationary, for example gross domestic product, consumption and income series almost always have trend. Moreover, Narayan and Narayan (2006) as well as Jongwanich (2010) suggest that ECM is suitable for small sample research and Nwanchukwu and Egwaikhide (2007) claim that this approach can be effective tool for saving forecasting. We have also applied this method as it is widely used in most of aforementioned studies of household saving.

Estimation and diagnostics of our ECM has been carried out with the help of method introduced by Engle and Granger (1987) in Eviews 7.1 software.

The first step of Engle-Granger method is as follows:

- testing of time-series of all variables for being of the same order of integration;
- estimation of cointegretion regression with ordinary least squares method;
- finding of cointegretion regression residuals and their testing for stationarity.

On the second step of Engle-Granger method error correction model is finally estimated.

Unfortunately, there is not enough reliable statistical data of household savings in Ukraine at macroeconomic level for sufficient econometric research. Such data limitation is common for papers, which analyze Ukrainian data. However, it is possible to use another aggregated macroeconomic indicator, which includes household savings, namely gross domestic savings (GDS). It is calculated as the difference between gross domestic product and total consumption. One of the main issues related with the use of this proxy is connected with the fact that GDS includes savings of other sectors of economy. In the worst case, influence of other sectors may bias the results of research by increasing significance of factors that are insignificant for household saving, but are significant for other sectors' saving.

According to Schmidt-Hebbel, Webb and Corsetti (1992) total saving of all sectors of economy can be a good proxy of household saving behavior, if latter is perfect substitute for both corporate and public sectors saving. Such substitutability is possible, when assuming that Ricardian equivalence holds. They also point out that most empirical work on saving in developing countries has used only aggregated data for saving due to lack of reliable sources. For instance, aggregated national saving data has been already used as a proxy of household saving in Fry (1980), Giovanni (1985), Gupta (1987), Zhuk and Zdrok (2014a) and so forth.

Hence, dependent variable in our research is y – gross domestic savings, bln. USD.

During the analysis of factors that have influence on formation of GDS, the following significant exogenous variables have been determined: x_1 – household consumption expenditures, bln. USD; x_2 – gross national income, bln. USD.

Statistical data used for the research has been obtained from World Bank database (mode of access: http://databank.worldbank.org/) and covers period from 1992 to 2013, which is 22 years.

3. Data Diagnostic

Before estimation of the model it is important to check whether data is stationary. For this reason we have used augmented Dickey-Fuller (ADF) test suggested by Dickey and Fuller (1979). The results of ADF unit-root test are presented in *Table 1*.

Table 1. ADF test results

Variable	5% level critical t-Statistic	Empirical t-Statistic	Probability
y	–3.0124	–1.8072	0.3669
x_1	–3.02997	1.5025	0.9985
x_2	–3.0123	0.01798	0.9466
Δy	–3.0207	–4.097	0.0054
Δx_1	–3.02997	–3.0763	0.0457
Δx_2	–3.0207	–4.3218	0.0033

The null hypothesis of the test states that there is unit root in time-series, while alternative hypothesis asserts that there is no unit-root in data. The empirical values of ADF

test statistics for level values of all variable (gross domestic savings, household consumption expenditures, gross national income) are higher than their critical values and their probability values are higher than 0.05. Therefore, the null hypothesis can not be rejected. It means that with 95% confidence probability level values of all variables are not stationary.

On the contrary, the ADF test of differenced values of our variables rejects the null hypothesis of the presence of a unit root in differenced data. Since empirical values of ADF t-Statistics are lower than their critical values, the null hypothesis can be rejected with 95% confidence probability. Thus, there is no unit root in first differences of gross domestic savings, household consumption expenditures and gross national income.

Summing up the results of augmented Dickey-Fuller test, we have found out that the time series of all variables are non-stationary at their levels. However, their first differences are stationary, which means that all variables are of the first order of integration.

4. Model Estimation

Consequently we can develop cointegration regression to receive stationary residuals for further ECM estimation according to Engle-Granger algorithm. Estimated cointegretion regression is the following:

$$y = 5.5635 - 0.5248x_1 + 0.4468x_2. \qquad (1)$$

Further we should test the residuals of cointegretion regression (1) for stationarity. The null hypothesis of ADF test states that there is unit root in the residuals of model (1). Empirical value of ADF test statistic is –2.9433, while critical value of ADF test statistic is –3.0124. As empirical value is higher than critical value the null hypothesis cannot be rejected, but results of the test showed that residuals of cointegration regression (1) are stationary with confidence probability of 94,28%. As the confidance probability is close to 95%, it is possible to develop error correction model according to Engle-Granger method.

Estimated multiple linear regression model with error correction term is following:

$$\Delta y = -1.4067 - 0.1592\,\Delta x_1 + 0.3065\,\Delta x_2 - 0.3929\,\hat{\varepsilon}_{t-1}, \qquad (2)$$

where $\hat{\varepsilon}_{t-1} = y_{t-1} - 5.5635 + 0.5248\,x_{1,t-1} - 0.4468\,x_{2,t-1}$.

Econometric properties of model (2) are presented in *Table 2*.

Table 2. Econometric properties of model (2)

Property	Value
R-squared	0.8101
Adjusted R-squared	0.7766
Standard error of regression	2.6653
Sum of squared residuals	120.7643
Log likelihood	–48.1656
F-statistic	24.1759
Probability (F-statistic)	0.000002
Akaike information criterion	4.9681
Shwarz information criterion	5.1671
Durbin-Watson statistic	1.0031

Source: author`s own estimations.

Properties of model (2) parameters are presented in *Table 3*.

Table 3. Properties of model (2) parameters

Variable	Parameter	Std. Error	t-Statistic	Probability
Δx_1	–0.1592	0.0934	–1.7047	0.1065
Δx_2	0.3065	0.0435	7.0428	0.000002
$\hat{\varepsilon}_{t-1}$	–0.3929	0.1985	–1.9789	0.0643

Source: author`s own estimations.

The R-squared value of model (2) is 0.8101. It means that exogenous variables (household consumption expenditures, gross national income and error correction term) explain 81% of endogenous variable (GDS) value variation, which shows a high level of model forecast ability. The adjusted R-squared value of model (2) is high as well (0.7766), which also proves adequacy of estimated model. According to model (2) F-statistic and its probability we can state that model (2) is adequate with more than 99% confidence probability. The value of Durbin-Watson statistic (1.0031) indicates potential positive serial correlation issue. However, Breusch-Godfrey serial correlation LM test presented in the following section shows no serial correlation in residuals of model (2) till sixth lag.

Parameter of variable of household consumption expenditures first differences Δx_1 and parameter of variable of gross national income first differences Δx_2 present short-term impact of these variables on the value of gross domestic savings. Parameter of error correction term shows long-term effect of household consumption expenditures and gross national income variables. Parameters of error correction model (2) can be interpreted as follows:

- 1 bln. USD increase of household consumption expenditures value will reduce the value of gross domestic savings by an average of 0.1592 bln. USD;
- growth of gross national income value by 1 bln. USD will increase value of gross domestic savings by an average of 0.3065 bln. USD;
- parameter of error correction term means that the speed of adjustment of the model to long-run equilibrium with the help of cointegration regression is 39.29%.

Parameter of household consumption expenditures variable of the model (2) is statistically significant with confidence probability of 89.35%.

Parameter of gross national income variable of the model (2) is statistically significant with confidence probability of more than 99.99%.

Parameter of error correction term of the model (2) is statistically significant with confidence probability of 93.77%. It has negative sign, which means that model specification is adequate.

5. Model Diagnostic

Further, adequacy of the estimated model should be tested. First of all, we have conducted normality test (Jarque and Bera, 1980) of model (2) residuals (*Figure 1*).

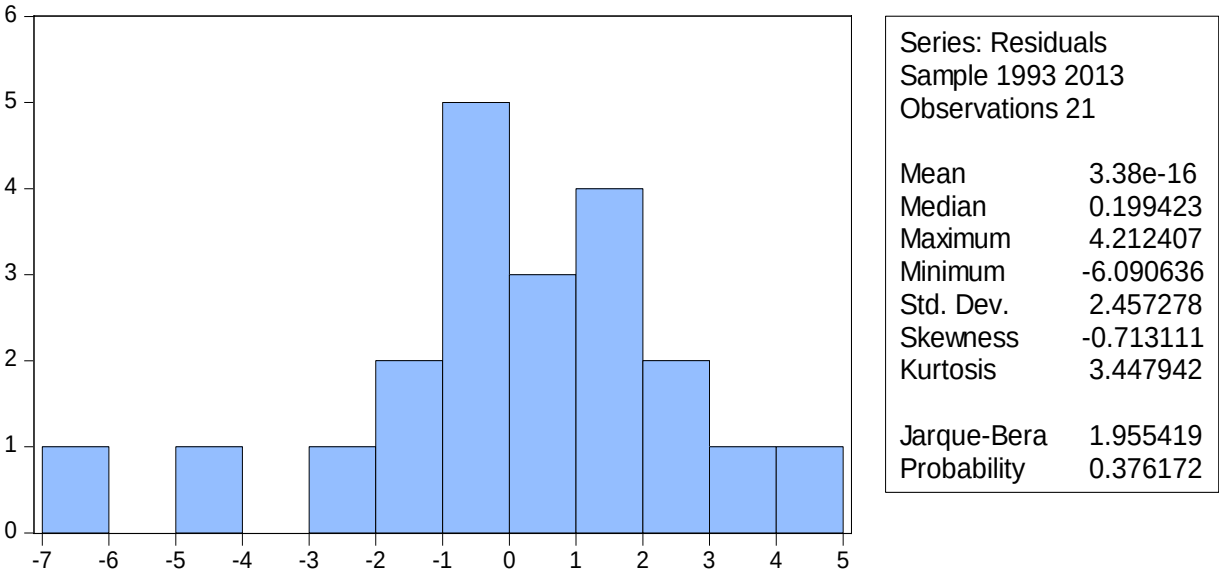

Figure 1. Results of model (2) normality test
Source: author`s own estimations.

The null hypothesis of normality test states that residuals of model (2) are normally distributed. As Jarque-Bera statistic is 1.9554 and its probability value is 0.3762, which is higher than 0.05, we cannot reject the null hypothesis. Consequently, the residuals of model (2) are normally distributed with confidence probability of 95%.

Secondly, model (2) has been checked for heteroskedasticity using test proposed by Glejser (1969). According to the null hypothesis residuals of model (2) are homoskedastic. F-statistic of Glejser test for model (2) is 0.656 and its probability is 0.5902. We cannot reject the null hypothesis because 0.656 > 0.05. Thus, residuals of model (2) are homoskedastic with confidence probability of 95%.

Thirdly, to test the residuals for serial correlation we have used Breusch-Godfrey serial correlation LM test (Godfrey, 1988). The null hypothesis of Breusch-Godfrey test indicates that there is not any serial correlation to a certain lag, in our case till sixth lag. F-statistic of Breusch-Godfrey test for model (2) is 0.7775 and its probability value is 0.6042. As 0.6042 > 0.05 we cannot reject the null hypothesis. Hence, there is not any serial correlation in residuals of model (2) till sixth lag with confidence probability of 95%.

Next, regression specification (RESET) test introduced by Ramsey (1969) has been carried out to test model (2) for specification error. The null hypothesis of RESET test assumes zero mean vector for residuals of model (2). The F-statistic of RESET test for one omitted fitted term is 0.1237, respectively its probability value is 0.7297. In addition, the F-statistic of RESET test for two omitted fitted terms is 0.868, its probability value is 0.4398. As a result both probability values for one as well as two omitted fitted terms in model (2) specification are higher than 0.05. Thus, the null hypothesis can be accepted for both cases, which proves that chosen specification form of model (2) is correct with confidence probability of 95%.

Furthermore, we have tested our model for stability with the help of recursive method of least squares (*Figure 2*). The idea of recursive least squares method consists in the following. Model parameters are evaluated several times using larger sample each consequent time. If you need to estimate *k* parameters of model, for this purpose the first *k* values of sample will be used. At every further step the number of sample is increased by one till the whole sample is used. Parameters estimated at every step are used for modeling of recursive residuals.

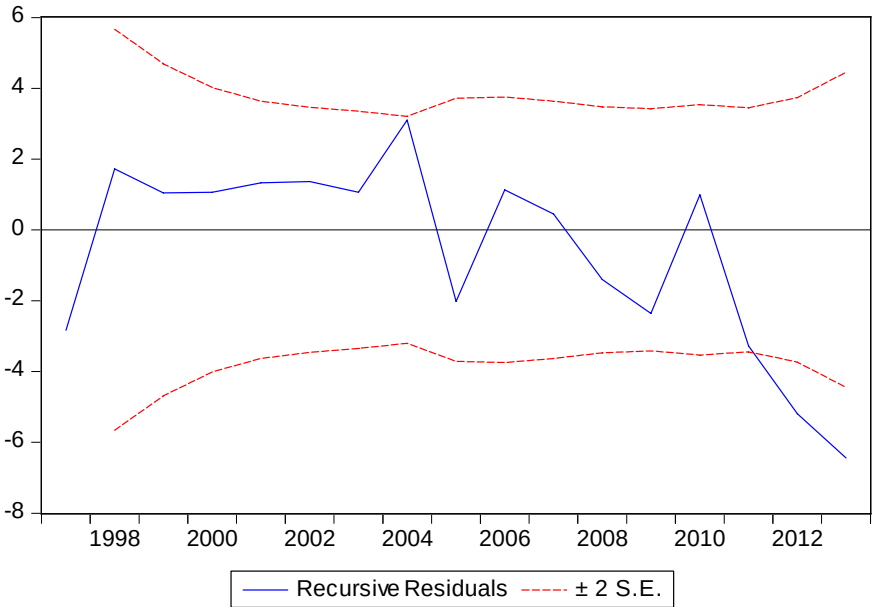

Figure 2. Recursive residuals of model (2)
Source: author`s own estimations.

Although the graph of recursive residuals has gone out of standard error interval in 2012, we can assert that our model is relatively stable because all the previous values were inside of it.

The following stability test of recursive parameter estimates is related to the previous one. *Figure 3* shows model (2) parameter estimates changes with the increase of sample as well as standard error intervals.

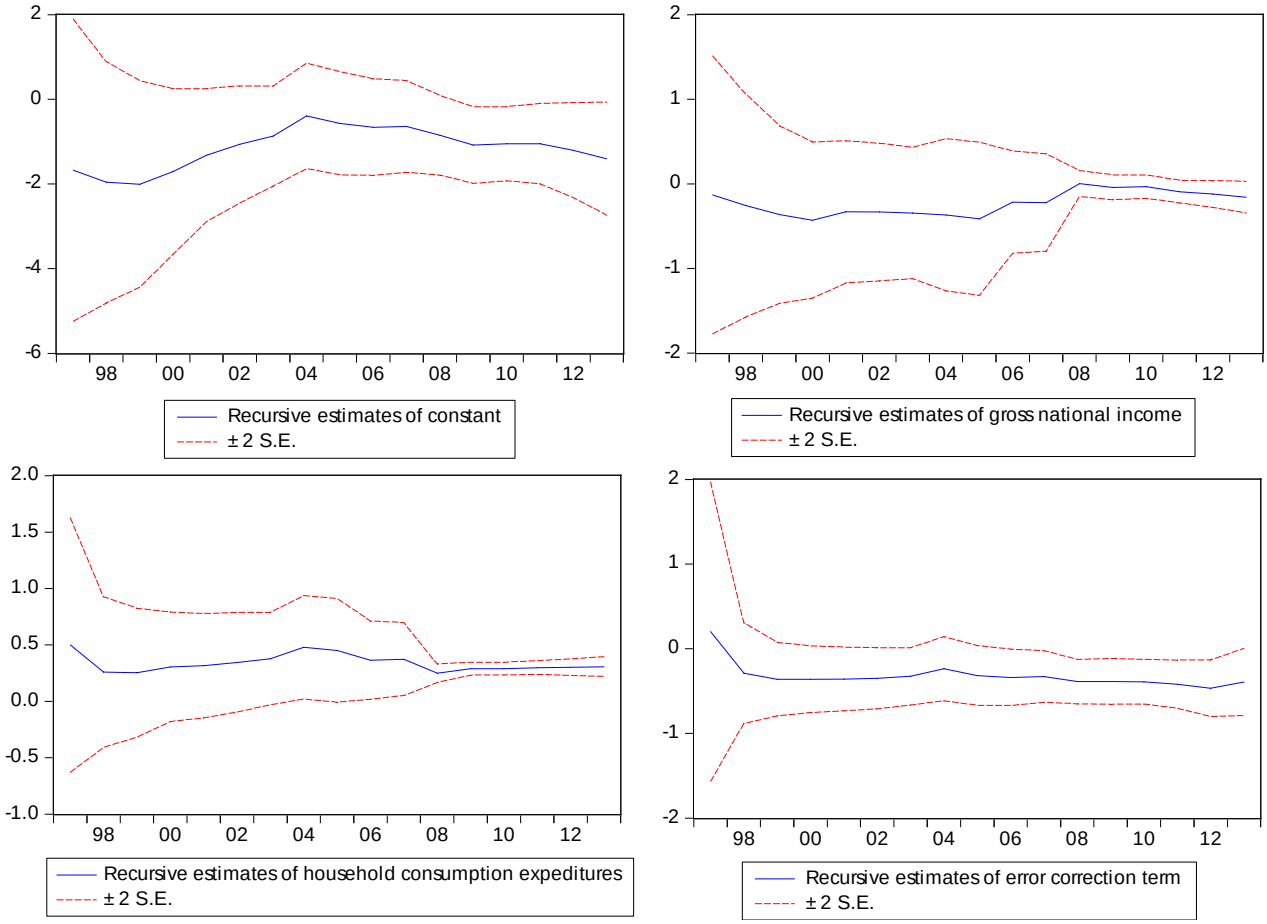

Figure 3. Recursive parameter estimates of model (2)
Source: author`s own estimations.

Recursive parameter estimates of all variables of model (2) are characterized to be stable during the time period reflected in *Figure 3*. Taking into consideration graphs of recursive parameter estimates our model is stable. Generally, all the tests confirmed stability and adequacy of model (2).

Finally, actual and fitted values of GDS differences are compared in *Figure 4* to check model (2) goodness-of-fit.

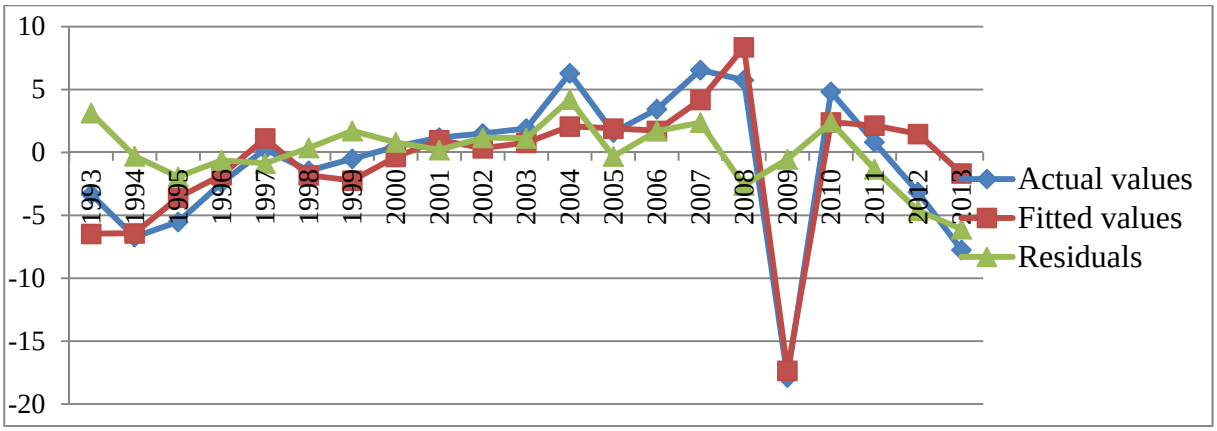

Figure 4. Actual and fitted values of gross domestic savings differences
Source: author`s own estimations.

Obviously model (2) showed good performance and goodness-of-fit (*Figure 4*).

Additionally, we have performed forecast of GDS level values from 1994 to 2013 to compare it with actual values in order to investigate model (2) forecast power (*Figure 5*).

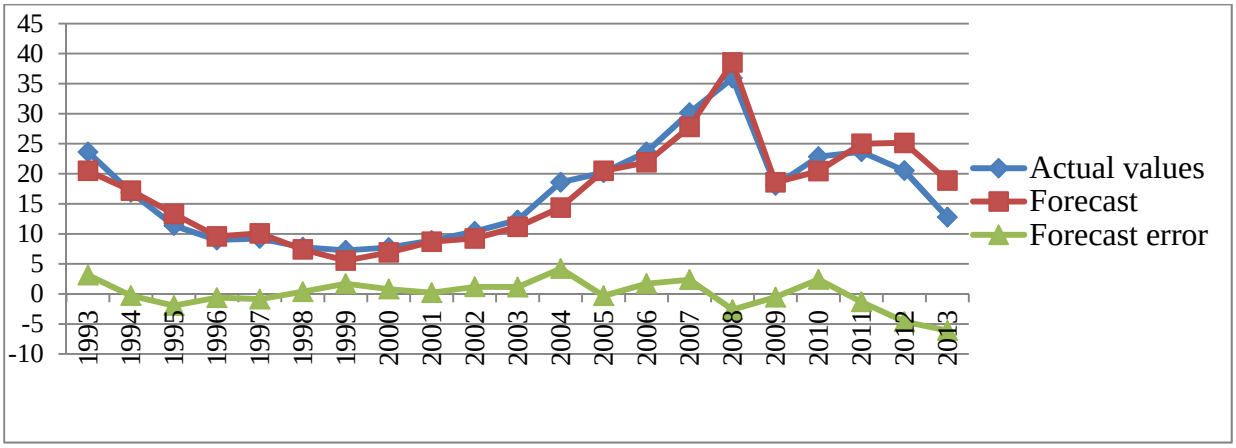

Figure 5. Forecast of gross domestic savings values
Source: author`s own estimations.

Received forecast values of gross domestic savings are very close to the actual values and confirm correct model specification, adequacy of model (2) as well as possibility of use in research and forecasting of gross domestic savings.

6. Structural Breaks Testing

In this section of the paper we would like to test gross domestic savings formation in Ukraine for structural breaks. For this reason Chow breakpoint test (Chow, 1960) is used. We have tested three years as breakpoints in formation of GDS in Ukraine: 2008 – year of world financial crises as well as 2009 and 2010 – years after start of crises. The null hypothesis states that there are no structural breaks at specified breakpoints. The test statistic and their respective probability values are presented in *Table 4*.

Table 4. Results of Chow breakpoint test of gross domestic savings formation in Ukraine

Breakpoint year	Test statistic	Probability
2008	F-statistic	0.1891
	Log likelihood ratio	0.055
	Wald Statistic	0.1257
2009	F-statistic	0.2141
	Log likelihood ratio	0.0676
	Wald Statistic	0.1513
2010	F-statistic	0.0045
	Log likelihood ratio	0.0001
	Wald Statistic	0.00004

Source: author`s own estimations.

Indeed, Chow breakpoint test showed interesting results. According to probability values of test statistic the null hypothesis of no structural breaks is not rejected in first two crises years (2008 and 2009) as all of them are higher than 0.05 (the null hypothesis for these

two cases is accepted with 95% confidence probability). However, the null hypothesis is rejected in case of year 2010 as probability values of F-statistic, Log likelihood ratio and Wald Statistic are less than 0.05. Therefore, there is structural break in Ukrainian gross domestic savings formation in 2010.

Conclusions

Household saving is one of the most important elements of household economic activities. Savings indicate level of life of a household and form resources for financial markets as well as investments in economy of the country.

Microeconomic importance of household savings is obvious. They provide safety in stochastic environment, ability to earn interest, psychological satisfaction as well as are an instrument of wealth accumulation for households. Generally, household savings have influence on whole macroeconomic system of the country.

We studied the formation process of household savings with the help of econometric modeling, particularly the multiple linear regression model with an error correction term. Econometric analysis showed the most significant macroeconomic indicators that influence formation of household savings in Ukraine, including household consumption expenditures and gross national income. Moreover, it was proved that levels of such macroeconomic indicators as gross domestic savings, household consumption expenditures and gross national income were of first order of integration and had unit root.

We have also interpreted the meaning of parameters of estimated error correction model. Postdiagnostic of developed model showed that our model was homoskedastic, it had no serial correlation and its residuals were normally distributed. Further, correct specification of model was proved with RESET test and its stability was tested with recursive least squares method.

Additionally, we tested hypothesis of structural break in formation of household savings in Ukraine after world financial crisis. In contrast to expectations Chow breakpoint test proved structural break in Ukrainian gross domestic savings formation only in 2010. This could mean that financial crisis had lagged influence on gross domestic savings formation.

Further research might include an analysis of influence of events that happened in Ukraine after 2013 on household saving and other household economic activities at both macroeconomic and microeconomic levels.

Scientific contribution of research consists in empirical determination of the most significant macroeconomic indicators that influence household savings. The results of the study may be interesting for policy makers and proposed model can be practically used for forecasting of gross domestic savings in Ukraine.

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