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Computational Methods in Social Sciences

Macroeconomic determinants of migration from Romania to Italy

Mihaela Simionescu[1,2*]
[1]Romanian Academy, Institute for Economic Forecasting, mihaela_mb1@yahoo.com, Calea 13 Septembrie, no. 13, District 5, Bucharest, Romania
[2]Prague Business School, Centre for Migration Studies, simionescu@pbs-education.cz, Werichova 1145/29, Prague, Czech Republic

Abstract

Taken into account various economic theories trying to explain the reasons that stay behind the decision to migrate to another country, this study uses empirical data to identify some macroeconomic motives for migrating from Romania to Italy. According to the estimations based on fast ridge regression, the stock of Romanian immigrants from Italy in the period 2002-2016 was influenced by: the real GDP per capita in Romania, real GDP per capita in Italy and life expectancy at birth in Italy. The number of Romanian migrants attracted each year in Italy in a period marked also by the global financial crisis (2007-2016) was related to factors like: real GDP per capita in Italy life expectancy at birth in Italy, unemployment rate and taxes on income, profits and capital gains in Italy. The overall results indicated that the better standard of life in Italy was a good incentive for Romanian migrants.

Keywords: ***migration, real GDP per capita, life expectancy, Bayesian ridge regression.***

JEL Classification: C40, C51, J68

1. Introduction

The determinants of migration have been the objective of a large variety of studies from economic, social, demographic, ethnic, politic or cultural perspectives. A significant attention was paid to the economic causes that stimulate emigration. Nowadays, the movement from developing countries to the more developed ones was observed. The East-West migration inside the European Union was favoured by high differences in income between old member states and new members that were integrated in 2004, 2007 and 2013. The new EU members had quite large populations and knew many transformations in society for passing to a functional market and a free society.

In this paper, the main macroeconomic factor that explain the emigration from Romania to Italy will be identified using a Bayesian approach. This approach is better than previous approaches that use survey data where a sample of migrants are taken into account that might not be representative. Moreover, a methodological novelty is brought in this research field, the Bayesian approach being used to select the migration determinants on a small set of data. The main results indicated that differences in real GDP per capita and life expectancy at birth had a significant impact on migration decision to Italy of the Romanian people after 2001.

After this introduction, the paper provides a short theoretical background for the migration determinants and the situation of Romanian migrants from Italy. In the next section, an empirical analysis is proposed by providing some Bayesian ridge regressions. The last part concludes.

2. Romanian migrants from Italy

In Italy, most of the migrants come from Romania (around 1.1 million according to the official statistics of 2016). The other countries that sent a large number of migrants in Italy are: Albania, Morocco, China, Ukraine, Philippines, India, Republic of Moldova and Bangladesh. The EU immigrants have a positive contribution on the Italian labour market. The Romanian immigrants from Italy are occupied in many sectors that suppose a significant manual labour, but with wages, working conditions or social positions that are not attractive for Italian people [1].

* Corresponding author: mihaela_mb1@yahoo.com.

There are not big language barriers for Romanian migrants that came in Italy mostly after 1999. In 2002, a large wave of Romanians chose Italy as destination country because of the legislative changes (Romanian citizens had the right to go in any Schengen Zone without any visa). On the other hand, the Italian welfare system is helped by the foreign workers in care sector. After Romanian's entrance in the EU, Italy did not require for any period of transition. In this context, the Romanian community doubled, because the Romanian's integration in the EU allow the illegal immigrants from Italy to have a legal status. The institutional framework was the one that allow the presence of non-documented immigrants in the informal economy. The recent economic crisis did not determine the migrants to be more eager to come back in the origin countries, as the data from surveys suggested [2].

The real motivation for migration of the Romanian citizens to Italy is in line with the trend for all eastern European countries. The economic transition characterized by high unemployment as well as the high level of education required for the jobs in the origin countries determined the Eastern European citizens to migration to developed countries like Italy [3]. On the other hand, the trends in the Italian labour market were factors that attracted many Romanian emigrants. Italy has an aged society and the skilled women were integrated in the national labour market. In this context, immigrants have an essential role in family sector, because they provide assistance to the elderly [4]. Given this situation in care sector, migration policies in Italy were subject to changes as to attract migrants from new EU countries.

Despite this particular context for migration, the motivations of Romanian citizens to establish in Italy might be related to the traditional reasons from economic literature corresponding to various theories.

The particular situation of Romanian migrants is closer to the theory of rejection factors that highlights the unfavourable conditions of the migrants in their origin country. Most common rejection factors that encourage the emigration are: high unemployment, low incomes, lack of political stability, ethnical and religious issues, climatic conditions [5]. The Romanian migrants also created social networks in Italy. The theory of social networks explains the functional networks that encouraged migration. These particular networks consider the interpersonal relationships between emigrants and the population in the origin country. The information about a foreign location is essential in the theory of Tiebout (1956) who considered that people follow a place where they have a maximal individual utility and best public services [6].

The decision to migrate in Italy might be also explained by the Keynesian economic theory that confirms the correlation between labour market supply and the real and nominal salary, respectively. According to Keynesian approach, the emigrants choose regions with higher nominal wages compared to their origin region from their country [7].

The neoclassical theory is based on differences in wages between regions/ countries that encourage the movement from regions with low wages and high unemployment rate to other regions/ countries with higher wages and lower unemployment rate. The neoclassical theory has been extended resulting "the new economics of migration". This recent perspective considers households, families and different groups of people as being the unit of analysis and not the market. The units of analysis are interested in having a minimum risk minimum and the maximum possible income. According to this theory, there are one or some members of family that emigrated to increase the family's income, but the other members of the family remained in the origin country with lower, but stable incomes. In terms of human capital investment, neoclassical theory considers that a person will emigrate if the expected income in another country will exceed the costs.

The search theory explains the decision to migrate by the need for a job in a foreign country [7]. Before migration, two types of evaluation are made: on one hand, the assessment of possible advantages and of migration costs and, on the other hand, the evaluation of that particular job.

These theoretical assumptions regarding causes of migration should be checked on empirical data. In this context, the economic literature passed from strictly theoretical reasons to those validated on empirical data. Various quantitative approaches were used to identify the determinants of migration to a certain country.

In the first econometric models, salary differentials were considered as explanatory variable staring from the heterogeneous degrees of labour market tightness. Later, the model was improved by Todaro (1969) [8] and by Harris and Todaro (1970) [9] that chose as migration cause the expected salary instead of current wage differentials. This type of econometric model is indicated for internal migration in less developed countries, but it

was improved as to explain the international migration. Even if these models were simple, they provided good forecasts. According to Bauer and Zimmermann (1999), many empirical studies identified salary differentials and employment as the most important predictors for migration [10]. However, these empirical researches have some limits that were showed by Harris-Todaro approach in the context of forecasts for migration in Spain, Greece, Portugal and A10 countries. The forecasts using this model overestimated the number of migrants from the mentioned countries. Therefore, the model should also include variables related to life quality in the origin country. The search for a better life determined people to choose a foreign country with more lucrative and productive jobs. Moreover, other types of differences between states should be introduced related to human rights, law rules or political stability.

The scientific literature provides various studies about the determinants of Romanian emigration based on data from surveys or official macroeconomic data. Based on Soros's survey made in August 2010, the probit models built by Hinks and Davies (2015) confirmed that low investment as well as low expected salaries from Romania stimulated emigration [2]. For Romanian migrants from Italy, Ailenei, Cristescu and Hrebenciuc (2015) proved, based on a survey from April-May 2011 and a logit model, that higher wages and better life and work conditions attracted Romanian citizens in Italy [11].

3. Empirical analysis

As we stated before, our aim is to identify some macroeconomic determinants of migration from Romania to Italy. Therefore, empirical data will be used to figure out some economic determinants of the Romanian people migration to Italy.

The variables used in this study refer to: stock of immigrants, number of immigrants that came each year, real GDP per capita in Euro in Italy and in Romania, life expectancy at birth in years, unemployment rate (% of total labor force) (modeled ILO estimate), taxes on income, profits and capital gains (% of revenue). For these variables, the time series refer to the period 2001-2016, excepting the immigrants for each year (period 2007-2016). The data for the number of immigrants are provided by *Bilancio demografico nazionale*. The data for the rest of the variables are provided by World Bank.

The real GDP per capita is used to compare the standard of living between countries or between different periods for the same country. It measures the economic output of a state divided by the population and adjusted for inflation.

The indicator "life expectancy at birth" expresses the average number of years that a new-born is expected to reach under the assumption that the mortality patters at the moment he/she born will remain constant in the future. An image of mortality characteristics is provided for a year, because this variable shows the number of people of different ages that will dye that particular year.

According to World Bank, taxes on income, profits, and capital gains are "levied on the actual or presumptive net income" of people, on the profits of firms and corporations, and on capital gains, even if they are not realized, on securities, land, and other assets. In this case, the intragovernmental payments are not considered in consolidation.

Unemployment rate represents the share of labour force without job, but available for work and seeking employment.

Since 2001, the stock of Romanian migrants knew an increase from a year to another till 2011, when the number of migrants decreased with around 15% compared to 2010. Since then, the number of migrants continued to increase, but in 2012 a lower level than that from 2010 was reached. The negative consequences of the financial crisis at the economic level (lower salaries, unemployment, fiscal chaos) might explained the withdrawal of a part of Romanian migrants.

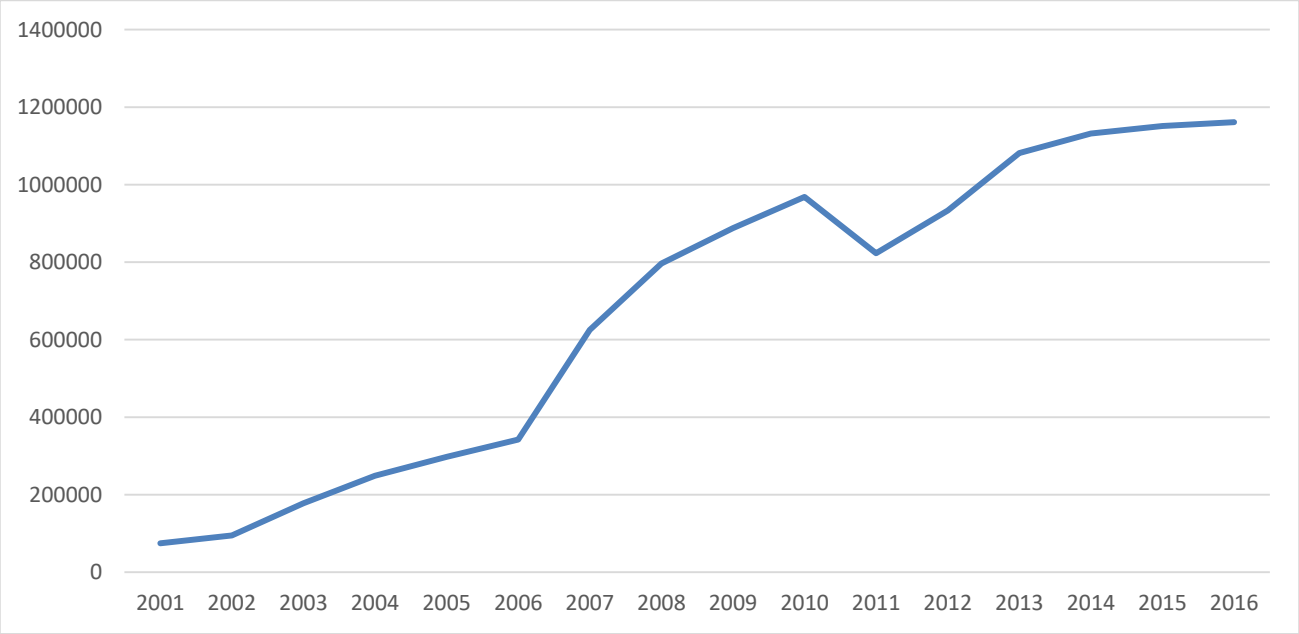

Fig. 1. The stock of Romanian migrants from Italy (2001-2016)

For identifying the determinants of migration, several types of Bayesian regressions are used:

- Fast ridge regression;
- Fast power ridge regression;
- Fast generalized ridge regression.

The dependent variable is stock of immigrants and then number of immigrants that came in a certain year. The posterior probability that the standardized coefficient is within 1 standard deviation of 0 (PP1SD) is computed. For a value of PP1SD lower than 0.5, the corresponding explanatory variable represents a significant predictor in that ridge regression.

The explanatory variables are: real GDP per capita in Euro in Italy and in Romania, life expectancy at birth in years, unemployment rate, taxes on income, profits and capital gains. According to the values of Akaike information criterion (AIC), the best model is the fast ridge regression. As this model showed, the main determinants of immigration stock are: real GDP per capita in Romania, real GDP per capita in Italy, life expectancy at birth in Italy.

More types of Bayesian ridge regressions were built, but the best one is that with the lowest value for Akaike informational criterion (AIC). The common fast ridge regression provided the best results for the period 2002-2016. We selected only the explanatory variables for which PP1SD is less than 0.5. According to the estimations based on fast ridge regression, the stock of Romanian immigrants from Italy was influenced by: the real GDP per capita in Romania, real GDP per capita in Italy and life expectancy at birth in Italy. The results are confirmed by expectations. Indeed, the high differences between real GDP per capita between Italy and Romania was a strong motive for migration as other studies highlighted [12]. On the other hand, the life expectancy at birth is closely related to the issue of aging in Italy. The Italian welfare system needs immigrants as caregivers. The foreign people that make elderly assistance are called *badanti* and migration policies have a particular legalization for them [4].

Table 1. Bayesian fast ridge regressions for stock of Romanian immigrants in Italy (2001-2016)

Explanatory variable	Fast ridge regression		Fast power ridge regression		Fast generalized ridge regression	
	Slope estimate	PP1SD	Slope estimate	PP1SD	Slope estimate	PP1SD
Real GDP per capita in Romania	75617.017	0.137	88670.064	0.424	56087.703	0.078

Real GDP per capita in Italy	-54254.539	0.157	-49743.961	0.588	-59866.092	0.062
Life expectancy at birth in Italy	73157.516	0.073	81016.772	0.475	61243.287	0.061
Unemployment rate in Italy	31101.151	0.535	-790.258	0.668	48322.304	0.078
Taxes on income, profits and capital gains in Italy	-13970.380	0.648	-5546.652	0.666	-27995.863	0.372
Intercept						
AIC	452.006		452.645		452.057	

Source: own calculations

The factors that attract Romanian migrants to come each year in Italy are also important for having a better picture of migration. According to AIC values, the fast power ridge regression performed better than the other two types of regressions. Excepting real GDP per capita in Romania, all the other variables explain the decision of Romanian people to come in Italy: real GDP per capita in Italy life expectancy at birth in Italy, unemployment rate and taxes on income, profits and capital gains in Italy. The real GDP per capita associated to a higher economic development is an important motive for migrating to Italy. Life expectancy at birth in Italy which is associated to elderly assistance explain the decision to establish in Italy to work in welfare system. The increases in the unemployment rate in Italy associated with the financial crisis were a factor that braked the migration. On the other hand, even if the taxes on income, profits and capital gains in Italy grew, the Romanians continue to choose Italy as destination country, because the salaries are higher than in Romania [13].

Table 2. Bayesian ridge regressions for Romanian immigrants in Italy (2007-2016)

Explanatory variable	Fast ridge regression		Fast power ridge regression		Fast generalized ridge regression	
	Slope estimate	PP1SD	Slope estimate	PP1SD	Slope estimate	PP1SD
Real GDP per capita in Romania	-9252.651	0.534	-3983.815	0.579	-11810.144	0
Real GDP per capita in Italy	21910.431	0.327	18155.138	0.008	14020.061	0
Life expectancy at birth in Italy	1930.43	0.656	10355.657	0.1	14153.659	0
Unemployment rate in Italy	-14071.597	0.478	-12518.168	0.116	-13923.339	0
Taxes on income, profits and capital gains in Italy	23796.799	0.127	21527.903	0.028	10593.031	0
AIC	232.143		231.135		234.127	

Source: own calculations

All in all, our empirical study confirmed that differences in life quality attracted many Romanian citizens to Italy. This result is also obtained by other studies [11]. The life quality is well related to real GDP per capita, an indicator of economic development with direction consequences on standard of living and life expectancy at birth. Particularly for Italy, the issue of demographic ageing related to life expectancy favour the attraction of Romanians for care sector.

4. Conclusions

The economic literature provided many theories to explain the decision to migrate in another country. Romanian trends in migration are placed in the framework of less developed Eastern European countries that faced problems related to economic transition. On the other hand, developed countries chosen as destination regions faces specific problems that justify the need of foreign people on labour market. Italy is known as a country that requires migrants for unqualified jobs. In the case of Romanian people, the theoretical arguments for migration to Italy are related to wage and unemployment differentials, life and work conditions, the existence of social networks among migrants.

The novelty of this research is given by the consideration of empirical data to identify the determinants of migration to Italy for the Romanian citizens. The stock of migrants as well as the number of migrants received each year in Italy were considered in this analysis. Contrary to previous studies, we do not use data based on survey. Official data were used to estimate some Bayesian ridge models. The empirical results confirmed that the gap between real GDP per capita in Romania and Italy and the high life expectancy at birth in Italy are among the reasons to leave Romania for Italy. The research is limited by the use of a small number of economic variables. In a future study, other variables might be introduced in the models as to catch social and political factors.

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On macroeconomic values investigation using fuzzy linear regression analysis

Richard Pospíšil[1], Miroslav Pokorný[2], Jarmila Koudelková[3]
[1]Palacký University of Olomouc, richard.pospisil@upol.cz, Křížkovského 10, Olomouc, Czech Republic
[2]Moravian College Olomouc, miroslav.pokorny@mvso.cz, Kosmonautů 1, Olomouc, Czech Republic
[3]Mendel University in Brno, xkoudel6@mendelu.cz, Zemědělská 1, Brno, Czech Republic

Abstract

The theoretical background for abstract formalization of the vague phenomenon of complex systems is the fuzzy set theory. In the paper, vague data is defined as specialized fuzzy sets - fuzzy numbers and there is described a fuzzy linear regression model as a fuzzy function with fuzzy numbers as vague parameters. To identify the fuzzy coefficients of the model, the genetic algorithm is used. The linear approximation of the vague function together with its possibility area is analytically and graphically expressed. A suitable application is performed in the tasks of the time series fuzzy regression analysis. The time-trend and seasonal cycles including their possibility areas are calculated and expressed. The examples are presented from the economy field, namely the time-development of unemployment, agricultural production and construction respectively between 2009 and 2011 in the Czech Republic. The results are shown in the form of the fuzzy regression models of variables of time series. For the period 2009-2011, the analysis assumptions about seasonal behaviour of variables and the relationship between them were confirmed; in 2010, the system behaved fuzzier and the relationships between the variables were vaguer, that has a lot of causes, from the different elasticity of demand, through state interventions to globalization and transnational impacts.

Keywords: ***fuzzy linear regression, vague property, genetic algorithms, construction production, agricultural production, GDP***

1. Introduction

Regression models are used in engineering practice wherever there is a need to reflect more independent variables together with the effects of other unmeasured disturbances and influences. In classical statistical regression, we assume that the relationship between dependent variables and independent variables of the model is well-defined and sharp. Although statistical regression has many applications, problems can occur in the situations in which number of observation is inadequate (small data set), difficulties verifying distribution assumptions exist, vagueness in the relationship between input and output variables exists, the ambiguity of events or degree to which they occur or inaccuracy and distortion introduced by linearization is possible [19].

However, in the real world, it is hampered by the fact that these conditions are more or less non-specific and vague. This is particularly true when modelling complex systems which are difficult to define, difficult to measure or in cases where it is incorporated into the human element.

The theoretical background for abstract formalization of the vague phenomenon of complex systems is the fuzzy set theory. In the paper vague data is defined as specialized fuzzy sets - fuzzy numbers and there is a fuzzy linear regression model as a fuzzy function with fuzzy numbers as vague parameters. The determination of regression model uncertainty using fuzzy approaches does not require meeting the above presumptions of statistical regression.

The application part of the fuzzy regression analysis was performed based on the analysis of the time series development of selected macroeconomic variables which can be of a seasonal character in the national economy. These include indicators of construction production, agricultural production and the rate of unemployment in the Czech Republic from 2009 to 2011.

The choice of macroeconomic variables was based both on their seasonal character and on their interrelationships. While construction and agricultural production grows from spring to autumn, the level of unemployment in the period generally decreases. And the indicators of construction production and agricultural production may evolve in the same period differently, which can have many causes: from different elasticity of demand for construction and agricultural production, through different levels and forms of state intervention in

these segments of the national economy, to the influence of foreign trade and globalization. Along with this form of development of the monitored construction and agricultural production variables the unemployment rate does not always behave completely normal and can, irrespective to the development of construction and agricultural production, have increasing and declining trends. The cause of this phenomenon can be seen, inter alia, in low elasticity of labour supply, strong influence of trade unions and an entire labour system of social security, which altogether distort the labour market. All three monitored variables were subjected to the fuzzy regression analysis of the time series development of 12 measured values per year from 2009 to 2011.

2. Fuzzy Regression Model Identification

2.1. Observed Output Variable y^0 Fuzzification

To define the type of the fuzzy regression model we use the version in which the input variables x are mentioned as crisp numbers and the observed values $\tilde{Y}^0$ as triangular fuzzy numbers, respectively. Thus, let us consider fuzzy number $\tilde{Y}^*$ as the estimate and fuzzy number $\tilde{Y}^0$ as the observed value of the model output variable respectively. The fuzziness d_j of the observed fuzzy value $\tilde{Y}_j^0$ at the step observation *j* can be determined using the observed values at the step (*j+1*) and (*j-1*), respectively (see Fig. 1).

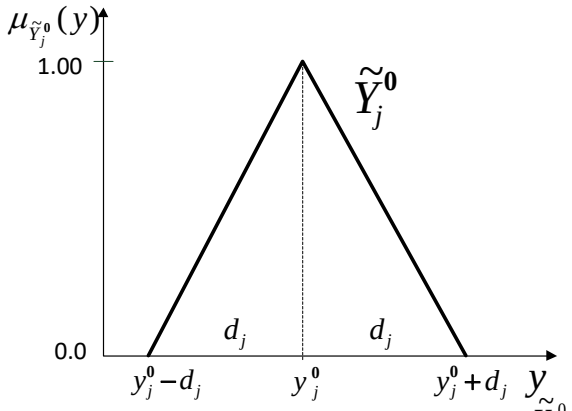

Fig. 1. Triangular membership function of fuzzy numbers $\tilde{Y}^0$
Source: [own processing]

It means, fuzzy number $\tilde{Y}_j^0$ is mentioned of a unequal triangular type. The values d_j we can calculate by the formulas

$$d_j = \frac{1}{2}\left|y_{j+1}^0 - y_{j-1}^0\right| \tag{1}$$

2.2. Fuzzy Regression Coefficients $\tilde{A}$ Determination

Finding values α_i and c_i as searched parameters of fuzzy regression coefficients $\tilde{A}_i$ (Fig.1) is defined as an optimization issue.

Fitness of the linear regression fuzzy model to the given data is measured through the Bass-Kwakernaaks´s index *H* – see Fig.4 [4], [8]. Adequacy of the observed and estimated values is conditioned by the relation (6) – the maximum intersection (consistency) of two fuzzy sets – the estimated $\tilde{Y}^*$ and the examined $\tilde{Y}^0$ - must be higher than the set value *H* (see Fig.2).

$$\max_{y}\left\{\mu_{\tilde{Y}^0}(y) \wedge \mu_{\tilde{Y}^*}(y)\right\} = Cons(\tilde{Y}^0, \tilde{Y}^*) \geq H \tag{2}$$

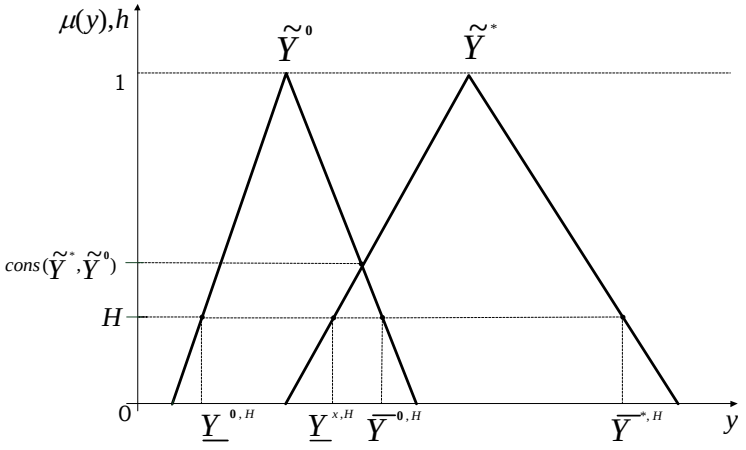

Fig. 2. Adequacy of Linear Regression Model

Source: [own processing]

Only if the condition (6) is fulfilled we assume good estimation $\tilde{Y}^*$ of the observed output value $\tilde{Y}^0$. The relation (6) is satisfied under the condition (see Fig.4)

$$\underline{Y}^{*,H} \leq \overline{Y}^{0,H} \tag{3}$$

$$\underline{Y}^{0,H} \leq \overline{Y}^{*,H} \tag{4}$$

Consider the determined level *H* the boundary of intervals $Y^{*,H}$ and relations (3), (4) we can express

$$\underline{Y}^{*,H} = -(1-H)\sum_{i=0}^{n} c_i |x_i| + \sum_{i=0}^{n} \alpha_i x_i \tag{5}$$

$$\overline{Y}^{*,H} = (1-H)\sum_{i=0}^{n} c_i |x_i| + \sum_{i=0}^{n} \alpha_i x_i \tag{6}$$

According to Fig. 2 we can write:

$$\underline{Y}^{*,0} = y^0 + (1-H)d \tag{7}$$

$$\overline{Y}^{*,0} = -y^0 + (1-H)d \tag{8}$$

Consider *j* = 1,2,…,m observations we can formulate the conditions (7), (8) in final form

$$\sum_{i=0}^{n}\sum_{j=1}^{m} \alpha_{i,j} x_{i,j} + (1-H)\sum_{i=0}^{n}\sum_{j=1}^{m} c_{i,j} |x_{i,j}| \geq y_j^0 + (1-H)\overline{d}^0 \tag{9}$$

$$-\sum_{i=0}^{n}\sum_{j=1}^{m} \alpha_{i,j} x_{i,j} + (1-H)\sum_{i=0}^{n}\sum_{j=1}^{m} c_{i,j} |x_{i,j}| \geq -y_j^0 + (1-H)\underline{d}^0 \tag{10}$$

$$c_{ij} \geq 0 \tag{11}$$

The requirement on adequacy of the estimated and observed values (6) will be complemented by the requirement on minimum possible total uncertainty of the identified fuzzy regression function

$$\sum_{i=0}^{n}\sum_{j=1}^{m} c_{i,j} \rightarrow \min , \quad i = 0, 1, \dots , n, \quad j = 1, 2, \dots , m \tag{12}$$

where $i = 1,2,\dots,n$ is the number of input values of the regression function and $j = 1, 2, \dots , m$ is the number of observations.

Then we can set the optimization problem

a) minimization of fuzzy model vagueness
b) under the condition

To solve the minimization problem under the condition, many authors use the linear programming method [1], [8]. Nevertheless, in this paper we use the genetic algorithm method to solve this problem [16]. Mainly, the reason is that the authors are oriented to use unconventional methods of artificial intelligence in order to prove their quality and efficiency in solving complex tasks. Genetic algorithms are a representative of evolutionary methods; their higher computational complexity is nowadays eliminated by high-performance computing. They are widely used in the search for optimal solutions. They can be well used for the identification of fuzzy regression models where they deal with the task of finding the optimal fuzzy regression coefficients as triangular fuzzy numbers.

The identification of fuzzy regression coefficients – fuzzy numbers $\tilde{A}_0, \tilde{A}_1,\dots, \tilde{A}_n$ - was divided into two tasks

a) the identification of the mean value (core) α_i of fuzzy number $\tilde{A}_i$ and
b) the identification of c_i as a half of the width of the carrier bearing $\tilde{A}_i = \{\alpha_i, c_i\}$.

The tasks are solved by using the genetic algorithm in series. First the identification of α_i and then the identification of c_i are done. Thus, the optimization of the fuzzy linear regression model is a two-step process when two genetic algorithms, designated G1 and G2, are used.

For the identification of the mean value (core) α_i of fuzzy number $\tilde{A}_i$ the minimization of the fitness function J_1 is defined in the form

$$\min J_1 = \min \frac{1}{m}\sum_{j=1}^{m}\left(y_j^0 - \beta_j\right)^2 \tag{13}$$

and the genetic algorithm GA1 is used. For the identification of c_i as a half of the width of the carrier bearing $\tilde{A}_i$ the minimization of the fitness function J_2 is defined in the form

$$\min J_2 = \min \sum_{j=1}^{m}\sum_{i=0}^{n}\left|c_{j,i}\right| \tag{14}$$

and the genetic algorithm GA2 with three constraints is used. Minimization of the fitness function J_2 is based on the previous identification of the role of the mean value (core) α_i and uses the already identified values of α_i for determining the width of the carrier bearing α_i.

The value of $H = 0,5$ is expertly determined in the next part of paper.

3. Time Series Fuzzy Regression Analysis

The fuzzy linear regression model has the opportunity to express not only the analytical linear approximation of multivariate functions, but also the size of its uncertainty (vagueness, fuzziness) in the form of an indeterminate possibility area. The graph of a one-dimensional fuzzy regression function we can see in Fig.5 together with the appropriate linear approximation and the possibility area of the estimated fuzzy output $\tilde{Y}^*$

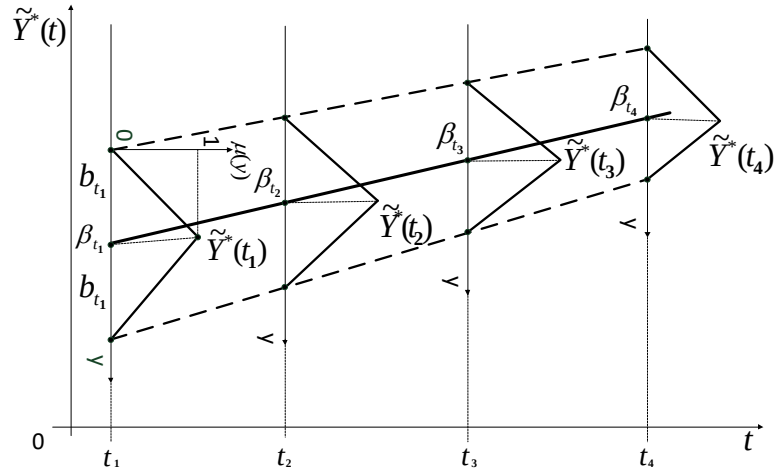

Fig. 3. One-Dimensional Fuzzy Linear Regression Function
Source: [own processing]

The one-dimensional fuzzy time series regression model has the ability to express its trend and seasonal cycles, respectively. Both of these features are enhanced by the possibility area that defines the size of the vagueness of the model and defines the range in which may be the value of the trend and seasonal cycles.

The one-dimensional fuzzy linear regression model of a time series trend is given by the formula

$$\tilde{Y} = \tilde{A}_0 + \tilde{A}_1 t \qquad t = 1, 2, \ldots \tag{15}$$

The value of a seasonal deviation in every month MSD (as fuzzy number) is calculated for each year $r = 1,2,\ldots, L$ and for each month $k = 1, 2, \ldots, 12$ as the difference between the trend value and the actual value to be estimated

$$MSD = (\tilde{Y}^0_{r,k} - \tilde{Y}^*_{r,k}), \quad r = 1,2,\ldots, L, \quad k = 1, 2, \ldots, 12 \tag{16}$$

The central value of fuzzy number MSD is calculated as the difference of the central values $\tilde{Y}^0_{r,k}; \tilde{Y}^*_{r,k}$, the fuzziness is calculated as the sum of fuzziness of fuzzy numbers $\tilde{Y}^0_{r,k}; \tilde{Y}^*_{r,k}$.

The seasonal cycle is then defined as the time series of 12 seasonal deviations for 12 months. A seasonal deviation for a given month $k = 1, 2,..., 12$ is calculated as the average value of the month of year $r = 1, 2, \ldots, L$ of the considered time series.

$$\tilde{Y}^*_k = \frac{1}{L}\sum_{r=1}^{L} (\tilde{Y}^0_{r,k} - \tilde{Y}^*_{r,k}); \quad r = 1,2,\ldots, L, \quad k = 1, 2, \ldots, 12 \tag{17}$$

For example, the seasonal variation for the first month of January is calculated as the mean of the January seasonal variations of the considered $r = 3$ years

$$\tilde{Y}_1^* = \frac{1}{3}\sum_{r=1}^{3} (\tilde{Y}_{r,1}^0 - \tilde{Y}_{r,1}^*) \tag{18}$$

The values of monthly deviations are calculated as fuzzy numbers. The core of fuzzy number $\tilde{Y}_k^*$ is calculated as the mean difference of the cores, the uncertainty is calculated as the mean of the sum of fuzziness. Thus, we calculate 12 fuzzy numbers, which pass into the timeline of 12 months as a curve of cores and their possibility areas.

4. Selected Economic Variable Investigation

The modelling of economic variables with high degree of uncertainty is very difficult, especially in current times of economic and financial crisis. The development of such variables is subject to a number of influences, both exogenous and endogenous, some of which are in fact hardly predictable or have a prominent degree of fuzzitivity. What is more, the relative effect of non-economic influences upon the development of the selected economic variables is growing in importance, as various subjects on the market – households and companies – contemplate their level of consumption, investment and savings on the basis of their uncertain future. Apart from rational evaluation of the relevant economic data, they are also under pressure of a number of influences from the area of psychology, politics, demographic development, natural circumstances, foreign affairs etc., and the so-called transactional motive is now replaced with the motive of caution. The submitted time series development regression analysis models 12 measured values of the selected variables in the years from 2009 to 2011 under these specifically defined conditions. The analysed time period was selected on the basis of the beginning and the proceedings of the crisis, as 2009 was the first year when the crisis proceeded in its fullest and throughout the year. In the measured period of three years, every year 12 values were analysed, which in the coherent time series already enable a complex, general and valuable analysis.

The selection of variables was methodically chosen with regard to the mutual interconnectivity and collaboration within the mechanism of national economy and their relative importance in the economy. This was the reason why two primary variables from the GDP production area were analysed (construction and agricultural production) and also one secondary variable was analysed (unemployment), which is in causal relationship to the two variables mentioned above. Both construction and agricultural production are variables with a highly seasonal cycle, which is, with some delay, mirrored in the development of unemployment in both directions. Simultaneously with this presupposition, the variables construction and agricultural production, however seasonal, may act differently, which is caused by the obvious differences in the characteristics of these disciplines. Whilst elasticity of demand by agricultural production may be very low, by construction production it is very high, thus households and companies postpone their consumption and investments until after the crisis, so for a more favourable time period. This is why the decrease in production in construction leads to the subsequent increase in unemployment, whilst for agricultural production, this is not the case. For agricultural production is in this case typical the so-called Giffen goods effect, where the demand for agricultural production does not grow nor fall significantly, as the income effect absolutely negates the substitution effect. Therefore also the increase in unemployment along with the decrease of the level of agricultural production is set rather by the effect of the seasonal cycle, whilst in the case of construction production the increase in unemployment is rather dictated by the decrease in demand for construction production.

Selected economic variables (macroeconomic variables) the values of which show a seasonal character (fluctuations) were subjected to the fuzzy regression analysis. Here we talk about construction production, agricultural production and the rate of unemployment) [20].

Construction and agricultural production usually grow from spring to autumn seasons, in winter we can see their decline. The opposite trend is shown by the unemployment rate which drops from spring to autumn, and in winter unemployment generally has the highest values (seasonal unemployment). This is a purely theoretical viewpoint, however, a number of certified work and empirical observations approve it. While the crisis, during the studied values (2009 - 2011), the economy could behave unpredictably. It is interesting to watch positive values of agricultural production, when consumers simply cannot significantly reduce demand, and greater fluctuations including negative values in construction production. However, for both types of production, despite

the mentioned diversity, we can apparently observe seasonal behaviour of variables, especially in the long-term perspective.

Unemployment behaves in the opposite way: when production declines (the GDP), unemployment rises and vice versa (due to fluctuation - decrease/ increase of demand). Thus, unemployment secondarily shows a seasonal character. It is (inter alia) the so called Okun's law which was formulated in the 1960s; it says that when there is a decline in GDP by 2%, the unemployment rate grows by 1%; or the proportion is approximately 2:1.

The identification of the time series fuzzy regression models was made using the standard genetic algorithms of the Optimtoolbox MATLAB program system [9].

The results are shown in the form of the fuzzy regression models of time series of Construction production (CPT) - Fig.4 and Fig. 5, Agricultural production (APT) - Fig. 6 and Fig. 7, and Unemployment (UNT) - Fig. 8 and Fig. 9. The figures represent their fuzzy trends and fuzzy seasonal cycles. Appropriate regression coefficients of regression functions are presented in the form $A\{\alpha; c\}$

$$A_0\{-0.7268; 2.0190\}$$
$$A_1\{-0.1533; 0.1187\}$$

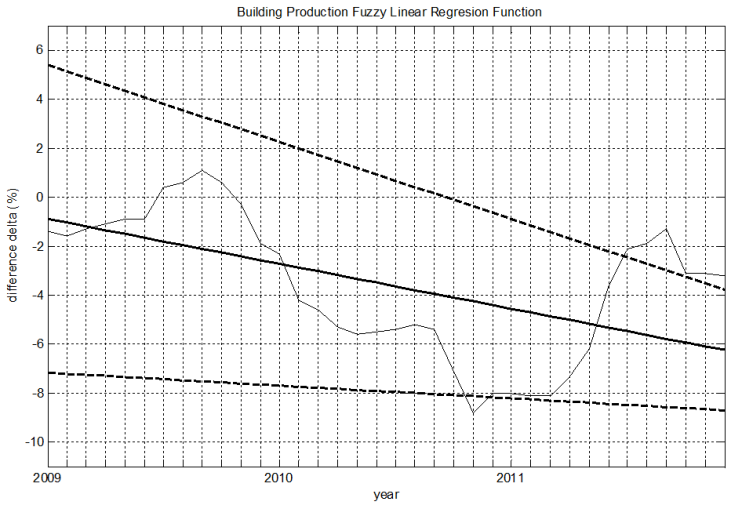

Fig. 4. Construction Production - Fuzzy Linear Regression Function
Source: [own processing]

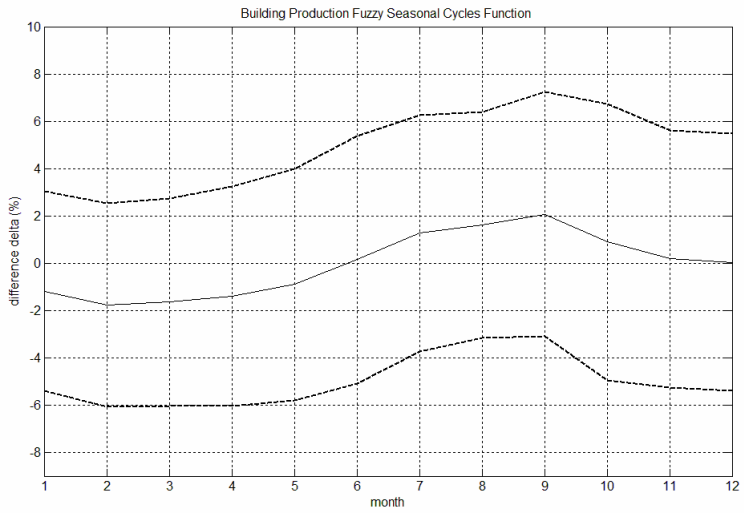

Fig. 5. Construction Production - Fuzzy Seasonal Cycles Function
Source: [own processing]

$A_0\{4.9646;0.7891\}$
$A_1\{0.1157;0.0243\}$

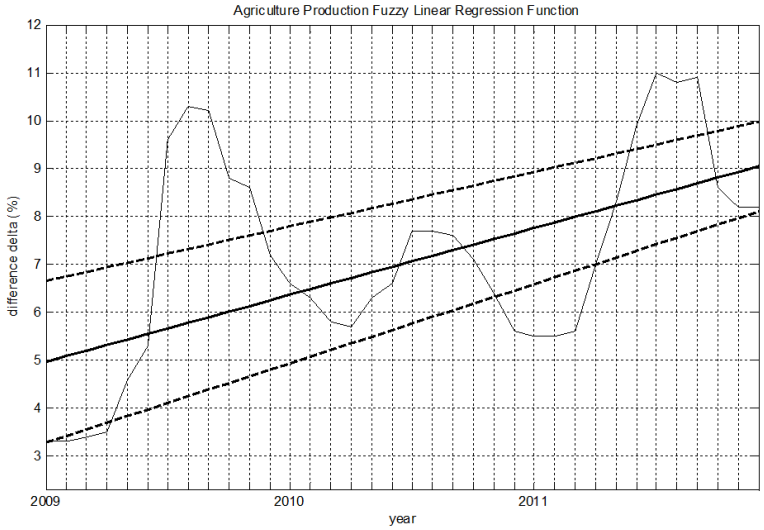

Fig. 6. Agricultural Production - Fuzzy Linear Regression Function
Source: [own processing]

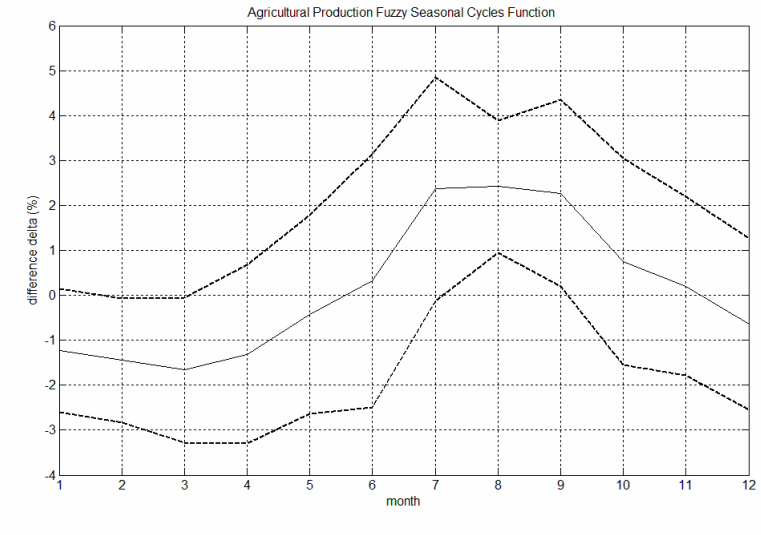

Fig. 7. Agricultural Production - Fuzzy Seasonal Cycles Function
Source: [own processing]

$A_0\{7.9438;0.5790\}$
$A_1\{-0.0385;0.0057\}$

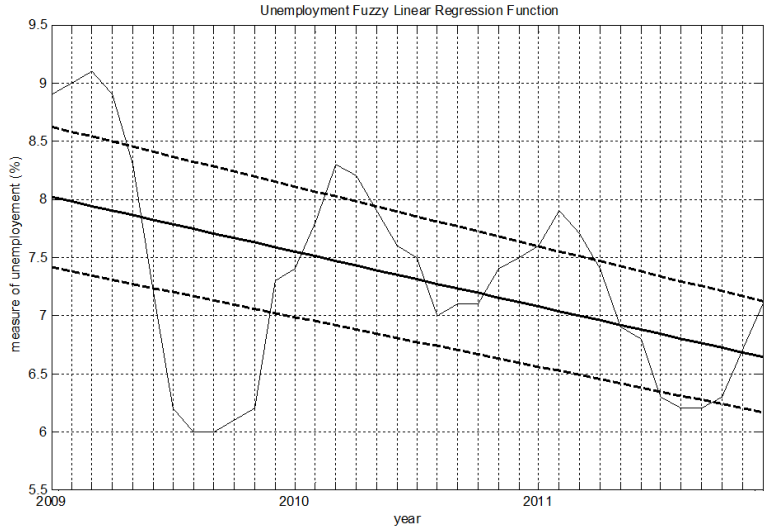

Fig. 8. Measure of Unemployment - Fuzzy Linear Regression Function
Source: [own processing]

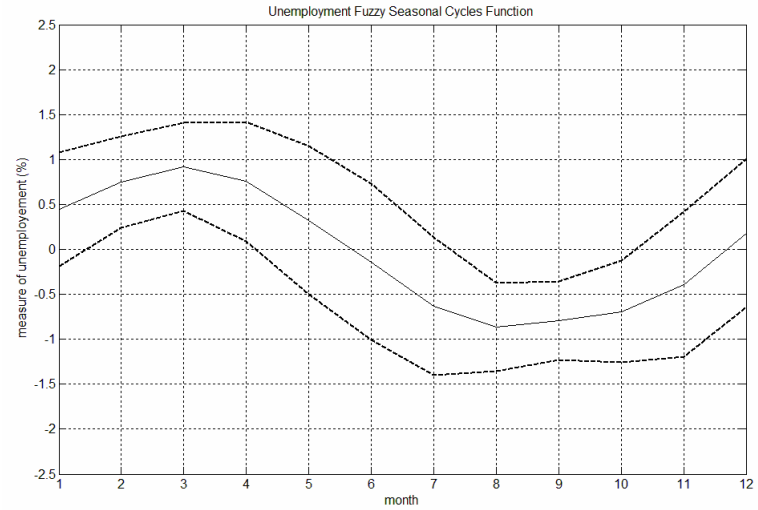

Fig. 9. Measure of Unemployment - Fuzzy Seasonal Cycles Function
Source: [own processing]

The results of the time series analysis of the development in macroeconomic variables of the unemployment rate (UNT), construction (CPT) and agricultural production (APT) which were found above show the interdependence of some of these demonstrated variables, but in some cases they also reflect a certain degree of vagueness, i.e. fuzzitivity. This concerns both the interdependence of CPT and APT variables in relation to UNT, and also in some periods basically the same trend of CPT and APT (2009 and 2011) and their opposite trend in 2010. The dependencies selected above were confirmed by a number of impartial scientific methods and long-term professional empirical observation [2]. However, some of the above mentioned assumptions were not confirmed by the presented work and it has some general reasons that can be satisfactorily explained.

One of the reasons can be seen in the market failure due to the global economic crisis. We rather do not talk about a state of stagnation or moderate inflation, but about the current so-called stagflation, which used to be a relatively rare phenomenon. It is a combination of two failures of macroeconomic equilibrium, namely economic stagnation, or rather stagnation of GDP growth, and rising prices (inflation). The existence of this type of failure raises serious national economic problems having impact on the fiscal and monetary policy of the country with an emphasis on the contradictory nature of these failures; especially the choice of current fiscal expansionary and also restrictive monetary instruments of the economic policy [17]. What also plays its role here is the global type of economy and thus limited effectiveness of measures at the national level. This is especially true for very small and open economy such as the Czech Republic.

Another important influence on the variables UNT, CPT and APT in time is the so-called time lag in the economy. It means series of delays resulting from the characteristics of an economic process based on a premise that from the moment when the problem (failure) appeared and then while watching the problem using conclusive measurable economic tools (recognition lag) some time (delay) will always pass; then there is particular time needed for making a decision and choosing tools for fixing the failure, and also there is time required to implement the tools including their positive effect (implementation lag). This fact significantly reduces efficiency of the economic policy and together with its global character fundamentally affects economic activity [5]. Then it refers to the mutual correlation of all the variables and their existing and proven fuzzitivity.

Another significant circumstance affecting fuzzitivity of the monitored system is a distortion of the market by existing government and political interference. In the monitored sample of variables it concerns mainly the APT variable which is significantly affected by agricultural subsidies at the national and European levels and deflects behaviour of particular economic market agents [10]. To some extent this also applies to the UNT variable which is affected, for example, by a minimum wage, state employment policy, amount of social benefits and a variety of other interventions that unilaterally deflect labour market out of the free market. Relatively free market environment exists only in the area of construction production. Government interventions that have a tendency to grow definitely increase vagueness of the variable behaviour of the monitored system.

The intermediate effects of the crisis, which changed within the three observed years in its character gradually from a financial crisis to an economic crisis, also have an undoubtable effect on the high fuzzitivity of the investigated system. The crisis at the same time slowly spread from individual market subjects to a crisis of public budgets and state debt crisis. This phenomenon, being much stronger in the Eurozone countries than in the Czech Republic, has an imminent influence upon foreign demand, upon which the Czech economy, being small and open, is to a certain extent very dependent. This is especially the case in agricultural production, half-finished products and food (i.e. generally APT), in a smaller extent also the export of construction materials, construction workforce and investment construction units (generally CPT). Foreign influences, however, tend to show also the other way round. It is mostly the large import of agricultural production into the Czech Republic, where also typical and traditional agricultural products of both cattle- and plant production are being imported into the Czech Republic, as well as technical and construction material. This import narrows down the operating space for traditional Czech manufacturers and their supply is limited. The foreign influences have the largest affect upon the variable UNT, as the free movement of labour force is one of the freedoms of the EU free market. The analysed economical areas of APT and CPT are rather less demanding in matters of the labour force qualifications, therefore they are most affected by the tide of foreign labour force. This feature cannot be influenced on the national level, thus it has an imminent influence upon the growth of UNT and is one of the reasons for its high fuzzitivity.

Despite the above mentioned facts, it is still possible to observe dependencies in the monitored variables sample; the dependencies can be demonstrated by this work. In 2009 and 2011, there was a similar trend of CPT and APT seasonal cycles in summer (from June to September) with a demonstrated decrease of UNT while in 2011 this trend was even stronger than in 2009. It is a well-known phenomenon of production growth (in this case, CPT and APT) with a parallel decrease of unemployment during summer, or more precisely, with the rise of unemployment during winter, the so-called seasonal unemployment. In 2010, the system behaved fuzzily with an unproven dependency of CPT and APT on UNT. In 2010 the cycle amplitude of APT was significantly lower than the CPT amplitude, which can be adequately explained by elasticity of demand, i.e. the proportion of the change in the demanded quantity and price. Elasticity in the APT area (together agricultural production and food) is much lower, sometimes almost zero, compared to elasticity of CPT (together private and public construction), where elasticity is high. Therefore, trends zone and seasonal cycles of APT are significantly narrower than the CPT ones and sustainably achieve smaller fluctuations. The same is also fuzzitivity of the relation between the APT and UNT variables, which is significantly lower than between CPT and UNT.

Comparing the trends zones of CPT and APT in relation to UNT in the monitored period in Czech conditions we can demonstrate the existence of the so-called Okun's law. It is an empirical relationship between cyclical movements of GDP (in our case the CPT and APT variables) and UNT. The law says that if a real GDP drops towards a potential one by 2%, the unemployment rate (in our case UNT) will increase by approximately 1%. This relationship applies to the total GDP (not only to the sum of CPT and APT); however, contradictory movement of these variables can be proved by this work. While APT trend zone is growing (CPT relatively

stagnant), the UNT trend zone is decreasing, i.e. when production increases unemployment decreases. This phenomenon can be observed in the variables during the period of 2009-2011, while in the last year of the period the phenomenon shows itself most strongly.

All the variables investigated above have an immediate effect on the fiscal area of the economic policy of the state. Whilst the level of production of the real GDP (parts of which are also APT and CPT) affects the level of public costs tax allocation, the level of UNT affects the level and rate of their later redistribution. However, the decrease in demand for APT and CPT has via its influence over the drop in price level and immediate affect on the monetary area of the economic policy of the state. Economic entities then react to the decrease in the expected inflation by trying to obtain interest-bearing assets by selling other assets. This way, they are trying to lower the losses from holding liquid assets that they got by the continuous inflation. Such purchases of new assets, however, lead to growth in their price and drop in their real pay-off, meaning that even an expected increase in inflation will lead to a lowering of the interest rate. In economic literature, this effect is called the Mundell-Tobin effect.

From the above shown outputs of the time series analysis of UNT, CPT and APT we can find out and especially demonstrate the interdependence of the variables described above, and so in some points even their high fuzzitivity. This is mainly due to the global nature of the economy, protracted economic crisis, time delays and mainly state interventions and political measures which influence free market and the national economy.

Conclusions

In classical statistical regression, we assume that the relationship between dependent variables and independent variables of a model is well-defined and sharp. Although statistical regression has many applications, problems can occur in the situations in which number of observation is inadequate (small data set), difficulties verifying distribution assumptions exists, vagueness in the relationship between input and output variables exist, the ambiguity of events or degree to which they occur or inaccuracy and distortion introduced by linearization is possible.

However, in the real world, it is hampered by the fact that this relationship is more or less non-specific and vague. The suitable theoretical background for abstract formalization of the vague phenomenon of complex systems is the fuzzy set theory. In the paper vague data is defined as specialized fuzzy sets - fuzzy numbers and a fuzzy linear regression model as a fuzzy function with fuzzy numbers as vague parameters. The determination of regression model uncertainty using fuzzy approaches does not require meeting the above presumptions.

To identify the fuzzy coefficients of the model, the genetic algorithm is used. The linear approximation of the vague function together with its possibility area is analytically and graphically expressed. The suitable application is performed in the task of the time series fuzzy regression analysis. The time-trend and seasonal cycles including their possibility areas of selected economical dependences are calculated and expressed, namely time-development of unemployment, agricultural production and construction.

A number of assumptions, concerning the development of the CPT, APT and UNT variables, their seasonality and also relationship between them, were proved by the performed fuzzy regression analysis of the selected variables and also by professional works and empirical observations. In the first (2009) and third (2011) years of observation there was a common and seasonal growth of CPT and APT, while the growth of CPT was lower due to higher elasticity of demand for construction, as well as to the full impact of the economic crisis in this segment of economy. The assumption that during the studied period UNT drops along with CPT and APT growth was also confirmed; that fact was successfully demonstrated by the fuzzy regression analysis.

However, the fuzzy regression analysis of the time series development of CPT, APT and UNT demonstrated a non-standard behaviour of the monitored variables in 2010; from an economic point of view this is a result of a number of causes. Here we talk about the third and deepest crisis year and we can see full influence of the state and a huge impact of globalization on the small and open economy of the CR. The delay, certainly, played its role here; it appeared in the economy during the second studied year (2010). This year, the system of indicators behaved fuzzily and the interdependence of CPT and APT on UNT was never proven by the model; moreover, the model behaved much vaguer, i.e. fuzzily, in relation of CPT to UNT than in relation of APT to UNT. The cause of the phenomenon we can find in low elasticity of demand for agricultural production, or, for example, in

the rising price of agricultural commodities throughout the period. State intervention and transnational influences on the APT and UNT variables are so large that they can be seen as one of the causes of non-standard and fuzzy behaviour of these variables during the year. The effect of efficiency functions vagueness was commented.

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Credit Risk Management and Interest Income of Banks in Nigeria

Fapetu, Oladapo[1], Seyingbo, Oluwagbenga Abayomi[2] & Owoeye, Segun Daniel[3]

[1]Department of Banking & Finance, College of Management Sciences, Federal University of Agriculture, P. M. B. 2240, Abeokuta, Ogun State, Nigeria, E-mail: drfapetu@gmail.com; Tel:+2348062163511

[2]Department of Finance, University of Ilorin, Kwara State, Nigeria, E-mail: seyingboolugbenga@gmail.com, Tel: +2347034852932

[3]Department of Banking & Finance, College of Management Sciences, Federal University of Agriculture, P. M. B. 2240, Abeokuta, Ogun State, Nigeria, E-mail: benesto133@gmail.com, Tel:+2348036049473

Abstract

This study examines the impact of credit risk on the interest income of banks in Nigeria between the period of 2000 and 2014. Unbalanced panel data analysis was used to estimate the model with unit root test, Breusch Pagan test, trend analysis, descriptive statistics, Perasan CD Test, heteroskedasticity test, heterogeneity test, serial correlation test, Jarque-bera, F-statistics, random effect, fixed effect, time effect, Prob value, Hausman test and rho as the estimation parameters. The study discovered that NPL, LLP and LA are statistically significant in explaining the variation in interest income across banks in Nigeria, while LA/TD is not statistically significant in explaining the variation in interest income across banks in Nigeria. Based on this, the study recommends that regular update of credit policy and adequate measures to monitor loans should be put in place by banks in Nigeria, as these measures will reduce bad loans and ultimately cause a reduction in loan loss provisions.

Keywords: ***Credit risk, non-performing loans, interest income, return on asset, risk management***

JEL Classification Codes: G11, G12, G21

Introduction

Credit risk management is a vital concept receiving crucial attention all over the world most especially in the financial institutions. The salient goals of corporate organization are to maximize profits, achieve high level of liquidity with the aim of guaranteeing organizations safety and also attain highest level of shareholder's net worth. The relevance of banks to the economy lies primarily in their ability to mobilize credit and grant loans to various sectors in the economy and also ensuring that it does not suffer from lack-of or excess liquidity. Lending operations are core banking activities and the most profitable asset of financial institutions. In many markets, banks have to operate in the economic environment that is characterized by the existence of obstacles to good credit management. When credit are not properly channeled, controlled and administered, it reduces interest income and banks profitability and also leads to bank distresses and failures (Berger and Christa, 2009; Eljelly, 2004).

Risk increases when credit principles are violated and sound banking practices require that bank management put in place standards for appraising and approving individual credit application to ensure that loans granted are repaid. However, due to poor credit administration caused by loopholes and violation in risk assessment and control techniques, bad and doubted debts still claim a bulk charge on bank performance causing many banks to witness institutionalized distress and some, total unexpected collapse. Since lending carries a reasonable portion of resource exposure of banks, the ability of a bank to generate much profit is largely a function of effective and efficient management of its lending portfolio (Aruwa and Musa, 2014). The major issues surrounding the study centers on the looming failures of financial institutions in which lack of adequate credit and liquidity management seems to be the major causes of banks distress in Nigeria and diaspora.

According to Ahmad and Ariff (2007), most banks in economies such as Thailand, Indonesia, Malaysia, Japan and Mexico experienced high non-performing loans and significant increase in credit risk during financial and banking crises, which resulted in the closing down of several banks in Indonesia and Thailand. The rate at which banks are failing in Nigeria has become a major source of concern for the stakeholders and practitioners in the banking industry. From the year 1994 to 2006, forty eight (48) Deposit Money Banks (DMBs) were liquidated (NDIC, 2011). In 2005, the number of licensed banks operating in Nigeria were reduced to twenty

four (24) due to the recapitalization and consolidation exercise, but as a result of merger and acquisitions, the total number of banks operating in Nigeria as at 2014 are twenty one (21). The major causes of the above banks failure can be attributed to poor risk management (Hamisu, 2011).

The crises in the banking sector led to the establishment of Nigeria Asset Management Corporation of Nigeria (AMCON) which commenced operation in the year 2010 to take over the management of the toxic assets in the books of the banks and also the management of failing banks in Nigeria such as Keystone banks, Enterprise Bank and Mainstreet Bank.

In spite of the measures put in place aimed at protecting depositors and other public interest, the incidence of bank distress and failure has been on the high increase in Nigeria. High rate of non-performing loans, increased in loan loss provisions, increases in the probability of bank default and reduction in interest income which serves as the bulk revenue portfolio for banks can be ascribed to the ineffectiveness of the Credit risks management of Nigerian banks.

Business conditions are often unpredictable and can lead to changes in the borrower's financial position and affects their ability to repay the loans at the date of maturity. With the above scenario, bank faces a credit risk of losing part or the entire loan including the interest receivable on such loans. This negatively affects the interest income accruing from such loans, reduces bank performance and also reduces its' capabilities to meet its' financial obligations as they fall due. As these conditions remain unchecked, the liquidity of the bank is also threatened (Bhunia, 2012).

Non-performing loans posed a great threat to the success of a bank and also reduced the profit channel of banks in Nigeria such as the interest income. Loan loss provision is also another credit risk management techniques which reduces funds to be channeled in viable investment by banks which ultimately affects its performance and survival. Inefficient credit management posed a great threat to the liquidity positions of a bank, as it affects the amount of cash balances, bank balances and treasury bills representing short term cash management which ensures the day-to-day running of the bank. Efficient credit management policies ensure high and constant interest income from loans and advances given to various individuals', firms, corporate bodies and government institutions. It is expedient that low credit management policies will drastically affect interest income.

Several studies such as (Hosna, Manzura and Juanjuan 2009; Kithinji, 2010; Simiyu, 2012; Madishetti and Rwechungura, 2013; Kargi, 2011; Idowu and Awoyemi, 2014) focused on credit risk management and banks performance, and it appears that no studies has examined the impact of credit risk management on interest income of banks in Nigeria. It is against this setback that the study examined the impact of credit risk management on interest income of banks in Nigeria using some selected quoted banks on the Nigerian stock exchange as at December 2015 as the case study. This study excludes those banks acquired by Asset Management Corporation of Nigeria (AMCON) such as the Keystone Bank, Enterprise Bank and Mainstreet Bank and also international banks in Nigeria such as Citi Bank, EcoBank, Standard Chartered Bank and it covers the period from 2000 to 2014, due to the fact that some banks in Nigeria are yet to publish their annual report for 2015 as at the time data is gathered for the study. The choice of this period was based on the fact that Nigerian banking industry experienced tremendous expansion when Universal Banking was introduced in 2000 and when consolidation reforms was also introduced in 2005.

The rest of this article is organised into four sections. Section two discusses the concepts of credit risk management and various empirical evidences related to the study. Section three provides the exposition of theoretical framework, conceptual framework, model specifications, estimation techniques and sources of data. Section four includes analysis of data and discussion of results while section five summarises the paper with some concluding remarks.

Literature Review

Conferring to Ingham (2002), credit can be described as the provision of loans by one party where the second party does not reimburse the first party immediately, thereby generating a debt, and instead arranges either to repay or return those resources or materials of equal value at a later date. Agreeing to Ejoh, Okpa and Egbe (2014), credit risk is a serious threat to the performance of banks which when unchecked would lead to the total

collapse of banks while, liquidity risk also act as a snare to banks with an unsound risk assessment and control policy.

In addition, Henderson (2011) opined that credit risk occurs when there is a loss in value as a result of a debtor's non-payment of a loan or other line of credit, either the principal or interest (coupon) or both. Credit risk according to Basel Committee of Banking Supervision BCBS (2001) is the possibility of losing the outstanding loan partially or totally, due to credit events (default risk). Campbell (2007) defined credit risk as the risk of loss due to debtor's non-payment of a loan or other line of credit. He further explained that credit risk management is very important in banks because it forms an integral part of loan process while, Nwankwo (2000) opined that credit constitutes the largest single income-generating asset in the portfolio of most banks and this explains why banks spend enormous resources to estimates, monitor and manage credit quality.

According to Kolapo, Ayeni & Oke (2012), credit management financial tools are loan loss provisions, loans and advances to total deposits ratio, non-performing loans, loans and advances while the non-financial tools are Capital Adequacy, Asset Quality, Management Quality, Earnings, Liquidity and Sensitivity to Market Risk (CAMELS).

Ejoh *et al.*, (2014) further explained that credit management policy is a comprehensive process that deals with identifying the target markets, credit extension, credit monitoring and identifying the proceeds while, Appa (1996) opined that credit management policy entails the mechanisms, standards and parameters that guide the bank officers in granting loans and managing the loan portfolio under the banking discipline. He further explained that it is a set of guidelines designed to maximize cost associated with credit while maximizing benefits from it.

Theoretical Framework

There are various theories on credit risk management and they are: liquid asset theory, anticipated income theory, commercial loan theory, shiftability theory, liability management theory. The theoretical framework that serves as the basis for the study is the anticipated income theory.

Anticipated Income Theory

Anticipated income theory was propounded by Prochanow in 1949, at the end of world war 11 as a result of the fact that the compositions of the earnings assets of commercial banks began to change as resources shifted back from the government to the private sector. The spectacular rise in the loan demand of the immediate postwar years provided commercial banks with strong incentives to expand their loan portfolios, and hence to increase bank earnings. After the postwar, commercial banks began to make loans that were of longer maturity, covered a much wider variety of borrowers, and extended to many more purposes than originally envisaged.

Bank's management had acquired more experience in meeting deposits withdrawals and had found that through prudent asset management, a mixture of very liquid and not-so-liquid assets could achieve the desired degree of overall liquidity. Thus, the loan portfolios of commercial banks in the postwar years have included such items as intermediate and long-term loans to customers, home owners, and business firm that would not qualify as liquid assets under the traditional theory of bank liquidity and would qualify only in part, if at all under the shiftability theory. However, loans of this type qualify under the anticipated income theory.

This theory is superior to the real bill doctrine and the shiftability theory because it fulfills the three objectives of liquidity, safety and profitability. Another importance of anticipated income theory is that, it is a method to analyze borrower's credit worthiness. It gives the banks criteria for evaluating the potentials of a borrower to successful repayment of loan on time.

According to Prochanow (1949), anticipated income theory argues that a bank can maintain its liquidity if loan repayments are scheduled on the basis of the anticipated income of the borrower rather than the use made of the funds of the collateral offered. This theory also suggests that banks should rely on debtors' income and its coverage is determined on the basis of inclusive cash-flow projections which ordinarily provide a reliable indication of the quality of the loan being financed. Hence, the future cash flows of the borrowers, rather than the nature of particular transactions being financed, assures the self-liquidating character of a loan because it will

determine a borrowers overall ability to meet interest and principal payments as they fall due. If the debtors anticipated income is estimated correctly, the bank will have a flow of funds that can be used to meet depositor's claims and/or other loan demand.

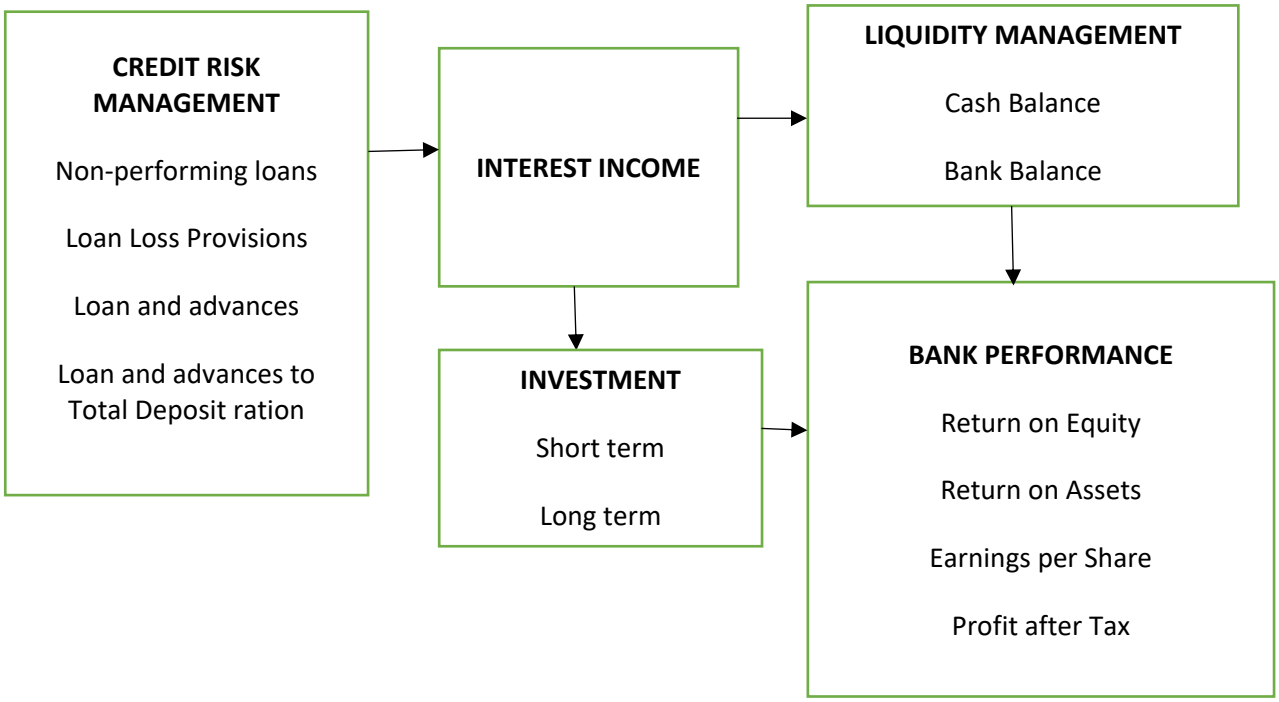
According to Ibe (2013), anticipated income theory holds that a bank's liquidity can be managed through the proper phasing and structuring of the loan commitments made by a bank to the customers. Here the liquidity can be planned if the scheduled loan payments by a customer are based on the future of the borrower. According to Nzotta (1997), the theory emphasizes the earning potential and the credit worthiness of a borrower as the ultimate guarantee for ensuring adequate liquidity.

Alshatti (2015) stated that the bank can manage its liquidity through the appropriate directing of the granted loans, and the ability to collect these loans when due in a timely manner and to reduce the possibility of delays in repayment at the maturity time. This theory posts that bank's management can plan its liquidity based on the expected income of the borrower, and this enables the bank to grant a medium and long-term loans, in addition to short-term loans as long as the repayment of these loans are linked by the borrowers expected income to be paid in a periodic and regular premiums, and that will enable the bank to provide high liquidity, when the cash inflows are regular and can be expected.

Conferring to Ngwu (2006), anticipated income theory of liquidity of commercial bank holds the view that banks liquidity can be estimated, and met if scheduled payments are based on the income of the borrowers. This theory does not deny the applicability of self-liquidating and suitability theories. It emphasized on relating loan repayment to income rather than relying heavily on collaterals. It also holds that, banks liquidity can be influenced by the maturity pattern of the loans and investment portfolios, short-term business and customer installment loans which would have more liquidity than those secured by real estate. Thus, appropriate credit risk management policies of a bank will increase interest income and ultimately ensures adequate liquidity.

In conclusion, anticipated income theory serves as the theoretical underpinning because it incorporates credit and liquidity management policies because it analyzes borrower's credit worthiness. It gives the banks criteria for evaluating the potentials of a borrower to successful repayment of loan on time which ultimately affect the interest income which can be used to influences the liquidity positions of banks.

Theoretical Model



***Source*: Prochanow (1949)**

Anticipated income theory holds the views that if credit were adequately managed, interest income will be influence, which will affect the investment opportunities and ultimately increase the liquidity position of the firm by ensuring the day to day operation of the firm and ultimately increase the organizational performance.

Empirical Review

Hosna, Manzura and Juanjuan (2009) examined credit risk management and profitability in commercial bank in Sweden over the period of 2000 to 2008. The study used quantitative approach and focused majorly on the descriptive statistics. Regression analysis was also used in the study. ROE being the function of NPLR and CAR. The findings revealed that credit risk management has effect on profitability in all 4 banks. NPLR has a significant effect more than CAR on profitability (ROE) at 1 percent level of significance and it was recommended that a qualitative study of credit risk management which will make the findings more objective and informative and profitability indicators could be developed by adding other dependent variables to grasp the whole variations in profitability.

Kithinji (2010) surveyed credit risk management and profitability of commercial banks in Kenya over the period of 2004 to 2008. A regression model was used to establish the relationship between amount of credit, Non-performing loans and profit. The amount of credit was measured by loans and advances to customers divided by total assets while, the Non-performing loans was measured using non-performing loans divided by total loans and profits was measured using return on total asset (ROTA). The result showed that there is a positive relationship between the amount of credit and profit while, there is a negative relationship between the level of non-performing loans and profit at 10 percent level of significance and the study recommends that commercial banks that are keen on making high profits should concentrate on other factors other than focusing more on amount of credit and non-performing loan.

Simiyu (2012) investigated the impact of credit risk management on profitability of commercial bank: A study of Europe. In the research model, Return on Equity (ROE) and Return on Assets (ROA) were defined as proxies for profitability while NPLR and CAR are defined as proxies for credit risk management. The research collects data from the largest 47 commercial banks in Europe. The findings revealed that credit risk management have a positive effect on profitability of commercial banks i.e NPLR has a significant effect on both ROE and ROA while CAR has an insignificant effect on both ROE and ROA at 5 percent level of significance. The study recommended that bank managers should put more efforts to the credit risk management, especially to control the NPLR.

Madishetti and Rwechungura (2013) determined the impact of credit risk on the performance of Tanzanian commercial banks over the period of 2006 to 2013 and the study used only secondary data which were sourced mainly form the annual reports of eight largest Tanzanian commercial banks were used in the study. Return on Assets (ROA) being a function of ratio of non-performing loans to loan and advances and ratio of loans and advances to total deposits. Multiple regression was used to estimate the relationship. The result of the study revealed that there is a negative relationship between credit risk and bank performance in Tanzanian and also that the relationship is statistically significant at 10 percent and the study also recommends that Tanzanian commercial banks management should put in place adequate credit policy which will ensure that credit risk is reduced and banks profitability level is improved.

Kargi (2011) also investigated the impact of credit risk on the profitability of Nigerian banks over the period of 2004 to 2008. Financial ratios as measure of banks performance and credit risk were collected from annual reports study used descriptive, correlation and regression techniques while the findings revealed that credit risk management has a significant impact on the profitability of Nigerian banks at 10 percent level of significance.

Idowu and Awoyemi (2014) examined the impact of credit risk management on the commercial banks performance in Nigeria over the period of 2005 to 2011. The panel regression model was employed for the estimation in the model. Return on equity and Return on Asset were used as the performance indicators while non-performing loans (NPL) and capital adequacy ratio (CAR) as credit risk management indicators and it was revealed that credit risk management has a significant impact on the profitability of commercial banks in Nigeria at 5 percent level of significance. The study recommends that commercial banks are recommends to establish sound and competent credit risk management units which are run by best practices in risk management.

Ogboi and Unuafe (2013) inspected the impact of credit risk management and capital Adequacy on the financial performance on commercial banks in Nigeria over the period of 2004 to 2009. Panel data model was used to estimate the relationship that exists among loan loss provisions (LLP), loans and advances (LA), non-performing loans (NPL), Capital adequacy (CA) and return on asset (ROA), using a time series and cross sectional data from 2004 to 2009. The result showed that sound credit risk management and capital adequacy impacted positively on banks financial performance with the exception of loans and advances which was found to have a negative impact on banks at 5 percent level of significance and the research recommends that Nigerian banks should institute appropriate credit risk management strategies by conducting rigorous credit appraisal before loan disbursement and drawdown.

Model Specification

The model used to achieve the objective was adopted from the study of Ogboi and Unuafe (2013) which was specified as:

$$ROA = f\left(NPL, LLP, LA, \frac{LA}{TD}\right) \quad \text{……..equation (i)}$$

$$ROA_{it} = \beta_0 + \beta_1 NPL_{it} + \beta_2 LLP_{it} + \beta_3 LA_{it} + \beta_4 \frac{LA}{TD}_{it} + \mu_{it} \text{……..…….....equation (ii)}$$

Where:

β_0 = Constant

ROA = Return on Asset

NPL = Non performing loan

LLP = Loan loss provision

LA = Loans and Advances

TD = Total Deposits

μ_{it} = Error term

The model was re-modified to capture interest income of banks as the dependent variables being a function of credit management financial indicators and it was re-modified as:

INTINC = *f*(Credit Management Financial Indicators)

$$INTINC = f\left(NPL, LLP, LA, \frac{LA}{TD}\right) \text{……..…..equation (iii)}$$

$$INTINC_{it} = \beta_0 + \beta_1 NPL_{it} + \beta_2 LLP_{it} + \beta_3 LA_{it} + \beta_4 \frac{LA}{TD}_{it} + \mu_{it} \text{……..……..equation (iv)}$$

When transformed to normalize the data, it becomes:

$$LOGINTINC_{it} = \beta_0 + \beta_1 LOGNPLit + \beta_2 LOGLLP_{it} + \beta_3 LOGLAit + \beta_4 LOG\frac{LA}{TD}_{it} + \mu_{it} \text{…equation (v)}$$

Where:

LOGINTINC =Logarithm of Interest Income

LOGNPL = Logarithm of Non-performing loans

LOGLLP = Logarithm of Loan loss provisions

LOGLA = Logarithm of loans and advances

LOG $\frac{LA}{TD}$ = Logarithm of Ratio of Loans and Advances to Total Deposits

μ_{it} = error term

The subscripts *i* and *t* refers to the cross-dimension and time series dimension of the model respectively, explaining the panel nature of the model.

Population/Sample Size of the Study

The population of the study comprises of the quoted twenty one (21) banks in Nigeria stock market. The sample size comprises of fourteen banks in Nigeria and these were selected based on some criteria which are: (i) Banks that are wholly or majorly owned by Nigerians; (ii) Banks that retained their brand names over time; (iii) Banks that experienced either universal reform or consolidation reform in Nigeria and (iv) Banks that also experienced merger and acquisitions in Nigeria.

Based on this criteria, the fourteen banks selected are: First Bank PLC, United Bank of Africa (UBA), Guaranteed Trust Bank (GTB), Union Bank, Unity Bank, First City Monument Bank (FCMB), Fidelity Bank, Access Bank, SKYE Bank, Sterling Bank, Wema Bank, Stanbic IBTC Bank, Zenith Bank and Diamond Bank.

Sources of Data

The data needed for the study are secondary in nature implying that data will be obtained from annual report for all the fourteen quoted banks. Other sources are journal and Nigerian stock exchange fact book 2000, 2005 and 2010 and 2014.

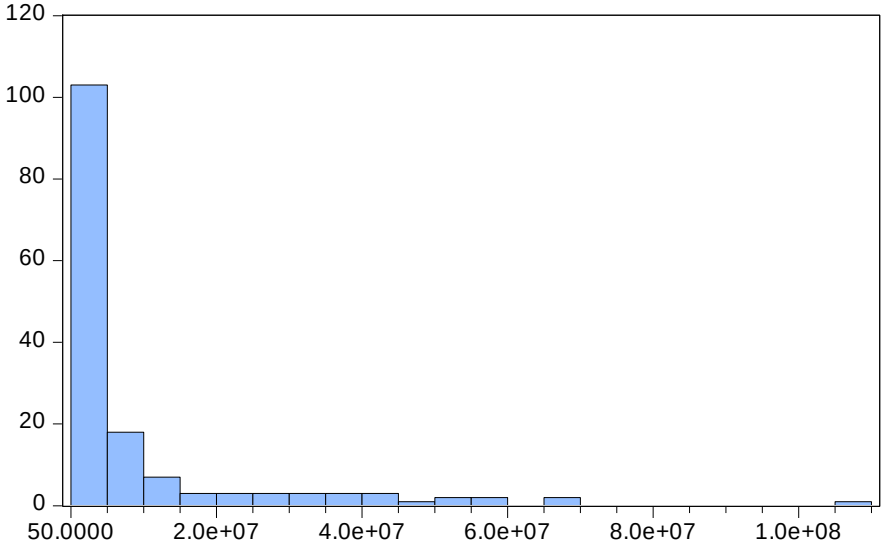
Method of Data Analysis

The model is estimated using unbalanced panel data analysis for the period 2000-2014 and the estimation parameters used for decision making in the study were unit root test, Breusch Pagan test, trend analysis, descriptive statistics, Perasan CD Test, heteroskedasticity test, heterogeneity test, serial correlation test, Jarque-bera, F-statistics, random effect, fixed effect, time effect, Prob value, Hausman test and rho. The study used Stata 11 statistical software version for its analysis.

Result

Descriptive Statistics of Variables

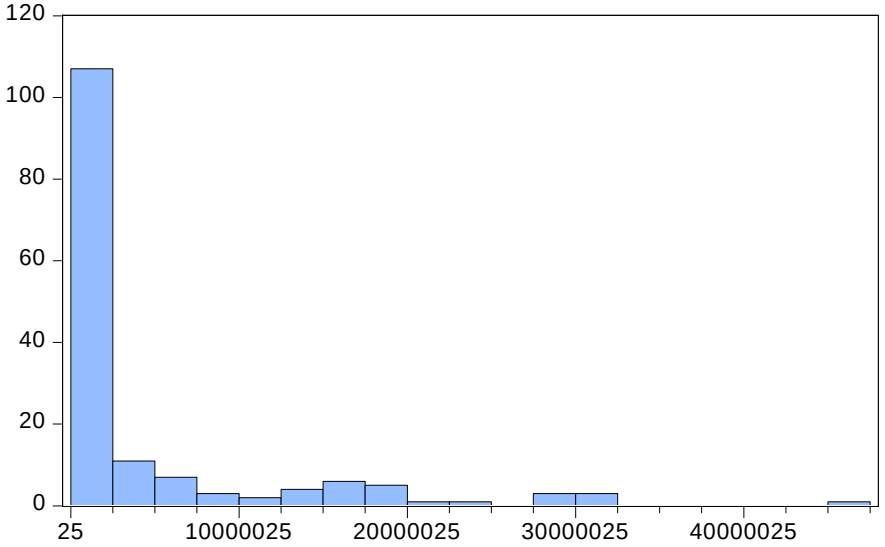
Figure 1: Non-Performing Loans



Series: NPL	
Sample 1 154	
Observations 154	
Mean	8754342.
Median	798887.0
Maximum	1.10e+08
Minimum	191.0000
Std. Dev.	16970283
Skewness	2.848770
Kurtosis	12.61241
Jarque-Bera	801.1879
Probability	0.000000

The diagram above shows the descriptive statistics of Non-Performing loans (NPL) across banks in Nigeria. It was revealed that Non-Performing Loans (NPL) across banks has a mean value of 8754342, a median value of 798887, a minimum value of 191.00 and also standard deviation value of 16970283 from mean value. The diagram also shows that the skewness is greater than 0 with a value of 2.8448. This indicates a right skewed distribution, while the kurtosis is also greater than 3, with a value of 12.612. This also indicates a lepotokurtic distribution. This implies that Non-performing loans (NPL) across banks has a sharper normal distribution with values concentrated around the mean and thicker tail.

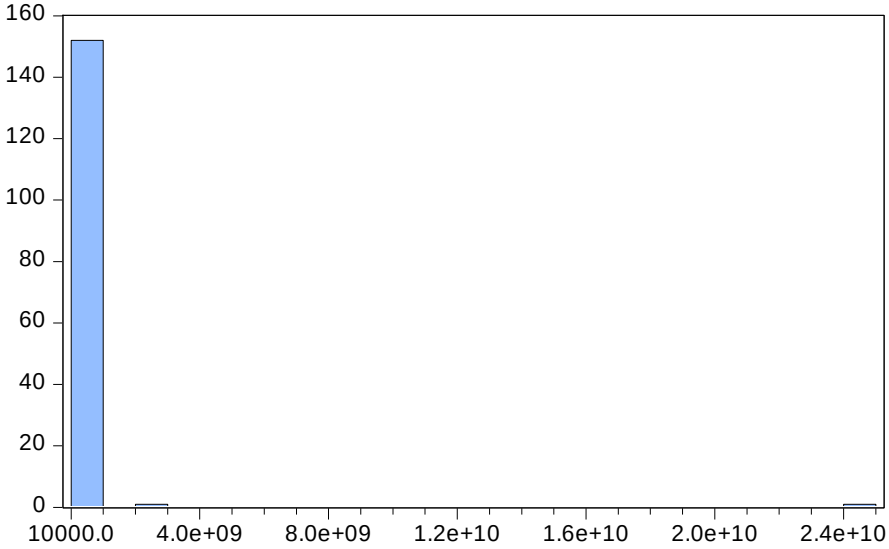
Figure 2: Loan Loss Provisions



Series: LLP	
Sample 1 154	
Observations 154	
Mean	4508595.
Median	360889.0
Maximum	45053329
Minimum	181.0000
Std. Dev.	8316562.
Skewness	2.336093
Kurtosis	8.398631
Jarque-Bera	327.0866
Probability	0.000000

The diagram above shows the descriptive statistics of Loan Loss Provisions (LLP) across banks in Nigeria. It was revealed that Loan Loss Provisions (LLP) across banks has a mean value of 4508595, a median value of 360889, a minimum value of 181.00 and also standard deviation value of 8361562 from mean value. The diagram also shows that the skewness is greater than 0 with a value of 2.336. This indicates a right skewed distribution, while the kurtosis is also greater than 3, with a value of 8.398. This also indicates a lepotokurtic distribution. This implies that Loan Loss Provisions (LLP) across banks has a sharper normal distribution with values concentrated around the mean and thicker tail.

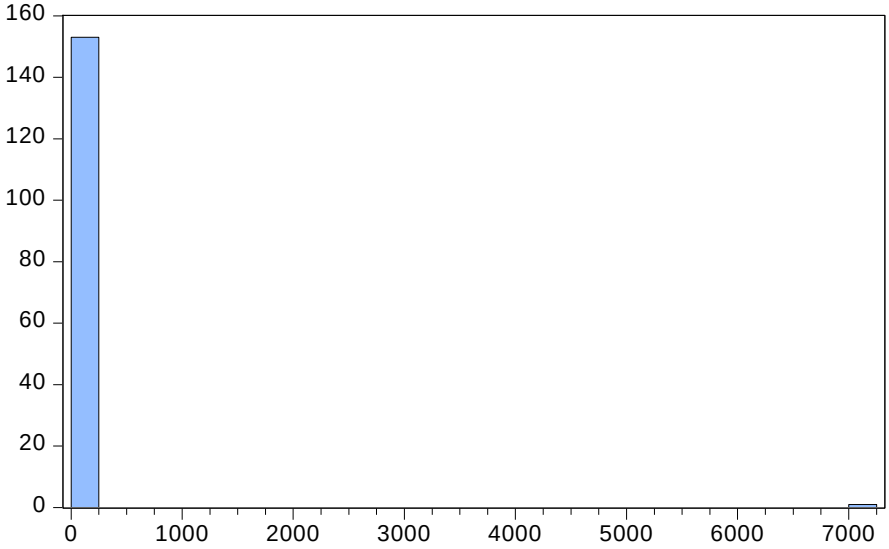
Figure 3: Loans and Advances



Series: LA	
Sample 1 154	
Observations 154	
Mean	2.62e+08
Median	5464013.
Maximum	2.45e+10
Minimum	12123.00
Std. Dev.	1.98e+09
Skewness	11.98726
Kurtosis	146.9398
Jarque-Bera	136632.9
Probability	0.000000

The diagram above shows the descriptive statistics of Loan and advances (LA) across banks in Nigeria. It was revealed that Loan and advances (LA) across banks has a mean value of 2.62, a median value of 5464013, a minimum value of 12123.00 and also standard deviation value of 1.98 from mean value. The diagram also shows that the skewness is greater than 0 with a value of 11.98. This indicates a right skewed distribution, while the kurtosis is also greater than 3, with a value of 146.93. This also indicates a lepotokurtic distribution. This implies that Loan and advances (LA) across banks has a sharper normal distribution with values concentrated around the mean and thicker tail.

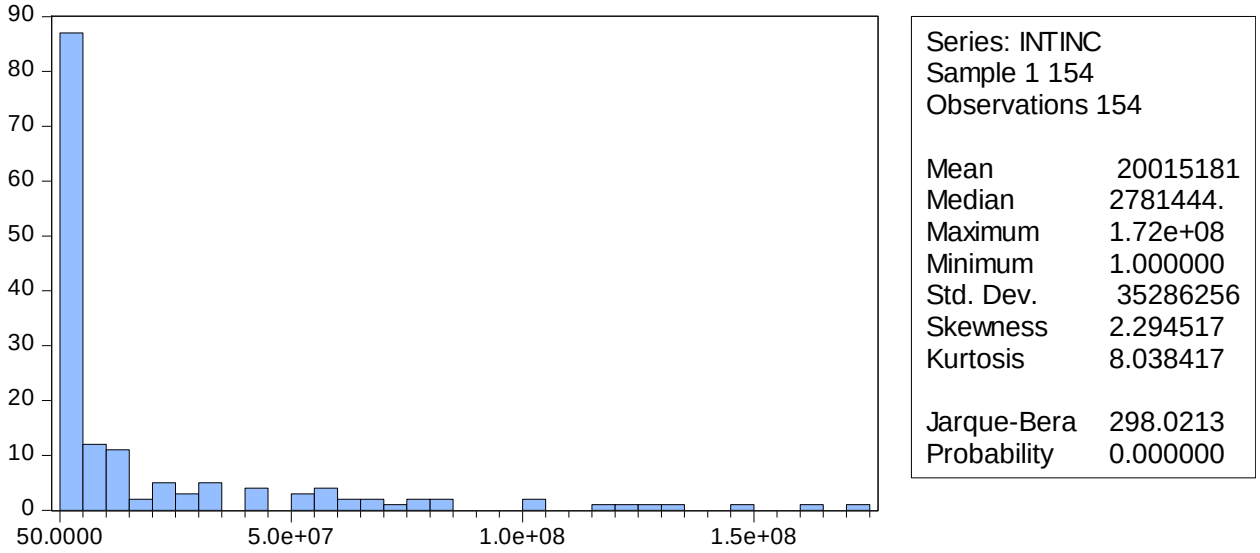
Figure 4: Ratio of Loan and Advances to Total Deposits



Series: LATD	
Sample 1 154	
Observations 154	
Mean	46.03242
Median	0.510500
Maximum	7005.000
Minimum	0.010000
Std. Dev.	564.4348
Skewness	12.28847
Kurtosis	152.0065
Jarque-Bera	146344.6
Probability	0.000000

The diagram above shows the descriptive statistics of ratio of Loan and Advances to Total Deposits (LA/TD) across banks in Nigeria. It was revealed that Loan and Advances to Total Deposits (LA/TD) across banks has a mean value of 46.032, a median value of 0.5105, a maximum value of 7005, a minimum value of 0.0100 and also standard deviation value of 564.43 from mean value. The diagram also shows that the skewness is greater than 0 with a value of 12.288. This indicates a right skewed distribution, while the kurtosis is also greater than 3, with a value of 152.006. This also indicates a lepotokurtic distribution. This implies that Loan and Advances to Total Deposits (LA/TD) across banks has a sharper normal distribution with values concentrated around the mean and thicker tail.

Figure 5: Interest Income



The diagram above shows the descriptive statistics of ratio of Interest Income (INTINC) across banks in Nigeria. It was revealed that Interest Income (INTINC) across banks has a mean value of 20015181, a median value of 2781444, a maximum value of 1.72, a minimum value of 1.0000 and also standard deviation value of 35286256 from mean value. The diagram also shows that the skewness is greater than 0 with a value of 2.2945. This indicates a right skewed distribution, while the kurtosis is also greater than 3, with a value of 8.0384. This also indicates a lepotokurtic distribution. This implies that Interest Income (INTINC) across banks has a sharper normal distribution with values concentrated around the mean and thicker tail.

Table 1: Variables Cross-Sectional Dependence

Variables	C-D Test	P-Value	Remarks
LOGINTINC	3.90	0.0000	Cross sectional Dependence
LOGNPL	1.38	0.167	No Cross sectional Dependence
LOGLLP	3.74	0.000	Cross sectional Dependence
LOGLA	7.75	0.000	Cross sectional Dependence
LOGLA/TD	2.15	0.032	Cross sectional Dependence

Source: Author's Computation, (2016)

The table above revealed that variables such as LOGINTINC, LOGLLP, LOGLA and LOGLA/TD, strongly reject the null hypothesis of no cross sectional dependence of variables across banks at 1 percent level of significance, while LOGNPL do no reject the null hypothesis of no cross sectional dependence of variables across banks in Nigeria.

Table 2: Cross Sectional Dependence

Test	**C-D**	-0.817
	Pr	0.4142
	Abs	0.281

Source: Author's Computation, (2016)

The table above revealed that the null hypothesis of no cross sectional dependence should not be rejected for the model, since the Pr value of 0.4142 is greater than 1 percent, 5 percent and 10 percent level of significance. This implies that the residuals are not correlated.

Table 3: Heteroskedasticity Test

	Chi2(14)	1776.49
Chi2	Prob >	0.0000

Source: Author's Computation, (2016)

The table above revealed that there is presence of heteroskedasticity in the model since the Prob>chi2 value of 0.0000 is significant at 1 percent. The null hypothesis of homoskedasticity should be rejected, implying that there is presence heteroskedasticity in the model. This implies that Pooled OLS is inappropriate, thus there is evidence of significant differences across banks in Nigeria.

Table 4: Test of Serial Correlation

F(1, 13)	0.787
Prob>F	0.3912

Source: Author's Computation, (2016)

The table above test for serial correlation in the model. It was revealed that the null hypothesis of no serial correlation should not be rejected and therefore concludes that the variables do not have first-order autocorrelation.

Table 5: Heterogeneity Test

Chi2(1)	19.85
Prob > Chi2	0.0000

Source: Author's Computation, (2016)

In table above, the Prob > chi2 gives a value of 0.000, implying that the null hypothesis should be rejected and it revealed that the random effect is appropriate due to the fact that there is evidence of significant differences across banks and this also implies that the variables cannot be pooled together, signaling that the Pooled OLS method is inappropriate.

Table 6: Summary Statistics of Panel Result

Independent Variables	Pooled OLS Coefficient	P-val	Random Effects Coefficient	P-val	Fixed Effects Coefficient	P-val
Constant	0.4736	0.446	1.1851	0.185	2.5288	0.060
LOGNPL	0.1567	0.075	-0.1945	0.026	0.1934	0.039
LOGLLP	0.4552	0.000	-0.4542	0.000	0.4382	0.000
LOGLA	0.3732	0.000	0.2966	0.000	0.2224	0.008
LOGLA/TD	-0.0684	0.633	-0.0901	0.522	-0.0812	0.583
					Corr (u_i, Xb)	0.3529
Prob>Chi2	0.0000		0.0000		0.0000	
R^2	0.7893		0.7877		0.7844	
Rho			0.1838		0.2684	
Sigma_u			0.6689		0.8538	
Sigma_e			1.4094		1.4094	
Hausman					0.09	

Source: Author's Computation, (2016)

LOGINTINC = 1.1851 - $0.1945LOGNPL_{it}$ - $0.4542LOGLLP_{it}$ + $0.2966LOGLA_{it}$ - $0.0901LOGLA/TD_{it}$ + $0.6689\mu_{it}$ + $1.4094e_{it}$

The result generated from using the random effect estimator is used to describe the impact of credit management financial indicators on interest income of banks in Nigeria. The presence of heterogeneity in the model also signals that the data cannot be pooled together. This therefore implies that the Polled OLS method is inappropriate for the model. The Corr (u_i, Xb) value of 0.3529 produced from the Fixed Effect (FE) model also shows that there is a weak correlation with the explanatory variables. A weak correlation usually indicates that random effect model is appropriate.

Furthermore, the Hausman test gives a Prob value of 0.09 and this implies that the probability value is not significant at 5%, therefore random effect is appropriate for the study. The R^2 was used to test the fitness of the model, it gives a value of 0.7877. This implies that the independent variables such as Non-performing loans

(NPL), Loan Loss Provisions (LLP), Loans and Advances (LA) and Ratio of Loans and Advances to Total Deposits (LA/TD) captures 78.77% variation in the dependent variables while the smaller percentage which is 21.23% was not represented in the model.

The result from the Random Effect (RE) model revealed that the Prob>chi2 gives a value of 0.0000, and this indicates that the model is statistically significant at 1%. The result also revealed that coefficients such as LOGNPL, LOGLLP and LOGLA are statistically significant in explaining the variation in interest income across banks in Nigeria, while LOGLA/TD is not statistically significant in explaining the variation in interest income across banks in Nigeria. The estimate of rho gives a value of 18.38%, and this explains that 18.38% of the variance is due to differences across panel.

Inferring from the result above, the coefficient of LOGNPL is statistically significant at 5 % and it also has a value (-0.1945). This implies a percent change in Non-performing Loans (NPL) would lead to 0.1945% change in interest income across banks. The negative relationship between LOGNPL and LOGINTINC indicated that as Non-Performing Loans (NPL) increases, interest income will also decreases and vice versa. The coefficient of LOGLLP is also statistically significant at 1% with a value of (-0.4542). This also implies that a percent change in Loan loss Provisions (LLP) would lead to 0.4542% change in interest income across banks. The negative relationship between LOGLLP and LOGINTINC indicated that as Loan Loss Provisions (LLP) increases, interest income will also decreases and vice versa.

The coefficient of Loans and Advances is also statistically significant at 1% with a value of 0.2966. This implies a percent change in Loans and Advances (LA) would lead to 0.2966% change in interest income across banks. The positive relationship between LOGLA and LOGINTINC indicated that as Loan and Advances (LA) increases, interest income will also increases and vice versa.

Discussion of Findings

The study discovered that NPL, LLP and LA are statistically significant in explaining the variation in interest income across banks in Nigeria, while LA/TD is not statistically significant in explaining the variation in interest income across banks in Nigeria. The null hypothesis which states that Credit management financial instruments do not significantly affect interest income of banks in Nigeria should not be accepted. This is because credit financial instrument such as NPL and LLP have a significant negative relationship with interest income across banks in Nigeria while LA has a significant positive relationship with interest income across banks in Nigeria. The study revealed that adequate credit management measure were not put in place by banks to reduce the volume of Non-performing loans of banks in Nigeria and this has ultimately increase the amount of money set aside as the provision for loan losses. This inadequacy negatively affects interest income of banks in Nigeria.

In addition, the study also revealed that loans and advances have a positive impact on interest income of banks in Nigeria. Based on the following conclusions, the study recommends that regular update of credit policy and adequate measures to monitor loans should be put in place by banks in Nigeria, this measures will reduce bad loans and ultimately cause a reduction in loan loss provisions; banks should improve on their credit management financial indicators such as reduction in Non-performing loans (NPL), reduction in Loan Loss provisions (LLP) and also increase in Loans and Advances (LA), as this indicators affect interest income across banks in Nigeria and also banks in Nigeria should increase loans and advances to individuals, corporate organization and various government institutions, but adequate measures should be put in place to cushion the incidence of bad loans, as loans and advances increases interest income, which also ultimately enhance banks liquidity.

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The Phillips Curve for the Romanian Economy, 1992-2017

Dorin Jula, Nicoleta Jula
Institute for Economic Forecasting – Romanian Academy and Faculty of Economic Sciences – Ecological University of Bucharest
Faculty of Economic Sciences – "Nicolae Titulescu" University of Bucharest Faculty of Economic Sciences

Abstract

The paper analyses the relationship between the unemployment rate and inflation, in Romania, during the 1992 – 1997 (March) period. For this purpose, we have estimated two econometric models, where the inflation trend has considered as a benchmark for inflation dynamics and the unemployment gap was built after applying the Hodrick-Prescott (HP) filter at unemployment rate. We have found that the unemployment gap had the greatest relevance in inflation model if we have taken a four months delay. The data support the hypothesis of a significant relationship between inflation and unemployment, with the shape described by the Phillips curve, namely the coefficients of unemployment gap were negative, econometrically significant and comparable as dimension in both models of inflation dynamics. We have calculated that the coefficient of unemployment gap is -0.344 in the Phillips curve model where the errors follow an ARMA(2, 2) process and -0.386 in the model which includes the inflation inertia.

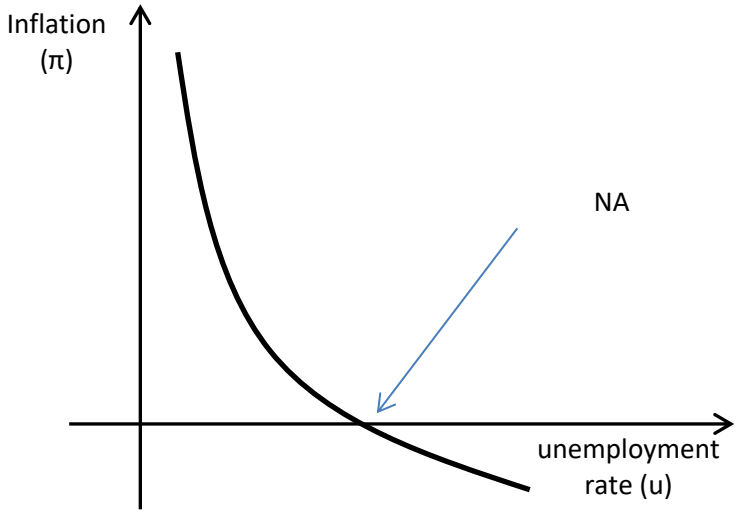
Keywords: ***Phillips curve, inflation, unemployment, Romanian economy.***

JEL Classification: C22, E31, J63

1. Introduction

In the literature, is called "Phillips curve" the inverse relationship between inflation and unemployment rate, in the sense that an increase in unemployment is associated with a reduction in inflation and vice versa.

Figure 1. Phillips curve



Starting with the 1958 Phillips seminal work (Phillips, 1958), there is a vast literature that analyses the relationship between inflation and unemployment (in his pioneering paper, Phillips analysed the relation between unemployment and the rate of change of money wage rates). We do not propose a review of the literature. We will present only a few of the analysis regarding the Romanian economy, released over the past 10 years.

On this line, Ciurilă and Murarașu (2008) estimated a reduced form of New Keynesian Phillips Curve in order to identify the main factors which drive inflation in Romania. In addition to other factors (such as the output gap, the unit labour cost, the capacity utilization rate, the economic sentiment indicator), they found that the unemployment rate was a significant factor in the dynamics of inflation. They used as exogenous variables in Phillips curve equation the inflation inertia, forward-looking expectations for inflation, respectively unemployment rate (as a *proxy* for real marginal cost). The coefficients of inertia and of inflation expectation

were positive, while the unemployment coefficient was a negative one (- 0.731). As dimension, this value is comparable to the one obtained by Iordache, Militaru and Pandioniu (2016). By analysing a period who stretch on 36 months (2006 – 2008), Diaconescu (2009) detected a trade-off between inflation and unemployment no more than at the end of 2006 and the beginning of 2007 (p. 256). Balaban and Vîntu (2010) analysed quarterly data from 2000 to 2009 and developed a Phillips curve model (through a relationship between inflation and output gap) with backward-looking component (distributed lag on past inflation). They found a nonlinear Phillips curve in Romania (the influence of the output gap on inflation is in the quadratic form) and a strong inertial tendency of prices.

Sâman and Păuna (2013) estimate the New Keynesian Phillips curve in the case of Romanian economy and found that "there are still rigidities present in the labour so that unemployment instantly reacts to the changes in output" and that "an increase in inflation is accompanied by a positive output gap" (p. 170). By mean of a simple linear regression model between consumer price index and unemployment rate, Ciupac-Ulici and Beju (2014) found for Romania that, over the period 1998-2013 (May), an increase in consumer price index was caused a decrease in unemployment rate (as well as in the Czech Republic, Poland and Slovakia). Simionescu (2014) tested a Phillips Curve for Romania (1990-2013) and found that there is a negative relation between inflation and unemployment rate in the short run and that Phillips curve is not valid for Romania on the long run (pp. 67, 72). The same, Herman (2010) was not identified a stable, statistically significant relationship between inflation and unemployment rate, in Romania, in the long run (1990-2009).

Tong (2014) was filtered the monthly series of the unemployment rate and inflation into business-cycles frequency (18 to 60 months) and then calculated the Pearson's correlations between these variables. He found significant negative correlations in most of the EU-member states. For Romania, the coefficient of correlation was -0.3388 (Jan. 1997 – Oct. 2013). Also, Tong calculated the Pearson's Correlations between inflation and unemployment gap (determined by the difference between the real unemployment rate and the NAIRU) and found for Romania -0.6631 (2000Q1 – 2014Q1). Iordache, Militaru and Pandioniu (2016) analysed a triangular model (in which inflation depends on its lags and both on demand-side and supply-side factors) by using quarterly data. The data covering the 2004-2014 (Q2) period revealed a relationship between inflation and unemployment (the unemployment coefficient in Phillips curve was at around -0.7), but the model used by the authors "shows that the intensity of the relationship between inflation and cyclical unemployment changes over time", with a "possible reduction in the slope of the Phillips curve starting 2007, with a more pronounced decrease occurring after 2010". (p.28-29). According to an International Monetary Fund paper (2016), "A one standard deviation change in unemployment gap leads to a 0.9 standard deviation change in headline inflation. It explains more than 10 percent of variations in headline inflation during the sample period" (p. 7). The unemployment gap coefficient in consumer price index equation is -5.05, if OLS was selected for estimating the regression and -7.18 for 2 stage OLS (the analysed period was 2003, December - 2015, September). The unemployment gap is derived using the HP filter.

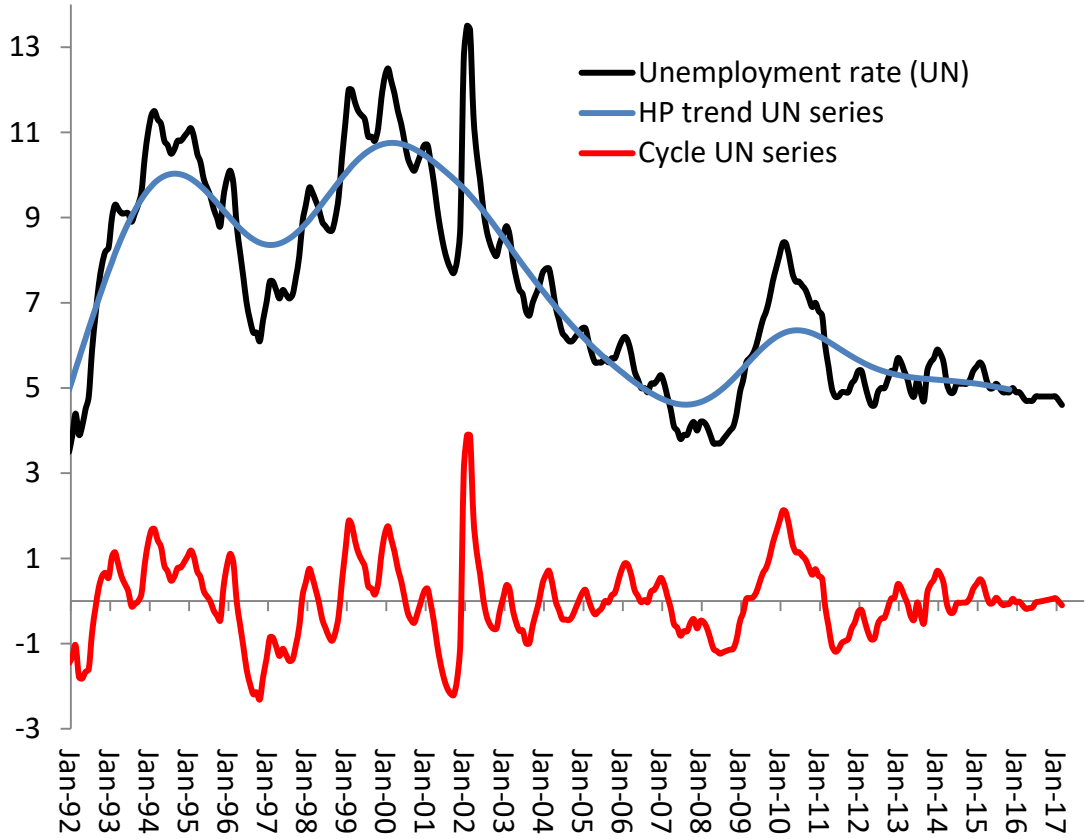
In this paper, we analyse the relationship between the unemployment rate and inflation, from Romania, during the period 1992-2017(March).

2. Data

2.1. The unemployment rate

The data on the unemployment rate are from the National Institute of Statistics, TEMPO-Online database (SOM103B - The unemployment rate registered at the end of the month, http://statistici.insse.ro/shop/index.jsp?page=tempo3&lang=ro&ind=SOM103B. The analysed period is January 1992 – March 2017.

Figure 2. Unemployment rate, Hodrick-Prescott trend and cycle, 1992 – 2017 (March)



Source: For the *unemployment rate*: National Institute of Statistics, TEMPO-Online database, table SOM103B - Unemployment rate registered at the end of the month, http://statistici.insse.ro/shop/index.jsp?page=tempo3&lang=ro&ind=SOM103B

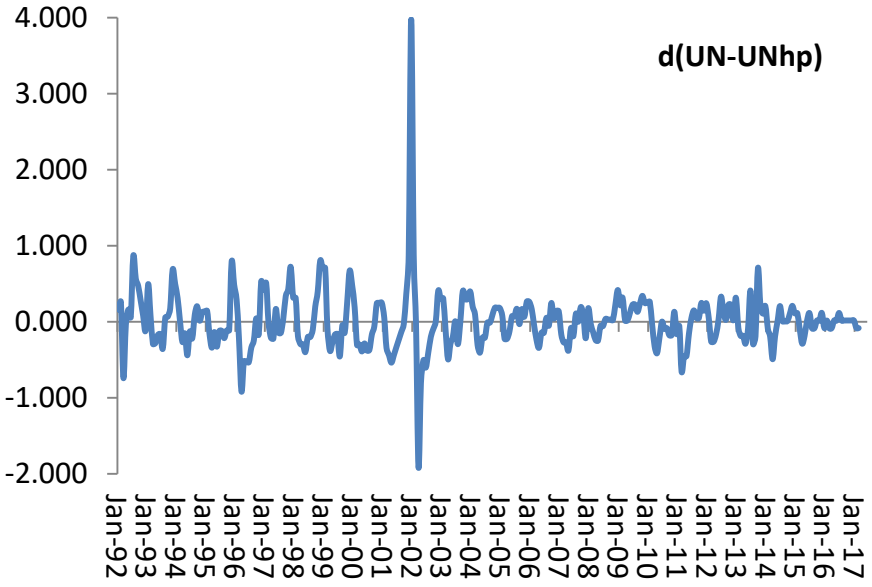
For *unemployment trend*: Hodrick-Prescott filter (own calculations). *Unemployment Cycle* = Unemployment rate – Unemployment trend (own calculations). Hodrick-Prescott filter are calculated for λ (smoothing parameter value) equal to 14400.

According to the unit root tests (Augmented Dickey-Fuller and Phillips-Perron), the unemployment rate, for the period from 1992 to 2017 (March), present stationary shocks around a deterministic trend (Annex 1).

To estimate the unemployment trend and the cycle, we use the Hodrick-Prescott (HP) filter (Figure 2). The cycle of the unemployment rate is stationary. Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests do not support the null hypothesis (presence of a root unit) at a standard level of significance and the Kwiatkowski-Phillips-Schmidt-Shin (KPSS) test does not reject the stationary hypothesis. The probability of the null hypothesis (cycle of the unemployment rate has a unit root) is 0.01% for Phillips-Perron test and is less than 0.01% for ADF test, while the probability of null hypothesis of stationarity for Kwiatkowski-Phillips-Schmidt-Shin (KPSS) test is less than 0.01%.

The data on unemployment rate shows outliers (with large differences in the trend) in early 2002, due to methodological changes in the calculation of unemployment. Differences between two successive values of the unemployment rate deviation from trend are shown in Figure 3. As we can see in the figure, the volatility of the series is higher in the first 10 years and a half (before June 2002) and lesser for the rest of time.

Figure 3. Differences between two successive values of the unemployment rate deviation from trend



Source: The same as the previous figure.

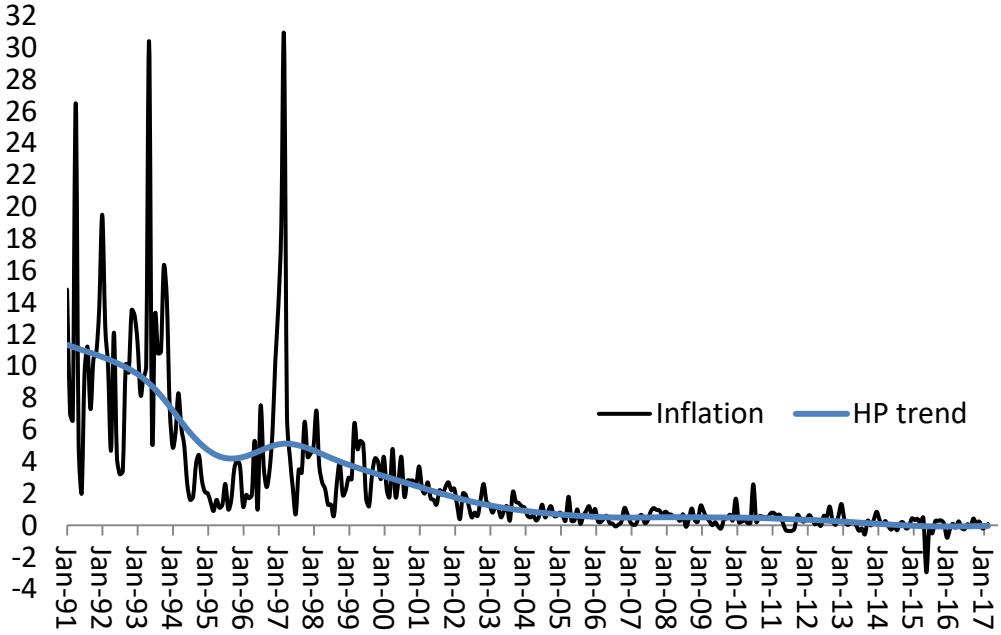
2.2. The inflation

The data on the *inflation* are from the National Institute of Statistics, TEMPO-Online database, table IPC102A – Consumer price indices - monthly evolution as against previous month (http://statistici.insse.ro/shop/index.jsp?page=tempo3&lang=ro&ind=IPC102A). The analysed period is January 1991 – March 2017. Inflation was calculated as follows:

Inflation = Consumer Price Indices – 100.

Just as we did for the previous series, we used the Hodrick-Prescott (HP) filter to estimate the trend. The data are shown in figure 4.

Figure 4. Inflation and the Hodrick-Prescott trend, 1991 – 2017 (March)

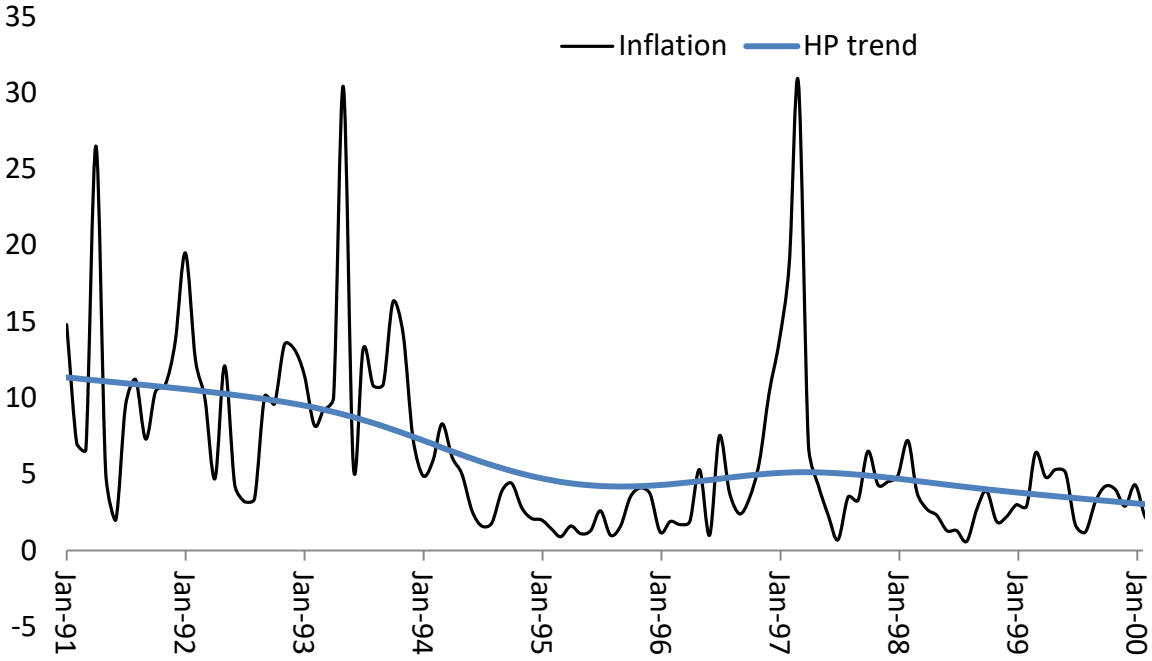


Source: For the *Inflation*: National Institute of Statistics, TEMPO-Online database, table IPC102A – Consumer price indices - monthly evolution as against previous month (http://statistici.insse.ro/shop/index.jsp?page=tempo3&lang=ro&ind=IPC102A). Inflation was calculated as follows: Inflation = Consumer Price Indices – 100. For *Inflation trend*: Hodrick-Prescott filter (own calculations). Hodrick-Prescott filter was calculated for λ (smoothing parameter value) equal to 14400.

Inflation in Romania has recorded a downward trend, with a higher volatility between 1990 and 1997. The dynamics of the consumer price index is shown in Figures 5 and 6, separately for the period 1990-1999 and 2000-2017 (March).

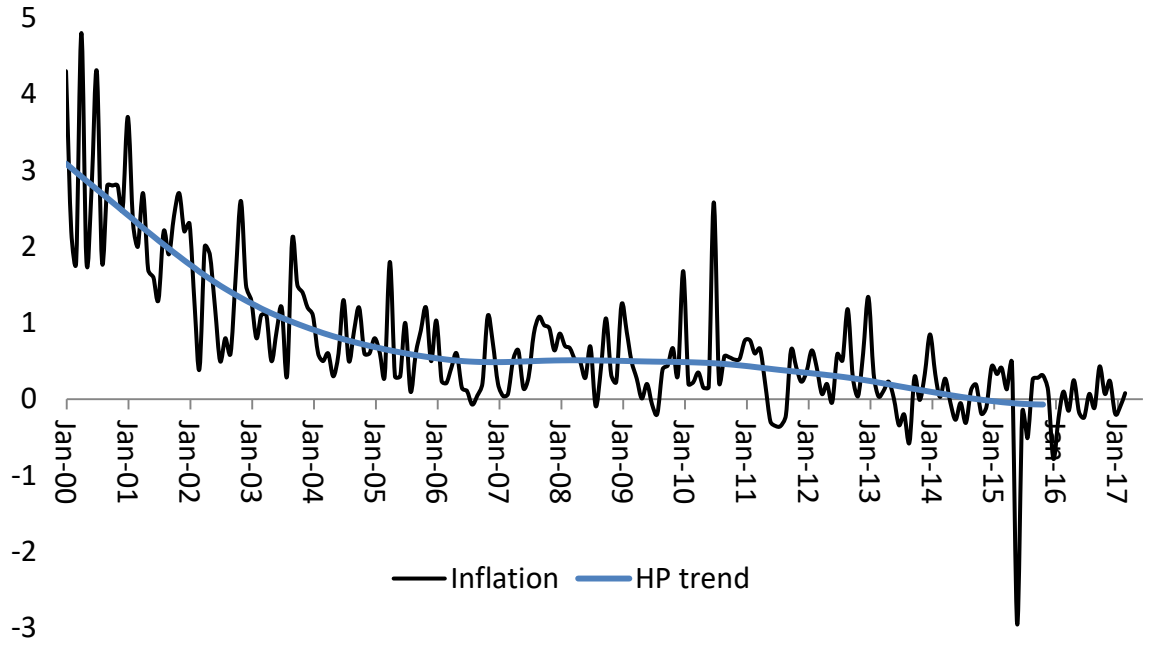
According to the unit root tests (Augmented Dickey-Fuller, Phillips-Perron, Elliott-Rothenberg-Stock Point Optimal, Elliott-Rothenberg-Stock DF-GLS, Ng-Perron, not and according to the KPSS test), the inflation, for the period from 1991 to 2017 (March), is stationary. Details are given in Annex 2.

Figure 5. Inflation, 1990 – 1999



Source: An extract from the dynamics presented in Figure 4 (1991-1999 period).

Figure 6. Inflation, 2000 – 2017 (March)

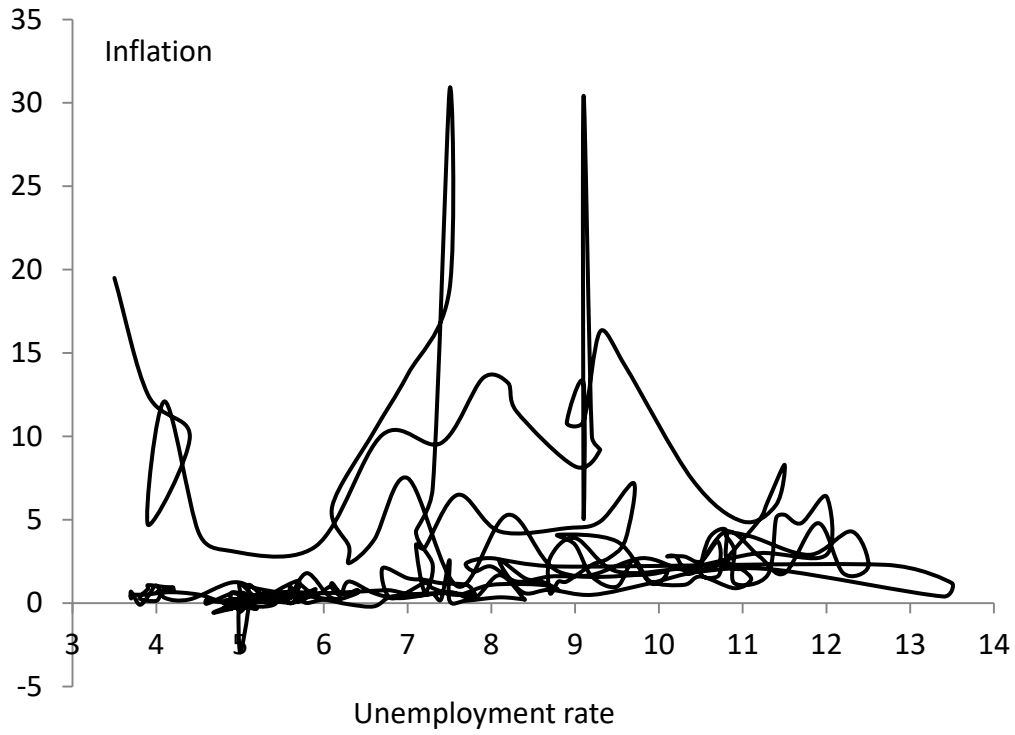


Source: An extract from the dynamics presented in Figure 4 (2000-2017 period)

3. The relationship between unemployment and inflation

The direct graphic representation of inflation in respect with the unemployment rate does not suggest an analytical form of the link between the two variables (Figure 7).

Figure 7. The relationship between unemployment and inflation

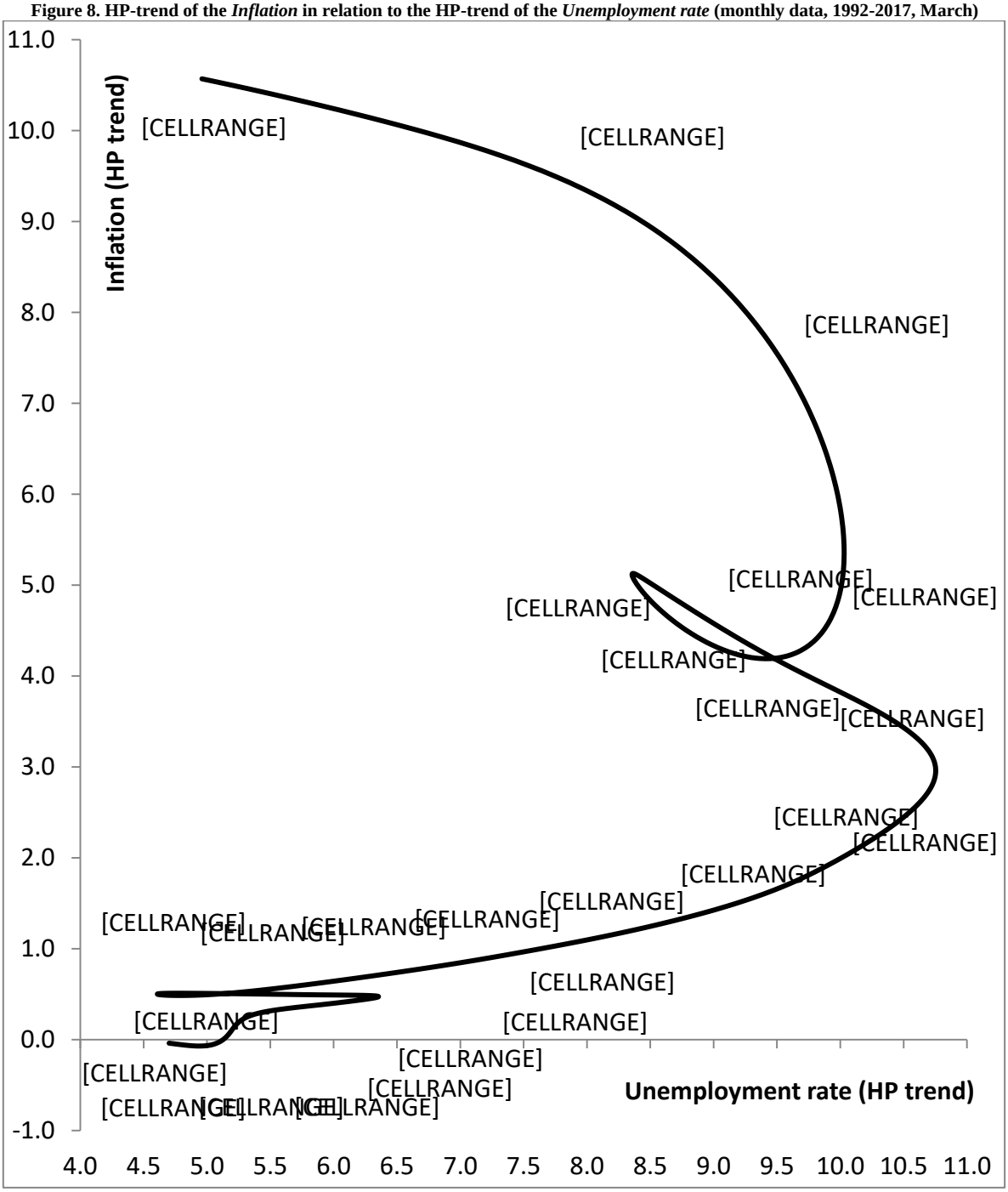


Source: National Institute of Statistics, TEMPO-Online database, tables IPC102A (Consumer price indices - monthly evolution as against previous month) and SOM103B (The unemployment rate registered at the end of the month).

Instead, there is a bifurcation relationship between the trends of the two variables, trends calculated using the Hodrick - Prescott filter. This relationship is shown in Figure 8 and a detailed graphic, for 2005-2017 (March), is shown in Figure 9.

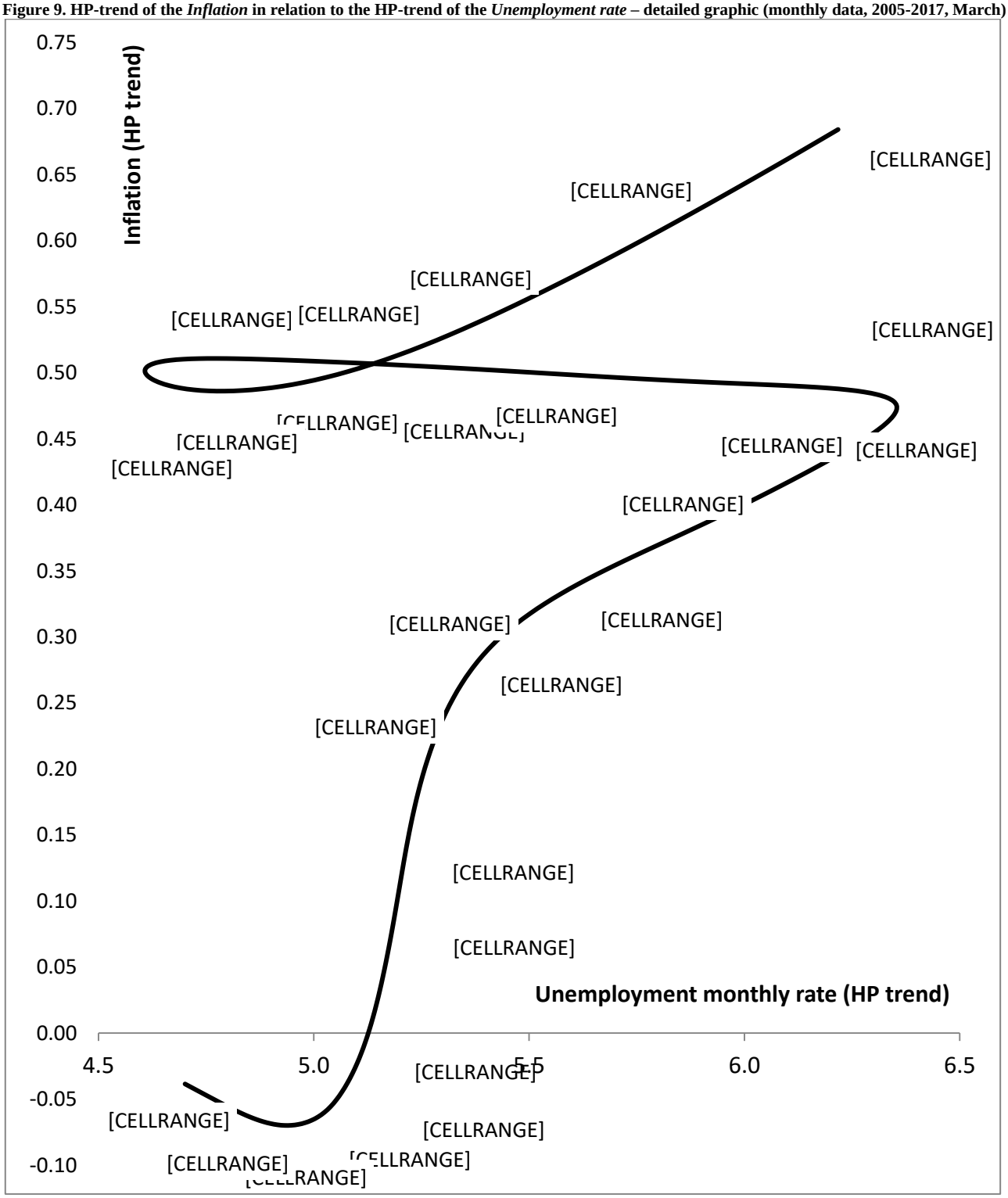
In their neo-classical form, the Phillips curve analyses the relationship between deviations from the normal level of the two variables (inflation and unemployment rate). Figure 10 shows the relationship between the deviation of the inflation from the anticipated (Hodrick-Prescott) level and the deviation of the unemployment rate from the trend (likewise, calculated through the HP filter). There is a negative relationship between the two variables, as predicted by Phillips's theory.

Figure 8. HP-trend of the *Inflation* in relation to the HP-trend of the *Unemployment rate* (monthly data, 1992-2017, March)



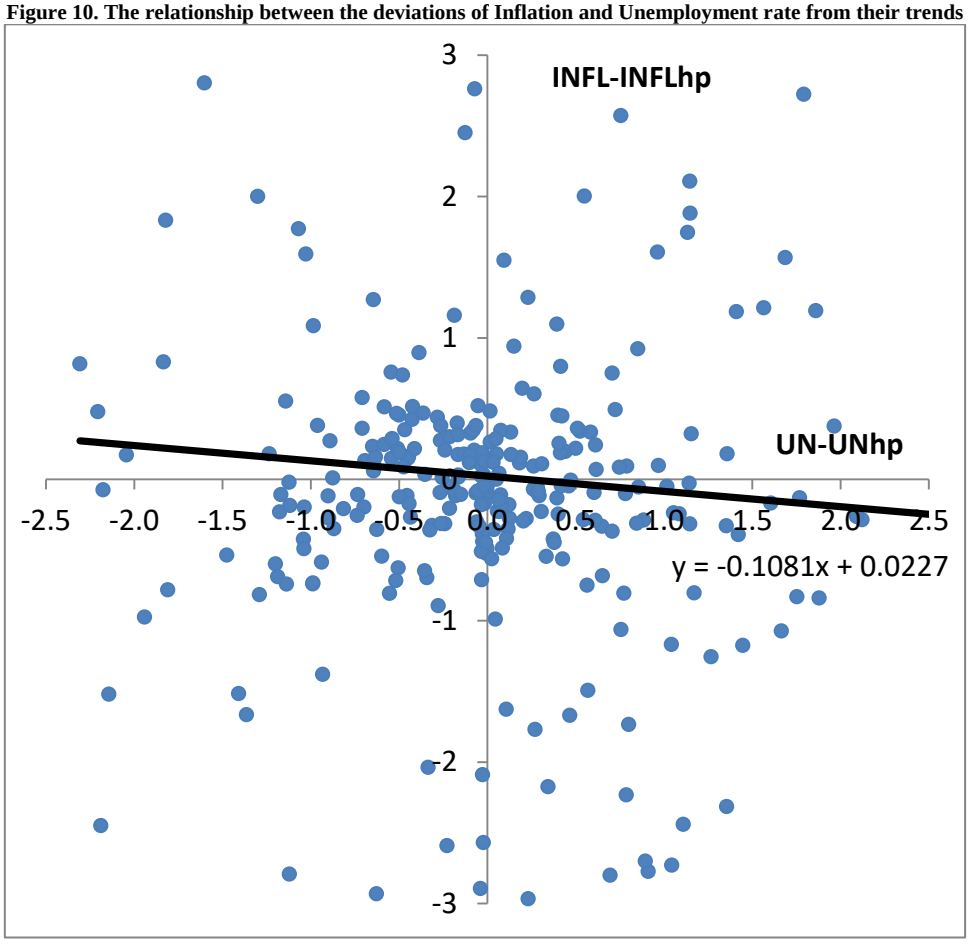
Source: Own calculations by using *TEMPO-Online Time series* database from National Institute of Statistics, table IPC102A (Consumer price indices - monthly evolution as against previous month) and SOM103B (Unemployment rate by gender, macroregions, development regions and counties, at the end of the month). Hodrick-Prescott filter was calculated for λ (smoothing parameter value) equal to 14400.

Figure 9. HP-trend of the *Inflation* in relation to the HP-trend of the *Unemployment rate* – detailed graphic (monthly data, 2005-2017, March)



Source: An extract from the dynamics presented in Figure 1 (1995-2017 period)

Figure 10. The relationship between the deviations of Inflation and Unemployment rate from their trends



4. Econometric model

The previous figure suggests a weak relationship between inflation and unemployment, a relationship which is, as sign, in line with the theoretical expectation. To analyse the link between inflation and the unemployment rate we used, as a first approach, the standard model described by the neo-classical version of the Phillips curve:

$$\pi_t = \pi_t^e - \beta(u_t - u_t^e) + v_t.$$

where π_t is the inflation at the month *t*, u_t is the unemployment rate at the month *t*, π_t^e symbolises the expected inflation, u_t^e represents the expected rate of unemployment (natural rate of unemployment - NAIRU) and *v* estimates the random innovations in supply. Concretely, we have estimated the inflation by the relationship $INFL_t = CPI_t - 100$, where CPI is consumer price index.

The trend of inflation (INFLhp) was calculated by applying the HP filter on INFL variable and, the same, for expected unemployment we have HP-filtered the unemployment rate. So, the econometric model is:

$$INFL_t - INFLhp_t = a_0 + a_1 \cdot (UN_{t-4} - UNhp_{t-4}) + v_t,$$

where the innovations v_t was defined as an ARMA process. Also, we included in the model two DUMMY variables (for May, 1993[1], symbolised by D_{93M05} and March, 1997[2], symbolised by D_{97M03}). The unemployment

[1] Government Decision No. 206 of May 7, 1993 on measures to further liberalization of prices and tariffs.
[2] Inflation induced by the strong rise in the leu / dollar exchange rate

gap has the greatest relevance in inflation model if we take a four months delay. In these circumstances, the model is:

$$INFL_t = a_0 + a_1 \cdot (UN_{t-4} - UNhp_{t-4}) + a_2 \cdot INFLhp_t + a_3 \cdot D_{1993M05} + a_4 \cdot D_{1997M03} + e_t$$

where e_t is ARMA(2,2)

If a Phillips relationship exists, between the unemployment and inflation, then the coefficient a_1 is significant and negative. We have dropped the constant term from the model because this coefficient is not econometrically significant. The results of the model are the following:

$$INFL_t - INFLhp_t = -0.344 \cdot (UN_{t-4} - UNhp_{t-4}) + 21.983 \cdot D_{93M05} + 18.072 \cdot D_{97M03} + e_t,$$
$$(1 + 1.102 \cdot L - 0.567 \cdot L^5) \cdot e_t = (1 - 0.494 \cdot L + 0.382 \cdot L^2) \cdot \varepsilon_t$$

All the coefficients are significant at standard level (2.3% for a_1 and less than 1% for everyone else), the ARMA process is stationary and invertible. The results are detailed in Annex 3. The coefficient of unemployment gap ($\hat{a}_1 = -0.344$) is significant and with the expected sign if we consider this gap with a 4-lag. Under the shown circumstances, the results do not reject the hypothesis of a relationship between inflation and unemployment, with the shape described by the Phillips curve. But, the main problem of this specification of Phillips curve is that the ARMA terms control only for serial correlation, while the errors remain heteroskedastic. In the presence of heteroskedasticity, the estimators are still unbiased and consistent, but the estimators lose the efficiency so that the t-statistics are misleading (Jula & Jula, 2017, pp. 202-236).

In a second approach, we have included in the model the inflation inertia, which derives from "assumptions of adaptive expectations and price rigidities in general" (Iordache, Militaru, & Pandioniu, 2016, p. 15). We have kept, as a benchmark, the expected inflation (INFLhp). As in the previous model, we have dropped the constant term, because this coefficient is not econometrically significant. And, likewise, the unemployment gap has the greatest relevance if we take a four months delay. Therefore, the model is:

$$INFL_t = a_1 \cdot INFL_{t-1} + a_2 \cdot (UN_{t-4} - UNhp_{t-4}) + a_3 \cdot INFLhp_t + e_t.$$

We used White version of least squares method, in order to control for heteroskedasticity. The results are the following:

$$INFL_t = 0.393 \cdot INFL_{t-1} - 0.386 \cdot (UN_{t-4} - UNhp_{t-4}) + 0.626 \cdot INFLhp_t + v_t,$$

where v_t is the residual variable. All the coefficients are significant at standard level: 3.9% is in the right-hand tail area for (negative) a_2 coefficient under the null hypothesis, 2.8% is in the left-hand tail area for (positive) a_1 coefficient, and less than 1% for (positive) a_3 coefficient). The errors are not serial correlated, at least until the lag 12 (Breusch-Godfrey Serial Correlation LM Test) and the White method allows to obtain heteroskedasticity-consistent estimates of the error variances and the corresponding robust t-statistics. The results are detailed in Annex 4.

The coefficient of unemployment gap ($\hat{a}_2 = -0.386$) is significant and with the expected sign if we included this variable with a delay of four months. As in the first model, the results do not reject the hypothesis of a relationship between inflation and unemployment, with the shape described by the Phillips curve. The unemployment gap coefficient is comparable with the one detected in the first model.

Conclusion

The purpose of our study was the analysis of the relationship between the unemployment rate and the inflation so that we have looking firstly on the significance of the coefficient that evaluates the linkage between the two variables. We found that the econometric analysis of unemployment rate and inflation, in Romania, during the period between 1992 and 1997 (March) do not reject the assumption that the relationships between these variables show a shape like the one described by the Phillips curve theory.

In a first model, we started from the hypotheses that the trend of inflation can be obtained through applying the HP filter on that variable and, the same, for unemployment trend (as estimating benchmark unemployment)

we had filtered (HP) the unemployment rate. The unemployment gap was calculated as a difference between the registered unemployment rate and their trend. In the second model, we adopt the assumption of an inflation inertia (the assumption of adaptive expectations) and keep the inflation trend as a benchmark for inflation dynamics. In both models, the unemployment gap has the greatest relevance in inflation model if we take a four months delay. The data support the hypothesis of a relationship between inflation and unemployment, with the shape described by the Phillips curve, and the coefficients of the unemployment gap are both negatives and econometrically significant. They are comparable (as a dimension) between the two specifications of the Phillips curve model: the coefficient of unemployment gap is -0.344 in the model where the errors follow an ARMA(2, 2) process and -0.386 in the model which includes the inflation inertia.

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Annexes

Annex 1. Unit Root Tests on Unemployment Rate

Unit Root Test	*Null Hypothesis*	*Test statistic*	*Critical value (5% level)*	*Decision*
Augmented Dickey-Fuller	unit root	-4.315	-3.989	I(0)
Phillips-Perron	unit root	-3.821	-3.425	I(0)
Kwiatkowski-Phillips-Schmidt-Shin	stationarity	0.138	0.146	I(0)

Note: The unit root tests were applied through test equations which include the constant and the trend (linear), as exogenous.

The t-statistic test values are below the 5% standard level for both tests (for the ADF, it is lower than the significance threshold of 1%, namely 0.34% and for PP test, it is 1.67%). This means that we do not accept the unit root hypothesis for the analysed series. For robustness, we also calculated the Kwiatkowski-Phillips-Schmidt-Shin (KPSS) test for stationarity. The result confirms the above conclusion: we do not reject the

hypothesis of stationarity for unemployment series, if we include both the constant and the linear trend in the test equation.

Annex 2. Unit Root Tests on Inflation

Unit Root Test		*Null Hypothesis*	*Test statistic*	*Critical value (1% level)*	*Decision*
Augmented Dickey-Fuller		unit root	-7.337	-3.988	I(0)
Phillips-Perron		unit root	-11.478	-3.988	I(0)
Kwiatkowski-Phillips-Schmidt-Shin		stationarity	0.287	0.216	I(1)
Elliott-Rothenberg-Stock DF-GLS		unit root	-4.736	-3.471	I(0)
Elliott-Rothenberg-Stock Point Optimal		unit root	2.446	3.998	I(0)
Ng-Perron	MZa	unit root	-38.801	-23.800	I(0)
	MZt	unit root	-4.380	-3.420	I(0)
	MSB	unit root	0.113	0.143	I(0)
	MPT	unit root	2.485	4.030	I(0)

Note: The unit root tests were applied through test equations which include the constant and the trend (linear), as exogenous.

Except for the KPSS test, all other tests reject the unit root hypothesis (the t-statistic test values are below the 1% standard level for these tests). This means that we do not accept the unit root hypothesis for the analysed series. The Kwiatkowski-Phillips-Schmidt-Shin (KPSS) test does not confirm the above conclusion, namely, if we reject the hypothesis of stationarity for inflation series, then the error is less than 1%. As consequently, we have also turned to other unit root tests: the value calculated for Elliott-Rothenberg-Stock Point Optimal (ERS) test statistic was 2.446 (in the model with linear trend), bellow the critical value for 1% level (3.998). Accordingly, we reject the unit root. The same, for Elliott-Rothenberg-Stock DF-GLS test statistic, the calculated value was -4.736, below the critical one (-3.471 for 1% level). Moreover, all the Ng-Perron test statistics where below the critical values, at 1% level of signification. Therefore, we reject the hypothesis of unit root for the inflation series, between 1991 and 2007 (March).

Annex 3: Phillips curve for Romanian unemployment gap and inflation, ARMA model

Dependent Variable: INFL-INFL_HP

Method: ARMA Maximum Likelihood (OPG - BHHH)

Sample: 1992M05 2017M03

Included observations: 299

Convergence achieved after 101 iterations

Coefficient covariance computed using outer product of gradients

Variable	Coefficient	Std. Error	t-Statistic	Prob.
UN(-4)-UNhp(-4)	-0.344375	0.150543	-2.287557	0.0229
@ISPERIOD("1993m5")	21.98274	0.877071	25.06381	0.0000
@ISPERIOD("1997m3")	18.07199	1.187510	15.21839	0.0000
AR(1)	1.102433	0.117267	9.401058	0.0000
AR(2)	-0.567298	0.077053	-7.362399	0.0000
MA(1)	-0.494377	0.115156	-4.293097	0.0000
MA(2)	0.381584	0.074070	5.151688	0.0000
SIGMASQ	2.015087	0.085874	23.46556	0.0000
R-squared	0.714718	Mean dependent var		0.006703
Adjusted R-squared	0.707856	S.D. dependent var		2.662181

S.E. of regression	1.438918	Akaike info criterion	3.594485
Sum squared resid	602.5110	Schwarz criterion	3.693493
Log likelihood	-529.3754	Hannan-Quinn criter.	3.634112
Durbin-Watson stat	1.951427		
Inverted AR Roots	.55-.51i	.55+.51i	
Inverted MA Roots	.25+.57i	.25-.57i	

Annex 4. Phillips curve model with inflation inertia

Dependent Variable: INFL

Method: Least Squares

Sample (adjusted): 1992M05 2017M03

Included observations: 299 after adjustments

White heteroskedasticity-consistent standard errors & covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
INFL(-1)	0.392785	0.204721	1.918633	0.0560
UN(-4)-UNhp(-4)	-0.386079	0.217937	-1.771517	0.0775
INFL_HP	0.625992	0.185253	3.379120	0.0008
R-squared	0.609954	Mean dependent var		2.218763
Adjusted R-squared	0.607319	S.D. dependent var		3.840121
S.E. of regression	2.406384	Akaike info criterion		4.604110
Sum squared resid	1714.042	Schwarz criterion		4.641238
Log likelihood	-685.3144	Hannan-Quinn criter.		4.618970
Durbin-Watson stat	2.086681			

Breusch-Godfrey Serial Correlation LM Test: $20.717 < 21.026 = \chi^2(0.05; 12)$