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Doctoral Thesis - Summary

Statistical analysis of the inflationary

phenomenon in Romania

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Introduction

The lasting manifestation of the the inflationary phenomenon in most countries, since the 70s, with negative economic effects, such as the reduction of the competitiveness of domestic products, price increase, affecting the purchasing power of consumers, require the analysis of this process, taking into account several factors influencing inflation.

The doctoral thesis entitled "Statistical analysis of the inflationary phenomenon in Romania" has as objective the quantitative analysis of the inflationary phenomenon in Romania, by applying a wide range of specific statistical methods for time series analysis.

The actuality of this subject derives from the fact that price stability is one of the major objectives of the economic policy, and between it and other objectives (sustainable economic growth, balance of payments, employment) there are interdependence relations. Through monetary policy measures, fiscal and budgetary measures, and salary measures, the decision-making authorities should ensure the existence of a stable economic environment and of a level of uncertainty as low as possible.

The actuality of the research is also reflected by the fact that the inflation rate is an indicator included in the nominal convergence criteria (the Maastricht criteria) that a state must fulfill in order to join the Eurozone.

Having chosen Romania as a case study is based on the multiple challenges faced by our country in order to ensure and maintain price stability over the 25 years of transition from centralized economy to market economy.

If until 1999, the macroeconomic variables were characterized by a high degree of instability, the inflation rate reaching extreme values (even 300%), after starting the negotiations in February 2000 about the opportunity of joining the European Union, authorities began adopting structural economic reforms. The effects did not take long to appear, the inflation rate falling to a strong downward trend beginning with 2002.

After the monetary policy regime changed in August 2005 and the recognition of price stability as the primary objective of monetary policy took place, the inflationary phenomenon has been effectively managed by the National Bank of Romania.

In this context, the main objectives of this Paper are the following:

➢ Identification of the specific economic features of our country that require the use of certain macroeconomic variables in the empirical analysis and of certain stochastic models for estimating the inflation.

➢ Modeling of the inflation rate both in relation to previous values (using a univariate model) as well as based on a system of macroeconomic variables (using a multivariate model) which have a significant influence on inflation (interest rate of the monetary policy, exchange rate, the broader monetary mass, average net nominal monthly wages, industrial production index). Typically, univariate autoregression models, integrated and of moving average (ARIMA) are used in the literature for modeling the inflation rate based on past values. In this paper, we also introduced the seasonal component in estimating the ARIMA model, in order to quantify the seasonal influences caused by weather conditions on the prices of agricultural products. Given the nature of the economy in Romania, the agricultural sector has a high share in the gross domestic product, compared with most countries in the European Union and a high share of food in the consumption basket, the inclusion of the seasonal componentm in the initial ARIMA model is justified.

Vector autoregression multivariate model with autocorrectrion quantifies the influence of several macroeconomic factors on inflation. The selection of these factors is performed using the principal components analysis (PCA). Based on the estimated multivariate models, we will highlight the inflation rate response to the emergence of shocks (innovation) on factors influencing the inflationary phenomenon, as well as the share of these shocks on the variation of the inflation rate;

➢ Making a comparative analysis of the predictive ability of the estimated stochastic models (vector autoregression model with autocorrection and the autoregressive, integrated and moving average model, including the seasonal component) for the period after the adoption of the inflation targeting regime in August 2005. The choice of this time interval is justified by the stability of the macroeconomic indicators and by the recognistion of achieving and maintaining price stability as a primary objective of monetray policy. Based on the chosen model, we will achieve the inflationary phenomenon forecast for the next two quarters;

➢ The analysis of the relationship between inflation and inflation uncertainty in the context of the importance of inflation anticipation in order to ensure and maintain price stability by the monetary authority. We will perform a comparative approach between the two existing monetary policy strategy in Romania after 1990. We will highlight which of the assumptions from the literature on the relationship between inflation and inflation uncertainty are validated for our country, depending on the features of each monetary policy regime existing over the period November 1990 - March 2015.

The summary of each chapter of the doctoral thesis

The paper is structured in 4 chapters and in the end the conclusions of the research are highlighted.

The first chapter, entitled "Conceptual approaches on the inflationary phenomenon", includes theoretical elements on the inflationary process, a comparative approach to how this phenomenon is treated in the main economic thought (the quantity theory of money, the monetarist theory and the Keynesian theory).

If the supporters of the quantity theory of money and then the monetarists believe that inflation is determined by the amount of money in the economy, Keynesians argue that inflation occurs when there is an imbalance between demand and the aggregate supply. In fact, the difference between the two approaches lies in the increased importance of fiscal policy and public expenditure in what concerns the Keynesians, compared to monetarists, who developed theories based on monetary policy. Moreover, Friedman believed that "the budget deficit is inflationary only if it is financed by printing money."

We also highlighted the causes and effects of inflation as well as the measurement method of the phenomenon, emphasizing the advantages and disadvantages of each indicator. The quantification of the inflationary phenomenon is achieved through a wide range of indices, among which: Consumer Price Index (CPI), Producer Price Index, Export-Import Price Index. To ensure comparability of the inflation rates in the European Union, the Harmonised Index of Consumer Prices (HICP) is used. A comparative approach between these indices, emphasizing the advantages and disadvantages, is performed in the first chapter. There are some opinions according to which targeting core inflation instead of the CPI inflation would be preferable. The main argument is the fact that core inflation may be directly influenced the monetary policy measures taken by the central bank of a country, compared with CPI inflation, which is influenced by factors that cannot be controlled by the monetary authority.

In the second part of this chapter we perform a short description of each channel of transmission of monetary policy impulses, highlighting the need for an economic policy mix to ensure a stable economic environment.

Proper management of the inflationary process can be achieved through a mix of monetary policy measures, fiscal and budgetary measures and salary and trade measures. By combining them, the decision-making authorities can restore macroeconomic equilibrium and ensure price stability. The actuality of the studied subject lies in the fact that price stability is one of the fundamental objectives of economic policy. All arguments in the literature converge to the conclusion that a central bank that maintains price stability contributes to achieving the objectives of economic policy concerning a sustainable economic growth, an increase in living standards and employment.

A widely debated issue is the link between price stability and economic growth. In the current conditions, we believe that an optimal level of inflation would be around 3-4%, allowing resumption of economic growth and providing more space for central banks to adopt restrictive monetary policy measures.

In the second chapter, entitled "Monetray policy strategies in order to ensure price stability" we approach by comparison the monetary policy strategies, highlighting the advantages, but also the limits of the inflation targeting regime adopted by a third of the world's central banks. In the context of the emergence of the global crisis in 2008 and the spread of its negative effects in most countries, there are opinions according to which the current monetary policy strategy has lost credibility and effectiveness and should be replaced.

The negative effects of the financial crisis which produced difficult to overcome macroeconomic imbalances have raised the issue of renouncing at the direct inflation targeting regime. The main reason was the crisis that occurred in a general economic environment characterized by price stability. Therefore, there are many opinions that the targeting strategy based on nominal GDP or price level targeting would be more appropriate.

We believe that it is necessary to abandon the inflation targeting regime, because the additional benefits offered by alternative strategies are not clearly defined. The incorporation of the objective of achieving financial stability (ensuring the development of a stronger financial infrastructure, has the rolw to allocate financial resources more efficiently across the economy) is more appropriate in order to avoid future crises. Also, the inclusion in the forecasting models used by central banks of suitable indicators of financial stability, improves forecast accuracy.

In this chapter we also summarize the main features of monetary policy strategies in Romania after 1990.

The monetary policy strategy adopted by the National Bank of Romania was based on monetary aggregates targeting *(monetary targeting)*, implemented in early 1990. According to the NBR Statute of 1991, the primary objective was "to ensure the stability of the national currency in order to contribute to price stability." The economic environment in the first years of transition was characterized by low investment, high inflationary pressures, imbalance of payments and low productivity. Due to the reduction of foreign reserves as a consequence of the liberalization of foreign trade, an objective of the NBR was to restore the balance of payments. The exchange rate leu / dollar has had a significant influence in this period, the depreciation of the leu being used to stimulate exports and stop imports, so that the external balance could be achieved.

After 2000, the cautious behaviour of the monetary policy, the appreciation of the national currency, changes in the banking sector, led to the gradual decline in inflation. To this inflation decrease agreements with international institutions in order to obtain support for the reforms necessary for joining the European Union have also contributed.

The adoption of the direct inflation targeting strategy by the National Bank of Romania, in August 2005, had a decisive role in achieving the disinflationist process. This was possible because inflation targeting was established as a main objective of monetary policy. The degree of reliability and transparency of the Central Bank gradually increased, as well as the indeoendance of the monetary authority in using monetary policy instruments. Also, the Monetary Authority of Romania has implemented measures to ensure financial stability (especially the banking sector) at the cost of disinflation achieved over a period of time.

The methodological aspects and the characterization of statistical models used are discussed in the third chapter, entitled "Modern statistical methods for analyzing time series".

The statistical methods used in this research include:

➢ descriptive methods of multivariate data analysis, through which we identify which are the determinants of price growth;

➢ stochastic methods for the analysis of time series based on autoregressive, integrated and moving average processes including the seasonal component (SARIMA), based on vector autoregressive with autocorrection processes (*vector error correction*) and heteroscedastic stochastic models : type ARCH (*Autoregressive Conditional Heteroscedasticity*) / GARCH (*Generalized Autoregressive Conditional Heteroscedasticity*) in order to estimate the uncertinty of inflations.

In the last chapter, entitled "Empirical study on the evolution of the inflationary phenomenon in Romania", we will analyze the inflationary phenomenon based on the methodologies described in the previous chapter.

Principal components analysis (PCA) aims to identify the significant links between inflation rate and the macroeconomic variables that are related to it, according to studies from the literature. Since Romania has experienced periods of strong economic imbalances, the inflation reached extremely high inflation rates (over 300%), but with periods when the inflationary phenomenon was controlled optimally, we decided to divide the analyzed time interval in three sub-periods , according to the existing monetary policy regime in Romania and depending on the evolution of the main macroeconomic variables.

Thus, we can distinguish a first period (January 1992 - May 1997) characterized by an unstable institutional and macroeconomic framework, by lack of structural reforms, by extremely high rates of

inflation, through incomplete liberalization of the currency market. The second period is the period June 1997 - July 2005, which highlights the completion of the liberalization of prices and accelerating economic reforms for accession to the European Union. The third period (August 2005 - March 2015) is justified by the adoption by the central bank of the direct inflation targeting regime, the inflation rate falling to a strong downward trend. Through the principal component analysis (PCA) we will highlight the statistical links between inflation rate and its main determinants, depending on the specific characteristics of the three periods taken into consideration.

The results indicate that for the period 1992: 01-1997: 05, the macroeconomic variables were characterized by severe imbalances. The inflation rate recorded the highest values, due to a lack of structural reforms, financing by the State of certain bankrupt enterprises, lack of correlation of wages with productivity, limited access to external financing. In addition, between inflation and nominal net monthly salary variation I found a strong direct link.

Beginning with the second half of 1997 (after an important phase in price liberalization), actions taken by authorities have become stronger, and with the start of negotiations for accession to the European Union, the measures were correlated optimally. The direct, strong connections between inflation rate, growth rate of broad money supply and exchange rate variation has been noticed. Also, we note that inflation reached high levels in late 1997 as a result of price liberalization. In the period between 1992-2000, the transmission mechanism of monetary policy impulses was in an early stage of configuration, the response time of macroeconomic variables to monetary policy decisions being made with a big gap of time, and efficiency being reduced.

The relationship between prices and money supply became insignificant after 2000 due to the financial disintermediation process influenced by the emergence of financial innovations and growth of the velocity of money. Aggregate demand was characterized by instability; the credit evolution was unpredictable, so the role of monetary aggregates decreased.

After the adoption of the direct inflation targeting regime in August 2005, when NBR has taken the objective of price stability, the monetary policy interest rate became the main tool of intervention. Moreover, according to the analysis carried out, it appears that between inflation and interest rates the link is direct and strong. Inflationary episodes have occurred with the onset of the global crisis, but the mix of monetary, fiscal and wage measures had the expected effects.

Once we have identified the significant statistical connections between inflation rate and other macroeconomic variables analyzed, we estimated a model based on autoregressive vector processes. Since most economic series are non-stationary (their average and variance is not constant over time) and the cointegration test indicated a link between these variables in the long term, we decided to

model the system variables, using the vector autoregressive with autocorrection (*vector error correction*).

Because relations between the variables were highly unstable before June 1997, we examined the response of inflation to a shock applied to the variables that influence the inflationary phenomenon for the periods 1997: 06-2005: 07 and 2005: 08-2015: 03, according to the existing monetary policy regime. In what regards the first period analyzed, the exchange rate variation explains the highest proportion of the variation in inflation, validated by the eclectic monetary policy strategy adopted by the NBR since 2000, due to the the weakening of the connection between money supply and price level.

The direct inflation targeting strategy implemented in August 2005 has changed the role of the monetary policy interest rate. Through it, NBR optimally managed the inflationary phenomenon, despite the fact that it has reached the target (inflation target) imposed only three times. Based on the estimated *vector error correction* model, we performed the inflation rate forecast for the period 2015: 04-2015: 12, in order to compare it with the predicted values that of the study through which we have modelled the inflation rate based only on past values of the variable.

Thus, through the autoregressive , integrated and moving average processes which include the seasonal component (SARIMA), we estimated several econometric models, but based on the information criteria (Akaike, Schwarz, Hannan-Quinn), we chose the optimal model that predicts the most accurate the inflation rate, after the change of the monetary policy strategy in August 2005. The inclusion of the seasonal component in the estimated model is based on the specifics of Romania's economy, where the agricultural sector is of primary importance. Adverse weather conditions have a negative influence on agricultural production and prices for the fruits and vegetables will have an upward trend, the emergence of inflationary pressures being very likely to take place. The seasonal component is highlighted by the autocorrelation and partial autocorrelation functions.

In order to compare the two forecasts made (based on the *vector error correction* model and the SARIMA model), we calculated the specific indicators for the forecasts (mean square adjustment error, mean absolute adjustment error, percentual mean absolute error, Theil inequality coefficient) and the findings indicate that the model based on the vector autoregressive with autocorrection has the ability to estimate with a lower error rate the future evolution of the inflation rate.

The latest study in the doctoral thesis makes a comparison between the two monetary policy strategy (implemented by the NBR after the transition to market economy), depending on the evolution of the statistical relationship between inflation and inflation uncertainty.

For the period 1990: 08-2005: 07, when monetary policy strategy was based on monetary aggregates targeting, and macroeconomic imbalances (low investment, uncorrelated wages with productivity, lack of legislation, balance of payments deficit, budget deficit, lack of structural reforms) led to a strong instability of the macroeconomic environment in Romania.

The inflation rate reached very high values, especially in the early years of the period of the analized interval, uncertainty being also very high. This result validates the Friedman-Ball hypothesis, that higher inflation influences the increase of inflation uncertainty. After making the first structural reforms fot the EU accession, inflation entered a downward trend, validating the Holland hypothesis, according to which a high uncertainty regarding inflation will reduce inflation in the future, thanks to the measures implemented by the authorities.

In the direct inflation targeting regime, the National Bank of Romania needs a high degree of credibility, people and businesses relying heavily on information provided by the monetary authority in decisions concerning saving, consumption, investment. The establishment of inflation targeting as its main objective makes the monetary authority responsible, so when inflationary pressures increase, it intervenes immediately through a mix of measures to stop price increases. In these conditions, inflation uncertainty is reduced, this result being consistent with the Pourgerami-Maskus and Hungarian-Zilberfarb assumptions from the economic literature.

The contribution of the paper to the literature and research limitations

The contribution of this paper to the professional literature derives from the choice of variables included in the equation, from the estimation of stochastic models and the performance of the forecast of the inflationary phenomenon for the period 2015:04-2015:12.

Regarding the implications of the studies performed in the doctoral thesis, we believe that the determining authorities should observe the following rules in implementing a macroeconomic policy mix that would ensure price stability:

- in times of economic recession, monetary policy should have a more relaxed conduct, but the authorities must treat with great attention the accumulation of inflationary pressures due to increased aggregate demand; according to the economic theory, monetary policy has a role in ensuring and maintaining price stability in the long term, influencing indirectly other macroeconomic variables, especially through the interest rate channel and the exchange rate.
- the fiscal policy must act in the opposite direction of the GDP deviation from the potential level; it was found that fiscal policy has a stronger impact in the case of an economy in

recession compared to the boom period, which indicates the need for early adoption of fiscal measures, in the case of an economy in recession.

Fiscal Relaxation (VAT reduction in a first phase to food, lowering the value of excise duties, the gradual reduction of social contributions) would be beneficial for investment and consumption only if applied durable, a recovery after a short period of time at previous quotas of the VAT or other charges leading to loss of credibility of the economy, the consequences being disastrous (high inflation, devaluation, low investment, high unemployment). Moreover, these measures should be clear and well planned.

- adoption of prudential policies in order to ensure and maintain financial stability;
- correlating salary increases to labor productivity; adopting measures to achieve convergence of wages from Romania with the European Union is necessary, but only if productivity will have a stable upward trend.

In respect of the limitations of the studies carried out in the doctoral thesis, they come from both the features of the used econometric models as well as from the macroeconomic climate in constant motion and transformation (especially in emerging economies).

The first part of the research (analysis of the correlations between inflation rate and the monetary policy interest, foreign exchange rate fluctuations, monetary growth in the broad sense, unemployment rate, change in industrial production, change in the nominal wage monthly net average) has as its main limitation the relevance of the data available because in the period of transition to inflation targeting strategy, the relations between macroeconomic variables were characterized by high instability.

With the help of autoregressive , integrated and moving average processes, including the seasonal component (SARIMA) we have modeled the inflation rate to estimate a model in order to forecast future values, quantifying the influences of bad weather that have significant impact on price developments in Romania. The choice of the model, based on both statistical indicators and the researcher's intuition, may be a constraint in terms of accuracy of results.

Using the methodology of the autocorrection vector (*vector error correction*), we estimate a model with six variables, and after applying the Johansen test they resulted to be cointegrated (significant statistical relationships on the long term between the analyzed macroeconomic variables). Using the methodology of *vector error correction* is justified by the nature of the investigation. Macroeconomic phenomena manifest as complex dynamic systems so that analyzes of the system type have the ability to estimate the connections between variables. The main limitations stem from the fact

that the vector autoregression method is not based on any economic theory and from the reduced number of variables that make up the system, which do not capture all the necessary information.

Making forecasts based on econometric models estimates is a way to observe the evolution of the macroeconomic phenomena, but empirical studies are not able to fully capture the relationships and behavior variables in the economy, especially in emerging economies where there is a climate of uncertainty, and the connections between variables are unstable over time.

General conclusions

The management of the inflationary phenomenon has positive effects on other macroeconomic variables in the system and the standard of living of the population. Establishing the optimal inflation rate is a challenge for the authorities, creating a mix of economic policy measures in order to ensure and maintain price stability and financial stability is imperative. Price stability helps people and businesses to take investment decisions, saving, consumption in an environment characterized by a lower degree of uncertainty.

In the last 25 years, the inflation rate in Romania had oscillated, depending on the characteristics of the macroeconomic environment, the measures taken by the decision-making authorities and the international context.

In the first calendar quarter of 2015, after the drop of the annual inflation rate in Romania below 1% and taking into account the current European economic context, when the annual inflation rates are minimal in most states, the issue of avoiding the deflationary phenomenon was brought forward. The effects of a widespread and prolonged drop in prices are as harmful as the effects of inflation, resulting in reducing the production and increasing the unemployment. Making the goods and services cheaper determines the drop of the companies' profit, that may resort to massive dismissals. In these conditions, the unemployment rate will increase, the consumption of the population will be reduced (especially if deflationary anticipations appear), and the economy may fall into recession.

NBR adopted several measures of monetary policy to prevent the emergence of deflation: gradual reduction of the interest rate (in May 2015 there was an interest rate with a minimal historical value of 1.75%), reduction of mandatory minimal reserves and narrowing the symmetrical corridor of the interest rate. These measures are aimed to re-launch the credit and thus the increase in aggregate demand.

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