Some Empirical Aspects regarding the Relationship between Inflation and Economic Growth in Romania – the Speed Limit Effect

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Abstract

This study briefly presents theoretical aspects related to the relationship between inflation and economic growth and provides an empirical study for the Romanian economy, for the period 2000 – 2011. The econometric methodology used is that of vector auto-regressions.

The results showed that a sudden increase in the change of the output gap (i.e. a shock to the growth rate of the output gap) does not determine an increase in CPI. Hence, the hypothesis of the existence of a speed limit effect in Romania is rejected. In concrete terms, this means that the monetary authorities should not fear for eventual inflationary pressures when sudden increases of demand arise, if the output gap is negative (the potential output is higher that the effective output). The National Bank of Romania may avoid, therefore, taking some monetary policy decisions meant to temper the rise in inflation (as would have been the case if a speed limit effect was present) but which would have induced unnecessary volatility into the output. However, the study indicates that National Bank of Romania should communicate to the public the state of the economy in order to timely anchor the inflation expectations. This is a very important aspect, since the inflation expectations firmly react to a shock into the growth rate of the output gap, i.e. to a strong increase in the effective output.

The study also showed a positive response of the growth rate of the output gap to a positive shock in inflation, with a maximum effect after three quarters. This shows that the inflation was mainly driven by demand factors in the analysed period, with the consumers increasing current consumption in order to avoid the future higher prices and with the economic agents increasing the supply such as to maximise the unitary profits. Also, this result shows a rather inelastic demand or a possible captivity of consumers in the face of producers.

Keywords: output gap, economic growth, speed limit effect, inflation

JEL Classification: C30, E31, E37

1. Inflation and the Economic Growth

Recent work on the design of monetary policy reflects a general consensus on the appropriate objectives of monetary policy; the monetary authorities as well as the majority of observers, and even politicians, perceive the stability of prices as the main goal to be achieved, as inflation is a very costly phenomenon. A part of the costs of inflation relate to its nominal level while other costs are due to the variability and the uncertainty of the inflation. The general idea is, however, that individuals and economic agents have lower economic performances when the inflation is high and unpredictable and that an efficient control of inflation brings higher benefits in terms of a higher sustainable economic growth in the future.

The conventional view in the academic literature holds that permanent and predictable changes in the rate of inflation are neutral: in the long run, they do not affect the real activity. However, empirical evidence suggests that sustained high rates of inflation have

adverse consequences for real economic growth in the long run, although it is much less agreement about the precise relationship between inflation and economic performance, and about the mechanism by which inflation affects economic activity. In a survey article on the costs of inflation, Briault (1992) says that there are many well-established theoretical reasons why inflation and uncertainty about future inflation may reduce economic welfare. Among these, he includes, at a very general level:

- The unplanned redistribution of income and wealth;
- Additional uncertainty about future prices introduced in the decisions about consumption, saving, borrowing, and investment; and,
- The higher costs of identifying changes in relative prices and allocating resources accordingly.

In the context of economic growth models, in which the continuous growth of the per capital income is the result of the capital accumulation and technical progress, the negative effects of inflation have been indicated as being significant. The uncertainty related with an unanticipated and volatile inflation has been accepted as one of the main factors that determines the return on capital and on investments (Pindyck and Solimano, 1993).The perfectly anticipated inflation may also reduce the rate of return on capital giving the non-neutrality of money that is embedded in the fiscal systems of most developed countries (Jones and Manuelli, 1993). Apart from these reasons, inflation weaknesses the trust of the resident and non-resident investors in the future monetary policy decisions and impacts other determinants of economic growths, such as human capital and research & development.

Also, inflation reduces the long term economic performance of market economies by lowering the productivity of the economic factors (*the efficiency channel*). The higher level of inflation produces frequent and costly changes in the prices shown on the shelves (*menu costs*) and reduces the optimal level of cash to be had by the consumers (*shoe-leather costs*). Inflation generates high forecast errors, through the distortion of the informational content of prices, making economic agents to spend more time and resources to gather relevant information about the relative prices and to protect themselves against price instability, impairing the efficient allocation of resources.

Another cost of inflation, at least on short term, is that associated with the disinflation process, estimated through the *sacrifice ratio* which indicates how much output is lost as a result of the restrictive monetary policy measures implemented in order to reduce inflation. Hence, to the extent that there is *cost push inflation*, there is a short term trade off between the variability of inflation and that of the output (Taylor, 1979). It is important to mention, however, that this trade off arise only for cost push inflation while for *demand-pull inflation* (in which the inflation depends only on current and future demand) the central banks are able to achieve both the inflation target and the output target by manoeuvring the interest rates.

In order to estimate the sacrifice ratio, the empirical studies (Ball et al., 1988) showed that it is related to the average rate of inflation. Thus, in countries with low inflation, the Phillips curve is relatively horizontal and the variability in aggregate demand mainly influences the output. In countries with high inflation, the Phillips curve is very step (almost vertical), the changes in aggregate demand being immediately absorbed into prices. The estimated data shows that the real impact of aggregate demand on output is twice as high at a 5% inflation rate as at a 10% inflation rate. Hence, disinflation is more costly as the inflation rate gets lower.

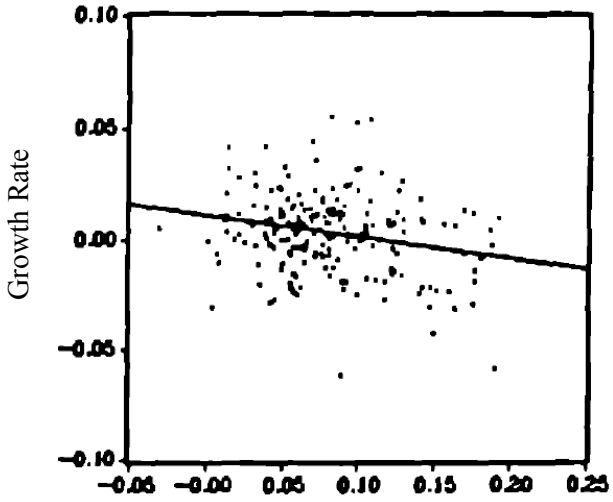
Regarding the relationship between inflation and economic growth, most authors have found a negative relationship (Barro and Sala-i-Martin, 1991; Barro, 1995, 1996; Andres and Hernando, 1997). From the scrutiny of this literature, it has been observed that the countries with high inflation had incurred a lower rate of economic growth, mainly because of reduced investments and lower growth of the productivity rate. This negative effect was observed for inflation rates over 10% and it was accentuated for inflation rates of over 40%. The study realised by Fischer et al. (1996) shows that the stabilisation of inflation precedes the growth in GDP, which arise if the inflation rate is below 50% for two consecutive years.

Notwithstanding the above, we need to say that the inflation has some positive effects as well. The argument for a moderate inflation starts from the observation that the decrease of nominal wages are rare, the employees and the employers being reluctant to accept and perform such reductions. However, a 2% wage decrease when the inflation rate is 0% is, in real terms, an identical situation with a 3% wage increase when the inflation rate is 5%. Hence, a low inflation produces equilibrium of the labour market that is characterised by sticky prices, avoiding thus the rigidity in the economy (*the grease effect*). Another positive effect is the so called *Tobin effect,* which argued that inflation induces a substitution effect in the portfolio of economic agents and individuals, from monetary assets toward real assets; thus, the investments as well as the ratio between capital and work increases, alongside the long term growth rate.

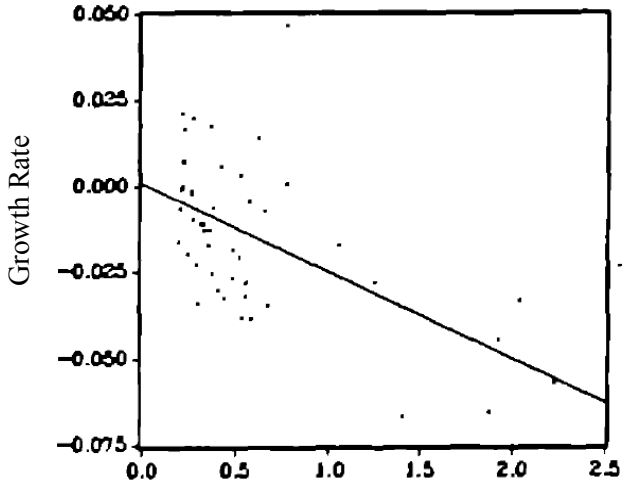
Leaving aside the *pro* and *cons* theoretical discussions on the viability of the econometric instruments used, Barro (1996) performed an empirical study for a number of approximate 100 countries, using data between 1960 and 1990. Within this study, the inflation rate was included in the regression equation as independent variable alongside other determinants of economic growth, such as: starting level of GDP, life expectancy, scholarship level, fertility rate, public spending, democracy index, index on legal rights, import / export prices ratio.

The coefficient estimated by Barro for inflation is negative (-0.029) and is statistically significant. This means that an increase with 10% of the annual inflation rate is associated with a decrease of 0.3% of the annual GDP growth rate. Other studies had similar results, for example Andres and Hernando (1997) estimated that the decrease of the inflation rate with 1% could increase long term output (GDP) by 0.5%. The diagram below shows the relationship between the growth in GDP and the inflation rate, and is a reproduction of the original graphics presented by Barro in his cross country study (the vertical axis measures the GDP growth rate, net of the impact of the other independent variables, showing thus the relationship between GDP growth and inflation when all other determinants of growth are held constant. The inflation rate is on the horizontal axis).

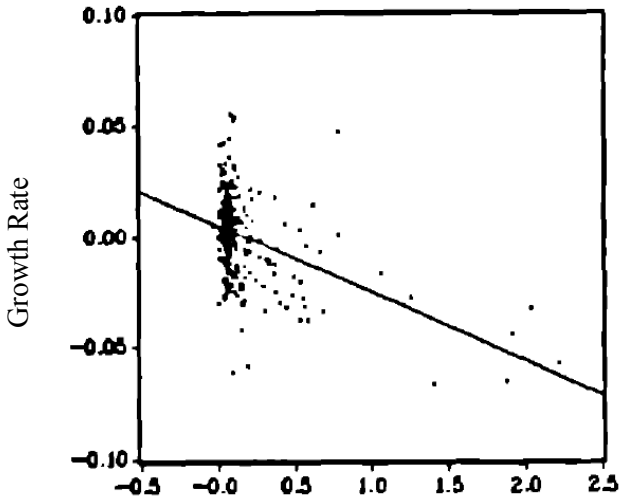
Figures 1A, 1B, 1C. The Relationship between the GDP Growth and Inflation



Inflation rate (for values < 20%)



Inflation rate (for values > 20%)



Inflation rate

Source: Barro R. (1996), p.116.

Figure 1A shows the relationship between the two variables for the countries which experiences inflation rates below 20%, Figure 1B shows the relationship for those countries which had inflation rates higher than 20%, while Figure 1C shows the relationship existent at the level of all countries that were analysed. The results indicate that, in those cases characterised by reduced inflation there is no enough information in order to precisely isolate the effect of inflation on growth, but this does not necessarily mean that this effect is small in case of low rates of inflation. We observe that the steepness of the estimated regression line in Figure 1C corresponds to the estimated regression coefficient of inflation (-0.029). Figures 1A and 1B show that the negative relationship is best estimated for very high inflation rates, while for those rates lower than 20% per year, the relationship between inflation and economic growth is not statistically significant, although the direction of the relationship (negative) is the one we would have expected.

The main problem when interpreting the effect of inflation on economic growth is given by the fact that a regression equation does not necessarily have to reflect the causality from inflation to economic growth. Inflation is an endogenous variable which may respond either to the economic growth or to another variable that is correlated with the GDP growth. An example of such an inverse causality may arise if, for example, a reduction of the growth rate determined by an adverse exogenous shock tends to generate higher inflation. The inflation arises in such a case because the monetary authorities react to the slowing of the economy by expansionist monetary policies. Moreover, if the trajectory of the monetary aggregates does not change, then the equality between the demand and the supply of money at each moment in time implies that a decrease of the growth rate automatically tends to increase the inflation rate (as the same or a higher quantity of money "chases" less goods and services). However, both studies of Barro (1996) and Andres and Hernando (1997) concluded subsequent to supplementary econometric tests that the observed negative effect of inflation on economic growth cannot be statistically rejected based on an inverse causality effect (from GDP to inflation).

As a conclusion of the theoretical aspects presented in this section, we may say that there is a rich literature and empirical research related to the relationship between inflation and economic growth. The general consensus is, although the results of the studies are somehow mixed, that there is a need for very low inflation rates in order to achieve a sustained economic growth (the grease effect) but, high inflation rates are for certain inversely correlated with the economic growth.

2. Speed Limit Policies

Giving the intricate link between inflation and economic growth briefly outlined in the previous section, a question arises as how should the monetary authorities manage such a relationship. A tentative answer is articulated by Svensson (1999), who says that *"....there is a considerable agreement between academicians and central bankers that the appropriate loss function both involves stabilising inflation around an inflation target and stabilising the real economy, represented by the output gap*".

However, as Walsh (2002) noted, the actual statements from several central banks shows that the inflation and the output gap may not be the real variables on which they actually focuses. For example, the Federal Open Market Committee emphasised the focus on

growth in output relative to the *growth* in potential, rather than the output gap itself (the *level* of output relative to the *level* of potential). In remarks at a public policy forum held in 1999, representatives of FED described monetary policy in terms of a focus on demand growth relative to growth in potential output: "*Solving a standard model of the macro-economy, such a policy would effectively convert monetary policy into what might be called "**speed limit**" form, where policy tries to ensure that aggregate demand grows at roughly the expected rate of increase of aggregate supply, which increase can be more easily predicted. [...] ... the monetary policy is happy with the cocktail party temperature at present but moves against anything that increases its warmth. Should demand growth threaten to outrun supply growth (the party to warm up), the seeds of accelerated inflation may be planted and monetary policy should curb the growth in demand by raising interest rates.*"

Therefore, a '*speed limit*' effect exists when the change in the output gap causes inflation to increase even if the level of the output gap is negative. When a negative output gap closes and the change in the output gap is positive as growth increases, then upward pressure in inflation may arise. Within a speed limit model, both the level and change in the output gap can be important for inflation. Practically describing the speed limit effect, it means that inflation can arise in case the aggregate demand increases suddenly, even if the output gap is negative. This is due to the fact that even with a large degree of spare capacity, there may sometimes be a limit to how fast that spare capacity can be put at work again without creating inflation problems. According to Dweyer et al. (2010), there are a number of channels through which inflationary pressures may be generated by the speed at which the output gap changes rather than by the level of the output gap. One such channel is the possibility that temporary supply bottlenecks develop when activity is rising rapidly. It can take time to plan and install new/old capacity and, as a consequence, temporary supply constraints can arise if demand increases more rapidly than spare capacity can be put in place (Dweyer et al. provided the example of the rapid growth in the UK manufacturing sector in 1994 and the service sector in 1995 – 1996 that caused the economy to run into bottlenecks, leading to higher inflation, even though the output gap was still negative). The temporary supply bottlenecks arise due to the fact that innovative processes need time to be implemented, the modern equipment required by the strong demand growth and advances in technology takes time to be put at work, some employees that were unemployed for a long period of time lose their working skills (the "hysteresis" hypothesis), etc. All these facts require a gradual adjustment of the spare capacities, even if the output gap is negative.

Walsh (2002) shows that growth in demand relative to growth in potential is equal to the *change* in the output gap, and states that the focus on *changes* in the output gap (i.e. a speed limit policy) may play an important role in the design of monetary policy. This is due to the following two reasons: **(i)** if the growth rate of potential is measured more accurately than its level, first differentiating the log level of the estimated gap will reduce the variance of the remaining measurement error; and **(ii)** pure discretion, in which the central bank minimizes the social loss function but is unable to commit to it, leads to inefficient stabilisation in the face of cost shocks; it is this inefficiency that is reduced if the central bank follows a speed limit policy[1].

[1] The reasons of these findings are detailed in Carl Walsh working paper, "*Speed limit policies: the Output Gap and Optimal Monetary Policy*", Draft, July 2002.

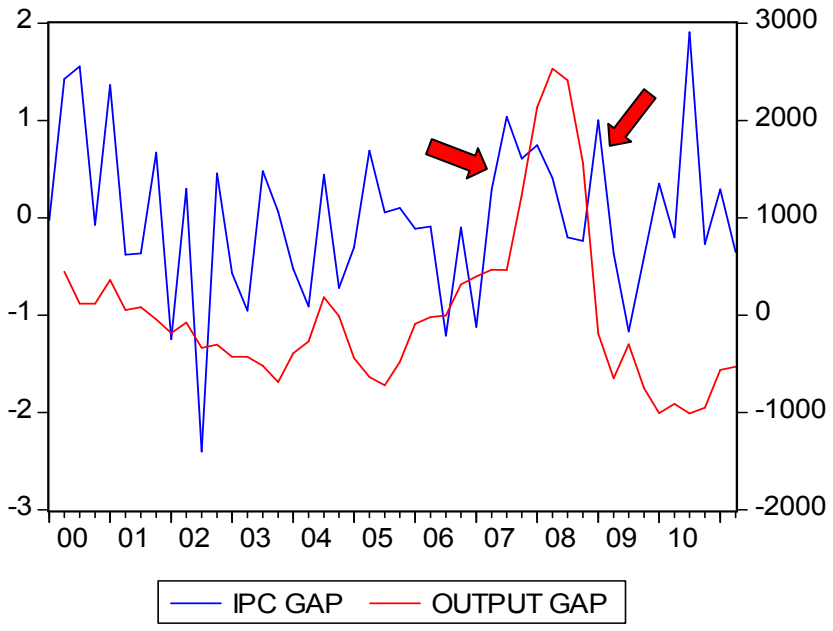
3. Empirical Study on Inflation and Economic Growth in Romania

Starting from the potential important role for the change in the output gap in the policy design, as shown by Walsh (2002), and having the study performed by Dweyer et al. (2010) for UK as reference, the present empirical study evaluates the direct and indirect effects that inflation had on economic growth, as well as the potential inverse causality (from output to inflation), in the particular case of the Romanian economy.

The econometric methodology adopted in this study is that of vector auto-regressions (VAR), which is a widely used empirical methodology to analyse the relationship between macroeconomic variables. The VAR methodology represents a system of linear regression equations in which a set of variables are estimated based on the past values of the same variables or of other variables included in the set. VAR uses the impulse-response function with a Choleski decomposition to identify the innovations in variables, the variance decomposition and the Granger causality tests. This method embeds economic theory within time series models, and it is widely used because it provides a convenient and powerful framework for policy analysis (Sims, 1989, 1991; Bernanke and Blinder, 1992; Leeper et al., 1996).

For testing the direct link between inflation and economic growth I have used as variables the change in the output gap and the general Consumer Price Index (CPI). The indirect effects have been studied through two variables which, at least theoretically, influence inflation and output, more specifically the inflation expectations and the import prices. Thus, I have built two models for which the data used has a quarterly frequency over the period 2000:Q1 – 2011:Q2. The description of the data, the specifications of the econometric models as well as the detailed econometric results are presented in the Appendix.

Figure 2. Evolution of output gap and inflation gap (left axis) between 2000 and 2011



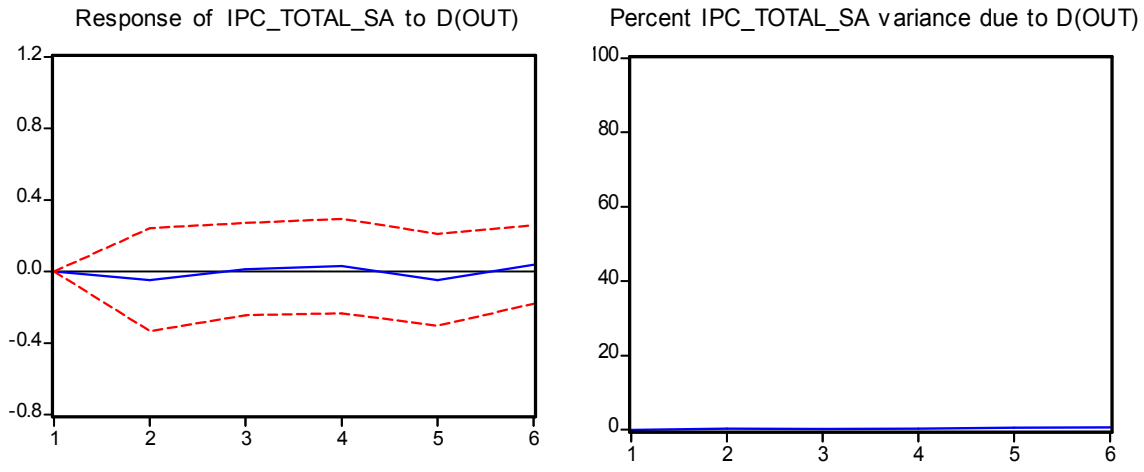
The *first model* presents the link between CPI, the change in output gap and inflation expectations. In the *second model*, instead of inflation expectations, I used an import price index. Based on the results obtained and in light if the economic theory, I will further present the most relevant conclusions for the theme of this article, specifically the relationship between inflation and economic growth and the potential existence of speed limit effects in Romania. In the present study, the output gap and the inflation rate gap have been computed using the Hodrick – Prescott filter[2], and Figure 2 shows the evolution of these two variables over the analysed period.

From the Figure 2 above it can be observed that two of the major fluctuations of the inflation rate preceded and followed the positive output gap between Q3 2007 and Q4 2008. Thus, the starting of the positive output gap has been preceded by an inflationary episode while the decrease of the output gap has been followed, after two quarters, by a significant decrease in inflation. In other words, the rapid growth in output arose after six months from the increase in prices, most probably due to a significant increase in demand. Then, in the middle of the strong increase of the output gap, the price level decreased, and when the output decreased, the inflation initially rose (showing the persistence of inflation) but in the end it firmly decreased, in Q3 2009.

The results of the VAR analysis do not confirm the existence of a speed limit effect in Romania in the period 2000 – 2011. As it can be observed from Figure 3 below, inflation does not respond to a change in the first difference of the output gap. Also, the latter variable does not show Granger causality for the level of prices, and its variance does not influence the variance of inflation at all.

Figure 3. Response of CPI to an impulse in the change of output gap (not in the level of output gap)

Response of CPI to change of output gap	Variance CPI due to change of output gap (percent)



Should the results presented above mean that there are no bottlenecks in Romania such that the speed limit effects do not arise? Can this be interpreted that the adjustments in supply are performed smoothly in case of sudden increases in demand? My answer to this

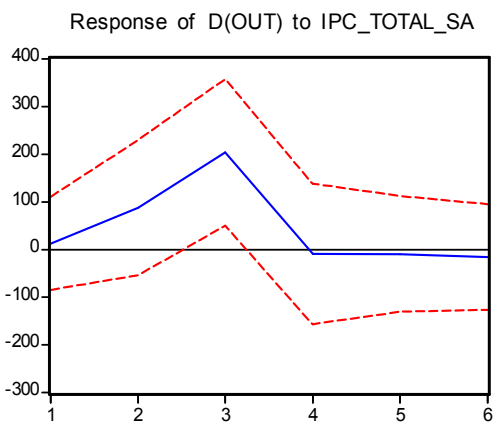
[2] Hodrick Prescott filter splits the data series in the cyclical component and in trend. For example, the potential GDP plus the cyclical component is equal with the effective GDP and the inflation trend plus its cyclical component is equal with the effective inflation.

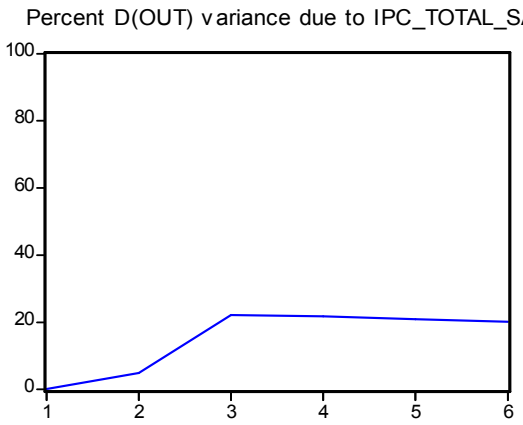
question is that the period 2000 – 2011 was mainly characterised by a sustained disinflation process; hence, the strong increase in demand up to year 2008 (and the related economic growth) manifested in a background of a sustained disinflation process pursued by the Romanian monetary authorities which countered the inflationary effects of strong demand. Unfortunately, the economic growth of the Romanian economy was mainly triggered by consumption, with limited input from the domestic supply side. Therefore, it was relatively easy for the monetary authorities to manage both the disinflation process and the increase of the output. Moreover, the possible bottlenecks have been circumventing by immediate availability of imports. Should Romania have been a more closed economy and its economic growth should have been based on internal production, I consider that the speed limit effects could have arose.

Further on, the effects of inflation on the change in the output gap are presented in Figure 4, showing that *an increase in the level of prices triggers an increase in the first difference of the output gap, after three quarters from the inflation shock*. This finding confirms the hypothesis that the increase in the level of prices may determine the growth of economic activity if the producers are anticipating higher unitary profits. In this respect, we remember that CPI does not include data for the prices of row and intermediary materials but only the prices of finished goods readily available for consumers. According to the standard economic theory, a sustained increase in price level should determine a decrease of the demand in the long run, and the output will shortly follow this decrease, but only after it increases in the short run. But the major part of the CPI contains mostly goods of immediate need, generally non-substitutable or with inelastic demand. Given this *status quo*, the reaction of consumers to an increase in prices may be opposite with that stated by the standard economic theory. Especially applicable for food products, an increase in their prices may determine an increase of consumption due to the fear that the prices will continue to rise even more. On the other hand, a higher increase may boost aggregate demand following a decrease of the real interest rate and the related increase of fixed rate borrowings.

Figure 4. Response of change of output gap to IPC

Response of change of output gap to a shock in CPI	Variance change of output gap due to CPI (percent)





Further on I tested for Granger causality, in order to see if lagged values of CPI have explanatory power on lagged values of the change in the output gap. The Granger tests indicate that CPI explains at 1% significance level the variance of the change in the output gap, and the variance decomposition shows that over 20% of the change in the output is due to a shock in inflation. These results may indicate that the inflation rate had in case of Romania a relative positive effect, inflation being the most easy way through which the economic agents or even the state managed to overcome the major structural problems of Romanian economy, such as:

- Over-dimensioning of the administrative functions and the mismanagement of human resources within the public sector;
- Inexistence of a level playing field in terms of competition, due to lack of transparency in public decisions;
- High degree of corruption;
- Lack of a well established middle class and innovative entrepreneurship;
- Depreciation of agricultural sector and decrease of the independent farmers.

In the next part of the study (*second model*), I have introduced in the model the import price index, due to the important role that imports have in the Romanian economy[3]. The influence of imports on the domestic inflation is explained by the fact that a part of the imported goods and services can be found in the consumers basket based on which the CPI is computed. Moreover, the imported goods and services are used as production factors and thus they impact the production costs[4]. It can be also mentioned another interdependence between the increase in the import prices and the local prices through the Ballassa Samuelson effect or through the substitution effect (when increases of domestic prices triggers an equivalent increase in the import prices of similar / substitute goods further to an increased demand for the latter). The academic literature says that if all goods and services would be *tradable* and the internal and external goods / services would be perfectly substitutable, then the changes in the exchange rates would be fully transmitted to the inflation, and the domestic inflation would be equal with the world inflation. However, as this condition is not satisfied in practice, the changes in the exchange rates do not pass-through to the inflation in the short run. Therefore, the import prices may have a more important role than the exchange rate for the evolution of inflation (Dweyer, Lam and Gurney, 2010), especially for small and open economies.

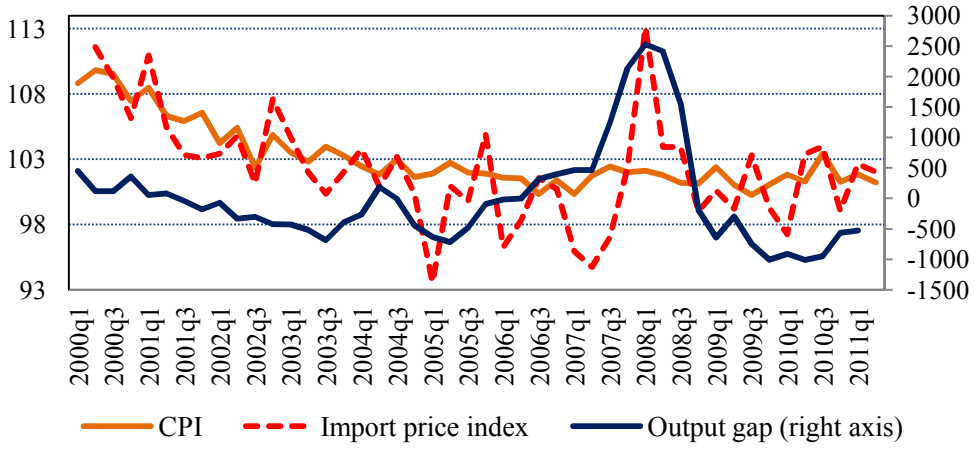
As it can be observed in Figure 5, for the period 2000 – 2011, the evolution of import price index had a similar trend with the evolution of inflation, but its variance is higher than that of CPI. This can be explained by the fact that CPI has an important share of national and fixed prices (*administered prices*), which alleviate the impact of import prices on CPI as well as the variance of CPI to various shocks. From the figure it can be also observed a strong link between the import price index and the output gap, the maxim and minimum growth rates of import prices arising in the same time with the highest point reached by the positive output gap (Q1 2008) and the lower point for the recession output gap from 2005, respectively. This finding confirms the fact that the share of imports within GDP is significant not only as volume but also in structure. More specifically, it confirms the fact that Romania imports row materials and the increased demand for such products is passed to import prices by the external counterparties, with a lag of one or two quarters. The decrease of import prices before the decrease in the output

[3] The ration Imports/GDP in the second quarter of 2012 was 42%.

[4] According to the NBR data, in the year 2009, the import of row materials and intermediate goods represented 62% of total imports and the import of consumer goods represented 19,6%.

gap shows that the world prices began to decrease once the international financial crisis and the related fears and anticipations regarding a recession were certain, with the domestic output gap following the trend with a lag of one or two quarters.

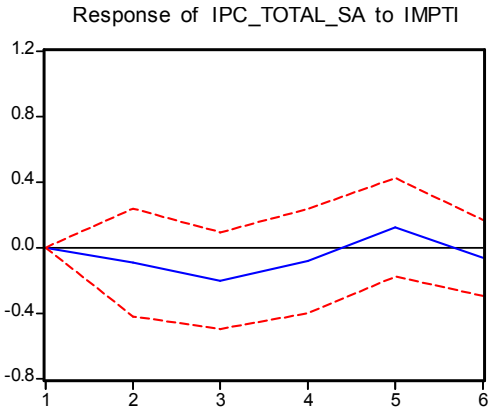
Figure 5. Evolution of import prices, CPI and output gap

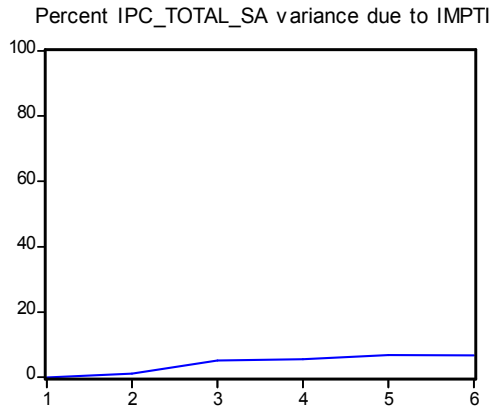


The impulse –response VAR function and the variance decomposition show us in Figure 6 below that a shock in the level of import prices does not significantly impacts CPI. In other words, although the imported goods and services significantly enter into the national production cycle, they do not affect CPI. As already mentioned this may be due to the administered prices which partially alleviate the external prices shocks as well as due to the fact that the national currency has appreciated in the period 2000 – 2011, counterbalancing the effect of the rise in import prices. Moreover, Romania faced a sustained disinflation process. Thus, the evolution of import prices has not exercised a strong influence on CPI but was merely integrated in the general trend of CPI. Another possible explanation could be that the effect of the rise in import prices was absorbed in Romania partially through prices and partially through quantities (larger quantities have been sold at the same prices).

Figure 6. CPI response to a shock in import prices index

CPI response to a shock in import price index	CPI Variance due to import price index (percent)

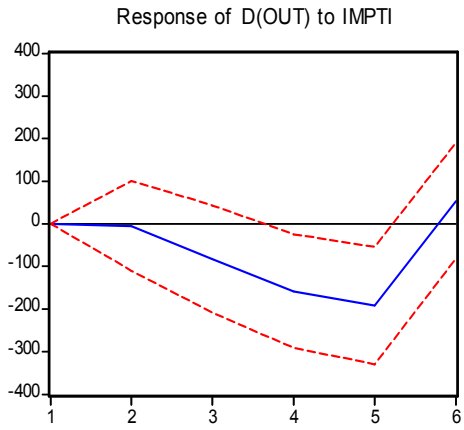


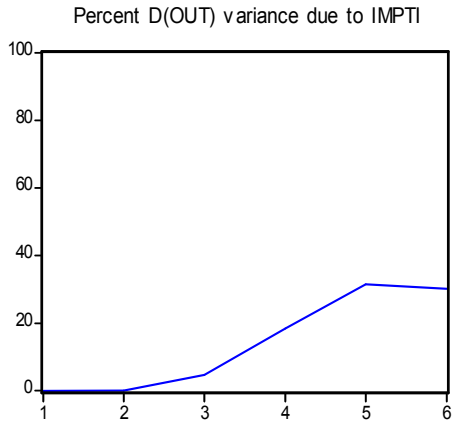


However, the increase of import prices has a significant impact over the change in the output gap, the effect being also confirmed by the Granger causality tests. Therefore, the increase of import prices does not reflect in the increase in the domestic prices but determines a decrease of economic activity with a one year lag, in fact a decrease of the first difference of the output gap, i.e. a decrease of output gap growth rate (see Figure 7).

Figure 7. Response of change in output gap to a shock in import price index

Response of change in output gap to a shock in import price index	Variance of change in output gap due to import price index (percent)

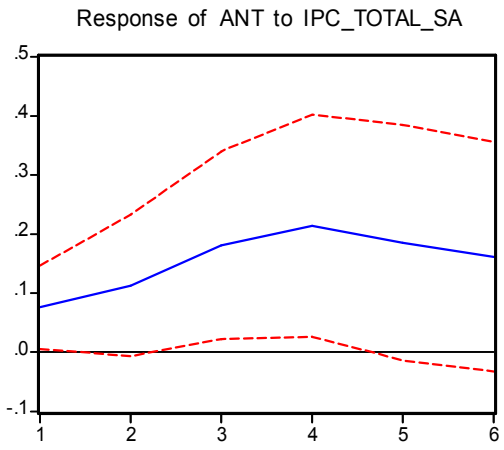


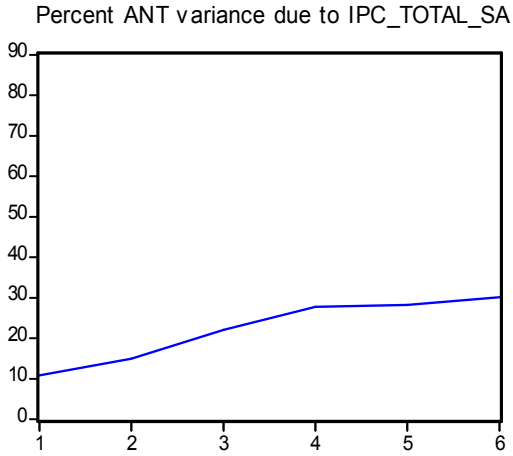


Regarding the role of inflation expectations, I have tested if an increased rate of the expected inflation generates inflationary pressures and will increase both the aggregate demand (as the consumer will rush to buy goods at current prices) and the aggregate supply (as the producers are expecting that future higher prices will trigger higher profits per each unit sold).

Figure 8. Response of inflation expectations to a shock in CPI

Response of inflation expectations to a shock in CPI	Variance of inflation expectations due to CPI (percent)





According to the results of the econometric analysis, when the expectations over future prices are formed, the economic agents and individuals also take into consideration the level of economic activity and not only the history of inflation. Thus, the inflation expectations are Granger caused (at 1% significance level) by the change in the output gap. According to the impulse response function, the inflation expectations are rising further to a shock either in inflation or in the change in the output gap (see Figures 8 and 9). In other words, people expect the prices to increase if they have encountered an inflationary period or if the output is growing.

Figure 9. Response of inflation expectations to a shock in changes to output GAP

Response of inflation expectations to a shock in changes in output gap	Variance of inflation expectations due to changes in output gap (percent)

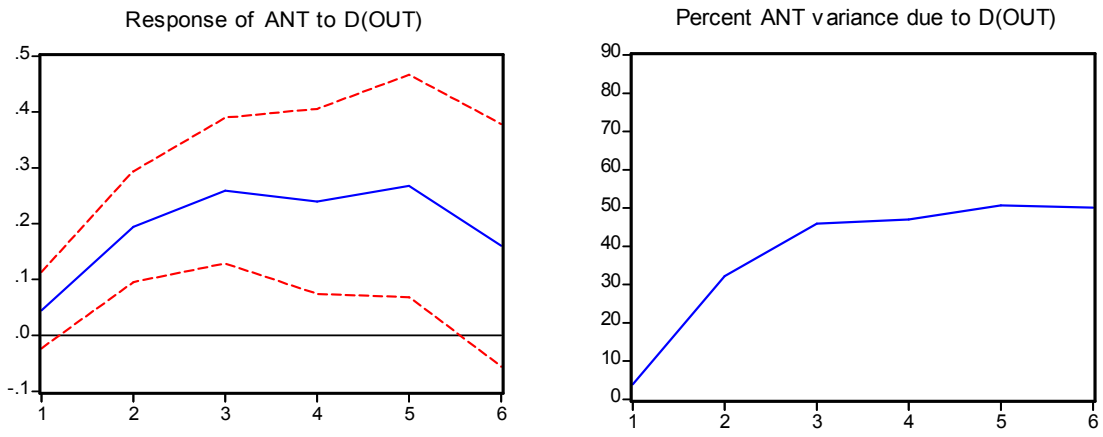
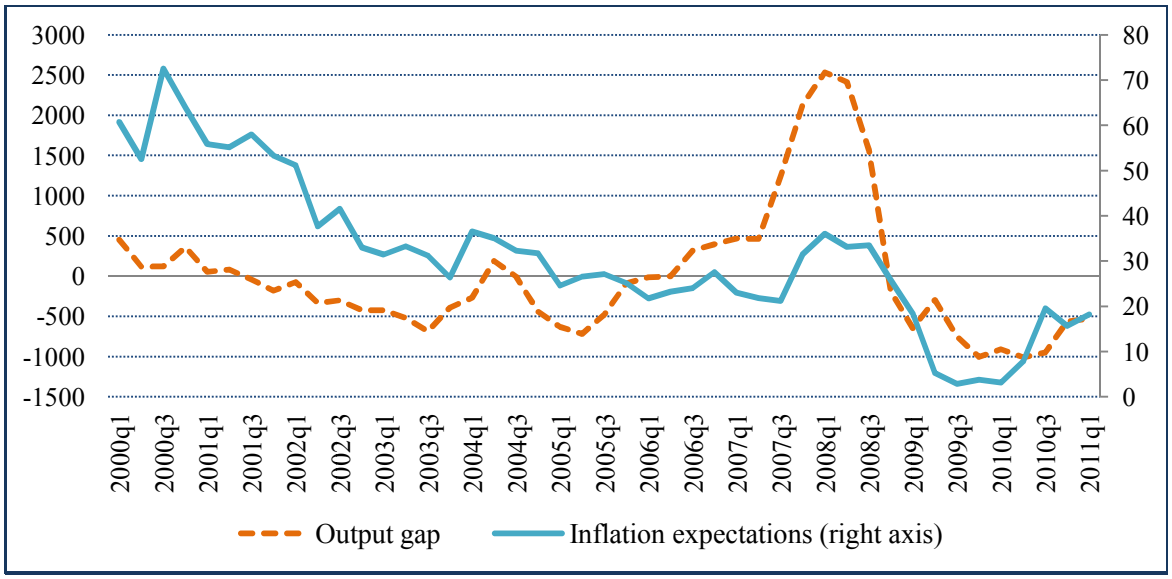


Figure 10 below shows a strong relationship between the output gap and inflation expectations, which can be interpreted in the sense that economic agents are able to "feel" pretty well when the economy is in a normal state or when its "*warmth is increased*" and the demand growth threaten to outrun supply growth.

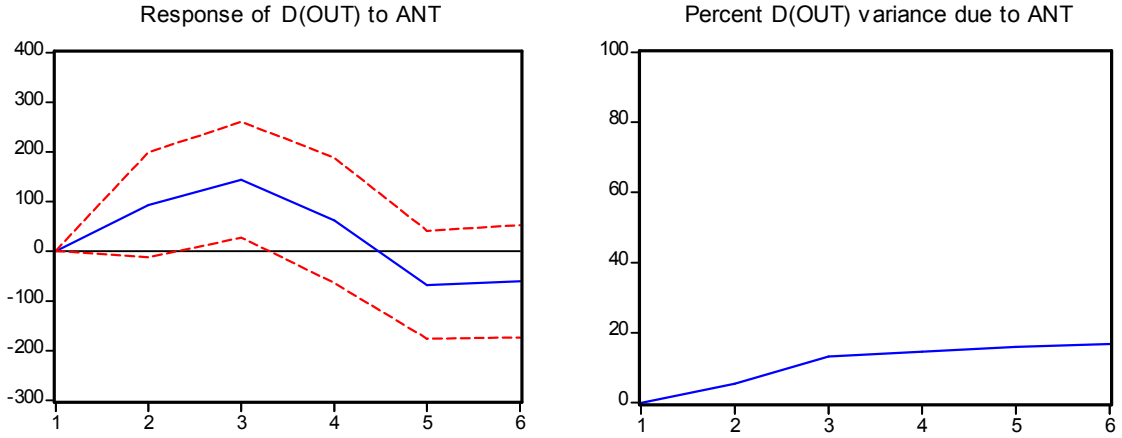
Figure 10. Evolution of inflation expectations and output gap



The VAR results show (see Figure 11) that a shock to inflation expectations triggers an increase in the growth rate of the output gap, which may be explained by the tendency to increase consumption when there are signs that the prices will increase in the future, in order to benefit from the current (lower) prices. Therefore, the inflation expectations represent a very important transmission channel for the effects of inflation to the output gap, as changes in past and current prices affects the inflation expectations which, at their turn, have an impact on the output gap.

Figure 11. Response of change in output gap to a shock in inflation expectations

Response of change in output gap to a shock in inflation expectations	Variance of changes in output gap due to inflation expectations (percent)



4. Conclusions of the empirical study about inflation and economic growth in Romania

This study mixed the current main theories related to the relationship between inflation and economic growth with a specific empirical study performed for the Romanian economy, for the period 2000 – 2011.

The results showed that a sudden increase in the change of the output gap (i.e. a shock to the growth rate of the output gap) does not determine an increase in CPI. Hence, the hypothesis of the existence of a speed limit effect is rejected. In concrete terms, this means that the monetary authorities should not fear for eventual inflationary pressures when sudden increases of output arise, if the output gap is negative (the potential output is higher that the effective output). Therefore, the National Bank of Romania may be able to avoid taking some monetary policy decisions meant to temper the rise in inflation (as would have been the case if a speed limit effect was present) but which would have induced unnecessary volatility into the output. However, the National Bank of Romania should communicate to the public the state of the economy in order to timely anchor the inflation expectations. This is a very important aspect, since the inflation expectations firmly react to a shock into the growth rate of the output gap, i.e. to a strong increase in the actual output.

However, the study showed a positive response of the growth rate of the output gap to a positive shock in inflation, with a maximum effect after three quarters. This shows that the inflation was mainly driven by demand factors in the analysed period, with the consumers increasing current consumption in order to avoid future higher prices and with the economic agents increasing the supply such as to maximise the unitary profits. Also, this result shows a rather inelastic demand or a possible captivity of consumers in the face of producers.

The present study also revealed that inflation expectations, although they do not significantly affect the CPI level (probably because they are rather adaptive expectations), impact the growth rate of the output gap. Therefore, the inflation expectations seem to be a very good proxy for the future economic activity.

Another result of the study is that the import price index does not affect the level of CPI but only the change in the output gap. Thus, although a significant part of the imports of Romania represents row materials and intermediate goods, the increase in their prices triggers only a decrease in the output but not an increase in the CPI. This result can be explained in case of Romania, on one hand by the important share of the imports in total GDP and, on other hand, by the fact that the national currency has appreciated in the major part of the analysed period, counterbalancing the effects of the increase in the import price index. Also, the effects of the import prices into the CPI are further balanced by the opposite signs effects of the fixed prices (administered prices), the food prices (in those years with good agricultural results) and the prices for services which incorporates to a lower extent goods and services from import.

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Appendix – Econometric Analysis

1. Variables used

Model	Variables used
1	➢ Consumer price index total (CPI), change in the output gap, inflation expectations
2	➢ Consumer price index total (CPI), change in the output gap, import price index

2. Description, source and method of computation for the time series used in the models

Variable name	Description	Data source	Computation method
ipc_total_sa	CPI	INS Tempo Online	Seasonally adjusted
out	Output gap computed based on quarterly GDP	INS Tempo Online	Quarterly PIB seasonally adjusted and determined by Hodrick-Prescot filter
impti	Quarterly index of import prices	INS Tempo Online	Series computed according to the formula: impti=ln(imp/imp(-1))*400
ant	Inflation expectations	DG ECFIN, Business and Consumer Surveys	No adjustments made ant = (percent of respondents which believe that the prices will rise in the next 3 months) − (percent of the respondents which believe that the prices will decrease in the next 3 months)

3. Order of integration for the time series has been tested using the Augmented Dickey-Fuller test

Series	ipc_total_sa	d(out)	impti	ant
Order of integration	I(0)	I(0)	I(0)	I(0),C,T

4. Complete results of the VAR analysis and of the specific econometric tests

4.1. *First Model* - CPI, change in output gap, inflation expectations

(ipc_total_sa d(out) ant)

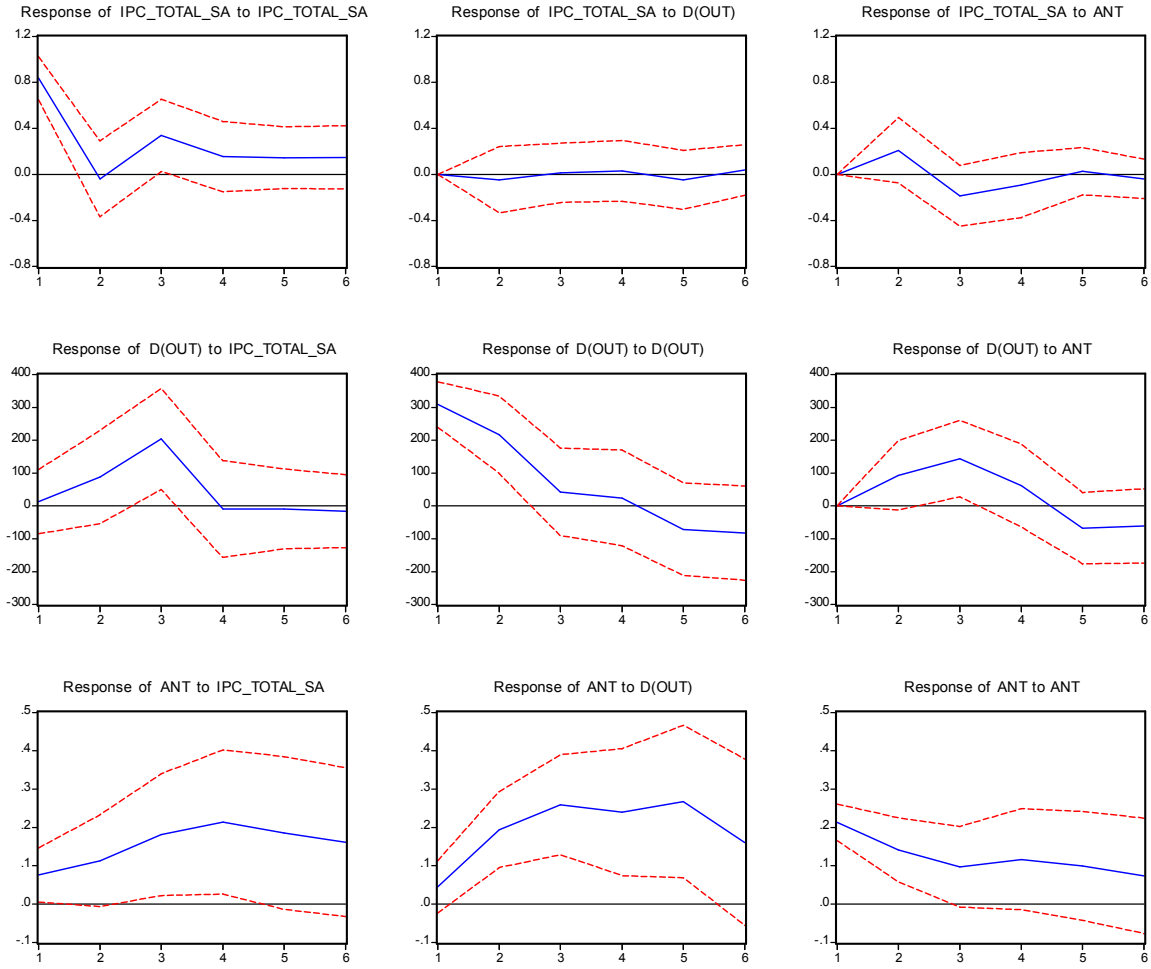
VAR Lag Order Selection Criteria	Roots of Characteristic Polynomial
indicates lag order selected by the criterion LR FPE AIC SC HQ 4 4 4 1 4	First two highest roots in modulus 0.857891 0.856116

Residual Serial Correlation Lagrange Multiplier Tests			**Jarque-Bera Residual Normality Tests**				**White Residual Heteroskedasticity Tests**		
H0: no serial correlation at lag order h			Orthogonalization: Residual Covariance (Urzua) H0: residuals are multivariate normal				No Cross Terms H0: no heteroskedasticity		
Lags	LM-Stat	Prob		Jarque-Bera	df	Prob.	Joint test:		
			1	6.093110	2	0.0475	Chi-sq	df	Prob.
1	8.515091	0.4832	2	1.343996	2	0.5107	135.1943	144	0.6881
2	12.24180	0.2000	3	6.161252	2	0.0459			
3	7.939047	0.5403	Joint	27.73436	25	0.3202			
4	11.73635	0.2286							

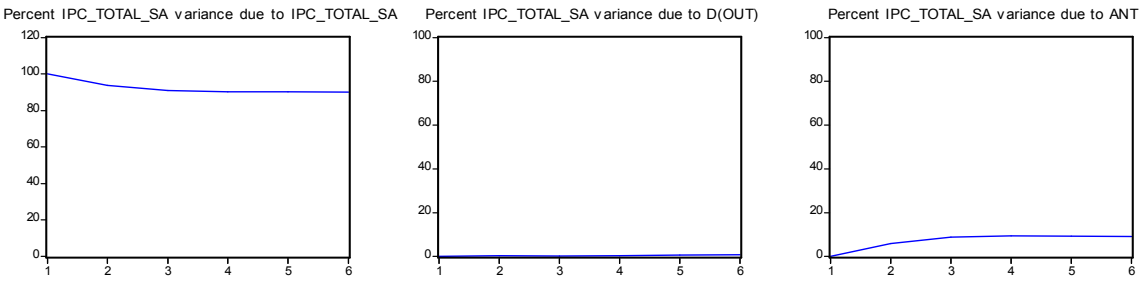
VAR Granger Causality/Block Exogeneity Wald Tests				
Dependent variable ↓	IPC_TOTAL_SA	D(OUT)	ANT	ALL
IPC_TOTAL_SA		0.6441	0.1754	0.3818
D(OUT)	0.0032		0.1134	0.0026
ANT	0.0005	0.0000		0.0000
The values represent the probability of null hypothesis being true: the variable on the horizontal line is not Granger-caused by the variable on the vertical line.				

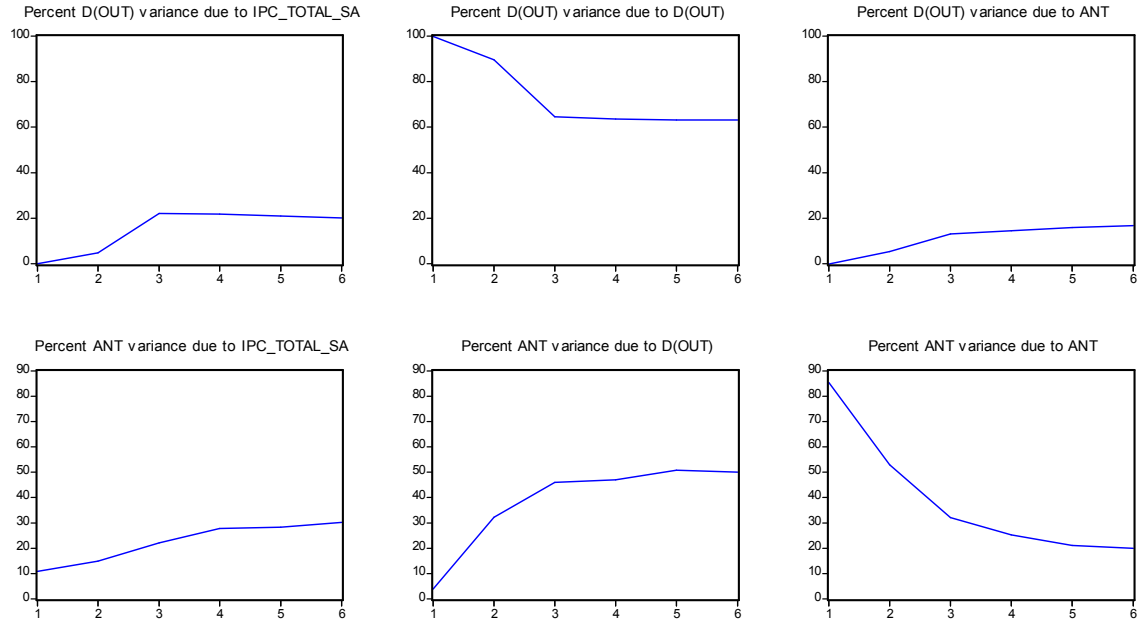
Residual Correlation Matrix			
	IPC_TOTAL_SA	D(OUT)	ANT
IPC_TOTAL_SA	1		
D(OUT)	0.041190	1	
ANT	0.328619	0.208710	1

Response to Cholesky One S.D. Innovations ± 2 S.E.



Variance Decomposition





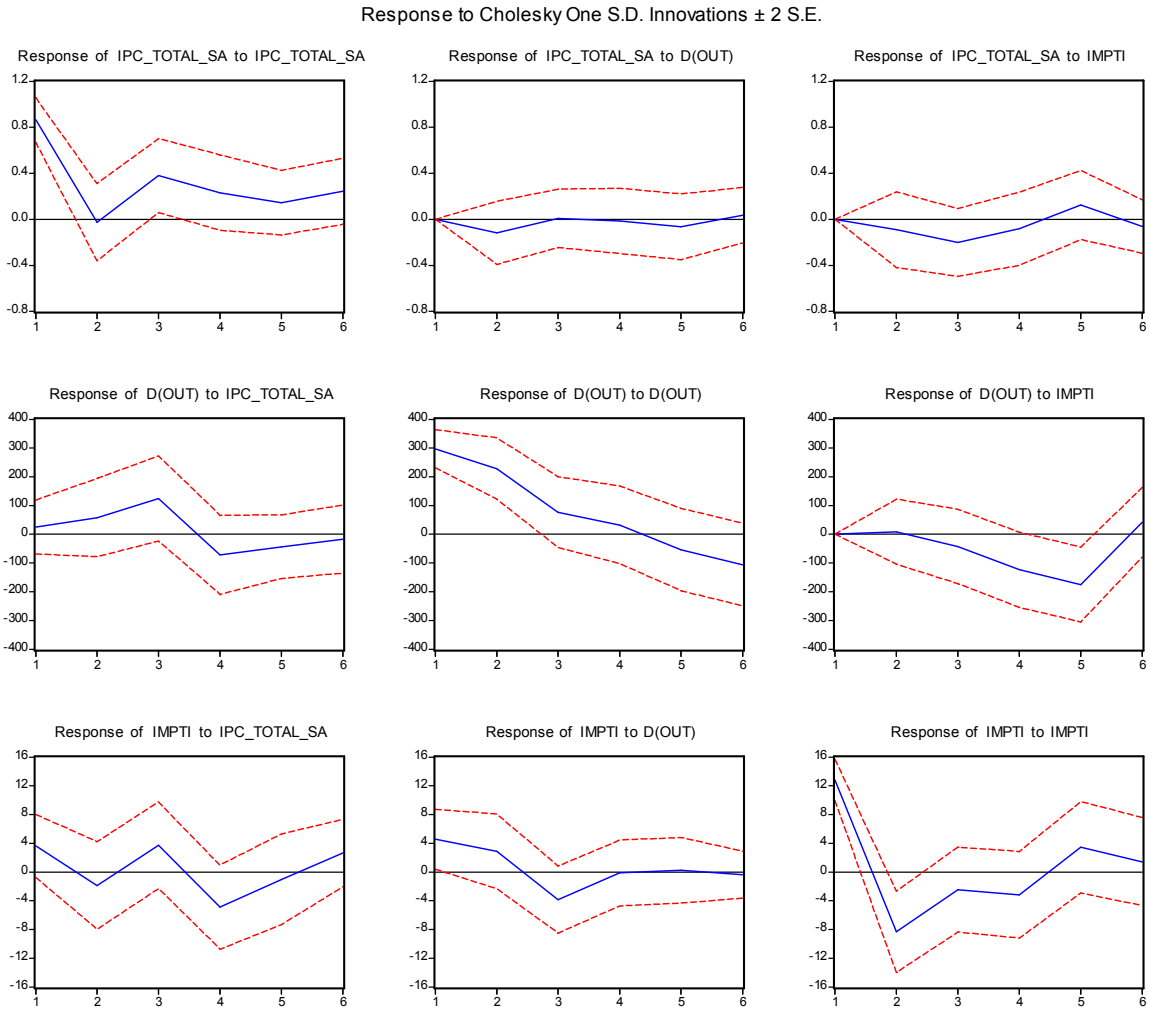
4.2. Second Model - CPI, change in the output gap, import price index **(Ipc_total_sa d(out) impti)**

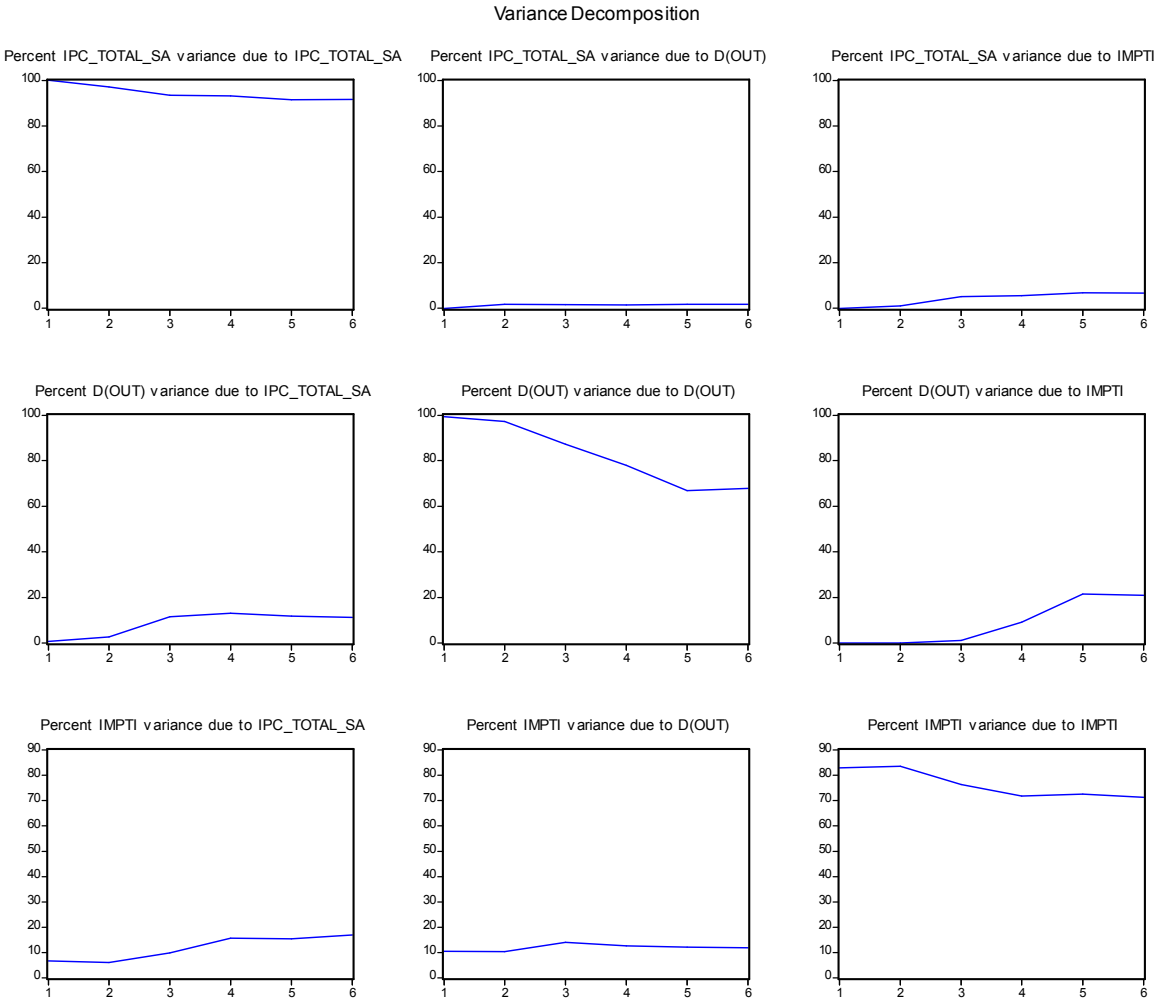
VAR Lag Order Selection Criteria	**Roots of Characteristic Polynomial**
indicates lag order selected by the criterion LR FPE AIC SC HQ 3 4 4 1 3	First two highest roots in modulus 0.856754 0.854794

Residual Serial Correlation Lagrange Multiplier Tests			**Jarque-Bera Residual Normality Tests**			**White Residual Heteroskedasticity Tests**		
H0: no serial correlation at lag order h			Orthogonalization: Residual Covariance (Urzua) H0: residuals are multivariate normal			No Cross Terms H0: no heteroskedasticity		
Lags	LM-Stat	Prob		Jarque-Bera	df	Prob.	Joint test:		
			1	3.141042	2	0.2079	Chi-sq	df	Prob.
1	9.715069	0.3740	2	3.026855	2	0.2202	156.4255	144	0.2263
2	13.74946	0.1315	3	3.796198	2	0.1499			
3	10.97592	0.2774	Joint	25.73759	25	0.4217			
4	16.78896	0.0521							

VAR Granger Causality/Block Exogeneity Wald Tests				
Dependent variable ↓	IPC_TOTAL_SA	D(OUT)	IMPTI	ALL
IPC_TOTAL_SA		0.5427	0.3732	0.6110
D(OUT)	0.0185		0.0407	0.0006
IMPTI	0.2132	0.1131		0.0687
The values represent the probability of null hypothesis being true: the variable on the horizontal line is not Granger-caused by the variable on the vertical line.				

Residual Correlation Matrix			
	IPC_TOTAL_SA	D(OUT)	IMPTI
IPC_TOTAL_SA	1.000000		
D(OUT)	0.083020	1.000000	
IMPTI	0.258094	0.343719	1.000000




Variance Decomposition
Percent IPC_TOTAL_SA variance due to IPC_TOTAL_SA
Percent IPC_TOTAL_SA variance due to D(OUT)
Percent IPC_TOTAL_SA variance due to IMPTI
Percent D(OUT) variance due to IPC_TOTAL_SA
Percent D(OUT) variance due to D(OUT)
Percent D(OUT) variance due to IMPTI
Percent IMPTI variance due to IPC_TOTAL_SA
Percent IMPTI variance due to D(OUT)
Percent IMPTI variance due to IMPTI