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THE NEW KEYNESIAN APPROACH TO THE DYNAMIC STOCHASTIC GENERAL EQUILIBRIUM MODELLING AND INFLATION DYNAMICS: MODELS AND MACROECONOMIC POLICY EVALUATION

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"I certify that all material in this dissertation which is not my own work has been identified and that no material is included for which a degree has previously been conferred upon me."

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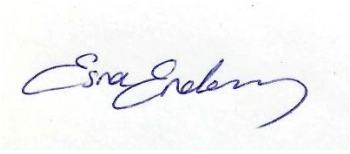

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ABSTRACT

This thesis aims to clarify the New Keynesian approach and its standing in macroeconomic policy analysis. In recent years, New Keynesian Dynamic Stochastic General Equilibrium (DSGE) models have been widely used in monetary policy analysis. The New Keynesian approach began by examining the basic model components and representation models. The building blocks of the current generation DSGE models are discussed in detail. In the DSGE model, the impulse response functions (IRFs) of fiscal policy, demand, cost obligation, technology and government expenditures, output, inflation and interest rates were analysed through the Dyner economy program. Then, the dynamics of inflation are covered by the New Keynesian macroeconomic framework. Inflation dynamics are explained by compiling empirical studies on inflation dynamics. Inflation targeting, which is crucial for shaping inflation expectations in line with the targets declared by central banks, is of immense importance in terms of the dynamics of the regime in understanding and regulating the expectations of the current period.

Keywords: Dynamic Stochastic General Equilibrium Model, Optimal Monetary Policy, New Keynesian Model, Inflation Dynamics, Inflation Expectation, Macro Economic Factors Determining Inflation Expectation.

SECTION 1- INTRODUCTION

Dynamic Stochastic General Equilibrium (DSGE) models have been used extensively in monetary policy analysis in recent years. Consequently, a New Keynesian model has emerged and become widely used in order to understand the relationship between monetary policy, inflation and the business cycle. Firstly, the New Keynesian model term was used by Michael Parkin (1988). The New Keynesian Macro Model provides a new framework for the implementation of economic policies and for tracking the consequences.

Following Lucas' Rational Expectations (Lucas et.al, 1969), which opened up new work in 1972, the academic world started to use macroeconomic data to develop models for explaining microeconomic findings. The first of these are the Real Business Cycle (RBC) Models. The microeconomic feature of these models is the attempt to maximize the economic individual's consumption and working tendency throughout his lifetime, depending on fluctuations in the conjecture. RBC models did not have a Keynesian structure and therefore do not include effects of monetary and fiscal policies and the concept of unemployment is not voluntary unemployment.

On the other hand, the DSGE model is a New Keynesian model which has been developed by taking into account marketplace conflicts (e.g. monopolistic competition (Blanchar and Kiyotaki 1987) or the participation of prices (Calvo 1983)). In short, DSGE is a general equilibrium model, i.e. a system in which more than one market is in equilibrium at the same time, modelling an objective function for each market individual (e.g. consumer and producer). That is, it is the optimum for each individual. When an exogenous shock occurs, the model examines how economic variables react and how the system returns to equilibrium. In recent years, the money economy has arguably been considered as the most important research area in macroeconomics. Consequently, a New Keynesian model which is widely used for monetary policy analysis has emerged from attempts to understand monetary policy, inflation and the business cycle. First, the New Keynesian model was used by Michael Parkin in 1984 (Gali, 2015). The New Keynesian Macro model provides a new framework for the implementation of economic policies and consequences. This model plays an important role in monetary policy in the short term, especially at the point of ensuring

economic stability. Starting from this perspective, the New Keynesian model is used by many central banks to generate price stability.

Central banks aim to control inflation expectations and maintain anticipations in the framework of long-term inflation targets. This importance attributed to inflation expectations is based on the assumption that expectations are one of the main determinants of inflationary realizations. In this framework, economic academic literature has often noted why inflation expectations are important, what features they have, whether they are adaptive or rational, how they should be measured, and how they respond to policy changes.

The macroeconomic stability and monetary policy inflation expectations have often been examined within the framework of economic theory. In this context, expectations were initially considered within the framework of the "adaptive expectations" hypothesis (Roberts,1995). From the mid-1970s onwards, coincidental expectations left the vision to "rational / rational anticipations" which, assuming the position of economic units, constitute not only the information from the past but also the optimal use of all the information they have acquired over time.

The main reason for the increase in inflation expectations is that inflationary expectations are the main determinant of future inflationary dynamics, as suggested in many empirical studies. Therefore, the New Keynesian Economy has introduced the New Keynesian Phillips Curve, which is often used in the economy, as the current inflation forecast is formulated as a function of the anticipated inflation expectations and future inflation expectations. (Roberts,1955)

Central banks' decisions on short-term interest rates affect economic activity through different channels and then impact inflation. Inflation expectations are becoming prevalent as an important channel in the monetary transmission mechanism.

Managing inflation expectations in the inflation targeting regime, which is being implemented by many central banks, is also important. Given the role played by inflation expectations among economic factors determining inflation, we see that the success of the inflation targeting regime is largely dependent on preoccupation with the publicly announced inflation target.

In this framework, the first part of the study is the literature review of the new Keynesian DSGE model. Following this the construction of the basic Keynesian model and the building blocks of the DSGE models are discussed in detail through explanation of the assumptions of the new Keynesian model.

In the DSGE model, the Impulse Response Functions (IRFs) of fiscal policy, demand, cost obligation, technology and government expenditures, output, inflation and interest rates are examined.

Inflation dynamics fall within the scope of the New Keynesian macroeconomic framework. Inflation dynamics are explained through compiling empirical studies on inflation dynamics. Empirical work has been presented in the literature review below, examining work on the determinants of inflation expectations in developed and developing countries, respectively.

SECTION 2 - LITERATURE REVIEW

Before 1940, macroeconomic theory was relatively under-developed, and the economy had new inventions. Empirical studies in this period focused on monetary policy and real business cycles. After the First World War(1940), the field of macroeconomics became a subject of extensive debate in economy. Following this, towards the end of the 1960s, a compromise around Neo-Classical Synthesis came to fruition, after the collapse of the exploding oil shock and the lack of macroeconomic results that were not based on microeconomic bases. These empirical failures of traditional approaches, nominal rigidities and inadequacies of explanations of economic problems led to a new round of theoretical research and debate (Mankiw, 1990).

The concept of New Classical Economics, which developed in the early 1970s under the leadership of Sargent and Wallace (1975), became dominant in theoretical debates of the short run. This approach, which considers rational expectations, has shown that the applied economic policies can only be effective on real economic activities in case of incompatibility (incomplete information). If the data for the implemented policy is perceived by economic agents, expectations and relative prices adapt to the new policy and the effect of economic policies on the real economic

activity ceases to exist. This inference, which is called "policy inefficiency", soon became dominant in discussions of economic policy. However, as the models were based on the hypothesis of rational expectations, they cannot easily be transferred to empirical studies and enjoy the same success. Conversely, the inability of traditional models to explain the 1970s stagflation, the link between economic activities and inflation and the role of the monetary policy in providing economic stability has been subject to many issues, pushing it to the forefront of economic debate.

The empirical failure of the New Classical Economic models has led to further acceleration of theoretical work in many ways including Theories of Real Business Cycles and the New Keynesian Economics in relation to the Keynesian tradition. RBC models focus on the role of real factors such as changes in productivity, savings and investment decisions to explain macroeconomic fluctuations (Dixon, 2008). RBC models have developed a dynamic general equilibrium model based on the intertemporal preferences of individuals. The contribution of theoretical calculations to a different environment is derived from Keynesian economists.

Fischer (1977) showed that monetary policy in the presence of rational expectations and long-term labor contracts has the power to influence output. The contribution of theoretical research to a different environment came from Keynesian economists. By the end of the 1970s, models emerged combining rational expectations with the rigidity of the Keynesian labor market. Similarly, Taylor (1980) tried to explain the continuity of unemployment with a model in which the staggered labor contracts are the sole source of rigor. Keynesian wage and price rigidities of common problems of models produced at the beginning of the 1980s, including the assumption of rational anticipations and the New Keynesian Economics.

Although both models accept the Rational Expectations hypothesis, the most important difference between the New Keynesian models and the New Classical Economics concerns the determination of prices. In the New Classical Economics models, firms are in a position to receive price data under perfect competition conditions and incomplete information. In the New Keynesian models, firms are in a pricing position under the conditions of incomplete competition (Snowdon et al., 1995; Gordon, 1990). The approach of New Keynesian economists, taking into account both the nominal and the real rigidities that have been developed since the 1980s, have

shown that economic policies can be used to stabilize the economy in in the short term.

Although there are differences in theoretical perspectives, a compromise is mentioned in modern macroeconomics. According to consensus, a satisfactory macroeconomic model includes rational anticipation assumptions, wage and price rigidities, and optimizing behaviors of individuals (Carlin and Soskice, 2006). The basic feature of this reconciliation is that it is built from both New Classical Economics and RBC theory, as well as New Keynesian Economics. This consensus brings together the elements of incomplete competition and cost-price adjustment of the New Keynesian economics approach with the assumption of intertemporal optimization and rational expectations of the New Classical Economics and RBC theory approaches (Goodfriend and King, 1997).

Seminal work using the new Keynesian DSGE model was carried out by Smets and Wouters (2003). This study has been cited numerous times to guide further studies. The authors developed a DSGE model based on sticky wages and prices for the Eurozone. The model includes parameters such as habit formation, adaptation cost in capital accumulation and capacity utilization characteristics. In the study, empirical analysis of monetary policy shocks, productivity shocks, cost shock shocks and other structural shocks (preferences, labor supply, etc.) are carried out using Bayesian techniques and the effects of these shocks on business cycle fluctuations in the Eurozone are examined. According to their results, the price and wage adherence in the Eurozone is high. In other words, monetary policy is effective in the short term.

The key idea in the new compromise is *shudder*: In the short run, there are some temporary nominal rigidities arising from firms' pricing behavior. Therefore, the real effects of monetary policy are mentioned. However, in the long run the money is neutral (Clarida et al., 1999). The new Neoclassical Synthesis differs from its predecessor in terms of dynamic micro-based dependence and incomplete competitive equilibrium models (Dixon, 2008). Additionally, the external supply of the previous synthesis is taken as an internal variable.

New Keynesian Macro Models suggest that total demand is the main determinant of real economic activity due to short term price rigidities. In this context, monetary policy

has a strong effect on the real economy. The prejudice attributed to monetary policy has both positive and normative consequences. In a positive sense, conjuncture fluctuations cannot be explained and interpreted independently of monetary policy implementations. From a normative point of view, total demand should be directed to ensure macroeconomic stability. However, supply forces are not the demand forces that determine the long-term output level. For this reason, monetary policy must be careful with the long-term determinants of the economy (Goodfriend and King, 1997). The New Keynesian approach to monetary policy analysis involves the systematic use of DSGE models developed within RBC models. A typical general equilibrium model is formulated as three blocks of aggregate demand, aggregate supply and a policy rule.

Total demand and aggregate supply, are both related to household's optimization and the profit maximization problems of firms. Policy maker's social loss is derived from the behavior of minimizing the function. Firms are modeled in the monopolistically competitive market. Each firm is confronted with a well-defined demand curve for the product it produces and is in a price-fixing position to maximize its reduced profit. Here, the main source of monetary policy bias is nominal rigor. Nominal rigidities are generally defined as constraints on how firms and employees adjust their prices and fees, respectively. These constraints imply that price and wage-making decisions are forward-looking, because every economic agent knows that the prices / wages they set will remain constant for a certain period of time. In this case, it would be optimal to include optimistic decisions about the future.

Section Summary

DSGE models have been used extensively in monetary policy analysis in recent years. As a result of their increase in popularity and use by central banks, they have become the subject of significant empirical work by many academics. The DSGE model, which occupies a large area in the literature, has been applied to many countries in the inflation targets and to provide academic stability in the determination of economic policies.

SECTION 3 - THE NEW KEYNESIAN APPROACH AND MODEL

3.1. The New Keynesian Approach

The New Keynesian approach to monetary policy emphasizes not only the effects of external changes in monetary policy instruments but also the internal components of monetary policy (i.e. monetary policy rules) and provides alternative definitions of these components. It can be used to both assess the desirability of alternative policy rules and also to determine a rule based on the optimistic behavior of consumers within the economy, using a welfare measure (Gali et. al, 2007). The common features of the New Keynesian macroeconomic models can be listed as follows (Carlin and Soskice, 2006):

I. There is unrelenting unemployment in the balance.

II. The structure of the supply within the economy determines equilibrium unemployment.

III. Total demand shocks can be removed from the output balance level in the economy, meaning that aggregate demand shocks are primarily due to output and employment, rather than wages and prices.

IV. The aggregate demand shocks on the economy may increase via the multiplier of the effect, i.e. the change in consumption output reaction.

V. The inertia of inflation leads to the continuation of the imbalance in the economy being above or below the balance value.

VI. The central bank is forward-looking and uses the response function to change the interest rate and bring the economy back into balance, in response to inflation and shocks to aggregate demand and supply.

VII. Multiple equilibria can occur due to labor productivity or demand flexibility changes at high and low output levels. Displacement offset or imbalance may affect the supply portion of the economy and therefore balance unemployment. This is known as hysteria.

VIII. Incorporating models such as justice (e.g. equality, honesty) that affect the benefits for workers other than consumption and leisure time can lead to a balanced range of employment rates.

An important feature of the New Keynesian approach is the basic model, open economy, incomplete information and learning, unemployment, credit rigidity etc. (Gali, 2002). In other words, it has the ability to expand to include many features. However, a New Keynesian macro model usually comes down to an inflation equation, a total demand equation, and a monetary policy rule. The inflation equation and the aggregate demand equation are derived from the inter-period optimization decisions of firms and households.

New Keynesian macro models emphasize the forward-looking nature of inflation and bring a new perspective on inflation dynamics. This feature is included in the models in which firms can adjust their own prices but face constraints on the frequency of price fixing. The firm determines the price in the current period and then determines the probability of a fixed price over a period of time. For such a firm, it is optimal to include in the price decisions, expectations of future costs and demand conditions (Gali, 2002). The inflation or aggregate supply equation is based on the approach developed by Calvo (1983). In this approach, inflation is expressed as a function of the expected inflation and output gap. In equation (1), π_t represents the current period inflation rate, y_t the output deficit and ε_{AS} the total supply shocks. Calvo (1983) analyzed the macroeconomic results of the assumptions that the nominal individual price determinations are not continuous and that price determinations are not made in an identical fashion. In the model where each price maker (or firm) is allowed to change its price in response to incidental signals, in each period only a part of the firm is changing its price. A price-setting firm will determine its price based on the expected average price level and expectations of market conditions.

The failure of the new Philips curriculum, which includes forward looking inflation dynamics, at the empirical level led many researchers to turn to a combination of the old and new Philips Curves. In the Philips Curve, inflation is expressed a combination of past and expected inflation. The Investment Savings (IS) equation is derived from the inter-period optimization decisions of economics agents.

In the basic model, demand is assumed to be the same as total demand, since demand does not come from another source. The aggregate demand equation is derived as a function of the real interest rate and the expected future output.

Furthermore, Smets and Wouters (2003, 2007), use Bayesian methods to show how parameters can be predicted more easily and effectively. The New Keynesian model has increasingly been used by central banks operating an interest rate instrument to maintain price stability, generating increased academic focus on this topic. As the New Keynesian model offers many uses for practical policy analysis and provides a new framework for the application and conclusion of economic policies. it plays an important role in monetary policy in the short term, especially at the point of ensuring economic stability.

3.2. The DSGE Model

Keynesian business cycle models are characterized by a number of basic assumptions. General equilibrium model conditions arise from optimization problems of consumers and manufacturers. Starting from this perspective, total demand and aggregate supply are derived from the benefit optimization of the households and profit maximization problems of the firms respectively. Households try to maximize the profits of firms while aiming to maximize their expected utility value. Firms are modelled on the monopolistically competitive market and have market strength on prices that enable the creation of short-term nominal price rigidities. Each firm is confronted with a well-defined demand curve for the product it produces and is in a price-fixing position to maximize its profit. As mentioned, the model assumes that there is incomplete competition in the commodity market in contrast to the RBC model. It further assumes that each firm determines their prices and produces a different commodity. Conversely, some constraints are implemented for the price adjustment mechanism by assuming that only a part of firms can reset their prices in any time. Calvo (1983) refers to this as a time-varying price model characterized by random pricing periods. Due to this nominal rigidity, the monetary authority will be active in the short-run to influence real activity, as real interest rates will not remain insensitive to short-term nominal interest rates and movements in monetary policy instrument. Thus, a central bank determines the nominal interest rate and tackles the market. However, the central bank, by contrast with households and firms, will not continue to behave optimally. As discussed in

Sections 1 and 2, this model has become most cruel for the analysis of monetary policy.

This section reviews the DSGE Model that is hold by households, monopolistically competitive firms, the monetary authority and a government sector and explains the key elements of the baseline model.

3.3. Building the Basic New Keynesian Model

3.3.1. Households

The model includes an expansive number of indistinguishable households, portrayed by composite consumption goods, real money balances and market employment. Households maximize the expected present discounted value of their utility. (Romer, 2012) In the below utility equation, C_t denotes the composite consumption good, M_t=P_t is measure of real money balances and N_t is the market employment.

$$\mathrm{E}_t \sum_{i=0}^{\infty} \beta^i \left[\frac{C_{t+i}^{1-\sigma}}{1-\sigma} + \frac{\gamma}{1-b} \left(\frac{M_{t+i}}{P_{t+i}} \right)^{1-b} - \chi \frac{N_{t+i}^{1+\eta}}{1+\eta} \right]. \tag{3.1}$$

The composite consumption goods basket that enters the household's utility function is composed of differentiated goods produced by monopolistically competitive firms. C_t therefore, also specifies the amount of goods that enter the household utility function of the period. It is assumed that there is a continuum of goods represented by the interval [0,1] in the model. The price index P_t is then defined as the minimum expenditure for which a household can purchase a unit of C_t and $0 < \beta < 1$ symbolizes the subjective discount factor.

$$C_t = \left[\int_0^1 c_{jt}^{(\theta-1)/\theta} \, dj \right]^{\theta/(\theta-1)}, \qquad \theta > 1. \tag{3.2}$$

$$P_t = \left[\int_0^1 P_t \, (i)^{1-\varepsilon} \, di \right]^{\frac{1}{1-\varepsilon}} \tag{3.3}$$

where P_t represents the price of good in period t. and ε denotes the the elasticity of demand.

$$C_t(i) = \left(\frac{P_t(i)}{P_t}\right)^{-\varepsilon} C_t. \tag{3.4}$$

This shows the household demand for goods based on their relative price ($P_t(i)/P_t$). Under rational expectations, the household budget constraints are:

$$P_t C_t + M_t + E_t Q_{,t+1} B_t \leq W_t H_t + M_{t-1} + B_{t-1} + T_t + \Gamma_t \tag{3.5}$$

N_t represents the number of household members employed, W_t is the nominal wage, B_t denotes the quantity of one–period purchases per bond, and this bond's price is denoted by $E_t Q_{t,t+1}$. $T_t$is a lump-sum component of income and Γ_t denotes firm profits defused to the household sector.

In this case, the household must now decide how to allocate its consumption expenditures among the different goods in order to maximize their utility. Thereby, the optimal consumption conditions of the household' expected utility maximization case become:

$$\frac{1}{R_t} = \beta E_t \frac{U_C(C_{t+1}, m_{t+1})/P_{t+1}}{U_C(C_t, m_t)/P_t} \tag{3.6}$$

$$\frac{V_H(H_t)}{U_C(C_t, m_t)} = w_t \tag{3.7}$$

$$\frac{U_m(C_t, m_t)}{U_C(C_t, m_t)} = \frac{R_t - 1}{R_t} \tag{3.8}$$

where W_t represents the real wage. U_c is the marginal utility of consumption, while U_m is real money balances and V_H denotes the marginal disutility of labor.

These conditions include the Euler condition for temporal distribution of consumption over time, the optimal intertemporal optimality of consumption, the intertemporal optimality condition setting the marginal rate of substitution between money and consumption equal to the opportunity cost of holding money, and the intertemporal optimality condition setting the marginal rate of substitution between leisure and consumption equal to the real wage.

3.3.2. Firms

Firms aim to maximize their profits under monopolistically competitive market conditions, subject to three constraints. Firstly, each firm has a common production technology, however they all produce a differentiated good. This is denoted by the production function as follows:

$$Y_t(i) = A_t N_t(i) \tag{3.9}$$

Where A_t represents an identical technology shock (where constant returns to scale are assumed) and $N_t(i)$ is amount of labor demand by firms. In terms of simplicity, capital is ignored and labor is the only production input.

Secondly, the demand curve faced by each firm is restricted. Demand for good i is shown as:

$$Y_t(i) = C_t(i) + G_t(i) \tag{3.10}$$

where $G_t(i)$ denotes government purchases of good i.

Thirdly, firms are price makers but it is not possible for them to adjust their prices every period. The specific model of price stickiness used here is that of Calvo (1983). Each period, firms that have the authority to set their prices are randomly selected. It is assumed that in a certain period, each firm can reset $P_t(i)$ only with $1-\theta$ probability. For this reason, each period, $1-\theta$ firms re-optimize their price, while the remaining θ firms do not change their prices. Importantly, the possibility of a change in the price of a firm is independent from the time since the last price change. This price stickiness

is a significant feature of the model as it allows monetary policy to affect real variables in the short run.

Production costs are the main determinants of firms' price determination decisions. Firms minimize costs while maintaining the profit maximizing level of production. The cost minimization problem can be shown as;

$$MC_t(i) = \frac{W_t}{A_t} \tag{3.11}$$

In equilibrium, the marginal costs of the firm equate to the division of wages into marginal labor products. Marginal costs are assumed to be the same among firms ($MC_t(i) = MC_t$). It is accepted that the firm resets its price during the period t by considering that the price determined today can be effective for a period of time and the demand of good can be as follows

$$\max_{P_t(i)} \sum_{j=0}^{\infty} E_t Q_{t,t+j} \theta^j Y_{t+j}(i) \left[P_t(i) - MC_{t+j}\right] \tag{3.12}$$

It is the stochastic discount factor, and the first-order condition can be shown as:

$$Q_{t,t+j} = \beta^j \frac{U_C\left(C_{t+j}, m_{t+j}\right)/P_{t+j}}{U_C\left(C_t, m_t\right)/P_t} \tag{3.13}$$

The price decision is forward-looking, because all firms behave by assuming that the prices which they set will remain constant for a certain time.

$$\sum_{j=0}^{\infty} E_t Q_{t,t+j} \theta^j Y_{t+j} P_{t+j}^{\varepsilon} \left[P_t^*(i) - \frac{\varepsilon}{\varepsilon - 1} MC_{t+j}\right] = 0 \tag{3.14}$$

In the equation, P_t^* denotes the optimal price set by a firm. Although individual firms produce assorted products, they all have the same production technology and demand curves, with constant and equal demand flexibility. In other words, they are essentially the same with the exception that they can set their prices at different dates. Therefore, all firms that change the period will set the same price for the same problem. $Pt^*(i) = Pt^*$. Thus, each firm adjusts the price P_t^* to be equal to the nominal marginal cost.

In this case, the optimal price creates a constant difference over the simultaneous marginal costs. Therefore, in the spurious price model, the optimal price should be determined on an aggregate basis of estimated future marginal costs.

$$P_t = \left[\theta P_{t-1}^{1-\varepsilon} + (1-\theta)\left(P_t^*\right)^{1-\varepsilon}\right]^{\frac{1}{1-\varepsilon}} \tag{3.15}$$

3.3.3. Money Authorities

Money Authorities, (the central bank and the government), are responsible for managing monetary and exchange rate policies affecting the real economy. The New Keynesian Economic model controls the economy with monetary policy through the central bank and fiscal policy through the government.

3.3.3.1. The Government

The government consumes a portion of goods produced by firms and the government budget identity is shown in equation (3.17):

$$Y_t = C_t + G_t \tag{3.16}$$

$$P_t G_t + B_{t-1} = \frac{B_t}{R_t} - T_t + M_t - M_{t-1} \tag{3.17}$$

Here, government spending is financed by state treasuries and tax revenues. Household decisions and the government's solvency depend not only on the specific path of taxation and government debt but also on the discounted values of household income and state income. Therefore, there is no need to follow the taxation time and state debt in the model. Governments adjust the present value of collective tax

revenues to ensure that government spending is satisfied with nominal prices and timely budget constraints.

3.3.3.2. The Central Bank

The central bank does not behave optimally to maximise their utility/profit, like households that are on the aggregate demand side of the economy and firms that are on the aggregate supply side. The monetary authority directly controls monetary growth. The model of monetary policy is a working target for the short-term nominal interest rate R_t. For this purpose, the central bank aims to control the real economy by executing open market transactions for the interest rate of the money market.

$$\frac{R_t}{R} = \left(\frac{\pi_t}{\pi}\right)^{\tau_\pi} \left(\frac{Y_t^{gap}}{Y^{gap}}\right)^{\tau_Y} \upsilon_t \quad (3.18)$$

$\Pi_t = P_t / P_{t-1}$ is the gross inflation rate and Y is the actual deviation. Variables that are not time dependent specify the steady state values of the variable. The non-systematic components of the interest rate policy are controlled by the monetary policy outcome. The monetary policy authority adjusts interest rates and adjusts inflation for supply and demand. The central bank will increase interest rates to buy gold and the supply will decrease, which eases the increased pressure on inflation.

Section Summary

This section firstly explained the assumption of the New Keynesian Model, before introducing the DSGE model that is used commonly by central banks. This model enables simultaneous analysis of multiple economic parameters. The DSGE Model examined households, monopolistically competitive firms, the monetary authority and a government sector and explained the key elements of the baseline model. From here, when economic factors are explained, the basic New Keynesian Model was constructed.

SECTION 4 – MODEL ANALYSIS METHODS

4.1. Methods

The Dynare tool box generates the curtailed form of the DSGE model, with which the model automatically performs stability and isometric analysis. The distribution values

of the model parameters are weighted with values used in the academic works of Smets and Wouters (2003) and Levin et al. (2005).

In this paper, we analyse how the IRFs of output, inflation and the interest rate react to the following shocks: demand, monetary policy and cost-push. Additionally, we evaluate how the IRFs change when the persistence of shocks changes, when the central bank responds more aggressively to inflation and when prices are stickier.

The solution of the DSGE model is more complicated than those of static models and the solution matrices are large, making it impossible to complete a manual solution, which explains why the DSGE model did not become popular until more recent times, when computational power became more available.

The persistence / temporal effects of random changes of the endogenous model variables can be shown by the IRFs. The impact of a shock on the whole economy can be isolated. In this paper, the IRF for the specific parameters of the linear approach mentioned in the basic New Keynesian model will be examined using the Dynare program.

Inflation, the output gap and interest rate endogenous model equations (including error terms) are shown in Table 1 below.

Table 1: The inflation, output gap and interest rate endogenous model equations

$$\pi_t = \beta \mathrm{E}_t \pi_{t+1} + \kappa x_t + e_t,$$

$$x_t = \mathrm{E}_t x_{t+1} - \left(\frac{1}{\sigma}\right)(i_t - \mathrm{E}_t \pi_{t+1}) + u_t$$

$$\hat{i}_t = \delta_\pi \pi_t + \delta_x x_t + v_t.$$

Where x denotes the output gap, i represents the nominal interest rate and π is the inflation rate. All variables are measured as percentage deviations around the steady state. u is the demand inconvenience that can be based on increases from preference of the household, fluctuations in the flexible price equilibrium or government spending. e demonstrates a cost shock and finally, v is the monetary policy shock.

Although the model itself is forecasted, certain parameters are determined by following Levin et al. (2005) where the subjective discount rate is considered ($\beta = 0.995$) which

signifies a steady state annualized interest rate that is almost 4%. Consumption demand and labour supply equilibrium parameters σ and η are set as $\sigma = 1$ and $\eta = 1$, based on assumptions from Ravenna and Walsh (2006).

Finally, the response parameters in the monetary policy function are chosen according to Taylor's rule ($\delta\pi = 1.5$ and $\delta X = 0.2$) (Taylor (1993)). The structural shock in our model is fixed as autoregressive coefficients as $\rho e = 0.6$ (the cost push shock), $\rho v = 0.8$ (the demand shock), $\rho v = 0.5$ (the monetary policy shock), $\rho A = 0.9$ (the technology shock) and $\rho g = 0.8$ (government policy shock) for persistence shock. On the other hand, for transitory shock all of ρ values are assumed to be zero as the effects are only in the short term.

Table 2: The value of the parameters which are used in the analysis

```
beta = 0.99;
omega = 0.8;
sigma = 1;
eta = 1;
gamma = sigma + eta;
k = gamma * (1 - omega) * (1 - beta * omega) / omega;
delta_pi = 1.5;
delta_x = 0.2;
rho_e = 0.6;
rho_u = 0.8;
rho_v = 0.5;
rho_A = 0.9;
rho_g = 0.8;
```

Section Summary

This chapter explained the methods which are used for our ongoing analysis. The analysis is tested by the Dynare Economic Programme. Additionally, while the model is forecasted, certain parameters are determined by following Levin et al. (2005) and the subjective discount rate is considered.

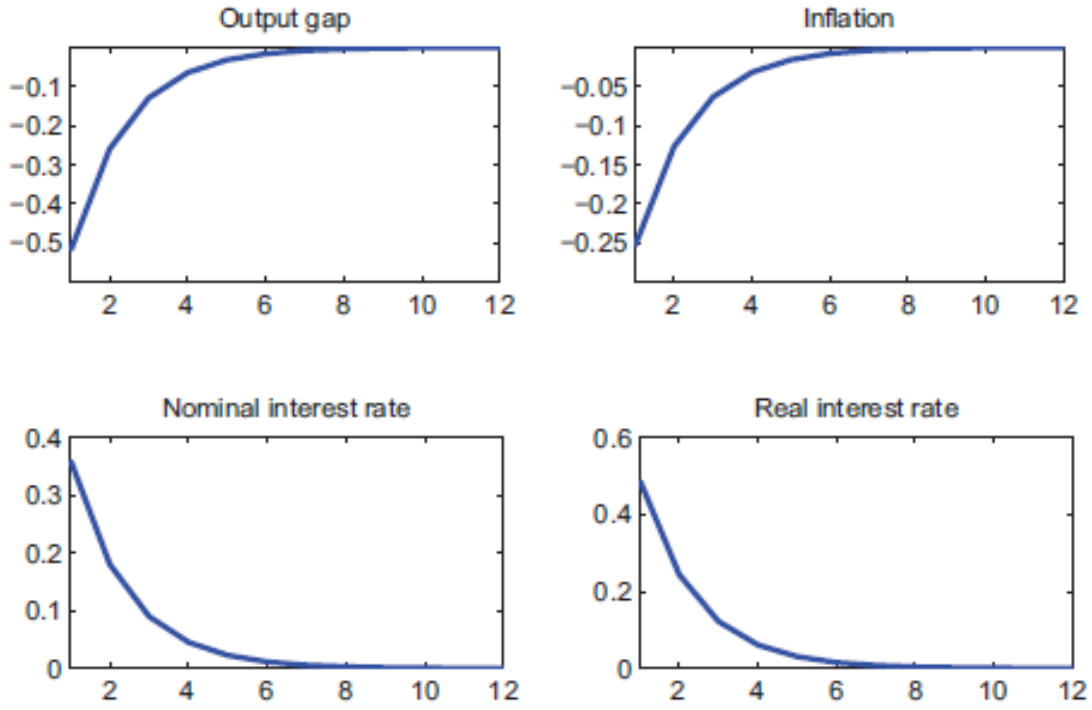
SECTION 5 – RESULTS

5.1. The Impulse Responses to a Monetary Policy Shock

$$\hat{\imath}_t = \delta_\pi \pi_t + \delta_x x_t + v_t. \tag{5.1}$$

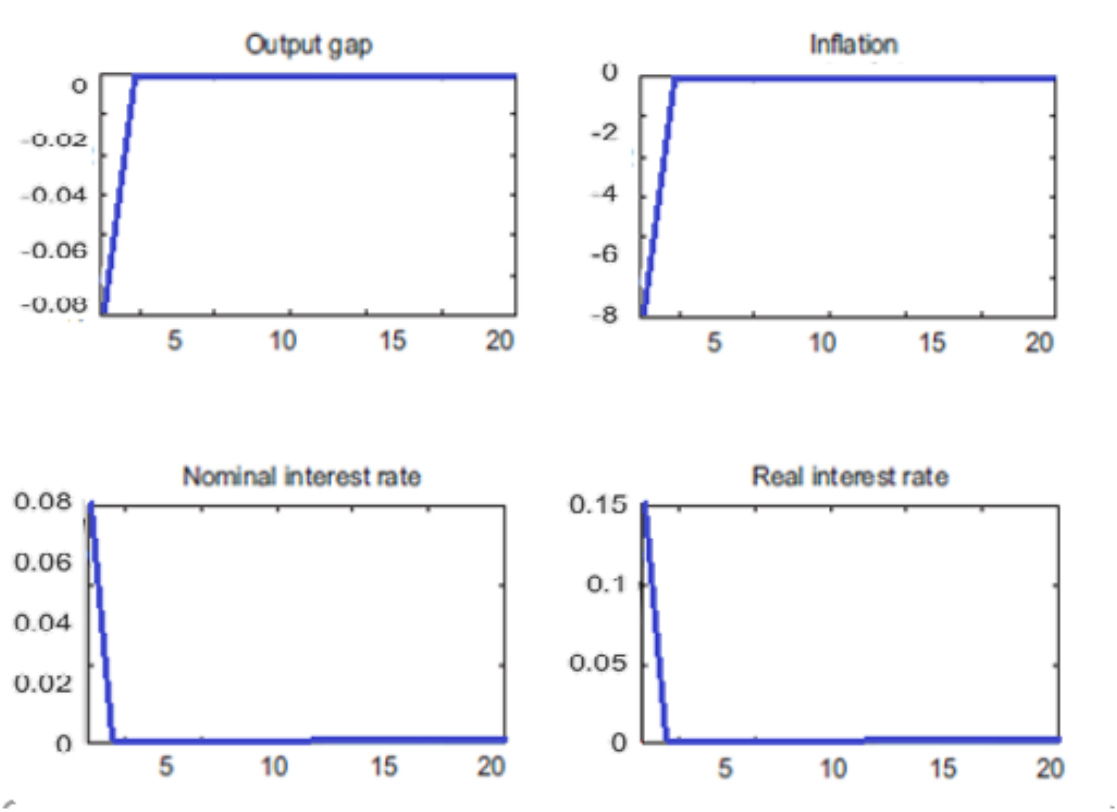
Previously the effect of the monetary policy shock (v_t) on output-gap, inflation and interest rates was examined with the pv value assumed as 0.5. The central bank must control the real interest rate by making adjustments to the nominal interest rate. In this way, monetary policy can affect the real economy. Figure 1 illustrates the dynamic impulse responses of the output gap, interest rate and inflation to a monetary policy shock. When the price is sticky, the price of nominal interest rates as a result of the money policy shock cause an increase in the real interest rate. In this case, households attempt to postpone today's consumption. Thus, current consumption is low relative to future consumption. The firms which face the low current consumption will in turn hire less labour. In this case, the marginal cost goes down, causing pressure on inflation. As is seen, the monetary policy merely affects moving the economic activity from its natural level. Thus, the output gap and output respond in the same direction as the shock. Finally, we argue that the rise in the nominal interest rate and decrease in the output specify the balanced real money demand of the household.

Figure 1: The Impulse Responses to a Persistence Monetary Policy Shock



Furthermore, in the case of a transitory shock, output, inflation and interest rates react in the same way. Following a transitory monetary shock, the increase in the nominal interest have same effect on inflation with persistence shock. The consumption postponed by households and the pressure of the producers on price levels cause the increase in output and the inflation rate for a while. IRFs to the monetary shock for both situations (transitory/ persistence) react in a same way. However, in the case of temporary shocks, the steady state conditions will change again after a certain period. The shock of the economy to the economy is the answer - $(pv = 0)$.

Figure 2: The Impulse Responses to a Transitory Monetary Policy Shock



5.2. The Impulse Responses to a Cost Push Shock

$$\pi_t = \beta \mathrm{E}_t \pi_{t+1} + \kappa x_t + e_t, \tag{5.1}$$

e_t represents the disturbance referred to a cost-push shock, which follows the exogenous AR(1) process in the DSGE model.

The central bank should react to inflationary pressures caused by cost changes by lowering productivity below its effective level, thus creating a negative output gap to mitigate the rise in inflation. Thus, the central bank is able to deviate from the targets of output deficit and inflation in proportion with the value of the cost push shock. Figure 3 shows the response of the output gap, inflation and interest rates under optimum decision making. The cost-push shock is persistent and the cost-push shock value (pe) is equal to 0.6 and it is assumed that there is a positive autocorrelation. In both cases, the central bank allows inflation to rise in part to compensate for the inflationary pressures resulting from the shock of cost pressures. However, Gali et. al(2007) notes that the increase in inflation in the economy is smaller than the increase achieved if the output deficit remains unchanged. Thus, in response to the shock of cost pressures, all variables appear larger. Instead, in the case of both persistent and transitory shocks, as shown in Figures 3 and 4, in accordance with the optimal appreciation authority policy, the impact on inflation is reduced by the adverse reaction of the output gap. Accordingly, the implied response of inflation, seems to have had an effect.

Figure 3: The Impulse Response Function to Persistence Cost-Push Shock

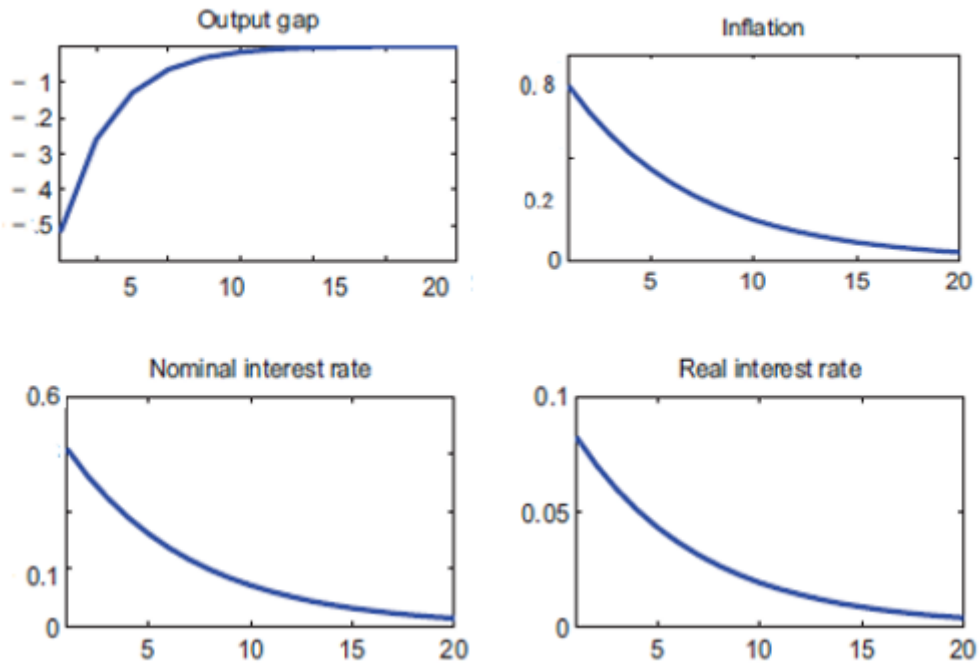
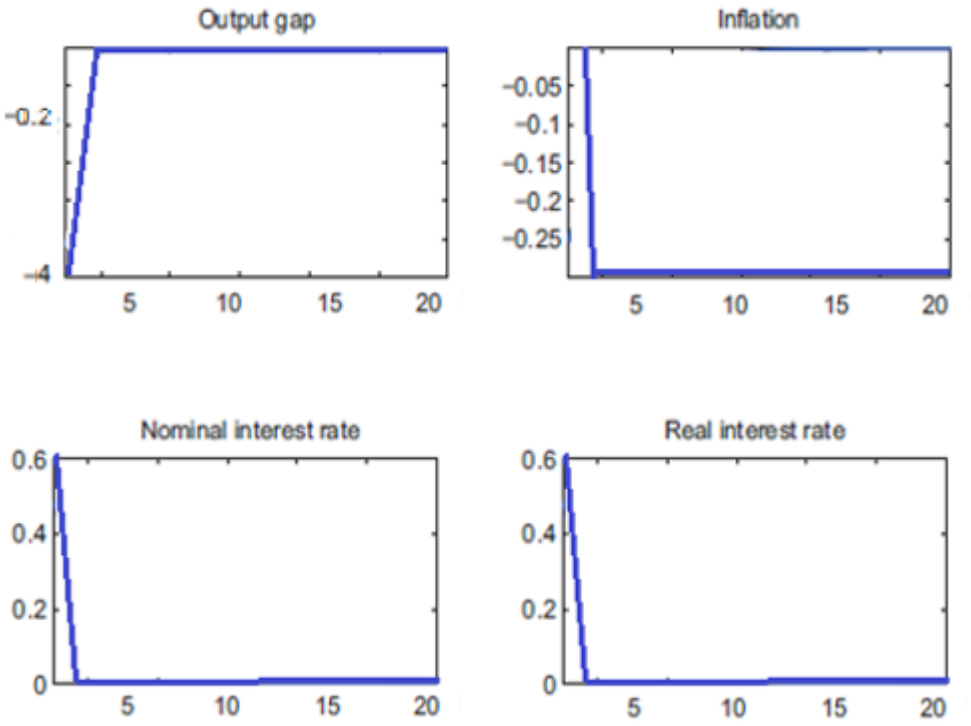


Figure 4 shows the transitory cost intrusion. this case, the pe value is equal to zero. In the analysis, it is assumed that there is a negative cost-push shock. Although the shock is not permanent, the output pendulum has strong positive serial correlation. The central bank is able to reduce future inflation expectations by holding inflation below a potential output (a negative output gap) for a few future periods after a positive cost shock. Output and inflation return to steady-state values in the period following the shock. Depending on the discretion of the central bank, this is the only means of achieving a cost-effective hedging of inflation. In the face of a positive outcome, x_t should fall to compensate for inflation.

Figure 4: The Impulse Response Function to Transitory Cost-Push Shock



5.3. The Impulse Responses to a Demand Shock

$$x_t = \mathrm{E}_t x_{t+1} - \left(\frac{1}{\sigma}\right)(i_t - \mathrm{E}_t \pi_{t+1}) + u_t \qquad (5.3)$$

$u_t$denotes the demand shock and its value in the analysis is ρu=0.8. Figures 5 and 6 illustrate the dynamic respond function of the output-gap, inflation and interest rate to the temporary and persistent demands shock. The demand shock is severely distorted by both the output gap and the volatility of inflation rising to a level associated with welfare losses on the core Taylor rule. The response of output to supply shocks is mitigated as output and consumer price inflation react to a demand shock grows and spreads. In the case of an unexpected increase in total demand, commodity prices and house prices (which increase the collateral value of the borrowers and decrease the real value of their debts) increase. Since the model's borrowers have a higher consumption tendency than lenders, the net effect of this resource transfer from debtors to the borrower is adverse and serves to increase the output response. However, a negative supply shock reduces inflation and thus leads to a lower output response by raising the real debt value of the debt.

Figure 5: The Impulse Responses to a Persistence Demand Shock

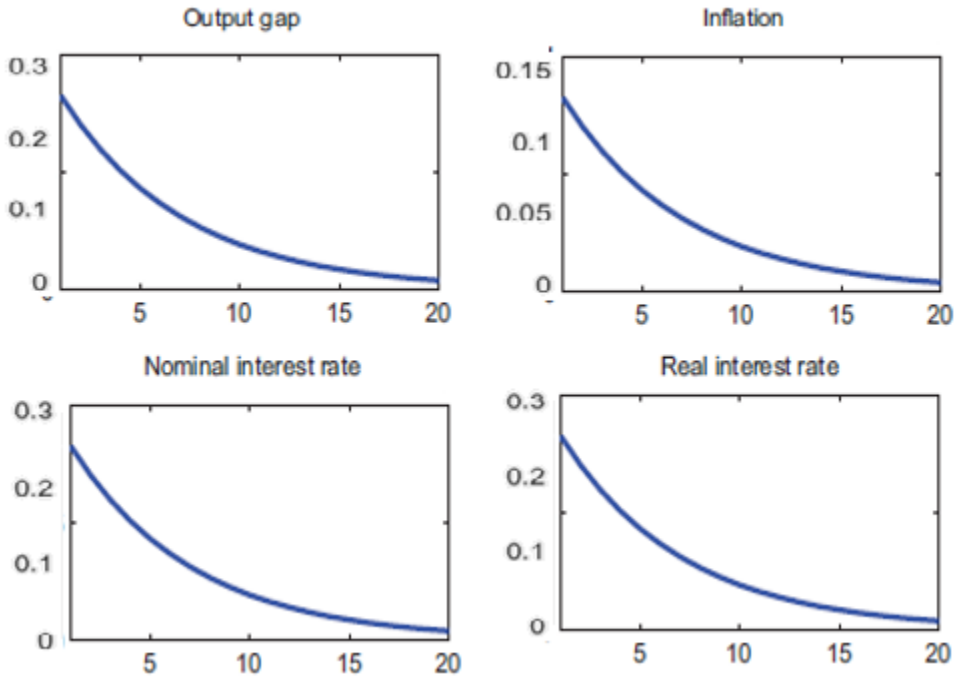
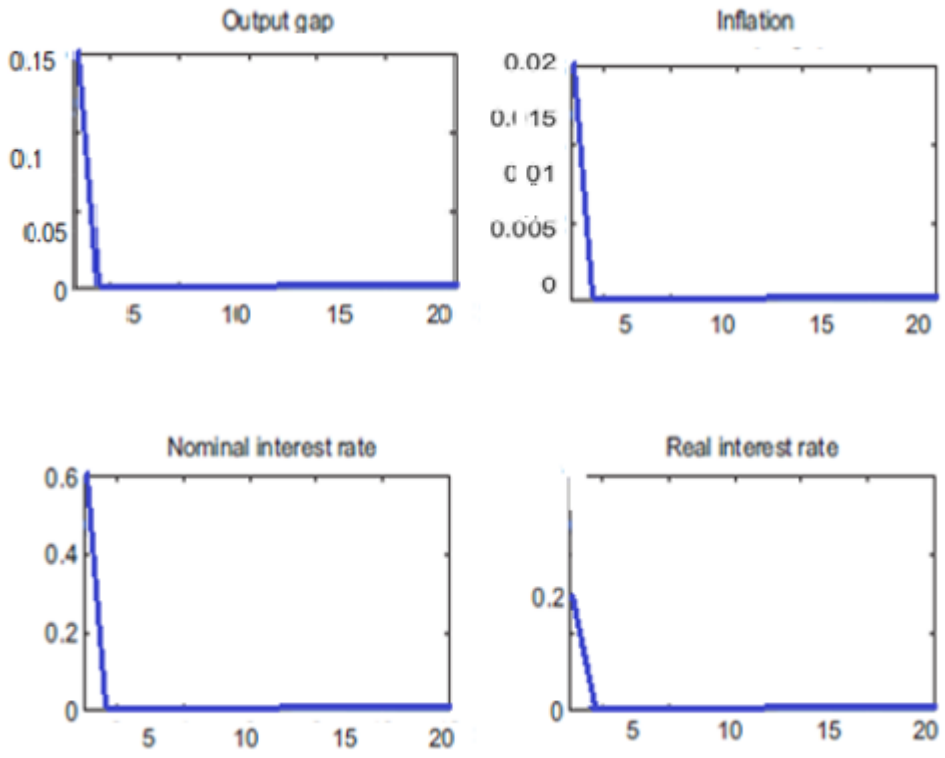


Figure 6: The Impulse Responses to a Transitory Demand Shock



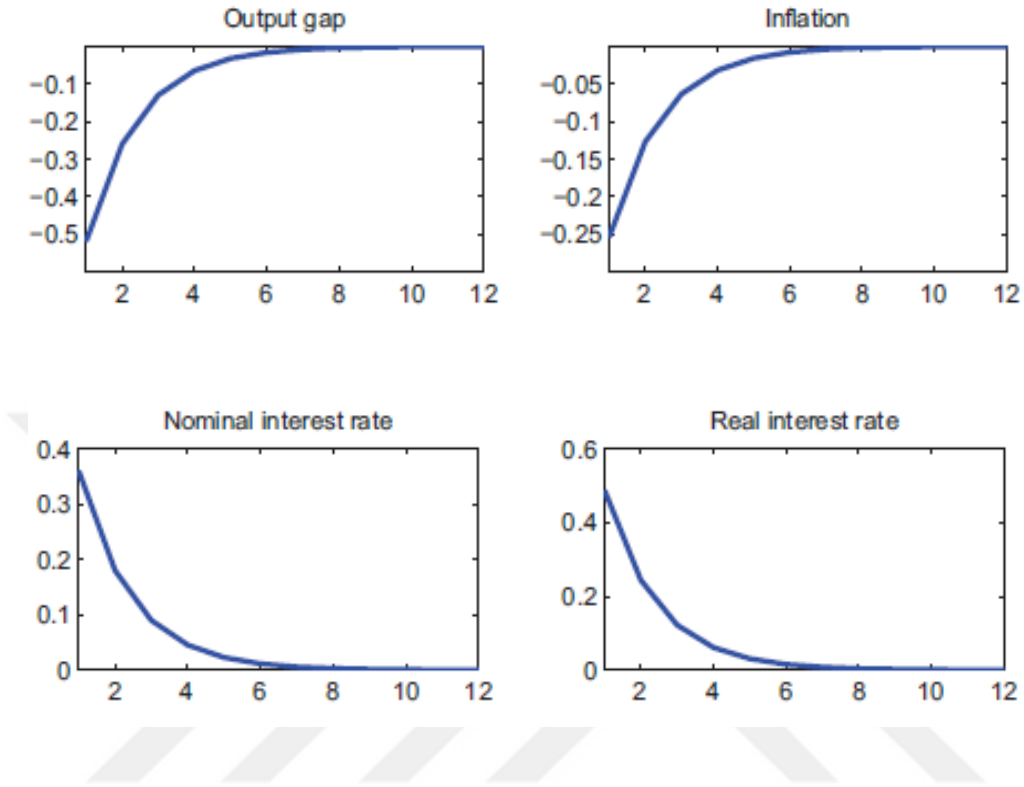
On the other hand, a temporary demand shock is similar with a persistent shock. However, in this case, the response of the variables analysed is more sharp and transient.

5.4. The Impulse Responses to a Technology Shock

The DSGE assumes that all firms face fixed capital levels and have the same production technology.In the case of a technological shock, the output gap declines from steady state. With the development in production technology, companies' production costs fall. In addition, price stickiness causes the deviation from the flexible-price level of output. Thus, only one share of firms can immediately drop prices. For this reason, the rise in aggregate demand and output is less than appropriate to the development in technology. Hence, the output gap will be negative. The central bank follows the monetary policies which reduce the interest rate level, because of the decline in inflation and the output gap. However, this reduction of the interest rate is not as significant as required to completely stabilize the fall in inflation and the output

gap level. According to Gal´ı and Rabanal (2004), this effect direction of the changes is explosive.

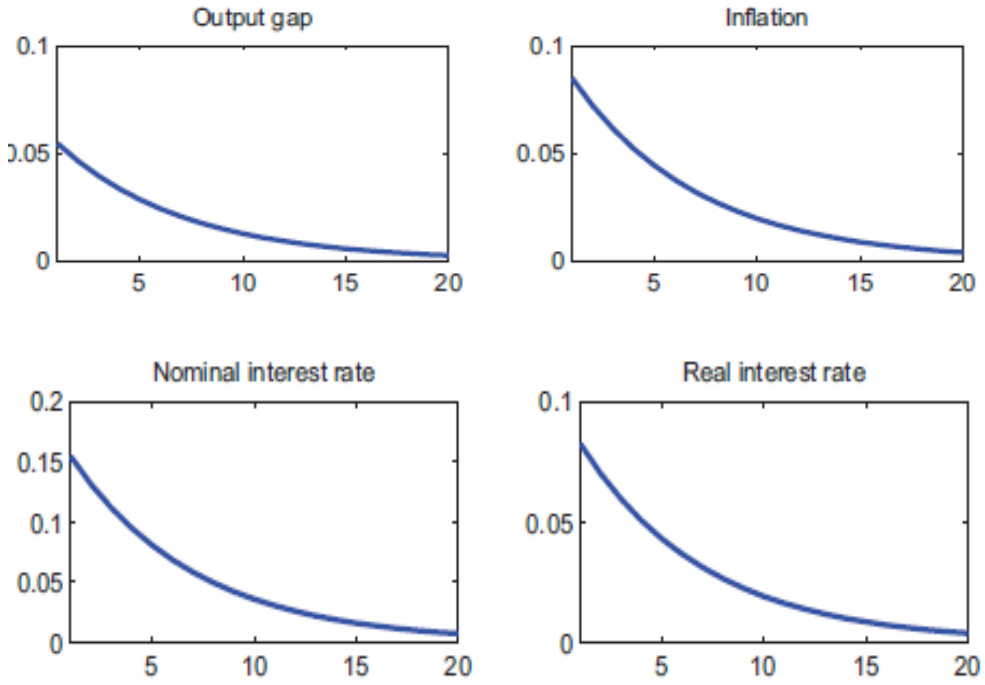
Figure 7: The Impulse Responses to a Persistence Technology Shock



5.5. The Impulse Responses to a Government Spending Shock

In this section, we demonstrate the response function to the government spending shock. As mentioned previously, the government consumes a portion of goods produced by the firms. Additionally, the increase in government demand affects aggregate demand in the same direction. This increase is not responded by output rises inadequately. The expected high tax that decrease the life annuity of households and the further increase of interest rates to fund the upswing in government consumption cause the decrease in the private consumption because of an intertemporal substitution effect. Moreover, the interest rate is not adequate to forestall the trivial increment of inflation and the output gap. There is however, disagreement in the empirical literature about government spending multipliers. According to Gal´ı et al. (2007), a government spending shock could actually lead to temporary increase in household consumption.

Figure 8: The Impulse Responses to a Persistence Government Spending Shock



5.6. A Model with Sticky Price and Wages

The concept of wage is an extremely important part of the theory of economics, since the wage (and prices) can be either flexible or sticky (rigid), indicating that markets will tend to balance themselves. In this context, neo-classical economics, for example, accepts that real wages and prices are flexible and therefore markets tend to self-balance. Neo-Keynesian economics argues that nominally, real wages are not as flexible as neo-classical economics predicts, and as such, markets cannot balance themselves.

If prices and wages are sticky, there is an imperfect condition in the economy. Here we analyse how the dynamic response function changes when price and wages are sticky. Specifically, we assume that the household and firms have power to set the price and the wage. It is also assumed that workers contend with Calvo's type constraint when they adjust the wage. (Calvo,1983)

Consequently, exactly balanced price inflation is no longer optimum. Therefore, the central bank should struggle to provide stability in prices and wages as well as in the output gap. This case causes ambiguity in the distribution of the resource which consequently causes a loss in household welfare.

Section Summary

This chapter analysed the IRFs of output, inflation and the interest rate to the following shocks: demand-pull, monetary policy and cost-push. In addition, we evaluated how the IRFs changed when the persistence of shocks changes, when the central bank responds more aggressively to inflation and when prices are stickier.

SECTION 6 - MACRO ECONOMIC FACTORS DETERMINING INFLATION EXPECTATIONS

Inflation expectations have been frequently studied by academics and central bankers for many years due to their decisive role in determining inflation itself. Inflation targeting is of great importance for the management of expectations for ensuring the effectiveness of the regime of understanding the formation period.

Estimating the factors that determine inflation expectations in developing economies is also important because of the high probability of encountering difficulties in lowering inflation. It is also important to know what variables are used when the inflation targeting regime is applied and the economic units used in the countries where inflation targets are sometimes difficult to meet. Indeed, when the expectations are fluctuating at a level close to the targets, it is easier to achieve macroeconomic goals.

6.1. The Importance of Inflation Expectations in Economy Theory

Since the explanation provided by Friedman (1968), which stressed the importance of inflation expectations in the American Economic Association, anticipations have played a key role in the analysis and design of monetary policies.

Managing inflation expectations is an important precondition for ensuring price stability. Central banks that control inflation expectations and fluctuate at the inflation target level are more successful in achieving this goal. In his study of inflation dynamics, Mishkin (2007) points out that the decline in inflation persistence in recent years has made the Phillips Curve more horizontal, and inflation expectations have fluctuated less infrequently than other variables.

6.1.1. Hypotheses of Compatible Expectations and Rational Expectations

The first effort on the modelling of expectations was made with the hypothesis of "Compatible Expectations" used in the 1950s and 1960s (Gali and Gertler, 1999). According to this, economic units use information sets from the past while they create expectations about what will happen in the future. For example, during times of rising inflation, general expectations assume that inflation to increase further:

$$\pi^e = \pi^e_{-1} + \lambda(\pi_{-1} - \pi^e_{-1}) \tag{6.1}$$

Here, π^e is the expected inflation rate for the following year, $\pi^e_{-1}$is the expected rate from the previous year, and π_{-1} is the inflation rate for the previous year. This equation therefore shows the inflation expectation of the inflation expectation and the error term for the past turn when λ takes a value between 0 and 1. Expectations are increasing or decreasing according to the magnitude of past inflation and past expectations.

With the application of coherent expectations theory to previous periods, inflation expectations regarding current turnover can be expressed as follows.

$$\pi^e = (1-\lambda)\sum_{j=0}^{\infty}(\lambda^j \pi_j) \tag{6.2}$$

In this equation, π_j represents the rate of inflation in the previous year. For this reason, the inflation anticipated for the current cycle reflects the weighted average of inflation rates observed in the past, with weights decreasing from the current period to the past.

These assumptions about the formation of expectations have been criticized on the grounds that they are not realistic and the theory of "Rational Expectations" has been developed as an alternative to the adaptive expectations hypothesis with the New Keynesian movement. Two basic features of the rational expectations theory stand out. First, economic agents not only use their past knowledge, but also any new information in the economy. Secondly, it assumes that economic units do not make systematic mistakes, i.e. even if they make mistakes, they are expected to fix this error in the next period.

Rational Expectations were first raised by Muth (1961) and developed by Sargent and Wallace (1975). According to the widely-used definition, price markers have all the necessary knowledge about the structure of the model that manages the economy and aim to make the best use of the information they possess to make unbiased and effective forecasts. In this direction, anticipation is unbiased:

$$\pi_{t+k} = \alpha + \beta E_t \pi_{t+k} + \Theta_t \gamma + \mu_{t+k} \quad (6.3)$$

This equation implies that the hypotheses $H_0: \alpha = 0 \; and \; \beta = 1$ are not rejected. In this model, inflation realized in π_{t+k} with $k \geq 0$; inflation expectations for the period $E_t \pi_{t+k}$ based on the information obtained at time t; while it expresses a shock. Rationality of expectations requires that expectations be effective as well as unbiased. The effectiveness of the prospects means the use of all relevant information available when the forecast is made or the forecast is made. Accordingly, while expressing the Θ information set, the hypotheses $H0: \alpha = 0, \beta = 1$ and $\gamma = 0$ should not be rejected.

There are several studies which determine whether inflation expectations are rational, and many of these studies conclude that anticipations are unbiased and ineffective (Taylor, 1988). Although the assumptions of expectations are purely pure or purely rational, the changes made in order to make them more realistic reduce the gap between them relatively (Gramlich, 1983).

6.1.2. New Keynesian Phillips Curve and Inflation Expectations

Inflation expectations are also considered as a determinant of current period inflation in relation to the New Keynesian Phillips Curve (NKPC). The relationship between inflation and unemployment was first directly addressed in the economic literature by Phillips' study of the period between 1861 and 1957 (Phillips, 1958). The results of the study show that there is a long-run, negative and non-linear relationship between wages and the unemployment rate. The original Phillips Curve does not include inflation expectations.

The "Expectation-Augmented Phillips Curve" emerged following further analysis by Phelps (1967) and Friedman (1968). These academics criticized the Phillips Curve for

not being valid in the long run. The Expectation-Augmented Phillips Curve that emerged as a result of these criticisms is as follows;

$$\pi = \pi^e - \alpha(u - u_n) \tag{6.4}$$

In this equation, π^e is the inflation expectation, π is the current period inflation rate, u is the current period unemployment rate, and u_n is the natural level of unemployment. The equation shows that unemployment is at the natural level when economic units correctly predict inflation.

The Expectation-Augmented Phillips Curve indicates that the fundamental element in determining the inflation in an economy is excessive demand. That is, in the short-term, the trade-off between inflation and production continues. theory was tested by Lucas and Rapping (1969) using US data, with the results confirming the expectant approach were reached. This provided evidence that the anticipation of the Phillips Curve should be included. In the 1970s, with the development of Rational Expectations, the Phillips Curve reinforced with expectations was criticized, arguing that the trade-off between inflation and unemployment could only happen under certain conditions. According to the theory of Rational Expectations, the economic units are predicted by using all kinds of information in the economy and systematic errors.

There is a need to create policy surprises in order to reduce the unemployment rate by causing an increase in inflation (Sargent, 1973; Sargent and Wallace, 1975). From this perspective, the total supply curve created by Lucas resembles the Phillips Curve reinforced with expectations. However, in the Lucas-type supply curve, the inflation expectation implies a rationally formed expectation.

The DSGE models, which began to develop in the 1990s, were then re-examined through the Phillips Curve. The DSGE models are based on the assumption that nominal prices are doubled, that there is monopolistic competition in commodity markets and that there is a positive relationship between demand and prices. In the model, the assumption is made that prices are generated by menu costs that the companies have to accommodate because of the rigidities in the producers' markets (Taylor, 1980; Calvo, 1983). In this gradual price model, firms cannot determine their

prices at the same time. Some firms change their prices while others keep their prices constant.

The NKPC, is derived from firms' optimization problems and responds to Lucas and Sims' critiques within these assumptions. This model, formed from a prospective point of view, reveals that economic activity and inflation in the current period are influenced by both present and future monetary policy expectations. According to this, NKPC is expressed as follows:

$$\pi_t = \beta E_t \pi_{t+1} + \Theta y_t \tag{6.5}$$

Here, π_t is the inflation level in the current period, $E_t \pi_{t+1}$ is the inflation forecast for the period $t + 1$, and y_t is the output deficit. NKPC shows that the current period inflation is dependent on future inflation expectations and outcomes. NKPC is similar to the early period Phillips curve as it indicates a positive relationship between inflation and output deficit in the short-term. However, the element that distinguishes NKPC is that it has a forward-looking perspective because inflationary dynamics also include future expectations. NKPC differs from the anticipated Phillips Curve because it is derived from micro-bases.

However, current period inflation can also be shown as a weighted average of future output turnaround expectancies.

$$\pi_t = \Theta \sum_{s=0}^{\infty} \beta^s E_t y_{t+s} \tag{6.6}$$

This means that a credible central bank can reduce inflation by announcing future output deficits without incurring a loss in production.

The NKPC has been developed by Gali and Gertler (1999) on the assumption that certain parts of firms use prospective pricing behaviour in addition to Calvo pricing. For Calvo-type pricing, the probability of firms setting prices at any time is $1 - \theta$, independent of the time since the last date they changed their prices. According to Gali and Gertler-type pricing, the probability of firms setting prices at any time is $1 - w$ independent of the time since the date they changed their prices. This hypothesis allows the continuity of inflation seen in real life can be modelled.

Additionally, real marginal cost has been added as a measure of modelling cost pressures, as the use of exit openness as a measure of economic activity cannot accurately measure the demand conditions in the economy. Based on these assumptions, the hybrid NKPC reveals that current period inflation is based on past inflation as well as inflation expectations and marginal cost (mc_t^r):

$$\pi_t = \gamma_b \pi_{t-1} + \gamma_f E_t \pi_{t+1} + \chi mc_t^r \quad (6.7)$$

Both NKPC and the hybrid NKPC show that inflation expectations are a determinant of current-period inflation. Accordingly, the expectation of economic units to increase inflation leads to an increase in inflation itself. For this reason, besides the marginal cost, the influences of inflation expectations will facilitate a central bank aiming at providing disinflation. This situation is expressed as the confirmation of inflation expectations.

Gali (2002) stated that the positive outcome of NKPC's assumptions in line with the theory is that this model is a primary convergence of inflationary dynamics for Europe and the US, even though a completely forward-looking outlook is rejected.

6.1.3. The Role of Inflation Expectations in the Frame of Monetary Transmission Mechanism

The mechanism of monetary transmission is the mechanism by which central bank decisions on monetary policy instruments affect real economic activity and inflation with various channels. Central bank decisions which use short-term interest rates as a means of monetary policy are influenced mainly by expectations, interest, asset prices and exchange rates. Consequently, inflation expectations play an important role in the functioning of the transfer mechanism.

We also determine how reliable the central bank is in terms of public confidence, and how the decisions taken on short-term interest rates have an effect on expectations. For example, if the central bank is reliable and the public believes the central bank's commitment to fighting inflation, increasing policy interest rates will lead to consumer and producer inflation expectations falling. Therefore, the inertia of inflation will be broken and the chances of a successful monetary policy will increase. However, if the central bank is not credible to the public, increasing the policy interest rates of the

central bank may lead to the expectation that future inflation rates may increase. Consequently, a reliable and transparent monetary policy strategy needs to be established in order for the central bank to enable expectations to work in their favour.

Nevertheless, expectancies depend on the Phillips Curve of how the price behaviour of the channel is influenced by the monetary transmission mechanism. In the case of Taylor (1980), where there is no inflation rate inertia and the inflation rate depends on the inflation expectation for the next period, the expectations are very efficient. On the other hand, Fuhrer and Moore (1995) base current inflation on both past inflation and future inflation expectations.

6.1.4. Inflation Targeting Inflation Expectations on the Regime Framework

In this regime, which has been implemented since the early 1990s, central banks have announced a numerical inflation target and are committed to using their monetary policy tools to meet this target. The inflation targeting regime gained popularity among both developed and developing countries due to its success in reducing inflation rates and its contribution to lowering the cost of disinflation. As a result, an increasing number of inflation-targeting regimes have been implemented by central banks in order to reduce inflation and maintain price stability. This ensures that the regime clearly believes that inflation targets are at the target level, particularly by guaranteeing public confidence in long-term inflation expectations.

$$\pi_{t+l} = s_t - i_t + \varepsilon_{t+l} \tag{6.8}$$

Here, s_t are the elements that create inflationary pressure, i_t is the policy rate, and ε_{t+1} is the shock that cannot be predicted. The inflation rate π_{t+1} after the period 1 is given as follows.

Under the assumption that the central bank's decision on the policy interest rate in time t does not affect the inflation rate in the same period but can affect it in the period $t + 1$, the central bank must solve the following problem when choosing the policy rate for each period:

$$\min_{i_t} E\left[\sum_{r=\tau}^{\infty} \delta^l \frac{1}{2}(\pi_{t+l} - \pi^T)^2 \,\middle|\, \Omega_t\right] \tag{6.9}$$

$$E\left[\pi_{t+l} \middle| \Omega_t\right] = \pi^T \tag{6.10}$$

Equation 5.10 shows that the central bank chooses the policy rate to equal to the inflation target of the inflation expectation. This is defined by Svensson (1997) as the "inflation forecasting target".

The inflation targeting regime allows fluctuations in inflation expectations at the level of announced targets, especially during adverse shocks, thereby reducing the output cost of disinflation (Cerisola and Gelos, 2009). In this regime, inflation targets are a guide to monetary policy objectives and help to shape expectations. In this direction, inflation targets, an important factor as an anchor in shaping the expectations of the markets, fall. However, the power to direct inflation expectations is directly related to the credibility of the central bank and, therefore, the targets which the bank has declared.

6.2. Empirical Studies on the Determining Factors of Inflation Expectations

6.2.1. Measuring Inflation Dynamics

The first issue faced by researchers during the implementation of empirical studies on inflation expectations was the measurement of inflation expectations. There are several prominent methods for measuring expectations, including through inflation-indexed government estimates. This method is based on the calculation of the difference between an ordinary bond and the inflation-indexed bond yield. The difference in yield between the two bond types reflects the inflation expectation. Second, inflation expectations can be calculated through inflation swaps, which provide protection against the inflation risk measured by the premium. Thirdly, questionnaires are used to measure inflation expectations through direct inquiries of the expectations of households, the public and academics. Finally, inflation expectations can also manifest themselves through some economic indicators such as wage bargaining. Wage negotiations between employees and employers reflect the anticipation that the parties will return the contract. We should note however, that such data may also reflect other factors such as ability to pay or productivity.

Each method has its own advantages and disadvantages. Market-based indicators can reflect risk premiums or other market factors as well as inflation expectations. The vast majority of studies on inflation expectations use inflation expectations measured through questionnaires.

6.2.2. Empirical Studies on the Determinants of Inflation Expectations in Developed Countries

The determinants of inflation expectations, (i.e. the macroeconomic information used by economic agents to build inflation expectations), are relatively underestimated when compared to other studies on expectations. However, for developed countries, studies on this subject have historically been based on inflation expectations.

A seminal study on the determinants of inflation expectations in developed countries was conducted by Carlson and Parkin (1975). When the inflation rate is high, the expected inflation is formed by the error learning process and the last two error terms are significant. This suggests that while considering their inflation expectations, people take into account the rate of change in inflation as well as the rate of inflation itself. When the inflation rate is relatively low, the expectations are completely autoregressive. Another factor affecting expectations is the exchange rate. Particularly, the depreciation of the exchange rate leads to a striking effect on the expected inflation. The authors highlight that anticipation should be lowered in order to reduce inflation, and that inflation expectations will also decrease due to the error-learning process as a result of the fall in inflation. In the formation of expectations, the effect of other macroeconomic indicators as well as realized inflation has been. Gramlich (1983) found that households and economists' expectations in the US were influenced by variables of fiscal policy, supply shocks and political factors as well as past inflation.

Figlewski and Watchel (1981) found that respondents' analysis of determinants of inflation expectations indicate that these determinants change over time and differ among participants. In parallel, Lee (1994) found that determinants of inflation expectations vary between sectors, using sectoral data for the UK for the period 1972-1989. Nevertheless, Lee shows that anticipations have been revised downwards

rapidly in periods of rising inflation and upwards revisions have been made in inflationary periods.

A more recent study on the subject was carried out by Ueda (2009). In this study inflation expectations, inflation rate for the previous quarter, short-term nominal interest rate and output deficit are internal; assuming energy prices and food prices as external variables and estimating the determinants of household inflation expectations for Japan and the US using the structural Vector Auto-regression (VAR) method. For Japan, IRFs suggest that a positive directional demand shock increases inflation expectation while a negative directional shock reduces inflation expectations. Nonetheless, inflation expectations, which are seen to react to monetary policy shocks as well as changes in energy and food prices, move faster than inflation. An inflationary shock affects expectancies in the same direction, but the effect is limited. Besides, the expectation of inflation is found to adapt more quickly than realized inflation. While similar results were found for the US economy in the study, the effects of energy and food prices on inflation expectations were found to be temporary in Japan and long in the US. Additionally, unlike Japan, inflation expectations in the US seem to react more to realized inflation, suggesting that the self-validation feature is more evident in the US.

Some empirical studies on expectations focus on how expectations of monetary policy statements are shaped. Johnson (2002) demonstrates that the clarity of monetary policy disclosures in Canada and reliable revisions to targets affect inflation expectations and unexpected disinflation processes. In addition, Leduc, Still and Stark (2007) showed that oil prices and monetary and fiscal policies are determinants of inflation expectations.

Clark and Davig (2008) use US data to prove that using the traditional VAR approach, led to an increase in shock to any of the expectations (in addition to short-term and long-term expectations). The study, which shows that the increase in inflation and food prices affects short and long-term expectations, with short-term anticipations particularly reacting more to inflation, suggests that this change is temporary, as changes in monetary policy cause anticipations to fall.

Studies of the process of setting up inflation expectations and the determinants of anticipation have often focused on the impact of the announcement of the inflation targeting regime and therefore the inflation targets. Johnson (2002) shows that inflation expectations fall in countries that implement the inflation targeting regime, with the announcement of inflation targets even after the control of the country and year effects, falling inflation and business cycles. Levin, Natalucci and Piger (2004) used data from US, Australia, UK, Sweden, Canada and New Zealand demonstrated that inflation expectations have changed due to changes in the current inflation rate. This situation is unexpected when inflation is completely overcrowded. Inflation targeting has been intended to assess the sensitivity of inflation expectations to realized inflation in countries which implement and apply inflation targeting regimes through pooled regressions to test whether the expectations of the countries that implement the regime are relatively better. The results indicate that long-term inflation expectations are less sensitive to inflation in countries that implement the inflation targeting regime. This finding suggests that the countries which implement the inflation targeting regime are more successful in breaking the link between anticipated inflation and realized inflation.

Nevertheless, Van der Cruijsen and Demertzis (2007), attempt to explain how central bank transparency affects the relationship between realized inflation and expectations. Panel data for nine countries, based on the view that institutional features and operations of the central bank affect the formation of inflation expectations above all else, suggests that in countries where the central bank is less transparent, inflation expectations are stronger in relation to inflation realizations and in relation to countries where central banks are more transparent indicating that the relationship between realized inflation and expected inflation has weakened.

Some studies investigating the determinants of inflation expectations have explored how macroeconomic variables considered by economic agents to affect the expectations of those who have more characteristics. In these studies, microeconomic-data is used at the participant level, revealing how the characteristics of the participants influence the process of setting expectations. In the period between 1998 and 2001, Bryan and Venkatu (2001) examined the results of the inflation expectation survey in the US and found that variables such as women, single, non-

white, high school education were left out and low-income people had higher inflation expectations. In parallel, Pfajfar and Santoro (2008) show that demographic factors are paramount in the formation of inflation expectations. The study shows that men in the US, better educated individuals and those with higher incomes, are better at estimating the level of inflation.

Blanchflower and MacCoile (2009) investigated the inflation expectation survey conducted by the Bank of England, the expectation questionnaire collected by Eurobarometer. They considered the argument that expectations are not an idea, and that they are in fact backwards. Nevertheless, it has been shown that participants in the formation of expectations in the study have differences in characteristics such as education, age, income and employment status. Accordingly, inflation expectations increase with age. Participants with lower education levels and non-hosts are more likely to expect inflation. The authors concluded that expectations were created from a retrospective point of view, but that past inflation is less deterministic in the formation of expectations for more educated people.

Generally, empirical studies show that inflation expectations are influenced by variables such as past inflation, monetary and fiscal policies, the state of the economy, and oil prices. Studies show that in developed countries, inflation expectations are becoming more aggressive over time, and thus less responsive to shocks. Nevertheless, it is observed that inflation targeting countries have been successful in reducing the inflation expectations of the countries applying the regime to the past inflation.

6.2.3. Empirical Studies on the Determinants of Inflation Expectations for Developing Countries

Although empirical studies on the determinants of inflation expectations in emerging countries are based on the past, they have increased in quantity in recent years for developing countries. This is thought to be due to the relatively high inflation in developing countries as well as the recent creation of the series of inflation expectations for these countries. The work done for these countries is still limited in comparison to developed countries.

Many factors contribute to the fact that inflation rates in developing countries do not fall to the targeted levels, such as the retrospective view of pricing behaviour and the lack of reliable stability efforts. In these countries, inflation is known to be sticky due to the retrospective perspective and indexing habit resulting from the effects of chronic inflation, which is a major problem for central banks aiming to reduce inflation (Dornbusch and Werner, 1994).

A limited number of empirical studies on the determinants of inflation expectations in emerging market economies seem to focus on expectations of credibility or fiscal policy (Patra and Ray, 2010). It is clear that some of the country-specific features, as well as the expectations of credibility and fiscal policy, will have an impact on inflation expectations. While there are some common elements among the variables used in the studies conducted, many studies are separated by the econometric methods they use.

Celasun et al. (2004) conducted one of the important studies on the determinants of inflation expectations on developing countries. The authors aimed to measure backward pricing behaviour and the relative importance of unreliable stabilization / stabilization policies in emerging economies and transition economies in the disinflation process. Expectations of inflation during the disinflationary periods were used to find out their relevance to past and current inflation as well as to current and expected budget deficits. An expectation for an after-year compilation by Consensus Economics was used in the study. In the ten countries surveyed, the authors attempted to estimate the anticipatory factors using the Generalized Waiting Method estimator (based on the Generalized Method of Moments (GMM) model) for each of the eleven disinflation periods that occurred. In the model, variables such as fiscal policy, past inflation, real effective exchange rate and real unit labour cost and monetary policy stance are discussed. The results show that past inflation has a positive and statistically significant effect on expectations, and for the periods considered the primary balance had a negative and significant effect on inflation expectations. This shows that the primary balance adjustments play a significant signalling role in lowering the expected inflation rate. In five of the analysed periods, a meaningful relationship was found between the expected one-year total financial balance and inflation expectations.

Minella et al. (2003) investigated the determinants of inflation expectations in Brazil using the OLS method. They find that the coefficient of past inflation is statistically significant, indicating that the retrospective view maintains its validity. Additionally, they show that expectants react to inflation targets simultaneously and that the coefficient of inflation targets is approximately 1. The results show that anticipations respond positively to the changes in policy interest rates. The study shows that the inflation targeting regime is effective in fluctuations of expectations, even though inflation exceeds the upper limit of the uncertainty range.

De Carvalho et al. (2006) selected key parameters for inflation expectations after twelve months of studies based on the economies of Brazil, Mexico and Chile, using key component analysis on many variables and choosing variables with stepwise regressions with lower correlations. They performed variance and autocorrelation tests on regression errors to test the resistance of the equations obtained. In the case of Chile, past inflation forecasts have a significant impact on inflation expectations after 12 months, meaning the reliability of inflation targets for longer-term expectants is likely to increase, as it is statistically significant. It appears that inflation expectations in Mexico are consistent, as well as forecasting errors, past supply and demand conditions.

Gelos and Iriondo (2008) used the GMM estimator to explain the determinants of inflation expectations for Uruguay. As explanatory variables, they used variables such as past inflation, inflation target, national income rate of primary balance, real effective exchange rate deficit, real wage deficit, unemployment rate, M1 growth and the annual exchange rate change. Forecast model results; past inflation, primary balance and marginal cost are variables that explain expected inflation.

Horváth (2008) used the Johansen and Juselius (1991) method to assess the long-term relationship between inflation expectations, inflation targets and other macroeconomic variables in their study of the Czech Republic from 1999 to 2007. Econometric findings indicate that inflation targets are an important determinant of expectations and more important than inflation in the formation of expectations. They find that a 1% decrease in inflation target is 0.4% in inflation expectations for financial markets after 12 months. This is associated with a decrease of 0.6% in expectations

for 36 months. In addition, low inflation targets as well as tight monetary policy have significantly reduced expectations.

Cerisola and Gelos (2009) investigated the change in inflation targets credits over time, the extent to which anticipations were created from a retrospective perspective. Additionally, they analysed what other macroeconomic variables influenced anticipation, taking into account the process since 1999 when Brazil began implementing the inflation targeting regime. In their study of long- and short-term relationships among the variables they deal with cointegration and vector error correction mechanisms. Cerisola and Gelos show that long-term cointegration relations exist between past inflation, inflation targets and the rate of primary balance. While there is a positive relationship between the lagged value of inflation and the inflation target and inflation expectations, the primary rate of national unemployment has reached the level of lowering the inflation expectations.

Another study on the determinants of inflation expectations was conducted by Patra and Ray (2010) in India. In the study of Hendry's general approach to the use of delay values, which are predicted by the OLS method, the authors use the lagged value of inflation, output deficit, government spending, real effective exchange rate and real interest rates for India as variables explaining inflation expectations. The results show that total demand tends to have an inflationary effect on expectations. Additionally, the effect of the real effective foreign exchange rate, which measures marginal cost, on inflation expectations is expected: Value appreciation of the exchange rate causes inflation expectations to decrease.

6.2.4. Evaluation of Empirical Studies on the Determinants of Inflation Expectations

In the literature, studies on the determinants of inflation expectations show that the number of studies on the subject is higher in developed countries. However, it is also observed that in recent years there has been an increase in the number of studies conducted on the subject, together with the establishment of the inflation targeting regime in emerging countries and the establishment of the series on expectations for these countries.

Studies on the determinants of inflation expectations show that past inflation continues to be an important determinant of inflation expectations in both developed and

developing countries. However, the central bank's credibility is allocated and the countries with a history of price stability show that the coefficients of the inflation targets announced by the central banks are relatively higher than past inflation.

Particularly with the inflation targeting regime, we observe that expectations of inflation fall and that the anticipation of inflation decreases. Moreover, in the countries that implement the inflation targeting regime, targets emerge as an important factor determining expectations.

Additionally, empirical studies show that economic units take into account different factors such as inflation outcomes, as well as variables such as interest rates, output deficit, fiscal and monetary policies.

Studies conducted in relation to the subject differ from each other in terms of the econometric method used. In studies conducted for developed and developing countries the OLS estimator and the GMM and Vector Specificity (VAR) methods have frequently been applied, taking into account the intrinsic nature of the variables used.

Even though the variables used in the forecasting models are non-stationary, the estimation by the OLS method will falsely show a non-existent relationship between the variables. This situation, known as fake coupling, can lead the researcher to reach the wrong conclusions. Another difficulty encountered in such situations is the intrinsic nature of the data handled in the model. Internalization of variables may lead to inconsistent results. As a solution, it is recommended to use methods such as GMM or vehicle variables.

De Mello and Moccero (2009) argue that the work on single equation techniques and the factors which determine inflation expectations is problematic for two reasons. Firstly, the use of levels of integrated variables in the econometric estimation method can lead to false associations. Secondly, the use of intrinsic variables may lead to biased results. However, when the GMM method is used, the non-stationarity of the variables may cause results to be inconsistent. In all these factors, we see that the econometric method used and the variables considered may vary according to the country covered.

Section Summary

This section briefly outlined the economic theorem of inflation expectations. Secondly, inflation dynamics were explained by examining the literature on the factors determining inflation expectations in developed and developing countries respectively. In this respect, we firstly introduced some methods which are predicated on the measurement of inflation expectations, followed by a summary of the studies carried out for the formation of expectations for developed and developing countries.

SECTION 7 - CONCLUSION

Following Lucas' 1972 Rational Expectations, the academic world has begun to develop models using macroeconomic data to explain microeconomic findings. These are known as the RBC models. However, RBC models did not have a Keynesian structure, so there was no effect of monetary and fiscal policies, and the unemployment situation was entirely voluntary. (Calvo 1983).

The New Keynesian macro model provides a new framework for the implementation of economic policies and consequences. This model plays a key role in monetary policy in the short term, especially at the point of ensuring economic stability. The DSGE is a general equilibrium model, where there is more than one market equilibrium, and for every market individual (for instance the consumer and the producer) the objective function is to be found. That is, it is a system that is optimized for everyone. The DSGE model is a dynamic time series model, which works on expected values. In the case of the general equilibrium in the model, the variables are disassembled and the effect of an incoming system on the system can be examined. When an exogenous shock enters the system, the economic variables react and the system indicates how the economy returns to balanced levels. It also provides a micro-based view of macro analyses to complete the missing aspects of earlier models.

In this work, the emergence of the New Keynesian economy, the DSGE model and the New Keynesian economic assumptions are briefly summarized. Secondly, the Basic New Keynesian economic model and the economic actors of this model are discussed. The central bank, which is the supply, demand and monetary authority in the model, is the basic element from which we model companies within the production sector and monetary authorities. Following this, we examined how shocks to costs, fiscal policy, demand, technology and government affect the economic system. Whether socio-emancipation is temporary or permanent affects the expectation and also determines the general equilibrium state of the system. Additionally, the temporary and permanent status of the shocks were examined separately. Since analysis is more difficult and complex than static models, it was not possible to complete a manual solution and therefore this analysis was completed with the help of the Matlab and Dynare programs. Finally, we critiqued the results of analysing the

effects of inflation and interest rates on shocks in the economy and the issue of inflation dynamism was discussed from the perspective of the DSGEmodel.

The DSGE model allows analyses to be carried out on many variables, meaning that the effects of economic shocks on the economy can be easily overcome. Due to these economies of the DSGE model, the model has recently become a trending model applied by central banks throughout the world.

Inflation expectations have been one of the topics which has been frequently studied by academics and central bank for many years due to their decisive role in inflation. Inflation targeting, which is particularly important for inflation expectations in the direction of the targets announced by the central banks, is of great importance in terms of managing expectations under the regime and ensuring the effectiveness of the regime's understanding of the period of development. In the literature, studies on determinants of inflation expectations show that countries with developed and relatively stable prices shows that the number of studies carried out is higher. However, we observe that in recent years there has been an increase in the number of studies carried out on the subject, together with the establishment of the inflation targeting regime in emerging countries and the establishment of the series on expectations for these countries.

In all these factors, it is seen that the econometric method to be used and the variables considered can vary according to the country covered.

APPENDIXIES

Appendix 1. The Analysis for Persistence Shocks

```
var pi x i e u v;
varexo eps_e eps_u eps_v;
parameters beta omega sigma eta gamma k delta_pi delta_x rho_e
rho_u rho_v;

 /*
 pi: inflation
 x: output gap
 i: nominal interest rate
 e: cost shock
 u: demand shock
 v: monetary policy shock
 */

beta = .99;
omega = .8;
sigma = 1;
eta = 1;
gamma = sigma + eta;
k = gamma * (1 - omega) * (1 - beta * omega) / omega;
delta_pi = 1.5;
delta_x = .2;
rho_e = .6;
rho_u = .8;
rho_v = .5;

 optim_weights;
 pi 1;
 x 1;
 i 1;
 end;
 osr_params delta_pi delta_x;
 osr;

 model(linear);
 pi = beta * pi(1) + k * x + e;
 x = x+1) - 1/sigma * (i - pi(+1)) + u;
 i = delta_pi * pi + delta_x * x + v;
 e = rho_e * e(-1) + eps_e;
 u = rho u * u(-1) + eps u;
 v = rho_v * v(-1) + eps_v;
 end;

 shocks;
 var eps_e = .05;
 var eps_u = .04;
 var eps_v = .01;
 end;

 stoch simul (irf=20, periods=1000);
```

MATRIX OF COVARIANCE OF EXOGENOUS SHOCKS

Variables	eps_e	eps_u	eps_v
eps_e	0.000000	0.000000	0.000000
eps_u	0.000000	0.000000	0.000000
eps_v	0.000000	0.000000	0.000000

POLICY AND TRANSITION FUNCTIONS

	pi	x	i	e	u	v
e(-1)	1.067616	-1.601423	1.281139	0.600000	0	0
u(-1)	0.533333	1.066667	1.013333	0	0.800000	0
v(-1)	-0.113661	-0.551913	0.219126	0	0	0.500000
eps_e	1.779359	-2.669039	2.135231	1.000000	0	0
eps_u	0.666667	1.333333	1.266667	0	1.000000	0
eps_v	-0.227322	-1.103825	0.438251	0	0	1.000000

THEORETICAL MOMENTS

VARIABLE	MEAN	STD. DEV.	VARIANCE
pi	0.0000	0.0000	0.0000
x	0.0000	0.0000	0.0000
i	0.0000	0.0000	0.0000
e	0.0000	0.0000	0.0000
u	0.0000	0.0000	0.0000
v	0.0000	0.0000	0.0000

VARIANCE DECOMPOSITION (in percent)

	eps_e	eps_u	eps_v
pi	79.15	19.75	1.10
x	62.91	27.91	9.18
i	60.18	37.65	2.16
e	100.00	0.00	0.00
u	0.00	100.00	0.00
v	0.00	0.00	100.00

All endogenous are constant or non stationary, not displaying correlations and auto-correlations

MODEL SUMMARY

Number of variables: 6
Number of stochastic shocks: 3
Number of state variables: 3
Number of jumpers: 2

Number of static variables: 1

MATRIX OF COVARIANCE OF EXOGENOUS SHOCKS

Variables	eps_e	eps_u	eps_v
eps_e	0.050000	0.000000	0.000000
eps_u	0.000000	0.040000	0.000000
eps_v	0.000000	0.000000	0.010000

POLICY AND TRANSITION FUNCTIONS

	pi	x	i	e	u	v
e(-1)	1.067616	-1.601423	1.281139	0.600000	0	0
u(-1)	0.533333	1.066667	1.013333	0	0.800000	0
v(-1)	-0.113661	-0.551913	0.219126	0	0	0.500000
eps_e	1.779359	-2.669039	2.135231	1.000000	0	0
eps_u	0.666667	1.333333	1.266667	0	1.000000	0
eps_v	-0.227322	-1.103825	0.438251	0	0	1.000000

MOMENTS OF SIMULATED VARIABLES

VARIABLE	MEAN	STD. DEV.	VARIANCE	SKEWNESS	KURTOSIS
pi	0.024980	0.585309	0.342587	0.142946	-0.028355
x	0.037396	0.851553	0.725143	-0.149974	0.138965
i	0.047864	0.790756	0.625295	0.168860	-0.084430
e	0.001713	0.288986	0.083513	0.149324	0.159093
u	0.033891	0.342842	0.117540	0.187248	-0.066303
v	0.002915	0.112443	0.012643	0.073978	0.146417

CORRELATION OF SIMULATED VARIABLES

VARIABLE	pi	x	i	e	u	v
pi	1.0000	-0.5666	0.9767	0.9218	0.4778	-0.0814
x	-0.5666	1.0000	-0.4199	-0.8400	0.4339	-0.0431
i	0.9767	-0.4199	1.0000	0.8322	0.6336	0.0425
e	0.9218	-0.8400	0.8322	1.0000	0.1028	-0.0731
u	0.4778	0.4339	0.6336	0.1028	1.0000	0.0678
v	-0.0814	-0.0431	0.0425	-0.0731	0.0678	1.0000

AUTOCORRELATION OF SIMULATED VARIABLES

VARIABLE	1	2	3	4	5
pi	0.6771	0.4719	0.3341	0.2235	0.1332
x	0.6538	0.4105	0.2753	0.1832	0.1088
i	0.7059	0.5221	0.3896	0.2747	0.1802

e	0.6335	0.3927	0.2510	0.1483	0.0674
u	0.8098	0.6689	0.5434	0.4412	0.3490
v	0.4933	0.2629	0.1158	0.0490	-0.0107

VARIANCE DECOMPOSITION SIMULATING ONE SHOCK AT A TIME (in percent)

	eps_e	eps_u	eps_v	Tot. lin. contr.
pi	77.27	15.27	0.19	92.72
x	82.13	28.85	2.13	113.11
i	60.96	30.19	0.39	91.54
e	100.11	0.00	0.00	100.11
u	0.00	100.11	0.00	100.11
v	0.00	0.00	100.11	100.11

Note: numbers do not add up to 100 due to non-zero correlation of simulated shocks in small samples

Appendix 2. The Analysis for Transitory Shocks

```
var pi x i e u v;
varexo eps_e eps_u eps_v;
parameters beta omega sigma eta gamma k delta_pi delta_x rho_e
rho_u rho_v;

 /*
 pi: inflation
 x: output gap
 i: nominal interest rate
 e: cost shock
 u: demand shock
 v: monetary policy shock
 */

beta = .99;
omega = .8;
sigma = 1;
eta = 1;
gamma = sigma + eta;
k = gamma * (1 - omega) * (1 - beta * omega) / omega;
delta_pi = 1.5;
delta_x = .2;
rho_e = 0;
rho_u = 0;
rho_v = 0;

optim_weights;
pi 1;
x 1;
i 1;
end;
osr_params delta_pi delta_x;
osr;

model(linear);
pi = beta * pi(+1) + k * x + e;
x = x(+1) - 1/sigma * (i - pi(+1)) + u;
i = delta_pi * pi + delta_x * x + v;
e = rho_e * e(-1) + eps_e;
u = rho u * u(-1) + eps u;
v = rho_v * v(-1) + eps_v;
end;

shocks;
var eps_e = .05;
var eps_u = .04;
var eps_v = .01;
end;

stoch simul (irf=20, periods=1000);
```

MATRIX OF COVARIANCE OF EXOGENOUS SHOCKS

Variables	eps_e	eps_u	eps_v
eps_e	0.000000	0.000000	0.000000
eps_u	0.000000	0.000000	0.000000
eps_v	0.000000	0.000000	0.000000

POLICY AND TRANSITION FUNCTIONS

	pi	x	i	e	u	v
eps_e	0.884956	-1.106195	1.106195	1.000000	0	0
eps_u	0.076696	0.737463	0.262537	0	1.000000	0
eps_v	-0.076696	-0.737463	0.737463	0	0	1.000000

THEORETICAL MOMENTS

VARIABLE	MEAN	STD. DEV.	VARIANCE
pi	0.0000	0.0000	0.0000
x	0.0000	0.0000	0.0000
i	0.0000	0.0000	0.0000
e	0.0000	0.0000	0.0000
u	0.0000	0.0000	0.0000
v	0.0000	0.0000	0.0000

VARIANCE DECOMPOSITION (in percent)

	eps_e	eps_u	eps_v
pi	98.52	0.74	0.74
x	52.94	23.53	23.53
i	66.63	3.75	29.61
e	100.00	0.00	0.00
u	0.00	100.00	0.00
v	0.00	0.00	100.00

All endogenous are constant or non stationary, not displaying correlations and auto-correlations

MODEL SUMMARY

Number of variables: 6
Number of stochastic shocks: 3
Number of state variables: 3
Number of jumpers: 2
Number of static variables: 1

MATRIX OF COVARIANCE OF EXOGENOUS SHOCKS

Variables	eps_e	eps_u	eps_v
eps_e	0.050000	0.000000	0.000000
eps_u	0.000000	0.040000	0.000000
eps_v	0.000000	0.000000	0.010000

POLICY AND TRANSITION FUNCTIONS

	pi	x	i	e	u	v
eps_e	0.884956	-1.106195	1.106195	1.000000	0	0
eps_u	0.076696	0.737463	0.262537	0	1.000000	0
eps_v	-0.076696	-0.737463	0.737463	0	0	1.000000

MOMENTS OF SIMULATED VARIABLES

VARIABLE	MEAN	STD. DEV.	VARIANCE	SKEWNESS	KURTOSIS
pi	0.000983	0.199906	0.039963	0.258222	0.221053
x	0.003174	0.283140	0.080169	-0.131059	0.178521
i	0.003752	0.264126	0.069763	0.232184	0.271827
e	0.000653	0.223555	0.049977	0.257536	0.212810
u	0.006926	0.200740	0.040297	0.025425	-0.086952
v	0.001643	0.097759	0.009557	-0.010444	0.369313

CORRELATION OF SIMULATED VARIABLES

VARIABLE	pi	x	i	e	u	v
pi	1.0000	-0.7770	0.9398	0.9966	0.1407	-0.0781
x	-0.7770	1.0000	-0.7330	-0.8265	0.4460	-0.1765
i	0.9398	-0.7330	1.0000	0.9369	0.2819	0.2437
e	0.9966	-0.8265	0.9369	1.0000	0.0670	-0.0466
u	0.1407	0.4460	0.2819	0.0670	1.0000	0.0717
v	-0.0781	-0.1765	0.2437	-0.0466	0.0717	1.0000

AUTOCORRELATION OF SIMULATED VARIABLES

VARIABLE	1	2	3	4	5
pi	0.0435	0.0135	0.0307	0.0186	-0.0020
x	0.0269	-0.0369	0.0056	0.0149	0.0171
i	0.0229	0.0183	0.0478	0.0153	-0.0092
e	0.0445	0.0055	0.0279	0.0176	-0.0000
u	-0.0179	0.0411	0.0092	0.0263	0.0443
v	-0.0202	0.0315	-0.0137	0.0106	-0.0506

VARIANCE DECOMPOSITION SIMULATING ONE SHOCK AT A TIME (in percent)

	eps_e	eps_u	eps_v	Tot. lin. contr.
pi	98.05	0.59	0.14	98.78
x	76.37	27.37	6.49	110.23
i	87.76	3.99	7.46	99.20
e	100.11	0.00	0.00	100.11
u	0.00	100.11	0.00	100.11
v	0.00	0.00	100.11	100.11

Note: numbers do not add up to 100 due to non-zero correlation of simulated shocks in small samples

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