CHAPTER 2

REVIEW OF RELATED LITERATURE

This chapter presents the theoretical framework related to this study. It will be divided into three sections. The literature related to the monetary policy rules will be presented in the first section. The monetary policy rules in the recent year will be referred to the interest rate rules which can be characterized either the instrument rules or the targeting rule. The first section provides a brief introduction of those.

The second section describes the conceptual framework of dynamic stochastic general equilibrium model (henceforth, DSGE) with new Keynesian feature, the framework that is well-known in monetary policy analysis. Moreover, this study focuses on the small open economy, thus the open economy structure will be provided in the third section. Finally, the fourth section provides the literature about the monetary policy and oil price-macroeconomy relationships.

2.1 Related Literature on Monetary Policy Rules

The issue of monetary policy rules has a long history in macroeconomics. In the 1980s the money supply is the instrument of monetary policy and it had been argued that the growth rate of the money supply should be the sum of the targeted inflation plus the desired growth rate of output. However, the money supply rule has drawbacks that the velocity of money has fluctuated too much and the demand for money is unstable. Therefore, at the beginning of the 1990s the short-term interest rate was proposes instead. The money supply rule is outdated and the short term interest rate should be an instrument for monetary policy, now. Carlstom and Feurst (1995) show by the cash in advance model that interest rate rules should be the central bankers’ policy choice. The interest rate rules have attracted and have been employed by the numerous central banks.

2.1.1 Instrument Rules and Targeting Rules[1]

The recent interest rate rules that become well known in recent literature are the Taylor rules (1993). Taylor (1993) argues that simple nominal interest rate rules might produce good stabilization performance. Taylor rule is an instrument rule that the interest should be a function of currently observed variables; the inflation rate, (π_t), the equilibrium real rate of interest rate, (r_t), and the output gap, (x_t). Taylor shows that the Federal Fund rate in the United States from the mid-1980s through 1992 could be matched by the specific form as the following:

$$\begin{aligned} i_t &= r^* + \pi^* + \alpha_x x_t + \alpha_\pi \left(\pi_t - \pi^*\right) \\ i_t &= r^* + \pi^* + 0.5 x_t + 1.5\left(\pi_t - \pi^*\right) \end{aligned} \tag{2.1}$$

Taylor assumes that the target level of average inflation $\left(\pi^*\right)$ and the equilibrium of real rate of interest rate $\left(r^*\right)$ equal to 2%. Note that the rule was defined with the pre-1993 data, this does not imply that the rule-prescribed values should be actual value in the historical record for other periods.

Taylor rule (1993) describes that the nominal interest rate deviates from the level consistent with the economy's equilibrium real interest rate and the target inflation rate if the output gap is nonzero or if the inflation deviated from the target. A positive output gap leads to a rise in the nominal rate, so does a deviation of actual inflation above a target. The coefficient $\alpha_\pi = 1.5$ is satisfied the "Taylor principle" that the nominal interest rate is changed more than one-for-one with deviations of inflation from its target to ensure that the economy has a unique, stationary, and rational expectations equilibrium.

How to get the right value of α_x and α_π become the issue after Taylor proposed his work. Since Taylor rule is ad hoc, it is not optimizing based rule. However there are many papers; e.g. Svennsson (1997), and Dennis (2004) argue that

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[1] See, also, McCallum (1999), Taylor (1999), and Svensson (2003) for a complete revision on this topic.

the right value of α_x and α_π will lead to optimal instrument rule. It would be possible to insert the relevant structural relationships into the first-order condition got from minimizing central bank's loss function, $E_t \sum_{\tau=0}^{\infty} \beta^{\tau} \left[\left(\pi_{t+\tau} - \pi^* \right) + \lambda x_{t+\tau}^2 \right]$, to yield the optimal instrument rule for a particular model. With β is discount factor, x_t is output gap, λ is weight on output gap, and E_t denotes expectations conditionals on information available in period t.

The Taylor rule is also criticized for not taking "judgment" into account (Svensson (2003)). Furthermore, there has been some evolution of interest rate rules since Svensson proposes a number of papers, (Svensson 1997, 1999, 2003, 2005), that introduce the concept of the targeting rules. The definition of the targeting rule is more complex than the simple Taylor rule. Svensson (1999) distinguishes monetary policy rule as an "instrument rule" and "targeting rule" as the following:

> "An instrument rule expresses the instruments as a prescribed function of predetermined or forward-looking variables or both. If the instruments are a prescribed reaction function of predetermined variables only, that is, a prescribed reaction function, the rule is an *explicit* instrument rule. If the instruments are prescribed forward-looking variables, that is, a prescribed implicit reaction function, the rule is an *implicit* instrument rule." (Svensson,1999 p.614)

and

> "By a targeting rule, I mean that the most general level, the assignment of a particular loss function to be minimized. More precisely, a target(ing) rule specifies a (vector of) target variable(s) Y_t, a (vector of) target level(s) Y^*, and a corresponding loss function […]that is to minimized."(Svensson,1999 p.617)

In Svensson's terminology, targeting rule also recognizes both general and specific variants. Svensson (2003) provides a definition of "general targeting rule" and "specific targeting rule" as the following:

> "A "general targeting rule" is a high-level specification of a monetary-policy rule that specifies operational objectives, that is, the target variables, the targets and the loss function to be minimized. A "specific targeting rule" is instead expressed directly as an operational condition for the target variables (or for forecasts of the target variables) p.448"

The major contribution of Svensson (2003) is that formulating policy in terms of a targeting rule has several advantages over an instrument rule. Svensson (2003) has presented a sophisticated and comprehensive case for the use of targeting rules, arguing that "monetary-policy practice is better discussed in terms of targeting rules than instrument rules". The superiority of targeting rules is, moreover, claimed to pertain to both normative and positive perspectives.

Svensson (2003, 2005) proposes that targeting rule can be interpreted as Euler equations that describe the optimizing behavior of the central bank. An optimal targeting rule is a first order condition for optimal monetary policy. It corresponds to the standard efficiency condition of equality between the marginal rates of substitution (MRS) and the marginal rates of transformation (MRT) between the target variables, the former given by the monetary-policy loss function, the latter given by the transmission mechanism of monetary policy. An optimal targeting rule is invariant to everything else in the model, including additive judgment and the stochastic properties of additive shocks. Thus, it is a compact, and structural representation of monetary policy. A simple targeting rule can potentially be a practical representation of robust monetary policy, a robust monetary policy that performs reasonably well under different circumstances.

For more understanding about the targeting rule, Walsh (2002), and Bofinger, Mayer, and Wollmershauser (2006) provide the simple inflation targeting model presented below.

Assuming that the economy is characterized by the following static version of new Keynesian macro model:

$$y = a - br + \varepsilon_1 \tag{2.2}$$

$$\pi = \pi^* + dy + \varepsilon_2 \tag{2.3}$$

where a, b, and d are constant coefficients and r, π^*, and y denote real interest rate , inflation target, and output gap, respectively. The white noise ε_1 and ε_2 are the shocks that hit the demand and supply equation, respectively. Equation (2.2) is aggregate demand or IS curve and equation (2.3) is aggregate supply or Philips curve (PC).

Assume that the central bank loss function (welfare function) is characterized by

$$L = \left(\pi - \pi^*\right)^2 + \lambda y^2 \tag{2.4}$$

In case of $\lambda > 0$, the central bank concerns both inflation and output gap and this preference of policy is named as "flexible inflation targeting". The case of $\lambda = 0$, is called as "strict inflation targeting".

The targeting rule can be derived by solving the following Lagrangian:

$$\mathcal{H} = \left\{\left(\pi - \pi^*\right)^2 + \lambda y^2\right\} + \xi\left(\pi - \pi^* - dy - \varepsilon_2\right) \tag{2.5}$$

Taking the derivative with respect to the output gap (y) and the inflation gap $\left(\pi - \pi^*\right)$, yield the following first order conditions

$$\xi = \frac{2\lambda y}{d} \tag{2.6}$$

$$\xi = -2\left(\pi - \pi^*\right) \tag{2.7}$$

Eliminating the Lagrange multiplier ξ and solving the resulting expression for the inflation gap $\left(\pi - \pi^*\right)$ yields the targeting rule:

$$\left(\pi - \pi^*\right) = -\frac{\lambda}{d} y \tag{2.8}$$

As Svensson (2002, 2005) shown, the marginal rate of transformation (MRT) between inflation gap $\left(\pi - \pi^*\right)$ and the output gap (y) has to be equal to the marginal rate of substitution (MRS). The MRS is determined by the loss function (2.4), which trades off the goal variables by a factor of λ. The MRT is embedded in the slope of the Phillips curve, d. According to MRS=MRT, yields:

$$\left[\frac{\partial L \Big/ \partial\left(\pi-\pi^{*}\right)}{\partial L \Big/ \partial y}\right]=\frac{\left(\pi-\pi^{*}\right)}{\lambda y}=-\frac{1}{d}=\left[\frac{\partial PC \Big/ \partial\left(\pi-\pi^{*}\right)}{\partial PC \Big/ \partial y}\right] \tag{2.9}$$

Thus the targeting rule can be interpreted as a high level specification of monetary policy rule, as it holds with equality if monetary policy is conducted optimally. Equations (2.2), (2.3), and (2.8) give a complete description of the economy under a regime of the targeting rule.

Svensson provides a number of papers that argue so strongly in favor of the targeting-rule. There is a convenient and more structural representation of monetary policy, namely in the form of a targeting rule. The targeting regime becomes popular issue in the recent literature, and “inflation forecast targeting” regime is the most widely discussed. The Inflation forecast targeting system is a system of operating monetary policy in which the central bank sets up an numerical inflation target within a pre-designated time horizon and makes use of the available policy instruments preemptively to attain that target. The advantages of this concept are the high degree of transparency and accountability (Svensson, 2003).

The major idea of a set of Svensson’s paper, as mentioned above, is that the targeting rule is an optimizing-based interest rate rule. Those provide micro-founded monetary policy in the same way as Euler conditions provide microfounded private sector behavior. Svensson (2005) argues that as the following:

> “The consumption function can be seen as an instrument for consumption behavior, where as the Euler condition […] can be seen as a targeting rule for consumption. When I argue for the adoption of targeting rules rather than instruments in modeling monetary policy, I am arguing for a development in the theory of monetary policy that already happened, a long time ago, in the theory of consumption.” (p.617)

2.1.2 Policy Welfare Functions

For the research , in 1980s, about the analysis of the effects of monetary policy rules, the monetary policy rules are evaluated in terms of ad hoc or non-structural loss functions usually constructed from variabilities in output gap and inflation (or price level) as the same form as (2.4). Until recently, Rotemberg and Woodford (1997), and Woodford (2003) derive an economically interpretable loss function from the deep structure of the closed economy model. They show that it is possible to derive a quadratic approximation from the expected utility of the representative household that takes the form of a discounted quadratic welfare loss function as similar to the one assumed in the traditional literature on monetary policy evaluation. They approximate the unconditional expectation of the representative households' utility using second order Taylor series approximation and assuming the price stickiness assumption (Calvo (1983), It can be stated as a weighted average of the variabilities in aggregate inflation and output gap as the following form:

$$E_t \sum_{i=0}^{\infty} \mathbb{W}_{t+i} \approx -\Omega E_t \sum_{i=0}^{\infty} \beta^i \left[\pi_{t+i}^2 + \lambda \left(x_{t+i} - x^* \right)^2 \right] \tag{2.10}$$

where $\mathbb{W}_{t+i}$ is the period utility of the representative agent, x_t^* is the gap between the steady state efficient level of output and the actual steady state level of output, Ω is the deep parameter derived from the model.

2.1.3 Discretionary and Commitment Policy

The monetary policy rule has been used to refer to both *discretionary* and *commitment* policy setting. The discretionary conducts of monetary policy mean that the central bank is free at any time to change its instruments settings (i.e., re-optimizing the loss function each period). The commitment conduct means the central bank chooses the path for current and future inflation, and output gap to minimize the loss function (2.4) or (2.10) (i.e., optimizing the loss function once and for all). Which type of monetary policy setting should be appropriate monetary policy? There are a number of explanation about the results come from each type of policy.

The "average inflationary bias[2]" is the originally problem of discretionary optimization monetary policy. This problem is sourced from the dynamic time inconsistency[3] of central bank policy, originated by Kydland and Prescoot (1977), and Barro and Gordon (1983), due to the central banks have an incentive to act in ways that are inconsistent with their earlier plans and announcements. They have an incentive to renege on their promises and deviate from the optimal plan promised in the first period once the inflation shocks have passed. The time-inconsistency problem, therefore, could lead to excessively high inflation. The attention becomes the issues of the credibility and ability of central banks to commit policies. The analysis of time inconsistency in monetary policy is important. The time-inconsistency literature provides positive attempts to explain the average inflationary bias, and what conducts should govern for the monetary policy.

Barro and Gordon (1983) is the original paper that model discretionary-policy describing the time-inconsistency problem. They show that the discretionary conducts of policies produce the average inflationary bias. The bias arises from a desire for economic expansions above the economy's equilibrium output level (or for unemployment rate below the economy's natural rate) and the inability of the central bank to commit credibly to a low rate of inflation. However, this bias has received little attention since it is generally assumed that the central bank targets a zero output gap.

Recently theoretical literature, for example, Clarida, Gali and Getler (1999) argue that even in the absence of an over-ambitious output target and an inflation bias, discretionary policy in the models with forward-looking agents remain inefficient, since they lead to a stabilization bias. Recent papers on optimal monetary policy have focused on this bias. In addition, they have shown that there are gains from commitment policy. A commitment conduct is one obvious way of eliminating the temptation of suboptimal behavior of central banks.

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[2] The inflationary bias means a equilibrium inflation exceeds the socially desired rate.

[3] A policy is time consistent if an action planned at time t for time $t+1$ remains optimal to implement when time $t+1$ actually arrive and a policy is time inconsistent if at time $t+1$ it will not be optimal to respond a originally planned.

The recent economic papers have not focused on inflationary bias but instead on a stabilization bias. A stabilization bias arises in forward-looking models under discretionary policy because of a lack of “history dependence” in the policy actions of the central bank, and this bias usually shows itself through greater inflation variability and lower output variability. Clarida, Gali, and Gertler (1999), and Woodford (1999) have shown that when agents are forward-looking, it is optimal for policymakers not only to respond to the current shocks and the current state of the economy but it is desirable to respond to lagged variables as well. They stress that the optimal commitment policy introduces inertia into output gap and inflation process. By responding to the lagged output gap, the past movements of output gap affect current inflation. This commitment to the lagged variables implies that the central bank’s actions at date t allow it to influence expected inflation. With forward-looking model, the expected inflation and the expected policy response become more important. Hence, a more gradual response to shocks allows the central bank to appropriately affect private sector expectations. This, in turn, improves the performance of monetary policy and the trade-offs between inflation stabilization and output gap stabilization the central bank faces.

There are also the fundamental problems of the commitment conduct of monetary policy. What if the commitment is not made in current period but far into the past, or alternatively, that any commitment in any period t is restricted as if it had been made far into the past. Woodford (1999) provides the solution to this problem, by proposing the more sophisticated kind of commitment, “commitment in a time-less perspectives”. This involves a commitment to recommit only to reaction functions to which one would prefer to commit oneself far into the past. McCallum and Nelson (2000) provide further extension of timeless perspective and discretionary monetary policy.

2.2 Basic New Keynesian Model

Lucas (1976) argues that the parameters of traditional macroeconometric models depended implicitly on agents' expectations of the policy process and were unlikely to remain stable as policymakers changed their behavior. This critique was influential in two respects. First, it helped re-orient macroeconomic research toward models with explicit expectations and "deep" parameters of taste and technology. These models calibrate the dynamic general equilibrium models with explicit optimization. Second, the Lucas critique helped change the focus of policy evaluation from consideration of alternative paths of the policy instrument to consideration of alternative policy rules, which allowed individual agents to formulate forward-looking dynamic optimization problems.

The dynamic stochastic general equilibrium techniques or DSGE, therefore, has been extensively used to study macroeconomic dynamics, to design and to analyze monetary policy rules. The DSGE model characterizes the objectives and constraints faced by optimizing agents; households, firms and policy makers, which interact in an uncertain environment to determine equilibrium prices and quantities.

Dynamic New Keynesian model (DNK) incorporates the short run nominal price and wage rigidities generated by monopolistic competition with staggered reoptimization in output and labor markets in to DSGE. The nominal rigidities permit a cyclical stabilization role for monetary policy, which is generally implemented through control of the nominal interest rate according to a monetary policy rule. The persistence of the effects of monetary policy shocks on output and inflation is often enhanced with these nominal rigidities features. In addition to the nominal rigidities of wages and prices, habit persistence in consumption, adjustment costs in investment, and variable capital utilization are discussed for the persistence of monetary policy shocks.

The examples of closed economy DNK model incorporating the features mentioned above include those of Yun (1996), Goodfriend and King (1997), Rotemberg and Woodford (1995, 1997), McCallum and Nelson (1999), Christiano, Eichenbaum and Evans (2005), Erceg, C. Henderson, D. and A. Levin (2000), and Smets and Wouters (2003).

The standard form of these models generally consists of three blocks: 1) an aggregate demand equation in the form of an IS curve, 2) an inflation equation in the form of a new Keynesian Phillips curve, and 3) a policy rule for the short-term nominal interest rate.

The first two block of basic new Keynesian model, usually, be taken the following form[4]

$$x_t = E_t x_{t+1} - \frac{1}{\sigma}\left(i_t - E_t \pi_{t+1}\right) + u_t \tag{2.11}$$

$$\pi_t = \beta E_t \pi_{t+1} + \kappa x_t + e_t \tag{2.12}$$

where x_t, π_t, i_t, respectively, denote the output gap, the inflation rate, and the nominal interest rate. Parameter σ denotes intertemporal elasticity of substitution. u_t (taste shocks to the consumer preferences, for example) and e_t (cost shocks, for example) denote zero-mean i.i.d. shocks.

The equation (2.11) is an intertemporal decision by individual agents or referred as household (i.e., derived from standard consumption Euler equation). The relationships in this block end up to the IS equation or the aggregate demand. The second block is the monopolistic competition in the goods market, which lead to staggering price adjustment process. The monopolistic competition is drawn form Dixit and Stiglitz (1977). Regard to the price setting assumption, each firm sets its price of good, but only some firms can flexibility adjust their prices in each period. The second block, finally, is the expression stating inflation-adjustment or the New Keynesian Phillps curve, as equation (2.12).

The third block is the policy makers which their behaviors do not always behave optimally. Instead of the optimal policy rule derived by minimizing the quadratic loss function ($E_t \sum_{i=0}^{\infty} \mathbb{W}_{t+i} \approx -\Omega E_t \sum_{i=0}^{\infty} \beta^i \left[\pi_{t+i}^2 + \lambda \left(x_{t+i} - x^* \right)^2 \right]$) , the simple instrument rule as Taylor' rule can be implemented. Combinations of these three fundamental blocks are also referred as the new Keynesian models.

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[4] In this case, the specific household utility function take the form $U = \frac{C^{1-\sigma}}{1-\sigma}$.

The new Keynesian Phillips curve expresses the relationship of inflation different from the traditional Phillips curve. The traditional one stated the relation between the unemployment and the rate of change of money wage rate in the United Kingdom between 1861-1957. The traditional Phillips curve has considered mainly backward looking behavior but the New Keynesian Phillips curve take the forward looking behavior into account. Unlike the traditional Phillips curve, new Keynesian Phillips curve implies that current inflation is the function of future inflation. In addition, the new Keynesian Phillips curve is explicitly derived on optimizing behavior and is conditioned on assuming economic environment, and it is simple enough to be useful for theoretical monetary policy analysis. The advantage of the new Keynesian Phillips curve is that it provides the structural parameters.

Another type of Phillips curve that has been employed in the policy analysis is the hybrid New Keynesian Phillips curve. Regards to the hybrid New Keynesian Phillips curve, backward-looking and forward –looking behavior are considered. Gali and Gertler (1999) propose a "hybrid" Phillips curve by adding a lagged inflation term to the standard model. Svensson (2003) provides the useful analysis of central banks’ behavior both in forward-looking and backward-looking model.

2.3 Basic 0pen Economy Model for Monetary Policy Analysis

A major area of research in very recent year for policy analysis of an open economy is based on dynamic stochastic open-economy macro models that feature rational expectations, optimizing agents, and staggered adjusting of wages and prices of goods. This kind of model is referred to ‘‘new open economy macroeconomics’’ (NOEM). The pioneer literature in this area is Obstefeld and Rogoff (1995, 1996). They present simplicity and tractability two-country model that has the advantage of capturing some of the important linkage between economies.

The standard framework of NOEM will combine three fundamental building blocks which is similar to closed economy DSGE but includes the interest rate parity block for characterizing the open economy feature. The introduction, in brief, of the standard forward-looking model of the small open economy model presents below.

The model consists of three equations, as following:

$$x_t = E_t x_{t+1} - a_1(i_t - E\pi_{t+1}) + a_2 q_t + u_t \tag{2.13}$$

$$\pi_t = E_t \pi_{t+1} + a_3 x_t + a_4 q_t + e_t \tag{2.14}$$

$$i_t - E_t \pi_{t+1} = i_t^f - E_t \pi_{t+1}^f - q_t + \varepsilon_t \tag{2.15}$$

where i_t^f is foreign nominal interest rate, π_t^f is foreign rate of inflation, and q_t is real exchange rate. The other notations are defined as same as in the basic new Keynesian described in the previous section. All parameters are positive.

Equation (2.13) and (2.14) are the IS and Phillips curve equations, that are similar meaning to those in the closed economy model, but the difference is both equations include the real exchange rate variable characterized as an important factor in the open economy. Equation (2.15) is the uncovered interest rate parity condition (UIP), expressed in real terms. This equation embodies the assumption of perfect capital mobility, reflecting the high level of integration of a small open economy's financial sector with the rest of the world. The disturbance term ε_t can be interpreted as a time-varying risk premium.

The blocks of the policy maker can be the simple rule as Taylor's rule or the optimizing-based rule as Svensson's targeting rule as presented above. Even if the real exchange rate is the important variable in monetary policy analysis for open economy, it does not enter explicitly in the monetary policy rule. The reason for the omission is that changes in the real exchange rate are reflected in changes in the output gap. Consequently, there is no need for the real exchange rate to appear as a separate argument in the loss function.

In the open-economy with the inflation targeting monetary policy, a choice of the inflation target of the central bank can be made between two measures of inflation: CPI inflation (consumer price index) or domestic inflation. There is an important distinction between domestic inflation targeting and CPI inflation targeting. Since the consumer price index is combination of indices of domestically produced goods and imported goods, it will respond to the exchange rate movements and the degree of exchange rate pass through. Based on the different definition of inflation, it is asked which inflation the central bank in an open-economy should be targeted. This topic has received some attention in the economics literature, as well. Examples include Clarida, Gali, and Gertler (2002), Aoki (2001) and Guender (2003), Svensson (2000).

Extension from the base line model of Obstefeld and Rogoff (1995,1996), there are many theoretical contributions with respect to the degree of exchange rate pass through, and the notable contributions include Gali and Monacelli (2005), Clarida, Gali, and Gertler (2001, 2002), Gertler, Gilchrist and Natalucci (2001), and Devereux, M. B. and Engel, C. (2000). See Lane (2001) for a survey of open economy literature.

Clarida, Gali, and Gertler (2002) explore monetary policy between two countries with and without corporation. They find that the openness gives rise to an important distinction between consumer price index (CPI) inflation and domestic inflation. If there is perfect exchange rate pass through, the central bank should target domestic inflation and allow the exchange rate to float, despite the impact of the resulting exchange rate variability on the CPI. Furthermore, under the corporation, the central bank should respond to the foreign inflation as well as the domestic inflation. Svensson (2000) compares strict domestic inflation targeting to strict CPI inflation and concludes that strict CPI inflation targeting leads to greater variability in output gap, real exchange rate, and nominal rate of interest.

However, Guender (2003) argues for the dominance of CPI inflation over domestic inflation targeting and he shows that the differing conclusions range from the specification of the objective function that the policymaker minimizes to the specification of the structural relations of the model.

2.4 Oil Shocks and the Macroeconomy

There are many empirical evidences that suggest the effects of oil price shocks on the economy, as introduced in the introduction. The relationship of the oil price shocks can be explained through many economics variables such as employment, inflation, output, etc. Hamilton (2000), Hamiltion and Herrera (2004) provide a discussion of the empirical literature on oil-price shocks and macroeconomic activity relationships. Those relationships are dicussed by Brown and Yücel (2002), and Donald, Leiby, and Paik (2003), as well. All of those relationships found from the U.S. economy.

The theoretical literature that suggest the effects of oil price shocks to the core macroeconomics variables are Rotemberg and Woodford (1996), and Finn (2000). Rotemberg and Woodford (1996) explain the relationship of oil prices and the inflation by simulating the imperfection competition model using the U.S. data. They suggest that a 10% increase in oil prices reduces the output by 2.5 percent in the fifth to the sixth quarter. By contrast, Finn (2000) experiments the simulation results from the competitive model. She concludes that the perfect competition with endogenous capital utilization can explain the volatility of the macroeconomy occurring from oil prices shocks, as well.

Miguel, Manzano, Martin-Mareno (2003) simulate the responses of aggregate macroeconomic variables and welfare on the oil price shock, using Spanish data. They conclude that their model can be used to explain the business cycle path of Spain.