CHAPTER 3

THEORETICAL AND CONCEPTUAL FRAMEWORKS

According to this study, we are taking the nominal rigidity into account for realizing on empirical evidence as NOEM approach. This chapter represents some theories and concepts which are used for analyzing the model in chapter 5.

3.1 Exchange Rate Pass-Through (ERPT)

Generally, the exchange rate pass-through is an important issue because there are some evidences of systematic failure of the law of one price to hold for internationally traded goods. So, this leads researchers attempting to look for alternative assumptions that may explain the apparent "paradox" [1]. Before we discuss on the causes and effects of exchange rate pass-through so far, we start firstly with a basic concept of what exchange rate pass-through is.

Exchange rate pass-through is usually defined in terms of the extent to which exchange rate changes are transformed into changes in the destination-currency prices of traded goods in other words, how the price (domestic, export, or import price) changes due to the change in foreign exchange rate. For example an import case, exchange rate pass-through is the percentage change in local currency import prices resulting from a one percent change in the exchange rate between the exporting and importing countries Goldberg and Knetter (1997).

From the definition, it is empirically noticeable that changes in exchange rate of domestic countries do not pass-through completely both prices, so called "incomplete exchange rate pass-through (IERPT)". It means that, for an import case, a

[1] See surveys by Rogoff (1996) and Goldberg and Knetter (1997). Persistent deviations from long run PPP is found by Engel (2000), while Chen and Rogoff (2003) show that the PPP puzzle applies to Australia, Canada and New Zealand.

one percent change in the exchange rate does not pass completely through in local currency import prices.

Recently, incomplete exchange rate pass-through is interesting both micro- and macro- aspects. For micro aspects, IERPT are mostly examined by econometric method emphasizing the degree of exchange rate pass-through from empirical data especially sectoral data of firm's prices which reviewd this issue in chapter 2. For macro aspect based on micro-foundation, the researchers have taken these empirical evidences into account and also attempted to perform models that represent the behavior of firm price setting in an optimization.

In this regard, the model shown in chapter 5, assumes that incomplete exchange rate pass-through in term of importers is allowed. That is, a reason is that there are some a part of the law of one price does not hold. A non-zero law of one price (LOP) gap represents a wedge between the world and domestic import prices. This, therefore, provides a mechanism for incomplete import pass-through in the short-run, implying that changes in the world import prices have a gradual affect on the domestic economy as shown below.

$$\Psi_t = \frac{P_t^*}{Z_t P_{F,t}} \qquad \text{for all } t = 0,1,2,... \qquad (3.1)$$

where P_t^* is a foreign price index, Z_t [2] is a nominal exchange rate expressed in term of foreign currency per unit of domestic currency, $P_{F,t}$ is a import price index. If the law of one price gap holds exactly $(\Psi_t = 1)$, the foreign price index equals the import price index expressed in foreign currency $\left(P_t^* = Z_t P_{F,t}\right)$. But if it does not holds, a law of one price gap is a difference between the foreign world price and the domestic price of imports.

A positive law of one price gap implies a difference between the foreign economy price and domestic import price. The law of one price gap, therefore, is a factor for an incomplete import pass-through and provides an influence of the foreign economy prices to the domestic aggregate price level.

[2] An increase of Z_t is an appreciation of domestic currency.

The reason behind this assumption is for the small open countries who are the price taker. For example, on the export side, prices are determined exogenously in the rest of the world. On the import side, competition in the world market is assumed to bring import prices equal to marginal cost at the wholesale level, but rigidities arising from inefficient distribution networks and monopolistic retailers allow domestic import prices to deviate from the world price. We have shown in chapter 4 that Thailand is a price taker and also been in a case of the incomplete exchange rate pass-through.

3.2 Habit Formation for Consumption

Habit persistence, namely 'habit formation' common representation, is a preference specification according to which the period utility function depends on quasi-difference of consumption or related to consumption in a past. For an economic sense is that under habit persistence, an increase in current consumption lowers the marginal utility of consumption in the current period and increases it in the next period. In the same way, for common sense is that the more the consumer eats today, the hungrier he wakes up tomorrow. It is in this sense that this type of preferences captures the notion of habit formation (Stephanie Schmitt-Grohé and Martín Uribe; 2005).

A Simple Habit Formation Model

There are two specifications of the representative consumer utility function are available: firstly, it is a ratio of current consumption to the level of habit yields utility (as in, for example, Abel (1990) [3] and Fuhrer (2000)[4]) and secondly it is

[3] Abel, Andrew B. (1990). "Asset Prices Under Habit Formation and Catching Up With The Joneses." American Economic Review, May 1990, vol. 80(2), 38-42.

[4] Fuhrer, J. (2000). "Habit Formation in Consumption and Its Implications for Monetary Policy Models." American Economic Review 90, 367-390.

difference between current consumption and habit yields utility (as in, for example, Christiano et al. (2005)[5]).

We consider firstly a specification of the utility function. The ratio-specification:

$$U\left(C_t, C_{t-1}\right) = \frac{1}{1-\sigma}\left(\frac{C_t}{C_{t-1}^b}\right)^{1-\sigma} \tag{3.2}$$

From above specifications, the parameter b is a measure for the degree of habit persistence. Lagged consumption C_{t-1} is the habit reference level while indexes the importance of this reference level relative to current consumption.

For the two extreme cases, If $b=0$, the utility function depends only on current consumption, but if $b=1$, the current consumption relative to previous consumption matters. It can be rewritten the consumption terms as:

$$U\left(C_t, C_{t-1}\right) = \frac{1}{1-\sigma}\left(\frac{C_t}{C_{t-1}} C_{t-1}^{1-b}\right)^{1-\sigma} \tag{3.3}$$

Now, if $b=0$ the second terms with lagged consumption has no influent any more, so that the level of C_{t-1} does not matter b can not exceed that 1 because otherwise steady state utility would be falling in consumption (Gali; 2004)[6].

For the specific model of Fuhrer (2000) considers the more general case introducing a new variable Z_t for the reference level replacing C_{t-1} in (3.1) as following:

$$U\left(C_t, C_{t-1}\right) = \frac{1}{1-\sigma}\left(\frac{C_t}{Z_t^b}\right)^{1-\sigma} \tag{3.4}$$

He assumes then that Z_t evolves according to

$$Z_t = \rho Z_{t-1} + \left(1-\rho\right) C_{t-1} \tag{3.5}$$

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[5] Christiano, Lawrence J., Martin Eichenbaum, and Charles Evans. (2005). "Nominal Rigidities and The Dynamic Effects of A Shock to Monetary Policy." The Journal of Political Economy, 113, 1{45).

[6] Gail, Michael. (2004). "Habit Persistence in Consumption in A Sticky Price Model of The Business Cycle" Discussion Paper No. 111-03 Universität Siegen.

Note that utility is no longer time-separable, because the consumption choice today influences the future habit reference level in next period's and all future periods' utility. This simple habit formation specification is conveniently parameterizes two features of habit formation:

1. The parameter b indexes the importance of habit formation in the utility function. If $b = 0$, then the standard model applies, in other words, the previous consumption has clearly not influent the current consumption. If $b = 1$, then *only* consumption relative to previous consumption matters. $b > 1$ is not admissible, because it implies that steady-state utility is falling in consumption.

2. The parameter ρ indexes the persistence or “memory" in the habit formation reference level. If $\rho = 0$, then only last period's consumption is important. For $0 < \rho \leq 1$, the larger is ρ, the further back in time is the reference level determined

Secondly, a specification model using in this study is based on Christiano, Eichenbaum and Evans (2005). They have considered the difference in consumption levels in the utility function, not the ratio as following:

$$U\left(C_t, C_{t-1}\right) = \frac{1}{1-\sigma}\left(C_t - hC_{t-1}\right)^{1-\sigma} \tag{3.6}$$

Deaton (1992) shows that this is a special case of the Fuhrer (2000) formulation where h captures both the influence of b and ρ.

According to many simple optimization-based macroeconomic models fail to replicate economically important and statistically significant dynamic correlations in the data. Some economists, therefore, try to makes some progress towards instead of a standard model. It does so by including a particular form of non time-separability in the utility function, namely “habit formation," or the assessment by consumers of utility relative to a habit level of consumption. Habit formation has directly given to the implication of the monetary polity analysis in order to conduct a reliable model for monetary policy analysis.

The reason for including the habit formation to consumer utility is that the permanent income hypothesis (PIH) model with rational expectations does not to explain a gradual response to monetary policy. In other words, under PIH is that

inflation acts like jump 'variables' completely front-loading or pulling forward in time their responses to shocks or consumption jumps immediately in response to current 'news' about lifetime resources (Fuhrer; 2000). Nevertheless, in fact, those variable acts like a gradual response to shocks or policy as a hump-shape behavior discovered by identified empirical VAR works especially impose response function (IRF) The habit formation, therefore, are employed[7].

3.3 Taylor Rule

In this section, we provide a brief overview of the theoretical literature on Taylor rule. Taylor rules (1993)[8] are simple monetary policy rules that prescribe how a central bank should adjust its short-term interest rate policy instrument in a systematic manner in response to developments in inflation and macroeconomic activity in other words, to achieve both its short-run goal for stabilizing the economy and its long-run goal for inflation.

They provide a useful framework for the analysis of historical policy and for the econometric evaluation of specific alternative strategies that a central bank can use as the basis for its interest rate decisions.

The original formulation of the Taylor rule is given by

$$i_t = r^* + \pi_t + f_\pi\left(\pi_t - \pi^T\right) + \phi_y y_t \qquad (3.7)$$

where i_t is the central bank policy rate, r^* the equilibrium real interest rate, π_t the twelve month inflation rate, π^T the inflation target of the central bank and y_t the output gap.

Taylor showed that the behavior of the federal funds interest rate in the United States from the mid-1980s through 1992 could be fairly well matched by a simple rule. That is $f_\pi = \phi_y = 0.5$ and Taylor assumed $\pi^T and\ r^* = 2\%$ as following

[7] Just a brief idea for understanding concepts. It can be found recently form many papers related to habit formation and monetary policy implication.

[8] Taylor, John B. (1993). "Discretion Versus Policy Rules in Practice," Carnegie-Rochester Conference Series on Public Policy 39: 195-214.

$$i_t = r^* + \pi_t + 0.5\left(\pi_t - \pi^T\right) + 0.5y_t \tag{3.8}$$

the Taylor rule for general coefficients is often written

$$i_t = r^* + \pi^T + \alpha_x x_t + \alpha_\pi \left(\pi_t - \pi^T\right) \tag{3.9}$$

The nominal interest rate deviates from the level consistent with the economy's equilibrium real rate and the target inflation rate if the output gap is nonzero or if inflation deviates from target. A positive output gap leads to a rise in the nominal rate, as does a deviation of actual inflation above target. With Taylor's original coefficients, $\alpha_\pi = 1.5$, so that the nominal rate is changed more than one for one with deviations of inflation from target. Thus, the rule satisfies the Taylor principle is that a greater than one-for-one reaction of ensures that the economy has a unique, stationary, rational expectations equilibrium (Walsh; 2003)

This allowed the development of a specification Taylor rule in the way of allowing for forward-looking behavior, by changing actual inflation to be the expected future inflation, and also backward-looking behavior, by the lagged nominal interest rate.

The lagged interest rate can be interpreted as the central banks adjust gradually toward a desired interest-rate level. For example, suppose that r_t is the central bank's desired value for its policy instrument. Suppose, however, that it wants to avoid large changes in interest rates. Such a smoothing interest rate objective might arise from a desired for financial market stability. It can be captured by a partial adjustment model of the form (Woodford; 2001);

$$r_t = \rho_r r_{t-1} + \left(1 - \rho_r\right)\left(\phi_1 \pi_t + \phi_2 y_t\right), \tag{3.10}$$

where ρ_r is the degree of interest rate smoothing, and ϕ_1 are ϕ_2 the relative weights on inflation gap and growth rate of output of the economy gap respectively. This specific Taylor rule is employed in this study.

3.4 The New Keynesian Phillips Curve (NKPC)

From the traditional definition of the Phillips Curve, it is an inverse relationship between the rate of unemployment and the rate of increase in money wages. The higher the rate of unemployment, the lower the rate of wage inflation. In other words, there is a tradeoff between wage inflation and unemployment. This relationship is also found to work well for price inflation and reasonable empirically in the early 1960s.

The case of this stable tradeoff was shattered in the late 1960s and early 1970s. On the theoretical side, the attack took the form of the importance of the natural rate hypothesis in unemployment and the inflation expectations. Friedman and Phelps argued that the idea that nominal variables, such as the money supply or inflation, could permanently affect real variables, such as output or unemployment, was unreasonable; in the long run, they argued, the behavior of real variables is determined by real forces. These thought brought the Phillips Curve become to a vertical long run Phillips Curve.

This demise of the traditional Phillips curve, and the sense that it was due to inadequate modeling of expectations on the forward-looking behavior in the inflation process, was a major impetus for the rational expectations school of thought in the 1970s, led by Robert Lucas and Thomas Sargent. And, in addition to being more precise about expectations formation, this school of economists relied more heavily on neoclassical micro-foundations for macroeconomic models and questioned the assumption that monetary policy could systematically affect output even in the short-run.

The modern approach featuring rational expectations and some form of micro-foundation for optimizing-agents models within a monopolistic environment[9] is known as New Keynesian macroeconomics. The principle microeconomic rationale of this school has been sticky prices or some type of price rigidity. In the New

[9] In monopolistic competition, there is a large number of firms, each producing differentiated products that buyers view as close, though not perfect, substitutes for one another. Each firm therefore has enough pricing power in the market for its particular product variant, that it can charge a price at a mark-up over its marginal cost of production.

Keynesian literature, models of sticky prices have been grouped in to two general categories (Roberts, 1995): "time-dependent" and "state-dependent". In state-dependent models, firms change prices when underlying determinants, such as demand and costs, reach curtain bounds. In time-dependent models, such as the staggered contracts models of Taylor and Calvo, firms set their prices for fixed periods of time which we will discuss later.

The New Keynesian Phillips Curve (NKPC) is a part of a small-scale New Keynesian model[10] for a closed economy - the supply block. For the demand block, it can be represented by an expectational IS curve, which is a linear approximation to the representative household's intertemporal Euler equation. The model is closed by a monetary policy which can either be directly derived from the minimization of a central bank's loss function or specified by optimal monetary policy design in such a framework in recent years, e.g. Taylor (1999), Clarida, Galí and Gertler (2001) and Woodford (2001).

3.4.1 Calvo Price Setting

As we discussed above, the New Keynesian Phillips Curve (NKPC) can be derived from time-dependent price setting in a closed economy framework as shown by Robert (1995), for example, (i) Taylor's (1980) fixed duration staggered wage-price contract setting, (ii) Calvo's (1983) random time-dependant price setting and (iii) Rotemberg's (1982) adjustment cost price setting, which is not strictly time dependent but its implication are similar to time-dependent models as shown by Roberts (1995).

Calvo's (1983) random time-dependent pricing as it is so commonly used in DSGE models. In his framework, each firm resets its price with probability $(1-\theta)$ each period, as each adjustment opportunity occur randomly and independently of the time that has passed since its last price adjustment. The number of firms is assumed large and they are further assumed identical, apart from their differentiated producers and the timing of their price adjustment. Hence, $(1-\theta)$ represents the

[10] In the New Keynesian framework, each variable is most often expressed in terms of its deviation form equilibrium, i.e. in "gap" terms.

fraction of firms adjusting their prices in each period and θ denotes the portion of firms keeping their prices unchanged. The aggregate price level, p_t , is then a combination of the lagged price level, p_{t-1}, and the optimal prices, p_t^*, chosen by the set of firms that adjust their prices in that period: $p_t = \theta p_{t-1} + (1-\theta) p_t^*$.

The optimal price, set at time *t* by the set of firms adjusting their prices in that period, is the price that maximizes expected discounted profits subject to the process for determining when the firm will next be able to adjust. This can be expressed as

$$p_t^* = (1-\beta\theta)\sum_{k=0}^{\infty}(\beta\theta)^k E_t\{mc_{t+k}^n\} \tag{3.11}$$

where $(1-\theta)\sum_{k=0}^{\infty} k\theta^{k-1} = (1-\theta)^{-1}$ is the average time over which a price is fixed.

Thus, firms consider the expected future path of marginal cost in light of the probability that their prices may remain fixed for a number of periods. Combining this with the expression for the aggregate price level and denoting the inflation rate as

$$\pi_t = \beta E_t\{\pi_{t+1}\} + \lambda mc_t \tag{3.12}$$

where β is a discount factor, $\lambda = \frac{(1-\theta)(1-\beta\theta)}{\theta}$ is a function of the frequency of price adjustment or a degree of price stickiness (θ) and mc_t is the percent deviation of the firms' real marginal costs from its steady state level or can be often expressed in terms of an output gap.

3.4.2 The Hybrid New Keynesian Phillips Curve

Galí and Gertler (1999) propose a hybrid marginal cost based Phillips Curve, where they assume that a subset of firms set prices according to a backward-looking rule of thumb. Hence lagged inflation enters the Phillips curve as an independent variable:

$$\pi_t = \lambda mc_t + \gamma_f E_t\{\pi_{t+1}\} + \gamma_b \pi_{t-1} \tag{3.13}$$

where $\lambda = (1-\omega)(1-\theta)(1-\beta\theta)/\phi$, $\gamma_f = \beta\theta/\phi$, $\gamma_b = \omega/\phi$, $\phi = \theta + \omega[1-\theta(1-\beta)]$.

This emphasize that the Hybrid Phillips Curve has differs in two important ways from other hybrid versions used in earlier empirical work, e.g. by Fuhrer and Moore (1995). First the coefficients in the Hybrid Phillips Curve are all explicit functions of three model structural parameters: the degree of price stickiness, θ, the degree of backwardness , ω, and the discount factor, β . Second, real marginal costs are used as a measure of demand pressure as opposed to an output gap. Real marginal cost are of course unobservable. Galí and Gertler (1999) propose using average unit costs to measure nominal marginal cost, which means using the labor share of income as a proxy for real marginal cost.

3.4.3 The Open Economy New Keynesian Phillips Curve

It becomes even more complicated in an open economy framework as the New Open Economy Macroeconomics (NOEM) literature has shown. The relationship between marginal costs and labor share becomes complicated as producers face a choice between imported and domestic intermediate inputs. Price setting is also more complex as the choice of currency, competition from abroad and the pass-through of exchange rate changes into becomes an issue. Modelling of real rigidities in capital and labor markets is also influenced by the introduction of the openness factor, especially in an era of increased globalization of product, labor and financial markets.

The models in the NOEM literature are DSGE models, with nominal rigidities and various forms of market imperfections. The NOEM literature represents an attempt to introduce New Keynesian economics into an open-economy framework[11]. NOEM has brought new insights into international transmission of shocks, different price setting behavior and policy coordination.

Monacelli (2005) combines a Calvo-type staggered price setting with a multi-sector approach where exchange rate pass-through is incomplete. His model is a small open economy DSGE model with imperfect competition and nominal rigidities where incomplete exchange rate pass-through represents a crucial rigidity. The

[11] In the open-economy macroeconomic literature, a small open- economy denotes an economy that is too small to influence world prices, interest rate or economic activity.

domestic economy is inhabited by infinitely-lived households consuming Dixit-Stiglitz aggregates of domestic and imported goods, domestic firms producing a differentiated good, and a continuum of importing firms that operate as price setters in the local market. All goods are tradable goods. In his model domestic firms set prices in a staggered fashion under a standard Calvo price setting behavior and domestic inflation is described by a forward-looking New Keynesian Phillips Curve. He assumes that the domestic market is populated by local retailers who import differentiated goods. In setting the domestic currency price of these goods the importers solve an optimal (optimal) mark-up problem. This generates deviations from the law of one price in the short-run, while complete pass-through is reached asymptotically.

In this thesis, The NKPC that we employ is in its setup similar to that of Justiniano and Preston (2004) which extend Monacelli's (2005) model by allowing for habit formation in consumption and hybrid price setting by indexation in the tradition of Christanio, Eichenbaum and Evans (2005). Therefore, the New Keynesian Phillips Curve for the open economy as the Hybrid New Keynesian Phillips Curve which include forward-looking and backward-looking inflation to the model.

From the extend of Justiniano and Preston (2004), the import price setting leads to get a hybrid New-Keyesian Phillps Curve for import goods as

$$\pi_{F,t} = \beta\left(1-\beta\theta_F\right)E_t\pi_{F,t+1} + \theta_F\pi_{F,t-1} + \lambda_F\psi_t \qquad (3.14)$$

where $\lambda_F = \dfrac{\left(1-\beta\theta_F\right)\left(1-\theta_F\right)}{\theta_F}$, θ_F, is the degree of exchange rate pass-through and ψ_t is a law of one price gap. According to the Phillips curve above, import price inflation will rise if the world price of imports is higher than the local currency price of the same good. This means that if the domestic currency depreciates and there is incomplete exchange rate pass-through, a wedge will surface between the price that local retails pay for their goods in the world prices in terms of the domestic currency, i.e. depreciation, will increase the marginal cost of the local retailers and thus increase foreign goods inflation. From the above equation, import price inflation depends on the l.o.p. gap, which is determined by the degree of pass-through:

$$\psi_t = -\left[(1-\alpha)s_t + q_t\right] = p_t^* - e_t p_{F,t} \tag{3.15}$$

where $s_t = p_{F,t} - p_{H,t}$ denotes the log terms of trade, i.e. the domestic currency relative price of imports, q_t is the log real exchange rate, α is related to the degree of home bias in preference and thus a natural index of openness.

The law of one price is inversely proportionate to the real exchange rate and the degree of competitiveness for the domestic economy. Hence there are two roots of deviations from aggregate purchasing power parity (PPP) in Monacelli's model First, the heterogeneity of consumption baskets between the small economy and the rest of the world, which effects are captured by the term $(1-\alpha)s_t$. Second deviations from the l.o.p, ψ_t, cause deviations from PPP. Hence with incomplete pass-through, the l.o.p gap contributes to the volatility of the real exchange rate.

For the domestic firms who is deciding the price by Calvo-type staggered price setting, the New Keynesian Phillips Curve featuring the indexation of prices to past inflation is

$$\pi_{H,t} = \beta(1-\beta\theta_H)E_t\pi_{H,t+1} + \theta_H\pi_{H,t-1} + \lambda_H mc_t \tag{3.16}$$

where $\lambda_H = \dfrac{(1-\beta\theta_H)(1-\theta_H)}{\theta_H}$, θ_H is a degree of price stickiness.

Aggregate inflation can be defined as the sum of domestic goods and imported goods inflation $\pi_t = (1-\alpha)\pi_{H,t} + \alpha\pi_{F,t}$.