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Master Thesis for the Master in Economics

INFLATION DYNAMICS IN VIETNAM

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Preface

I would like to thank my supervisors, Kyrre Rickertsen and Per Halvor Vale, for their patience, help and useful feedback and comments. A special thanks to all my helpers who have contributed with proof reading and tips to all my minor mistakes.

I would also express my gratitude towards my close friends and family who have supported me and been able to cope with me for the past two years.

To all my fellow students, thanks for a great time!

Hien Thi Thu Le

Ås, August 2011

Abstract

Inflation has been a persistence problem in Vietnam and it needs a well-developed practical model which can capture the important driving forces to analyze inflation dynamics in Vietnam. Despite the vast research of hybrid New Keynesian Phillips Curve on developed and developing countries, little is known about the case of Vietnam. This thesis contributes to literature by investigating the possibility of hybrid New Keynesian Phillips Curve in explaining inflation dynamics in Vietnam and examining what is the main causes of high inflation in Vietnam. The output is calculated from the difference between actual GDP and potential GDP which is de-trended by Hodrick Prescott Filter. The hybrid NKPC is estimated by Generalized Method of Moments, in which future inflation expectation is examined by actual value. The findings show that the hybrid New Keynesian Phillips Curve fits Vietnamese data very well. Inertial inflation and inflation expectations are both important determination of inflation persistence. The output gap also contributes to the inflation dynamics. The estimation is extended by include global oil price and global food price and the results supports to the roles of these two variables in inflation process. The study will contribute to future research on similar topics.

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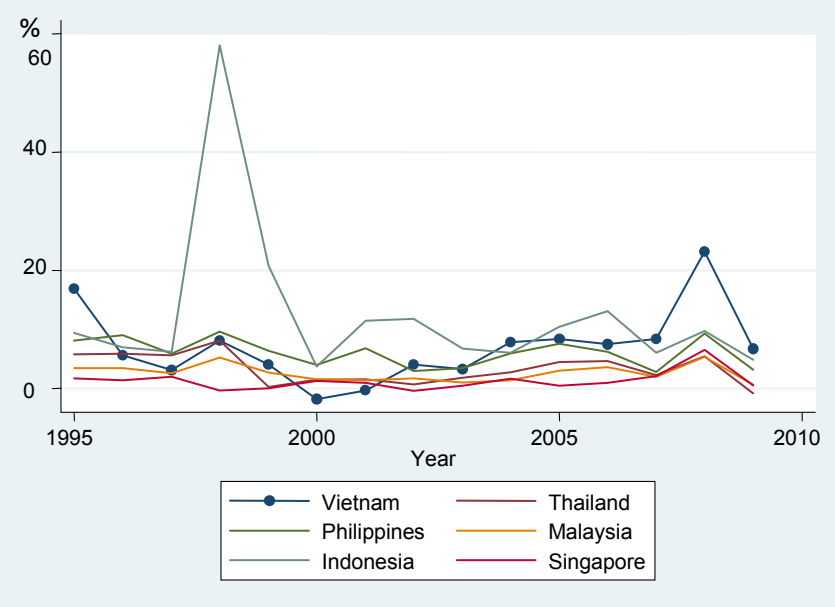
Figures and Tables

1. Introduction

Inflation – a rise in the general level of prices of goods and services in an economy over a period of time has been a persistent problem in Vietnam. The country took a decade to succeed in fighting hyperinflation since transforming its command economy toward to more market-oriented one in the late 1980s. Inflation fell from 453% in 1986 (Thanh, 2008) to single digits during the second half of the 1990s. However, in recent years, the inflation has risen again. Inflation began an upward trend that accelerated in 2004. The average rate of inflation rose to 7.7% in 2004 and peaked at 8.3% in 2005, before easing somewhat in 2006. The annual inflation rate increased to 23% in 2008, the highest rate in the past 10 years and among the highest in other emerging markets in the region as shown in figure 1. The causes of the growth in inflation for the period after 1995 have been controversial. Some economists suggested that the rise was a consequence of expanding monetary policy, while others argued that the reason came from exogenous factors, such as higher oil prices in the world market. However, those arguments were based on thought experiment rather than on empirical work. Thus, this raises concerns about a well-developed practical model which can capture the important driving forces to analyze inflation dynamics in Vietnam.

Figure 1: Inflation rate (%) in Vietnam and other selected ASEAN[1] countries, 1995-2009



Source: International Monetary Fund – 2010 Economic Outlook

[1] Vietnam became a full member of ASEAN (Associations of Southeast Asian Nations) on 28 July 1995. Vietnam's accession to the various ASEAN agreements demonstrates commitment to economic cooperation in the region, to the opening up to the economy and to trade liberation.

As is well known, the New Keynesian Phillips Curve (NKPC) and recently the hybrid NKPC has attracted a great deal of interest. NKPC is a widely used structural model of inflation dynamics. NKPC describes correlations between expected future inflation and marginal cost or output gap[2]. The reason that the NKPC has drawn more attention of policy makers is that it can explain significantly the situation of inflation persistence by emphasizing the role of inflation expectations. In the benchmark NKPC, current inflation depends mainly on future expectation inflation and output gap. Gali and Gertler (1999) improved NKPC by incorporating lagged inflation and named the resulting model as hybrid NKPC. The idea is to let inflation depend on a combination of expected future inflation and lagged inflation. This theory assumes that there is some link between past and future inflation beyond effects operating through expectations.

To my knowledge, the use of the NKPC has not been applied in Vietnam. I will use this model on the hybrid version to investigate inflation dynamics in Vietnam for the period 1995:1-2009:4. The period after 1995 has experienced a good performance of Vietnam's economy compared to previous periods in achieving high economic growth and inflation control. The thesis aims to investigate where the main causes of high inflation in Vietnam.

This thesis is structured as follows. Section 2 gives a brief description of inflation in Vietnam from 1980 until 2009. Section 3 presents the theoretical framework used in this thesis. Section 4 describes the economic literature relevant to my research objectives. Section 5 discusses the data. The study model is provided in Section 6. Results from the estimations are presented in Section 7. Section 8 concludes.

2. Inflation in Vietnam from 1980-2009

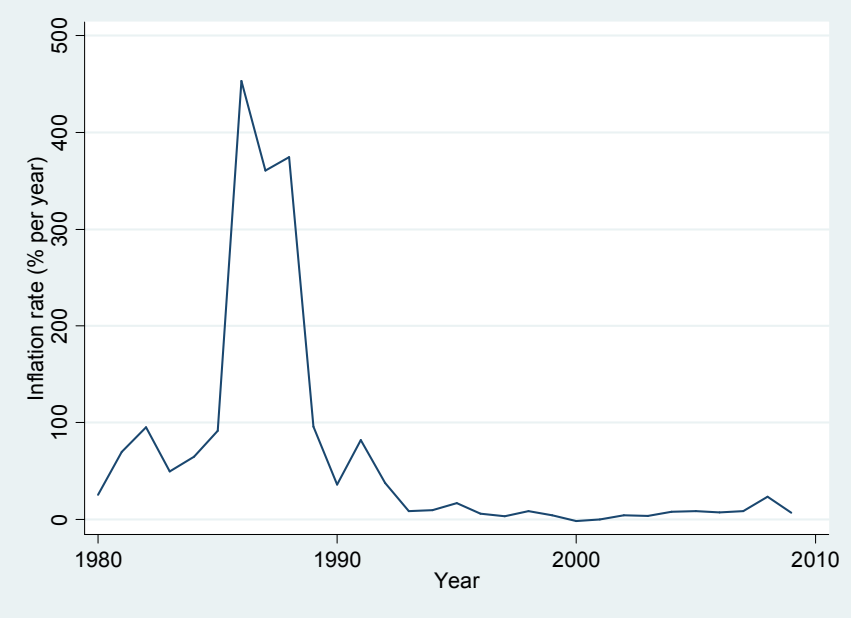
To give a background for the problem stated in this thesis, I start with providing an overall outlook of Vietnam's economy and its inflation problem from 1980 until 2009. Although this thesis studies on the period 1995-2009 only, it is useful to look back on the inflation background before 1995. Vietnam had centralized and closed economy with rationing system after getting its independence in 1975. Despite the government's strict control of commodity prices and wages, the government failed to ensure the stability of prices. One illegally parallel

[2] Output gap is the difference between actual output and potential output which drives the current inflation rate.

market-called free market[3] existed together with the official planned market controlled by the government.

Based on the fluctuations of inflation, the over economy of Vietnam might be divided into the two following sub-periods: 1986-1995 and 1996-2009. Figure 2 summarizes the evolution of inflation rate from 1980-2009, and we can see the distinct different patterns of inflation before and after 1995.

Figure 2: Annual Inflation rate (% per year), 1980-2009



Source: International Monetary Fund – 2010 Economic Outlook

2.1. The period 1980-1994

In the first period, Vietnam's economy experienced the hyperinflation. Vietnam had been unified in 1976 and the economy had been totally destroyed and faced extremely excess demand for building dominant industrial sectors, food and other commodities. Many economic reforms were launched to stabilize the economy, simulate export and investments and enhance economic growth. Measures to raise output were needed. The government tried to co-integrate the planned market with the parallel markets to stimulate supply. In addition, farmers were allowed to sell a part of their product to the State at negotiated prices instead of fixed price as it had been before. Such incomplete reforms raised the total output; however,

[3] where people exchange their goods with a much higher price in comparison to legally planned market

CPI inflation rate was pushed up to over 200% in 1982 as a result of partly reform on price (Thanh, 2008).

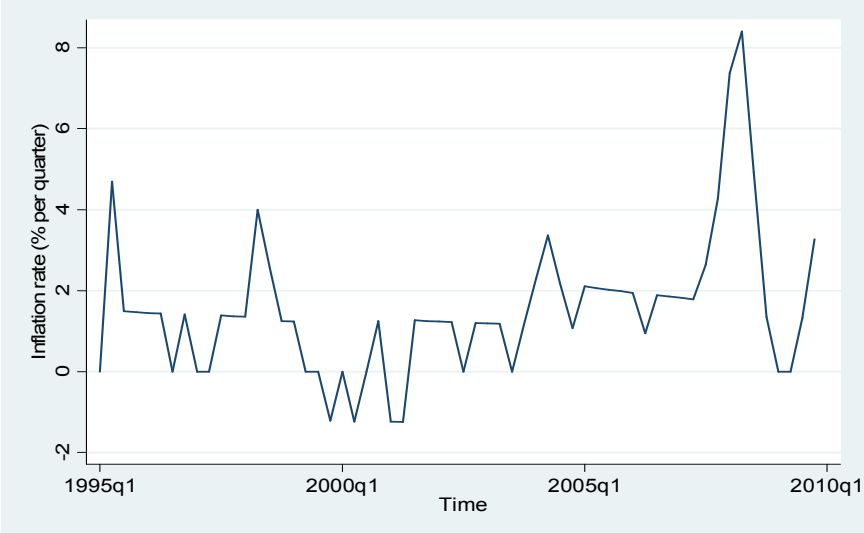
In 1986, inflation jumped to its peak of 453% (Thanh, 2008) and maintained to be at several hundred percent for several years later. In this year, the renovation program "Doi Moi" was initiated. Key components consisted of increasing supply by the removal of price controls and the tightening of monetary as well as the relaxation of exchange rate control (Goujon, 2006). Despite of hopeful expectation from the government, the immediate aftermath of this adjustment made inflation more serious.

Eventually, the inflation rate dropped to 37.7% in 1989 (Thanh, 2008) after a decade of hyperinflation. Even though inflation maintained fairly high over first three years of the 1990s due to inertia characteristics, "Doi Moi" was considered as the initial achievement of innovation program, bringing about a new phase of Vietnam's economy. This success in inflation controlling suggested the important role of supply obstacle and excess demand matter in the planned economy of Vietnam.

2.2. The period 1995 – 2009

Inflation problem was reduced substantially as compared with the prior period but not stable, and the fluctuations in the inflation growth are shown in figure 3.

Figure 3: Inflation rate (%), 1995:1-2009:4



Source: International Monetary Fund – 2010 Economic Outlook

Inflation was under successful control within two digits. Vietnam's inflation was protected from the Asian financial crisis in 1997 due to the government's control of the economy and a nonconvertible currency. However, GDP growth declined sharply. The average annual rate of real economic growth for two years before the crisis was 9.4%, but it fell markedly in 1998 and 1999, from 5.8 to 4.7%. To prevent an economic downturn, the government returned to expansionary fiscal policy and eased monetary policy. The average annual money growth during this period was 31%, the average inflation rate was 3.7%. Since 1999, Vietnam has relaxed the exchange rate regime in order to improve international competitiveness. Domestic economy was opened in this period. Trade liberalization and capital inflow helped lessen the balance of payment as well as budget deficit problem. Problems with good shortages were solved by increasing number of efficient enterprises in private sectors.

The economy began to recover in late 1999 – largely due to a revival of domestic investment, but it was growing at a slower rate than in the early 1990s. Vietnam experienced two years of a mild deflation in 2000-2001 owing to excess capacity and depressed commodity prices, and inflation remained low in 2002-2003.

Real GDP picked up and inflation rose sharply between 2004 and 2007. The strong growth was fuelled by buoyant consumption and export growth, notwithstanding a number of supply shocks (the avian flu, a drought, and rising international prices of inputs). Inflation was rising sharply on the back of the sustained strength of international commodity prices and the growing excess demand.

Growth declined to 6.25% in the beginning of 2008, the slowest pace since 1999. The slowdown was driven by subdued activity in the construction and services, following a steep downturn in the property market. Inflation suddenly increased to 25.2% in the middle of 2008[4]. Vietnam's surging inflation was driven by both domestic and global forces, including high fuel and food costs. Overall food costs were up 42.4% from a year ago, driven by a 67.8% jump in the price of grain, including rice – the staple food (Fig. 4). The oil prices also increased up to 12, 87% in May 2008 over last month (Fig. 5). Housing and construction material rose 22.9% over last year. Rapid economic growth and looser lending policies in these recent years, which has spurred investment, also contributed. However, inflation

[4] *http://www.iht.com/articles/ap/2008/05/27/business/AS-FIN-ECO-Vietnam-Inflation.php*

moderated near the end of 2008, due to the weakening domestic demand but also lower food and energy prices.

Figure 4: Nominal Food Price Index (US $), 1995:1-2009:4

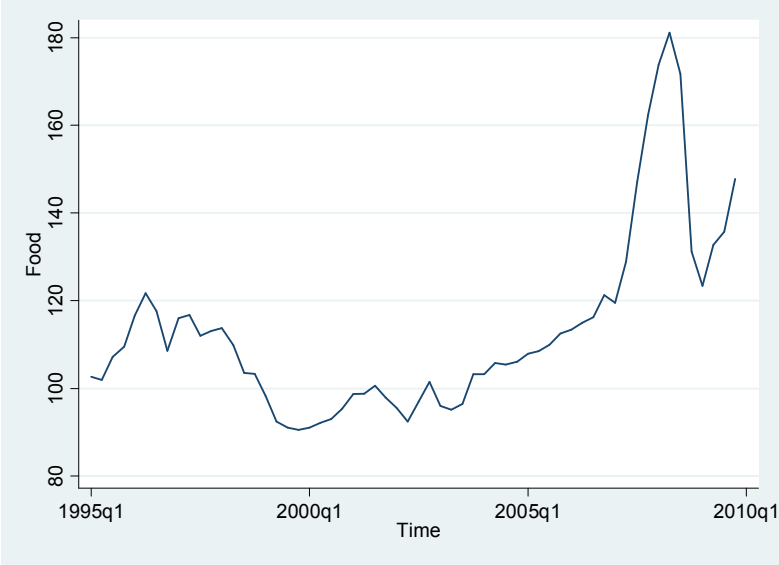
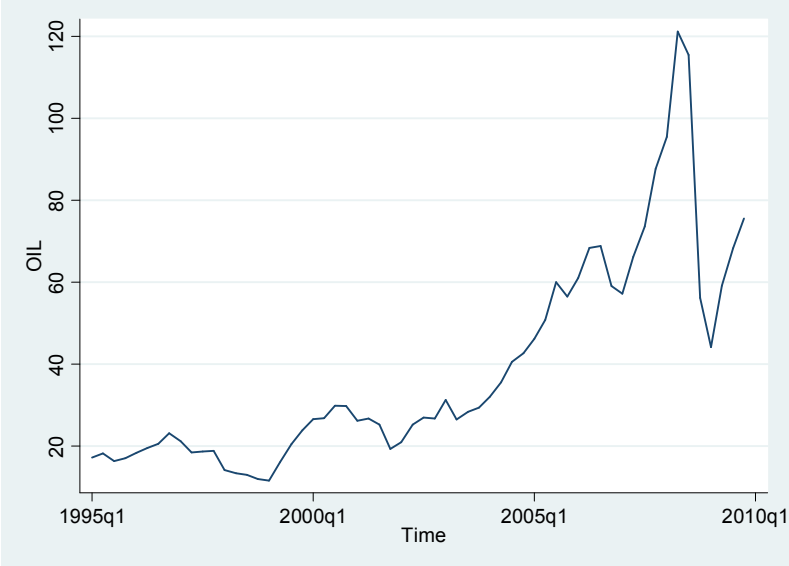


Figure 5: Nominal Crude Oil Price Index (US $ per Barrel), 1995:1-2009:4



3. Theoretical considerations

3.1. Determinations of inflation

This section arranges the broadly theoretical explanation on inflation determination. Identifying the causes driving inflation is very important in analyzing inflation dynamics. In fact, inflation can be caused by a variety of different factors. And different schools of thought provide diverse views on what actually causes inflation. Through several theoretical literatures about causes of inflation I have studied, the modern inflation theory of Samuelson and Nordhaus (2005) on the book *Macroeconomic-18th edition* and the study of Thanh (2008) researching on inflation of Vietnam in the period 1997-2008 seem to be relevant to my analysis. Then, this part will be based on three main aspects of inflation's causes from their works and further discusses these one by one. Three main causes of inflation are as follows:

- Demand-pull approach
- Cost-push approach
- Future inflation expectations and inertia inflation

3.1.1. Demand-pull approach

Demand-pull inflation happens when the level of aggregate demand is growing at an unsustainable rate leading to increased pressure on scare resources and a positive output gap. Aggregate demand is made up of all spending in the economy. An increase in aggregate demand could be because consumers are spending more, perhaps because interest rates have fallen, taxes have been cut or simply because there is a greater level of consumer confidence. Furthermore, it could be because by firms who are investing more under the expectation of future economic growth. It could be that the government is boosting spending on defense, health, education and so on. Last but not least, increases in the broad money supply – the total amount of money available in the economy at a particular point in time increase aggregate demand, which in turn increases the price level. Whatever it is, it will be inflationary if demand grows faster than supply.

The output gap, which is the difference between actual and potential GDP as a percent of potential GDP, is used in assessing the degree of demand-pull inflation pressure in the economy at a particular time. Actual GDP is aggregate demand or real GDP while the potential GDP is defined as the level of GDP that is consistent with full utilization of all factors of production under conditions of stable inflation.

Equation (1) describes how to measure output gap.

$$y_t = \frac{y_t^r - y_t^p}{y_t^p} \quad (1)$$

where

y_t is the output gap during the year t

y_t^r is actual GDP during the year t

y_t^p is the potential GDP of the economy during the year t

Therefore, the level of the output gap is crucial for determining inflationary pressures in the economy. When actual GDP lies well above potential GDP, meaning that there is excess demand in the economy. Producers are able to raise prices and achieve bigger profit margins because they know that demand level is running faster than the underlying level of supply. A positive output gap exists and inflation pressures will be rising. When aggregate demand is well below the productive potential of the economy (so called potential GDP), a negative output gap exists. The implication is that the rate of inflation is likely to fall because inflationary pressures are falling. In a recession, a fall in aggregate demand leads to a negative output gap.

Nevertheless, contrary to actual GDP, potential GDP cannot be observed directly from the available data. Since it has to be estimated using statistical methods, it is subject to a high degree of uncertainty. Various methodologies have been suggested for estimating potential output such as such as exponential smoothing, Kalman Filter, and Hodrick Prescott Filter, etc. All of them assume that GDP growth is divided into two components: trend growth and cyclical growth and provide virtually identical results. However HP filter is the simplest among them and often selected because it has performed best in terms of both explanatory and predictable power and diagnostic tests. Potential output is an exogenous variable in this model. Therefore, changes in the output gap purely reflect movements of aggregate demand. An increase in output gap thus implies an upward pressure of aggregate demand. In particular, a value of the output gap that is greater than 1 reflects excess aggregate demand (Jongwanich and Park, 2008).

3.1.2. Cost-push approach

This approach on causes of inflation claims that prices rise due to increasing costs of the factors of production. Other things remain the same, the higher the cost of production, the smaller is the amount produced. Thus, the decrease in supply will make the prices increase. Accordingly, labor will demand higher money wages and this will in turn raise costs. Cost-push inflation is considered to be caused by:

- Increases in factor prices e.g. oil price increase
- A devaluation or depreciation of currency leading to an increase in import prices
- Interest rate increases will increase the cost of borrowing, etc.

Cost-push inflation happens when costs increase independently of aggregated demand. It is important to look at why costs have increased, as quite often costs are increasing simply due to the economy booming. When costs increase for this reason, they are generally just a symptom of demand-pull inflation and not cost-push inflation. For example, if wages care increasing because of a rapid expansion in demand, they are simply reacting to market pressures. This is demand-pull inflation which is causing cost increase.

3.1.3. Future inflation expectations

Future inflation expectations is considered as an important determinant of inflation and this has increasingly been recognised by economists and policy-makers in recent years. They are what affect people's behavior in ways that have a long-term impact on inflation. People take account of their expectations in their wage claims. If inflation is expected, people will include that in their claim to ensure that they get a real wage increase. This increases firms' costs and so can in itself cause inflation.

People form their expectations based on the past relevant information, particulary past inflation rates. This built-in inertial inflation rate tends to persist at the same rate for a while until shocks such as changes in aggregate demand, commodity-price changes, movements in the foreign exchange rate, etc causes it to move up or down.

Moreover, people can use simply current information on their judging and take no account of the part. For example, if people believe that increases in the money supply will simply cause inflation, any increase will simply lead to inflation and no real increase in output or employment. This is because they will simply anticipate the effects.

3.2. The New Keynesian Phillips Curve model[5]

The NKPC describes a simple relationship between inflation, the expectation that firms hold about future inflation, and marginal cost or output gap. According to the NKPC, inflation will tend to rise when output gap rise, as firms pass on higher costs in the form of higher prices, and when expectations of future inflation rise, as firms raise their price today anticipating higher prices tomorrow. Although the NKPC can be obtained several different ways, it is most commonly derived using an approach pioneered by Calvo (1983), which is discussed Whelan (2005)**.**

3.2.1. Price setting

Derivation of any form of the NKPC typically starts with the assumption of monopolistically competitive firms which face a constraint on the frequency of price adjustments that can be made in response to shocks. Price rigidity and staggered pricing strategy across firms arise from this constraint.

The form of price rigidity faced by the Calvo firms is as follows. Each period, only a random fraction $(1-\theta)$ of firms are able to reset their price; all other firms keep their prices unchanged. When firms do get to reset their price, they must take into account that the price may be fixed for many periods. We assume that they do this by choosing a log-price z_t, that minimize.es the "loss function"

The loss function is considered as follows:

$$L(z_t) = \sum_{k=0}^{\infty} (\theta\beta)^k \, E_t(z_t - p^*_{t+k})^2 \qquad (2)$$

z_t: the log-price

β: discount factor $0 < \beta < 1$

p^*_{t+k}: the log of the optimal price that the firm would set in period *t*+*k* if there were no price rigidities

The firm's optimal pricing strategy without frictions is assumed to be involved setting prices as a fixed markup over marginal cost:

[5] See the full derivation of the NKPC in Whelan, Karl (2005) *"Topic 7: The New Keynesian Phillips Curve"*

$$p_t^* = \mu + mc_t \quad (3)$$

μ: constant frictionless markup

mc_t: real marginal cost

Thus, the optimal reset price for firms in case of price rigidity can be written as

$$z_t = (1 - \theta\beta) \sum_{k=0}^{\infty} (\theta\beta)^k E_t(\mu + mc_{t+k}) \quad (4)$$

3.2.2. The New Keynesian Phillips Curve (NKPC)

These next equations are the derivation of the behavior of aggregate inflation in the economy.

The aggregate price level is just a weighted average of last period's aggregate price level and the new reset price of all firms in the economy, where the weight is determined by θ:

$$p_t = (1 - \theta) z_t + \theta p_{t-1} \quad (5)$$

The inflation rate equation:

$$\pi_t = p_t - p_{t-1} \quad (6)$$

From several re-arrangements, these equations can be summarized as the New Keynesian Phillips Curve.

$$\pi_t = \beta E_t \pi_{t+1} + \frac{(1-\theta)(1-\theta\beta)}{\theta} (\mu + mc_t - p_t) \quad (7)$$

We can see that inflation is a function of two factors:

- Next period's expected inflation rate, $E_t\pi_{t+1}$
- The gap between the frictionless optimal price level $\mu + mc_t$ and the current price level p_t. Another way to state this is that inflation depends positively on real marginal cost, $mc_t - p_t$.

Let denote that:

$$\widehat{mc}_t = \mu + mc_t - p_t \quad (8)$$

So we can write the NKPC as

$$\pi_t = \beta E_t \pi_{t+1} + \frac{(1-\theta)(1-\theta\beta)}{\theta} \widehat{mc}_t \quad (9)$$

3.2.3. Marginal cost and output gap

One problem with attempting to implement this model empirically is that we don't actually observe data on real marginal cost. National accounts data contain information factors that affect average costs such as wages, but do not tell us about the cost of producing an additional unit of output. That said, it seems very likely that marginal costs pro-cyclical, and more so than prices. When production levels are high relative to potential output, there is more competition for the available factors of production, and this leads to increases in real costs, i.e. increases in the costs of the factors over and above increases in prices.

For these reasons, many researchers implement the NKPC using a measure of the output gap (the deviation of output from its potential level) as a proxy for real marginal cost. In other words, they assume a relationship such as:

$$\widehat{mc}_t = \rho y_t \tag{10}$$

This implies a NKPC of the form as follows:

$$\pi_t = \beta E_t \pi_{t+1} + \frac{(1-\theta)(1-\theta\beta)}{\theta} \rho y_t \tag{11}$$

3.2.4. The hybrid NKPC

The hybrid NKPC is an improvement of the NKPC by Gali and Gertler (1999). The "pure" NKPC has been argued that observed inflation behavior does not correspond well with the models of purely forward-looking inflation. In particular, the NKPC does not capture the empirical observation that inflation is highly persistent (Fuhrer and Moore, 1995). Gali and Gertler (1999) propose a hybrid marginal cost based Phillips Curve, where they assume that a subset $(1-\theta)$ of firms set prices according to a backward looking rule of thumb, remainders use a forward-looking rule. Hence, lagged inflation enters the Phillips curve as an independent variable.

Therefore, a typical hybrid NKPC model has two terms, namely, a backward-looking inflation component reflecting the inertial effect in prices and a future expected inflation capturing optimal price adjustment.

$$\pi_t = \lambda \rho y_t + \gamma_f E_t\{\pi_{t+1}\} + \gamma_b \pi_{t-1} \tag{12}$$

where

$\lambda = \frac{(1-\omega)(1-\theta)(1-\beta\theta)}{\emptyset}$ [6],

γ_f is the coefficient of forward looking inflation, $y_f = \frac{\beta\theta}{\emptyset}$

γ_b is the coefficient of backward looking inflation, $\gamma_b = \frac{\omega}{\emptyset}$

$\emptyset = \theta + \omega[1 - \theta(1 - \beta)]$

The estimation of the hybrid NKPC can explain the dynamics of the economy. It is estimated either through Generalized Method of Moments (GMM)[7], Maximum Likelihood (ML) technique, or the Vector Auto regression (VAR), etc. However, evidences based on these different techniques are not the same. For instance, GMM technique is easy to handle and require minimum assumptions about exogenous variables but it gives biased results in small samples and choice of instruments is not an easy task (Stock, 2002).

4. Literature review

In this section, I provide a review of recent studies that estimate the ability of hybrid NKPC to explain inflation dynamics for both developed countries and developing countries.

Using the approach of the hybrid NKPC, Suzuki (2006) investigates the differences of inflation dynamics between U.S. and Japan. The output gap is calculated by the log-difference between actual real GDP and potential GDP which is de-trended by HP-filter. To estimate the hybrid NKPC, they use EHL's sticky price-wage model in which the real wage gap is also used as an explanatory variable as well as the output gap[8]. Expected inflation is substituted by actual inflation in estimations having expectation variables. In an attempt to avoid the bias caused by the correlation between explanatory variables and error terms, GMM is used for estimation. The indicators for inflation as dependent variables in the regressions include the GDP deflators for both countries and the core PCE deflator for the U.S. and the core CPI for Japan. The instrument set includes the lagged variables of inflation rate, labor

[6] See full derivation of the hybrid NKPC in Gali, Jordi & Gertler, Mark, 1999 *" Inflation dynamics: A structural econometric analysis",* Journal of Monetary Econometrics, Elsevier, vol. 44(2)
[7] See more details of Generalized Method of Moments (GMM) in Appendix 2
[8] See more details in Suzuki (2006), "*The New Keynesian Phillips Curve (Sticky price-wage model) in the U.S. and Japan",* Mizuho Research Institute

income share, output gap and real wage gap. The result reveals that Japan's coefficient of output gap is not significant, in contrast to the coefficient being significant in the U.S. As for inflation expectations, while the importance of forward-looking factors and backward-looking factors are almost the same in the U.S., the forward-looking factor is dominant in Japan.

Using the approach of the hybrid NKPC in including expected future inflation, lagged inflation, and output gap, Crichton (2006) analyzes inflation in Malaysia during 1991-2006. Output gap is measured by the HP filter and GMM is used to estimate the hybrid NKPC. Instruments include four lags of inflation. Dummies for Asian crisis and increases in administered fuel prices are included in preliminary estimations. He finds out that both expected inflation and backward looking component are important to understand inflation dynamics. Also the exchange rate and a measure of demand pressure play important roles in driving inflation rate in this country.

However, there are some evidences giving more support to only the benchmark NKPC. Dua and Gaur (2009) estimate hybrid NKPC for eight Asian countries - Japan, Hong Kong, Korea, Singapore, Philippines, Thailand, China and India. In order to determine the drivers of inflation in an open economy setup, they investigate the importance of the demand and supply side measures for each of these eight Asian countries such as monetary aggregate, exchange rate, import index, etc. To measure the output gap, we use the HP filter with a smoothing coefficient of 1600 to de-trend the data. They use the IV method to estimate the hybrid NKPC. The instruments include lagged variable of all the endogenous variables. The results are that there exists a positive and statistically significant relationship between output gap and inflation for all the countries. However, the expected inflation provides a better fit compared to the backward looking variant. The international effect in the countries is captured by different variables.

In other case, Satti, Malik and Saghir have estimated hybrid NKPC for Pakistan over the period 1976-2006. For real marginal cost, log labor income share excluding the share of agriculture is taken. They have estimated dynamic correlations between inflation and real marginal cost both at leads and lags finding a positive correlation. It means that whenever there is a positive shock to real marginal cost, it would lead to higher inflation in the future. Using GMM as estimation technique and two lagged of inflation, labor share, output gap, call money rate, wage inflation and CPI inflation as instruments, they found that future expectations of inflation play significant role in inflation determination. Results show that the

inflation does not pose backward inertia rather it is dominated by forward-looking behavior. Moreover, real marginal cost and not the output gap is one of the driving forces of inflation.

To my knowledge, there are evidences in the literature that the pure NKPC and the hybrid NKPC model with the output gap as the driving variable of inflation can explain inflation dynamics in many large industrial economies reasonably well such as the findings of Suzuki (2006) for the case of Japan and U.S. or Crichton (2006) for the case of Malaysia. However, a number of studies, for example, Dua and Gaur (2009) for the case of eight Asian countries and Satti, Malik and Saghir (2007) for the case of Pakistan, have also shown that those two models are not always appropriate in tracking inflation dynamics for particular country.

5. Data

The study period is quarterly data in the period 1995:1-2009:4. I will focus on four central variables: the output gap, the broad money growth, global food prices and global oil prices. The choice of variables is based on the approach of inflation's determinations and empirical studies as discussed in previous sections. Although changes in interest rate, currency devaluation, tax policies, investment, government spending are also considered as potential explanatory variables, the model does not capture them due to the lack of data on these variables.

The data is shown in the appendix 4 and collected from various sources. The data is based on the four main variables. The real Gross Domestic Product to calculate output gap and inflation rate are obtained from General Statistics Office of Vietnam (GSO). Money supply is from the database of World Development Indicators Online (WDI-online). Oil price and food price are collected from the database of International Monetary Fund (IMF).

Table 1 presents some basis descriptive statistics for my sample.

Table 1: Descriptive data

Variable	Name	Mean	Min	Max
π	Quarter inflation rate (%)	1.53	-1.25	8.396947
M2	Nominal Broad money supply (billion VNDs)	131925646	4766093	567062181
GDP	Real Gross Domestic Product (billion VNDs)	83115.2	37548.86	15317.4
FOOD	Nominal Food Price Index (US $)	112.85	90.5	181.1
OIL	Nominal Crude Oil (Petroleum) Price (US $ per Barrel)	38.6	11.6	121.4

In my sample, inflation rate differs from the maximum of 8.39% in 2008:2 to the minimum of -1.25 (%) in 2001:2. Broad money supply (M2) also varies largely; the lowest is 4766093 billion VNDs, and the highest is 567062181 billion VNDs. Real Gross Domestic Product also varies between 37548.86 billion VNDs and 15317.4 billion VNDs and the average is 83115.2 billion VNDs. The difference in food price index is double between the most highest of 181.1 US dollar and the cheapest of 90.5 US dollar. However, the price of crude oil event fluctuates more than the price of global food from 1995-2009; that is, the highest is 121.1 US dollar and the cheapest is only 11.6 US dollar – ten times cheaper.

The subsections will discuss about the four main variables; that is, the reason why I select those variables into my model.

5.1.The output gap

In this thesis, the aggregate demand is proxied by output gap. The actual output is real GDP while the potential output is proxied by the trend of real GDP which will be derived from Hodrick-Prescott Filter (1997) (HP) with the standard lambda value of 1600[9]. The reason of choosing the real value of GDP is to strip the unreal valued included in the nominal GDP that added by inflation[10]. The results of output gap estimation are provided in section 7.1.

5.2.Broad money supply (M2)

Broad money supply[11] is one important determination of inflation as mentioned in the section 3.1.1. In the case of Vietnam, literature has shown that there is a strong correlation between inflation and broad money supply for different period of time. For example, in the study of IMF (2006), the outcome of analysis suggests the fairly significant role of monetary factors in explaining inflation in Vietnam from 2001:1-2006:2; especially the impact of money supply became stronger from 2002. Camen (2006) also found that monetary factors contribute to Vietnam's inflation in the period 1996-2005.

That is, since 1996, the annual money growth has increased, even higher than the GDP growth rate, which is clearly seen in table 2 and figure 6. The increasing rate of money growth

[9] See more details of Hodrick-Prescott Filter in Appendix 1

[10] Which is calculated by this function: $GDP\ deflator = \frac{nominal\ GDP}{real\ GDP} * 100\%$ (Thanh, 2008)

[11] Two widely used definitions of the money supply are narrow money (M1) and broad money (M2). M1 consists of currency and checking accounts. M2 equals M1 and saving accounts and time deposits (Federal Reserve Board, available at www.federalreserve.gove/releases/)

in 2000 reached up to 35.42%, much higher than GDP growth rate (6.79%). If we add the growth rate of money supply for the period 2000-2007, the result is 249.82%, four times higher than the GDP growth rate for the same period (61.0.2%). When money supply increases more than aggregate demand of the country, inflation exists. Especially in 2006, 29.67% increases in money supply growth rate with other determinants contribute to boost inflation rate up to 8.23% in 2007. In 2007, money supply growth rate reached its peak (49.11%), making inflation high in the end of 2007 and the beginning of 2008.

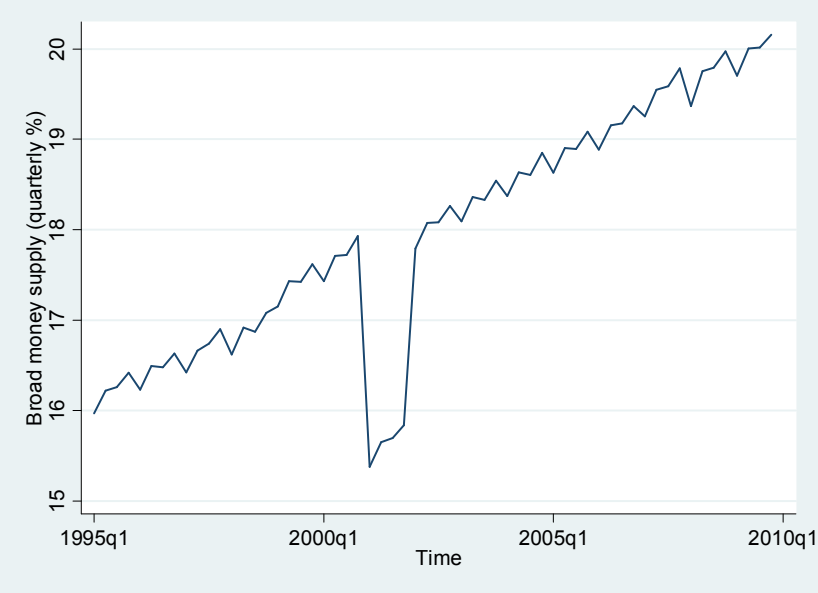
Table 2: Broad money growth (annual %) and GDP growth (annual %)

Year	Broad money supply (annual %)	GDP growth (annual %)
1995	unavailable[12]	9.54
1996	25.8	9.34
1997	25.29	8.15
1998	23.81	5.76
1999	66.45	4.77
2000	35.42	6.79
2001	27.34	6.89
2002	13.27	7.08
2003	33.05	7.34
2004	31.05	7.79
2005	30.91	8.44
2006	29.67	8.23
2007	49.11	8.46
2008	20.7	6.31
2009	26.23	5.32

Source: World Development Indicators

[12] There is no available data for the broad money supply in 1994 to calculate the variation over 1994-1995.

Figure 6: Broad money supply (quarterly %)



5.3.Nominal food price index and nominal crude oil price

The theory of cost-push approach is presented by the variables of nominal food price index and nominal crude oil price[13]. For the case of Vietnam, Camen (2006) revealed that Vietnam's inflation in the period 1996 to 2005 resulted from the fluctuations of world price of petrol and rice. The prices of petrol and rice explain 21% and 11% respectively of CPI inflation.

5.4.Future inflation expectations and inertia inflation

Future inflation expectations and lagged inflation play a crucial role in determining inflation as mentioned in the section 3.1.3 and Literature review. Nevertheless, the significance of inflation expectations and inertial inflation has not been investigated for the case of Vietnam. In my study, I will investigate whether future inflation expectations and inertial inflation contribute to the high inflation persistence in Vietnam for the period 1995:1-2009:4.

I will use actual value of future inflation (McCallum, 1976) to measure expected inflation since I do not have direct observations of this variable. The instrument set includes three lags of inflation, three lags of output gaps, three lags of broad money supply, three lags of global food price, and three lags of global oil price. To test whether the instrumental variables are

[13] The reason of choosing these two variables is mentioned in the section 2.2

appropriately chosen, I look at the J-statistics. The Hansen's J test tests the validity of the over-identifying restrictions imposed by the instruments with the null hypothesis that the over-identifying restrictions are satisfied (the instruments are valid). If J is large, either the orthogonality conditions or the other assumptions (or both) are likely to be false.

6. The study model

To capture the response of inflation to the changes of explanatory variables, these variables come into the model under the form of growth rate. The growth rate is quarterly base; in other words, it reflects the percentage in change of this quarter value in comparison to last quarter value.

As described above, the model is estimated on the quarterly time series. To overcome the problem of seasonality in the data, the model includes three dummies (D1, D2, and D3) to control fixed seasonal effects, and to allow for shifting seasonal effects over time[14].

The basic hybrid NKPC I use is

$$\pi_t = \gamma_b \pi_{t-1} + \gamma_f \pi_{t+1} + \lambda_t logGAP + \theta_1 logM2 + \theta_2 logOIL + \theta_3 logFOOD + \beta_1 D_1 + \beta_2 D_2 + \beta_3 D_3 + \epsilon_t \quad (13)$$

t is quarter t

π_t: the quarterly inflation rate

π_{t-1}: backward − looking inflation

π_{t+1}: forward-looking inflation expectations

logGAP: log of the output gap

$logM_2$: log of broad money supply

$logOIL$: log of global oil price

logFOOD: log of global food price

ϵ_t is disturbance term

[14] See more details of the method of dummies variables in seasonal analysis in Gujarati (2009), *Basic econometrics*, page 290-295

$\gamma_b, \gamma_f, \lambda_t$, θ_1, θ_2, θ_3 denote the coefficients of backward-looking inflation, forward-looking inflation expectations, the output gap, broad money supply, nominal crude oil price, and nominal food price index, respectively

$\beta_1, \beta_2, \beta_3$ denote the coefficients of three dummy variables D1, D2, and D3, respectively

I will apply the Generalized Method of Moments (GMM) to estimate the hybrid NKPC. Since GMM estimation requires that underlying variables are stationary[15], I firstly test the inflation variable for a unit root in its data generation process for all variables except output gap, since HP filter produces the output gap stationary over a wide range of smoothing values. I use conventional Augmented Dickey Fuller Tests (ADF) for all the lags from 0 to 4. I.e. from ADF(0)-ADF(4)[16] by including a constant term only, and a linear trend together with a constant term in ADF equations.

Expected sign of coefficients

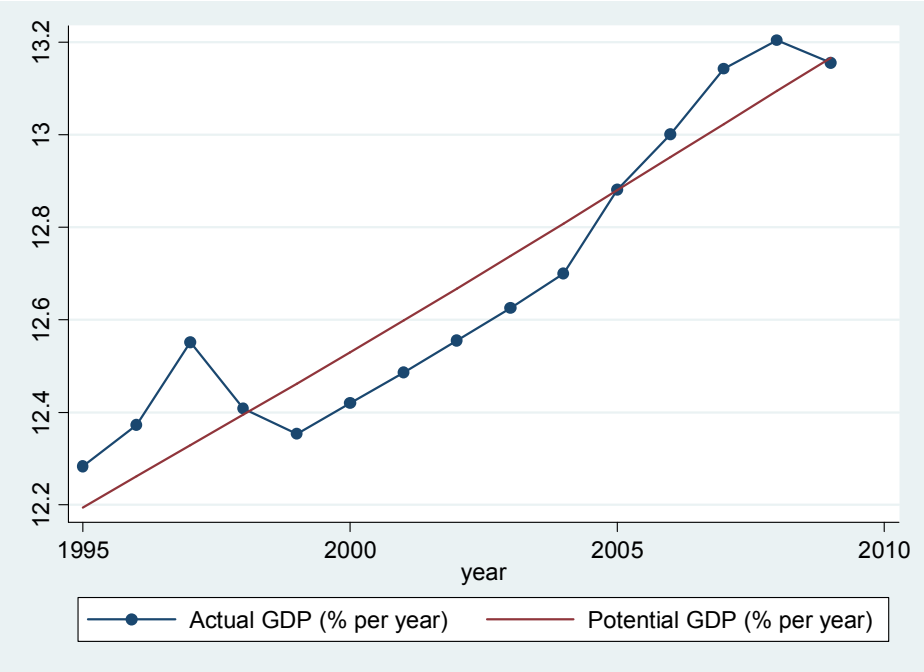
- Previous inflation contributes to present inflation through inertia characteristic; therefore, γ_b should be positive and significant.
- Large future inflation expectations raise present inflation, so γ_f should be positive and significant.
- Positive output gap results positive inflation rate; λ_t is considered to be positive and significant.
- Most theories agree that changes in money supply affect inflation. Thus, θ_1 is certainly expected to be positive and significant.
- An increase in either global oil price or global food price has indirect effects on an increase in inflation rate; then θ_2 and $\theta_3$are expected to be positive and significant.

[15] See more detail of stationary time series and Augmented Dickey-Fuller Tests in Appendix 3
[16] Since I have quarterly data, I decided to use four lags.

7. Empirical findings

7.1. Output gap estimation

Figure 7: Potential GDP and actual GDP (% per year)



When estimating production gap as a proxy for real marginal cost, I have used yearly data of actual GDP. Figure 7 shows the results from my calculations of the output gap when the potential GDP is de-trended by the HP filter. The resulted potential output and output gap are stationary. We can see from the figure 7, there are positive gaps in the years from 1995 to 1999 and from 2005 to 2009, negative gaps in the years from 1999 to 2004.

I could also used quarterly data; then, I should have introduced dummy variables to catch up the seasonal variation within the year, which I found complicated for the use of the HP Filter.

In my estimation of the hyrbid NKPC, I have therefore used the yearly output gap shown in figure 7.

7.2. Regression model

Since GMM estimation requires that underlying variables are stationary, the first test is a test for stationary. A test for stationary (or non-stationary) that has become widely popular over the past several years is the unit root test.

I use conventional Augmented Dickey Fuller Tests (ADF) for all the lags from 0 to 4 for quarterly time series from ADF(0)-ADF(4)[17] for all variables except output gap since output gap produced from HP filter is stationary. Also from the figures 4, 5, and 6, we see that over the period of study, the logs of broad money supply, nominal crude oil price, and nominal food price have been increasing, that is, showing an upward trend; thus, I include a linear trend together with a constant term in ADF equations.

Table 3: Test results of Augmented Dickey Fuller Tests

Time series variables		First difference of time series variables	
π_t	-3.335*** (0.0607)		
π_{t-1}	-3.279*** (0.0698)		
π_{t-2}	-3.259*** (0.0732)		
π_{t-3}	-3.035 (0.1225)	$\Delta\pi_{t-3}$	-4.808* (0.0005)
π_{t+1}	-3.456* (0.0443)		
$logM2_t$	-2.855 (0.1774)	$\Delta logM2_t$	-4.998* (0.0002)
$logM2_{t-1}$	-2.830 (0.1861)	$\Delta logM2_{t-1}$	-4.944* (0.0003)
$logM2_{t-2}$	-2.802 (0.1964)	$\Delta logM2_{t-2}$	-4.890* (0.0003)
$logM2_{t-3}$	-2.767 (0.2094)	$\Delta logM2_{t-3}$	-4.785* (0.0005)
$logOIL_t$	-2.840 (0.1825)	$\Delta logOIL_t$	-4.849* (0.0004)
$logOIL_{t-1}$	-2.843 (0.1817)	$\Delta logOIL_{t-1}$	-4.519* (0.0014)
$logOIL_{t-2}$	-2.836 (0.1839)	$\Delta logOIL_{t-2}$	-4.239* (0.0039)
$logOIL_{t-3}$	-2.824 (0.1883)	$\Delta logOIL_{t-3}$	-3.816** (0.0157)
$logFOOD_t$	-1.585 (0.7982)	$\Delta logFOOD_t$	-5.619* (0.0000)
$logFOOD_{t-1}$	-1.745 (0.7305)	$\Delta logFOOD_{t-1}$	-4.519* (0.0014)
$logFOOD_{t-2}$	-1.608 (0.7893)	$\Delta logFOOD_{t-2}$	-4.239** (0.0039)

[17] Since I have quarterly data, I decided to use four lags.

$logFOOD_{t-3}$	-1.731 (0.737)	$\Delta logFOOD_{t-3}$	-3.816** (0.0157)

Note: Δ denotes first difference and p-values in parentheses. *, **, and *** indicate significance at 1%, 5%, and 10%, respectively.

The first two columns of table 3 report the estimates for ADF Test. We can see that p-value of all variables except inflation rate and two lags of inflation rate, which in absolute terms are much less than even 10% critical value of -3.178, suggesting that the time series in my sample is not stationary or has a unit root. To avoid the spurious regression problem that may arise from regressing a non-stationary time series, we have to transform non-stationary time series to make them stationary.

If a time series has a unit root, the differences of such time series are stationary (Gujarati, 2009). Then the solution here is to take the first difference of the time series. The second two columns reports the estimates of ADF test after transforming variables. The p-value of all variables are larger than the critical value of 1%, 5%, and 10%, I conclude that the first-differenced variables are stationary.

Table 4: Structural estimates of the hybrid NKPC

	Coefficient	Robust Std. Err.	P-values
π_{t-1}	0.5583766	0.0745489	0.000
π_{t+1}	0.5630206	0.0729794	0.000
GAP_t	0.2428032	110.6363	0.003
$\Delta logM2_t$	0.15101	0.1461519	0.057
$\Delta logOIL_t$	0.1946854	0.9529984	0.041
$\Delta logFOOD_t$	0.2973023	0.2527206	0.085
D_1	0.2001171	0.2986636	0.001
D_2	0.0814431	0.3751117	0.001
D_3	-0.1569746	0.3660008	0.012
$\_cons$	0.3802867	0.3072703	0.0216
$R-squared =$	0.7556		
J-test	15.0165 (0.3063)		

Note: p-value for J-test in parentheses

Table 5: Variations of R-squared when excluding each independent variable

Excluded variables	R-squared
π_{t-1}	53.74%
π_{t+1}	55.46%
GAP_t	66.92%
$\Delta logM2_t$	67.03%
$\Delta logOIL_t$	66%
$\Delta logFOOD_t$	67%

The table 4 reports the estimation of hybrid NKPC by GMM method and the table 5 describes the changes of R-squared when I exclude each explanatory variable, one by one to see the importance of each independent variable to the model, keep other variables remaining in the model.

From the table 4, we can see that test for valid instrument has a p-value for the J-test larger than 0.05 indicating that the instruments are appropriately chosen. All the variables are statistically significant and have the expected signs. The model has R-squared value of 0.7556, which means that my estimated regression line explains 75.56% of the variation of inflation rate.

The estimation presents the fact that inertia inflation plays an important role in inflation behavior. With one percentage point increases in inertial inflation, we should expect the inflation rate this year will increase accordingly by 0.56 percentage point, which means there is high persistence in inflation dynamics in Vietnam for this period. This is similar to expectation and other empirical studies for the case of Vietnam. Study of IMF (2006) recorded the presence of inflation inertia with a lag of 12 months. Expected inflation also reflects the behavior of inflation in Vietnam. One percentage point of next year inflation expectation raises 0.56 percentage point of this-year inflation. Thus, both inflation expectation and inertial inflation play important role in the high inflation problem in Vietnam for the study period; that is, when I exclude inertia inflation and expected inflation one by one from the model, the R-squared reduced from 75.56% to 53% and 55%, respectively, which can be seen in table 5.

Vietnam's inflation in this period has positive response and seems to be sensitive to the variations of output gap. This partially explains for the fluctuation of inflation rate over the

period 1995:1-2009:4. Whenever inflation has positive response to output gap, the inflation is considered to be caused by exceed demand.

Broad money supply is also a significant variable; that is, the changes in two quarters of broad money supply will increase the inflation rate up to 15%. The changes in two quarters of global oil price and global food price totally affect the inflation rate, as the slopes between those two exogenous variables and inflation rate are 0.194 percentage point and 0.297 percentage point, respectively. As shown in table 5, the R-squared decreased to 66% and 67% when I exclude broad money supply, global oil price and global food price from the model. It means that those of three explanatory variables have explanatory meanings to changes of inflation rate. These results are consistent with the findings of empirical studies in inflation in Vietnam which are mentioned in previous sections.

For dummy variables, the result shows that the coefficients of three dummy variables are significantly different from zero.

8. Conclusions

In this thesis, I estimate a hybrid NKPC for Vietnam, using quarterly data for the period 1995:1-2009:4. My results using Generalized Methods of Moments (GMM) tend to support the hybrid NKPC. The estimated hybrid NKPC based on inertial inflation, expected inflation, output gap, broad money supply, global food price and global oil price provides a good description of the evolution of inflation in Vietnam during the period under analysis. All the variables are significance and have expected signs. Therefore the hybrid NKPC can be a useful tool for analyzing inflationary dynamics.

The inertial inflation and the expected inflation both highly affect inflation, explaining high inflation persistence. Thus, one of the major objectives of modern monetary policy is to control inflation expectations, because controlling inflation is the first step in controlling inflation.

The output gap also plays an important role in inflation dynamics in Vietnam. A positive output gap is indicative of demand pressures and a signal that inflationary pressures are increasing and that policy may need to tighten. That makes sense for Vietnam – a developing country. The economy's capacity to produce is always on pressures to satisfying the increasing demand for manufacturing, building industrial sectors, and simulating exports and investments. This tends to put upward pressures on prices, bringing inflation go up.

Broad money supply is a significant variable. Inflation also depends on the global oil price and global food price, meaning that Vietnam's inflation rate is vulnerable to the fluctuation of international prices in world market. The inclusion of any of these variables should not alter the results that the inertial inflation, inflation expectations and output gap is a useful indicator of inflationary pressures, but is likely to improve the forecast performance.

Because this study is a primary work in the estimation of hybrid NKPC, there are some limitations with respect to the model and the data may affect accuracy of the results, which are need to be included in further investigation. It is necessary to analyze more in detail how robust my estimates are to weak identification. GMM estimation of the structural parameters of the NKPC may be inaccurate because of weak instruments. Therefore, further research should test whether the instruments are not only valid but also relevant. Also, in further studies, it is better to include other international good prices into hybrid NKPC to see how much vulnerable inflation rate in Vietnam to the changes of those prices. Previous study results are very important for comparing with the results obtained in this investigation. The lack of similar empirical works for the Vietnam economy prevents me from evaluating the results of my estimates.

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Appendix

Appendix 1: The Hodrick-Prescott Filter method

The HP filter is a flexible de-trending method that is widely used in empirical macro research. It smoothes actual output, removing trend from the data by solving a least square problem. Thus, potential output is a weighted average of past and future actual value.

Let's suppose that the original series x_t is composed of a trend component g_t and a cyclical component c_t

$$x_t = g_t + c_t$$

This decomposition assumes that series being de-trended does not contain any seasonality and, because the cycle is derived residually, it does not separate out the cycle from any irregular movements. The resulting cycle is therefore measured with error. HP minimizes the variance of c_t subject to a penalty for variations in the second difference of the growth term (W. A. Razzak & Richard Dennis, 199). Their filter is given by:

$$\sum_{t=1}^{T}(x_t - g_t)^2 + \lambda \sum_{t=2}^{T-1}[(g_{t+1} - g_t) - (g_t - g_{t-1})]^2 \quad (15)$$

The first term is a measure of the fitness of the time series while the second term is a measure of the smoothness. λ is called the "smoothing parameter" and penalizes the variability in the growth component. The larger the value of λ, the smoother the growth component and the greater the variability of the output gap (Araujo, Areosa & Guillen, 2004). In the literature, the following values are suggested:

100	Yearly data
1600	Quarterly data
14400	Monthly data

The main advantage of the HP filter is that it produces an output gap that is stationary and it allows the trend to follow a stochastic process. Although this technique can be very useful, it also has several drawbacks. This method will usually produce a potential output series that approximates the average level of actual output over time; that is, the estimated output gap will generally have an average value close to zero. This technique thus does not allow for the possibility that output maybe above potential more often than it is below or vice versa. In

addition, output gaps derived from the HP filter will not necessarily be consistent with the concurrent behavior of inflation (Jane T. Haltmaier, 1996).

Appendix 2: Generalized Method of Moments (GMM)

I follow the derivation of GMM method from Yazgan and Yilmazkuday (2005), *Inflation dynamics of Turkey: A structural estimation.*

Estimation of hybrid NKPC under the rational expectation assumption typically involves the Generalized Method of Moment (GMM) to cope with the unobserved forward looking component of the hybrid model. GMM expresses the expected variable $E_t\{\pi_{t+1}\}$ as a function of an instrument set, without referring to the structure of the process driving the forcing variable. The use of instruments which reflect information on available in real time, helps avoid the possibility that the error term in the equation is correlated either with the demand variable or with the difference between lagged and future inflation.

Since under rational expectations, the error in the forecast of $\{\pi_{t+1}\}$ is uncorrelated with information dated t and earlier, it follows equation (12) that

$$E_t\{(\pi_t - \lambda\rho y_t - \gamma_b\pi_{t-1} - \gamma_f\pi_{t+1})z_t\} = 0 \quad (16)$$

where z_t is a vector of variables dated t and earlier (and, thus, orthogonal to the inflation surprise in period *(t+1)*. The orthogonality condition given by equation (7) then forms the basis for estimating the model via GMM.

Since nonlinear estimation using GMM is sometimes sensitive to the way orthogonality conditions are normalized in small samples, I use two alternative specifications or the orthogonality conditions. By using equations (4) and (7), the alternative specifications are as follows:

$$E_t\{(\theta\pi_t - (1-\omega)(1-\theta)(1-\beta\theta)\rho y_t - \theta\beta\pi_{t+1} - \omega\pi_{t-1})z_t\} \quad (17)$$

Appendix 3: The Augmented Dickey-Fuller (ADF) Test

I follow the derivation of the ADF test from Gujarati (2009), *Basic Econometrics*

We start with Y_t - a time series

$$Y_t = \rho Y_{t-1} + u_t \quad -1 < \rho < 1 \tag{18}$$

u_t denotes a white noise error term

We know that if $\rho = 1$, that is, in the case of the unit root. However, we cannot estimate the equation (9) by OLS and test the hypothesis that $\rho = 1$ by the usual t-test because the test is severely biased in the case of a unit root. Therefore, we manipulate equation (9) as follows: Subtract Y_{t-1} from the both sides of equation (9) to obtain.

$$\begin{aligned} Y_t - Y_{t-1} &= \rho Y_{t-1} - Y_{t-1} + u_t \\ &= (\rho - 1)Y_{t-1} + u_t \end{aligned} \tag{19}$$

which can be alternatively written as:

$$\Delta Y_t = \delta Y_{t-1} + u_t \tag{20}$$

where $\delta = (\rho - 1)$ and Δ, as usual, is the difference operator

In practice, therefore, instead of estimating equation (9), we estimate equation (11) and test the null hypothesis that $\delta = 0$, the alternative hypothesis testing being that $\delta < 0$. If $\delta = 0$, then $\rho = 1$, that is we have a unit root, meaning the time series under consideration is non-stationary.

Dickey and Fuller (DF) have shown that under the null hypothesis that $\delta = 0$, the estimated t-value of the coefficient of Y_{t-1} in equation (11) follows the **τ (tau) statistic.** To allow for the various possibilities, the DF test is estimated in three different forms, that is, under three different null hypotheses.

Y_t is a random walk:

$$\Delta Y_t = \delta Y_{t-1} + u_t \tag{21}$$

Y_t is a random walk with drift:

$$\Delta Y_t = \beta_1 + \delta Y_{t-1} + u_t \tag{22}$$

Y_t is a random walk with drift around a deterministic trend:

$$\Delta Y_t = \beta_1 + \beta_2 t + \delta Y_{t-1} + u_t \quad (23)$$

In conducting the DF test, it was assumed that the error term u_t was uncorrelated. But in case the u_t are correlated, DF have developed another test, known as the augmented Dickey-Fuller (ADF) test. This test is conducted by augmenting the preceding three equations by adding the lagged values of the dependent variable ΔY_t. To be specific, suppose we use equation (23). The ADF test here consists of estimating the following regression:

$$\Delta Y_t = \beta_1 + \beta_2 t + \delta Y_{t-1} + \sum_{i=1}^{m} \alpha_i \Delta Y_{t-i} + \varepsilon_t \quad (24)$$

where ε_t is a pure white noise error term and where $\Delta Y_{t-1} = (Y_{t-1} - Y_{t-2})$, $\Delta Y_{t-2} = (Y_{t-2} - Y_{t-3})$, etc. The number of lagged difference terms to include is often determined empirically, the idea being to include enough terms so that the error term in equation (15) is serially uncorrelated, so that we can obtain an unbiased estimate of δ, the coefficient of lagged Y_{t-i}. In the ADF test, we will test whether $\delta = 0$ and the ADF test follows the same asymptotic distribution as the DF statistic, so the same critical values can be used.

Appendix 4: Data

OBS	TIME	INF	GDP	M2	FOOD	OIL
1	1995q1	0	37548.86	8598937	102.7	17.2
2	1995q2	4.6875	48500.62	11106960	101.9	18.2
3	1995q3	1.492537	50221.61	11501078	107.2	16.4
4	1995q4	1.470588	58865.67	13480625	109.5	17
5	1996q1	1.449275	42626.88	11228328	116.6	18.3
6	1996q2	1.428571	55181.81	14535417	121.7	19.5
7	1996q3	0	54326.28	14310061	117.6	20.6
8	1996q4	1.408451	63523.25	16732631	108.6	23.1
9	1997q1	0	44402.88	13552915	116	21.1
10	1997q2	0	56659.93	17294085	116.7	18.5
11	1997q3	1.388889	61077.09	18642317	112	18.7
12	1997q4	1.369863	71437.76	21804664	113.1	18.8
13	1998q1	1.351351	46228.64	16517606	113.7	14.2
14	1998q2	4	62127.38	22198264	109.8	13.3
15	1998q3	2.564103	59603.15	21296350	103.5	13
16	1998q4	1.25	73134.2	26131027	103.3	11.9
17	1999q1	1.234568	49486.13	28090245	98.3	11.6
18	1999q2	0	65631.26	37254851	92.4	16

19	1999q3	0	65093.09	36949365	91	20.4
20	1999q4	-1.21951	78675.51	44659271	90.5	23.8
21	2000q1	0	51722.88	37231942	91.1	26.6
22	2000q2	-1.23457	68279.66	49150103	92.1	26.8
23	2000q3	0	68991.2	49662288	93	29.9
24	2000q4	1.25	84754.36	61009166	95.4	29.7
25	2001q1	-1.23457	55581.65	4766093	98.7	26.1
26	2001q2	-1.25	73133.75	6271175	98.8	26.7
27	2001q3	1.265823	76351.63	6547107	100.6	25.2
28	2001q4	1.25	88082.29	7553003	97.9	19.3
29	2002q1	1.234568	58827.79	53362300	95.6	20.9
30	2002q2	1.219512	77998.5	70751931	92.5	25.2
31	2002q3	0	78625	71320219	97	26.9
32	2002q4	1.204819	93974.1	85243290	101.5	26.7
33	2003q1	1.190476	64222.41	72209422	96	31.3
34	2003q2	1.176471	84060.75	94514950	95.1	26.5
35	2003q3	0	81034.56	91112412	96.4	28.4
36	2003q4	1.162791	100536.7	113039880	103.2	29.4
37	2004q1	2.298851	69587.52	95125878	103.2	32.1
38	2004q2	3.370786	90608.75	123861820	105.8	35.6
39	2004q3	2.173913	88035.46	120344144	105.4	40.6
40	2004q4	1.06383	111992.4	153093209	106.1	42.7
41	2005q1	2.105263	74675.89	123229010	107.9	46.1
42	2005q2	2.061856	98257.75	162143434	108.4	50.8
43	2005q3	2.020202	97000.05	160067998	109.9	60
44	2005q4	1.980198	117516.3	193923547	112.5	56.5
45	2006q1	1.941748	80523.11	159203330	113.4	61
46	2006q2	0.952381	105492.5	208570660	115	68.3
47	2006q3	1.886792	108044.7	213616724	116.2	68.8
48	2006q4	1.851852	130589.5	258190292	121.2	59
49	2007q1	1.818182	84887.3	230735527	119.5	57.2
50	2007q2	1.785714	113952	309737365	128.8	66.1
51	2007q3	2.631579	118528.5	322177019	147.1	73.6
52	2007q4	4.273504	143717.9	390645279	162.4	87.6
53	2008q1	7.377049	83868.32	258816004	173.8	95.5
54	2008q2	8.396947	122614.5	378385971	181.1	121.1
55	2008q3	4.929577	127519.1	393521410	171.7	115.5
56	2008q4	1.342282	153022.9	472225692	131.2	56.1
57	2009q1	0	97631.35	361100917	123.4	44.2
58	2009q2	0	131724.8	487199650	132.7	59.2
59	2009q3	1.324503	133274.5	492931411	135.7	68.2
60	2009q4	3.267974	153317.4	567062181	147.8	75.5