Macroeconomic Determinants of Vietnam's Inflation 2000-2010: Evidence and Analysis

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All errors and mistakes are made by authors only. For comments and suggestions, please contact us at nguyen.thuhang@vepr.org.vn.

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Abbreviations

ADF	:	Augmented Dickey-Fuller
CPI	:	Consumer Price Index
ER	:	Exchange Rate
FDI	:	Foreign Direct Investment
FII	:	Foreign Indirect Investment
GSO	:	General Statistics Office Of Vietnam
HCMC	:	Ho Chi Minh City
IFS	:	International Financial Statistics
IRRS	:	International Rice Research Institute
IMF	:	International Monetary Fund
M2	:	Broad Money
MoF	:	Ministry of Finance
NKPC	:	New-Keynesian Phillips Curve
PI	:	Import Price Index
PPI	:	Producers' Price Index
PPP	:	Purchasing Power Parity
SBV	:	State Bank of Vietnam
SOCB	:	State-owned Commercial Bank
UNDP	:	United Nations Development Programme
USD	:	United States dollar
VAR	:	Vector Autoregression
VECM	:	Vector Error Correction Model
VND	:	Vietnam dong
WB		World Bank
WTO	:	World Trade Organization

Policy Research Note

As macroeconomic stability is the key item on Vietnam's policy agenda in 2010, inflation is one of the four most pressing issues regarding macroeconomic stability at the moment (together with exchange rate management, budget deficits and trade deficit). For more than two decades now, inflation, especially its determinants and evolution, has been one of the most debatable topics in Vietnam. The reason is obvious: Vietnam underwent hyperinflation during the 1980s and early 1990. The persistent hyperinflation was one of the reasons that triggered the economic reforms in Vietnam since late 1980s. With the only exception during 2000-2003 when inflation was low and stable at 5% or below, inflation rate in Vietnam has been higher, more persistent and more volatile than those of its trading partners. Understanding the causes and consequences of these issues is essential for assessing the impact of macroeconomic policy on the economy.

Recent events such as the joining the WTO, the great influx of foreign exchange in 2007-2008, the problems in the foreign exchange markets in 2009 and 2010 and the global economic crisis as well as the threat of returning inflation have posed many new challenges for macroeconomic management and in particular inflation control in Vietnam. These many changes in macroeconomic environment and economic policy during the past few years have posed the need for a systematic and thorough approach to identify the key macro determinants of inflation in the new context of Vietnam.

In this study, we use an evidence based approach to identify and analyze the key drivers of inflation in Vietnam in recent years. The literature on inflation in Vietnam, which is mainly not up-to-date with recent events and changes, focuses on the demand-pull factors of inflation and ignores the cost-push factors. The only consideration for supply side factors is the inclusion of world prices (often as external supply shock). Also, one important demand factor that has not been studied (quantitatively) is the role of budget deficit and public debt on inflation. The study is expected to provide the current policy debates in Vietnam with a reliable, scientific and evidence-based macroeconomic research on the main causes of inflation. As controlling inflation is one of the key concerns of the policy agenda this year and the next, this study hopes to clarify the problem and contribute to the macro policy making process.

We start the study with a short overview of the Vietnamese economy over the past decade as well as a historical review of inflation dynamics in Vietnam during 2000-2010. The observations we receive from this overview combined with our thorough review of the literature on inflation determinants in Vietnam as well as in other emerging economies have helped us to build a model to study empirically the macroeconomic determinants of Vietnam's inflation. The model used in the paper specifies three channels through which various endogenous and exogenous variables can affect prices. These channels are the purchasing power parity (PPP) channel, the aggregate demand (AD) channel and the aggregate supply (AS) channel. The model is built with 12 variables using monthly data of CPI, industrial production, money supply M2, credit, interest rate, exchange rate, producers' price index PPI, cumulative budget deficits, trading value of the stock market, import price index, world oil price and world rice price over the period from 2000-2010. The variables are estimated using a Vector Error Correction Model.

The empirical findings from the model provide useful policy insights.

***First*,** it is found that the role of the public's memory and expectation on inflation are both crucial in shaping the current inflation. This implies the significant role of credibility of government's policy toward inflation.

Memory about a period of high inflation in the past seems only to begin to fade away after 6 months of consistently low and stable inflation. This implies that for fighting inflation, only by

successfully keeping inflation low for at least 6 months, can the government start to rebuild the public's confidence about a more stable environment of the general price level. This is a good suggestion for the government to be patient in fighting inflation. Six months can be considered as a lower threshold for the government efforts to maintain a low inflation environment in order to rebuild its credibility concerning a serious commitment against inflation, and therefore macroeconomic stability.

It is also shown that most of the changes in major macro variables (such as exchange rate, money and credit growth) affect the consumer price index several months before the producer price index. This implies the relative strength of expectation channel vs. the real channel (transmitting through the real production process).

The combination of a long memory and sensitive expectation in affecting the inflation explains a fact that it is hard to fight inflation when it is high, and it is also hard to maintain price stable when it is low. In other words, inflation is very sensitive to the current conditions, especially those that can lead to changes in the public's expectations. Low inflation is in fact an unstable or fragile condition, while high inflation tends to be self-containing in the Vietnamese economy.

Second, despite the government's common explanation that inflation is mostly imported, inflation is basically an internal problem. We find that the world prices tend to play a less significant role than other factors. The world prices, however, do have important effects on production prices. The production prices in fact do not intermediately transmit into consumer prices (inflation), but take some months to realize its impact.

Third, the speeds of adjustment of the foreign exchange market and the money market to disturbances are very low or even near zero. This shows that once these markets deviate from the long-run trend, it will take a very long time for the economy to revert back on track despite policy efforts. This has an important implication for policy against inflation: preventive measures with clear guidelines and targets for inflations are much better choices than trying to cope with high inflation after it already started. Also, a wrong choice of policy action will be hard to correct and high inflation will last long.

On the other hand, the speed of adjustment from disturbances in the supply side has higher (though still small) impact on inflation. Even though more careful experiments needed to be done with more data on the real side of the economy such as wages and input costs, this initial finding implies that stimulating the real economy through increasing productivity and output growth have better impact on controlling inflation in the longer run than monetary and non-monetary measures.

Fourth, the government did have reactions against inflation by both fiscal and monetary tools, but normally acted lately or passively in most of the cases. For fiscal tools, it is rather easy to understand and accept the fact, as it takes time for an adjustment in fiscal plan to be approved and implemented. However, monetary tools are also seen as being carried out at a considerable lag after the first signals of inflation occur. This may be explained with the fact that inflation specification is always a controversial issue, where the government is very reluctant to accept the situation of inflation. The government usually blames the worse situation for some "objective" or "external" reasons. It therefore takes time to turn the inflation issue from the public's consciousness to the government's one, and thus an appropriate monetary reaction. For example, it is shown in the paper that in most of the cases, interest rates are adjusted following the changes in CPI after about 3 months. These adjustments are indeed to make the interest rates more comparable with the current inflation rather than to be an action of tightening monetary policy to fight against inflation.

Even when a tightening monetary policy takes place, it takes more than 5 months in average to produce effects on the inflation. By that time, inflation rate has been high for 7 to 8 months. This

would have created a long memory on inflation and therefore the cost of fighting inflation will be high.

It seems that among monetary tools, raising interest rate has a prompt effect on inflation in comparison with the money growth and credit tightening. However, the effect of a change in interest rate is rather weak. Therefore, the monetary tools are not a really ones for quick response as assumed.

Fifth, in contrast to previous study results, the model found considerable role of exchange rate, a devaluation in particular, on increasing pressures on inflation. This difference in results may be explained partly by the fact that previous studies used data from periods when the exchange rate was mostly kept rigid. Recently, since late 2008, the exchange rate has been devaluated more often and with bigger magnitudes. In addition, recent episodes of distortions in the foreign exchange market, especially in the parallel black market, in 2009 and 2010 due to declining trust in VND, speculations and dollarization have increased public expectations about returning inflation. This may contribute to the larger impact of exchange rate on inflation found in this study.

Finally, the study did not show clear impact of budget deficits on inflation during the study period. This does not mean that budget deficits have no inflationary pressures. The reason for this is that the financing of budget deficits has two opposing impacts on inflation. On the one hand, financing budget deficits through government borrowing increases interest rate due to higher demand for funds in the loan markets. This is equivalent to tightening monetary policy and thus helps reduce inflation to some extent. On the other hand, financing budget deficits through money creation (if any) is equivalent to expanding money supply and thus causes inflationary pressures. These two opposing forces mitigate and sometimes cancel out each other's effect on inflation.

From the above characteristics of inflation in Vietnam, one may come to a policy implication that the Vietnamese government should have a strong commitment not only in fighting against inflation when it is high, but also, and more importantly, in keeping it low when it is low. This strategy is actually hard to follow as far as the government still prefers economic growth to macroeconomic stability.

Introduction

Macroeconomic stability is the key item on Vietnam's policy agenda in 2010. Four most pressing issues regarding macroeconomic stability currently are: inflation, exchange rate management, trade deficits and budget deficits. These problems that Vietnam is facing are inter-related and need to be addressed simultaneously.

For more than two decades now, inflation, especially its determinants and evolution, has been one of the most debatable topics in Vietnam. The reason is obvious: Vietnam underwent hyperinflation during the 1980s and early 1990. The persistent hyperinflation was one of the reasons that triggered the economic reforms in Vietnam since late 1980s. With the only exception during 2000-2003 when inflation was low and stable at 5% or below, inflation rate in Vietnam has been higher, more persistent and more volatile than those of its trading partners. Understanding the causes and consequences of these issues is essential for assessing the impact of macroeconomic policy on the economy. Vo Tri Thanh *et.al.* (2000), Carmen (2005), Packard (2005) and Baker *et.al.* (2006) are samples of comprehensive studies on monetary policy and inflation dynamics of the period before 2005.

However, recent events such as the joining the WTO, the great influx of foreign exchange in 2007-2008, the problems in the foreign exchange markets in 2009 and 2010 and the global economic crisis as well as the threat of returning inflation have posed many new challenges for macroeconomic management and in particular inflation control in Vietnam. The recent debate on inflation, such as Pham The Anh (2009), Vo Van Minh (2009) and Pham Thi Thu Trang (2009), has been putting the blame on loose monetary policy, rigid exchange rate management, market imperfections, and changes in world prices and in domestic food prices for driving up consumer prices. The many changes in macroeconomic environment and economic policy during the past few years have posed the need for a systematic and thorough approach to identify the key macro determinants of inflation in the new context of Vietnam.

In this study, we use an evidence based approach to identify and analyze the key drivers of inflation in Vietnam in recent years. The literature on inflation in Vietnam focuses mainly on the demand-pull factors of inflation and ignores the cost-push factors. The only consideration for supply side factors is the inclusion of world prices (often as external supply shock). Also, one important demand factor that has not been studied (quantitatively) is the role of budget deficit and public debt on inflation. The study is expected to provide the current policy debates in Vietnam with a reliable, scientific and evidence-based macroeconomic research on the main causes of inflation. As controlling inflation is one of the key concerns of the policy agenda this year and the next, this study hopes to clarify the problem and contribute to the macro policy making process.

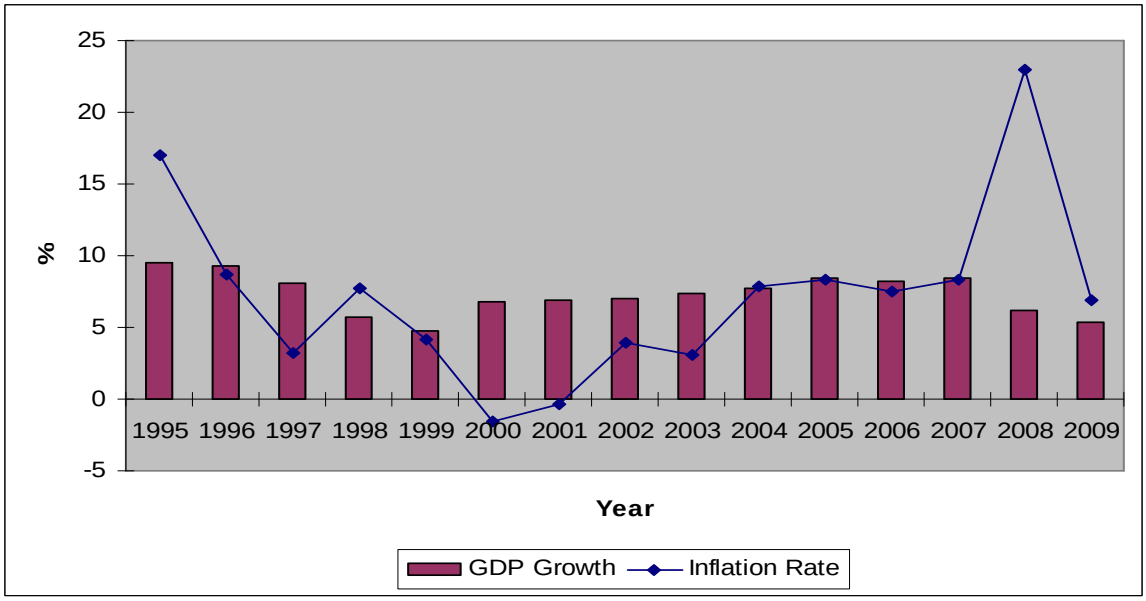
The paper is organized as follows. Section 2 provides a short overview of the Vietnamese economy over the past decade as well as a historical review of inflation dynamics in Vietnam during 2000-2010. Section 3 reviews the literature on inflation determinants in Vietnam as well as in other emerging economies. Section 4 outlines the theoretical framework, reports and discusses the empirical results. And the last Section provides some policy discussion and concluding remarks.

Overview of Vietnamese Economy and Inflation Dynamics, 2000-2010

Overview of Vietnam's economy

In comparison with the previous decade, Vietnam witnessed a period of low economic growth in the first decade of the 21st century. In the late 1990s, Vietnam's economic growth slowed down due to Vietnam's sign of hesitation in the process of economic reform from 1996. Concurrently, Vietnam was negatively affected by the spread of the 1997 Asian financial crisis. Consequently, the economy experienced a period of both declining growth rate and deflation in the years 1999-2001 (see Figure 1).

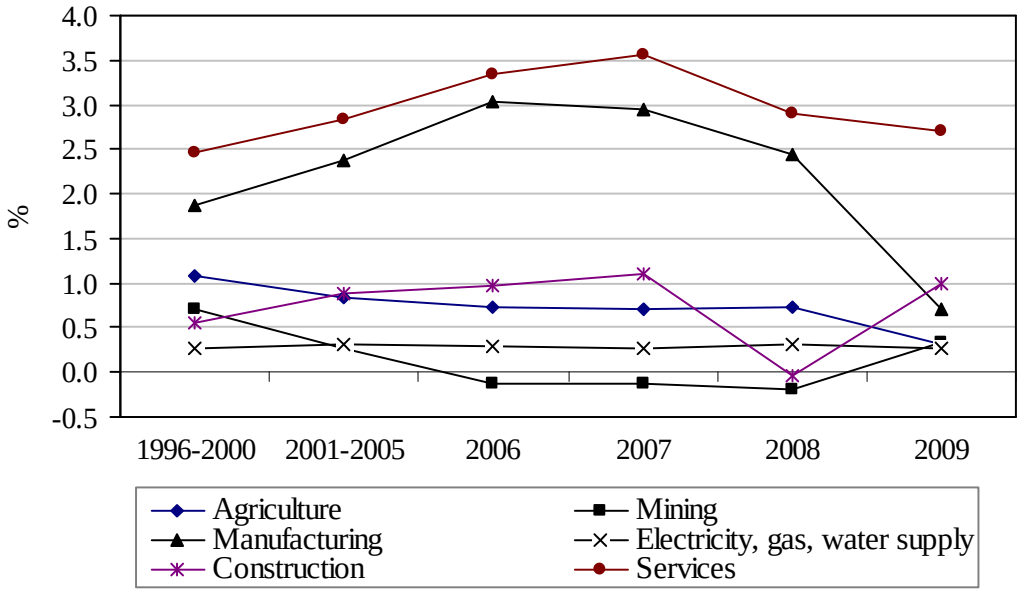
Figure 1. Economic Growth and Inflation, 1995-2009



Source: Authors synthesized from GSO (2010)

Under these circumstances, an economic stimulus plan of loosening credit and expanding State investment began to be implemented from 2000. In the following years, the relatively uninterrupted maintenance of the stimulus policy has somewhat helped the economy regain its growth on one hand, but has also agglomerated seeds of high inflation, which have been disclossured since mid-2007. In addition, joining the World Trade Organization (WTO) in 11/2006 led to a period of ever deepening integration, increasing trade exchange and international investment, and making a strong rise in capital influx (both direct and indirect investment). Demand for VND stability required State Bank of Vietnam to sterilize a large amount of foreign currency, thus contributing to high inflation in 2008. Overall, macro-control in this period proved embarrassing. These factors, together with the tremendous impact of the world economic crisis made the economy suffer a period of low economic growth and high inflation from 2008-2009.

Figure 2. GDP Growth Rate Contribution by Sector, 1996-2009

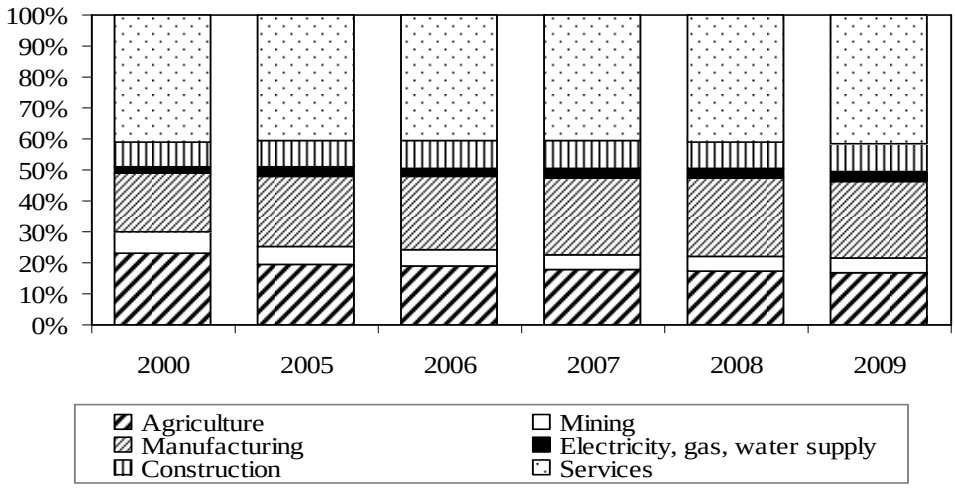


Source: Phạm Văn Hà (2010)

Figure 2 shows the level of contribution to GDP growth of the economy in the period 1996-2009 by major sub-sectors. It can be easily seen that for more than a decade services and the processing industries (manufacturing) have been a spring-board of economic growth. Due to the impact of the crisis, however, the contribution of the processing industry significantly decreased in 2009. Under the influence of economic stimulus packages, construction and services became the most important industries for growth. This is understandable because both industries, as non-trade industries, do not participate in international trade, and are thus the main objects of domestic stimulus policy. The third industry to become important was mining, due to the quick price recovery of raw materials and minerals, under great demand from China. That the mining industry became more important is not only pure chance in the context of recovery after the crisis, rather, as Coxhead (2007) has pointed out, it is likely to be part of a longer-term trend. It is the rise of China that has caused the Southeast Asian countries, which develop more slowly than China, to disperse from exporting processing goods, towards exporting resource-intensive goods. This is due to the attraction of price and profit from China's great demand. And he called it a "new resource curse".

Figure 3 shows the structural shift of GDP in the period of 2000-2009. Generally, the movement tendency matches common rules of the developing countries, with the narrowing rate of agriculture and expanding ones of services and industries.

Figure 3. Industry Shares in GDP at Constant Price, 2000-2009



Source: Phạm Văn Hà (2010)

Table 1 provides information on the growth rate of industrial output growth by ownership. It can be seen very clearly that the domestic sector grew strongly, followed by the FDI sector. The growth of SOEs slowed down, especially local SOEs constantly narrowing in particular. This shows, to some extent, the process of economic restructuring in the direction of expanding both domestic and foreign invested sectors. The SOEs grew more slowly, concentrating more on the central (including corporations and economic groups).

Table 1. Industrial Output Growth by Ownership, 2005-2009

Unit: %

	2005	2006	2007	2008	2009
Total	17,1	16,8	16,7	13,9	7,6
SOEs	7,2	5,9	5	2,7	1,6
Central	12,4	8,9	6,8	4,8	4,1
Local	-5,2	-2,9	-0,7	-4,5	-7,7
Non-State Sector	25,5	25,7	24,7	19,8	10,1
FDI Sector	21,2	19,9	19,7	16,9	9,2

Source: GSO (2010).

From the aggregate demand side of the economy, the growth rate of all components of aggregate demand decreased in 2009, especially negative net export growth. This explains why this year's growth rate was much lower than that of the same period in previous years (Table 2). Concurrently, the inflation rate's slowing down signals that the economy was growing below its potential line, due to suppressed demand.

Table 2. Growth Rate of Aggregate Demand's Components, 2005-2009

Unit: %

	2005	2006	2007	2008	2009
TOTAL	8,44	8,23	8,46	6,31	5,32
Investment	11,15	11,83	26,80	6,27	4,31
Fixed asset accumulation	9,75	9,90	24,16	3,82	8,73
Change in inventory	33,48	37,17	54,56	26,98	-26,18
Final consumption	7,34	8,36	10,63	9,17	4,03
State	8,20	8,50	8,90	7,42	7,60
Private	7,26	8,35	10,80	9,34	3,68
Net export of goods and services	-18,87	25,01	184,19	17,23	-8,19

Source: GSO (2010).

Table 3 shows the component structure of aggregate demand over time, in which the growing rate of final consumption and investment can be clearly seen. This must be paired with trade deficit (negative net exports) in order to create a macroeconomic balance.

Table 3. Final Demand Components in GDP, 2005-2009

Unit: %

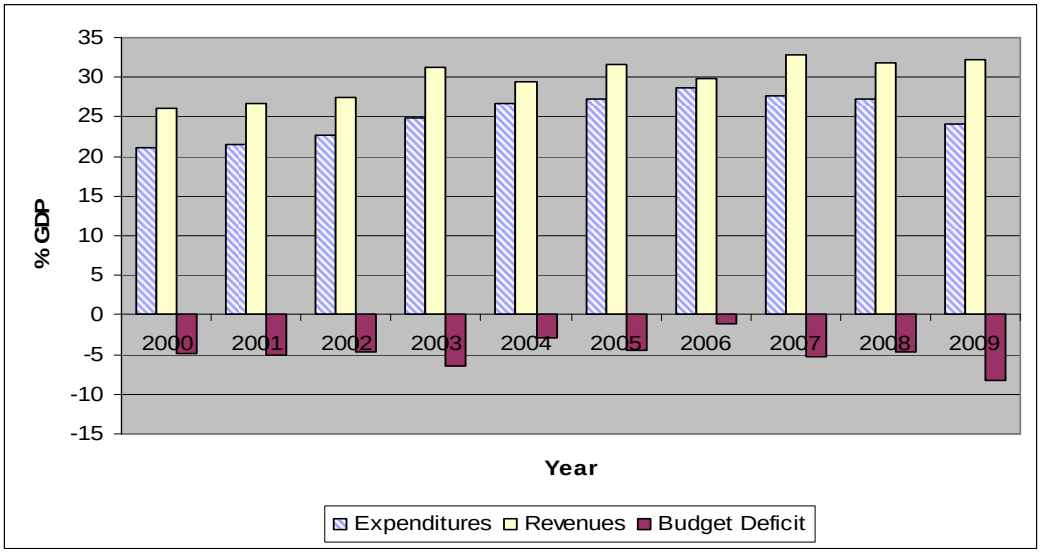
	2005	2006	2007	2008	2009
TOTAL	100	100	100	100	100
Investment	35,58	36,81	43,13	39,71	38,13
Fixed asset accumulation	32,87	33,35	38,27	34,61	34,52
Change in inventory	2,71	3,46	4,86	5,10	3,61
Final consumption	69,68	69,38	70,81	73,53	72,77
State	6,15	6,03	6,05	6,12	6,30
Private	63,53	63,35	64,76	67,41	66,47
Net export of goods and services	-4,18	-4,56	-15,85	-15,21	-10,35
Error and omissions	-1,08	-1,63	1,91	1,97	-0,55

Source: GSO (2010).

An interminable high deficit is a fundamental characteristic of Vietnam's state budget. At the same time, public debt has continuously increased over the past 10 years.

Figure 4 shows budget revenue (in GDP) increasing continuously and steadily from about 21% of GDP in 2000 to nearly 28% of GDP in 2007. However, budget expenditure increased just as rapidly as budget revenue, creating a persistent deficit at 5% of GDP. The deficit was particularly high in 2009 due to the implementation of a large economic stimulus package against the economic slowdown.

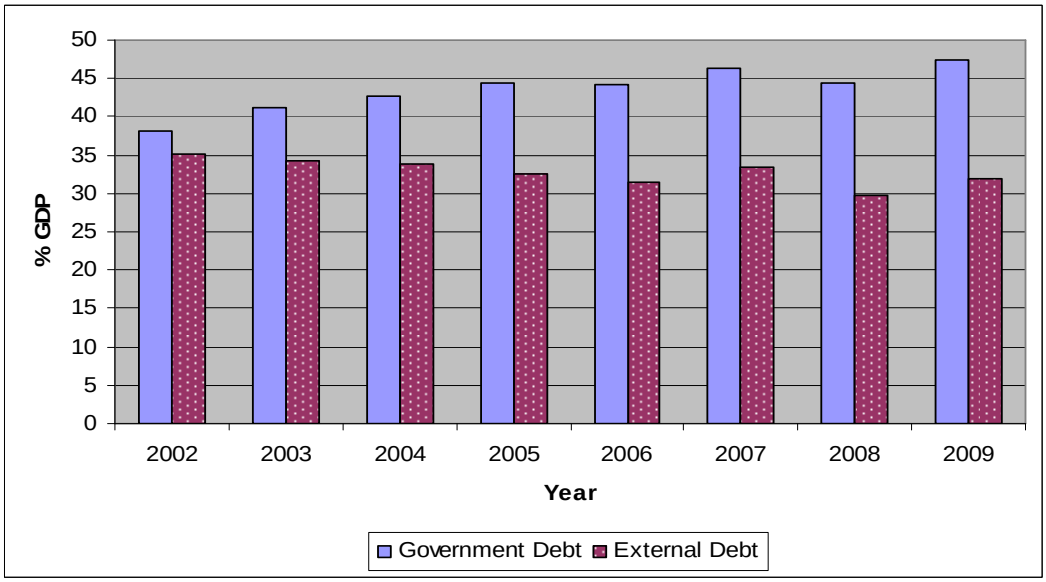
Figure 4. Revenues - Expenditures and Budget Deficits, 2000-2009



Source: Authors synthesized from IMF (2003, 2006, 2009)

Public debt (including government debt and debt guaranteed by government) has gradually increased its proportion in GDP over the past decade, from less than 40% of GDP to approximately 50% of GDP in 2009. Meanwhile, foreign debt has been mostly stable at below 35%, and only increased during the years influenced by world economic crises.

Figure 5. Public Debt and External Debt, 2000-2009

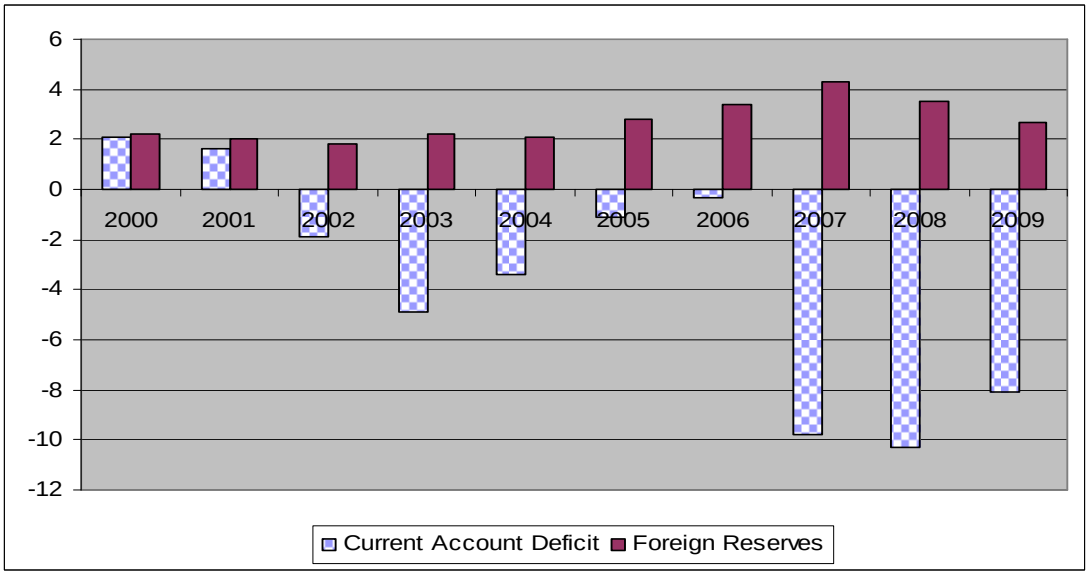


Source: Authors synthesized from IMF (2003, 2006, 2009)

International trade is a field currently undergoing special development in Vietnam as the country is increasingly integrating into the global economy, signing more and more bilateral free trade agreements, and participating in multilateral organizations such as the World Trade Organization.

Such deep integration, however, has brought not only many opportunities but also many new challenges for Vietnam. It is worth noting that since 2002 the current account has returned to the deficit that mainly originated from trade deficits. However, remittance flows have begun to rise, which has somewhat helped to balance the current account. Also, this is a relatively stable period for capital inflows into Vietnam, thus creating a capital surplus and overall balance surplus. As a result, the country's foreign exchange reserves have continuously improved (Figure 6). In 2007, the first year of Vietnam's joining the WTO, the current deficit skyrocketed, but the capital account surplus also increased at a faster rate. However, with the slowdown of capital flow under the world economic crisis in 2008, the current account deficit has not narrowed. As a result, Vietnam was forced to strongly reduce foreign exchange reserves, in order to offset the foreign exchange deficit.

Figure 6. Current Account Deficit and Foreign Exchange Reserves, 2000-2009

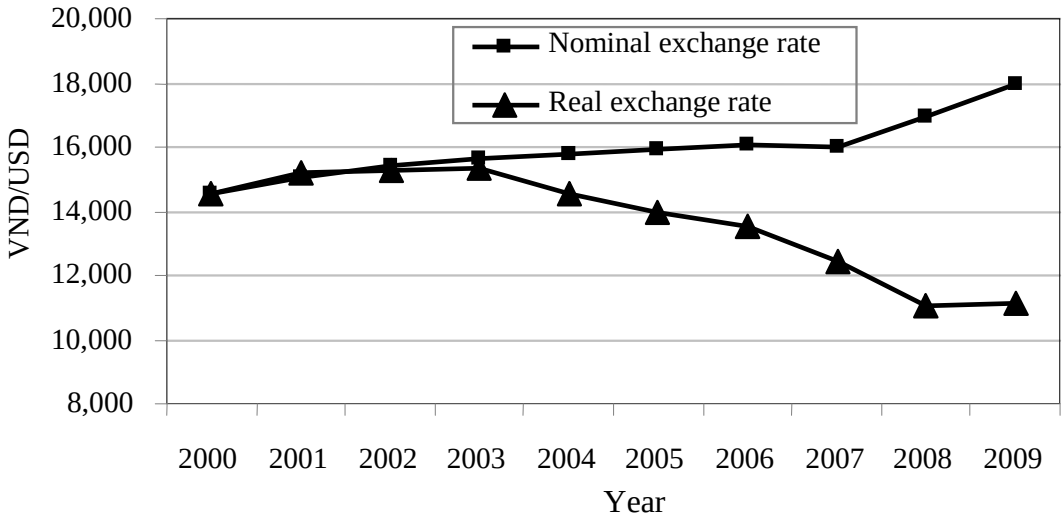


Source: Authors synthesized from IMF (2003, 2006, 2009)

A continuous deficit of the current account, along with high domestic inflation, caused exchange rates to become a problem. Looking back at nominal VND/USD exchange rates over the past decade, we can see a clear depreciation trend especially since 2007. However, real exchange has exhibited an opposite trend, with a widening gap between nominal and real exchange rates, especially in 2008 and 2009. Vietnam's CPI (consumer price index) increasing by 99.5% during the period from 2000 to 2009, while that of the US increased by only 23.7% over the same period. The VND/USD rate increased only 23.6% over the period. Thus, if we take the year 2000 as the base year, then the VND has appreciated by 38% in real terms. This would have contributed to a more severe trade deficit of Vietnam after 2003.

Figure 7. Real and Nominal Exchange Rate VND/USD, 2000-2009

(base year=2000)



Source: Nguyen Thi Thu Hang et al. (2010)

In short, the macroeconomic characteristics of Vietnam can be summarized as follows:

- Growth rates are high in comparison with regional ones but tend to slow down; at the same time, growth still heavily depends on investment expansion.
- The economy is becoming increasingly unstable with its integration into the world economy (stronger fluctuation of inflation);
- The budget is in interminable deficit, in addition to a trade deficit (dual deficit);
- Even when supported by a large remittance flow, the current account balance remains in deficit. The overall balance sheet is supported by a high level of capital account surplus. However, under the influence of international conditions, capital flows tend to be gradually less stable, leading to the probability of high fluctuation from surplus to deficit.
- With the exchange rate pegged flexibly on the USD (crawling peg), domestic currency tends to appreciate.

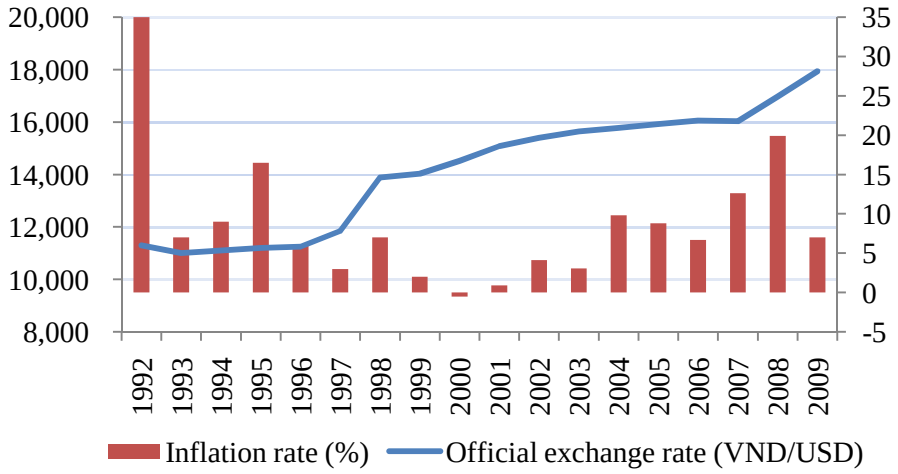
Vietnam's inflation dynamics with key changes in policy and economic environment

Vietnam experienced hyperinflation during the latter half of the 1980s (above 300% per annum) and early 1990s (above 50% per annum). The main reasons for this were the unfavorable weather and food shortages, sluggish growth in both agriculture and manufacturing and weak financial system during the 1980s. These crises were followed by price liberalization and a series of structural economic reforms causing inflation to soar greatly becoming a crisis itself.

Faced with these crises, SBV had to aggressively tighten monetary policy with monthly interest rate raised to 12% and exchange rate pegged rigidly against USD. As a result of these policies, inflation started to fell sharply to below 20% in 1992 and close to 10% in 1995. This was a remarkable feature of Vietnam's emergence in the global economy during the second half of the 1990s.

The government continued its prudent macroeconomic policies along with far-reaching reforms to liberalise domestic prices and open up Vietnam's economy to international trade and investment during the 1990s. The period after 1995 was characterized by modest inflation and even the first ever slight deflation in Vietnam in the year 2000 with annual inflation rate reported at -0.5%. Interest rate had also been gradually liberalized since the mid-1990s with the basic interest rate were introduced to replace the ceilings for lending rates in August 2000. And since 2002, commercial banks in Vietnam have been able to legally set lending rates and deposit rates according to market conditions.

Figure 8. Vietnam's inflation rate and nominal ER VND/USD, 1992-2009

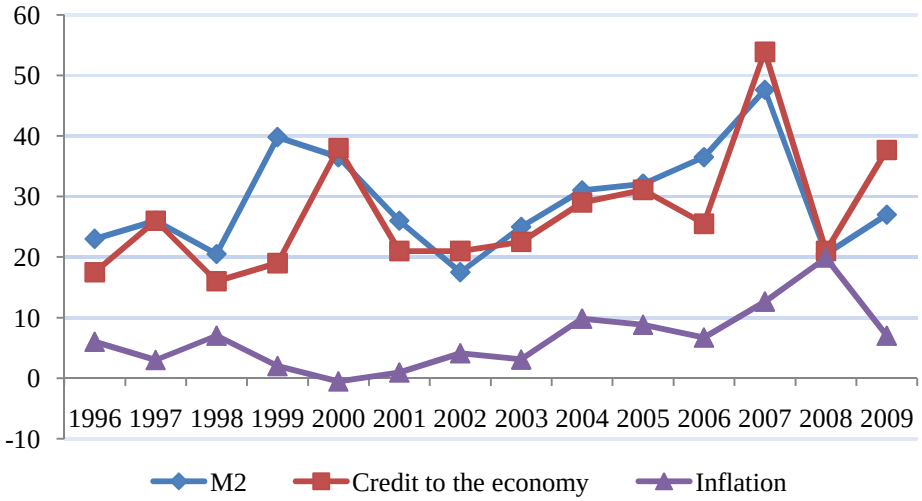


Source: GSO and SBV, 2010

The period of late 1990s and early 2000s witnessed the aftermath of the 1997-1998 Asian Crisis which caused sharp decline in world prices as well as aggregate demand (domestic and international demand for Vietnamese goods). These are the main reasons why despite rapid increases in money and credit (30-40% per annum) and large devaluations of VND (total of around 36%) during 1997-2003, inflation stayed at modest levels.

Camen (2006) suggests the rapid rate of monetization in Vietnam as reflected in a strong decline in velocity as another reason for the seemingly lack of a connection between the inflation rate and growth of money and credit.

Figure 9. Vietnam's inflation rate, money and credit growth rate, 1996-2009



Source: IFS and SBV, 2010

After this modest period, inflation started to pick up again, with annual inflation rates of 9.5% in 2004 much higher than the 6% target set by the government. Figure 9 shows that money/credit and inflation appear to have higher level of correlation since 2003. As money/credit started to pick up again, so did inflation. As the adverse effects on growth of the Asian crisis subsided, demand started to pick up. This increasing demand coupled with rising nominal wages in both civil service sector and FDI sector in 2003 caused prices to rise. Contributing to this increase in inflation were the supply side shocks that were caused by the bird flu outbreaks and bad weather. The Vietnamese authorities appear to favor this latter hypothesis. These supply shocks primarily affected food prices with food prices increased by 15.5% compared to an overall inflation of 9.5% and non-food inflation of 5.2% in 2004.

Worried by the return in inflation, SBV started to tighten monetary policy causing the interest rates to increase slightly and keep the exchange rate rather rigidly again since 2004. However, the interest rate did not increase much mainly due to the facts that three quarters of loans were in the hand of SOCBs which did not often take into account full credit risks and that SBV and MoF continued to influence the interest rate by indirect measures other than monetary policy (Camen, 2006). At the same time, the rigid management of the exchange rate which lasted until late 2008 failed to repeat the success of stable inflation period of 2000-2003. Inflation rate, after going down slightly in 2006, peaked at 12.6% in 2007 and soared to 20% in 2008. (See Figure 8)

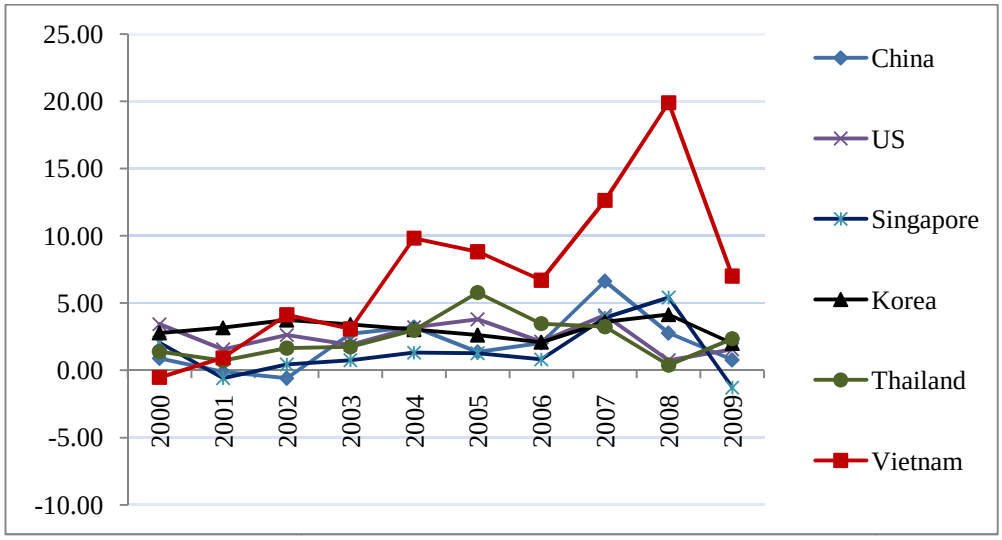
Many reasons have been cited for this strong return of inflation during 2007-2008. These include the large increase in minimum wage, the rising international commodity prices, the loose and not flexible monetary policy, the rigid and irresponsive exchange rate management, the opening up of Vietnam to the world economy since it joined the WTO in late 2006 which caused great influx of FII which in turn caused stock and asset prices to soar.

An expansionary monetary policy together with inflation expectation often leads to actual inflation in the next phase of the business cycle. ER policies amplify the impacts of contemporary monetary policy on the economy. The rapid increase in money and credit during this period contributed to the inflationary pressure. Vietnam's money and credit expansion has been strong for the past decade, reaching their peak in 2007 with money grew by 47% and credit grew by 54% per annum.

At the same time, Vietnam appeared to have the signs of the "impossible trinity" problem. Impossible trinity states that we cannot achieve at the same time all three of the following: (i) a fixed ER regime; (ii) free capital flows and (iii) the independence of monetary policy. Before (in the 1990s), in the closed economy where there were no free flows of capital, a relatively fixed ER arrangement accompanied by monetary policy to control inflation was feasible and in fact proved to be effective during 1992-1996. However, as the Vietnamese economy integrates more into the world economy, even though Vietnam has not yet completely freed its capital account, the easier flows of capital pose new challenges in implementing the policies in the impossible trinity.

Vietnam's balance of payments shows that for many years before 2006, foreign exchange inflow to Vietnam was not large. Until 2005, foreign exchange inflows reached only around USD 9 billion (not including unofficial inflows). However, within only two years 2006-2007, foreign exchange actually flooded domestic market due to foreign indirect investment, making official reserves increase by 1.6 times the cumulative reserves. This situation posed new challenges for monetary policy in 2007. Within the first 6 months of 2007, SBV had to inject a large amount of VND (equivalent to roughly USD 9 billion) to buy foreign exchange to keep the ER stable. The excess supply of domestic currency was not timely sterilized. At the same time, raw material prices increased rapidly. The result was the rise of inflation, which for the first time in the decade reached double digits. However, even if the injected money had been sterilized, we would not be able to sustain the interest rate. This is an unprecedented and difficult task for SBV. It was clear that the policy of keeping stable the ER during 2005-2007 did not help control inflation, instead it contributed to the increased pressure for higher inflation due to the fact that SBV needed to buy USD to maintain the set ER. Clearly, international integration brings with it new challenges for SBV and ER management. High inflation rate led to unacceptably high interest rate during 2007-2008.

Figure 10. Inflation Rates of Vietnam and Selected Countries, 2000-2009



Source: Nguyen Thi Thu Hang et al. (2010)

Figure 10 shows that since 2004, Vietnam has been experiencing high, more volatile and more persistent inflation rate relative to that of its major trading partners.
The global economic crisis of 2008-2009 has contributed to the downward trend in Vietnam's inflation until late 2009. Declining international price accompanied with decreasing demand helped Vietnam to reverse the detrimentally upward trend of 2008. As the government's

stimulus packages were being accelerated during the second quarter of 2009, money supply started to increase strongly again and so did lending. Commercial banks found themselves running out of cash and trying to increase interest rate to attract household deposits. Thus, the interest rate competition began causing lending rates to rise (above the ceiling rate due to lending fees) as well. Although the increasing trend in interest rate of 2009 did not lead to unhealthy high levels of 2008, both lending and borrowing rates stayed at high levels. Prices started to rise again during the latter half of 2009.

In 2010, inflation was high during the first two months due to Tet holiday and the electricity price hike. The inflation rate was quite low and stable during the 5 months from April to August 2010. This implies the effectiveness of inflation control measures of the monetary authorities. However, inflation started to rise again since September 2010 making the CPI for the first 11 months already rose by 9.58% compared to 20.71% and 5.07% for the same period in 2008 and 2009 respectively (see Figure 11). Recent devaluation of the VND against USD in August and the fluctuations in both international and domestic gold prices have been cited as some of the main reasons for this new episode of high inflation.

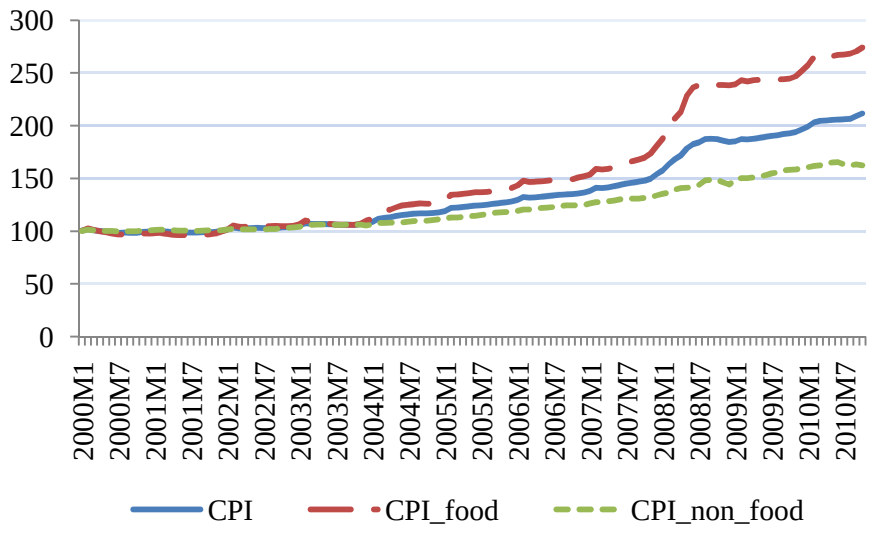
It is obvious that inflation rate is high and volatile in Vietnam. The year 2008 marked the highest level as well as volatility of inflation in Vietnam over the past decade. There are still potential threats that may cause higher inflation in 2010 which include (i) prices of key commodities such as electricity and petroleum are still depressed; (ii) VND is still under depreciation pressures despite considerable devaluations by SBV in 2010; (iii) increasing prices in China pushing up import costs of ongoing infrastructure projects which need imported materials from China and (iv) pressures for more monetary expansion. Part of these pressures as already been realized during the past few months of 2010.

The potential unfavorable effects of inflation on poverty and growth are well known. Inflation increases income inequality because it is similar to a regressive tax which has an adverse impact on the poor. If poor households holds most of their wealth in cash and bank deposits with little financial assets like those in Vietnam, high inflation rate will quickly erodes their purchasing power. High inflation can also hurt growth, cloud price signals and limit the quality and quantity of investment. It can also hurt a country's export competitiveness due to increases in domestic production costs and appreciations of the real exchange rate. (Easterly and Fischer, 2001).

These premises hold even stronger in Vietnam as food and food stuffs account for 40-50% of the consumption basket during 2000-2010. Before 2001, food and foodstuffs accounted for over 60 percent of the CPI basket. The share of food was reduced to 48 percent when the living standard survey of 2000 was released. Figure 11 shows that while non-food price has increased 1.7 times compared to that of the year 2000, food price has increased by more than 2.6 times over the same period with headline inflation increased by a little more than 2 times.

Figure 11. Vietnam's Monthly Food and Non-Food CPI, 2000-2010,

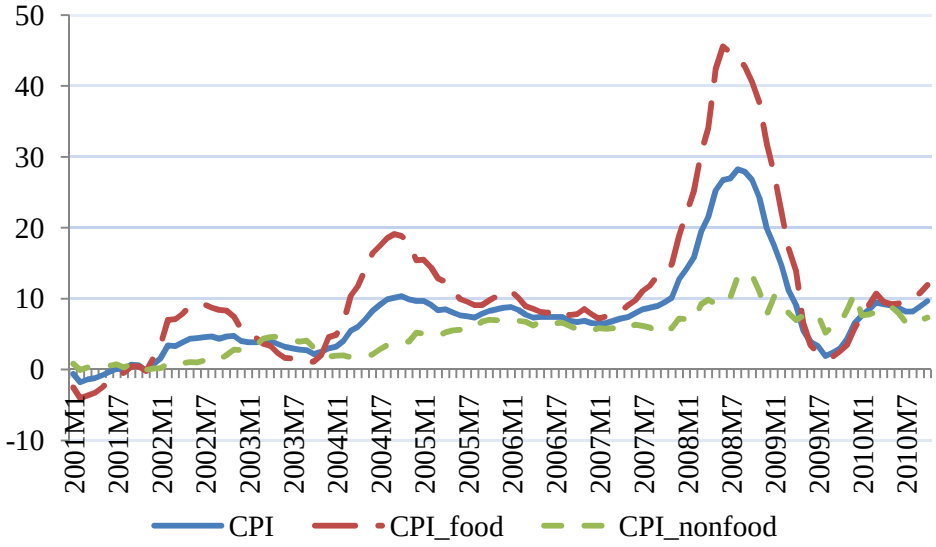
(base at beginning of 2000)



Source: GSO, 2010

Not only that food prices has increased much more than non-food crisis, Figure 12 shows that they are also much more volatile. Food prices moved more in line with headline inflation, showing two big spikes in 2004 and 2008. Non-food prices appear to have more persistent upward trend over the period of 2000-2010. Because food prices tend to move closely and sometimes more extreme than general prices, some have mistakenly blamed food-prices as one of the main determinants of inflation in Vietnam. As food comprises such a large share of the CPI basket and food prices are less rigid compared to other commodities in the basket, any change in other factors that can affect prices in general would be reflected almost immediately in food prices. In other words, food prices reflect changes in inflation but not the major cause of inflation itself. Blaming increasing in food prices as a cause of inflation may hinder one's ability to realize more sinister factors (such as monetary and fiscal policy that distorted aggregate demand or unfavorable shocks that affect supply), that actually cause food prices to go up in the first place. However, world food prices can be a source of increasing inflation due to the fact that Vietnam is a large player in world food market. Domestic food exporters seeing high world prices could try to increase domestic prices as well.

Figure 12. Vietnam's monthly year-on year food and non-food inflation, 2000-2010 (%)



Source: GSO, 2010

The above historical review of Vietnam's inflation dynamics during 2000-2010 has helped us to identify possible inflation determinants in Vietnam. These include external shocks, money and credit conditions, exchange rate management, government policies that affect aggregate demand, and other supply shocks. In the next section, we will review the literature on inflation determinants in the world and in Vietnam with the aim to arrive at a list of possible macroeconomic determinants of inflation for Vietnam. These will be the inputs for our model and analysis in Section 4.

Literature Review on Macroeconomic Determinants of Inflation

International Research

Inflation has been studied extensively in the literature from theoretical discussions to more empirical based research that goes into specific cases of individual countries. Some research studied the impact of inflation on the economy and welfare while other focused mainly on determinants of inflation. We will focus our attention on reviewing the literature on inflation determinants in this study.

We cannot begin to discuss inflation determinants without reviewing the classic ideas and models set forth and built upon by famous economists. The current inflation theory is mostly based on the Phillips curve model which was developed by Phillips (1958) and Lipsey (1950) based on the assumption that there exist a stable and negative relationship between unemployment rate and inflation rate.

(1)

Friedman (1960) and Phelps (1967) later added the role of (adaptive) expectations about inflation into the model and differentiated between long-run and short-run Phillips curve. However, in the 1970s, empirical results did not support the Phillips curve model and Sargent (1971) and Lucas (1972) (the leader of the rational expectation revolution) raised their criticism of the Phillips curve saying there is no systematic trade-off between inflation and unemployment.

More recently, building upon various criticism, the Phillips curve have been continuously modified by Fischer (1977) and Taylor (1979) who introduced nominal rigidities, Calvos(1983) who modeled random price adjustment and Gali and Gertler (1999) who introduced labor share into the model. As a result of these continuous modifications, the New-Keynesian Phillips Curve (NKPC) was built which has forward-looking characteristics, i.e., inflation is determined by forward looking manner. However, the NKPC had to be modified again as profound empirical evidence showing the dependence of inflation on its own lagged values. Woodford (2003) and Christiano, Eichenbaum, and Evans (2005) are among the recent studies that include inflation lags into the Phillips curve. The hybrid-NKPC takes the following form which has both forward- and backward-looking characteristics and a measure for inflationary pressures which captures the excess demand in the system among other.

$$\pi_t = \gamma_f E_t \pi_{t+1} + \gamma_b \pi_{t-1} + \theta x_t \quad (2)$$

As opposed to Keynesian position that the real economy is highly unstable and that monetary management has little control over it, the monetarist school (started by Milton Freidman) argues that the real economy is fairly stable but can be destabilized by changes in monetary growth and thus monetary policy is important. They formulate that an unexpected increase in the rate of growth of money supply raise economic growth (higher than expected) which lead to a reduction in unemployment rate (Okun's law), which in turn increase inflation rate via the Phillips curve. Unexpected growth in money supply can come from excessive monetary financing of budget deficits or too much credit extended to the private sector. Thus, the monetarist model of inflation determinants usually takes the following form.

$$\pi = \alpha_0 + \alpha_1 m + \alpha_2 y + \alpha_3 \rho \quad (3)$$

where *m* is the growth rate of money supply, *y* is the growth rate of income and *ρ* captures the opportunity cost of holding money. Interest rate and past inflation are known to be used as a measure for opportunity cost of holding money.

However, the monetarist approach to inflation originated from the developed world where the financial system is well developed and there are few structural bottlenecks such as those found in the developing world. The structuralist approach to inflation determinants identifies rigidities that caused inflationary pressures. Such inflationary pressures in developing countries can be caused by distorting government policies, productivity differences in different sectors of the economy, wage hikes, inelastic supply of food, foreign exchange constraints and government budget constraints. These rigidities lead to increase in prices and thus inflation (Akinboade *et.al.* 2004). The structuralists also view "real" shocks to the economy such as exogenous increase in import prices or sudden increase in budget deficits as causes for inflation. They called them "cost-push" factors to inflation because in essence those factors increase the cost of production, causing upward pressure in prices of certain part of the economy. More often than not, such factor induces an increase in money supply and thus inflation in one part spills over to the whole economy (Greene, 1989).

In addition to the monetarist approach and the structuralist approach to inflation, the literature on inflation dynamics and inflation determinants also comprises of a third and perhaps simplest approach to inflation: the purchasing power parity (PPP) approach. This stems from the Law of

One Price which state that in the absent of transport and other transaction costs, the relationship between world price and domestic price becomes

$$P = EP^w \quad (4)$$

where *E* is the exchange rate between domestic currency and foreign currency.

Equation (4) suggests that inflation is influenced either indirectly by higher import prices or directly through increase domestic demand. This equation also implies that exchange rate plays a certain role in determining price level and exchange rate pass-through need to be considered. Exchange rate devaluation can directly affect domestic prices of tradable goods but also indirectly affect the general price level if pricing decisions are affected by import costs. This is especially true for countries which rely on import of intermediate goods for production and/or has relatively high level of dollarization like Vietnam.

All of models suggested in the three approaches above have extensively been used, tested empirically and criticized in more recent literature. The PPP approach is criticized for being too simple, ignoring transaction costs (transportation costs and costs created by trade and non trade barriers), ignoring the non-tradable sector and assuming same method of price index calculation across countries. The evidence on the validity of PPP theory is for developing countries is mixed with PPP theory performs better for country that are geographically closed to each other and have strong trade relation, or in countries with high inflation that witnessed rapid exchange rate depreciation. (See more detailed review in Akinboade *et.al.*, 2004).

The monetarist approach is criticized for not taking into account structural rigidities and "real" shocks (cost-push factors) which have been proved to be important in developing countries by the structuralist approach. The structuralist approach by itself misses out many factors on the demand side suggested by the monetarists.

Thus, efforts have been made in response to such criticisms. A typical recent study on inflation determinants in a small open economy captures the elements of all three approaches. Chhibber (1991), for example, models inflation as a weighted average of inflation in tradable good, non-tradable good and controlled prices and applies it to study inflation determinants in various African countries. Tradable good inflation was model according to PPP approach. Non-tradable good inflation is modeled to depend on elements of both cost-push and demand-pull inflation.

Akinboade *et.al.* (2004) studied the relation between inflation in South Africa and money market, labor market and foreign exchange market. They showed that labor costs, broad money supply had positive correlation with inflation and effective exchange rate had negative impact on inflation in the short run. In the long run they found inflation correlated negatively with interest rate and positively with broad money supply. They also noted that monetary authorities in South Africa had little control over these determinants of inflation making it difficult to achieve inflation targets.

Byung-Yeon Kim (2001) studied the relative impacts of monetary, labor and foreign sector on Polish inflation for the period from 1990-1999 and showed that exchange rate and wage but not money play an important role in determining inflation. They suggested that Polish monetary policy was passive during the studied period.

Jongwanich and Park (2008) studied cross-country inflation determinants for nine developing Asian countries (including Vietnam) using a hybrid model that comprise both cost-push factors (exogenous oil and food inflation) and demand-pull factors (excess aggregate demand, exchange rate pass-through, import prices, producer price inflation and consumer price inflation). The authors found out that the 2007-2008 surge in Asia's inflation was caused mainly by excess aggregate demand and inflation expectations (demand pull) and not by the two cost-push factors even though the surge of inflation coincided with increase in international oil and

food prices. Overheating demand and years of lax monetary policy that gave rise to widespread inflation expectations fueled inflation in these countries.

Most of the empirical studies confirmed the important role of money factors on inflation in the long run. In the short-run, monetary factors, past inflation, public sector deficits and exchange rate are factors that contribute to inflationary pressures. Samples of such studies are Chhibber (1991) on Africa's inflation, Lim and Papi (1997) on Turkey inflation, Laryea and Sumaila (2001) on inflation in Tanzania, Akinboade *et al.* (2004) on South Africa's inflation, Lehayda (2005) on Ukraine's inflation and Jonguanich and Park (2008) on Asian developing countries' inflation.

The literature on the relationship between exchange rate and inflation, however, shows mixed results. For example, Chhibber (1991) shows that the impact of devaluation on inflation depends on the degree of exchange rate flexibility, openness of capital account and the level of price controls. In addition, many studies analyze structural and cost-push factors such as oligopoly pricing and cost pressures stemming from wage increases and devaluations. The results are mixed as well, with some of the studies found that markup pricing alone could not explain the causes of persistent inflation and had a relatively small impact on inflation while others found significant impact of rising labor costs on inflation in the long-run. Examples include Lim and Papi (1997), Chhibber (1991), Akinboade *et al.* (2004) and Leheyda (2005).

Bodart (1996) explored the inflation implications of exchange rate reforms in a small open economy by combining fiscal view of inflation with multiple exchange rate systems. He found that a fixed crawl of the official ER has only temporary effects on inflation while a depreciation has more permanent impact on inflation under a system of continuous adjustment of the official rate towards the parallel market rate. Also, long-run increase in fiscal deficit leads to permanently higher inflation.

Ito and Sato (2006) studied the exchange rate pass-through in post-crisis Asian countries and show that though the pass-through to import prices was quite high, such pass-through to CPI was rather low (with the exception of Indonesia) and that exchange rate pass-through to CPI was the main reason for Indonesian inflation and nominal depreciation after the Asian crisis.

Previous Studies on Vietnam's Inflation

Various attempts have been made to explain inflation dynamics in Vietnam. These studies range from non-quantitative (non-technical) to extensive empirical works. For the purpose of this study, we will focus mainly on reviewing the recent empirical works that have been done about the case of Vietnam.

Following the economic theories set forth in the literature on inflation, studies on Vietnam's inflation also incorporate as many factors as possible from both the cost-push and the demand pull sides of inflation in trying to explain Vietnam's inflation dynamics. However, due either to the lack of data or to the choice of the authors, most studies ignore the supply side factors and focus mainly on the demand side factors of inflation. The only inclusions of supply side factors are external shocks in world prices (of oil and in rare occasion of rice). The current literature on Vietnam's inflation determinants circulate around the following factors: CPI, money aggregates, interest rate, exchange rate, output, international oil prices and international rice prices.

One of the first comprehensive and quantitative studies is Vo Tri Thanh *et.al.* (2001). The authors, using monthly data from 1992 to 1999 in a Vector Autoregression (VAR) model with error correction terms, studied the relations between money, CPI, exchange rate and real industrial output. They found out that money growth responded to past movements in inflation and output, indicating a passive monetary policy during the studied period. Exchange rate was

found to have significant influence on inflation while money aggregates did not seem to have predicting power regarding the future movements of prices.

Similar results on the role of money aggregates on inflation were found in a study by IMF staff in 2003, also using a VAR model of seven variables: international oil prices, international rice prices, industrial output, exchange rate, money, import prices and consumer prices for the period from Jan 1995 to Mar 2003. The results show that own innovations are important in explaining the behavior of headline inflation, core inflation (non-food inflation) and import prices. Exchange rate has significant influence on import prices but not CPI, reflecting the large weight of non-tradables in the CPI basket and that import prices do not directly feed into domestic prices despite the increasing level of openness. They also show that international rice prices, domestic demand conditions and broad money growth had modest impact on headline inflation but had substantial persistence.

However, a later study by the IMF (2006) using quarterly data from 2001 to 2006 found substantial role of money aggregates on inflation. Although the results might be questionable due to a rather small sample, they confirmed the observation that money and credit growth started to have correlation with inflation in since 2002 (as seen in Figure 4). Part of this change can be explained by the liberalization of various important prices during the early 2000s. This study also shows that while inflation expectation and output gap had influencing role on inflation, oil price shocks and exchange rate had a modest role in explaining inflation during the studied period. In addition, Vietnam's inflation had an inertia component higher than in the other regional countries. This suggests that once inflationary expectations are present, it is more difficult to control inflation. The higher inertia may be a result of public's memory of hyper inflation that lasted until the early 1990s. Also Balassa-Samuelson effects are not strong on inflation i.e., even though productivity growth is higher in tradable sector, there is no strong evidence of medium-term increase in relative prices between tradable and non-tradable sector.

Camen (2006) used a VAR system with monthly data for the periods February 1996 and April 2005 and found that: (i) total credit to the economy accounted for 25% of variation in CPI and is the key variable in explaining the CPI after 24 months; (ii) total liquid and interest rate explain only a very small part of CPI variation (less than 5%); (iii) oil price and rice price are important which suggest the important role of commodity prices and exchange rate (19%); (iv) US money supply (m3) as a measure of international liquidity also plays an important role in most sample periods.

Another study that focus mainly on the influence of dollarization on inflation by Goujon (2006) showed that given the dollarized nature of the economy, money only matter to inflation if dollar holdings were included. The study used a monetarist approach for the period from January 1991 to June 1999.

Truong Van Phuoc and Chu Hoang Long (2005) used Granger estimation methods on monthly data from July 1994 to December 2004 and found out that the main determinants of inflation during this period were inflation lags and output gap. Money supply did not appear to have any influence while the impacts of rice, oil and exchange rate pass-through were modest.

Nguyen Thi Thuy Vinh and Fujita (2007) used a VAR approach to study the impact of real exchange rate on output and inflation in Vietnam for the period from 1992 to 2005. The authors found out that the main sources of variance in output and price levels were "own shocks" and exchange rate had stronger impact on trade balance and output than on inflation. The VAR model includes industrial output, CPI, exchange rate, money supply, trade deficit and US interest rate (as an exogenous variable). The model focused mainly on the exchange rate pass-through and thus ignored most of the other determinants of inflation.

A similar study by Vo Van Minh (2009) used similar method to study exchange rate pass-through to inflation but with more update data (from January 2001 to February 2007) on nominal effective exchange rate, output gap, oil prices, CPI, import price index and broad money M2. The results show that exchange rate pass-through in Vietnam is incomplete and the degree of pass-through is lower than found in IMF (2003). The author explained this reduction by citing different inflationary environment, less dollarization and deregulation of interest rate policy between the two periods. The study also calls for removal of exchange rate intervention.

Nguyen Viet Hung and Pfau (2008) studied the monetary transmission mechanisms in Vietnam using for the period from 1996Q2 to 2005Q4 and shows that there is a strong link between money supply and real output but no strong connection between money supply and inflation.

Pham The Anh (2008) used traditional data for 1994M1-2008M8 in a structural VAR model and shows that own innovations explained most of the variations in inflation with shocks to M2 and interest rate playing modest role. Pham The Anh (2009) studied inflation determinants during 1998Q2-2008Q4 using CPI, money supply, interest rate, exchange rate, industrial output and the error correction terms obtained from the cointegration tests for long run PPP and money demand relationships. This study also confirms the role of inflation lags and output and rejects the role of international oil prices on current period inflation. An important finding of this study is the important role of money supply growth on inflation (after three lags) while interest rate show passive role.

In addition, there are several non-technical studies relating to inflation dynamics and determinants such as one by Dragon Capital (2007) which blamed international inflation for the increase in Vietnam inflation and UNDP (2008) on food inflation in Vietnam. Both studies tend to support the government stance that inflation was mainly externally generated.

In summary, the review of literature on inflation determinants in Vietnam shows a few key points.

1. Most studies only take international oil price (and occasionally international rice price) as representative for the supply side factors, ignoring other factors such as cost, mark-up, and other rigidities.
2. Most of the studies (with the exception of Pham The Anh (2009) which covers until the end of 2008) are outdated and thus did not take into account the recent surge in inflation as well as the world economic crisis of 2008-2009 that has led to various changes in macroeconomic environment and policy.
3. Empirical results on the role of money as determinants are mixed probably due partly to different studied periods, different frequencies of data, and different estimation methods.
4. On the other hand, the literature is quite consistent about the important role of inflation lags, the modest role of exchange rate and international prices.

It is on these points that we hope to confirm/reject and improve when building our model.

Analysis of Key Macroeconomic Determinants of Vietnam's Inflation

The model

Basing on the above review of literature on the macroeconomic determinants of inflation, we develop a hybrid model of inflation determinants that comprise both the structural approach and

the monetarist approach. This means that inflation is not only a money phenomenon caused by the distortions in the domestic monetary market but also a result of certain structural/cost-push elements. As we also, following Chhibber (1992), decompose prices into tradable and non-tradable components, we will also test the PPP in the long-run for the case of Vietnam. So in essence, our model combines all three approaches discussed in the previous section.
Following widely accepted economic theories, we can express a country's price level (often measured by the consumer price index - *CPI*), at any point in time, as a weighted average of tradable good prices (prices of goods and services that are exported or imported by the country) and non-tradable good prices (prices of goods and services produced and consumed within the country only). According to Chhibber (1992), inflation, expressed as a change in price level *logP*, depends on the change in tradable good prices $logP^T$, in non-tradable good prices $logP^N$ and in controlled/administered prices ΔP^C. This relation can be expressed in the following forms.

$$\log P = \alpha_1 \log P^T + \alpha_2 \log P^N + (1 - \alpha_1 - \alpha_2) \log P^C \quad (1)$$

where $\alpha_1 + \alpha_2 < 1$

For tradable goods, as Vietnam is a small open economy, changes in tradable good prices depend on changes in the world market prices $logP^f$ and changes in the prevailing exchange rate *logE*. And thus, strictly speaking, we can model tradable good prices according to the PPP rule. We will call this the tradable price channel to inflation.

$$\log P^T = \log P^f + \log E \quad (2)$$

Non-tradable good prices are more complicated to model and we will need to look at the domestic market to determine change in those prices. We assume here that the market for non-tradable goods move in line with the country's aggregate market. Then non-tradable good prices depend on aggregate demand and aggregate supply.

On the supply side, basically, changes in prices of non-tradable goods depend on changes in intermediate input costs (both imported and domestically supplied intermediates) *IC*, labor costs (as measured by wage *W*) and a supply mark-up MU^s which can be caused by market imperfections. Changes in imported intermediate good prices follow the PPP rule in equation (2). These can be considered cost-push factors that affect domestic inflation.

On the demand side, aggregate demand depends on income *Y*, interest rate *r*, wealth, government spending and taxes. Changes in these factors may create excess demand and affect prices and can be considered demand-pull factors of inflation.

The factors from both supply and demand side can cause changes in non-tradable good prices and thus channel to the general price level. We can specify the non-tradable channel as follows.

$$\log P^N = \beta_1 MU + \beta_2 \log IC + \beta_3 \log W \quad (3)$$

A change in the general mark-up depends on the combination of supply side mark-up and the excess demand in the economy which in turn translates into excess real money balances (excess in the domestic money market). Note that changes in the any of the above components in the productions process are reflected in producers' prices. So we can proxy changes in non-tradable prices by changes in producers' price. However, as we are interested in examining the role of money market on domestic inflation, it is worth decomposing our mark-up *MU* further. As we will, following previous literature, use excess real money balances (*EMB*) as a proxy for the mark-up in non-tradable good prices we can specify *MU* as followed.

$$MU \approx MU^s + EMB = MU^s + \log\left(\frac{M^s}{P}\right) - \log\left(\frac{M^d}{P}\right)$$

$$= \mathrm{MU}^{\mathrm{s}} + \log\left(\frac{\mathrm{M}^{\mathrm{s}}}{\mathrm{P}_{-1}}\right) - \log\left(\frac{\mathrm{M}^{\mathrm{d}}}{\mathrm{P}}\right) - \Delta\log\mathrm{P} \quad (4)$$

where MU^s is the supply/producer mark-up, M^s is money supply, M^d is money demand and P_{-1} is price level in the previous period. When real money demand is different from real money supply, we have EMB different from zero and the money market is not in equilibrium. According to economic theories, the demand for money depends on real income Y, interest rate r and changes in expected inflation ΔP^e. Thus, the money demand function can be specified as:

$$\log\left(\frac{\mathrm{M}^{\mathrm{d}}}{\mathrm{P}}\right) = \gamma_0 + \gamma_1 \log(\mathrm{Y}) + \gamma_2 \mathrm{r} + \gamma_3 \Delta\log\mathrm{P}^{\mathrm{e}} \quad (5)$$

Equations (1) to (5) can be combined to form a function for inflation as follows (lower case represent log of the variables).

$$\Delta\mathrm{p} = \mathrm{F}(\Delta\mathrm{p}^{\mathrm{f}}, \Delta\mathrm{e}, \Delta\mathrm{ic}^{\mathrm{d}}, \Delta\mathrm{logw}, \Delta\mathrm{m}^{\mathrm{s}}, \Delta\mathrm{u}, \Delta\mathrm{r}, \Delta\mathrm{p}^{\mathrm{e}}, \Delta\mathrm{p}^{\mathrm{C}}) \quad (6)$$

where expected inflation is proxied using past inflation.

As for the case of Vietnam, several modifications to the model (6) above is needed given the knowledge inferred from our review of Vietnam's inflation dynamics in Section 2 and the examination of data. We must first emphasize that almost all of the studies on inflation in Vietnam ignore the supply side factors with the only exceptions are world price of oil and in few cases world price of rice which are treated as exogenous shocks. Following are five main modifications we made to the traditional model. The first two are due to lack of data. The omission of wage and other non-tradable input cost and price controls are also common among the literature on Vietnam's inflation.

First, as reliable information on wage and domestically supplied input costs are not available for the time period of the study, where applicable we will use *PPI* (producers' price index) as a proxy that represent the supply side with a note that *PPI* already includes imported prices and well as certain part of the supply/producer mark-up. Yet, we believe that *PPI* is still a good proxy for the supply side effects on inflation.

Second, controlled/administer prices used to play a very important role in the transition period of Vietnam in the 1980s and 1990s. In the 2000s, many regulations on prices have been removed. Still, prices of certain key commodities are still controlled such as public utilities (electricity, water, transportation), petroleum, postal and telecommunication services. However, the relation between price liberalization and inflation was not clear with high inflation followed some price liberalizations but not others. Also, controlled prices account for less than 10% of the *CPI* basket during the studied period. Although it might be might help explain in part certain short episode of price changes, the study of correlation between price liberalization and change in inflation will be postponed until a further study.

Third, we would also like to include a measure for market imperfections into the model. Market imperfections such as rigidities, market power/structure (such as monopoly or oligopoly) and speculations can increase transaction cost, push up prices, keep them at high level and change inflation expectation, thus increase the demand for money. Thus, market imperfections, though a supply side factor can affect the demand side as well. Market imperfections such as nominal rigidities sometimes help buffer and reduce the volatility of inflation in short run. However, in the medium run, nominal rigidities amplify and prolong impacts of monetary and other kinds of shocks to the real economy, affecting inflation expectation and can cause higher inflation. Also, market imperfections in forms of monopoly or oligopoly market structure can cause high mark-up which can translate into higher inflation. Firms with market power often try to push up their prices and keep them at high level (even when input prices return to normal after a shock). This market structure imperfection often leads to persistently high prices in certain markets.

However, measuring market imperfection is a very difficult task, especially in Vietnam where it is almost impossible to observe price setting behaviors of firms, where serial data on prices at different stages of production and marketing, on market concentration ratios in each market are unavailable. Moreover, different markets have different types of imperfections. Going into details in each market for each commodity in the *CPI* basket is outside of the scope of this study. In our model, these market imperfections will be captured partly in the producers' price *PPI* and partly in the excess real money balance resulted from market distortions.

Fourth, as reviewed in the literature, public sector deficits have been found to have correlation with inflation. Although the causal relation can go in both directions, the manner of financing public sector deficits (through money creation rather than borrowing) can be inflationary. Data for budget deficit financing through money creation is not available. Even though the data for budget deficit and public borrowing are available, the ad-hoc nature and stocks vs flows issues of the two series make it impossible to infer a reliable/accurate time series money creation (if any). However, the evolution of cumulative real budget deficits (a proxy for increase in public financing through public debt and money creation if any) can affect inflation expectation thus it might be interesting to examine their relationship.

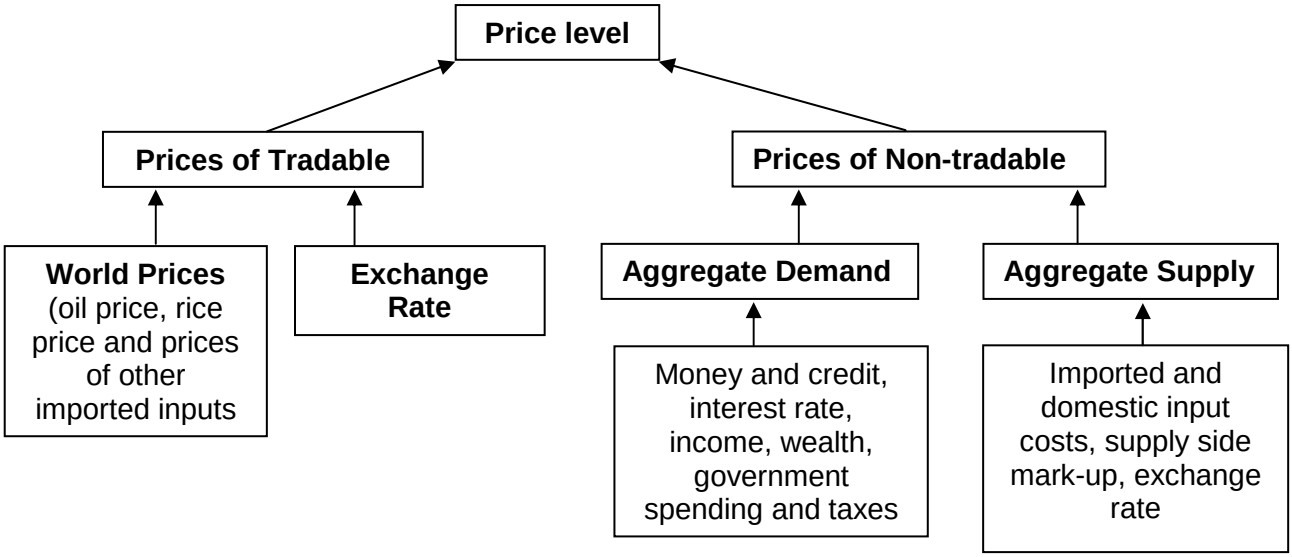
Finally, asset prices (such as that of real estate and stocks) have been known to affect inflation through wealth effect. As asset prices increase, people's wealth increases making them feel richer which increases their demand. We include a measure (called Wealth) for changes in wealth due to changes in asset price in the model to test its role in determining inflation.

The above modifications to the traditional model of inflation determinants bring about the following specifications for the inflation equation (lower case represent log of the variables).

$$\Delta p = F(\Delta p^{f}, \Delta e, \Delta ppi, \Delta m^{s}, \Delta y, \Delta wealth, \Delta pdebt, \Delta p^{e}, \Delta r) \quad (7)$$

We can summarize the transmission channels to inflation in our model in the following diagram.

Figure 13. Transmission Channels to Inflation



Data

To carry out estimations for macroeconomic determinants of Vietnam's inflation, we use monthly secondary data covering the period from January 2001 to March 2010. These data were collected from the General Statistics Office (GSO), State Bank of Vietnam (SBV), Ministry of Finance (MoF), International Finance Statistics (IFS), International Rice Research Institute (IRRI) and HCMC Stock Exchange. Details about each series are discussed below. These data series can be grouped into two main groups: (1) conventional data that have previously been used in the case of Vietnam and (2) less conventional data that have rarely or even never been used in the studies about inflation determinants in Vietnam. Innovation of the data during the studied period can be observed in the Appendix.

Conventional data series

These data series appear in virtually all studies on inflation determinants not only in Vietnam but in the other countries as well.

CPI: The monthly data on *CPI* were obtained from the GSO and re-based to the beginning of January 2000. Examination of the series shows a 200% increase over the studied period of the *CPI* (see Figure 11).

Industrial output: Real income has been known in economic theory and proved empirically to affect demand for money and thus price. We use real industrial production value in 1994 prices as a proxy for real income.

Money supply: Monetary policy has direct impact on inflation. Milton Friedman's famous saying "Inflation is always and everywhere a monetary phenomenon," although does not completely settle issues on causes of inflation, has made it necessary to include money in any study about inflation.

In Vietnam, nominal money and credit growth are known to affect the rate of inflation. As reviewed above, Vo Tri Thanh *et.al.* (2000) and Carmen (2005) both confirmed the positive relationship between money/credit growth and inflation in Vietnam. An expansionary monetary policy together with inflation expectation often leads to actual inflation in the next phase of the business cycle (See Figure 9). Many have argued that Vietnam's economic growth in recent years has depended mainly on the expansion of money and credit, not on real improvement in supply and productivity. Thus, any sign of overheating growth would be immediately translated into higher inflation. In other words, due to slow changes in income/output and in the velocity of money, most of the changes in money supply are translated into higher price levels. At the same time, increases in output are supposed to ease the demand pressures in the economy and thus reduce inflation. But due to the reliant on expansionary policy to growth, inflation in Vietnam does not appear to reduce as growth rate increases and only slowed down when the economy entered a recession (such as in 2009).

However, other studies like IMF (2003) and Nguyen Viet Hung and Pfau (2008) show little or no significant effect on money on inflation. Obviously empirical results regarding the case of Vietnam are mixed. Reasons cited for these mixed results are the underdeveloped financial market and dollarization in Vietnam. To examine the relation between money and inflation, we use monthly data for M2 obtained from the IFS. We also add domestic credit (obtained from the same source) in our model as credit growth has been of great concerns in Vietnam in recent years.

Exchange rate: As updated monthly nominal effective exchange rate is not available, we use the official exchange rate (*E*) as a proxy. Daily official exchange rate was obtained from the SBV and monthly average was calculated based on the daily series. As reviewed in Section 2,

the official exchange rate in Vietnam which for some periods has been kept rather rigid, is believed to exacerbate shocks to inflation and even caused increases in inflation. Past studies have shown only a small pass-through of exchange rate to inflation.

Interest rate: We use monthly data on lending rates (per annum) obtained from the IFS and SBV as an indicator for interest rate. Empirical findings on the role of interest rate on inflation are also mix, as with the case of money.

World oil price: Data on world oil price were collected from America's Energy Information Administration (EIA). World oil price is measured in USD/barrel.

Less conventional data

As analyzed above, we include the following less conventional data in our model to make the economic model richer and more specific to the case of Vietnam. As data are not available for the indicator the economic model calls for, we substitute them with other proxies. As data for producers' price index *PPI*, import price index *PI*, and accumulated budget deficits are available by quarter only monthly series have been inferred from quarterly data.

World rice price: Data on world rice price were collected from International Rice Research Institute (IRRI). World rice price is measured in USD/ton. World rice price was used before in Pham Thi Thu Trang (2009) and IMF (2003) and found to have impact on CPI.

Import price index: Import price index (PI) series was collected from the GSO and used as one of the proxies for world price. *PI* were calculated with the year 2000 as the base year.

Producers' Price Index: We obtain this data from the GSO. PPI were calculated with the year 2000 as the base year.

Cumulative Budget Deficit: In our model, we use cumulative budget deficits which in turn is measured as the gap between budget revenue and budget expenditure. The data were collected from the MoF.

Asset Prices: We collected three daily data series and obtained monthly averages for VNIndex, total break-even market value of listed firms and total trading value from the HCMC Stock Exchange. We only select trading value as a proxy to study the wealth effect caused by asset prices on inflation as it appears to move more in line with CPI.

Tests

Unit-root Tests

Our first step is to check the above set of data series (in log form and seasonally adjusted) to see if they are stationary. Both Augmented Dickey-Fuller (ADF) test and Phillips Peron (PP) test were used to derive the accurate conclusion on unit roots of the variables. The number of lags in ADF test was selected according to Akaike Information Criterion (AIC), Schwarz Information Criterion (SIC) and LR Criterion. The test statistics suggest that all of the series have unit roots (non-stationary). However, their first differences show stationary which means all variables are integrated of order one I(1). The result of some of these unit-root tests are reported in tables 1A and 2A of the Appendix.

Cointegration Tests

We anticipate certain long run relationships among variables of the model. In this step, we use Johansen cointegration test to check for long run relationships in accordance with economic theory. As all the variables are integrate of order one in levels, log values will be used directly (rather than first differences) in the cointegration test.

Our economic model suggests there are three long run relations in our model, equivalent to three transmission channels to inflation: (i) PPP channel, (ii) aggregate demand channel and (iii) aggregate supply channel.
For the PPP relationship, we use seasonally adjusted log forms of the CPI, import price index, and the official exchange rate *i.e. cpi*, *pi*, and *e*. The results of the test (reported in Table 3A of the Appendix) suggest cointegrating relations exist among the variables.

For the aggregate demand relationship, we use seasonally adjusted log forms of the CPI, M2, industrial output and interest rate, *i.e. cpi*, *m2*, *ind* and *in_rate*. The results of the test are reported in Table 4A of the Appendix and suggest cointegrating relations exist among the variables.

For the aggregate supply relationship, we use seasonally adjusted log forms of the CPI, PPI and the variables in the PPP relationship that affect the imported input cost *i.e. cpi*, *ppi*, *pi* and *e*. The results of the test are reported in Table 5A of the Appendix and suggest cointegrating relations exist among the variables.

The error correction terms (*ecms*) from the Johansen tests will be included in our estimation of inflation determinants if they are statistically significant.

Results of Vector Error Correction Model (VECM)

We use VECM to test the determinants of monthly percentage change in domestic inflation. For this part we started with a baseline model with only conventional data that include CPI, industrial output, M2, interest rate, exchange rate and world price of oil. Then, we extend the model to add "less conventional data" and explore the effects they have on inflation.

The base line model

Six variables are included in this baseline model: CPI, industrial output, M2, interest rate, exchange rate and world price of oil. These variables have traditionally been included in international literature as well as the literature on Vietnam's inflation. The contributions (to current literature on Vietnam's inflation) that we have in this exercise include: a more up-to-date data base, confirmation as well as rejection of previous findings on inflation determinants in Vietnam.

The short-run dynamics of the determinants of inflation under the baseline model are reported in Table 6A of the Appendix. Only significant statistics are reported. The most striking feature is that most of the variables are determined mainly by their own paste innovation. We will explore this point further when we carry out the variance decomposition. As for the determinants of inflation dynamics, the following observations can be made from the results.

First, disturbances that deviate the long-run trend of the PPP relation (as measured by the error correction term - *ECM*) has a statistically significant but very modest impact on inflation while the equivalent term for the money demand relation is not significantly different from zero. These coefficients of the *ECMs* measure the speed of adjustment of the foreign exchange market and

the money market to disturbances. A small coefficient implies very low or even near zero speed of adjustment. This is an important finding because it shows that once these relations deviate from the long-run trend, it will take a very long time for the economy to revert back on track despite policy efforts. This has an important implication for policy against inflation: preventive measures with clear guidelines and targets for inflations are much better choices than trying to cope with high inflation after it already started. Also, a wrong choice of policy action will be hard to correct and high inflation will last long.

Second, inflation varies negatively and slightly with changes in output growth. This result confirms the economic theory that faster output growth reduces the pressure on inflation.

Third, the results confirmed past research in Vietnam that (short-run) past inflation plays a key role in determining current inflation. This high inertia is not surprising given the fact that public memory of hyperinflation during the 1980s and early 1990s and the double digit inflation of 2008 is still strong.

Fourth, the results also confirm a previous research results on modest or almost insignificant role of money and interest rate on inflation in the short run. The impact of money growth on inflation only takes effect after 5 months. Increases in interest rate do have negative but very small impact on inflation. On the other hand, past inflation appears to influence positively on interest rate with 3 month lags implying passive and delayed monetary policy in response to inflation.

Another key finding of the baseline model is that exchange rate devaluation appears to increase inflation. This result is different from past research results which show small to insignificant impact. This difference in results may be explained partly by the fact that previous studies used data from periods when the exchange rate was mostly kept rigid. Recently, since late 2008, the exchange rate has been devaluated more often and with bigger magnitudes. In addition, recent episodes of distortions in the foreign exchange market, especially in the parallel black market, in 2009 and 2010 due to declining trust in VND, speculations and dollarization have increased public expectations about returning inflation. This may contribute to the larger impact of exchange rate on inflation found in this study. However, the model uses official exchange rate declared by SBV rather than an effective exchange rate thus further studies need to be done using the effective exchange rate to have a stronger confirmation on the impact.

Finally, the results confirm the findings of previous literature that world price do not appear to have significant impact on inflation. It should be noted, however, that the baseline model uses world price of oil as a proxy for world price and the government has been subsidizing gasoline prices. Thus the impact of changes in world oil prices does not seem to be significant. This finding will be double-checked using more accurate measures of world prices in the extended model below.

The extended model

We extend the baseline model to include "less conventional" data into the model. These data, as described above, include: credit, trading value of the stock market, import price index, world rice prices, and cumulative budget deficits.

The extended model shows long-run cointegrating relationships, the error correction terms of which are included in the VECM. Economic theory suggests these long-run relationships are the *PPP*, aggregate demand (*AD*) and aggregate supply (*AS*) relationships. We use these relationships as restrictions in our VECM.

The short-run dynamics of the model is reported in Table 7A of the Appendix. Again, only significant statistics are included. The following can be observed from the results.

The findings from the baseline model are reconfirmed in the extended model.

First, the disturbances that deviate the long-run trend of the *PPP* relation (as measured by the *EMC*) has statistically significant but still very small impact on inflation. The speed of adjustment for the aggregate demand relation is again insignificant. The merits of the findings we had in the baseline model still hold true in the extended model. *Second*, past inflation is still the most important coefficient among determinants of inflation implying high inflation inertia in Vietnam. Inflation reverts itself only from month 6th. *Third*, the results obtained for the impact of exchange rate, money and interest rate as well as world oil prices are similar to the results from the baseline models.

In addition, new and interesting findings can be concluded from the results of the extended model for the studied period. *First*, the residual from the aggregate supply relation is statistically significant and has slightly larger impact on inflation than that of the *PPP* relation implying a certain role of supply factors on inflation. However, changes in the growth rate of producers' price index *PPI* does not appear to have significant short-run impact on inflation. On the other hand, 3-month lagged inflation has important impact on *PPI* confirming the fact that firms do adjust their pricing due to increases in CPI after certain lag.

Second, money growth appears to have larger and longer short-run (though still small) impact on PPI than on inflation and the same goes for credit. This finding has an implication that money and credit policy affects the real economy more than it affects inflation which is influence mainly by public expectation. Also, short-run innovations of interest rate have a smaller but quicker impact on inflation than money growth does.

Third, exchange rate does not only have impact on inflation but also on PPI with a longer lag. This is understandable given the more rigid pricing behaviors by firms and also because of the time lag in production from the time the inputs are imported to the time the products are sold by firms.

Fourth, changes in budget deficits have no significant short-run impact on inflation but have a small (and mixed) impact on PPI after 4-5 month lag.

Finally, world prices as measured by the imported price index rather than just world oil price show considerable impact on inflation and more profoundly on PPI during the studied period. This means the pass-through of international price shocks to producers is stronger than to consumers. Changes in world prices of oil and rice in particular has much smaller effects compared to that of the general imported price index with rice price has a slightly higher impact on consumer price than oil price.

Variance decomposition

To identify which part of the innovation of endogenous variables can be attributed to their own innovations and which to innovations of other variables, we carry out variance decomposition using Sim's Recursive Choleski method (following the estimations of our extended VECM).

The results show that in short-run (within 3 months) own shocks account for more than 80% of changes in inflation and most other variables. When we look at inflation in particular (Table 8A of the Appendix), we can see that shocks in lags of most variables (rather than inflation) cause very small changes in inflation in the short-run. Shocks to PPI only account for more than 5% of inflation variation after 4 months and shocks to credit after 5 months. The impact of shocks to money supply as well as interest rate stay at low level for at least 6 months implying the long lag it takes for money policy to have impact on inflation. Again, inflation response quicker with

stronger effect and for a longer period to changes in interest rate than to changes in money supply suggesting that interest rate is perhaps a better tool in coping with inflation.

Impulse Response Functions

Impulse response functions measure the responses of inflation to unanticipated shocks to the endogenous variables of the model. We choose a 24 months horizon and use Choleski decomposition method. The results (reported in Figure 2A in the Appendix) show that shock to money supply (an increase) has lags (5-6 months) before taking into effects but leads to a considerable increase in inflation. Shocks to interest rate and exchange rate do not have significant impact on inflation in the short-run.

On the other hand, we also consider the effects of unanticipated inflation shock on other endogenous variable of the model. An unexpected increase in inflation leads to short-run increase in PPI and interest rate but a short-run decrease in money supply and budget deficits and a devaluation of the exchange rate. While the increase in PPI lasts longer than a year, the reduction in money supply and budget deficits and the increase in interest rate only last for about 6-8 months. The response we see from the model to inflation shock is a monetary contraction and the tightening of budget expenditure which revert themselves after 6-8 months.

Policy Discussion and Concluding Remarks

Policy discussion

The empirical findings in this study lead to a number of policy insights.

First, it is found that the role of the public's memory and expectation on inflation are both crucial in shaping the current inflation. This implies the significant role of credibility of government's policy toward inflation.

Memory about a period of high inflation in the past seems only to begin to fade away after 6 months of consistently low and stable inflation. This implies that for fighting inflation, only by successfully keeping inflation low for at least 6 months, can the government start to rebuild the public's confidence about a more stable environment of the general price level. This is a good suggestion for the government to be patient in fighting inflation. Six months can be considered as a lower threshold for the government efforts to maintain a low inflation environment in order to rebuild its credibility concerning a serious commitment against inflation, and therefore macroeconomic stability.

It is also shown that most of the changes in major macro variables (such as exchange rate, money and credit growth) affect the consumer price index several months before the producer price index. This implies the relative strength of expectation channel vs. the real channel (transmitting through the real production process).

The combination of a long memory and sensitive expectation in affecting the inflation explains a fact that it is hard to fight inflation when it is high, and it is also hard to maintain price stable when it is low. In other words, inflation is very sensitive to the current conditions, especially those that can lead to changes in the public's expectations. Low inflation is in fact an unstable or fragile condition, while high inflation tends to be self-containing in the Vietnamese economy.

Second, despite the government's common explanation that inflation is mostly imported, inflation is basically an internal problem. We find that the world prices tend to play a less significant role than other factors. The world prices, however, do have important effects on

production prices. The production prices in fact do not intermediately transmit into consumer prices (inflation), but take some months to realize its impact.

Third, the speeds of adjustment of the foreign exchange market and the money market to disturbances are very low or even near zero. This shows that once these markets deviate from the long-run trend, it will take a very long time for the economy to revert back on track despite policy efforts. This has an important implication for policy against inflation: preventive measures with clear guidelines and targets for inflations are much better choices than trying to cope with high inflation after it already started. Also, a wrong choice of policy action will be hard to correct and high inflation will last long.
On the other hand, the speed of adjustment from disturbances in the supply side has higher (though still small) impact on inflation. Even though more careful experiments needed to be done with more data on the real side of the economy such as wages and input costs, this initial finding implies that stimulating the real economy through increasing productivity and output growth have better impact on controlling inflation in the longer run than monetary and non-monetary measures.

Fourth, the government did have reactions against inflation by both fiscal and monetary tools, but normally acted lately or passively in most of the cases. For fiscal tools, it is rather easy to understand and accept the fact, as it takes time for an adjustment in fiscal plan to be approved and implemented. However, monetary tools are also seen as being carried out at a considerable lag after the first signals of inflation occur. This may be explained with the fact that inflation specification is always a controversial issue, where the government is very reluctant to accept the situation of inflation. The government usually blames the worse situation for some "objective" or "external" reasons. It therefore takes time to turn the inflation issue from the public's consciousness to the government's one, and thus an appropriate monetary reaction. For example, it is shown in the paper that in most of the cases, interest rates are adjusted following the changes in CPI after about 3 months. These adjustments are indeed to make the interest rates more comparable with the current inflation rather than to be an action of tightening monetary policy to fight against inflation.

Even when a tightening monetary policy takes place, it takes more than 5 months in average to produce effects on the inflation. By that time, inflation rate has been high for 7 to 8 months. This would have created a long memory on inflation and therefore the cost of fighting inflation will be high.

It seems that among monetary tools, raising interest rate has a prompt effect on inflation in comparison with the money growth and credit tightening. However, the effect of a change in interest rate is rather weak. Therefore, the monetary tools are not a really ones for quick response as assumed.

Fifth, in contrast to previous study results, the model found considerable role of exchange rate, a devaluation in particular, on increasing pressures on inflation. This difference in results may be explained partly by the fact that previous studies used data from periods when the exchange rate was mostly kept rigid. Recently, since late 2008, the exchange rate has been devaluated more often and with bigger magnitudes. In addition, recent episodes of distortions in the foreign exchange market, especially in the parallel black market, in 2009 and 2010 due to declining trust in VND, speculations and dollarization have increased public expectations about returning inflation. This may contribute to the larger impact of exchange rate on inflation found in this study.

Finally, the study did not show clear impact of budget deficits on inflation during the study period. This does not mean that budget deficits have no inflationary pressures. The reason for this is that the financing of budget deficits has two opposing impacts on inflation. On the one hand, financing budget deficits through government borrowing increases interest rate due to

higher demand for funds in the loan markets. This is equivalent to tightening monetary policy and thus helps reduce inflation to some extent. On the other hand, financing budget deficits through money creation (if any) is equivalent to expanding money supply and thus causes inflationary pressures. These two opposing forces mitigate and sometimes cancel out each other's effect on inflation.

From the above characteristics of inflation in Vietnam, one may come to a policy implication that the Vietnamese government should have a strong commitment not only in fighting against inflation when it is high, but also, and more importantly, in keeping it low when it is low. This strategy is actually hard to follow as far as the government still prefers economic growth to macroeconomic stability.

Concluding remarks

In this paper, we review the dynamics of Vietnam's inflation over the past decade in close relation with various changes in economic environment as well as macroeconomic policy. In addition, the review of literature on determinants of inflation in general and the particular case of Vietnam helps us to form a list of potential macroeconomic determinants of inflation for Vietnam and formulate hypothesis regarding their correlation.

The paper then explores the macroeconomic determinants of inflation in Vietnam for the period from 2000-2010. The model used in the paper specifies three channels through which various endogenous and exogenous variables can affect prices. These channels are the purchasing power parity (PPP) channel, the aggregate demand (AD) channel and the aggregate supply (AS) channel. The main findings of the paper are (1) inflation inertia is high and an important determinant of current inflation in Vietnam; (2) adjustment speeds are very slow in both the foreign exchange market and the money market implying difficulty for inflation to be controlled effectively once it starts to climb; (3) the exchange rate pass-through is found to be considerable in the short-run where a devaluation leads to higher prices while cumulative budget deficits do not play an important role in inflation determination; (4) money supply and interest rate has delayed impact on short-run inflation; and (5) short-run pass-through of international inflation to domestic prices is significant.

The main limitation of the study are the use of official exchange rate between USD and VND rather than the effective exchange rate between VND and its trading partners so the PPP relation is not fully reflected due to the neglect of the role of other currencies in international trade. However, using the official rate allows us to see the impact of devaluation on inflation and the pressure of higher inflation on the official exchange rate. Another limitation is the lack of data for wages and firm pricing behaviors as supply side factors that potentially affect inflation. However, reliable data on these factors cannot be obtained. Potentially interesting findings could be found if such data can be observed.

As the study focus mainly on macroeconomic determinants of inflation, it ignores the role of micro-level determinants such as market structures, localities, types of commodities… that may help to explain the volatility as well as persistence of inflation. These would be ideal extensions to our model.

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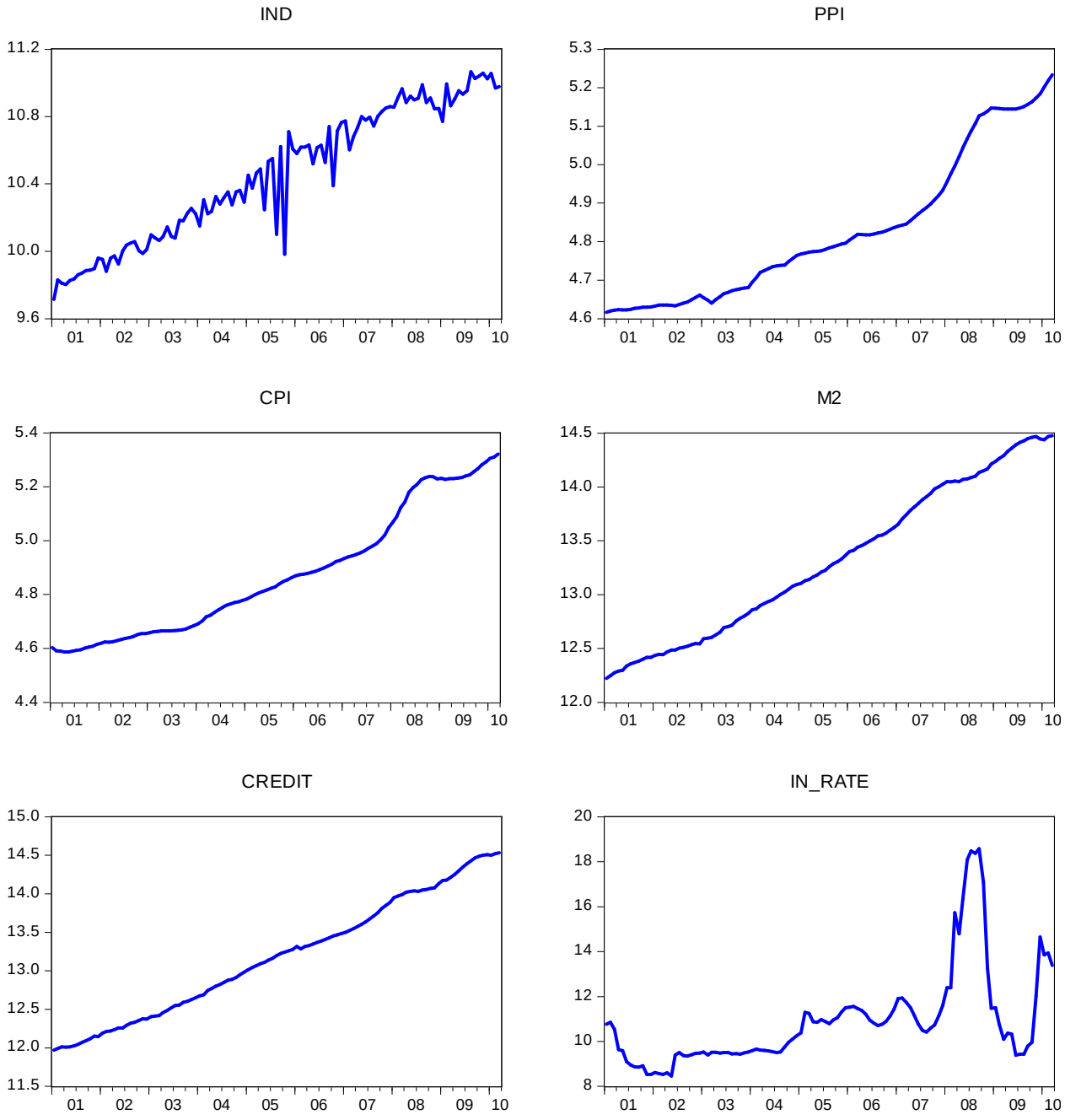
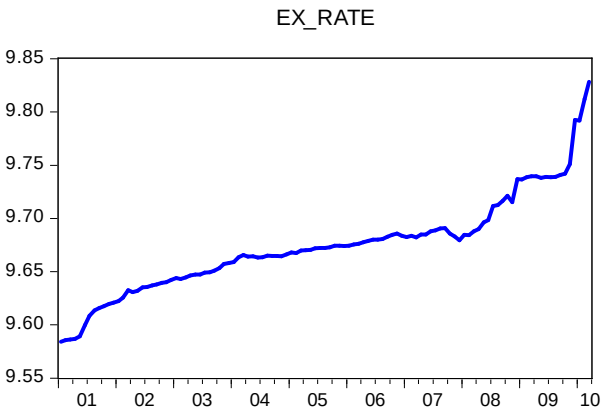
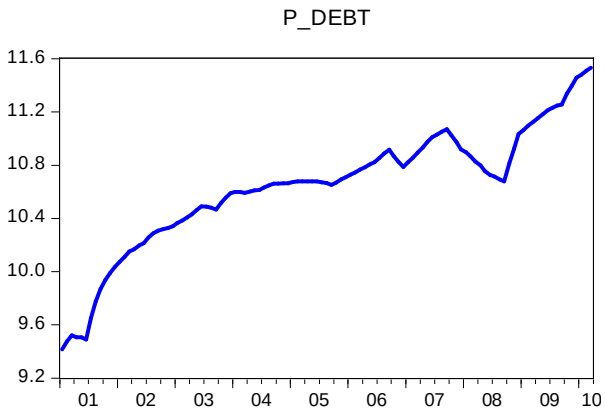
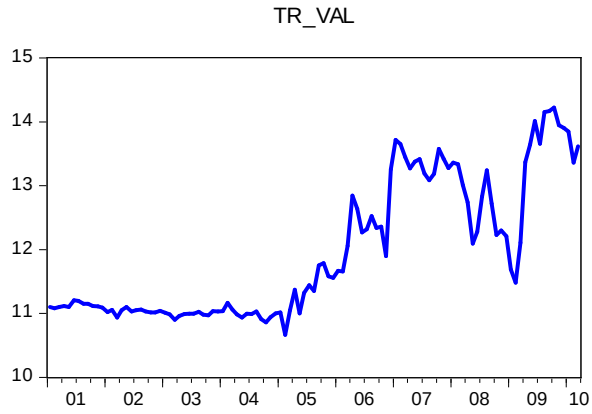
Appendices

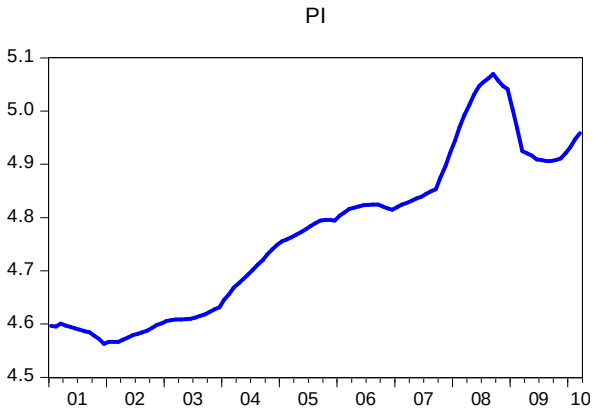
Figure 1A. Innovations of data in log term, 2001-2010

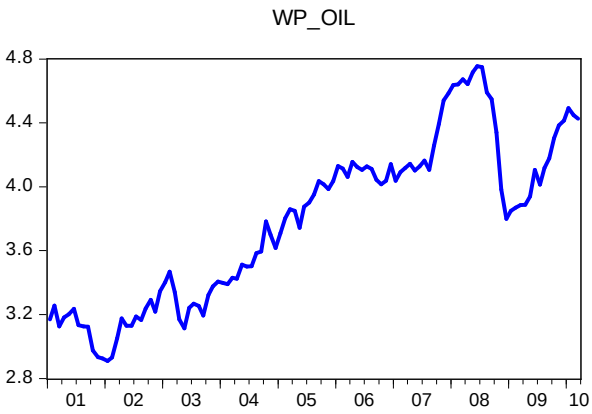



EX_RATE
9.85
9.80
9.75
9.70
9.65
9.60
9.55
01 02 03 04 05 06 07 08 09 10


P_DEBT
11.6
11.2
10.8
10.4
10.0
9.6
9.2
01 02 03 04 05 06 07 08 09 10


TR_VAL
15
14
13
12
11
10
01 02 03 04 05 06 07 08 09 10


PI
5.1
5.0
4.9
4.8
4.7
4.6
4.5
01 02 03 04 05 06 07 08 09 10


WP_OIL
4.8
4.4
4.0
3.6
3.2
2.8
01 02 03 04 05 06 07 08 09 10

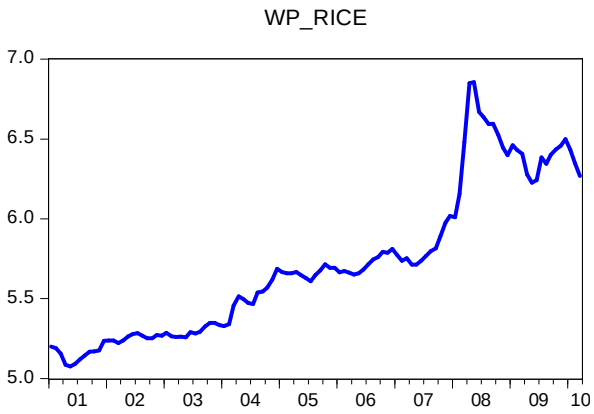

WP_RICE
7.0
6.5
6.0
5.5
5.0
01 02 03 04 05 06 07 08 09 10

Table 1A. Unit root test on variables at level

Null Hypothesis: Unit root (individual unit root process)
Sample: 2001M01 2010M03
Exogenous variables: Individual effects
Automatic selection of maximum lags
Automatic lag length selection based on SIC: 0 to 7
Total number of observations: 1294
Cross-sections included: 12

Method	Statistic	Prob.**
ADF - Fisher Chi-square	7.12641	0.9997
ADF - Choi Z-stat	4.51477	1.0000

** Probabilities for Fisher tests are computed using an asymptotic Chi square distribution. All other tests assume asymptotic normality

Intermediate ADF test results INF

Series	Prob.	Lag	Max Lag	Obs
IND	0.7432	2	12	108
PPI	0.9989	1	12	109
CPI	0.9997	7	12	103
M2	0.9653	3	12	107
CREDIT	0.9612	3	12	107
IN_RATE	0.1652	1	12	109
EX_RATE	0.9886	1	12	109
P_DEBT	0.7069	4	12	106
TR_VAL	0.8417	0	12	110
PI	0.7618	1	12	109
WP_OIL	0.7603	1	12	109
WP_RICE	0.7313	2	12	108

Table 2A. Unit root test on variables at first difference

Null Hypothesis: Unit root (individual unit root process)
Sample: 2001M01 2010M03
Exogenous variables: Individual effects
Automatic selection of maximum lags
Automatic lag length selection based on SIC: 0 to 3
Total number of observations: 1296
Cross-sections included: 12

Method	Statistic	Prob.**
ADF - Fisher Chi-square	395.197	0.0000
ADF - Choi Z-stat	-15.9950	0.0000

** Probabilities for Fisher tests are computed using an asymptotic Chi
-square distribution. All other tests assume asymptotic normality.

Intermediate ADF test results D(INF)

Series	Prob.	Lag	Max Lag	Obs
D(IND)	0.0000	1	12	108
D(PPI)	0.0540	0	12	109
D(CPI)	0.0189	3	12	106
D(M2)	0.0131	2	12	107
D(CREDIT)	0.0100	2	12	107
D(IN_RATE)	0.0000	0	12	109
D(EX_RATE)	0.0000	0	12	109
D(P_DEBT)	0.0059	3	12	106
D(TR_VAL)	0.0000	0	12	109
D(PI)	0.0157	0	12	109
D(WP_OIL)	0.0000	0	12	109
D(WP_RICE)	0.0000	1	12	108

Table 3A. Johansen cointegration test on PPP relation

Sample (adjusted): 2001M10 2010M03
Included observations: 102 after adjustments
Trend assumption: Linear deterministic trend
Series: CPI PI EX_RATE
Lags interval (in first differences): 1 to 8

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.373216	83.37218	29.79707	0.0000
At most 1 *	0.286475	35.72262	15.49471	0.0000
At most 2	0.012603	1.293713	3.841466	0.2554

Trace test indicates 2 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.373216	47.64956	21.13162	0.0000
At most 1 *	0.286475	34.42891	14.26460	0.0000
At most 2	0.012603	1.293713	3.841466	0.2554

Max-eigenvalue test indicates 2 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Table 4A. Johansen cointegration test on AD relation

Sample (adjusted): 2001M10 2010M03
Included observations: 102 after adjustments
Trend assumption: Linear deterministic trend
Series: CPI M2 IN_RATE IND
Lags interval (in first differences): 1 to 8

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.179773	51.14095	47.85613	0.0238
At most 1 *	0.166717	30.92724	29.79707	0.0369
At most 2	0.105494	12.32424	15.49471	0.1420
At most 3	0.009299	0.952897	3.841466	0.3290

Trace test indicates 2 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None	0.179773	20.21371	27.58434	0.3266
At most 1	0.166717	18.60300	21.13162	0.1089
At most 2	0.105494	11.37135	14.26460	0.1366
At most 3	0.009299	0.952897	3.841466	0.3290

Max-eigenvalue test indicates no cointegration at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Table 5A. Johansen cointegration test on AS relation

Sample (adjusted): 2001M10 2010M03
Included observations: 102 after adjustments
Trend assumption: Linear deterministic trend
Series: CPI PPI PI EX_RATE
Lags interval (in first differences): 1 to 8

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.396425	107.3546	47.85613	0.0000
At most 1 *	0.334361	55.85626	29.79707	0.0000
At most 2	0.108581	14.34144	15.49471	0.0740
At most 3	0.025335	2.617435	3.841466	0.1057

Trace test indicates 2 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.396425	51.49833	27.58434	0.0000
At most 1 *	0.334361	41.51482	21.13162	0.0000
At most 2	0.108581	11.72401	14.26460	0.1214
At most 3	0.025335	2.617435	3.841466	0.1057

Max-eigenvalue test indicates 2 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Table 6A. Baseline VECM results

Vector Error Correction Estimates
Sample (adjusted): 2001M08 2010M03
Included observations: 104 after adjustments
Standard errors in ( ) & *, **, *** denote significant at 10%, 5% and 1%, respectively

LR test for binding restrictions (rank = 2):

Chi-square(3)	9.548179
Probability	0.022824

Error Correction:	D(IND)	D(CPI)	D(M2)	D(IN_RATE)	D(EX_RATE)
CointEq1(PPP)		0.001130**			
		(0.00060)			
CointEq2 (AD)		-0.022750			
		(0.01379)			
D(IND(-1))		-0.030960**			
		(0.01675)			
D(IND(-2))		-0.028791**			
		(0.01441)			
D(IND(-3))		-0.025288**			
		(0.01212)			
D(IND(-4))		-0.023514**			
		(0.01031)			
D(IND(-5))		-0.016405**			
		(0.00800)			
D(CPI(-1))		0.507602***			
		(0.14540)			
D(CPI(-3))		0.539215***		51.80418*	
		(0.14570)		(27.7660)	
D(CPI(-5))		0.251694**			
		(0.12307)			
D(CPI(-6))		-0.259352**			
		(0.11439)			
D(M2(-5))		0.114689***			
		(0.03920)			
D(IN_RATE(-2))		0.002753***			
		(0.00093)			
D(IN_RATE(-3))		-0.002615***			
		(0.00099)			
D(IN_RATE(-4))		0.001670*			
		(0.00094)			
D(IN_RATE(-5))		-0.001948**		-0.519141***	
		(0.00094)		(0.17854)	
D(EX_RATE(-1))		0.226803**	-0.656594*		
		(0.09911)	(0.33349)		
D(EX_RATE(-2))		-0.247623**			
		(0.10156)			
D(EX_RATE(-3))		0.286577***			
		(0.10341)			
D(EX_RATE(-4))				-46.39706*	
				(26.9498)	
D(WP_OIL(-1))		0.009779*			

		(0.00530)			
C			0.012037*		
			(0.00637)		
R-squared	0.795503	0.853476	0.527230	0.572230	0.452223
Adj. R-squared	0.675950	0.767815	0.250841	0.322149	0.131984
Sum sq. resids	0.454472	0.000663	0.007508	24.08087	0.001708
S.E. equation	0.083617	0.003194	0.010747	0.608667	0.005126
F-statistic	6.654010	9.963479	1.907565	2.288180	1.412142
Log likelihood	134.9469	474.5069	348.3132	-71.49501	425.2975
Akaike AIC	-1.845132	-8.375133	-5.948331	2.124904	-7.428798
Schwarz SC	-0.853485	-7.383486	-4.956685	3.116551	-6.437151
Mean dependent	0.010744	0.007003	0.020402	0.042680	0.002109
S.D. dependent	0.146890	0.006628	0.012417	0.739286	0.005502

Table 7A. Extended VECM results

Vector Error Correction Estimates
Sample (adjusted): 2001M08 2010M03
Included observations: 104 after adjustments
Standard errors in ( ) & *, **, *** denote significant at 10%, 5% and 1%, respectively

LR test for binding restrictions (rank = 3):
Chi-square(20) 407.6980
Probability 0.000000

Error Correction:	D(IND)	D(PPI)	D(CPI)	D(M2)	D(CREDIT)	D(IN_RATE)	D(EX_RATE)	D(P_DEBT)	D(TR_VAL)
CointEq1(PPP)			-0.038466*						
			(0.02210)						
CointEq2(AD)			0.052330						
			(0.03959)						
CointEq3(AS)			0.100670**						
			(0.04598)						
D(CPI(-1))				-1.318734*					
				(0.67163)					
D(CPI(-3))		0.359712**	0.580655***						
		(0.15708)	(0.16598)						
D(CPI(-6))			-0.356607**						
			(0.16548)						
D(M2(-3))		0.233534***	0.117679*						
		(0.05848)	(0.06179)						
D(M2(-4))				0.595684*					
				(0.30658)					
D(M2(-5))		0.173791**							
		(0.07748)							
D(CREDIT(-1))		0.090526**		-0.333680*					
		(0.04503)		(0.16911)					
D(CREDIT(-5))						18.90321**			
						(7.81399)			
D(CREDIT(-6))							0.132456**		

							(0.05269)		
D(IN_RATE(-1))			-0.002385*	-0.012570***		-0.510377**			
			(0.00124)	(0.00442)		(0.21009)			
D(IN_RATE(-2))						-0.590047**			
						(0.25606)			
D(IN_RATE(-3))			-0.003263**			-0.475447**			
			(0.00129)			(0.21711)			
D(IN_RATE(-6))								-0.020459**	
								(0.00905)	
D(EX_RATE(-2))				1.501310***			-0.374874**	2.510492**	
				(0.54747)			(0.18394)	(0.98757)	
D(EX_RATE(-3))			0.243256*	1.186950**					
			(0.13446)	(0.47788)					
D(EX_RATE(-4))		0.501922**	0.554607**						
		(0.24322)	(0.25698)						
D(EX_RATE(-5))		0.427214*		1.579643*	2.201279*				
		(0.24719)		(0.92829)	(1.23253)				
D(P_DEBT(-1))	-1.730387*			-0.172000*			0.104893***		-4.461876**
	(0.93141)			(0.09795)			(0.03291)		(2.25295)
D(P_DEBT(-2))							0.077215***		-2.905588*
							(0.02451)		(1.67771)
D(P_DEBT(-4))		-0.056626**							
		(0.02803)							
D(P_DEBT(-5))		0.048651**							
		(0.02286)							
D(P_DEBT(-6))					0.198223*				
					(0.10051)				
D(PI(-1))	-10.07349*	0.302765**	0.292792*					-2.084422**	
	(5.34579)	(0.14970)	(0.15818)					(1.01414)	
D(PI(-2))							0.334365*		
							(0.19219)		
D(PI(-3))						53.10642*			
						(30.9452)			
D(PI(-5))		0.448763***	0.406398***						-17.91753*

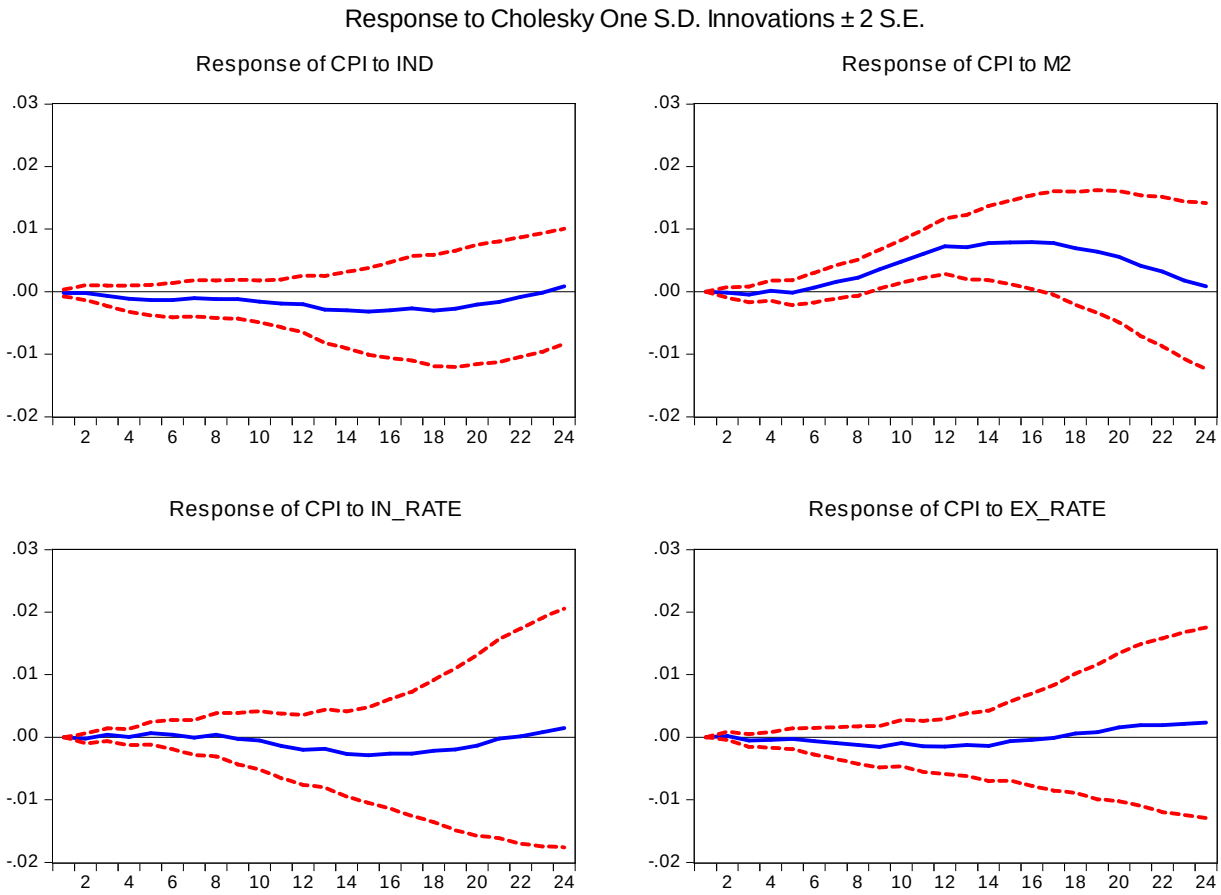
		(0.12461)	(0.13166)						(10.7630)
D(PI(-6))		-0.224043*	-0.318403**	0.803692*				3.265324***	
		(0.12276)	(0.12971)	(0.46099)				(0.83158)	
D(WP_OIL(-1))			0.022041***					-0.084821*	
			(0.00798)					(0.05114)	
		-							
D(WP_OIL(-6))	0.576816*	0.033189***	-0.025790***						
	(0.30575)	(0.00856)	(0.00905)						
D(WP_RICE(-1))		0.027654**	0.031817***						
		(0.01145)	(0.01210)						
D(WP_RICE(-5))			0.020458*			6.346063***	0.061186***		
			(0.01040)			(1.75461)	(0.01241)		
D(WP_RICE(-6))						6.008803**			
						(2.53380)			
		-							
C		0.010456***							
		(0.00328)							
R-squared	0.894540	0.959219	0.954655	0.836773	0.791742	0.896152	0.906174	0.930560	0.856030
Adj. R-squared	0.612056	0.849984	0.833195	0.399559	0.233908	0.617989	0.654855	0.744559	0.470395
Sum sq. resids	0.234374	0.000184	0.000205	0.002592	0.004570	5.845999	0.000293	0.008435	1.371299
S.E. equation	0.091490	0.002562	0.002707	0.009622	0.012775	0.456931	0.003233	0.017356	0.221303
F-statistic	3.166700	8.781220	7.859852	1.913873	1.419314	3.221676	3.605666	5.002998	2.219796
Log likelihood	169.3823	541.2247	535.4973	403.6136	374.1320	2.119327	517.0477	342.2585	77.51928
Akaike AIC	-1.795813	-8.946628	-8.836487	-6.300262	-5.733308	1.420782	-8.481686	-5.120356	-0.029217
Schwarz SC	0.136626	-7.014189	-6.904048	-4.367823	-3.800869	3.353222	-6.549247	-3.187917	1.903223
Mean dependent	0.010744	0.005861	0.007003	0.020402	0.023961	0.042680	0.002109	0.018092	0.023304
S.D. dependent	0.146890	0.006615	0.006628	0.012417	0.014595	0.739286	0.005502	0.034341	0.304096

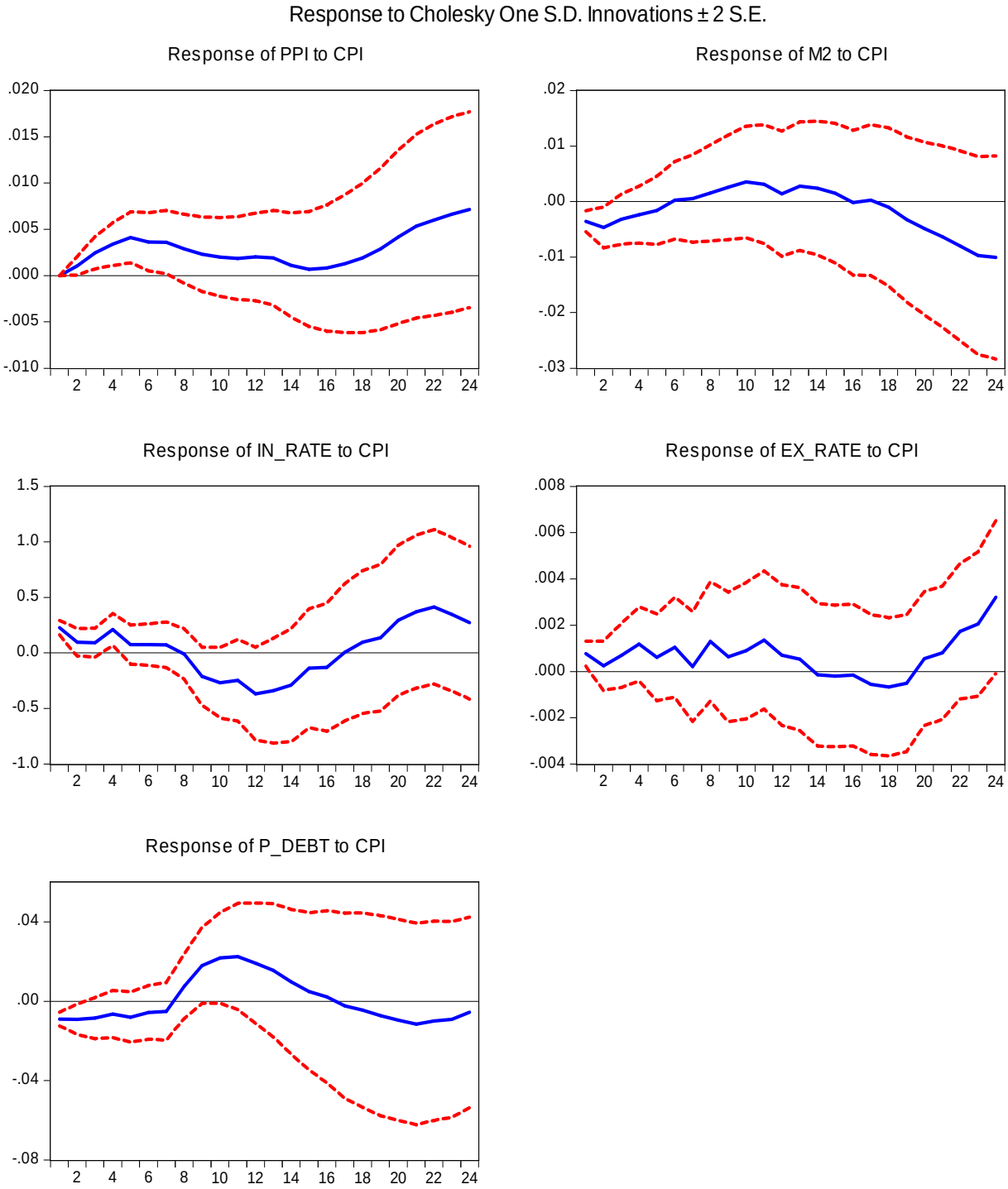
Table 8A. Variance Decomposition of CPI

Period	S.E.	IND	PPI	CPI	M2	CREDIT	IN_RATE	EX_RATE	P_DEBT	TR_VAL	PI	WP_OIL	WP_RICE
1	0.091490	0.055616	1.944485	97.99990	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
2	0.107721	1.295910	3.256676	87.27775	0.449794	0.947576	1.055727	0.222478	0.116934	3.00E-07	0.036591	1.333131	4.007434
3	0.115444	1.628797	4.986047	80.18828	0.439092	2.653534	0.471194	1.040999	0.077626	0.714945	0.025057	1.561710	6.212715
4	0.123700	0.794632	5.398001	77.16246	0.673287	4.265145	0.286160	1.822734	0.725011	0.346545	0.606896	0.944275	6.974851
5	0.131903	0.754905	8.401898	71.15065	0.522207	7.761343	0.527098	1.184001	1.167485	0.221000	0.867410	0.797908	6.644091
6	0.153946	0.498965	9.725187	67.50246	0.402032	9.288752	1.024140	0.764286	1.669691	0.156497	2.380502	0.707519	5.879967
7	0.172866	0.405000	12.04409	63.12409	0.395437	9.917197	1.551216	0.606102	1.818211	0.110299	3.423547	0.766507	5.838310
8	0.187499	0.327286	12.78731	56.60595	0.299199	11.42749	4.621835	1.303545	2.099077	0.189085	4.578581	0.669854	5.090797
9	0.206320	0.249438	11.92975	49.91643	0.229287	11.39785	9.279221	3.180149	2.105618	0.417838	6.673859	0.729371	3.891187
10	0.223554	0.243432	10.16010	41.71817	0.395215	10.52876	15.43776	7.502547	1.812264	0.762950	7.838804	0.675402	2.924600
11	0.233642	0.305109	7.637867	32.95792	0.987214	8.906086	22.28570	13.29126	1.339224	1.253628	8.127600	0.631191	2.277206
12	0.242750	0.391580	5.533045	25.19095	2.010553	6.950506	27.03578	18.77922	0.974151	2.075940	8.449320	0.579090	2.029867
13	0.250946	0.342027	3.961674	18.31959	3.505154	5.207066	32.22378	23.15852	0.681684	2.664438	7.691436	0.406788	1.837832
14	0.256092	0.335628	3.412872	13.32840	5.060302	3.769534	35.14053	26.05307	0.546550	3.101951	6.960971	0.289616	2.000576
15	0.261050	0.300344	3.434597	10.17342	6.443155	2.795205	36.12042	28.02514	0.500165	3.538446	6.329233	0.213541	2.126333
16	0.269202	0.224447	3.818115	7.898846	7.522645	2.125636	36.95251	29.16493	0.487069	3.921915	5.481254	0.164427	2.238201
17	0.276056	0.176854	4.447684	6.432288	8.390655	1.674134	36.80343	29.64181	0.515529	4.290006	5.010754	0.130133	2.486722
18	0.279659	0.157809	4.960525	5.543069	9.116141	1.401388	36.61767	29.84990	0.482561	4.587359	4.635872	0.111094	2.536608
19	0.285989	0.165405	5.727037	4.984222	9.576601	1.236534	36.43623	29.85796	0.491286	4.689123	4.184221	0.096650	2.554731
20	0.297815	0.180628	6.440531	4.783069	9.914628	1.125865	35.79324	29.71976	0.498322	4.848365	3.973199	0.084693	2.637701
21	0.310132	0.255645	6.937203	4.822558	10.17321	1.103758	35.41920	29.52082	0.485197	4.894325	3.722344	0.079154	2.586579
22	0.319628	0.312964	7.572550	4.984395	10.41229	1.103595	34.79036	29.28263	0.516312	4.898855	3.499689	0.072820	2.553534
23	0.351485	0.379363	8.035890	5.451166	10.59484	1.147476	33.96385	28.98267	0.527969	4.900568	3.391177	0.073368	2.551663
24	0.382828	0.519869	8.395639	6.159217	10.65197	1.317831	33.24019	28.63328	0.525517	4.783841	3.229959	0.070037	2.472645

Cholesky Ordering: IND PPI CPI M2 CREDIT IN_RATE EX_RATE P_DEBT TR_VAL PI WP_OIL WP_RICE

Figure 2A. Impulse response functions




Response to Cholesky One S.D. Innovations ± 2 S.E.
Response of PPI to CPI
Response of M2 to CPI
Response of IN_RATE to CPI
Response of EX_RATE to CPI
Response of P_DEBT to CPI