Three Essays on Monetary Policy and Inflation in Developing Countries

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Abstract

The principal objective of this thesis is to evaluate appropriate measures of inflation which are to be applicable for implementing monetary policy in developing countries. The first essay attempts to assess real effects of high inflation episodes for Indonesia, Malaysia and Pakistan. In order to investigate the real effects of high inflation episodes, the study adopts an indicator for the inflationary real effect, named inflationary real response (*IRR*), which is the difference between the expected and output-neutral inflation. Both the expected and output-neutral inflation are computed as the decomposition of shocks induced in the vector autoregressive (*VAR*) model. The main finding of this chapter is that there is a positive real effect in economic growth in the period after high inflation. The second essay investigates the responses of real output and inflation to oil price, aggregate supply and demand shocks in the four Asian developing countries; Indonesia, Malaysia, Pakistan, and Thailand. The structural *VAR* model is used to identify the different shocks and to explore the relative contributions of these shocks in explaining macroeconomic fluctuations. It is found that oil price shocks have negligible effects on economic activities for all the examined countries. However, aggregate supply and demand shocks are key sources of variation in output and inflation. The final essay examines whether the central bank should target a broader measure of the price index that incorporates stock prices alongside the prices of current goods and services. The primary contribution of this chapter is the estimation of a price index that can be efficiently utilised by central banks aiming to minimise output volatility. The results suggest that the central bank should use a price index that gives a sizeable weight to the fundamental component of stock prices to minimise output gap variance.

Dedication

This work is dedicated to my beloved mother, loving wife and to the sweet memories of my late father

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Chapter 1

Introduction

This thesis deals with issues of monetary policy and inflation in Asian countries. Monetary policy and inflation are closely related concepts and the former can be utilised to efficiently lessen the effect of the latter. Inflation is the continued rise in general level of prices, while monetary policy is the regulation implemented by central bank to stabilise prices and maximise economic growth. The main objective of many central banks is to achieve and maintain price stability, which is fundamental to stabilise both inflation and output. In the scenario of inflation targeting mechanism, a central bank declares its long term monetary policy objective by controlling inflation by announcing quantitative targets for inflation. Furthermore, inflation targeting makes it possible for monetary policy to focus on domestic circumstances and react to shocks in the domestic economy. In such a framework, the inflation targeting becomes the economy's nominal instrument as much as monetary aggregates would be under a monetary policy rule.

The level of inflation is at the core of central banks' exertions to monitor and follow price stability. In the long run the main contribution of monetary policy is to foster economic growth while maintaining low and stable inflation. Inflation targeting is a monetary policy framework that was first pioneered in New Zealand in 1990. Gradually many more countries implemented it such that as of 2011 it has been adopted by about 27 developed and developing including Sweden, Canada, UK, Chile, Indonesia, Thailand etc[1]. In most of these countries, inflation targeting policy has led to lower and stable inflation levels as well as increased output growth.

Visibly, if an inflation-targeting structure is to be functioning, then the vital question of the exact measure of inflation to aim for cannot be overlooked. However it is difficult to

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[1] Source: Bank of England, Hammond (2011).

give a straight single answer to the question of which gauge is to be adopted because so far different countries have adopted different strategies in their inflation targeting policies.

There is widespread agreement that central banks should focus on stabilizing a general index of prices, such as the consumer price index (*CPI*). Although the consumer price index is a broad measure of price index it includes a number of elements, such as temporary and exogenous (imported inflation) shocks, non-monetary supply shocks and indirect taxes, which monetary authorities frequently observe as problematic (Roger, 1998; Smith, 2005).

On the other hand, many central banks, like the Bank of Canada, Bank of Thailand, Bank of Poland, Czech National Bank etc., have adopted a measure of the underlying trend rate of inflation called “core inflation” to target an alternative policy. The aim is to investigate the development of medium term trends underlying price movements rather than transitory variations. Policymakers agree that core inflation should be a good indicator of the fundamental inflation trend by adjusting the *CPI* for some of those components (such as removing transitory components) that do not respond to monetary policy. Economists classify core inflation by using numerous different definitions. The most famous measure of core inflation is overall household inflation that excludes the food and energy prices from *CPI*. Some other studies suggest alternative measures of core inflation; Clark (2001) proposed two series of core inflation, the *CPI* excluding energy only, and the *CPI* systematically excluding the eight most volatile components, while Bryan and Cecchetti (1994) introduced a trimmed mean that excludes the relative prices changes in each month. Additionally, Blanchard and Quah (1995) defined core inflation as that inflation rate that has no long run impact on output. However, given that core inflation is unobservable (non-stationary) and has to be estimated, there is no agreed method of measuring it.

Developing countries are currently experiencing inflation crises not for the reason of deteriorating macroeconomic performance but due to the fact that oil and food prices are soaring, with these items representing a higher percentage of average household expenditure than in developed countries**.** While certain developing countries including Egypt, Indonesia, Poland, Thailand and Turkey have officially adopted inflation targeting as policy, many others such as Malaysia, India and Pakistan have not yet done so. Walsh (2011) suggested that it may be better to focus on headline inflation rather than core inflation in developing countries who do not publish separate core inflation measures. Generally, the main challenges for the conduct of monetary policy and the adoption of inflation targeting in the developing world are the magnitude of external shocks, high exchange rate instability, and inefficiency in domestic financial sectors.

The secondary goal of this thesis is to investigate the sources of macroeconomic instability, and thus contribute to an understanding of how to achieve macroeconomic stability. In recent years, a major concern of macroeconomics has been to identify and decompose the source of economic fluctuations. Existing studies have been concerned with reporting the real contribution of economic shocks to the generation and spread of business cycles (Bjornland, 1998 and 2000; Blanchard and Quah, 1989; Shapiro and Watson, 1988). With particular reference to developing countries, many studies have identified sources of economic shocks in aggregate supply and demand shocks but have not investigated further the decomposition of these. Assessing the effect of internal and external shocks on the output and inflation of developing countries is of paramount importance given that the results of these shocks may cause poverty and lower standards of living in these countries. The identification of different shocks is significant not only for explaining fluctuations in macroeconomic variables, but also for designing appropriate macroeconomic policies in response to those fluctuations.

It is generally accepted that rises in oil prices and exchange rate volatility are regarded as factors contributing to depressing economic growth. Hahn (2003) analysed the pass-through effect of external shocks (i.e. oil price shocks and exchange rate shocks) on Euro-area inflation and found that external shocks contributed significantly to inflation. An oil price shock may typically have real effects, as a higher energy price may affect output through the aggregate production function, by reducing the net amount of energy used in production. External shocks are generally acknowledged to have important effects on both economic performance and macroeconomic policy. The respective roles of oil prices and exchange rates are central issues for policy makers in an open economy. A number of economists have come to an understanding that oil price changes have an adverse effect on output growth in oil importing countries through higher cost of inputs and reallocation of resources (Mork 1989; Bjornland, 2000; Hamilton, 2003 and 1996; Cologni and Manera, 2008).

The nature of the relationship between inflation and economic performance is not straightforward. Extant empirical literature suggest that high inflation is problematic for not only one variable, but for overall economic performance. Policymakers continuously try to control inflation by adjusting monetary policy, yet there remains the question of what would be the real effect of inflation crisis on various economic activities. Existing empirical literatures have argued that high inflation is less expected and leads to increased uncertainty and a negative net effect of inflation on *GDP* growth (Grier and Grier, 2006). In spite of a large quantity of existing literature on inflation targeting in developing countries, little attention has been paid to the consequences of active monetary policy on economic growth. Critics of the inflationary targeting claim that it focuses excessively on inflation and does not pay enough attention to real outcomes, while others suggest that it has the potential of raising instability of output that would lead to lower economic growth. Tsenkwo (2010) indicated that:

> "One of the disadvantages of inflation targeting is its negative impacts on economic growth and its exclusion of the targets above the zero inflation rates reflects the fact that the central bank does not ignore the outgrowth totally and it takes into account a possible deflation and the undesirable impacts of deflation on the economy".

The fundamental question for inflationary targeting is what would represent good timing for monetary policy activity in terms of output effects. This includes the consideration that any anti-inflationary measure would be responsible for potential output loss. An important rationale for the timing of monetary measures is that this suggests such measures should be adopted when their real effects would be most favourable. Currently little empirical work has been done on the expected real effects of inflation targeting in developing countries.

There is a general understanding towards structuring monetary policy, it is understood that monetary policy should be conducted with the objective of stabilizing the economy via the channels of price stability (Svensson, 2002; Mankiw and Reis, 2003). For a central bank to achieve sustainable price stability in the medium to long term, it is not sufficient to only observe the movement of the usual price indices that reflect on current inflation (Mankiw and Reis, 2003; Goodhart and Hofmann, 2000). Some papers argue that a price index used to measure inflation should not only include the prices of current goods and services (*CPI*) but must also incorporate the prices of future goods and services which are reflected in current asset prices (Alchian and Klein, 1973; Goodhart and Hofmann, 2000; Goodhart 2001). Goodhart and Hofmann (2000) argued:

> "The consensus in principle is that the monetary authorities, whom we term henceforth the central bank, should adjust their current policy in so far as asset price fluctuations have predictive content for future, *RPI* or *CPI*, inflation".

The thesis tackles the above problems and consists of three different chapters comprised of both empirical and theoretical analysis, contributing to the study of monetary policy and inflation in Asian developing countries. The study further extends the basic framework of monetary policy according to different inflation measures to propose new measures of inflation and explore the implications of using these new measures of inflation as target variables. Where the study focuses on developing economies, empirical evidence is relatively scarce because of the countries' relatively short term experience, and consensus views have not yet been formed due to the several difficulties encountered in managing the monetary policy frameworks. The study also assesses external and internal shocks as important sources of economic fluctuations. This research uses data from various developing Asian economies to estimate different inflation measures in structuring their monetary policies. As Pakistan is the base country, to understand how different inflation measures are related to the monetary policy, it was necessary to have countries with similar economic outlook within a similar economic region. However, the long period quarterly data for *GDP*, sectoral prices and their weights in *CPI* is not available for comparable neighbouring countries (such as Bangladesh, Sri Lanka). On the other hand, this data is available for Southeast Asian countries used as comparators in the present study. Moreover as all three comparator countries (Indonesia, Malaysia and Thailand) are small developing economies, it is viable to test Pakistan in their backdrop rather than comparing Pakistan with major economies such as (India and China) which could lead to inconsistent results.

Overall, the thesis aims to respond to three specific goals, as follows:

1. To evaluate the real effects of inflation in a situation where there are episodes of high inflation.
2. To reveal the effects of oil prices, aggregate supply and demand shocks on *GDP* and inflation in small oil exporting and oil importing Asian countries.
3. To determine whether a central bank should target a broader price index, including stock prices in addition to current goods and services, in order to minimise variance of output gap.

Chapter 2 tackles aforementioned goal one and attempts to assess real effects of inflation in situations where there are episodes of high inflation. It also tries to verify the hypothesis developed by Bruno and Easterly (1996) which states that short periods of high inflation might not have lasting damaging effects on output in developing countries. In order to analyse the real effects of high inflation episodes, the study adopts an indicator for the inflationary real effect, named as inflationary real response (*IRR*). This is the difference between the expected and output-neutral inflation[2]. This indicator may help to evaluate in advance whether episodes of high inflation are likely to have a positive or a negative real effect. The general conjecture here is such that if inflationary expectations exceed output neutral-inflation, generating positive real effects in periods after increased inflation, then the Bruno and Easterly hypothesis is partially proven. *IRR* could further be useful to indicate suitable timing for monetary policy decisions taken to control inflation, suggesting when their real effect would be most favourable. If the central bank wants to keep inflation within a target, the *IRR* may help to assess in advance the likelihood of whether an inflation control measure will also cause a minimum output distortion.

[2]The indicator was developed by Charemza and Makarova (2006) in the context of monetary policy rather than growth. Their original study did not take into account the effect of high inflation periods.

To compute the decomposition of headline inflation, which includes expected and output-neutral inflation, the two-equation vector autoregressive (*VAR*) model for inflation and output gap[3] is applied to estimate both components of headline inflation. The expected inflation[4] is an indicator of the overall inflationary tendency over a long period of time, while output-neutral inflation is the component of inflation that has no impact on real output in the medium to long term, and is derived from the decomposition of a structural *VAR* analogous to that used by Quah and Vahey (1995). The empirical analysis has been conducted for Indonesia, Malaysia and Pakistan using a vector autoregressive model with estimated quarterly data on inflation and output gap for more than 20 years.

In answering my second goal, chapter 3 uses a baseline model to analyse the responses of real output and inflation to oil price, aggregate supply and demand shocks in four Asian developing countries; Indonesia, Malaysia, Pakistan, and Thailand. The chapter then extends the analyses by using alternative models to observe the response of economic activities to real oil price, exchange rate, aggregate supply, and demand shocks. The choice of the real exchange rate in the model is important because it plays a significant role in accounting for responses of output and inflation in small open economies. Additionally, the study also assesses the sources behind the real exchange fluctuations that can affect economic activities through changing exchange rates in developing countries.

A three-dimensional structural vector autoregressive (*VAR*) model is applied, imposing dynamic restrictions recommended by economic theory, composed of changes in international real oil price, real *GDP* and domestic prices. This *VAR* model is used to identify the structural shocks and explore the relative contributions of the different

[3] The output gap is defined as the difference between actual output and potential output.
[4] Eckstein (1981) proposed a measure of core inflation as the trend increase in the cost of factor inputs.

shocks in describing output and inflation fluctuations in the developing countries over time[5]. This study proposes an economic model that justifies the identification restrictions. Three identification restrictions are applied to identify three specific shocks, which are considered in relation to both long and short terms. The assumption is that demand shocks can only affect output in the short term; while oil price and supply shocks affect output in the long run. The model assumes that oil price is exogenous and only oil price shocks will affect oil prices in the long term. These identification restrictions adequately restrict the reduced form of the macroeconomic variables to allow estimation of the shocks and their influence on the macroeconomic variables.

Structural impulse response functions are applied to determine how output and prices respond to different structural shocks. Furthermore, structural variance decompositions are employed to explain the relative importance of each of the structural shocks in variations of output and price level at different time horizons[6]. To extend the empirical analysis, the four variable alternative structural *VAR* model (consisting of change in domestic real oil price, change in real exchange rate, change in real *GDP*, and inflation) is used to identify the oil price, supply, real exchange rate (real demand) and demand (nominal) shocks. The different disturbances will be identified through long term restrictions on the alternative *VAR* model, based on the technique developed by Blanchard and Quah (1989). The restrictions assume that only oil price shocks affect oil prices in the long term. The assumption is that demand side (real and nominal) shocks have no long term effect on output, and that nominal demand shock cannot affect the real exchange rate in the long term.

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[5] The study uses variant aggregate supply and demand functions (presented by Cover et al., 2006; Enders and Hurn, 2007) to model the macroeconomic fluctuations in Asian developing countries, and follows the structural *VAR* analysis introduced by Blanchard and Quah (1989) and extended to open economies by Bjornland (1998, 2000), and Mohsen and Oskoui (2006).

[6] The *VAR* model is used to estimate impulse response functions and variance decompositions.

In answering the third and final goal, chapter 4 focuses on which inflation measure should be used by the central bank as a target variable if it wants to minimise variance of output gap. The study investigates the issue of how to choose the right price index for the central bank and whether the central bank should target a broader measure of the price index that incorporates the current prices of goods and services and also stock prices. The starting point of this idea is that a central bank commits itself to adopt an inflation targeting framework. The main objective of chapter 4 is to select target weights that will lead to greater economic stability, because a central bank faces the problem of how to choose weights for different sectoral prices. These discussions form the basis of the Mankiw and Reis (2003) model, which creates an optimisation approach to this problem, using representative consumers and heterogeneous sectors that can differ with regard to their consumption weights, cyclical sensitivity, price rigidities and magnitude of sectoral shocks. For situations where the goal of the central bank is to maximise macroeconomic stability through changing the weight applied to different sectors in the price index, Mankiw and Reis (2003) proposed a target price index called the stability price index. A higher target weight is assigned to a sectorial price in the stability price index if it has highly cyclical sensitivity, low idiosyncratic shocks, has slow response to changes in economic conditions and small consumption weights as compared to other sectoral prices.

The study further extends the Mankiw and Reis (2003) model by including the financial sector (stock prices) with combined components of the consumer price index to compute optimal weights for the central bank price index. The main focus of this current chapter is an empirical estimation of the approach rather than a theoretical investigation as per Mankiw and Reis (2003). This study also derives the objective function of the central banks’ problem by a four sectoral price algebraic solution. Also, a different methodology is applied compared to previous studies, using a generalized method of moments (*GMM*) to estimate the parameters (characteristics) for the model.

Goodhart (2001) and Shiratsuka (1999) argued that asset prices experience large idiosyncratic shocks (large fluctuations) and raised the question of whether monetary policy should target unstable asset prices with large sectoral shocks. The present study further contributes to an understanding of the issues by investigating the question of whether central banks should use stock prices as a component in the stability price index, which is decomposed into fundamental and non-fundamental (bubble) components. It is expected that the fundamental is permanent (trend) and bubbles are cyclical (temporary) components of stock prices.

Chapter 5 links the findings of each chapter of the study, describing major policy implications as well as recommendations for further research. Appendices provide information about data description, analytical processes, econometric tests, correlation matrices, figures and robustness checks for the empirical estimations described in chapters 3 and 4.

Chapter 2

Periods of High Inflation and Real Effects: Some Empirical Evidence

Abstract

This chapter attempts to evaluate the real effects of inflation in a situation where there are episodes of high inflation. It also attempts to verify the Bruno and Easterly (*BE*, 1996) hypothesis that short periods of high inflation might not have lasting damaging effects on output. The study adopts inflationary real response (*IRR*), which is the difference between expected and output-neutral inflation, as an indicator for inflationary real effect. Empirical analyses have been conducted for Indonesia, Malaysia and Pakistan using a vector autoregressive model, with quarterly data on inflation and output gap for the period 1981q1-2010q3. The main finding is that for episodes of high inflation, including hyperinflation, there is clear evidence of increased and positive *IRR*. This means that, at these periods, inflationary expectations exceeded neutral inflation, generating positive real effects in periods after increased inflation. This indirectly confirms the Bruno and Easterly hypothesis discussed above.

2.1. Introduction

Several theoretical and empirical studies have explored the link between inflation and economic growth. The question of the existence and nature of associations between inflation and growth has been of great interest over the last few decades. There is general consensus among economists that permanent and anticipated changes in the inflation rate have no effect on real activity in the long run. Several studies support the view that the relationship between inflation and growth is non-linear, indicating positive association at low levels of inflation becoming negative at high rates[7]. Li (2004) further pointed out that non-linearity between inflation and growth differs in industrial countries and developing countries. The question to be asked is what would be the effect of medium level inflation when low inflation is helpful and high inflation is detrimental for economic growth? Mubarik (2005) argued that moderate inflation facilitates economic growth while high inflation produces uncertainty and damages economic performance. In contrast, empirical results provided by De Gregorio (1992) and Fischer (1993) confirm that moderate inflation has been a significant factor in reducing economic growth.

However, considerable evidence suggests that a continued high inflation rate might have a harmful effect on real growth, even in the long run (Fischer 1993, Li 2004). The negative long term association between inflation and growth is based on the assumption that high inflation influences the price signalling mechanism, leading to a misallocation of resources in market economies. Researchers investigating high inflation rarely expressed doubt that inflation was detrimental to the economy. Faria and Carneiro (2001) found that longer periods of high inflation have no effect on real output, although high inflation exerts negative impact on output in the short term.

It is almost universally acknowledged that high inflation negatively affects growth. Empirical results related to low and medium inflation are of a mixed nature; some papers (mainly those analysing developed economies) argue that moderate inflation negatively affects growth (e.g. De Gregorio 1992 and 1993; Fischer 1993; Alexander, 1997; Faria and Carneiro 2001; Gillman et al., 2004; Gillman and Harris 2009) while others argue that moderate inflation actually has a stimulating effect. The empirical

[7] See, Khan and Senhadji (2001), Bruno and Easterly (1996 and 1998), Fischer (1993), Christoffersen and Doyle (1998), Charemza and Makarova (2009). Fischer (1993) was first to identify the non-linear relationship between inflation and growth.

evidence here mainly relates to developing economies (see e.g. Christoffersen and Doyle, 1998; Nell, 2000; Mallik and Chowdhury, 2001; Khan and Senhadji, 2001; Khan, 2002; Mubarik, 2005). It can be noticed that all these papers univocally dismiss the claim that high inflation can ever be beneficial for growth.

However, the empirical methodology applied by most of these papers might be subject to criticism, especially when used in the analysis of developing economies. The long run (error correction) approach applied by researchers such as Mallik and Chowdhury (2001) is dubious, because the time series data for developing countries are subject to frequent structural changes, are not long enough to allow for the development of long run patterns and are often subject to non-linear non-stationarity, which negatively affects traditional cointegration analysis. Other papers (e.g. Gillman et al., 2004) use a panel data approach which is equally prone to bias due to non-normality and non-stationarity (see Sun, 2009). Moreover, these empirical papers often concentrate on the evaluation of the relation between inflation and the *GDP* rate of growth, thus confusing supply and demand effects.

In this context, this chapter develops from the Bruno and Easterly (1996, 1998) hypothesis that short periods of high inflation might not have damaging effects on growth in developing economies. Empirical analysis in this study is limited to the simple question of whether periods of high inflation generate positive or negative real effects, as the researcher is also convinced that long run analysis of high inflation data from developing economies is statistically implausible.

The general conjecture here is such that, if the effects are positive, the Bruno and Easterly hypothesis is partially proven (only partially, as the effects of high inflation on full-capacity output are not considered here). This study defines the measure of the real effect of inflation as the inflationary real response (*IRR*); that is, the difference between expected and output-neutral inflation, where both expected and output-neutral inflation are computed as the decomposition of shocks induced in the *VAR*. The methodology applied here has been developed on the grounding of earlier findings by Charemza and Makarova (2006), who suggested that the difference between expected and output-neutral inflation is an indicator for the expected real effects. They applied a two-equation *VAR* model for output gap and inflation to provide the numerical evaluation of such an indicator. However, their paper was set in a context of monetary policy rather than real sphere growth and they did not consider the possible effects of high inflation.

The conjecture is that when *IRR* is positive then a positive inflationary shock is more likely to stimulate output growth than when *IRR* is negative. Also, if *IRR* is negative, the expected real effect of a positive inflationary shock is smaller than when *IRR* is positive. From the perspective of monetary policy, if $IRR>0$ the climate for undertaking monetary policy action is favourable, because if monetary policy is expansionary then expected output growth is high and if monetary policy is contractionary then expected loss in output is small. Conversely, if $IRR<0$ the climate is bad for monetary policy actions because in this case if monetary policy is expansionary then the output gain is small, and if monetary policy is contractionary then the output loss is higher. In a situation of negative *IRR*, it is better that the monetary authorities do not intervene. The derivation of *IRR*, in the context of a two-equation *VAR* model for output gap and inflation, is given in section 2.3 of this chapter.

Through empirical application, this study estimates the relationship between inflation and output gap. Output gap is frequently estimated as a key determinant of inflationary pressures in the short term, and this is a relationship that only exists in the short term. On the surface, no relationship exists between *IRR* and growth because the resource capacity is assumed constant in the short run analysis. However, as *IRR* increases the output gap widens and also exerts pressure on investment to change[8]. An increase in investment (increasing capital stock and its efficiency) leads to an increase in real *GDP;* if the increase in real *GDP* is caused by an increase in investment, as in the theoretical Keynesian model, then there will be an increase in potential *GDP* in the short and medium term, which is equivalent to *GDP* growth[9].

The empirical analysis considers three developing countries, each with different inflation dynamics over the last 20 years: Indonesia, Malaysia, and Pakistan. Indonesia suffered from a period of hyperinflation in 1998-1999, Pakistan has been experiencing high inflation since the beginning of 2008, and Malaysia has recently seen relatively stable inflation (with some periods of high inflation in 2008-2009) with some evidence of random cyclicality. To analyse inflation measure and monetary policy of Pakistan, comparator economies of Indonesia and Malaysia are included in this chapter. Indonesia has gone through high inflation periods and relatively reeling under high inflation for some time, whilst Malaysia is a low inflation country but recently experienced bouts of high inflation. Moreover long period of quarterly *GDP* data from Indonesia and Malaysia was available, while as similar comparable data was lacking from other neighbouring countries. The data used in the analyses are quarterly; since 1990q1 for Indonesia, 1991q1 for Malaysia and 1981q1 for Pakistan. For each country the *VAR* model has been estimated by the maximum likelihood method and *IRR* has been calculated and forecast according to these estimates.

[8] The output gap is computed as the percentage difference between actual and potential *GDP* level. The potential *GDP* is the level of output at which aggregate demand and aggregate supply are consistent with a steady inflation rate (Gibbs, 1995). It is determined on the supply side of the economy, by such means as capital stock, labour use and accessible technology. During a boom, output increases above its potential level and the output gap is positive. However, during a recession the economy will decline below its production potential and the output gap is negative (Billi, 2011).

[9] A boom (crisis) can increase (decrease) potential output in the short and medium term through its positive (negative) impact on investment (European Economy, 2009).

The main finding of the chapter is that, for the periods of hyperinflation (in Indonesia and Pakistan) and upward movements of inflation (in Malaysia) there is clear evidence of increased and positive *IRR*. This means that during these periods inflationary expectations exceeded neutral (core) inflation, as a result generating positive real effects in periods after increased inflation, and thus diminishing the damage done by high inflation. This confirms the Bruno and Easterly hypothesis discussed above.

The rest of this chapter is structured as follows: section 2.2 briefly reviews the existing literature on the relationship between inflation and economic growth. Section 2.3 describes the derivation and concept of *IRR*, in the framework of a two-equation *VAR* model for output gap and inflation. Section 2.4 discusses high inflation periods and their consequences for selected countries. Section 2.5 describes certain issues related to the data, then reports and discusses the estimated results. Section 2.6 characterises and evaluates the variability of the estimates by a bootstrap method. The relationship between *IRR* and monetary policy is described in section 2.7. Finally, section 2.8 presents the conclusion of the study.

2.2. Inflation and Growth: Some Existing Evidence

Over the past two decades an increasing number of studies have analysed the relationship between economic growth and inflation. However, the empirical findings concerning this relationship are ambiguous. De Gregorio (1992) analysed data concerning inflation and growth for twelve Latin American countries for the period 1950-1985. He employed a single equation model to investigate the relationship between inflation and growth, which led him to conclude a negative correlation between inflation and growth. Research conducted by Harris et al. (2002) to study inflation and growth by using data of OECD and APEC member countries covered the period 1961-

1997. The interpretations arrived at by this study also concluded that inflation had a negative impact on economic growth.

Furthermore, Mallik and Chowdhury (2001) examined the inflation-growth relationship by using time series annual data for Bangladesh, India, Pakistan and Sri Lanka. They used cointegration and error correction models and confirmed a long run positive relationship between economic growth and inflation for all these countries. They further demonstrated that faster economic growth may lead to unstable inflation, and that moderate inflation in itself is helpful to growth. Using data for Bangladesh during the period 1980-2005, Ahmed and Morteza (2005) investigated the relationship between inflation and growth during both short and long term periods. They observed that empirical evidence indicated a significant long term negative association between inflation and economic growth.

Recently macroeconomists have focused on the non-linear relationship between inflation and growth. In other words, at lower rates of inflation the relationship is nonexistent or even positive, but at higher rates it becomes negative. It is worth questioning what would be the threshold level (inflection point), at which the direction of the inflation-growth relationship would change (Khan and Senhadji 2001). Fischer (1993) was the first to discover the non-linear relationship between inflation and economic growth while noting that the threshold and the direction between the two variables are inclined to change. Mubarik (2005) conducted research that estimated this threshold level of inflation in Pakistan by using time series data covering the period 1973-2000. His empirical findings suggest that moderate inflation, such as that below 5 percent, has a positive effect on economic growth. However, he also stresses that inflation depresses growth when it passes 9 percent. Ahmad and Morteza (2005) again estimated this threshold model and suggested that inflation above 6 percent has adverse affects on economic growth.

Khan and Senhadji (2001) reexamined the existence of threshold effects in the inflation-growth relationship through their new econometric methods, utilising data that covers 140 developing and developed countries for the period 1980-1998. Their findings strongly indicated that inflation exerts a negative effect on growth beyond a certain threshold. Their estimated threshold model suggested 1-3 percent (lower) as the threshold level of inflation for industrial countries and 7-11 percent (higher) for developing countries. Li's (2004) study found a non-linear relationship between inflation and economic growth. He argued that the effect of inflation on growth is neither significant nor positive when the inflation rate is below the lower threshold level. He further argues that within the threshold levels the effect of inflation is negative and statistically significant. However the impact of inflation on economic growth remains negative but statistically insignificant when the rate of inflation exceeds the upper threshold level. Furthermore, Charemza and Makarova (2009) use a panel data series for 141 countries to estimate linear and non-linear persistence measures of inflation by using a bilinear autoregressive average model. They concluded that in recent years non-linear inflation has contributed positively to changes in economic growth.

Studies carried out by Gosh and Philips (1998), and Christoffersen and Doyle (1998) established the existence of negative relationships between inflation and economic growth beyond particular thresholds. Using data from 1960-1990, Barro (1996) assessed the effect of inflation on 100 countries to determine the effect of inflation on economic performance. His studies concluded that inflation above than 20 percent was significantly harmful for growth because of the negative effects of inflation, but that there is insignificant negative correlation between inflation and growth when inflation is below 20 percent.

Bruno and Easterly (1996) presented their analysis of the empirical links between inflation crises, stabilization and growth, by using data of 26 countries that had inflation crisis at some point between; 1961-1992. Their study defined high inflation episodes as when inflation over a 12 month period is above 40 percent. Their study found no evidence of any consistent relationship between inflation and growth at any level. However, evidence suggested that growth declines rapidly during high inflation periods but then stabilises after inflation declines. In addition, considering the decrease in growth during an inflation crisis and its immediate recovery after the crisis the net effect on growth would be around zero.

Based on the above findings, it is reasonable to conclude that the evidence to date regarding the inflation-growth relationship is relatively ambiguous. This chapter tries to overcome the ambiguity within the inflation-growth relationship by narrowing the concept of inflation and evaluating the relationship between growth and decomposition of inflation, rather than growth and headline inflation. The indicator *IRR* has been adopted to examine the relation between inflation and its real effects. The indicator measures the real effect of inflation in circumstances where there are periods of high inflation. That is, *IRR* examines inflation and growth indirectly via real effects.

2.3. The Basic Model

The general problem can be explained with the use of a simple short run representation of a typical aggregate supply function:

$$y_t = \theta(\pi_t - \pi_t^n) \qquad \theta > 0 \ , \tag{2.1}$$

where y_t is the output gap defined as the difference between the logs of the actual and natural output levels, π_t is headline (observed) inflation and output-neutral inflation is π_t^n. Evidently:

$$\pi_t = \pi_t^e + \upsilon_t \quad , \tag{2.2}$$

where υ_t is a shock unexpected at *t*-1. However, in an economy with sticky prices, some individual relative prices cannot be fully adjusted after a shock and could have long-lasting effects on output, even if fully expected. Consequently, another decomposition of π_t is:

$$\pi_t = \pi_t^n + \omega_t , \tag{2.3}$$

where ω_t is the non-neutral component of inflation. The evaluation of π_t^n is also based on information available at time *t*-1. Referring to the seminal literature on inflation decomposition, π_t^e is similar to core inflation in the sense of Eckstein (1981), i.e. the systematic (predictable) component of the increase in production costs. In turn, π_t^n is analogous to core inflation in the sense of Quah and Vahey (1995), i.e. the component of expected inflation which does not cause a real effect in the medium and long run.

From (2.2) and (2.3) we obtain ω_t as:

$$\omega_t = \pi_t^e - \pi_t^n + \upsilon_t \quad ,$$

which gives $E_{t-1}\omega_t = \pi_t^e - \pi_t^n$, where E_{t-1} denotes an expected value conditional on observations available at time *t*-1. Hence conditional expected value of output gap is:

$$E_{t-1}y_t = \theta \cdot E_{t-1}\omega_t = \theta \cdot (\pi_t^e - \pi_t^n) \quad . \tag{2.4}$$

The relationship (2.4) gives rise to defining the indicator of inflationary real effect, *IRR*, as:

$$IRR_t = \pi_t^e - \pi_t^n \quad ,$$

so that, the positive difference between the expected and output-neutral inflation indicates that a positive real effect of inflation will occur in time t, if there is no additional shocks to the system. The negative *IRR* can be interpreted conversely. One way of computing π_t^n is similar to that derived from the Quah and Vahey (1995) structural decomposition of a vector autoregressive model[10]. This decomposition was applied by Charemza and Makarova (2006), albeit in a different context.

Suppose that such *VAR* model can be written as:

$$A(L)Z_t = K + U_t \quad , \tag{2.5}$$

where $Z_t = \begin{bmatrix} y_t \\ \pi_t \end{bmatrix}$, $A(L)$ is the lag polynomial operator, $K = \begin{bmatrix} k_1 \\ k_2 \end{bmatrix}$ the vector of constants, $U_t = \begin{bmatrix} u_{1t} \\ u_{2t} \end{bmatrix}$ innovations with zero expectations and variance-covariance matrix $\Sigma = \begin{bmatrix} \sigma_{11} & \sigma_{12} \\ \sigma_{12} & \sigma_{22} \end{bmatrix}$. Suppose further that the output innovation u_{1t} can be decomposed into the technological shock, w_t, and the real effect of the inflation 'surprise', u_{2t}, i.e.:

$$u_{1t} = w_t + \delta u_{2t} \quad . \tag{2.6}$$

The vector moving average representation of (2.5) is

$$Z_t = M + C(L)U_t \quad ,$$

[10] Gartner and Wehinger (1998), Wehinger (2000) and Hahn (2002) employed analogous structural decomposition of a *VAR* to compute output-neutral inflation.

where $M=[m_1, m_2]'=EZ_t=C(1)K$ and $C(L)=A^{-1}(L)=I+C^{(1)}L+C^{(2)}L^2+\ldots$.

Let us further denote by $W_t=[w_t, u_{2t}]'$ (note that matrix W_t is diagonal). Hence:

$$Z_t = M + C(L)\begin{bmatrix}1 & \delta\\ 0 & 1\end{bmatrix}W_t = M + S(L)W_t \quad ,$$

where: $S(L)=C(L)\begin{bmatrix}1 & \delta\\ 0 & 1\end{bmatrix}=I+S^{(1)}L+S^{(2)}L^2+\ldots$, and $S^{(i)}=C^{(i)}\begin{bmatrix}1 & \delta\\ 0 & 1\end{bmatrix}$.

Decomposition into the unitary innovations is given by

$$Z_t = M + \Gamma(L)\Phi_t \quad ,$$

Where $\Gamma(L)=\Gamma^{(0)}+\Gamma^{(1)}L+\Gamma^{(2)}L^2+\cdots$, $\Phi_t=[\varphi_{1t}, \varphi_{2t}]'$, and $E\Phi_t\Phi_t'=I$ (identity matrix). The desired long run output-neutral decomposition is defined as:

$$Z_t^* = \begin{bmatrix}\gamma_{11} & 0\\ \gamma_{21} & \gamma_{22}\end{bmatrix}\times\begin{bmatrix}\varphi_{1t}\\ \varphi_{2t}\end{bmatrix} \quad ,$$

where γ_{kj} (k,j = 1,2) are elements of the long run matrix $\Gamma(1)$, i.e.

$$\Gamma(1)=\Gamma^{(0)}+\Gamma^{(1)}+\Gamma^{(2)}+\cdots=\begin{bmatrix}\gamma_{11} & 0\\ \gamma_{21} & \gamma_{22}\end{bmatrix} \quad .$$

After some manipulation, it gives:

$$\Gamma(1)\times\Phi_t = C(1)\times U_t = S(1)W_t \quad ,$$

Where $\Gamma(1)$ can be computed as the lower-triangular Cholesky factor of $C(1)\Sigma C(1)'$.

Further denote:

$$V_t=\begin{bmatrix}v_{1t}\\ v_{2t}\end{bmatrix}=S(1)\times W_t=\left(I+S^{(1)}+S^{(2)}+\ldots\right)\begin{bmatrix}w_t\\ u_{2t}\end{bmatrix} \quad ,$$

this leads to:

$$\Phi_t = \begin{bmatrix} \varphi_{1t} \\ \varphi_{2t} \end{bmatrix} = \Gamma^{-1}(1) \times V_t = \frac{1}{\gamma_{11}\gamma_{22}} \begin{bmatrix} \gamma_{22} & 0 \\ -\gamma_{21} & \gamma_{11} \end{bmatrix} \begin{bmatrix} v_{1t} \\ v_{2t} \end{bmatrix} = \frac{1}{\gamma_{11}\gamma_{22}} \begin{bmatrix} \gamma_{22} v_{1t} \\ -\gamma_{21} v_{1t} + \gamma_{11} v_{2t} \end{bmatrix} \quad .$$

One-step ahead forecast of π_t can be computed as:

$$\pi_t^e = m_2 + \sum_{i=1}^{\infty} (\gamma_{21}^{(i)} \varphi_{1t-i} + \gamma_{22}^{(i)} \varphi_{2t-i}) \quad ,$$

where $\gamma_{kl}^{(i)}$ are the elements of matrices $\Gamma^{(i)}$.

The output-neutral inflation is given by:

$$\pi_t^n = m_2 + \sum_{i=1}^{\infty} \gamma_{22}^{(i)} \varphi_{2t-i} \quad ,$$

where $\varphi_{2t-i} = ([c_{21} - c_{11} \frac{\gamma_{21}}{\gamma_{11}}] w_{t-i} + [(c_{22} + \delta c_{21}) - \frac{\gamma_{21}}{\gamma_{11}} (c_{12} + \delta c_{11})] u_{2t-i} \quad .$

So that, IRR_t is given by:

$$IRR_t = \pi_t^e - \pi_t^n = \sum_{i=1}^{\infty} \gamma_{21}^{(i)} \varphi_{1t-i} \quad . \qquad (2.7)$$

As *IRR* is based entirely on information from the past, it can be used for economic policy analysis and various type of forecasting.

2.4. High Inflation Episodes

We have evaluated *IRR* for three developing economies for the period from 1991 until 2010, two of which exhibit evidence of high inflation in this period (Indonesia and Pakistan), while the third one (Malaysia), with a markedly low average inflation, is used as benchmark for comparison. Below we outline briefly the development of inflation and causes for its increases in these countries.

2.4.1. Indonesia

Indonesia faced a deep economic recession due to the 1997-1998 Asian financial crisis. The crisis that started from high devaluation of the Thailand's currency then affected Indonesia and some other Asian countries (Hirawan and Cesaratto, 2008). As the result Indonesia experienced a massive depreciation in its currency causing the stock market to collapse. The economy faced unstable financial position because of Indonesian corporations borrowing practices in foreign currencies without hedging against currency devaluation. The exchange rate went out of control; foreign investors feared losses and started withdrawing their finances. At the same time, domestic firms with foreign borrowings began selling local currency to buy enough foreign currency to cover for their outlays and interest payments, furthering the domestic currency decline. The rate of inflation increased sharply and reached about 80 percent in mid 1997. In response to high inflation, the Bank of Indonesia raised the interest rate to around 70 percent. Indonesian *GDP* growth rapidly declined witnessing negative economic growth of over 13% in 1998.

Since the currency crisis during 1997-1999, Indonesia has introduced a wide range of institutional reforms and redirected monetary policy towards maintaining price and exchange rate stability. As the result, price stability has been reinstated. However, the annual economic growth rate in 2001 slipped to about 3.5 percent with the inflation rate of around 13%. In the fourth quarter of 2005 Indonesia experienced a minor crisis due to international oil shock coupled with high imports. The Indonesian government was forced by *IMF* to cut its oil subsidies to stabilise the economic situation, but the economy responded by sharp inflation rise of 17% in 2005. After that, economic growth increased slowly to 4.9% in 2004 and steadily reached 5.6% in 2005. The Bank of Indonesia had officially launched its inflation targeting policy as its new monetary policy framework in July 2005. In the wake of the economic crisis, the Bank of Indonesia has been granted both goal and tool independence as part of conditionality of the International Monetary Fund's rescue package.

2.4.2. Malaysia

Unlike Indonesia and Pakistan, Malaysian economy has not experienced episodes of substantially high inflation. Since 1991 inflation rate averaged 2.9%. In 1990, oil price shock as a result of Gulf war increased Malaysian inflation merely to 4.75% in 1991. Cheng and Tan (2002) suggested that main factors affecting Malaysian inflation were external (foreign trade, foreign direct investment and technology transfer). Malaysia has been comparatively successful in balancing strong economic growth with moderate levels of inflation in the periods preceding and following the Asian Financial crisis (Guimaraes-Filho and Crichton, 2006). During the Asian Crisis period inflation was well controlled and on averaged increased around 5 percent.

After facing an economic recession for about two years since 1997, Malaysian economy has began to pick up again from the third quarter of 1999. Inflation rate started to accelerate since 2005 when the world oil prices rose. Although core inflation has increased moderately, recent adjustment in the administered prices of fuel and other consumption items caused an increase in headline inflation.

2.4.3. Pakistan

Low and moderate inflation has been one of the main characteristic of the Pakistan economy until 2008. Average annual inflation was above 11 per cent for only 8 of the past 28 years. Average real per capita income growth was 2.8 per cent in years with less than 11 per cent inflation as compared to the years of high inflation with an average of 1.5 per cent (Khan et al, 2007). Pakistan did remarkably well in bringing down inflation to the fold of the single digit during 1980s, despite devastating floods in 1988 and Afghan wars.

In 1991 inflation increased to 11.7% as a result of the oil shortage caused by the first Gulf war. The rate of inflation remained just under 10% during 1992-1993. Inflation again accelerated during the 1994-1995 and crossed the single digit line. The considerable decline from the fiscal targets set in the 1994-1995 budget appears to be the key factor responsible for the high rate of inflation in that period (Hassan et al., 1995). In case of Pakistan, it is argued that main causes behind high rate of inflation would be lack of fiscal management resulting in the large monetary expansion, supply side sluggishness, sources of financing deficits, uneven economic growth and exchange rate depreciation resulting in imported inflation. Large fiscal deficit and rises in indirect taxes have the major factors for the persistence of the high inflation rate during most periods of 1990s. Through tight monetary policy Pakistan did extremely well in keeping inflation under control and reduced it to 5% after 1998 which remained stable until 2003. Pakistan has made significant progress in implementing economic and institutional reforms since 2000 (Khalid, 2006). It also accomplished the fastest privatization of the banking system during this period and the State Bank of Pakistan (*SBP*) has been identified as the most capable central bank in rising economies in 2004. Inflation has been brought to single numbers and economic growth has reached a record high level. Consequently, it has been suggested that it was an appropriate time for policy makers in Pakistan to consider inflation targeting as a monetary policy strategy (see Khalid, 2006).

After 2003, there was an increase in inflation peaking at 11% in 2005. The most significant factors which explain high inflation in 2005-06 were an increase in inflationary expectations, growth in the non-government sector borrowing, subsidising prices of wheat and the exchange rate effect (Khan et al., 2007). Monetary policy in Pakistan, in line with State Bank of Pakistan Act, was reasonably successful in promoting economic growth and maintaining price stability. However, the stability was distorted in 2008 when, triggered by increasing worldwide petrol prices, inflation in Pakistan reached about 25.0%. This is highest inflation rate since 1975. Inflation was further stimulated by an increase in agricultural prices and industrial uncertainties caused by political instability.

2.5. Empirical Evaluation of *IRR*

The estimation used quarterly data for *CPI* inflation provided by the *IMF* International Financial Statistics report (*IFS*) for all three countries. As the quarterly *GDP* data is not available for Pakistan, the study interpolated annual series, supplied by *IFS*, into quarterly observation using the Simpson's (parabolic) rule (see e.g. Al-Turki, 1995). Although official quarterly data are available for Pakistan for some periods, their quality has been widely criticised. For Indonesia and Malaysia quarterly *GDP* data are available from the *IFS*, and the *GDP* deflator data for Indonesia was obtained from the Bank of Indonesia. Output gap figures for all countries were computed by applying the Hodrick-Prescott smoother to the relevant data and computing the differences. All the data have been seasonally adjusted. The estimation period varies across the different countries; Indonesia 1990q1 to 2010q3, Malaysia 1991q1 to 20010q3 and Pakistan 1981q1 to 2010q4.

With the use of these data, the *VAR* model (2.5) has been estimated for each country by the maximum likelihood method, where the number of lags has been set using the Akaike Information Criterion, with a maximum admissible lag of 4. Then, applying the estimated parameters, *IRR* has been computed using equation (2.7). Figures (2.1)-(2.3) plot the computed *IRR* against headline inflation for each of these countries.

Figure 2.1: *IRR* and Inflation in %, Indonesia

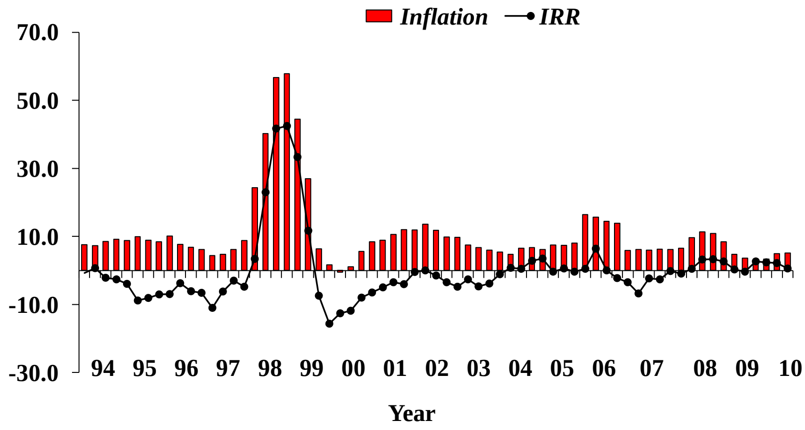


Figure 2.2: *IRR* and Inflation in %, Malaysia

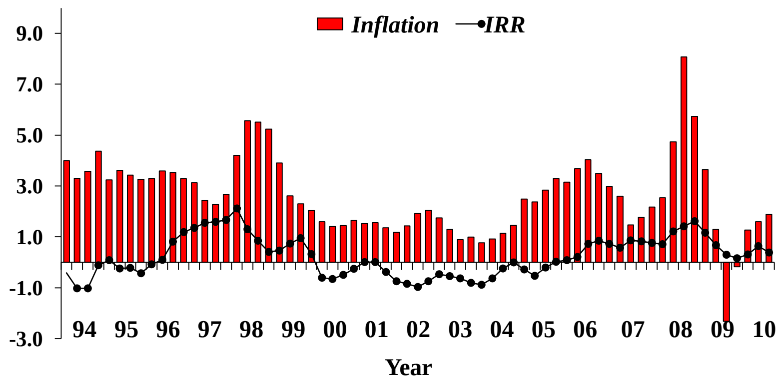
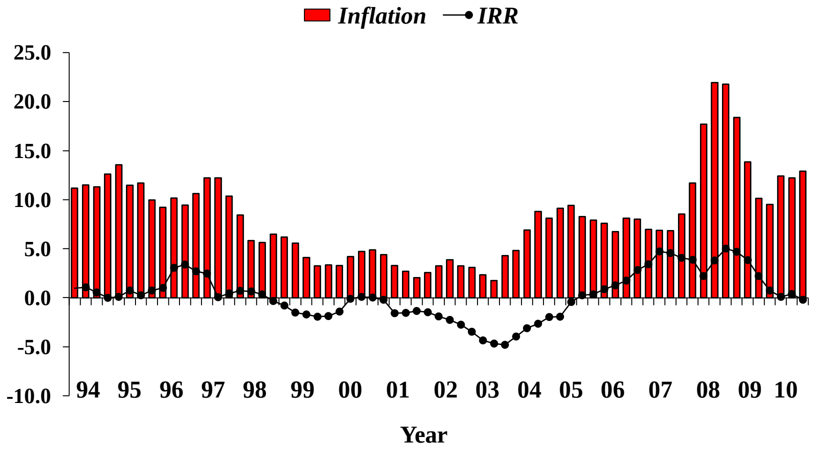


Figure 2.3: *IRR* and Inflation in %, Pakistan



Without a need for any additional computing it is evident that, for all three countries, there is a substantial positive relationship between inflation and *IRR*, particularly in periods of high inflation. The strongest relationship is clearly for Pakistan, where *IRR* has followed headline inflation for periods of increasing and declining inflation. For Pakistan the real effects of high inflation in 2008 eventually lead to a positive real effect in 2010. For Indonesia the relationship is less strong, although *IRR* and inflation moved closely together around the period of high inflation in 1998-1999. Even in Malaysia, with no evident high inflationary period, inflation and *IRR* increased simultaneously in 1998. Additionally in this case, the relationship is also visible at the end of the period analysed, in 2008 where inflation peaked again and *IRR* also increased. These findings confirm that for all countries episodes of high inflation are linked with positive real effects, where the expected inflation is greater than output-neutral inflation. They also show that *IRR* immediately declines with a reduction in inflation.

For each country, figures (2.4)-(2.6) plot *IRR* against the change in *GDP* on two separate axes. Although it is clear that there are drastic drops in *GDP* during the high inflation period, the recovery is quick and sustainable if *IRR* is positive. For Indonesia in particular, immediately after the high inflationary period in 1998-1999, there was an unprecedented increase in *GDP*, reaching 20% in 2000. Even in Malaysia and Pakistan, there is evidence of dramatic *GDP* growth collapse during high inflation crises (2009 and 2008 respectively) and recovery in growth was followed by reduction in inflation in 2009-10. These results support the idea that for all countries high inflation periods have a transitory effect on *GDP* growth but no permanent effect on growth. In other words, economic growth decreases during an inflation crisis and after that period recovers back to the pre-crisis trend.

Figure 2.4: *IRR* and *GDP* Growth in %, Indonesia

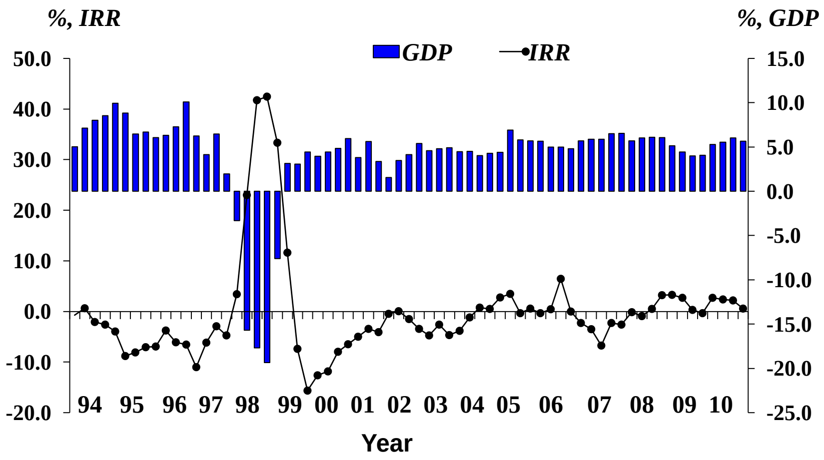


Figure 2.5: *IRR* and *GDP* Growth in %, Malaysia

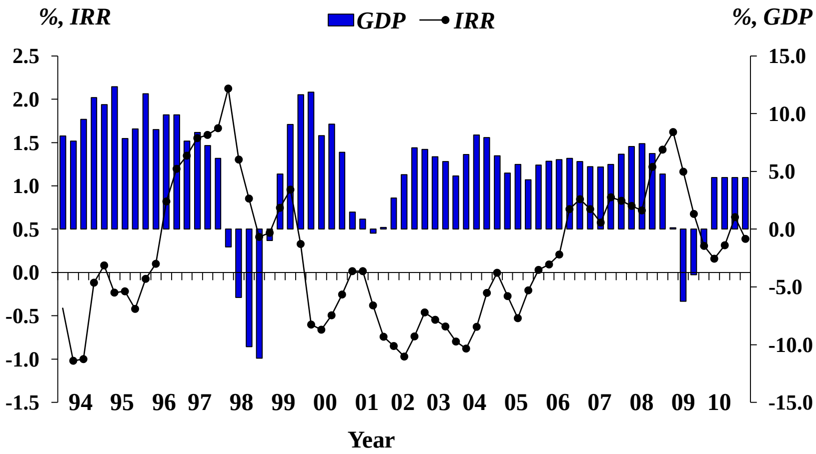
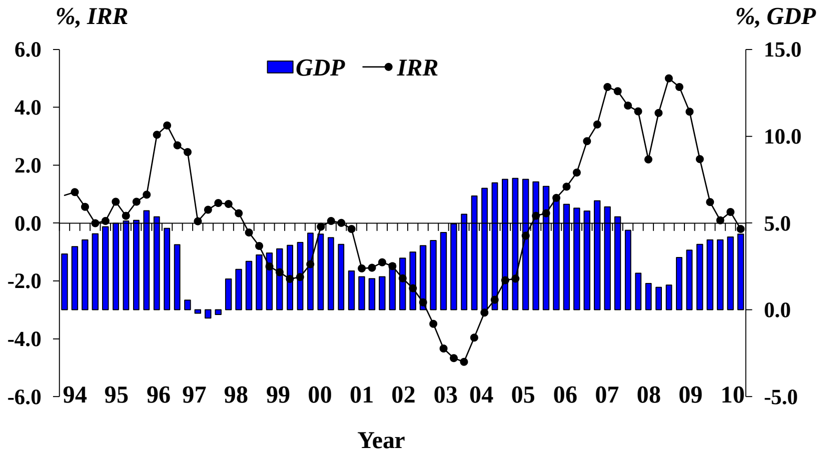


Figure 2.6: *IRR* and *GDP* Growth in %, Pakistan



2.6. Evaluating *IRR* Variability through the Bootstrap Method

In empirical application, the expected (π_t^e) and output-neutral (π_t^n) inflation are not observable and are computed from the decomposition of the structural *VAR* empirical analysis. The distribution or test statistics of the components of inflation are unknown.

As there is no directly observable data for *IRR*, the concern here is with an assessment of the variability of the *IRR*. Reflecting the estimation uncertainty, the bootstrap method is employed to construct the confidence intervals for *IRR*.

Efron (1979) was the first to propose the bootstrapping statistical technique, which operates as a general method for estimating distribution of sample statistics by resampling with replacement from the original random variables. In other words, it engages estimation of a model numerous times using resampled data. The bootstrap method provides a robust standard error and confidence interval for the estimates. Its premise is that when a test statistic of interest has an unknown distribution under the null hypothesis test, the relevant information is used in the analysed data set so that the distribution can be characterised (Davidson, 2007).

The bootstrap is superior to certain other asymptotic methods such as the traditional normal approximation and the first order approximation. It yields an approximation to the distribution of a test statistic that is at least as accurate as the approximation obtained from other asymptotic methods (Horowitz, 1997). The bootstrap provides a method of alternative calculation for mathematical analysis when it is difficult to compute the asymptotic distribution of an estimator (Horowitz, 1997). It may also be applied to statistics that are not asymptotically pivotal, including cases where the distribution of test statistics is unknown.

There are many versions of the bootstrap method; this study employs residual pairwise bootstrapping. Residual bootstrap begins by resampling the residuals from the regression and adds the resampled residuals to the models, than the estimates are recomputed. Freedman (1981) first suggested the pairwise bootstrap technique which consists of resampling residuals directly from the original data in order to resample the response predictor pairs. In the empirical analysis the two-dimensional residuals are jointly resampled independently and with replacements in the *VAR* model (2.5). Resampled independency between the residuals is one of the main reasons for using pairwise bootstrapping as it maintains the correlation between the residuals. The idea of residual pairwise bootstraps proceeds as follows: first the *VAR* Model is estimated where the estimated residuals pairs are obtained, and then bootstrap residuals pairs are generated by randomly drawing with replacements from these estimated residuals. These bootstrap residual pairs are used to compute firstly bootstrap expected inflation, secondly output-neutral inflation and lastly *IRR* estimates. The step is repeated 100 times, and bootstrap distributions of the *IRR* are obtained.

Figures (2.7)-(2.9) show confidence intervals (± two standard deviations around the computed value of *IRR*) obtained by the residual pairwise bootstrap applied to the residuals of the *VAR* model. For most periods, the confidence intervals include zero, which means that the hypothesis that the true values of *IRR* is equal to zero cannot be rejected. However, for high inflation intervals (1998q2 for Indonesia, 1998q1-1998q4 and 2009q1-2009q2 for Malaysia and 2008q4-2009q1 for Pakistan), zero is outside the confidence intervals, which implies statistical significance for the estimated *IRR* for these episodes. This suggests a statistical significance in the positive relationship between the observed headline inflation and the decomposition proposed in high inflation periods.

Figure 2.7: Pairwise Bootstrapping of *IRR*, Indonesia

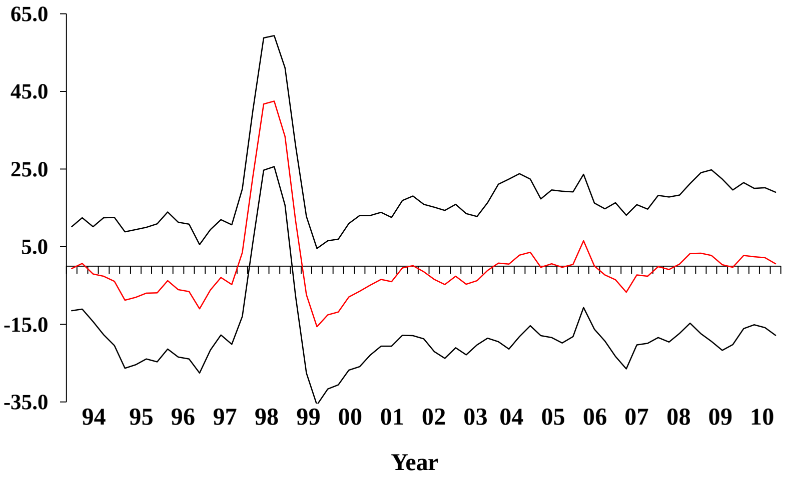


Figure 2.8: Pairwise Bootstrapping of *IRR*, Malaysia

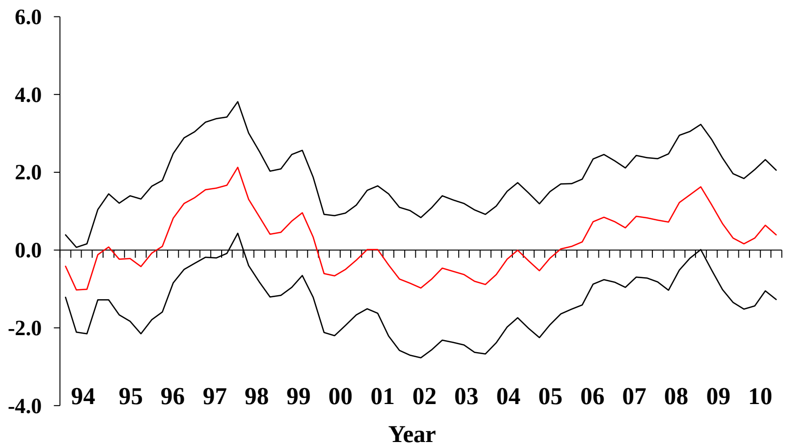
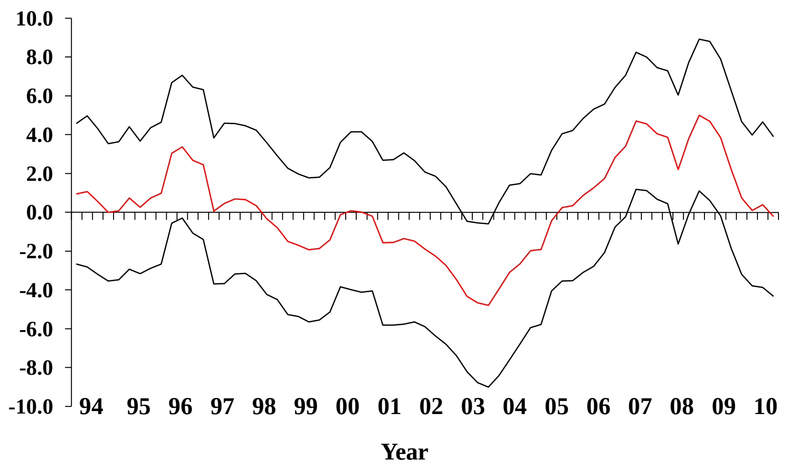


Figure 2.9: Pairwise Bootstrapping of *IRR*, Pakistan



2.7. *IRR* and Monetary Policy

The most significant role of inflation targeting is to construct a highly reliable central bank whose only long term objective is to achieve a low and stable rate of inflation, as monetary policy can only influence inflation in the long term. *IRR* can also be utilised to set the optimal times for monetary actions in the context of inflation targeting. Therefore it can be stated that the consideration of *IRR* as a means of monitoring monetary policy for the three countries, and of the different critical hypothesis built in the present study, should be used by the central banks to set the optimal timing for monetary actions. It is supposed that policy makers have some prudence concerning the timing of their monetary actions. Charemza and Makarova (2006) computed the original indicator of expected real effects of a monetary policy aimed at targeting inflation for

Poland and Russia[11]. They focused on the effects of monetary policies and how these aim to control inflationary pressure with minimal output loss.

IRR may be useful for determining suitable timing of monetary actions when the aim is to keep inflation within target levels. It is assumed that the central bank wants to employ contractionary or expansionary monetary policy to target inflation. It is conjectured that active monetary policy would be more effective in a situation with positive *IRR*s, and that timing for implementing monetary policy would be unfavourable when *IRRs* are negative. Intuition suggests that the output gain produced by an expansionary monetary policy measure would be higher when expected inflation is greater than output-neutral inflation, rather than when $IRR < 0$. Similarly, it is believed that anti-inflationary measures would cause minimal output loss with a positive *IRR*.

Indonesia has gradually developed a monetary policy framework over more than thirty years. At the beginning of this period, the fundamental objective of the monetary policy was ambiguously formulated to include both inflation and exchange rate stability, with the exchange rate being the main instrument of monetary policy. In 1999, soon after the Asian financial crisis, the Indonesian government launched a new legal structure for monetary policy in Indonesia, the new law stating that responsibility for achieving and maintaining the stability of the rupiah (the Indonesian currency), which is reflected by inflation and exchange rates, lay solely with Bank Indonesia (Mardanugraha and Widjaja 2009). In July 2005, Bank Indonesia decided to move to interest rate based inflation targeting rather than money based, and chose interest rates as an instrument for monetary policy (Mariano and Villanueva 2006). The interest rate, referred to as the

[11] Charemza and Makarova (2006) proposed a simple indicator which has been used by the Polish Monetary Policy Council for inflation targeting since 2001. Their study claimed that the use of the indicator contributed to a significant decrease in Polish inflation in 2003 and an increase in output growth in 2004.

Bank Indonesia rate, was chosen as the monetary policy anchor against inflation. Bank Indonesia adopts inflation targeting as the ultimate objective of monetary policy in the long term.

Before the Asian financial crisis in 1997-1998, Indonesia had implemented the managed floating (less flexible) exchange rate regime. In response to financial crisis of 1997-1998, Indonesia adopted a free floating exchange rate arrangement in 1998, so that the exchange rate of the Rupiah is determined by supply and demand in foreign exchange markets (Sahminan, 2005).

The Central Bank of Malaysia has experienced three phases of changing monetary strategy in terms of exchange rate, interest rates policy and monetary aggregate (Karim et al. 2010). Malaysia moved its monetary framework from monetary aggregate to interest rate targeting in 1995 and has experienced comparatively good inflation performance under the existing monetary policy framework. Currently Malaysia is an export oriented country and has experimented with monetary condition indices based on both interest rate and exchange rate. The currency of Malaysia (Ringgit) is regulated by Central Bank of Malaysia. Over last two decades, Malaysia has followed different paths of exchange rate regimes. The Malaysian Ringgit was determined on a trade weighted basket currencies until Asian financial crisis (Liew et al., 2003). In response to Asian financial crisis of 1997-1998, the managed floating exchange rate was replaced with a fixed exchange rate system, pegged against the US dollar rate.

Historically, Pakistan has followed a monetary policy framework that does not exclusively target inflation but is an in-between framework that suits small economies. The State Bank of Pakistan (*SBP*) started targeting monetary aggregates in 1994 with the ultimate objective of low and stable inflation and output growth. Monetary policy variables included broad money as an intermediate target and base money as operational target in order to control inflation. Since 2005, *SBP* has implicitly adopted interest rate based inflation targeting rather than monetary aggregate as its operational target. Arif (2005) argued that Pakistan's monetary policy is passing through the period of switching from monetary aggregate targeting to inflation targeting, and is not sufficiently prepared to adopt inflation targeting as its operational target.

Pakistan's exchange rate in last six decades was deregulate and market-oriented. In 1982, Pakistan implemented the controlled flexible exchange rate system linked to trade-weight currency basket (Zakaria and Ghauri, 2011). During the financial crisis in 1998, Pakistan adopted multiple exchange rate system (comprised of official rate, a floating inter-bank rate and composite rate) unified and pegged to US dollar rate. However, US dollar rate band was removed in 2000. Currently Pakistan has floating exchange rate because its exports are brittle and requires depreciation of domestic currency.

The computed *IRR* and headline inflation for Indonesia, Malaysia and Pakistan are respectively reported by figures (2.10), (2.12) and (2.14), plotted on different axes. The arrow signs indicate the suggested policies in terms of interest rate adopted by the monetary authority. The length of the arrows suggests the size of the interest rate adjustment. Figures (2.11), (2.13) and (2.15) give quarterly headline inflation and *GDP* growth for all three countries. It can be noticed that positive *IRR*s generally correspond to periods of high inflation for all three countries.

It is generally recognized that the average response of *GDP* to a change of the interest rate is in the range of 3 to 4 quarters. In Indonesia, during the period 2009-2010 positive *IRR* follows low inflation. Hence, a decline in interest rate might have a positive effect on output in 2011 and 2012. Furthermore, a smaller output loss would be generated by contractionary action in 2006q1. However, negative *IRR* during 2006q2 to 2006q4 renders ineffective any further actions undertaken regarding the interest rate. During the period 2001 to 2003 high inflation coincides with negative *IRR*s, indicating an unfavourable climate for active monetary action to be implemented. For Indonesia, considerable *GDP* growth in the period 2010 was accompanied by low inflation. It seems more likely that active policy measures were affected in 2008-2009 during periods of positive *IRR*. The increase in *GDP* followed by low inflation in 2010 suggests that the timing was favourable for the monetary actions taken in 2008-2009.

In Malaysia, negative *IRR* was identified during the period 2001 to 2005, after which *IRR* becomes positive. Within the period of negative *IRR*, there was substantial decrease in *GDP* growth accompanied by low inflation, when any monetary actions implemented would not be useful. As expansionary monetary policy was not very effective in 2002-2003 during the period of negative *IRR*, the economic growth first increases, then becomes steady and gradually declines after 4 to 5 quarters, suggesting that the timing of these actions was not very good. Malaysia faced high inflation during 2008 and mid-2009 due to the global economic crisis. However, this episode of high inflation corresponded with positive real effects, and further active monetary policy decisions regarding interest rate increase would less likely to have an adverse affect on Malaysian economic growth in 2010-11. Figure (2.12) shows that the actions taken resulting in a fall of interest rates in the last quarter of 2009 to the third quarter of 2010 have positively affected output in 2011. Similarly, in Pakistan, high inflation in 2008 coincided with a positive real effect in the year 2009-2010. Thus, further actions regarding the interest rate increase in 2009 are likely to show efficient results. For Pakistan, positive real effect follows significant *GDP* growth during the period 2004 to 2007, which may be the result of active expansionary measures in 2003-2004. This substantial *GDP* increase suggests that the timing of expansionary monetary measures was favourable.

Figure 2.10: *IRR*, Inflation and Monetary Policy Decision, Indonesia

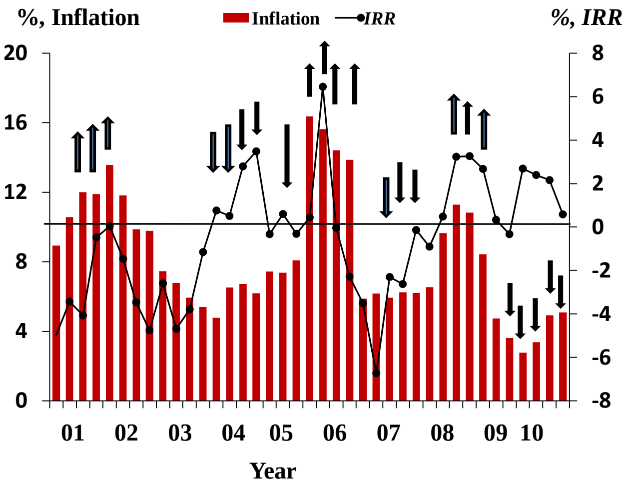


Figure 2.11: Inflation and *GDP* Growth in Indonesia, 2001-2010

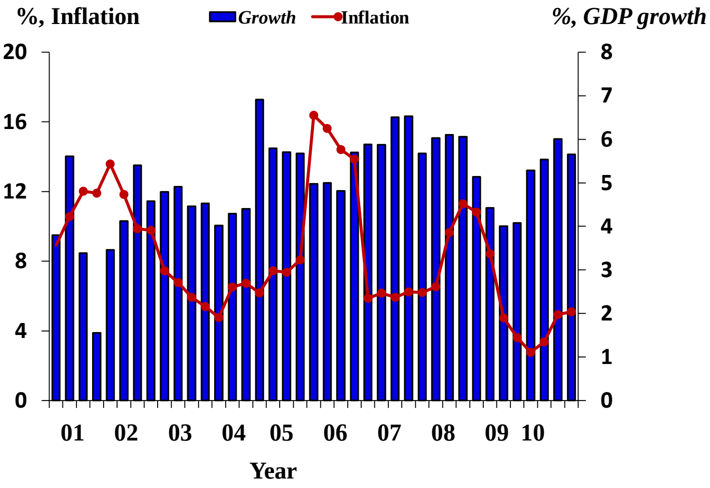


Figure 2.12: *IRR*, Inflation and Monetary Policy Decision, Malaysia

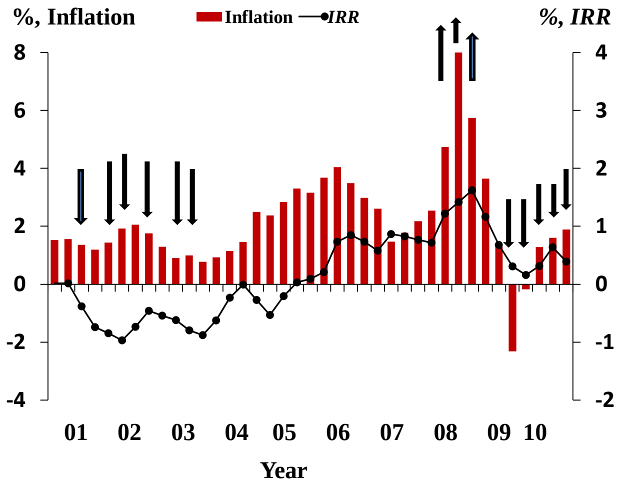


Figure 2.13: *IRR*, Inflation and *GDP* Growth in Malaysia, 2001-2010

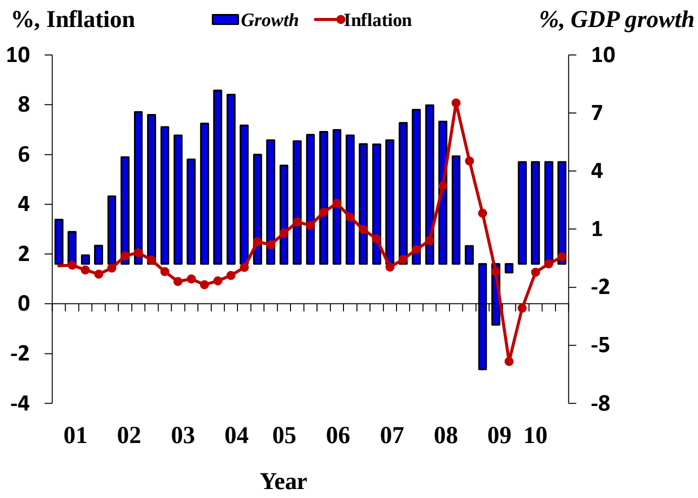


Figure 2.14: ***IRR*****, Inflation and Monetary Policy Decision, Pakistan**

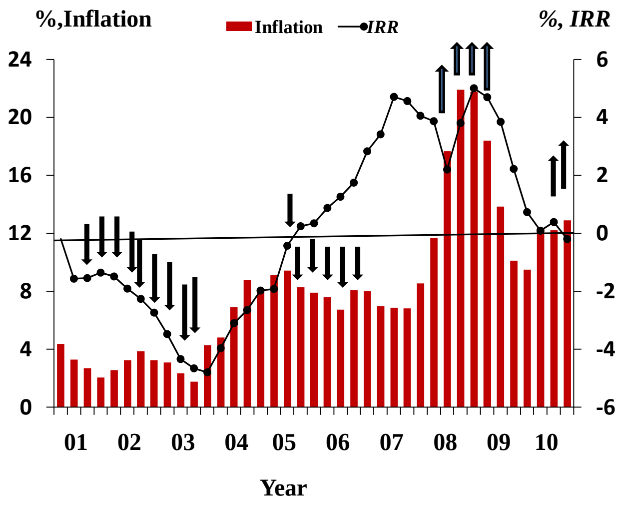
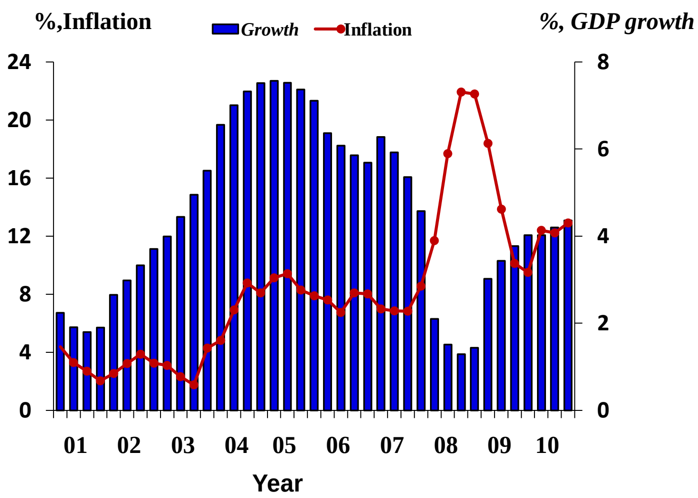


Figure 2.15: Inflation and ***GDP*** **Growth in Pakistan, 2001-2010**



2.8. Conclusions

The findings of this chapter generally support the Bruno and Easterly (1996) hypothesis that episodes of high inflation in developing countries do not affect their prospects of further growth. Evidence of growth collapse during episodes of high inflation with immediate recovery after inflation reduction supports the view that crises of high inflation have had a temporary impact on growth for Indonesia, Malaysia and Pakistan. This is supported by an evaluation of future real effects, based on decomposition of shocks in a simple *VAR* model of output gap and inflation. For all three countries investigated, there are clear indicators of a positive relationship between the observed headline inflation and the proposed decomposition, especially during periods of high inflation. These are particularly strong for both Malaysia and Pakistan, where the *IRR* peaked in 2008-2009 and the recovery in 2009-2010 has been confirmed. Moreover, the bootstrapping results of the applied indicator are statistically significant during high inflation crises. These findings all favour the Bruno and Easterly hypothesis.

In all three countries, the *IRR* indicator has been employed as a means of observing monetary policy rather than as an active tool. It should be used by the central banks to set the optimal timing for monetary actions. By adopting *IRR* as an indicator, they will be better placed to control inflation with minimal output loss. The indicator can be used to set the optimal timing of monetary policy instruments in terms of long run output effects. In future, it is hoped that this idea may contribute to tackling problem of controlling inflation via active monetary policy. Hence the output loss (output gain) generated by a contractionary (expansionary) policy would be smaller (larger) if the action is undertaken at a time of positive *IRR*. The findings for all three countries suggest that active monetary policy measures during positive *IRR* achieved more favourable results regarding output than those from negative *IRR*. In Indonesia, positive *IRR* pursued low inflation in the period covering 2009 and 2010. Therefore, the decrease in interest rates set by the central bank in 2009-2010 may in time be seen to have a positive effect on output in 2011 and 2012. Malaysia went through a period of high inflation during the global economic crisis of 2008-2009. But, this high inflation was closely followed by positive real effects, suggesting that economic growth in Malaysia for 2010-2011 would not be adversely affected by a policy decision to increase interest rates. Similarly, in the case of Pakistan, positive real effect followed significant *GDP* growth during the period 2004 to 2007, which may be the result of active expansionary policy employed by central bank measures in 2003-2004.

This chapter has a number of potential extensions for future research. The Monte Carlo simulation can be employed to show that this decomposition, *IRR*, is positively related to inflationary shocks, thus generating positive real effect and also identify the usefulness of *IRR* in cases of when the economy is prone to episodes of high inflation would be interesting. The Monte Carlo analysis can also be employed for forecasting of output gap based on *IRR* with some alternatives.

Chapter 3

The Dynamic Effects of Different Structural Shocks on the Developing Economies

Abstract

This chapter examines the dynamic effects of oil price, aggregate supply and demand shocks on macroeconomic variables in four small developing countries and establishes the role of shocks in explaining output fluctuations over time. The study also attempts to assess whether oil price shock is distinguishable from other macroeconomic shocks, and whether the relative contributions of these shocks are different among various countries in this study. To identify the various structural shocks and explore their relative contributions to business cycle movements over time, a structural *VAR* model is applied, imposing dynamic restriction as recommended by economic model. The analysis is applied to two net oil exporting countries Indonesia and the Malaysia and two oil importing countries Pakistan and Thailand. Estimated results show that oil price shocks have positive effects on output in all the above countries but in each country the magnitude of the response is very small and negligible. There is no evidence that an oil price shock has a substantial impact on macroeconomic variables in any of the countries. The study finds that aggregate demand and supply shocks are key sources of fluctuation in both inflation and output, supporting the real business cycle theory. The findings confirm that in all countries various economic crises during the period studied have been due to supply, real and nominal demand shocks.

3.1. Introduction

Developing economies are generally considered highly vulnerable to external shocks, and prominent among these is volatility in international oil prices. Indonesia, Pakistan, Bangladesh, India and many other developing countries have all recently confronted oil price crises. It is expected that oil price fluctuations will have different consequences in oil importing and oil exporting countries. The implication of fluctuations in oil prices is judged in both the short and long term. Most of the empirical studies have confirmed that oil price changes have negative effects on output growth in oil importing countries (e.g. Hamilton, 1983, 1996 and 2003; Mork, 1989; Ferderer, 1996; Bjornland, 2000; Atukeren, 2003; Schneider, 2004; Awerbuch and Sauter, 2005; Jimenez-Rodriguez and Sanchez, 2005; Cologni and Manera, 2008; Korhonen and Mehrotra, 2009). These studies tend to indicate that increases in oil price and the resultant instability affect the economy through higher input costs, reallocation of resources, decreases in income and depreciation of currency. Consequently, economic growth is reduced while inflation and unemployment rise. Cologni and Manera (2008) indicated that spikes in the oil price are commonly observed to be an important contributor to the business cycle, through income transferred from oil importing countries to oil exporting economies.

A sudden increase in the oil price causes an exogenous inflationary shock because higher oil prices put pressure on the general price level. Consequently, an increase in oil price results in higher inflation and thus leads to higher interest rates and even a push into recession. Some of the studies have indicated that increased oil price is associated with higher growth in net oil exporting countries, through an increase in state revenue which leads to higher national income and currency appreciation (Bjornland, 2000 and 2004; Rautava, 2002; Jin, 2008; Aliyu, 2009; Jalil et al., 2009).

Many studies have also found that oil prices have an asymmetric effect on the gross domestic product (*GDP*) growth, confirming that oil price increases strongly affect

GDP while decreases have only very small effects[12]. Recently Hamilton (2003) found that oil price increases are much more reliable forecasters of *GDP* than are decreases. This result confirms the non-linear relationship between changes in oil price and economic growth.

The recent spikes in international oil prices have had severe effects on the economic activities of developing countries, particularly on those countries that are over-dependent on oil. The economic effect of high oil prices is generally more prominent for oil importing developing countries than for OECD countries because the economies of the former are more oil dependent. Furthermore, oil importing developing countries use more oil to produce one unit of output because oil is used less efficiently in such countries[13]. For example, in 2002 Thailand used almost two and half times as much oil per unit of *GDP* compared to developed countries (International Energy Agency, 2004). Also, oil price is one of the principle economic inputs in the oil importing countries. For example, Pakistan imports more than 80% of the oil that it uses domestically, which is the single largest cost in its energy sector, accounting for its negative effect on the trade deficit and *GDP* growth (Federal Bureau of Statistics of Pakistan, 2008).

Jimenez-Rodriguez and Sanchez (2005) pointed out that oil price movements are expected to have considerably different consequences in oil importing and exporting countries[14]. An oil price increase would be deemed bad news in oil importing countries and good news in oil exporting countries, and the contrary should be expected if the oil price declines. Oil price shocks affect the economy via the supply side and the demand side. On the supply side, an increase in oil price consequently involves higher

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[12] Various studies have confirmed that rising and falling oil prices do not have symmetrical impacts on economic activities (Mork, 1989; Hooker, 1996; Jimenez-Rodriguez and Sanchez, 2005; Awerbuch and Sauter, 2005; Cologni and Manera, 2008; DePratto el al, 2009).

[13] Oil intensive manufacturing normally accounts for a large share of their *GDP* and energy is used inefficiently in the developing countries (see report of the International Energy Agency, 2004).

[14] See Bjornland (2000), Mehrara and Oskoui (2006) and Jimenez-Rodriguez and Sanchez (2005).

production costs, leading to a decline in output. Meanwhile, on the demand side higher oil prices drive up the aggregate price level leading to lower real disposable incomes, inducing lower consumption and investment. However, DePratto et al. (2009) found that oil price affects the output through supply, rather than demand. Their study concluded that higher oil prices affect the short term output gap and long term growth.

It is also interesting to investigate whether oil price increases have adverse effects on output in the oil importing countries and positive impacts on output in the smaller oil exporting countries. Bjornland (2000) analysed the dynamic effects of oil prices and other shocks which caused business cycle fluctuations in two oil exporting countries (UK and Norway) and two net oil importers (US and Germany). His results surprisingly revealed that oil price shocks have a significant negative impact on the output of the net oil importing countries and also on that of the net oil exporting UK; however, this impact is positive in the case of Norway.

The main focus of this chapter is to explore the effects on *GDP* and inflation of oil price, aggregate supply and demand in four developing Asian countries. Additionally, this study also suggests that oil price shocks are distinguishable from other macroeconomic shocks and investigates the relative contribution and nature of these shocks as causes of business cycles. The small open economy model that is used to identify the different shocks is a structural vector autoregressive (*VAR*) model developed by Bjornland (2000)[15]. These structural shocks are identified through a combination of short run and long run restrictions on the *VAR* model, as recommended by the economic model. The study proposes an open economy model that satisfies the

[15] This is a structural *VAR* analysis as proposed by Blanchard and Quah and expanded to open economies by Bjornland (1998, 2000 and 2003). Bjornland (2000) applied a three equation *VAR* to capture the impact of economic shocks on macroeconomic variables. However, the current study aims to capture the effect of international oil price shocks on both output and price level and to distinguish the different economic shocks affecting developing Asian countries.

identification restrictions[16]. The key identification assumption is that both oil price and supply shocks affect output in the long term. Aggregate demand can affect output, but only in the short term (Blanchard and Quah, 1989). A further short run zero restrictions is the assumption that the contemporaneous effects of supply and demand shocks on oil price are zero. Yet, demand and supply can influence the oil price after a period (i.e. after one quarter).

Thus, a three variable structural *VAR* model is composed of changes in international real oil price (i.e. oil price in US dollars), in real *GDP* and domestic prices. This is then applied as a baseline model to examine the involvement of these disturbances over time in describing output and inflation fluctuations in specified countries. The *VAR* model implies that oil price, demand and supply disturbances cause the movements in output and inflations.

To check the robustness of the results, this chapter also separately assesses the dynamics of oil price on the economy by using the international oil price in United States (US*)* dollars and oil price in domestic currency (called domestic oil price). For this purpose an alternative *VAR* model is calculated, with domestic oil price instead of international oil price. The study also checks if the results of the baseline model across the oil price are accurate by estimating the alternative *VAR* model using domestic oil price instead of international oil price[17]. If both international (in US dollar) and local currency oil price effects are similar then that verifies the flexible exchange rate in the economy and negates any distinction in prices across local and international markets.

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[16] The *VAR* model is identified through non-recursive restrictions, rather than recursive restrictions proposed by Sims (1980). It represents the combination of contemporaneous and long term restrictions on the effects of structural shocks. See, Shapiro and Watson (1988), Blanchard and Quah (1989), Clarida and Gali (1994), Quah and Vahey (1995), Bjornland (1998, 2000 and 2003).

[17] Cunado and Gracia (2004, 2005) considered both international oil price and local oil price in domestic currency for certain Asian developing countries and European countries. They found that in Malaysia, Thailand and the Philippines the effect of oil price on economic growth and inflation is larger when oil price is measured in domestic currency.

For oil importing (oil exporting) countries, an increase in oil price rise may reduce (increase) wealth effects that consequently depreciate (appreciate) the exchange rate. This identifies the respective effects of the two different oil price variables on business cycles. Furthermore this study will investigate whether domestic oil price can be associated with the exchange rate, and whether the impact of this association on the macroeconomic variables will be higher than that of the oil price in US dollars.

This study further includes the real exchange rate in the alternative model, because it plays an important role in small open economies in accounting for output and inflation responses to currency shocks. A four variable structural *VAR* model consisting of changes in domestic real oil price, real exchange rate, real *GDP* and domestic prices is used to identify oil price, exchange rate, aggregate supply and demand shocks. The alternative model also captures the impact on macroeconomic variables of real exchange movements caused by oil price shocks; given that exchange rate volatility has been significant in discouraging real economic activity. Additionally, the appreciation of the exchange rate would encourage *GDP* growth and lower inflation. Identification schemes containing long term restrictions analogous to models used by Blanchard and Quah (1989), Clarida and Gali (1994), Bjornland (2004) and Korhonen and Mehrotra (2009) are employed in order to identify the different disturbances. Impulse responses are used to analyse the dynamic relationship between the variables and also to observe the size and pace of these structural shocks' effects on output and inflation. Variance decompositions are estimated to calculate the relative contribution of these shocks in explaining economic fluctuations.

Although this chapter tackles the same question as Bjornland (2000), it differs from existing literature in various aspects. First, the restrictions proposed by the model are imposed on the structural *VAR* to identify the different structural shocks using real oil price, real *GDP* and domestic prices. This compares to Bjornland's use of real *GDP*, real oil price and unemployment to identify the structural shocks. Secondly, while most of the existing studies focus on developed countries and established world market economies, such as the United States (US) and OECD countries[18], the present study focuses on the effects of oil price and other shocks on small developing economies. The neglect of research into developing countries can be explained by the lack of reliable data and their historically low dependence on oil. However, in the last two decades, these countries have experienced higher demands for energy due economic development in various sectors. This recent development justifies the exploration of the effect of oil price fluctuations on these economies. Thirdly, this study conducts robustness checks on oil price by estimating the alternative *VAR* model using domestic oil price instead of international oil price. Finally the real exchange rate is incorporated in the alternative model, to identify the impact of the real oil price shocks on the real exchange rate.

The empirical analysis considers two oil exporting countries and two oil importing countries, each of which have experienced the same oil price shocks alongside different fluctuations in other macroeconomic variables over the past twenty years: Indonesia, Malaysia, Pakistan and Thailand. As Pakistan is the main country, to understand its oil price and other economic shocks it was necessary to have countries with similar economic outlook within a similar economic region. The availability of quarterly *GDP* data (for long periods) from these countries (Indonesia, Malaysia and Thailand) and the relative unavailability of such data from other neighbouring nations (such as Bangladesh, Sri Lanka) made the former as comparators for this study.

[18] Those studies contain Hamilton (2003, 1996 and 1983), Bjornland (2001), DePratto et al (2009), Jimenez-Rodriguez and Sanchez (2005), Cologni and Manera (2008) and Mork (1989).

In Southeast Asia, Malaysia has the third highest oil reserves but its net oil exports are very tight due to the small gap between domestic production and demand. Indonesia is the largest oil producer in Southeast Asia and was also a significant exporter. But due to its aged oil fields and inadequate investment to explore new oil fields, the economy faced stagnant oil production which transferred its status from oil exporter to oil importer in 2004 (Bradsher, 2008). However, over the period under this study Indonesia was net oil exporter during most of the period examined. Thailand is a significant net oil importing country with two-third reliance on imports, thus, spending a significant amount of its *GDP* on oil imports. Similarly, Pakistan is oil importing country but one of the lower users of oil. It has limited domestic oil reserves and relies much on imports.

For all these countries, except Malaysia, reliance on oil imports meant significant expenditure of their *GDP* on oil imports. Therefore, government control and provision of subsidies on oil prices was necessary to reduce the adverse effect of oil price shocks on real activities. In section 3.5 the role of oil price and significant economic features of selected developing countries during 1981 to 2010 are discussed.

According to the empirical results, oil price shocks have a positive effect on economic activities in Indonesia, Malaysia, Pakistan and Thailand. For net oil importing countries, the positive real effect of oil prices is unexpected, and is possibly due to the exceptional situations undergone by the Pakistan and Thai economies. However, the magnitude of the response to the oil price shock is small and statistically negligible for all selected countries. In addition, the aggregate supply and demand shocks are the main contributors to the business cycle in all countries. On the other hand, the results confirm that supply shock causes real exchange rate appreciation in all the countries except Pakistan. The evidence also illustrates that exchange rate fluctuations are a significant source of variation in economic activities in all the examined countries. These findings suggest that the exchange rate is an important source for *GDP* and inflation forecasts in all countries, especially those of Southeast Asia.

The rest of the chapter is structured as follows: section 3.2 reviews relevant available literature on the responses of *GDP* and inflation to oil price shocks. The simple aggregate supply and demand macroeconomic model of economic fluctuations that includes oil price shocks is explained in section 3.3. The econometric framework and methodology of the chapter is described in section 3.4. Section 3.5 describes a number of economic features of the countries included in the sample, for the period 1981–2010. Section 3.6 covers the description of the data and the empirical results. The alternative model used for the empirical analysis is presented with its results in section 3.7, and the analysis and results are reviewed in 3.8 section.

3.2. Oil Price and Macroeconomic Variables

A large number of existing studies have analysed the impact of oil price shocks on macroeconomies. Previous papers have focused on developed countries that are either oil exporting or oil importing countries. However, this study is focused on less developed economies, both oil exporting and oil importing. There are various studies indicating that oil prices have no substantial effect on real variables. Olomola and Adejumo (2006) analysed the effects of oil price on macroeconomic variables in Nigeria. They found that oil price affects neither output nor inflation in Nigeria. However, their results displayed appreciation of the real exchange rate following an increase in oil price.

Several recent papers find that oil price disturbances have affected *GDP* and inflation (Hamilton, 1983, 2003; Hooker, 1996; Mork 1989, Kilian, 2008a). Jin (2008) examined the effect of oil price and exchange rate shocks on economic activities in Russia, China and Japan. He observed that oil price shocks had a negative effect on *GDP* growth in Japan and China and a positive effect in Russia. Cologni and Manera (2008) found that in the *G7* countries an unexpected oil price shock is followed by a rise in inflation rate and by a decrease in output growth. They also identified that the monetary response to an oil price shock may involve raising the interest rate to control inflation.

Recently, Aliyu (2009) developed a Johansen *VAR* based cointegration technique to measure how oil price shock and exchange rate fluctuation have affected economic growth in Nigeria over the past 20 years. He concluded that oil price shocks and exchange rate appreciation have a positive impact on *GDP* growth. Moreover, he also found that the positive effect of oil price on *GDP* is greater than that of the exchange rate. Hamilton (2003) reported a clear non-linear relationship between oil price change and output growth. He claimed that increasing oil prices were more useful than decreasing oil prices for predicting *GDP*.

DePratto et al. (2009) found that positive oil price increases have a small negative but persistent effect on output. They concluded that high oil prices temporarily affect output gap and trend growth, which in turn causes an enduring decline in *GDP*. They found that oil prices affect the economy mainly through the supply side in the short term. They also reported that compared to oil demand shocks, oil supply shocks in the US have deeper and more persistent negative impact on growth.

Kilian (2008a) estimated the relationship between oil supply disturbances and macroeconomic variables in the G7 countries using quarterly data over the period 1971q1-2004q3. He found that oil supply fluctuations cause a short term decline in real *GDP* growth, and that this decline is more pronounced in the second year after the shock. He pointed out that exogenous oil supply shocks do not always lead to sustained inflation. He also found that in all G7 countries the oil supply shocks during 1973-1974 and 2002-2003 had no substantial effect on growth, while lower *GDP* growth due to shocks was reported in some G7 countries during the periods 1978-1979, 1980 and 1990-1991.

Cunado and Gracia (2005) analysed the relationship between oil prices and macroeconomic variables for certain Asian countries. For all countries they examined, different results were obtained depending on whether the researchers used international or domestic oil prices. They found that the impact of oil price in the local currency was larger than that of international oil price, and that the short term effects of oil prices on economic growth and inflation are statistically significant. According their results the relationship between oil prices and consumer prices is more significant when oil prices are measured in the domestic currency.

Jalil et al. (2009) studied the dynamic relationship between oil prices and *GDP* in Malaysia using quarterly data from 1991q1 to 2005q4. The cointegration results confirm a positive long term association between *GDP* and oil price variables. They also revealed the existence of an asymmetric relationship between oil price changes and the economy, with an increase in oil prices having a greater effect than falling oil prices on aggregate economic activity. Rafiq et al. (2009) examined the impact of oil price shocks on economic activity in Thailand by employing a *VAR* model. Using quarterly data from 1993q1 to 2006q4 they found a structural break in the time series data during the Asian financial crisis of 1997-1998. They also found that the budget deficit originated mainly from movements in oil prices during the post crisis period, which may have been due to the floating exchange rate policy. Their results showed an unidirectional causality running from oil price volatility to economic variables such as investment, unemployment rate, trade balance and interest rates for all horizons.

In contrast to the existing studies, which analyse the impact of oil price shocks on economic activities by employing *VAR* models identified through exclusion restrictions following a recursive structure (see Sims, 1980), this chapter identifies the different shocks through a combination of the short run and long run restrictions for developing economies as proposed by economic model. Furthermore, this study analyses the effects of oil price and other macroeconomic shocks in four developing countries from various regions, while most of the existing literature focuses on developed economies, particularly the US.

3.3. Economic Shocks and Fluctuations

The relationship between economic variables and oil price is complex. Higher oil prices act like technology shocks, which decrease output by increasing production costs in oil importing countries. Oil price affects the supply side of the economy by increasing the cost of inputs and necessitating a rearrangement of resources. Higher oil prices affect transportation costs, limiting the economic accessibility of important production inputs, thus leading to lower *GDP*[19]. Oil price fluctuations can also affect the economy through the demand side via the income effect. Spikes in oil price will shift income from oil importing countries to net oil exporting countries. This decline in income will decrease consumption, investment and output in oil importing nations, while in oil exporting countries rising oil prices will lead to higher export revenue. As a result, real national income will increase leading to higher aggregate demand and an appreciation in the currency. This part of the current study offers a simple modification of the aggregate demand and supply model (presented by Cover et al., 2006, Enders and Hurn, 2007),

[19] Brown et al. (2004) suggested that increasing oil prices are similar to a tax that is collected by oil exporting countries from oil importing countries. They also mentioned that rising oil prices decrease purchasing power and consumer demand in oil importing economies, and that the opposite should be expected for oil exporting nations.

proposing an economic model where oil price, demand, and supply shocks affect the economy.

Consider the aggregate supply (*AS*) curve (Lucas, 1972) and aggregate demand (*AD*) relationship:

$$y_t^s = {}_{t-1}y_t + \alpha(p_t - {}_{t-1}p_t) + \varepsilon_t^s + \beta\varepsilon_t^{op} \quad (3.1)$$

$$(y_t + p_t)^d = {}_{t-1}(y_t + p_t)^d + \varepsilon_t^d + \gamma\varepsilon_t^{op} \quad (3.2)$$

$$y_t^s = y_t^d \quad (3.3)$$

$$op_t = {}_{t-1}op_t + \varepsilon_t^{op} \quad (3.4)$$

$$p_t = {}_{t-1}p_t - \mu\varepsilon_t^s + \mu\varepsilon_t^d + \rho\varepsilon_t^{op} \quad (3.5)$$

Where p_t denotes domestic price level, p_{t-1} price at time *t-1*, y_t is output, ${}_{t-1}y_t$ and ${}_{t-1}p_t$ are their conditional expected values at the end of time period *t*-1, and the superscripts and define supply and demand. Whereas ε_t^s, ε_t^d and ε_t^{op} describe the structural aggregate supply, demand and oil price shocks respectively. All shocks are uncorrelated with unit variance and zero covariance.

Equation (3.1) describes the *AS* curve where output increases as a result of an unpredicted increase in price levels, oil price shock ε_t^{op}, and positive realization of the supply shock ε_t^s. However, high oil prices affect the economy through supply shock and tend to increase marginal costs and inflation in oil importing countries. At the outset of this study, it is expected that $\beta < 0$ for oil importing countries, as oil price increases should contribute to higher input and production costs leading to lower supply, and that oil exporting countries will respond positively ($\beta > 0$) to oil price shocks by high inflation and an increase in national income through greater oil export revenue[20]. Equation (3.2) explains that aggregate demand equals its expected value given the information available at the end of period *t-1*, plus the effect of oil price shock ε_t^{op} and demand shock ε_t^{d}. If $\gamma < 0$, higher oil prices may subsequently lead to lower level of demand by rational consumers. If $\gamma > 0$ for oil exporting countries, then "where the oil producing sector is large compared with the rest of the economy, higher oil prices will typically increase the level of demand from energy producers (like the government)" as argued by Bjornland (2000). Equation (3.5) states that the general level of price is a function of its expected value at time *t-1* for time *t*, negative realization of supply shocks, plus the effect of demand and oil price shocks.

In the short term, oil price, supply and demand shocks influence the output due to nominal and real inflexibility; see equations (3.1) and (3.2). Therefore this study assumes that supply and oil price shocks have permanent effect on the level of long term output, while demand shocks have only a short term effect on output[21] (Blanchard and Quah, 1989). Demand shocks have a transitory effect on output; specifically, the effect peaks after a year and disappears after two to three years. However, from equation (3.5) we can see that oil price, aggregate demand and supply shocks have both short term and long term effects on domestic prices.

The effect of positive domestic demand shocks on domestic prices is expected to be positive and persistent over time. It is expected that aggregate supply shock (such as a technology shock) would lower the domestic prices in line with the Real Business Cycle (*RBC*) theory. Equation (3.5) implies that all the shocks; supply, demand and oil price

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[20] This is the case for those oil exporting countries, where the oil sector is large compared with the rest of the economy. This suggests $\beta > 0$ for oil-exporting countries.

[21] Shapiro and Watson (1988) use this assumption in a *VAR* model identified using the long term restrictions employed by economic theory.

will have long term effects on relative price levels. Additionally, it is assumed that oil price can only be affected by the shocks of oil demand and oil supply (hence, other factors are considered exogenous to oil price)[22]. This is due to the fact that oil prices have been dominated by political events such as the OPEC embargo in 1973, the Iranian revaluation in 1978-1979, the Iran-Iraq War in 1980-81, the Gulf War in 1990-1991, and increasing demand confronting declining world production in 2003-2008 (see, e.g., Shapiro and Watson, 1988; Hamilton, 1996 and 2003; Killian, 2008a and 2008b). As a contribution to the literature, this study introduces oil price to the model and also assumes that oil price variations have long term effect on output and domestic prices. Oil is considered an input in the production function in which competitive producers treat the real price of oil as a parameter (see, Bjornland 2000 and Atukeren 2003). Oil price enters the economy through the supply relation, so any shock in oil price is considered to be a supply shock. According to Blanchard and Quah (1989) supply shocks do affect output in the long run. When oil prices increase, firms in the economy respond by using less oil, so output consequently declines[23]. The current model proposes that oil price shocks may affect the economy in several ways, but that oil price is not affected by domestic supply and demand shocks. From equation (3.4) we can also see that only oil price shocks will affect the oil price in the long run[24].

3.4. Identification and Structural *VAR*

Sims (1980) promoted vector autogressive (*VAR*) models for macroeconomic analysis, which replaced large simultaneous equation models. The current study uses structural *VAR* models and a combination of short and long term restrictions (after Blanchard and

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[22] This is the same assumption used by Bjornland (2000).

[23] In such a case the productivity of any given amount of capital and labour declines and potential output falls.

[24] Kilian (2008a, 2008b) argued that changes in oil price are caused by exogenous political events in the Middle East.

Quah, 1989) to identify the effects of the different shocks. Bjornland (2000) imposed similar restrictions in his analysis of structural shocks.

There are a large number of variables which impact output and inflation. This study uses only a three variable *VAR* model of oil price, real output, and domestic prices to identify instances of the three different structural shocks; oil price, aggregate demand and supply shocks. The unit root tests show that real oil price, real *GDP* and price level variables are non-stationary, i.e. integrated *I (1)* and stationary *I (0)* taking the first differences. Cointegration testing is employed to check that there is no long run relationship between the variables in levels. The *VAR* model considers the following variables: change in international real oil price Δop_t^w, real *GDP* Δy_t and domestic prices Δp_t. In the basic model, I assume that the oil price is exogenous; hence the oil price equation does not include current and lagged values of the other variables. Consider a simple trivariate *VAR* model[25] designed to be used for a small open economy:

$$\Delta op_t^w = a_{10} + \sum_{j=1}^{k} a_{11j} \Delta op_{t-j}^W + e_t^{op}$$

$$\Delta y_t = a_{20} + \sum_{j=1}^{k} a_{21j} \Delta op_{t-j}^w + \sum_{j=1}^{k} a_{22j} \Delta y_{t-j} + \sum_{j=1}^{k} a_{23j} \Delta p_{t-j} + e_t^s \qquad (3.6)$$

$$\Delta p_t = a_{30} + \sum_{j=1}^{k} a_{31j} \Delta op_{t-j}^w + \sum_{j=1}^{k} a_{32j} \Delta y_{t-j} + \sum_{j=1}^{k} a_{33j} \Delta p_{t-j} + e_t^d$$

Where e_t^{op}, e_t^s and e_t^d are reduced form disturbances with covariance matrix Ω. The matrix form of equation (3.7) can be written as,

[25] See Enders and Hurn (2006, 412-413). They used a similar three variable *VAR* model which includes real foreign *GDP*, real domestic *GDP*, and domestic inflation. They assume that real foreign output changes independently of the other variables, while other variables affect foreign output in neither the short term nor the long term.

$$z_t = K + A_1 z_{t-1} + ... + A_p z_{t-p} + e_t$$

$$A(L)z_t = K + e_t \qquad (3.7)$$

Where $A(L)$ is the matrix polynomials lag operator, z_t is define as vector of stationary *VAR* variables $z_t = (\Delta op_t^w, \Delta y_t, \pi_t)'$, e_t is a vector of reduced form residuals, and $K = (k_1, k_2, k_3)'$ is the vector of intercepts. A set of restrictions must be imposed to achieve full identification of the structural parameters of a *VAR*. These restrictions are entailed to convert the reduced form to structural form model.

The vector moving average representation of (3.8) can be established using the Wold representation theorem[26]:

$$z_t = C_0 + C_1 e_{t-1} + C_2 e_{t-2} + ...$$

$$z_t = C(L)e_t \qquad (3.8)$$

Where $C(L) = A(L)^{-1}$ and C_0 is the identity matrix. The orthogonalized restrictions are imposed to the components of e_t, because these components are contemporaneously correlated and cannot be interpreted as structural disturbances. I assume that the world innovations e_t are to be associated to each other through different types of structural

[26] According to Blanchard and Quah (1989), "The Wold Representation Theorem implies that, under weak regularity conditions, a stationary process can be represented as an invertible distributed lag of serially uncorrelated disturbances. In order to identify the underlying disturbances it is assumed that they are linear combinations of the Wold innovations. If this assumption does not hold the 'correct' disturbances cannot be recovered" (see, Blanchard and Quah, 1989; Bjornland, 2000). Alessi et al. (2011) indicated that econometricians interpret u_t as a vector of unexpected shocks affecting the economy as a whole and structure shocks (u_t) is always y_t–fundamental (y_t is economy wide process). However, researchers examine only finite information such as only observe a subset x_t of economy wide process. They pointed out that y_t-fundamental process u_t becomes x_t –non-fundamental when observing only small subsets x_t of the economy-wide process y_t. Non-fundamentalness means that the variables used by the econometrician do not have enough information to recover the structural shocks and the linked impulse response functions.

shocks. These innovations are created by the orthogonal structural shocks liable for changes in Δop_t^w, Δy_t and Δp_t.

$$e_t = D_0 \varepsilon_t \tag{3.9}$$

Where $\varepsilon_t = (\varepsilon_t^{op}, \varepsilon_t^s, \varepsilon_t^d)$ vector of structural shocks are defined as: ε_t^{op} is an international oil price shock, ε_t^s is an aggregate supply and ε_t^d is an aggregate demand shocks. Replacing (3.9) in to (3.8) yields

$$z_t = C_o D_0 \varepsilon_t + C_1 D_0 \varepsilon_{t-1} + C_2 D_0 \varepsilon_{t-1} + ...$$

$$z_t = D(L)\varepsilon_t \tag{3.10}$$

The assumption that structural shocks are linear combination of the reduce form residuals is necessary[27],

$$C(L)D_0 = D(L) \tag{3.11}$$

In the three variable equations, there are fifteen unknowns to identify. The *VAR* residuals and structural disturbances connected by matrix D_0 containing nine elements, in the variance-covariance matrix of structural innovations (Ω) has three variances and three covariances elements[28]. The problem is then to identify D_0 imposing nine restrictions. These restrictions are required to identify the different disturbances. Such

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[27] See Bjornland (2000), $\sum_{j=0}^{\infty} C_j D_0 = \sum_{j=0}^{\infty} D_j$, matrix form can be written as,

$$\begin{bmatrix} c_{11}(1) & c_{12}(1) & c_{13}(1) \\ c_{21}(1) & c_{22}(1) & c_{23}(1) \\ c_{31}(1) & c_{32}(1) & c_{33}(1) \end{bmatrix} \begin{bmatrix} d_{11,0} & d_{12,0} & d_{13,0} \\ d_{21,0} & d_{22,0} & d_{23,0} \\ d_{31,0} & d_{32,0} & d_{33,0} \end{bmatrix} = \begin{bmatrix} d_{11}(1) & d_{12}(1) & d_{13}(1) \\ d_{21}(1) & d_{22}(1) & d_{23}(1) \\ d_{31}(1) & d_{32}(1) & d_{33}(1) \end{bmatrix}$$ Indicate the long run matrix of *C(L) and D(L)* respectively.

[28] Due to symmetry, there are three [$n(n+1)/2$] dissimilar covariance in Ω.

identification restrictions is followed from Shapiro and Watson (1988), Clarida and Gali (1994), Blanchard and Quah (1989) and Bjornland (2000 and 2004).

These restrictions restrained six non-linear restrictions, $n(n+1)/2$, and three, $n(n-1)/2$, long run and short run restrictions on the matrix $D(L)$.

$$\Omega = D_0 D_0' \tag{3.12}$$

The structural shocks ε_t's are normalized so that the structural variances are equal to one $(\sigma^2_{op,t} = \sigma^2_{s,t} = \sigma^2_{d,t} = 1)$ and the covariances are also equal to zero $(\sigma_{ops,t} = \sigma_{sd,t} = \sigma_{dop,t} = 0)$. Three more restrictions are applied to find the structural shocks. According to the theoretical model display in equation (3.4), real oil prices are only affected by oil price shocks in the long term. Hence the contemporaneous effects of supply ε^s_t and demand shocks ε^d_t on oil price are zero, $d_{12,0} = d_{13,0} = 0$, which allow us to identify the oil price shocks. However, the first and second quarter demand and supply shocks are free to affect oil price. However, oil price shocks contemporaneously affect the output and domestic prices (see theoretical model in section 3.3). In the long run, domestic price level is fully adjusted to changing economic condition, therefore it would be expected that domestic demand shocks will have no impact on oil price in the long term. Also, oil price disturbances have long term effects on domestic prices; see equation (3.5). Finally, the long term output-neutrality restriction it is inferred that demand shocks have no long term effects on domestic output level $d_{23}(1) = 0$. This restriction was first discovered by Blanchard and Quah (1989) and has been extensively employed in recent empirical. The demand shocks have only transitory effects on output, but the long run effects of demand disturbances on inflation are unconstrained. However, supply shocks may have permanent effects on output and domestic prices in the model reported in equations (3.1)-(3.5) (see Blanchard and Quah, 1989). Equation (3.5) implies that all shocks can affect inflation in the long run.

3.5. Economic Background of Selected Developing Countries

This section gives a theoretical explanation for all countries on the main transmission channels through which the different crisis affected the economy for about 20 years. The selected countries experienced three major crises in the past 15 years; the Asian financial crisis 1997-1998[29], the 2008 higher oil prices and the global financial crisis 2008-2009. Table (3.1) reports the annual real *GDP* growth and inflation rate for all four countries. Southeast Asian countries experienced a huge recession during 1997-1998, *GDP* growth collapsed with hyper inflation. Indonesia, Malaysia and Thailand, the real growth rate was -14.1, -7.6 and -11.1 respectively in 1998 (table 3.1). The inflation was very high about 58% in Indonesia, while Malaysia and Thailand also faced high inflation. This negative growth and hyper inflation in 1998 was mainly attributed to the Southeast Asian Financial crisis.

During the past twenty years Pakistan economy has been subject to exceptionally large fluctuations. Pakistan faced double digit inflation and lower real *GDP* growth in mid 90s. In 1996-1997, Pakistan faced renewed political instability that damaged private sector confidence which led to sharp decline in *GDP* growth. According to Khan (2009), fiscal year 1996-1997 was stained by political and constitutional disasters and the effect of the Asian financial crisis in Pakistan. This crisis further extended into economic sanctions imposed by *IMF* and other developed countries which was due to

[29] This crisis originated from the devaluation of Thai's Baht to US dollar which then infected East Asian countries (Hirawan and Cesaratto, 2008). The crisis hit many countries especially in East Asian countries but Indonesia was among the most severely affected one.

the nuclear test in 1998. Consequently, Pakistan economy faced declining foreign loans, trade and aid. This led to capital flight from the economy and more reduced growth.

Table 3.1

Pattern of Real GDP Growth and Inflation

Year	Indonesia		Malaysia		Pakistan		Thailand	
	Growth	Inflation	Growth	Inflation	Growth	Inflation	Growth	Inflation
1994	7.3	8.5	8.8	3.7	3.8	12.4	8.6	5.0
1995	7.9	9.4	9.4	3.5	5.0	12.3	8.8	5.8
1996	7.5	8.0	9.5	3.5	4.9	10.4	5.7	5.8
1997	4.6	6.2	7.1	2.7	-0.1	11.4	-1.4	5.6
1998	-14.1	58.4	-7.6	5.3	2.5	6.2	-11.1	8.0
1999	0.8	20.5	6.0	2.7	3.6	4.1	4.4	0.3
2000	4.8	3.7	8.5	1.5	4.2	4.4	4.6	1.6
2001	3.6	11.5	0.5	1.4	2.0	3.1	2.1	1.6
2002	4.4	11.9	5.3	1.8	3.2	3.3	5.2	0.7
2003	4.7	6.6	5.6	1.0	4.7	2.9	6.8	1.8
2004	4.9	6.2	6.6	1.5	7.1	7.4	6.0	2.8
2005	5.5	10.5	5.2	3.0	7.4	9.1	4.4	4.5
2006	5.4	13.1	5.7	3.6	6.0	7.9	5.4	4.6
2007	6.2	9.1	6.3	2.0	5.5	7.6	4.8	2.3
2008	5.8	11.1	4.6	5.4	1.6	20.3	2.4	5.4
2009	4.5	2.8	-1.7	0.6	3.6	13.6	-2.3	-0.9
2010	5.9	7.0	6.9	1.7	4.3	13.9	7.5	3.3

Data source: International financial statistics

The developing economy observed food and fuel price shocks in 2007 and was followed by global financial shocks that is known as global economic crisis. The global economic crisis 2008-2009 impacts developing economies through several channels such as exports, transportation, consumption, production, imports, aid, remittances and investment. Global financial crisis was started to appear with bursting of the US housing mortgage bubbles in 2005 due to loan incentives for instance easy initial terms, the trend of rising housing prices that boosted borrowers.

So many borrowers easily entered the difficult mortgages in confidence that they would be able to quickly refinance at more suitable terms in future. However, the increasing interest rates and decreasing house prices in several parts of US made 2007 remortgaging more difficult (Ali, 2009). This led to the collapse of mortgage market in US and soon widespread economies.

In 2009, countries like Malaysia, Pakistan and Thailand except Indonesia have experienced deteriorating economic performance. Malaysia and Thailand suffered the most and recorded -1.7 and -2.3 in real *GDP* growth rate respectively in 2009 (table 3.1). The negative growth was dominated by global financial crisis and also with adverse effect of oil price shock. Meanwhile, Indonesia and Pakistan managed to maintain positive real *GDP* growth although at declined rates during the period of crisis. However, for Pakistan real *GDP* growth declined from 5.5 in 2007 to as lower as 1.6 percent in 2008 with combined highest inflation was 20.3 percent recorded in 2008. These figures are not surprising at all, because developing economies are highly integrated with the global market with regards to goods, services and finance. As a result, these economies are highly sensitive to any external shocks. The study describes a number of significant economic features of selected developing countries during 1981-2010 in next part of this section.

3.5.1. Indonesia

Indonesia has large rural economy with a flexible agriculture sector and significant oil reserves. During the last twenty years, Indonesian's small open economy has been subject to exceptionally large economic fluctuations. Before the Asian financial crisis in 1997, the country experienced one of the fastest and impressive economic growth rates 5.5-7.5 percent for the period of 1986-1996. In the last 15 years the country has experienced the two main economic crises. The first ever Asian financial crisis was in 1997-98 and the global economic recession (crisis) in 2008-2009 was the second. The first financial crisis (1997-1998) was mainly from unexpected large capital outflow from Indonesia, as a direct consequence there was a huge exchange rate depreciation 55-70% against the US dollar which led to the collapse of the national banking sector and several companies were bankrupted (Tambunan, 2010). Consequently, *GDP* fell about 14% a 60-70% rise in inflation. Soon after the crisis, Indonesia's economy started to recover quickly. Real *GDP* grew by 5.1% in 2004 and 5.4% in 2005.

Indonesia was also affected global economic crisis in 2008-2009 which was caused by the huge financial crisis in US, rise in prices of goods and energy. The country's exports consisted of mining agriculture, furniture and electronic appliances, while imports were mainly food items, machinery, equipments, and chemicals. A sizeable population of the Indonesian workers went abroad; hence the economy's increasingly dependent on remittance from abroad especially in villages. This resulted into global financial crisis affecting the country's exports, Investment and remittance (Tambunan, 2010). Indonesia's economy performed well during the global recession and managed to maintain positive economic growth. While, growth rate declined during the crisis from 6.2% in 2008 to 4.5% in 2009. In 2010, the growth came back up to 6%.

Indonesia was the only country in Southeast Asia that was the member of Organization of Petroleum Exporting Countries (OPEC) and also among the top twenty oil producing country in the world (Prawiraatmadja et al., 2006). Indonesia is the largest oil producer in Southeast Asia and was a significant exporter, but due to old oil fields and lack of investment in exploration of oil the economy experienced stagnant oil production (Brown and Wu, 2003). Due to a combination of rapid oil consumption and slow production, Indonesia transferred from huge oil exporter to oil importer in 2004 (Bradsher, 2008). In 2000, Indonesia produced 1430 thousand barrels (*TB*) and consumed 1040 thousand barrels per day (*TB/D*) of oil. In 2009, the country produced 1022 (*TB/D*) and consumed 1268 *TB/D*. This means that Indonesia had to import roughly 246 (*TB/D*) to meet its consumption needs per day in 2009[30]. These numbers show that Indonesia is not heavily dependent on oil import. The domestic oil price is low compared to the international oil price (Situngkir, 2004). This is caused by the Indonesian government directly subsidizing oil prices to protect the poor citizens and domestic industry since 1970s. Mourougane (2010) indicated that the size of the energy subsidies was higher than the international standard in 2008. Indonesian energy subsidies led to a peak at 4.5% of *GDP* in 2008, caused by sharp increase in oil prices in 2007-2008. In 2009, energy subsidies decreased to 1.7% of *GDP* as the government tightened its subsidy policy. The increase in oil price in 2008 did not affect economic growth negatively because of oil subsidies and capital inflow. *IMF* representative in Indonesia Milan Zavadjil (2011) said "the oil price fluctuations did not impact negatively on Indonesia's economy, among others, because of capital inflows that entered into Indonesia which strengthened the rupiah"[31].

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[30] For all countries, information regarding the selected countries production and consumption is taken from US Energy Information Administration.

[31] Sources: Antra News (2011).

3.5.2. Malaysia

Malaysia is a small open economy with lot of economic achievement in its credit. Generally, Malaysian economic achievements are high growth, low inflation and smaller foreign debt. The past two decades Malaysia has recorded only two episodes of economic crises. The Asian financial crisis in 1997 was due to internal sources which started with a rapid short run capital outflow from the country as a result of floating of Thailand's baht in 1997 (Cheng, 2003). This caused sudden exchange rate depreciation and collapse of the banking system in Malaysia. Malaysian economy went into the recession. The immediate impact of the collapse in the financial sector lends to negative effect on the economic activities. In 1998, there was an extraordinary reduction in *GDP* of 7.5 percent and a 5 percent rise in the inflation. Following a couple of years of economic recession, Malaysia continues to experience a moderate economic recovery that began in 1999 with the *GDP* grown by 5.6 percent (Cheng, 2003).

After some years of good economic growth, at the end of 2008, the country started experiencing a decline in economic growth caused by financial instability generated by speculative investment and lending in US economy. For Malaysia, however the exchange rate and banking sector was not affected so much compared to other countries. Tambunan (2010) described that national currencies did not depreciate in South Asian countries due to the no capital flights and thus no adverse effects on domestic enterprises. During the global crisis export and industrial output in Malaysia deteriorated. The country's export is dominated by the manufacturing products about 80% consists mainly of electronics and electrical components. With regards to export channel, the demand of Malaysian products from the advance economies (US and Japan) fell significantly due to the crisis in 2008-2009 (Mah-Hui, 2010). *GDP* was affected during the financial crises as it only grew by 0.1% in the last quarter of 2008 compared to a 5.9% growth in the first nine month of 2008. In the first quarter of 2009, *GDP* fell about 6.2% and became negative for the first time in 2001[32]. Malaysia's economy started to moderately recover in 2010 with the growth rate being 2-3%.

Malaysia exports more manufacturing products than oil. The country is also a net oil exporting country. The oil reserves in Malaysia are the third highest in the Southeast Asian countries. The oil market is relatively very tight due to the small gap between domestic production and demand. In 2009, Malaysia's total oil production was 693 *TB/D* while consumption was 577.87 *TB/D*. Arshad and Shamsudin (2006) indicated that the contribution of the oil and gas sector in the *GDP* has declined from 37% in 1980 to 7.2 % in 2006. With increasing relative oil dependence and decline in oil production, it is expected that Malaysia could become a net oil importer from 2011 (Mitchell and Schmidt, 2008). The increase in oil prices is expected to raise income in the country through export revenue leading to a reduction in the budget deficit. Arshad and Shamsudin (2006) pointed out that this is not case because Malaysia is deeply involved in big subsidies to all sector of economy. Hence, oil prices increase will causes more financial load on the government budget to sustain lower prices for customer and producers.

In 2008, Malaysian economy was also affected by the unexpected increase in global oil prices through its effect on the balance of payments and domestic inflation. As an oil exporting country it was expected that increase in oil price should have a positive impact on the economy through increase in foreign revenue. In contrast, higher oil price affects the purchasing power of the household through higher transportation and energy cost, thereby, reducing the disposable income and consumption in worldwide economy. Oil price hike has a negative impact on the exports. So the negative impact of the oil

[32] See Khoon and Mah-Hui (2010), and Athukorala (2010).

price on the economy dominated with *GDP* growth declined 3.5% and the inflation increased about 8% in fourth quarter of 2008.

3.5.3. Pakistan

Pakistan is an agricultural country with a population of more than 170 million people. About 65% of her population lives in the rural areas. Agricultural sector employs 44% of the country's labour force and half of these are women. The sector also contributes about 21% to *GDP* after the services sector, which contributes almost 53% of the *GDP* in 2008 (Asian Development Bank, 2008). In 1950 Agricultural sector's contribution to *GDP* was 50%; this declined to 20% in 2008. The manufacturing sector remains the third important contributor in *GDP*, with a share of 19% in 2008, and has increased from 15.1% to 19.9% in the same year. Pakistan's major exports are consisted on the rice, leather goods and sports goods. However, imports are mainly on the machinery, petroleum, and steel products.

The Pakistan economy achieved very impressive growth rate about 7% in 1980s and was not affected by the global crisis in 1979-1982. However, Pakistan economy performed below its potential in 1992-1993 followed by a sharp decline in real *GDP* growth. During this period, Pakistan faced the impact of devastating floods and political instability (Khan, 2009). Meanwhile, the economy was also slightly affected by the Asian financial crisis in 1997-1998. Economic problems deteriorated as another financial crisis hit Pakistan economy at the same time in 1998. The crisis was generated by the nuclear tests in May 1998 which made Pakistan isolated in economic and financial perspective. The economy is dependent on the foreign loans and aid to cover its budget deficit, due to sanctions from *IMF* and World Bank stopped payments of a period. Immediately after the sanction government froze all foreign currency accounts, which was an attempt to stop capital outflows this worsened the situation. As a result, the capital flows, *GDP* growth, the stock market and real exchange rate were affected. Foreign reserves fell to its minimum level at about 425 million US dollar and the exchange rate depreciated 28% (Morrow and Carriere, 1999). The global economic crisis in 2008 affected the Pakistan economy through trade, investment, consumption, production and remittance channels. Pakistan was facing high international food and energy prices raising inflationary pressure in 2007-2008. As a result, the country faced scarce infrastructure, security concern and power shortage which lead to economic instability. The crisis lowered the *GDP* growth from 8% to 3% followed with more than 25% inflation (Draz, 2011).

Pakistan is an oil importing country and among the lower users about 0.49% total energy consumption per capital (Federal Bureau of Statistics, 2008). Pakistan has limited domestic oil reserves and relies almost totally on imports to meet its consumption. Pakistan oil production is 55.97 *TB/D* while demand of oil is 397 *TB/D* in 2009. In 2008, transportation sector had the largest share of oil consumption in Pakistan 51.92% followed with 39.18% in power generation sector and 5.98% in industrial sector (Bedi-uz-Zaman et al. 2011). The economy achieved good growth rate from 2002-2007, demand for energy also grew quickly which has a direct link with the economic development. The contribution of net oil imports in *GDP* is about -5.24% in 2006 (Malik, 2008). The government of Pakistan also subsidizes the energy price to protect the poor consumer but energy subsidy cost increase the budget deficit. In 2008, increase oil price caused the fell in *GDP* and rose in domestic prices, as the rise to imported oil leads to rise in the production and the transportation costs. Pakistan *GDP* growth rate was recorded about 1.2% in 2010.

3.5.4. Thailand

Thailand is small industrialized economy which is heavily dependent on export. The share of exports is more than two third of *GDP*. In 2010, exports of the good and services were about 70% of the *GDP* (Shi, 2010). Thailand's exports consist mainly of machineries, electronic products, agricultural goods and jewellery. Thailand achieved rapidly growth rate of 8% in 2010 due to a gain in export and proved to be one of the fastest growing economy in South Asia. In 2009, Thailand's services, industry and agriculture sectors contributed 45.1%, 43.3% and 11.6% of *GDP* respectively[33].

Thai economy developed quickly from mid 70s to 1996 where real *GDP* growth rate was at an average 9% annually for 1990-1996. Thailand was one most affected country during the Asian financial crisis in 1997-1998. The crisis originated with the devaluation of Thai baht against the US dollar and rapidly spread to other South Asian countries. As a result, Thailand experienced a rapid decline in economic activities, and huge fluctuations of the Thai baht. The real *GDP* growth decrease was dramatic, reaching -1.37% and -10.51% in 1997 and 1998 respectively, whereas *GDP* growth rate was 5.9% in 1996.

Soon after the 1998 financial crisis, the economy started to recover really fast that between 2000-08 average *GDP* growth rate was about 4% annually before the global financial crisis in 2008-2009. The global crisis also hit the Thai economy through the export, stock market, tourism industry and private investment perspectives. The crisis reduced exports to about 23.4% in 2009 which contributed to two thirds of *GDP*. In 2009, due to high dependence on external sector, the economy's growth rate reached -

[33] Source: Market Fact Sheet-Thailand, Government of Western Australia (2010).

2.8%[34]. However, there was a rebound in 2010 with more than 7% growth rate due to progress in manufacturing-based export (Government of Western Australia, 2010).

Thailand is a significant net oil importing country and its share of the imported oil is 14% of *GDP*. Thailand has limited domestic oil production and depends almost totally on imports to meet its consumption. It is importing more than 70% of the total domestic demand and spending significant amount of budget on oil import. Thailand's demand for energy has increased notably due to its growing manufacturing-based economy. Oil price gradual increase since 2000 reached its maximum in 2008 which significantly affected Thai's economy due its high dependence on oil import. There was negative growth and increase inflation, oil price hike and political instability in 2009.

The oil sector in Thailand, since the 70s has been regulated through the government established oil fund. The main objective of the oil fund is to control the ceiling prices of oil to maintain selling prices of oil to keep it in line with government policy in the event that the international oil prices are significantly soaring (Harnphattananusorn, 2008). Oil fund also pays subsidies for oil prices to maintain oil prices within the country and minimise the economic and social impacts generated by oil price shocks. Petroleum Federation of India (2004) found that "Thailand's overall economic performance has remained relatively unaffected by price flows in international oil". Jiranyakul (2006) confirmed that there is positive relationship between oil price and industrial production index in long run and also indicated that the manufacturing sector can adjust itself to higher costs of production cause by the increase in oil price.

[34] Thai's economy collapsed in 2009 also because of political problem, new immigration laws and a collapsing tourist industry.

3.6. Data and Empirical Results

In the present study, I have used seasonally adjusted quarterly time series data for Indonesia, Malaysia, Pakistan and Thailand. It should also be noted that when computing a structural *VAR* analysis with a small number of variables, a large number of observations are required to adequately identify structural shocks. Unfortunately, quarterly data series for *GDP* are not available for an extended period of time in developing countries in particular Pakistan where this is completely unavailable. Furthermore, in some cases where the data are available, its authenticity is criticised. Consequently quarterly *GDP* data for Pakistan is interpolated from the annual series[35]. This does not subtract from the analysis, as the results show that the structural shocks for Pakistan are correctly identified.

In the case of Indonesia, quarterly *GDP* is available from 1990q1 but real effective exchange rate figures starts from 1994q1. Therefore, the time spans are different for different countries depending on the availability of data. For Indonesia the data runs from 1994q1 to 2010q3, Malaysia 1991q1-2010q3, Pakistan 1981q1-2010q4 and Thailand 1993q1-2010q3. The empirical analysis in the chapter is divided into two main sections. Firstly, the dynamic effects on output and inflation of aggregate supply and demand and real oil price shocks are captured in the baseline model. The variables for each country are changed to international oil price, real output, and domestic prices. Secondly, an alternative model is examined where oil price, exchange rate, demand and supply shocks are the main determinants of the business cycles. In order to implement robustness in the alternative model, domestic real oil prices (oil price in domestic currency) replaces international real oil prices (oil price in US dollars), along with the inclusion of an additional variable, real exchange rate. All the data series are obtained

[35] This chapter interpolates annual real *GDP* observations for Pakistan into quarterly series by using the parabolic (Simpson's) rule in numerical integration (see e.g. Al-Turki, 1995).

from the International Financial Statistics (*IFS*) database except the real effective exchange rate and *GDP* deflator for Indonesia. The real effective exchange rate data for Pakistan and Malaysia are obtained from the *IFS,* while real effective exchange rate for Thailand and Indonesia are taken from the database of the Bank of Thailand and Bank for International Settlements respectively. The *GDP* deflator for Indonesia is obtained from the Bank of Indonesia. The details of the datasets are described in appendix 3.A.

A unit root test is used to identify the properties of the time series macroeconomic variables. The reports of the Augmented Dickey Fuller (*ADF*) and Phillips Perron (*PP*) tests are described in table 3.B1 (appendix 3.B). The results reveal that none of the variables real oil price, real *GDP*, real exchange rate and domestic prices is stationary at level. This implies that the variables are integrated of order one. The *ADF* tests indicate that oil price $\left(op_t^w\right)$, real *GDP* $\left(y_t\right)$, domestic prices $\left(p_t\right)$ and exchange rate $\left(E_t\right)$ are first difference stationary[36] $I(1)$. Before estimating the structural *VAR*, the Johnson test of cointegration was performed with appropriate assumptions on trends and lags to check whether or not the variables are cointegrated. The result of the cointegration condition for all countries is reported in table 3.B2 (appendix 3.B) using the methodology proposed by Johansen and Juselius (1990). For all countries, the calculated trace and maximum eigenvalues test statistics are smaller than the critical values at 1% and 5% significance level, suggesting that there is no cointegration (long term) relationship between real oil price, real *GDP,* domestic prices and real effective exchange rate. The general conclusion therefore is that there is no cointegration evidence among all variables for all the countries. The *VAR* models (3.10) of $z_t = [\Delta op_t^w, \Delta y_t, \Delta p_t]'$ are estimated for different data sets for Indonesia, Malaysia, Pakistan, and Thailand. The

[36] Both constant and time trend are included for *GDP*, while for all other variables only constant is included.

model is calculated with maximum 3 lags, where the numbers of lags have been obtained from Akaike (*AIC*), Schwarz and Hannan-Quinn information criteria.

3.6.1. Impulse Response Function

In order to explore the effect of structural shock on endogenous variables, the study assesses the impulse response functions using structural decomposition, and also the cumulative responses. The impulse response functions show the response of the economic variables to the shocks in terms of the size and speed of adjustment. These impulse response functions are estimated to expose the response of the model to a standard deviation shock to the structural disturbances. The structural decomposition is designed to impute impulse response functions for shocks to oil price, supply and demand. The cumulative impulse responses of output and inflation to oil price (*OP*), aggregate supply (*AS*) and demand (*AD*) shocks are reported in figures (3.1) to (3.2). The bootstrapping method is used to construct the confidence intervals for individual impulse responses, because this method measures the statistically reliability of the estimated impulse responses. To ensure the significance of the results, the 95% bootstrapping confidence intervals are used in the analysis, which is estimated with 200 replications (see appendix 3.C; figures 3.C1-3.C6)[37].

Figure (3.1) shows the cumulative dynamic effects of oil price, supply and demand shocks on *GDP* for all the countries. The results indicate that oil price shocks have a positive and permanent effect on the level of output in all investigated countries. The

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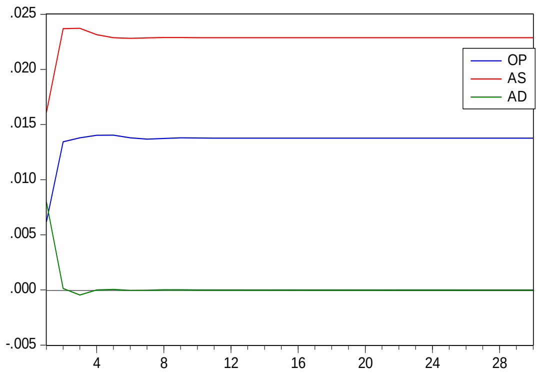
[37] The impulse response functions are computed based on the structural *VAR* specification (with long run restrictions) which need reliability measures. In empirical applications, such measures are unusually given by confidence intervals of impulse responses. In the econometric softwares like EViews, Stata, structural impulse responses discovered by long run restrictions does not provide standard error confidence bounds see figures (3.1) and (3.2). The Hall 95% confidence bootstrapped confidence intervals are used in the analysis, in which computation is based on the resample *VAR* residuals with replacement with 200 replications. The idea of bootstraps proceeds as follows, the bootstrap data has been obtained by using the estimated *VAR* coefficients and the bootstrap residuals. Then, *VAR* is estimated and structural factorization using bootstrap data. Finally, store the individual impulse responses using the *VAR* estimates and repeated this steps to 200 times. The study used the bootstrap method proposed by Hall (1992) and Benkwitz et al (2000).

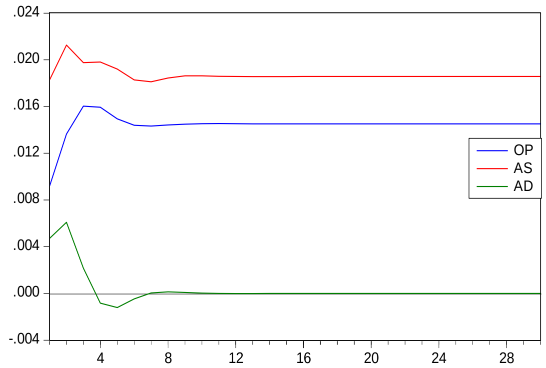
cumulative response of output to a one unit oil price shock in the net oil exports of Indonesia and Malaysia is presented in figures (3.1.a) and (3.1.b) where a one percent shock increases *GDP* by about 1.4 and 1.6 percent respectively[38].

Figure 3.1: The Cumulative Dynamic Effects of Oil Price, Supply and Demand Shocks on *GDP*

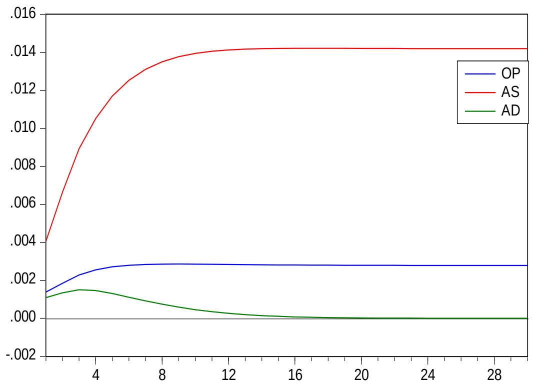
a) - Indonesia



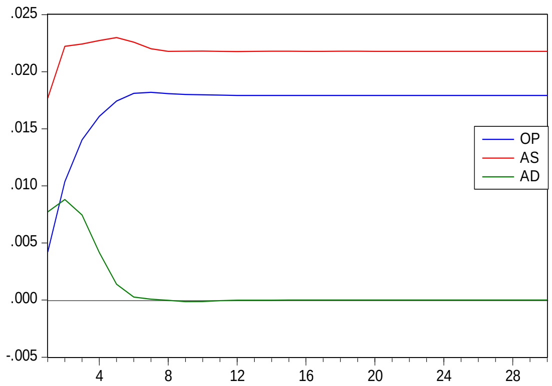
b) – Malaysia



c) - Pakistan



d) - Thailand



This positive output response is consistent with the economic model reported in section 3.3, given that an increase in oil prices leads to a rise in countries' oil revenue and income[39]. Additionally, considering this positive shock to oil price as a positive supply

[38] Bjornland (2000) finds that oil price has a negative effect on output in the UK, and a positive effect on output in Norway, both of which at that time were net oil exporting economies.

[39] The income transfer effect arises because the increase in oil prices increases the income of oil exporters leading to an improvement in their terms of trade. Thus the output response to oil price increase is positive for oil exporting countries.

shock for the oil exporting economies, the resultant increase in income and wealth consequently amplifies consumption (given a constant propensity to consumption for income and wealth). This result also supports the findings in the existing literature (Bjornland, 2000 and 2004; Jimenez-Rodriguez and Sanchez, 2005; Mehrara and Oskoui, 2007; Jin, 2008; Aliyu, 2009), which suggest that oil price shocks have a positive effect on output in net oil exporting countries.

In Indonesia and Malaysia, the confidence band confirms that oil price innovations have a small effect on output in all horizons (appendix 3.C; figures 3.C1). The smaller magnitude output response to oil price shock is due to these countries' less dependence on oil. However, Indonesia and Malaysia are also facing a decline in oil production and increasing domestic demand for oil. The smaller gap between domestic production and demand for oil can be attributed to the fact that Indonesia has turned from being a net exporter to a net importer since 2004, while Malaysia is expected to become net oil importer within the next few year.

For oil importing countries like Pakistan and Thailand, the positive response of economic activities to the oil price innovations is surprising and unexpected. The *GDP* response to oil price is positive both countries and the degree of response in Thailand is larger than that in Pakistan[40]. Real oil price disturbances have a very small positive impact on output in Pakistan. Although Pakistan is net oil importing country which imports 80% of its oil for domestic demand, it is considered a very lower user of oil. Thus, oil accounts for a small share its consumption basket (see report of Federal Bureau of Statistics, 2008). This may explain why Pakistan suffers less from oil price shocks. In particular, the response in bootstrap confidence interval band is negligible

[40] Jiranyakul (2006) calculated that oil price and industrial production have a positive relationship in Thailand in the long term.

and close to zero, as reported in figure 3.C1and appendix 3.C. The band results verify that the effect on output of oil price shocks is not significant in both Pakistan and Thailand. There are many reasons for rising oil prices, which these results suggest may either have a slight positive effect on output in Pakistan and Thailand, or leave it unaffected[41]. Thailand produces a sizeable amount of oil, which meets some part of domestic demand even though it is a net oil importing country. Furthermore Thailand has implemented export promotion policies for many years. As a result, its trade surplus declined following a rise in international oil prices. It should be noted that if data from several decades are used, the long run output response may well be revealed as negative, which would be consistent with the expectations of the economic model for oil importing countries. Nevertheless, the quarterly data of *GDP* for the developing countries in this study are not available for such a period of time. Additionally, although these countries use oil in their production processes they may not entirely dependent on it, and are often given oil subsidies. Finally, the period under consideration might not be most suitable for study, since oil prices did not fluctuated a great deal over that time.

As expected, the reaction of output to aggregate supply shocks is positive and permanent in all countries. In Indonesia, Malaysia and Thailand, the output response to the supply shock is much larger than in Pakistan. The impact of a one unit supply disturbance varies from 1.6 to 2.4 percent. It is likely that real *GDP* will increase after positive technology shocks, which can be viewed as supply shocks. However, the immediate effect of a one percent supply shock fluctuates from period to period for each economy. Based on appendix 3.C (figures 3.C2), it can be concluded that the effect of

[41] In Pakistan and Thailand, oil prices have been set by the government since the 1970s. The Thai government have established an oil fund to provide subsidy, and a supporting apparatus that enables the government to stabilise the domestic oil price during global oil price instability.

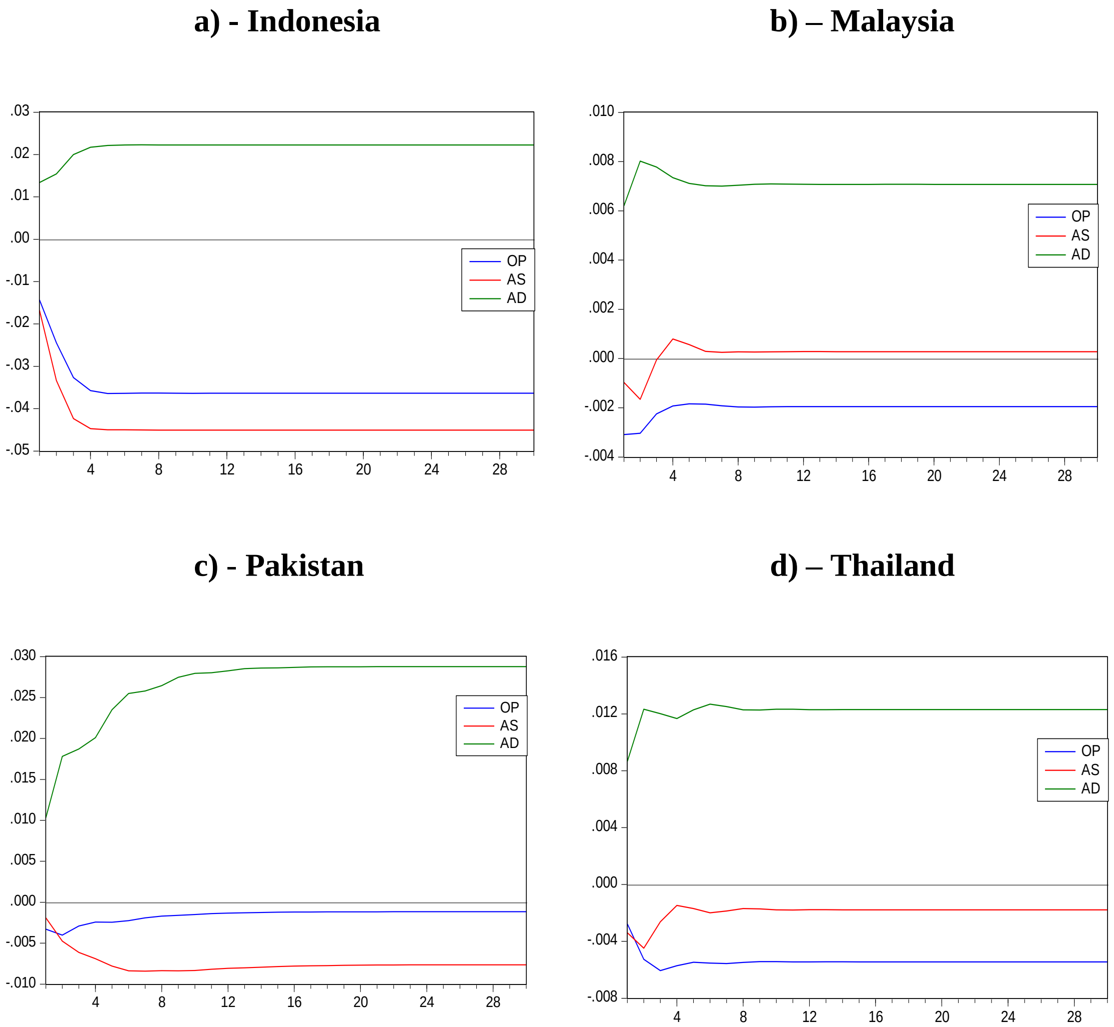
supply shocks on output is statistically significant in both the short term and long term in all countries.

Aggregate demand shocks have a very small impact on output movements in all countries in the short term. They have an immediate positive impact on the level of output in Indonesia, Malaysia, and Thailand, since these are export dependent countries see figure (3.1). The effect is highest in Thailand where output increased by about 1 percent, and smallest in Pakistan where output is raised by less than 0.05 percent (see appendix 3.C). In the long term, the response of *GDP* to demand disturbances disappears in all countries, which is consistent with the theoretical expectations and restrictions. This result is in line with the explanation of Blanchard and Quah (1989).

Oil price shocks have negative effects on domestic prices, which cause deflation in all countries. In Malaysia and Pakistan, an oil price shock initially has a high negative effect on domestic prices, but the negative effect gradually decreases thereafter. The effect is largest in Indonesia where price level decreases by about 3.6 percent after the fourth quarter. This result is in line with the statement of Milan Zavadjil (2011) in which he indicates that Indonesia has recently experienced huge capital inflows which strengthened the rupiah, resulting in no adverse effect from the steady oil price increase during 2003-2008. Additionally, in all countries, the negative response of domestic prices to oil price can be attributed to governments directly subsidised oil prices to protect citizens and domestic industry from international oil price increases. Subsidised oil prices benefit many economic sectors including transportation, manufacturing and power. The present oil subsidy system is working effectively to control inflation in these countries. Indonesia and Malaysia are net oil exporters and reap the benefits in terms of higher export earnings, while, Thailand is net oil importer but a major trading partner of Indonesia and Malaysia. Therefore the indirect effect of high oil prices on

Thailand is positive. In terms of inflation responses to oil price shocks, in Pakistan this decreases gradually after first quarter and approaches zero, where one unit shock increases inflation by about 0.2 percent. Appendix 3.C confirms that the response of inflation to oil price disturbances is not significantly different from zero in this set of countries.

Figure 3.2: The Cumulative Dynamic Effects of Oil Price, Supply and Demand Shocks on Price Level



Supply shock has a stable negative impact on inflation as expected, in all countries except Malaysia. The effects of supply shock on inflation in Malaysia become positive after one year but the magnitude of the shocks is insignificant. In Indonesia, the confidence interval band confirms that the statistical effect is significantly different from zero in the short term. Indonesia immediately exhibits a very sizeable reaction to supply shocks where inflation decreases by about 4.6 percent. The effect is smallest in Pakistan, where inflation is reduced by less than 0.9 percent.

Demand disturbance has a permanent and positive effect on inflation in all countries, supporting the economic model. The impact of a one unit demand shock is positive, shifting from 0.8-2.7 percent across the set of countries. The response is highest in Indonesia and Pakistan, where a single unit shock corresponds to about 2.1-2.7 percent rise in inflation. Malaysia is a low inflationary country, where the highest response to the demand shocks is about 0.8 percent in the longer term. The magnitude of the long term inflationary response to demand shock is significantly different from zero in all countries (see appendix 3.C).

3.6.2. Variance Decomposition

Variance decomposition technique verifies how much of the forecast error variance is explained by shocks to each explanatory variable in a system, over a series of time horizons. It is based on structural decomposition (orthogonalization) estimated in the factorization matrices for an identified *VAR*. For each country in this study, variance decomposition is used to measure the proportion of fluctuations in *GDP* and domestic prices due to shocks in oil price, demand and supply respectively; the results are presented in tables (3.2)-(3.5). Variance decomposition indicates the relative impact of the different shocks on the variance of output and domestic prices.

The forecast-error variance decompositions for Indonesia are reported in table (3.2). These results show that real oil price shock causes 11 percent of short term and about 17 percent of long term variations in output. Aggregate supply disturbances contribute 71 percent of the changes in output in Indonesia in the short term, while in the long term this contribution falls to 59 percent. Aggregate demand shocks explain about 24 percent of the fluctuation in *GDP*. Oil price disturbances explain about 31 percent of the variations of inflation in the long term, while supply disturbances explain about 52 percent of forecast-error variance of inflation in Indonesia.

In the short term, demand shocks contribute about 26 percent of the variations in prices but this percentage gradually decreases with time, reaching about 17 percent. Table (3.2) clearly shows that in the 30th quarter these demand shocks only explain 16.8 percent of long run variations of prices. Unlike the findings of Cover et al. (2006), who find that the major source of long term inflation variation is demand shocks, the current results indicate that in Indonesia supply shock causes the greatest changes in inflation.

Table 3.2: Variance Decomposition of *GDP* and Prices in Indonesia

Quarters	Output			Inflation		
	OP	***AS***	***AD***	***OP***	***AS***	***AD***
1	10.551	71.780	17.669	30.768	42.301	26.931
2	17.044	59.416	23.541	29.356	53.127	17.516
4	17.043	59.359	23.598	31.147	52.064	16.789
6	17.050	59.357	23.593	31.167	52.038	16.795
8	17.053	59.356	23.592	31.167	52.038	16.795
10	17.053	59.355	23.592	31.167	52.038	16.795
14	17.053	59.355	23.592	31.167	52.038	16.795
18	17.053	59.355	23.592	31.167	52.038	16.795
24	17.053	59.355	23.592	31.167	52.038	16.795
30	17.053	59.355	23.592	31.167	52.038	16.795

Table (3.3) indicates the role of real oil price, aggregate supply and demand shocks in explaining output and domestic prices variability in Malaysia. In Malaysia, oil price shocks account for 19-21 percent of the forecast-error variance in output. These oil price shocks have a constant effect on output in the longer term. The contribution of supply disturbances to output variability ranges between 68 and 76 percent.

Regarding long term inflationary change in Malaysia, about 18 percent of this is explained by real oil price shocks. Aggregate demand disturbances are the single most significant source of variations in inflation, accounting for about 74 percent of variance. Supply shocks only explain 8 percent of these fluctuations in the long run.

Table 3.3: Variance Decomposition of *GDP* and prices in Malaysia

Quarters	Output			Inflation		
	OP	***AS***	***AD***	***OP***	***AS***	***AD***
1	19.173	75.777	5.050	19.501	1.933	78.565
2	22.119	72.765	5.116	18.117	2.686	79.196
4	21.828	68.554	9.618	18.038	8.252	73.710
6	21.948	68.363	9.689	17.989	8.448	73.563
8	21.932	68.333	9.735	17.997	8.450	73.553
10	21.931	68.334	9.735	17.997	8.450	73.554
14	21.931	68.334	9.735	17.997	8.450	73.554
18	21.931	68.334	9.735	17.997	8.450	73.554
24	21.931	68.334	9.735	17.997	8.450	73.554
30	21.931	68.334	9.735	17.997	8.450	73.554

In Pakistan, oil price shocks have a relatively small effect on output. They contribute only 6 percent of long term variations in *GDP* (see table 3.4). With regard to the variance of output in Pakistan, supply disturbances are an important causal factor. These contribute 90 percent of the variance across the time period under investigation. Demand shocks explain only 4 percent of long term output fluctuations and real oil price disturbances contribute about 6 percent to the variations in domestic prices. In the short term, aggregate demand disturbances explain about 88 percent of the variations in domestic prices, with this contribution gradually declining as time goes on. Aggregate supply disturbances are less important for explaining inflation changes in Pakistan, contributing only 3 percent in the short run and 7 percent in the long run.

Table 3.4: Variance Decomposition of *GDP* and Prices in Pakistan

Quarters	Output			Inflation		
	OP	***AS***	***AD***	***OP***	***AS***	***AD***
1	9.684	84.265	6.050	8.952	2.979	88.069
2	7.967	87.321	4.713	6.118	6.311	87.571
4	6.875	89.428	3.697	6.675	7.395	85.930
6	6.555	89.794	3.651	6.159	7.340	86.501
8	6.463	89.765	3.772	6.214	7.319	86.467
10	6.438	89.690	3.872	6.185	7.275	86.540
14	6.431	89.634	3.935	6.189	7.289	86.522
18	6.431	89.626	3.943	6.189	7.294	86.517
24	6.431	89.626	3.943	6.189	7.294	86.517
30	6.431	89.626	3.943	6.189	7.294	86.517

The forecast-error variance decomposition for output and domestic prices in Thailand is reported in table (3.5). In terms of variance decomposition of output, supply shocks contribute the largest portion of the variance in Thailand. The short term effect is 80 percent which decreases with the forecast horizon to about 68 percent as expected. The long term impact both of oil price and aggregate demand disturbance is modest, accounting for about 15 and 17 percent of the variation of the output respectively. Demand shocks in Thailand account for the largest fluctuation in inflation. They represent about 73 percent of the long term variability in inflation. Real oil price disturbances explain about 12 percent of the variation in inflation and supply disturbances describe about 15 percent.

Table 3.5: Variance Decomposition of *GDP* and Prices in Thailand

Quarters	Output			Inflation		
	OP	***AS***	***AD***	***OP***	***AS***	***AD***
1	4.537	80.180	15.282	8.216	12.245	79.539
2	12.388	74.101	13.510	12.084	11.040	76.875
4	15.270	69.439	15.292	12.138	14.448	73.414
6	15.371	67.865	16.764	12.117	14.472	73.412
8	15.362	67.880	16.758	12.120	14.492	73.399
10	15.362	67.878	16.760	12.112	14.495	73.394
14	15.362	67.877	16.761	12.112	14.495	73.393
18	15.362	67.877	16.761	12.112	14.495	73.393
24	15.362	67.877	16.761	12.112	14.495	73.393
30	15.362	67.877	16.761	12.112	14.495	73.393

To summarise the forecast-error variance decomposition results, the study concludes that aggregate supply disturbances are the most important factor behind output movements in both short and long term in this set of countries. For all four countries, output behaviour seems consistent with real business cycle theory. Aggregate demand is the main determinant of the variability in domestic prices in Malaysia, Pakistan and Thailand. In Indonesia, supply shocks are more dominant than demand shocks in explaining domestic price fluctuations. In all countries, the supply, and demand shocks are a significant source of business cycles.

3.7. Alternative Model

In the baseline model in the section 3.6, the oil price in US dollar is used as a variable for analyses. In the current section, the robustness of results in the baseline model is compared with an alternative model. In this alternative model, the oil price in US dollar is substituted for the oil price in local currency. The real exchange rate is also added as a variable**.** The principal reason for the use of an alternative model is that the empirical evidence in the baseline model shows that oil prices have small or negligible effects on the macroeconomic variables. It is expected that for developing countries the magnitude of oil price shocks may be larger in the domestic currency than in US dollars, as reported by Cunado and Gracia (2005). The current study therefore investigates whether domestic oil price changes have similar effects on output and inflation as those revealed by the baseline model. If this is the case then the exchange rate in these countries will be flexible. If this effect is different then it will be necessary to assess which of the two oil price structures (US dollars or local currency) has a greater effect on *GDP* and inflation. A further important contribution of the alternative model is the decomposition of demand shocks into real and nominal demand shocks, to accurately assess the movements in macroeconomic variables in the selected countries. This model also explores the impact of oil price changes on the exchange rate in oil importing and exporting countries. The fluctuation in oil prices is expected to have a significant impact on the relative value of currency in small open economies with floating exchange rates. Because international oil prices are dominated by the US dollar then any change in the oil price will have large implications for foreign exchange demand and supply (Dawson, 2006). The impact of an oil price increase is different in oil importing and exporting countries; an increase in the international market price of oil is expected to depreciate the value of the local currency relative to US dollar in oil importing countries.

This part of the study will also investigate the effect of exchange rate on output and inflation. Existing literature acknowledges that appreciation of the exchange rate pushes imports and depresses exports, whereas the depreciation of the exchange rate leads to decreased imports and increases exports (Jin 2008; Aliyu 2009). Therefore, real exchange rate depreciation lends to an income shift from importing economies to exporting economies by a transfer in the terms of trade. Kandil et al. (2007) verified that exchange rate depreciation, whether expected or unexpected, has a negative impact on economic performance in developing countries because exports in developing countries mainly consist of processing industrial goods, mostly natural resources, whereas their major imports are final goods.

Exchange rate fluctuations can influence both output and inflation through their effect on aggregate demand and supply. On the supply side, higher import costs connected with exchange rate devaluation raises the marginal cost of production, which leads to higher domestic prices and lower output. On the other hand, exchange rate depreciation increases foreign demand and therefore exports, causing a raise in aggregate demand (Vinh and Fujita 2007). This may increase output, which is associated with higher aggregate demand, in turn raising input prices through higher wages, which leads to higher domestic prices.

The existing literature confirms that exchange rate appreciation increases output growth in net oil exporting countries. Jin (2008) finds that an appreciation of the real exchange rate corresponds with positive output growth in Russia and negative output growth in China and Japan. Ito and Sato (2006) reveal that inflation sensitivity to exchange rate shock in Indonesia was relatively high compared to other Southeast Asian countries during the Asian Financial Crisis. Rautava (2002) indicated that in the case of Russia high oil price is connected with an increase in growth, whereas exchange rate appreciation is deteriorative to output.

The *ADF* and *PP* tests indicate the domestic oil price (op_t^D) and real effective exchange rate are first difference stationary $I(1)$ as reported in table (3.B1) and (3.B2). The vector variables are placed in following order, i.e. $Z_t = [\Delta op_t^D, \Delta y_t, \Delta E_t, \Delta p_t]'$, where Δop^D is the change in domestic real oil price and ΔE_t is define as change in real exchange rate. The four serially uncorrelated structural shocks are $\varepsilon_t = [\varepsilon_t^{op}, \varepsilon_t^s \varepsilon_t^{ER}, \varepsilon_t^d]'$; where ε_t^{ER} is the exchange rate (real demand shock) (*ER*) shock. The long term expression of the structural *VAR* model including real exchange rate and using domestic oil price instead of international oil price can be written as:

$$\begin{bmatrix} \Delta op_t^d \\ \Delta y_t \\ \Delta E_t \\ \Delta p_t \end{bmatrix} = \begin{bmatrix} d_{11} & d_{12} & d_{13} & d_{14} \\ d_{21} & d_{22} & d_{23} & d_{24} \\ d_{31} & d_{32} & d_{33} & d_{34} \\ d_{41} & d_{42} & d_{43} & d_{44} \end{bmatrix} \begin{bmatrix} \varepsilon_t^{op} \\ \varepsilon_t^s \\ \varepsilon_t^{ER} \\ \varepsilon_t^d \end{bmatrix} \qquad (3.13)$$

To identifying the *VAR* model six economic restrictions are required. They are applied to identify oil price (*OP*), exchange rate (*ER*), aggregate supply (*AS*) and aggregate demand (*AD*) shocks. These restrictions are employed as long run restrictions. The methods employed in this section to shocks identification follows the works of Clarida and Gali (1994), Bjornland (1998, 2000 and 2004), Huang and Guo (2007), Mehrara and Oskoui (2007), Ozata and Ozer (2008), Korhonen and Mehrotra (2009), which in turn are based on the technique developed by Blanchard and Quah (1989). Three identification assumptions are employed to identify the oil price shocks. This means that only oil price shocks can influence real oil prices in the long term, i.e. $d_{12} = d_{13} = d_{14} = 0$. Oil prices have been dominated by the external oil supply shocks such as the 1973

OPEC ban, the excess in oil supply in 1986 and the Iraq war in 1990-1991 (Bjornland 2000 and 2004; Korhonen and Mehrotra, 2009).

The two long run output-neutrality restrictions, demand (nominal) shocks and real exchange rate (real demand) shocks do not have any long run effects on output and are written as $d_{23}(1) = d_{24}(1) = 0$ (Blanchard and Quah 1989). In the long term, production will be determined by the oil price and supply shocks (supply side factors). However, due to price and real rigidity all the shocks affect output in the short run.

The exchange rate is placed as the third variable in the model; following the identification restriction that real exchange rate is assumed to be affected by all the shocks except nominal (demand) shock[42]. In other words, the exchange rate is not affected by demand (nominal) shock in long run, $d_{34}(1) = 0$. This restriction is consistent with most models of short run exchange rate fluctuations in that the exchange rate includes both short run instability and long run variations from purchasing power parity (Clarida and Gali, 1994)[43]. This study does not impose any restrictions on domestic prices, and all four shocks are expected to have a long term impact on price level. For oil price, exchange rate and supply shocks, a permanent impact on relative price is expected in the long term. A positive supply shock will immediately lower prices; however, the long term effect may be positive or negative.

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[42] Clarida and Gali (1994) proposed a two-country model, where output, prices and the real exchange rate are driven by three shocks: supply, non-monetary (real) demand (exchange rate) and nominal (demand) shocks. However, Bjornland (2003) Mehrara and Oskoui (2007), Ozata and Ozer (2008), Korhonen and Mehrotra (2009), amplified oil price in the model.

[43] The Mundell-Flemming-Dornbusch model suggested that supply shocks depreciate the real exchange rate (Clarida and Gali 1992). In contrast to the Mundell-Flemming-Dornbusch model, the Balassa-Samuelson effect may indicate that supply shocks generate fluctuations in the real exchange rate via tradable and non-tradable sectors. Specifically, the impact of these shocks in tradable sectors causes real exchange rates to appreciate, and more rapid productivity growth in the tradable sector than the non-tradable sector relative to main trading partners induces exchange rate appreciation. On the other hand, the impact of supply shocks in non-tradable sectors causes real exchange rates to depreciate (Ozata and Ozer, 2008).

The restrictions are imposed such that first the variable may have permanent effects on the rest of the variables; all the variables have a long term response to the second variable except the first. The third variable has an effect on all variables except the first and second variables, etc (Blanchard and Quah, 1989). The primary objective of this four dimension *VAR* of $Z_t = [\Delta op_t^D, \Delta y_t, \Delta E_t, \Delta p_t]'$ in the alternative model is to examine the dynamic effects on output and domestic prices of domestic oil price shocks as compared with international used in the baseline model. In addition, the impact of real exchange rate on output and domestic prices is explored. Finally, the different disturbances are distinguished and calculate the relative contributions of the different shocks in the real business cycles.

The four variable *VAR* models (3.13) for each country are individually estimated, while a maximum of 3 lag length is obtained from Akaike (*AIC*), Schwarz and Hannan-Quinn information criteria. Figures (3.C7) to (3.C8) (see appendix 3.C) provide an assessment between the cumulative impulse response functions of *GDP* and inflation to different structural shocks derived from the alternative model, includes the replacement of international oil price by domestic oil price, and the addition of the real exchange rate. The dynamic effects of different shocks on macroeconomic variables with 95% bootstrapped confidence intervals are also reported in figures 3.C10-3.C12 (appendix 3.C).

As can be observed in these figures, the responses of output and inflation to the real oil price, aggregate demand, and supply shocks are almost identical over the two models expect in the case of Indonesia (appendix 3.C). In Malaysia, Pakistan and Thailand, the impulse response functions of output to oil price shock are replicated in the baseline model. In the Indonesian economy, the impact of oil price in local currency differs to that of oil price in US dollars. A positive oil price shock increases output in the first two quarters, and thereafter output becomes negative across the time horizon. Regarding domestic prices, the responses in Malaysia, Pakistan and Thailand are extremely robust across the two models. For Indonesia, an oil price increase causes inflation after the second quarter in the alternative model, which may be due to exchange rate variations or the role of oil price in the local currency. Furthermore, Indonesia has recently experienced increase production dependency on oil and a high share of oil in consumption bundles, transforming it into a net oil importer. However, in the baseline model oil price shocks have a permanently negative impact on inflation across all time horizons in Indonesia. This means that oil price in the local currency has an adverse effect on economic activities in Indonesia.

In all countries, the output response to the demand shocks dies out in the long run and this is in line the predictions of the economic model. Demand (nominal) shocks have permanent and significantly positive effect on price level in the long term in all countries over the two models but Indonesia. However, supply shocks are significantly the main source of variations in Indonesia rather than demand shocks. Similarly, the impulse response functions of output and inflation to an aggregate supply shock are similar across the two models**.** Consistent with the expectations of the model, a supply shock has a permanent positive effect on relative output and permanent negative effect on price level in all countries. The results show that aggregate supply effecting price and output to move in the opposite directions, the finding in line with interpretation of Blanchard and Quah (1989).

The estimated results of this chapter indicate that in addition to supply shock, exchange rate volatility (real demand shock) also has a significant influence on Indonesian *GDP* and inflation (see figures 3.C7 and 3.C8, appendix 3.C). Real exchange rate appreciation has an immediate negative impact on output in Southeast Asian countries (i.e. Indonesia, Malaysia, and Thailand), while in Pakistan the response is positive. The output response to exchange rate (real demand shock) contradicts the findings of Clarida and Gali (1994), in which after a quarter of real exchange rate shocks, output gradually increases and become zero in the long run. The positive output response to exchange rate shocks is temporary and much smaller in Pakistan. The findings that real exchange rate appreciation works to increase *GDP* are similar to those of Korhonen and Mehrotra (2009), and Jin (2008). A supply shock appreciates the real exchange rate in Indonesia, Malaysia and Thailand; this is inconsistent with a Mundell-Flemming-Dornbusch model[44]. However, evidence suggests that faster productivity growth in the tradable sector than the non-tradable sector in relation to major trading partners encourages real exchange rate appreciation, which supports the Balassa-Samuelson effect phenomenon. This evidence is apparent for export dependant countries like Indonesia, Malaysia and Thailand (see section 3.5 for details). Real effective exchange rate appreciation temporary causes inflation in all the countries under investigation. However, after two to three quarters, real exchange rate shocks lead to decreased inflation in Southeast Asian countries**.** This is principally due to real exchange rate appreciation which decreases marginal costs and depresses exports, leading to lower domestic prices. However, the response of domestic prices to exchange rate shock is persistently positive in Pakistan**.**

Regarding the effects of positive real oil price disturbances on the exchange rate (depicted in figure 3.C9 appendix 3.C), the results for Indonesia and Malaysia show the depreciation in the exchange rate. The response becomes positive in Malaysia after

[44] The real exchange rate appreciation resulting from a supply shock is in line with the finding by Clarida and Gali (1994) and Korhonen and Mehrotra (2009), former for Germany and the UK and later for Kazakhstan and Venezuela.

three quarters, where a one percent shock in oil price appreciates the real exchange rate by about one percent. In Indonesia, the real exchange rate shows a permanent negative response to oil price shocks and depreciates by about three percent in the third quarter after the shock. However, in Pakistan and Thailand, the exchange rate has zero response to an oil price shock in the first two quarters and thereafter the exchange rate appreciates negligibly. These findings are unexpected for oil importing developing countries like Pakistan and Thailand, due to the fact that the data sample under investigation may be too small to identify the correct effect of oil prices on exchange rate. However, quarterly *GDP* data for several decades is not available for most developing countries. The impact of oil price shocks on the exchange rate do not account for large fluctuations in the four economies currently under consideration. A positive exchange rate shock, which is a real demand shock, has a persistent positive effect on real exchange rate as expected. In all countries nominal demand shocks depreciate the real exchange rate. In the long term, demand (nominal) shocks have no effect on the real exchange rate, which supports the economic model.

The variance decomposition for the alternative model is displayed in tables (3.B3) to (3.B8) (see appendix 3.B). In terms of comparison the variance decompositions still show that the most significant source of variations in both output and domestic prices are aggregate supply and demand shocks, in all countries except Indonesia. In Indonesia, real exchange rate shocks have a larger impact on output after supply shocks and explain about 39 percent of the movement in short term output and 22 percent of movement in the long term. Also in Indonesia, exchange rate shocks explain 18 percent and supply shocks 62 percent of long term fluctuations in domestic prices. In contrast the findings of the baseline model demand shock is not the secondary source of variability in the inflation in Indonesia. From the alternative model, it is evident that changes in the exchange rate, which can be regarded as real demand shocks, are a significant source in describing the forecast-error variance of output and inflation, which in Indonesia are about 23 and 17 percent respectively. This is similar to the findings of Ito and Sato (2006), who found that depreciation of exchange rate was the major cause of domestic business cycles during the Southeast Asian financial crisis 1997-98. Hirawan and Cesaratto (2008) indicated that the effects of capital outflow and the exchange rate depreciation were among the main determinants of the financial crisis in Indonesia.

The alternative model is helpful for dividing demand shocks into real and nominal demand disturbances with regards to the investigated countries. In Indonesia, innovations in the real oil price and exchange rate explain 27 and 22 percent of variations in output and inflation respectively. For Thailand, the real exchange rate contributes about 12 percent of variation in output, whereas supply shocks are main source of the variance in Thailand's output, accounting for approximately 66 percent. The contribution of real exchange rate shock to the variance of inflation in Pakistan is about 26 percent in the long term. However, exchange rate shocks are of little importance for movements in relative price levels in Malaysia and Thailand.

Real demand innovation contributes to most of the fluctuations in exchange rates in all countries expect Indonesia (see table 3.B7-3.B8, appendix 3.B). In Malaysia and Thailand, exchange rate shocks account for about 24 and 22 percent of movements in output respectively. Aggregate supply shocks explain 76 percent of forecast-error variance on the real exchange rate in Indonesia, which is inconsistent with the findings of Clarida and Gali (1994) that real demand (exchange rate) shock is the main source of variation in real exchange rate. The evidence suggests that supply shock is the major source of variations in exchange rate rather than real demand (exchange rate) shock, which may be due to rapid productivity growth in tradable sectors. Furthermore, supply shock explains substantial variation in the real exchange rate in Malaysia and Thailand, at about 28 and 38 percent respectively. However, the main source of variations in real exchange rate is exchange rate shocks (real demand shock in both countries). In all countries, oil price shocks are a small source of variations in real exchange rate. In Malaysia and Thailand, nominal demand shocks (inflation) are a negligible source of variability in exchange rates.

3.8. Conclusions

The chapter first examined the dynamic effect of oil price, aggregate supply and demand shocks on both output and inflation in Indonesia, Malaysia, Pakistan, and Thailand, using structural *VAR* models for the different time periods. In the model identification scheme, a mixture of short run and long run restrictions are used to identify the shocks. The impulse response and variance decomposition functions of the variables were computed for the baseline model, and robustness of the results was then assessed by extending the empirical analysis through the alternative approach. This involved calculating the impulse response and variance decomposition functions according to a similar model which included real exchange rate and oil price in domestic currency. In the alternative model identification restrictions taken from existing literature were employed to identify the different shocks.

For all the countries investigated in this study, the effect of oil price shocks on output is positive for all horizons, although the effect is not statistically significant. The findings of the current study also suggest that oil price shocks reduce domestic prices in all countries, which contradicts an earlier conjecture (see section 3.3). The response of domestic prices to oil price shock is negative in all countries but in every case the magnitude of the response is very small and negligible. However, after two to three quarters, domestic prices start to increase in response to the oil price shocks. Positive oil price disturbances depreciate the real exchange rate in Indonesia and Malaysia though this effect is not significant. Regarding forecast error variance, oil price explains only a relatively small variation in the macroeconomic variables in this set of countries. These findings suggest that in all the examined countries oil prices account for only a relatively small portion of macroeconomic variation. They also provide clear evidence that oil price has a small effect on macroeconomic variables in the countries under consideration.

The results also indicate that the effect of real oil price shock on output and prices in the alternative model is similar to the baseline model in each country except Indonesia. This result contradicts the findings of Cunado and Gracia (2005) which suggested that the effect of oil price on economic growth and inflation in Asian developing countries is larger when the price is measured in the local currency. In contrast to the baseline model, after two quarters, oil price shocks have a negative impact on economic activity in Indonesia. This finding shows that the alternative model may be preferable to the baseline, due the fact that it gives realistic results in line with general expectations for new oil importers such as Indonesia.

According to the findings, the impact of oil price shocks on Asian developing economies is not as high as in industrialized countries highly dependent on oil, for instance the US, Japan, Russia, UK, Norway and China, which are among the biggest oil users in the world (Bjornland, 2000; Rautava, 2008; Jin, 2008; DePratto el al., 2009). Compared to large and established economies, the countries selected for this study suffer less after oil price shocks due to low dependency on oil for production and small contribution of oil in the consumption bundles. The evidence suggests that the relationship between oil price and *GDP* is positive though very marginal.

The relatively small effect of oil price shocks on macroeconomic variables can be attributed to direct government control and providing subsidies on oil prices, which reduces the adverse effect of the price of oil on real activities. This enables the countries in this study to avoid the high inflation and decline in *GDP* which may otherwise be caused by international oil price hikes. However, governments transfer the cost burden of oil subsidies by raising taxes and increasing domestic and foreign borrowing to minimise the resultant budget deficit. The high inflation rates and fall in *GDP* observed in 2008-09 in Malaysia, Pakistan and Thailand may partly have been a result of oil subsidies which indirectly affected the respective economies through budget deficits.

Indonesia has been a net oil importer since 2004; the recent oil price hike has not affected the economy due to its large capital inflow. The impact of oil price on economic activities is larger in Southeast Asian countries than in Pakistan, due to the fact the Pakistan is a small oil user. The unexpected responses in the oil importing countries Pakistan and Thailand suggest that oil dependent economies can react very similarly to oil price shocks, although if their governments have different preferences and priorities when deciding economic policies. This unexpected outcome could be rationalized in terms of the fact that manufacturing sectors in Pakistan and Thailand may adjust production costs as oil prices change.

The impact of supply disturbances on output is positive and on domestic prices is negatively significant in all quarters for all countries examined. This shows that supply shocks move output and price in opposite directions, which supports the explanation given by Blanchard and Quah (1989). Nominal demand shocks work to temporarily increase the output, although the magnitude of the response is very small and dies out in all countries in the long term. This confirms the restriction imposed by the model.

According to the results regarding output; supply shocks are the most important and permanent source of variation in all countries.

A supply shock appreciates the real exchange rate in Indonesia, Malaysia and Thailand this finding is consistent with expectations for export oriented countries. The finding also shows that supply shock is the main source of variations in exchange rate rather than real demand (exchange rate) shock in Indonesia, which may be due to rapid productivity growth in tradable sectors. Furthermore, supply shock explains substantial variation in the real exchange rate in Malaysia and Thailand. The evidence suggests that faster productivity growth in the tradable sector than the non-tradable sector in relation to major trading partners encourages real exchange rate appreciation, which supports the Balassa-Samuelson effect phenomenon.

In Malaysia, Pakistan, and Thailand, demand disturbances dominate movements in domestic prices in all time horizons, while supply shocks are the major source of inflation in Indonesia. Demand (nominal) shocks have a positive, permanent and significant effect on inflation in all countries, and this finding is consistent with the model. On the other hand, supply shocks have negative effects on price level in all countries, as explained by the economic model.

In the cases of Indonesia, Malaysia and Thailand, after real exchange rate appreciation (i.e. real demand shock) occurs, the output in each country immediately becomes negative. However, the negative values gradually diminish and become zero after the third and fourth quarters. However, the response of output to real exchange rate shock is positive in Pakistan. On the other hand, after 2 quarters exchange rate appreciation causes deflation in all countries except Pakistan. Additionally, the real exchange rate is a significant contributory source of variation in *GDP* and inflation in all the investigated countries, particularly Indonesia. In fact in Indonesia, the effect of real exchange rate depreciation is one of the main determinants of domestic business cycles during the period under consideration.

The results of the study suggest that supply shocks, real demand (exchange rate) and nominal demand shocks are the main sources of variations in business cycles in all countries during the different economic crises, especially the Asian financial crisis of 1997-1998 and the global economic crisis of 2008-2009. The findings confirmed all the restrictions imposed by the model to identify the different shocks. Most of the dynamic changes of the macroeconomic variables are in line with the economic model, and the shocks fit well with actual events that have occurred in the various countries. The study also calculated the relative contribution of the different innovations to the real business cycle. Shocks of real exchange rate, aggregate supply and demand all played an important role in explaining recession, particularly the 1997-1998 exchange rate shock in Southeast Asian countries. The recession experienced in all countries in 2008-2009 was largely caused by aggregate supply and demand shocks. From analysis of the variance decompositions, the study concludes that real demand, supply and nominal demand shocks are the primary sources of variations in exchange rate, output and inflation respectively.

Chapter 4

Should a Central Bank consider the Fundamental or Bubble Components of Stock Prices?

Abstract

This chapter examines whether central banks should adopt a broader measure of the price index incorporating stock prices in addition to the prices of current goods and services. The presupposition is that if the central bank's target is to minimise volatility in the output gap, it maintains its inflationary target by focusing on the appropriate measure of the inflation rate. The chapter also investigates the question of whether central banks should use stock prices as a component in the stability price index. The optimisation approach is used to estimate target weight for different sectoral prices, which depend on sectoral parameters that differ from those applicable to the consumer price index. Empirical analyses have been conducted for Malaysia and Pakistan. The results suggest that to achieve the least volatility in the output gap the central bank should use a price index that gives sizeable weight to fundamental component of stock prices. Furthermore, the study also finds that fundamental component of stock prices are subject to fewer idiosyncratic shocks and this increases their reliability as indicators within the central bank's price index. Finally, the findings suggest that improvements in macroeconomic stability might increase from targeting a stability price index rather than the consumer price index.

4.1. Introduction

Over the past twenty years inflation targeting as an objective of monetary policy has had important implications for sustainable price stability. Inflation targeting is used to avoid both high inflation and economic recession. Currently, inflation targeting is at the core of central banks' policy-making and is characterized by declared numerical inflation targeting, an execution of monetary policy that gives a key role to inflation forecasting and requires a high degree of clarity and accountability (Svensson, 1999a, 1999b, 2002; Clarida et al., 2000 and 2001; Woodford, 2004).

Most recent work on the structuring of monetary policy is agreed that the objective of the central bank is to stabilise both output and inflation. Svensson (2002) states that the stabilization objective of inflation targeting is found in the central bank's efforts to minimise quadratic social loss function; which responds to deviation in inflation and output. He also argued that the central bank should include not only inflation but other variables such as output gap (stabilizing resource utilization) as target variables. It is almost universally acknowledged that central banks should adopt inflation targeting to lessen economic fluctuations (Cecchetti et al., 2000; Cecchetti and Kim, 2003; Mankiw and Reis, 2003; Dai and Sidiropoulos, 2005).

Policy makers have used different methods in their attempts to control inflation and minimise its damaging effect on the economy, seeking to decrease inflation or maintain it at levels that are consistent with price stability, where economic growth is not affected. Policy makers and analysts may modify the consumer price index (*CPI*) by excluding certain components such as food prices, energy prices or indirect taxes; under the assumption that these components provide relatively little information about the underlying inflation. Clark (2001) indicated that food and energy prices are highly volatile because of supply shocks such as drought or oil price shocks. The large fluctuations in food and energy prices are seen as temporary movements, and therefore policy markers do not want to react to transitory changes in inflation, which are often related to supply disturbance. Furthermore, these movements represent supply shocks and are non-monetary in nature. Their intention is to find an inflation measure known as "core inflation" that excludes from *CPI* certain components subject to large relative changes. As an indicator of future inflationary pressures, the central bank should use explicit or implicit inflation forecast targeting thereby paying close attention to core inflation, excluding food and energy inflation (Eusepi et al., 2009).

The consumer price index covers only a section of the cost of living, and assets prices such as real estate or equities are excluded by definition. Existing literature recognizes that price indices constructed to measure the cost of living may not be the most suitable for the purposes of conducting monetary policy (Mankiw and Reis, 2003; Goodhart, 2001). Asset price fluctuations can have a significant effect on the real economy and should therefore play a role in establishing monetary policy.

Asset price variations have an impact on expenditure decisions made by households and companies. An increasing asset value makes people richer and may support additional spending. Raising (reducing) asset prices increases (decreases) the cost of asset financing and might encourage (discourage) investment. Such claims are borne out by the experience of the 1980s Japanese asset price bubble, the 1990s US stock market bubble and 2007 US mortgage market crisis. Inflation targeting has been successful in keeping inflation low and stable, but there has been growing concern that the achievement of stable prices may be related to amplified risks of financial instability. Kent and Lowe (1997) argued that increases in asset prices tend to have small direct effects but large indirect effects through their impact on the financial structure. They mention that after rises in asset prices financial institutions have expanded credit to purchase assets or accepted assets as guarantees for loans.

One question that is worth posing here is whether central banks should respond directly to stock price volatility when determining monetary policy? A further question asks whether monetary policy in both industrial and developing economies should respond to stock price booms and busts, which have been significant causes of economic fluctuations. The major reason for this is that asset prices bubbles create inflationary/deflationary pressure on investment and consumption, which leads to variability in both output and inflation. Bernanke and Gertler (1999 and 2001) suggested that central banks should react to stock price movements only to the extent that they generate inflationary or deflationary pressures. They suggest that banks give comparatively larger weight to inflation and less to the output gap when conducting monetary policy, and therefore argue that central banks do not respond appropriately to asset price movements.

In addition, researchers from one school of thought argue that it is not easy to forecast bubbles[45] but that if a stock price bubble can be identified, then altering interest rates would be an inefficient way to burst that bubble (Bernanke and Gertler, 2001; Haugh, 2008). Haugh (2008) argued that only non-fundamental movements of asset prices affect the output gap and inflation. He suggested that when there is uncertainty about the equilibrium value of asset prices, it would be necessary to permit some margin of error so that the targeting asset price is subject to certain threshold effects. Bernanke and Gertler (1999) also recommended that monetary authorities should incorporate non-fundamental fluctuations in asset prices in their efforts to achieve financial and

[45] An asset price bubble is that part of asset price movement that is unexplained.

macroeconomic stability. They also pointed out that it is difficult to identify whether asset price movements are caused by fundamental or non-fundamental factors or both.

The other school of thought takes a different view on this issue. Blanchard et al. (1993) concluded that fundamental movements in asset prices have a larger influence on investment, which in turn affects output and inflation. Cecchetti et al. (2000) argued that monetary authorities should give substantial consideration to asset price fluctuations as well as aggregate price movements, to reduce misalignments which could help in minimising the risk of macroeconomic instability, and that asset prices may be a useful indicator in forecasting static inflation. They recommended that central banks should react to the fundamental movements of asset prices through the interest rate in order to achieve minimised macroeconomic volatility.

Kontonikas and Montagnoli (2005) found that fundamental asset price volatility affects future inflation and current period inflation through wealth effects on aggregate demand, and central banks should therefore incorporate fundamental asset price changes while conducting monetary policy. Cecchetti et al. (2000) reported that central banks can improve macroeconomic performance by adjusting interest rate by taking into account asset prices when aiming for inflation and output stability. Inflation targeting involves increasing the interest rate during an asset price boom and decreasing it during an asset price bust. MacDonald et al. (2011) while suggesting policy implications in dealing with asymmetric effects of monetary policy due to consumption-wealth channel. Their suggestion to central banks in this regard is to re-assess the monetary policy during periods of asset price inflation and rising price inflation. They think both pre-emptive and progressive interest rate increases are needed to weaken the asset price increases and also to contain future inflation.

Large swings in stock price in many countries from 1980 to 2010 have had significant effects on the real economy. For instance, a sustained increase in equity prices in Japan in the late 1980s and the Southeast Asia stock market crash in 1997-1998 were associated with poor economic performance. De Grauwe (2008) found that reducing the volatility of stock prices could be useful in managing the volatility of the entire macroeconomy. This depends entirely on the credibility and effectiveness of the inflation targeting regime. Okina and Shiratsuka (2002) contend that asset price bubbles affect the output gap through wealth effects on consumption and investment and through changes in the external finance premium. Cassola and Morana (2004) show that the central bank can use stock market information as a direction indicator when determining monetary policy, which is focused on maintaining price stability in the long run and can also contribute to stock market stability. The attainment of macroeconomic stability requires proper inflation targeting.

Economists have argued that a price index calculated using the cost of living is not essentially right for determining monetary policy because it does not target future expected inflation (Alchian and Klein, 1973; Kent and Lowe, 1997; Shiratsuka, 1999; Goodhart, 2001). Some economists recommend that the central bank should include asset prices in the aggregate target price index (Matalik et al., 2005). Alchian and Klein (1973), Goodhart and Hofmann (2000), and Goodhart (2001) concluded that a price index used to measure inflation should not only incorporate the prices of goods and services but must also include the future prices of goods and services which are reflected in current asset prices. They argue that a broad measure of inflation should anticipate changes in the monetary cost of a basket of current and future goods and services, and the correct measure of inflation should take into account asset price changes. According to Goodhart (2001) inflation is a fall in the value of money, not an increase in the consumer price index[46]. Kent and Lowe (1997) pointed out that one of the reasons that a monetary authority should target movements in asset prices is that these movements can create future difficulties in the financial system, affecting future output and inflation.

This study supposes that a central bank commits itself to achieving an inflation target and considers what measure of the inflation rate it should use to minimise volatility in economic activities. This is the starting point for a central bank adopting a system of inflation targeting. The current chapter sets out to investigate the issue of choosing the right price index for the central bank to target, and recommends one which not only incorporates current costs of living but also stock prices. This study does not focus on how the central bank is to achieve its target. However, it does address a crucial problem faced by the central bank, namely the construction of an appropriate price index and how to assign weights to different sectoral prices.

In this chapter the modified approach of Mankiw and Reis (2003)[47] is utilised to compute optimal weights for the central bank price index. This approach refers to the price index that the monetary authorities should use as a "stability price index". The approach is based on different weights being assigned to sectoral prices to construct an index dependent on sectoral characteristics which differs clearly from those applicable in a consumer price index; these includes cyclical sensitivity, idiosyncratic shocks, consumption weight and price rigidities.

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[46] For more details, see Goodhart (2001), pp. F335-F338.

[47] Mankiw and Reis (2003) constructed a stability price index from US data using a general framework model combining components of the consumer price index and nominal wages with a view to targeting macroeconomic stability. Their numerical example concluded that central banks aiming to achieve greater economic stability should use a stable price index that puts a larger weight on nominal wages. They do not model how this target is to be achieved.

The main contribution of this chapter is its construction of a stability price index (*SPI*) for the central bank to use in its targeting that combines the financial sector (stock prices) with consumer price index components. The study computes the target weights assigned to the different sectoral prices to construct a price index to achieve minimum fluctuations in economic activities. This chapter also considers how *SPI* weighting should depend on certain sectoral characteristics. Its major concern is the generation of a price index that would ensure economic stability. Additionally, the variance of output gap is computed separately using stability price index (*SPI*) and consumer price index (*CPI*), to examine the gain in economic stability achieved by targeting *SPI* rather than *CPI*. This is important because generally volatility is a serious problem in an economy as it hampers growth and renders economic planning problematic.

The current study differs from that of Mankiw and Reis (2003) in several aspects. Firstly, in this study stock prices are used in place of nominal wages. Secondly, the current project employs a different methodology, namely generalised method of moments (*GMM*), to estimate the parameters for model. Thirdly, this chapter further extends the work of Mankiw and Reis (2003) by resolving the identification problem that arises due to the strong correlation between the consumer price index and sectoral shocks (such as food price or energy price increases). The necessary instrument errors are calculated to control the correlation between shocks and the consumer price index. Fourthly, the main focus of that previous study was a theoretical investigation of the effect of heterogeneity on the inflation target in a two-sector model, and its empirical estimation is only meant to be suggestive. However, the centrepiece of this chapter is a quantitative application of the approach. Finally, a four-sector theoretical analysis of the central bank problem is undertaken and an algebraic solution is derived.

Mankiw and Reis (2003) pointed out that stock market prices experience large idiosyncratic shocks and cyclical sensitivity. It is therefore reasonable to suppose that by giving higher weight to stock prices, which are subject to large sectoral shocks, the resulting price index becomes unstable[48]. To overcome this problem stock prices are decomposed in the empirical analysis into fundamental (systematic) and bubble (non-fundamental)[49] prices, which represents an extension of the original model.

This study further proposes to explore whether a central bank should use fundamental or bubble stock prices to compute their price index. The general conjecture is that stock price bubbles are more procyclical than fundamental stock prices. On the other hand, asset price changes taken from the fundamental are subject to smaller sectoral shocks than bubble stock prices. The parameters and optimal weights are estimated for three different combinations of sectoral prices, which provide a broader picture of the results thus leading to more robust and accurate conclusions. In the first part of the empirical estimation this study calculates the optimal weight for the central bank target price index by using the actual stock price with three sector price indices from the categories of the consumer price index. In the second and third parts the stock price is replaced with fundamental and bubbles components of stock prices respectively to choose the weights for the target price index.

The chapter therefore estimates target weights with a view to constructing a stability price index for the attainment of a stable macroeconomic environment and to assuage the effects of unpredictable fluctuations. The approach used in this chapter provides a better way of minimising volatility in the output gap for the developing economies of

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[48] See, Goodhart (2001) and Shiratsuka (1999).

[49] Goodhart (2001) advocated more suitable weighting methods which incorporate housing prices in the price index instead of including volatile asset prices. He suggested that the current measure of inflation needs to be amended to include asset prices, which at the time were excluded.

Malaysia and Pakistan. This approach seems more robust and appealing as it allows for minimisation of volatility and hence provides a quicker way of achieving macroeconomic stability. To estimate this, Malaysia is taken as a comparator to Pakistan as this is one of the few developing countries in this economic zone with access to long period official data for sectoral prices (such as food, energy, health) and relative weights in *CPI*.

The major finding of the chapter is that the central bank price index is more stable when it includes fundamental components rather than actual and bubble components of stock prices. Fundamental stock prices are highly sensitive to output, with lower levels of sectoral shocks, greater sluggishness and lower consumption weight compared to other sectoral prices. This study suggests that a central bank that aims to achieve maximum economic stability should use fundamental stock prices and give substantial weight to the stability price index when targeting inflation. In conclusion, this study does not argue for replacing the present consumer price index measures, but suggests that central banks adopt to a broader measure of the appropriate price index, which involves a combination of the cost of living and the expected cost of living (asset prices).

The chapter is set out as follows: section 4.2 locates and explains the problem, section 4.3 derives a four-sector algebraic solution to the central banks' problems, and section 4.4 describes the estimation procedures and methodology. Problems related to the data, descriptions of the data, the structures of the stock markets and the decomposition of the aggregate stock price into fundamental and non-fundamental components are all examined in section 4.5. The empirical results regarding optimal weights, parameters and stability price indices constructed separately from actual stock prices, fundamental and bubble components of stock prices are presented in section 4.6, and section 4.7 concludes.

4.2. The Basic Model

Within inflation targeting, the problem for central banks is how to choose and weight a target price index that would lead to minimising the volatility in output. Mankiw and Reis (2003) model this problem using several differing sectoral prices with regards to four characteristics: the budget share and *CPI* price weighting of various sectors; changing economic conditions that affect the flexibility of some prices but not others; prices that are highly responsive to the business cycle in some sectors, while less so in others; and comparatively high levels of idiosyncratic shocks in certain sectors.

The general model used by Mankiw and Reis (2003) considers many sectors and identifies four sources of differences in characteristics. The framework applied here has been developed to examine the optimal choice of a price index for the central bank to target before shock realization. New Keynesian literature on price adjustment is chosen to validate these sectoral differences and to relate the stability price index problem[50]. The existing literature allows for the inclusion of sectoral differences and their implications for monetary policy (Aoki, 2001; Mankiw and Reis, 2002).

The study considers sectors which differ in their responsiveness to the economy and in the respective strength of their sectoral shocks. It begins by assessing the responsiveness of sectoral prices with respect to changes in the business cycle, and essentially provides an indication of a sector’s price changes in relation to the output gap. The output gap puts pressure on marginal costs and on the market powers of firms, and thus shifts the equilibrium price. In the general equilibrium model, changes in output gap also

[50] See Romer (2001; Chapter 6).

influence equilibrium prices through marginal costs. The response of the relative prices to the changes in business cycle is either countercyclical or procyclical[51].

Secondly, the level of noise (as measured by variance of idiosyncratic shocks) differs between the relative prices. The idiosyncratic relative price shock is also called sector supply shock, and represents the sectoral shock to productivity[52]. It is a sector-specific error term, which captures idiosyncratic price dynamics that are not attributed to macroeconomic movements (Kaufmann and Lein, 2011). It reflects sectoral productivity and markup shocks (Mankiw and Reis, 2003). The equation for the equilibrium price in sector *k* is[53]:

$$p_k^* = p + \beta_k y + \varepsilon_k \tag{4.1}$$

where p_k^* is the equilibrium price in sector k, p is the aggregate price index, y is the output gap, β_k is the responsiveness of sector $k's$ equilibrium price to the business cycle, and ε_k represents idiosyncratic shock to k sector with variance σ_k^2. The parameter β_k is the percentage change in the sectoral price caused by the percentage change in the output gap. All these variables are stated in logs. Equation (4.1) reveals that the optimal relative price in a sector is equal to the *CPI* plus the shape of the business cycle and idiosyncratic shocks.

Thirdly, sectoral prices differ on the basis of their weights in the *CPI* maintained by the Bureau of Statistics. *CPI* is a measure that observes the weighted average of a basket of consumer goods and services such as food, energy, medical services and education. The

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[51] Procyclical is defined as having a positive correlation between sectoral prices and economy, while a negative correlation between sectoral price and the economy is said to be countercyclical.

[52] Idiosyncratic shocks (non-systemic shocks) are disturbance terms that are unconditionally related to the explanatory variable but conditionally uncorrelated to the dependent variable.

[53] The framework and notation is similar to that used by Mankiw and Reis (2003).

consumption weights are meant to reflect the relative importance of the goods and services as measured by their contributions in the total spending of households. As weights are based on the amount of money spent by the household on different goods, they are referred to as consumption (expenditure) weights. For sector *k*, the standard *CPI* is represented by following relationship:

$$p = \sum_{k=1}^{K} \delta_k p_k \qquad (4.2)$$

where δ_k is the relative percentage (consumption weight) of different sectors in the usual consumer's budget. In all the sectors, the *CPI* affects the equilibrium prices, demand and costs.

Finally, the model considers that for each time period, there are some firms within an economy that gather updated information about the current state of the economy and adjust the optimal path of future prices. The remaining firms continue using their previous plans and thus set prices based on outdated information. The model focuses on the response of relative prices to changes in economic conditions. Some sector prices are flexible and others are sluggish. Sticky prices are slower than flexible prices to respond to changing economic conditions.

Suppose λ_k set prices based on advance plans and updated information, and $1-\lambda_k$ is the part of sector *k* that sets prices based on old information. The sector price is given by:

$$p_k = \lambda_k p_k^* + (1 - \lambda_k)E(p_k^*) \qquad (4.3)$$

where $E(p_k^*)$ denotes the expected value of equilibrium sectoral price and the parameter λ_k measures sluggishness of prices in sector *k*. Smaller values for parameter

λ_k imply that relative prices do not react immediately to changes in economic conditions, while for a higher value of λ_k (approaching 1) the sector's actual price is closer to its equilibrium price level.

The stability price index *(SPI)* is the weighted average of sectoral prices. It is assumed that the central bank maintains a weighted mean of prices at a given level to target inflation, which can be set equal to zero without the loss of generality. This can be described as:

$$\breve{p} = \sum_{k=1}^{K} \omega_k p_k \tag{4.4}$$

where $\breve{p}$ is the stability price index, and ω_k is the target weight in sector *k* and a pick variable of the central bank. The sum of the target weights ω_k is equal to one.

$$\sum_{k=1}^{K} \omega_k = 1 \tag{4.5}$$

This study assumes that the central bank's objective is to minimise the variance of the output gap $(Var(y))$ from the target value with a view to achieving macroeconomic stability. The study focuses on minimising instability in the output gap by choosing appropriate weights in its targeting price index. The main objective of this study is to choose target weights ω_k to construct a stability price index that would minimise volatility in the output gap. The weight for each sector depends on the sector's characteristics, including cyclical sensitivity β_k, consumption weight δ_k, magnitude of idiosyncratic shocks ${\sigma_k}^2$ and the responsiveness of the price in each sector to changing economic circumstances λ_k. These sectoral characteristics of the parameters (β_k δ_k, ${\sigma_k}^2, \lambda_k$) are considered as predetermined in this model.

Combining all of the above, the central bank's problem can now be formulated as follows:

$$\min_{\{\omega_k\}} Var(y)$$

subject to:

$$\breve{p} = \sum_{k=1}^{K} \omega_k p_k$$

$$\sum_{k=1}^{K} \omega_k = 1$$

$$p_k = \lambda_k p_k^* + (1 - \lambda_k) E(p_k^*)$$

$$p = \sum_{k=1}^{K} \delta_k p_k$$

$$p_k^* = p + \beta_k y + \varepsilon_k$$

Subject to the restrictions the economy imposes on the development of prices over time, the central bank selects the target weight ω_k in its price index in order to minimise fluctuations in the output gap. The solution to the central banks' problem will result into set of optimal weights in a target price index which depends on the sector characteristics, including β_k, δ_k, $\sigma_k{}^2$ and λ_k. Hence, this problem centres on determining optimal weights ω_k in a target price index. If this price index is kept on target, it will lead to greater stability in economic condition as defined by stability in the price index. The next section of the chapter finds the solution to this problem.

4.3. Solving for the Central's Bank Problem

This section of the current study derives a four sectoral function addressing the problem faced by the central banks following the model of Mankiw and Reis (2003) who offered a two sectoral theoretical analysis of the problem. It should be noted that the algebraic solution that is used here is a lengthy and time-consuming process. As has been stated, in a given country the central bank's objective is to minimise volatility in the output gap by choosing a target price index, given the constraints imposed by the price-setting procedure. The central bank sets the optimal weights to minimise the variance of the output gap. The following assumptions are used to derive the four-sector solution:

a. There are only four sectors, called sectors 1, 2, 3 and 4 $(k = 1,2,3,4)$.

b. The sectoral shocks $(\varepsilon_1, \varepsilon_2, \varepsilon_3, \varepsilon_4)$ are uncorrelated[54].

c. The cyclical sensitivity parameters $\beta_1, \beta_2, \beta_3$ and β_4 are all greater than zero.

In appendix 4.A, the variance of the output gap is derived by equation (4.E12). The desired optimal weights are estimated by minimising the variance of the output gap. These optimal target weights are denoted by $\omega_1^*, \omega_2^*, \omega_3^*$ and ω_4^* for sectors 1, 2, 3 and 4 respectively. These are functions of the sectoral characteristics. Mankiw and Reis (2003) suggested several propositions that can be obtained from these optimal weights to shed light on the nature of the solution. The summary of their propositions is that if the two sectors have different characteristics, then the stability price index gives them varying weights, and when two sectors have same sectoral characteristics, then the stability price index assigns them equal weights. The results are more appealing when the sectoral characteristics diverge, as this reflects the asymmetry of the two sectors.

[54] This assumption is used to obtain a straightforward theoretical solution, while the empirical analysis does not use this assumption, and therefore estimates the target weights for sector prices with both correlated and uncorrelated shocks.

To begin with the effects on the optimal target weights of cyclical sensitivity parameter β_k; if a sector price is more responsive to the business cycle, that sector's price should reveal higher optimal ω_k^* in the stability price index. This suggests that optimal ω_k^* increases with an increase in β_k. This can be proven by taking derivatives of optimal weight ω_k^* with respect to β_k; consequently, if $\lambda_k \leq 1$ and $\delta_k \leq 1$, then the sign can be stated $\frac{\partial \omega_k^*}{\partial \beta_k} \geq 0$, and so the denominator and numerator would be positive. This indicates how sensitive the sector price is to the output gap. An increase in β_k implies higher responsiveness of sector prices to business cycle fluctuations, and hence provides a useful indictor for the central bank. A sector's price is important for monetary policy when its sensitivity to output is high.

To consider the effects of idiosyncratic shocks on the optimal target weights; the larger the size of shocks in a sector, the lesser the importance that sector's price should receive in the stability price index. This means that an increase in the variance of the sectoral shocks σ_k^2 decreases the optimal weight ω_k^*. By taking derivatives of optimal weight ω_k^* with respect to σ_k^2, which would be negative, the argument is the same as in the previous proposition and implies that $\frac{\partial \omega_k^*}{\partial \sigma_k^2} \leq 0$.

When economists refer to sector prices as a useful indicator for monetary policy, they generally do so on the basis that these prices have low noise (i.e. fewer idiosyncratic shocks as measured by σ_k^2). A large and unpredictable price change is likely to be accompanied by large idiosyncratic shocks, therefore carrying relatively small information about price trends which in turn leads to a small weight in the target index (Cecchetti et al., 2000). Finally, when economists increase the weight they assign to certain sectors, they do so on the basis of the high responsiveness of output and the low magnitude of shocks. In cases of price sluggishness, smaller values of λ_k raise the optimal weight ω_k^*. That is, the less flexible a sector's price, the more weight that sector's price is granted in the stability price index. Taking the derivative of ω_k^* with to respect to λ_k, it can be stated $\frac{\partial \omega_k^*}{\partial \lambda_k} < 0$. Therefore, provided $\omega_k^* < 1$ then this proposition holds.

Many of the goods that reveal higher price fluctuations, including food and energy, are traded in competitive markets, while in markets where goods are monopolistically produced, prices are adjusted more slowly. Sluggishness in price exacerbates the effect of the business cycle on a sector's price. On the other hand, price of a sector tends to be very sensitive to changes in economic conditions, which serves as a good yardstick for measuring economic activity particularly when prices are sticky. An effective central bank compensates the effect of this dampening from price stickiness by giving a greater weight to stickier sectors (Mankiw and Reis, 2003). Price stickiness is good instrument for measuring persistent output movements in response to aggregate demand shocks (Kiley, 2000).

In a special case, when two sectors' characteristics are the same $(\beta_A, \sigma_k^2$ and δ_k are identical) except one is fully flexible and the other is sticky (different λ's) then the monetary authority should only target the sticky-price sector. This condition is only applied in special cases where two sectors are identical in all respects. Otherwise, if a sector has fully flexible prices, the optimal monetary policy generally assigns weight to that sector. Aoki (2001) and Eusepi et al. (2009) reported that optimal monetary policy is based on targeting inflation in the sticky price sector rather than on a broad inflation measure[55]. A sector with high price stickiness is useful for a central bank in a situation where the inflation rate exhibits relatively low shock and is relatively stable. Ball et al. (2005) illustrate that optimal monetary policy includes price level targeting in the sticky information model[56].

Turning to the consumption weight that the sector receives in the consumer price index; a price sector with a comparatively high percentage in the aggregate price index should receive low optimal weight. This means that an increase in consumption weight reduces the target weight. Taking a derivative of ω_k with respect to δ_k, it can be stated $\frac{\partial \omega_k^*}{\partial \delta_k} < 0$.

It has been suggested that a price index computed for the attainment of economic stability should also take into account consumption weights. Conversely, in the consumer price index, relative weights depend on the share of each product in the consumption budget of the ordinary consumer. This illustrates that constructing a price index for determining monetary policy is different from doing so for calculating the cost of living. Consumption weighting is positively related to sectoral shocks that result in unwanted movements in output and inflation. Through optimal policy making, the central bank should attempt to dampen the effect of these shocks on price equilibrium. For instance, measuring core inflation under inflation targeting is achieved by applying relatively less importance to, or permanently excluding, certain components of the price index on the grounds that their prices are considered to be more unstable[57]. The higher the shock the more problematic it appears to be. Therefore, to minimise the adverse effect of a shock, a central bank should reduce the weight of the sector in the target

55 Aoki (2001) applied an approach that considers flexibly priced goods in a competitive market and a continuum of differentiated goods with sticky prices. He indicates that optimal monetary policy should target prices in the sticky-price sector.

56 Ball et al. (2005) derive optimal monetary policy from a behavioural model of business cycles.

57 Core inflation measures are obtained by excluding food prices, since supply of food goods can be seriously affected by changes in weather conditions.

price index. Thus, keeping all the other characteristics constant sectors with a small share in the consumer price index should be given a larger weight in the stability price index. This suggestion is probably less insightful than others concerning consumption weighting.

In summary, the solution to the central banks' problem requires that a central bank should assign higher optimal weights to the sectoral prices which are highly responsive to the economy, experience low idiosyncratic shocks, have sticky prices, and have a small weight in the consumer price index. In other words, a higher target weight is assigned to a sectoral price if it has high β_k, lower σ_k^2, smaller λ_k and lesser δ_k. Sectoral prices with these above characteristics are perfect for a central bank. The model uses the assumption that the shocks are uncorrelated across sectors to obtain interpretable theoretical results**.** Equally, only two propositions hold a general covariance matrix. The first proposition is that the optimal weight does not decline as a sector's responsiveness increases $\frac{\partial \omega_k^*}{\partial \beta_k} \geq 0$. The second is that if two sectors are identical in all aspects but one has a sticky price and the other is fully flexible then optimal policy targets the former sector. From the empirical results in section 4.6, it can be observed that the zero correlation between the shocks does not affect the vital conclusion.

4.4. Estimation Procedure

This chapter explains the optimisation approach developed by Mankiw and Reis (2003) to estimate target weights applied to different sectors in the price index, where the goal of the central bank is to minimising the variance of the output gap. These target weights depend on sectoral parameters. In this approach, the problem is to correctly measure the key sectoral parameters. The calculations used by Mankiw and Reis (2003) are not specified in their study, although they state that it is very difficult to estimate all the relevant sectoral parameters. However, the present study attempts to identify an appropriate method for the estimation of the model. The current study began by estimating the following equation to obtain the parameters β_k and σ_k^2:

$$p_k - E(p_k) = \lambda_k\left(p - E(p)\right) + \beta_k \lambda_k \left(y - E(y)\right) + \lambda_k (\varepsilon_k - E(\varepsilon_k)) \tag{4.6}$$

Equation (4.6) states that the price disturbance in sector k depends on the aggregate price disturbance, output disturbance and shock. The equation can be rewritten as follows:

$$\tilde{p}_k = \lambda_k \tilde{p} + \beta_k \lambda_k \tilde{y} + \lambda_k \tilde{\varepsilon}_k$$

The difference between the variable and its expected value is denoted by a tilde over the variable. These disturbance variables are obtained by taking residuals from the calculation of the corresponding regressed variables p_k , p and y on a constant, a time trend and their own three lags. The major concern in obtaining these parameters in equation (4.6) is that the shocks are likely to be correlated with the consumer price index. This identification problem makes it harder to estimate the correct parameters.

To address this prospective problem this study further formulates the appropriate sectoral disturbance variables. These sectoral disturbance variables are calculated by dividing the sluggishness parameter in sector k and subtracting from the aggregate price disturbance $\left(\frac{\tilde{p}_k}{(\lambda_k)} - \tilde{p}\right)$ where the rigidity parameter of the each sector is independent from aggregate price. Rewriting equation (4.6):

$$\tilde{p}_k = \beta_k \tilde{y} + \tilde{\varepsilon}_k \tag{4.7}$$

All the following estimations used these residuals (disturbance variables) as the data set. It is assumed that estimated shocks $\tilde{\varepsilon}_k$ are idiosyncratic. The explanatory variable output gap $\tilde{y}$ data is observed as a disturbance variable (error term). It is likely that idiosyncratic shocks are correlated with non-idiosyncratic components, thus causing the identification problem making formal estimation difficult. Equation (4.7) allows the possibility that some or all elements of the explanatory variable may be related with idiosyncratic shocks (composite error). This is the main source of endogeneity for certain explanatory variables in the regression equation. Error in regressors leads to the failure of classical estimation methods, for instance the ordinary least squares (*OLS*). The estimated *OLS* estimators are biased or inconsistent as the consistency of *OLS* estimation crucially depends on zero correlation between the explanatory variable and shocks $E(\tilde{\varepsilon}_k \tilde{y}) = 0$. If this assumption does not hold then $\tilde{y}$ will be an endogenous variable.

Addressing the consequences of the approach, the current study utilises Generalized Method of Moments (*GMM*) estimation techniques to compute the cyclical sensitivity and variance of the idiosyncratic shocks. For the current purposes, *GMM* has large advantages over maximum likelihood or two-stage least square, because *GMM* allows estimation under restrictions implied by the economic theory and does not imply any additional distributional assumptions which are not part of the theory (Wooldridge, 2001). The assumption of the *GMM* method (moment condition) is that the explanatory variable (instrument variable) is orthogonal to the disturbance term $E[\tilde{y}'(\tilde{p}_k^* - \beta_k \tilde{y})] = 0$. The role of *GMM* is to estimate β_k, so that the corresponding sample moments are close to zero. In other words, *GMM* estimates β_k from the orthogonal condition that[58]

$$E[\tilde{y}'(\tilde{p}_k^* - \beta_k \tilde{y})] = 0.$$

The parameters β_k, the sensitivity of sector price to economic activity, and $\tilde{\varepsilon}_k$, the shocks in a sector, are computed by the *GMM* using a time series estimation[59]. The magnitude of idiosyncratic shocks σ_k^2 (variance of shock) in each sector is estimated by taking the variance of these shocks.

The parameter λ_k measures the degree of price sluggishness, and depends on the realistic assumptions that some sector prices are fully flexible while other prices are sluggish. For a completely flexible sector it is assumed $\lambda_k = 1$, while for sluggish prices it is assumed $\lambda_k = 0.5$. The parameter of consumption weight δ_k is the relative percentage of each sector in the consumer price index. After assigning the parameters to the four sectors these are then substituted these into the variance of output gap (equation 4.E12; appendix 4.A1). Then next step is to numerically minimise the variance of the output gap equation (4.E12) with respect to ω_k. This is subject to restrictions where the sum of the weights is equal to one, $\left(\sum_{k=1}^{K} \omega_k = 1\right)$ and additionally the non-negative optimal weights $(\omega_k \geq 0)$. Finally, the relative variance of output gap is estimated from *SPI* and *CPI* respectively for comparison. This is done to check how far the variance of output gap is minimised by targeting *SPI* rather than *CPI*. The variance of output gap for the *SPI* is estimated by replacing the four sectors' parameters and optimal weights in the objective function equation 4.E12 (see appendix 4.A1). However, output gap variance is estimated for the consumer price index by evaluating

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58 See Baum and Schaffer (2002).

59 For general *GMM* notation and explanation see appendix 4.A2.

the objective function where the weights (omegas) ω_k are equal to the consumption weights $\omega_k = \delta_k$.

4.5. Data Description

The countries selected for analysis are Malaysia and Pakistan. Annual data is available for both countries although the observation differs somewhat between Malaysia and Pakistan, reflecting data availability (Malaysia, 1982-2009; Pakistan, 1982-2010). This study is interested in analysis of four sectoral prices: the price of energy, the price of food, the price of other goods and services and the price of the stock market, in order to design a price index for use by the central bank. Unfortunately, there is no complete and accessible database of the consumption weights in developing economies such as Pakistan and Malaysia. Following numerous informal contacts with the relevant authorities, the study utilises the weights of different sectors in the typical consumer's budget for Pakistan since 1981, taken from publications of the Central Bank of Pakistan. Before this period the basket weight for the composite price index is not available. Meanwhile, in Malaysia the energy prices are combined with housing prices[60] and given collective weight in the consumer price index taken from Department of Statistics Malaysia publications. In the case of Malaysia, separate statistics for energy and housing prices could not be obtained.

The data used for both countries is for four sectoral price indices (the price of energy, the price of food, the price of other goods and the price of the stock market), the output gap and the consumer price index. However, for Malaysia the energy price index is replaced by the energy & housing price index. The output gap for both countries has been estimated by the deviation of real *GDP* from a Hodrick-Prescott smoother. The

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[60] Energy and housing price is equal to gross house rent, fuel and power prices.

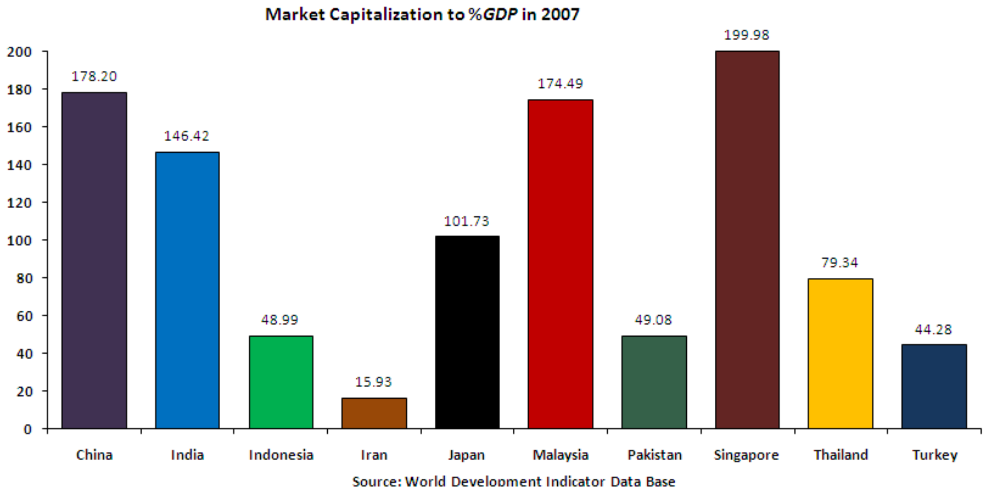
share price used as the stock price variable for Pakistan is the weighted index from all stock market prices, while for Malaysia the Kuala Lumpur Composite Index is used. All the price indices are in logarithmic form with the 1982 price as the base year. The data is taken from the International Financial Statistics (*IFS*) in the *ESDS* database, the State Bank of Pakistan and the Department of Statistics in Malaysia. Then, in section 4.5.2, this study attempts to decompose the stock prices into their fundamental and non-fundamental (speculative) components.

4.5.1. Stock Markets and their Structure in Malaysia and Pakistan

The Kuala Lumpur Stock Exchange (*KLSE*) in Malaysia is one of the most prominent and the largest stock exchanges in Asia. The *KLSE* was ranked 23rd in the world and 8th in Asia in 2004 (Yusof and Majid, 2007). The current study focuses on a *KLSE* index known as the Kuala Lumpur Composite Index (*KLCI*), which is normally employed to reflect the Malaysian equity market performance and use to measure stock prices. The index was first introduced in 1986 as a yardstick for the stock market index; it is based on a sample of the 100 largest companies and its value weighted. The *KLCI* achieved more than 1200 points in 1993 and again in 1996 before the financial crisis occurred in 1997-1998. After the financial crisis, the *KLCI* recovered and reached 1080.66 points in 2006 (Asmy et al., 2009).

There are three stock exchanges in Pakistan; the Karachi Stock Exchange (*KSE*), the Lahore Stock Exchange (*LSE*) and the Islamabad Stock Exchange (*ISE*). The *KSE* is the largest and oldest of the three, accounting for about 85% of turnover (Iqbal, 2008). Stock prices for Pakistan are represented by a weighted index from all stock market prices. Iqbal (2008) indicates that the index is a market capitalization weighted index of 100 companies, comprising the top market capitalization stock from each of 34 sectors while remaining the 66 companies are selected on the basis of market capitalization without considering their sectors.

Figure 4.1: Comparison of the Size of Malaysia and Pakistan Stock Markets to the Selected Countries



The size of the stock markets depends on the ratio of market capitalization to *GDP*. Figure (4.1) shows the size of the stock markets for Malaysia and Pakistan compared to various other countries in 2007. Among the selected countries, some of these are more developed and others are regional markets. The Malaysian stock market is one of the largest, with market capitalization at about 174.5% of the *GDP*. One of the causes of the high capitalization ratio in Malaysia is the general level of financial development. However, Pakistan's market capitalization is about 49% of *GDP*, which suggests a low level of investment in the stock market. With respect to stock market size it is smaller than most of the selected countries. Iqbal (2008) indicates that the general level of illiteracy and financial illiteracy is one of the reasons for low capitalization.

4.5.2. Fundamental and Bubbles Components of Stock Prices

An important question concerning monetary policy relates to the matter of whether central banks should incorporate stock prices in the appropriate price index. Many economies have recently experienced huge rises and falls in stock prices and large movements in real economic activities. This volatility in stock prices has made it quite difficult for central banks to construct a reliable price index. Shiratsuka (1999) concluded that the reliability of the consumer price index is higher than that of volatile stock price statistics. In contrast, Goodhart (2001) formalized alternative weighting schemes and suggested that policy makers should consider a broader price index that includes housing and stock market prices.

An increase in asset prices results in high expected goods and services price inflation on the part of the private sector; which then leads to higher actual inflation (Kent and Lowe, 1997). To distinguish the two stock price components, the current study predominantly follows the framework and notation of Blanchard and Fischer (1989) to understand the theoretical derivation of stock prices. Consider that the rate of return from the riskless asset r is equal to the one period expected return from holding the risky asset:

$$r = \frac{E[p_{t+1}^{s} \mid I_t] - p_t^{s}}{p_t^{s}} + \frac{d_t}{p_t^{s}} \tag{4.8}$$

where p_t^s denotes the price of a stock, d_t is the dividend and $E[p_{t+1}^s \mid I_t]$ is the expected price of the asset (stock) in time period *t+1*, conditional based on the information set I_t at time *t*. Solving out equation (4.8):

$$p_t^{s} = aE[p_{t+1}^{s} \mid I_t] + a\,d_t \tag{4.9}$$

where $a = \frac{1}{1+r} < 1$ is the one period discount factor and is less than one if the interest rate is positive. This means that stock price is the function of the current expectation of its value next period and the real dividend. To find the solution of (4.9), follow Blanchard and Fischer (1989) by taking a law of iterated expectations for (4.9), which yields the following solution through repeated substitution till time *T*:

$$p_t^{s} = a^{t+T+1}E[p_{t+T+1}^{s} \mid I_t] + a\sum_{i=0}^{i=T} a^{i} E\left[d_{t+1} \mid I_t\right] \tag{4.10}$$

It is considered that the expectation in the second term of (4.10) does not grow too fast and that the second term converges as T tends to infinity. Since it is assumed that stocks have infinite horizons, the transversality condition (4.11) applies.

$$\lim_{T\to\infty} a^{T+1} E\left[p_{t+1}^{s} \mid I_t\right] = 0 \qquad (4.11)$$

Then the solution is called the fundamental solution:

$$p_t^{fs} = a\sum_{i=0}^{\infty} a^i E\left[d_{t+i} \mid I_t\right] \qquad (4.12)$$

where p_t^{fs} denotes the fundamental stock price, which satisfies the no-bubbles transversality condition in (4.11). Thus, the stock price is equal the fundamental stock price P_t^{fs} that is the discount value of all future dividends. Equation (4.12) indicates that the fundamental stock price in period t is equal to the expected present value of future dividends paid by the stock.

Fundamental analysis is a stock valuation method that uses financial and economic analysis to predict the movement of stock prices. The fundamental share price of a firm is the discount present value of the firm's expected cash flows (Anderson and Subbaraman, 1996). Zhong et al. (2003) measure the fundamental stock price by separating the permanent component of stock prices from their non-fundamental component.

However, if condition (4.11) does not hold, then the general solution to equation (4.9) is given by

$$p_t^{s} = p_t^{fs} + b_t \qquad (4.13)$$

where b_t is the bubble component of the stock price. Bubbles b_t are the disparity between actual and fundamental stock prices. Bubbles are defined as the element of the market price which overprices or underprices an asset's fundamental value. In other words, bubbles are episodes in which financial investors buy stock for a price higher or lower than its fundamental value.

4.5.3. Hodrick- Prescott Based Fundamental Stock Price

There are many alternative methods for the decomposition of the stock price equation (4.13)[61], which can be used to measure the fundamental and non-fundamental (bubble) components of stock prices. This chapter utilises a Hodrick-Prescott (*HP*) filter method to decompose the stock price into fundamental and bubble components. The Hodrick-Prescott filter is a useful empirical technique for researchers attempting to distinguish cyclical behaviour from the long run path of economic series[62]. Hodrick and Prescott (1997) proposed a filter, usually referred to as the HP-filter that estimates an unobservable time trend (growth) component of given time series variable. The main goal of the HP-filter is to serve as a means to split the cyclical component in time series from the growth component. It uses algorithms that filter the original time series to estimate its trend components.

The framework suggested by Hodrick-Prescott can be stated as:

$$x_t = x_t^g + c_t \qquad (4.14)$$

Equation (4.14) indicates that series x_t is equal to trend component $\left(x_t^g\right)$ and a cyclical component $\left(c_t\right)$. Hodrick and Prescott (1997) propose a way to separate c_t from x_t by following minimization problem:

$$\underset{\{x_t^g\}_{t=-1}^{T}}{Min}\left\{\sum_{t=1}^{T} c_t^2 + \Gamma\sum_{i=1}^{T}\left[\left(x_t^g - x_{t-1}^g\right) - \left(x_{t-1}^g - x_{t-2}^g\right)\right]^2\right\} \qquad (4.15)$$

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[61] Anderson and Subbaraman (1996) divided the fundamental and speculative components of share prices and found that only the former has an impact on investment. Later, Branston and Groenewold (2004) separated the fundamental and speculative components of share prices by using four different methods and concluded that the effect of the speculative component is at least as large as that of a fundamental component.

[62] The current study follows the approach of Redding (2001) and Gouteron and Szpiro (2007) to computed fundamental (trend) components of stock price by using *HP*-filter. Gouteron and Szpiro (2007) used an HP-filter to separate the stock prices into permanent and transitory components, where the transitory component is estimated by deviation from fundamentals (permanent).

The parameter Γ is a smoothness parameter which penalizes unpredictability in the growth component. As Γ approaches infinity, the growth component tends to smooth. Hodrick and Prescott (1997) suggested using $\Gamma = 1600$ for quarterly data, while Brooks et al. (2000) proposed values of 12000 for monthly and 400 for annual data[63]. Equation (4.15) is the division of a given series into stationary and non-stationary components in such a way that the sum of squares of the non-stationary component is minimal with a penalty on changes to the derivatives of the non-stationary component.

After the theoretical explanation of the stock price components, the next step is to determine how to empirically estimate the different components of the stock prices. Kubicova and Komarek (2011) stated that the fundamental component of stock price is not directly observable and must be estimated. They indicated that a bubble is an explosive and asymmetric deviation of stock price from its fundamental value[64]**.**

The trend value of the stock price is calculated by using the HP-filter to derive the fundamental component of stock prices, and then taking the log. This is used as a proxy for the fundamental stock price. The trend signifies the fundamental value that is linked to the discount rate because the trend is attached to each asset due to the risk premium contained in the discount rate (Gouteron and Szpiro, 2007). The bubble component of stock price is the deviation from the fundamental of stock price. It is the irregular component of stock prices. Bernanke and Gertler (1999) use the term bubbles to denote temporary deviations of stock prices from fundamental values.

This study derives the fundamental stock prices by using the trend value of stock prices as proxy. However, the stock price bubble is estimated by taking the exponential of the

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[63] However, Maravall and del Rio (2001) proposed to set $6 < \Gamma < 14$ and $100{,}000 < \Gamma < 140{,}000$.

[64] A similar approach is used by the Borio and Lowe (2004), Adalid and Detken (2007) and Goodhart and Hofmann (2008) to define asset price booms. They define an asset price boom as a persistent deviation of asset price from a smooth (HP) trend.

log difference of stock prices and its trend value[65]. Figure (4.2) reports the fundamental component of stock prices and the actual stock price for Malaysia and Pakistan. Under this decomposition, fundamental stock prices are clearly smoother and more reliable than their actual counterparts, and are below or above the actual stock prices during periods of a rapid rise or fall in stock prices for both countries.

Figure 4.2: Actual and Fundamental Stock Prices in Malaysia and Pakistan

Figure 4.3: Bubble Component of Stock Prices in Malaysia and Pakistan

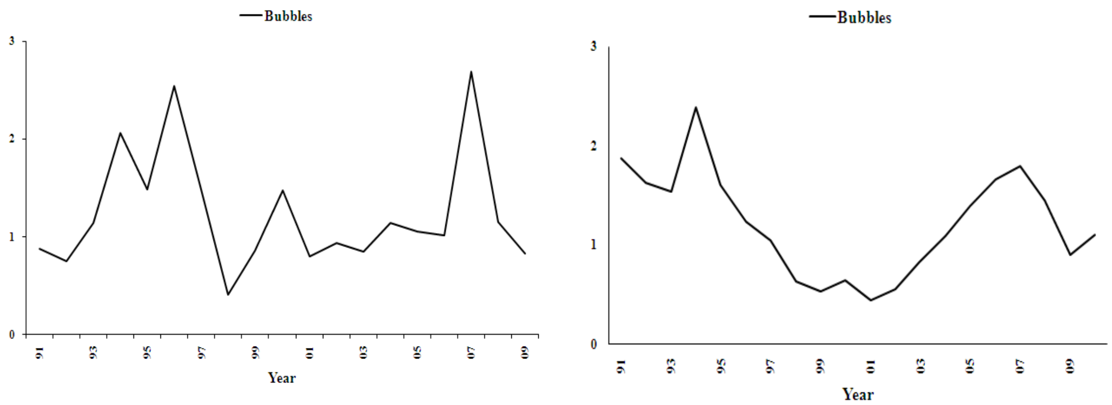

Figure (4.3) shows boom-bust cycles for stock prices bubbles[66] throughout the analysed period for both countries. Figure (4.3) indicates that for Pakistan the bubbles were overvalued during 1993-1994. In both countries bubbles decreased dramatically in the period after 1996, although in Pakistan this bust lasted longer than it did in Malaysia.

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[65] Kent and Lowe (1997) explored only positive bubbles.

[66] Positive bubbles are calculated by taking the exponential of the log of stock prices in deviation from the log of fundamental value.

Stock prices increased and declined, but when compared to the bubble component, the fundamental component looks more reliable and stable.

After the decomposition of asset prices into their fundamental and non-fundamental components, the optimal weights for the central bank target price index are estimated by separately using actual stock prices, fundamental and bubble components of stock prices.

4.6. Empirical Results

This section of the study focuses on estimating the optimal weights for the central bank price index, depending on the four sectoral parameters: cyclical sensitivity β_k, idiosyncratic shocks σ_k^2, price sluggishness λ_k, and the weight in the consumer price index δ_k. All these parameters are exogenous. The optimisation approach is used to compute the weight for different sectors in the price index; where the aim of the policy maker is to minimise the variability of output gap. The solution to the problem implies that the sectoral price which is given the largest optimal weight in the central bank price index is that which has large β_k, small σ_k^2, low λ_k, and small δ_k**.** This study considers four sectoral price indices (the price of energy, the price of food, the price of other goods and the value of the stock market), as well the output gap and the consumer price index, in both Malaysia and Pakistan.

The analysis begins by assigning parameters to the four sectors**.** For the parameter λ_k which measures the degree of price sluggishness (price rigidity), it is assumed $\lambda_k = 1$for fully flexible sectors such as food and energy prices. This signifies that price setting in these sectors is completely dependent on real economic condition. Meanwhile, it is assumed that $\lambda_k = 0.5$ for sluggish sectors such as other goods and services, and stock prices. This supposes that half of the price setting in these sectors depends on expectations and the other half on actual economic conditions[67]. Mankiw and Reis (2003) used these values for flexible and sluggish sectors in their study. The parameter consumption weight δ_k is taken from the relative percentage of each sector in the consumer price index as indicated by the Bureau of Statistics. The consumption weight for stock prices is zero.

4.6.1. Optimal Weights - Stock Prices

In equation (4.6) stock prices are used in addition to the three components of the consumer price index, namely energy, food and other goods and services, while output gap and *CPI* itself are used to obtain the parameters. The first step is to calculate the data series for the estimation. The data set for the estimation comprises the disturbance variables, which are the residuals of the regression for each of the variables, including sector prices, consumer price and output gap, each on three of their own lags, a constant and a time trend. *GMM* is used to estimate equation (4.7) for the parameter cyclical sensitivity β_k and the separate sectoral shocks. The magnitude of the idiosyncratic shocks σ_k^2 is calculated by taking the variance of the shocks. These numerical parameter values are substituted in the equation 4.E12 (appendix 4.A) and then minimised with and without the constraints.

The results for the four-sector prices for Malaysia are reported in table (4.1). The column β_k represents the coefficient of the cyclical sensitivity, and the numbers in brackets are the standard error for β_k. The numbers in column δ_k are the consumption weights taken from the Statistics Bureau. The column ω_k^C reports the non-negative

[67] However, in the empirical analysis it is also assumed stock prices are set according to more updated information, giving higher λ_k . This makes it possible to check the extent of change in stock price sectoral weights.

optimal weights in the stability price index, and the column labelled ω_k^{UC} represents unconstrained sectoral weights which allow the possibility of negative weights. The column marked ω_k^{UCU} imposes the constraint that all shocks are uncorrelated and also allows the possibility of negative weights. Finally, column ω_k^{CU} indicates the non-negative sectoral weights where estimated shocks are uncorrelated. The correlation matrix of the shocks is displayed in appendix 4.B.

Table 4.1 - Parameters and Optimal Weights for Malaysia – Stock Prices

Sector	λ	β_k	$Var(\varepsilon)$	δ_k	ω_k^{UC}	ω_k^{C}	ω_k^{UCU}	ω_k^{CU}
Housing & Energy	1	0.0672 (0.0458)	0.00010	0.214	0.05	0	0.06	0
Food	1	0.1012 (0.0473)	0.00007	0.333	-1.27	0	-1.26	0
Other goods	0.5	0.2312 (0.152)	0.00042	0.453	1.83	0.69	1.85	0.79
Stock	0.5	9.132 (1.7186)	0.1065	0	0.39	0.31	0.35	0.21

As expected, actual stock prices respond very highly to output gap and large idiosyncratic shocks, as reported by table (4.1). The parameter of cyclically sensitive β_k is 9.132 and variance of shocks σ_k^2 is 0.1065 for stock prices, figures that are very high compared to other sectors. The large sensitivity to the output gap is due to large cyclical movements in stock prices. However, highly volatile and non-systemic movements in stock prices cause large idiosyncratic shocks. As a result, stock prices are assigned sizeable optimal weight in the stability price index despite their showing a large variance in sectoral shocks.

The indication of these particular results is that stock prices have large β_k, low λ_k and zero δ. The robustness of the results has also been checked by assigning a higher value to the price rigidity parameter, because one might suspect that a low value λ_k for stock prices is largely responsible for the high target weight. Table 4.B1 in appendix 4.B verifies that stock prices are still given significant weight in the *SPI*. However, with the change in the value of λ_k then the estimated values of the β_k, the variance-covariance matrix and optimal weights change also.

The columns ω_k^{UC}, ω_k^{C}, ω_k^{UCU} and ω_k^{CU} confirm that the price index that central banks should use to maximise economic stability gives substantial weight to stock price. The results show that non-negative optimal weight ω_k^{C} for stock prices is 0.41, compared to 0.59 for other goods and services. Higher weight for other goods and services sectors is due to the low idiosyncratic shocks they experience compared to stock prices. The last two columns of table (4.1) represent the constrained and unconstrained optimal weights when shocks are zero correlated. The target weight of other goods increases from 0.59 to 0.69 while the target weight for stock price decreases from 0.41 to 0.31.

These results essentially depend on the pattern of associations among the estimated shocks. However, target weights for energy and food are zero. This is due to the high correlation between shocks affecting other goods and energy prices, and that between other goods and food, as reported in table 4.B2 in appendix 4.B. Consequently, an *SPI* that gives higher weight to other goods tries to minimise the effect of shocks on other goods by giving zero weights to the prices of food and energy. This *SPI* includes a combination of prices such that shocks that correlate between the sectors are counteracted in the overall index. This confirms that the variance-covariance matrix of shocks is a key factor in the optimal choice of price index for a central bank.

This study identifies a separate consumption weight for the energy sector for Pakistan. In the analysis energy price was used as a component instead of energy & housing sector prices. The estimation results with regards to Pakistan are reported in table (4.2).

Table 4.2 - Parameters and Optimal Weights for Pakistan – Stock Prices

Sector	λ_k	β_k	$Var(\varepsilon)$	δ_k	ω_k^{UC}	ω_k^{C}	ω_k^{UCU}	ω_k^{CU}
Energy	1	0.226 (0.723)	0.0015	0.073	-1.11	0.01	-1.14	0
Food	1	0.269 (0.197)	0.0004	0.403	-0.01	0.31	-0.07	0.16
Other goods	0.5	0.13 (0.414)	0.00008	0.523	1.85	0	1.74	0.14
Stock	0.5	3.774 (3.985)	0.1318	0	0.27	0.68	0.46	0.70

The value of β_k for stock price is very high and larger than for the all other sectors, which makes it a desirable sector for the *SPI*. This parameter value β_k also reflects the fact that stock prices are procyclical. The variance of shocks in the stock price sector, measured by σ_k^2 , is very large, making it an unfavourable sector for use in the *SPI*. The combination of high β_k, low λ_k and zero consumption weights gives higher weight to stock prices in the stability price index. The column ω_k^C shows that stock prices received largest target weight, 0.68, in the price index for the central bank. Table (4.B3) in appendix 4.B shows that the correlation among shock of other goods and stock is 0.53. The stability price index gives zero weights to other goods and attempts to remove the shock to stock prices.

The next step is to calculate the variance of the output gap under the consumer price index and the stability price index respectively. The main purpose of this exercise is to check if the increase in output stability is larger when targeting the stability price index compared to the consumer price index. This procedure first involves estimating all the parameters and optimal weights for each sector. Then, it is a simply necessary to substitute all the parameters in the objective function equation 4.E12 (appendix 4.A). However, output gap variance is estimated for the consumer price index by evaluating the objective function where the optimal weights are equal to the consumption weights. Additionally, the parameters and weights for stock price are equal to zero because this is not an element of *CPI***.**

Table 4.3 - Comparison: Variance of Output Gap – Stock Price

Countries	Consumer Price Index	Stability Price Index
Malaysia	0.15864	0.0120
Pakistan	0.02760	0.02397

Variance of output gap for both countries, estimated from the stability price index and the consumer price index, is reported in table (4.3). The results show that the estimated variance of output gap for both Malaysia and Pakistan is smaller for *SPI* compared to *CPI***.** The findings favour the suggestion that targeting *SPI* achieves higher economic stability than targeting *CPI*.

Finally, this study further extend the analysis is to computes stability price index by using one time estimated optimal weights (with constraint) for the whole time period. *SPI* is the weighted average of sectoral prices. Inflation is then computed from the *SPI* and the *CPI* and displayed in figures (4.4)-(4.5).

Figure 4.4: Comparison Consumer Price Inflation and Stability Price Inflation for Malaysia-Stock Prices as Component

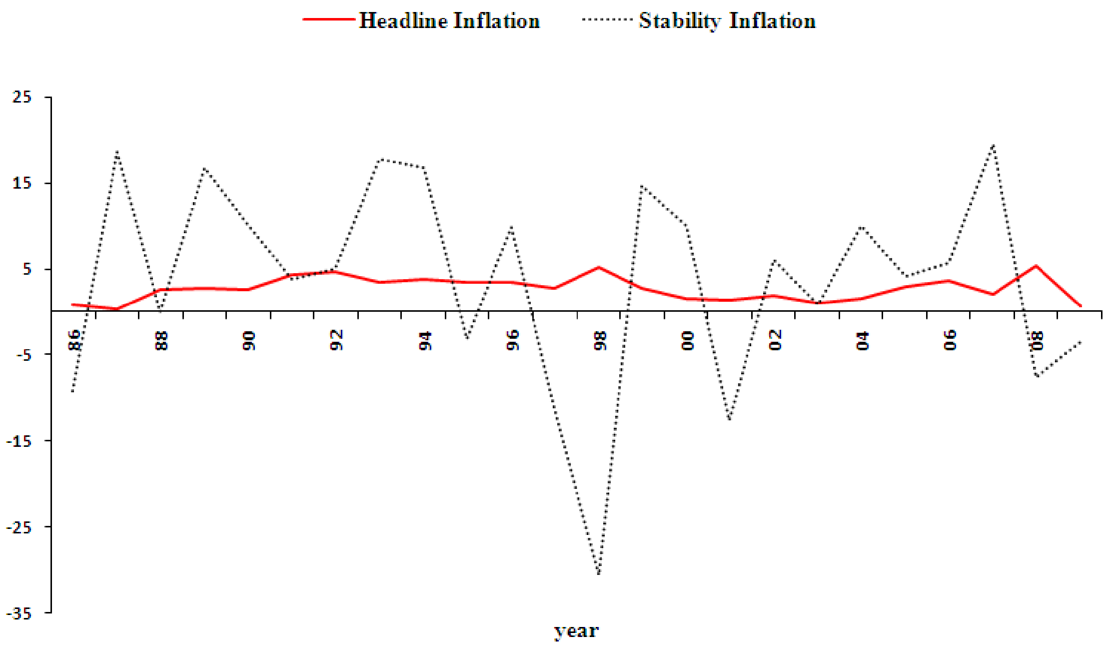
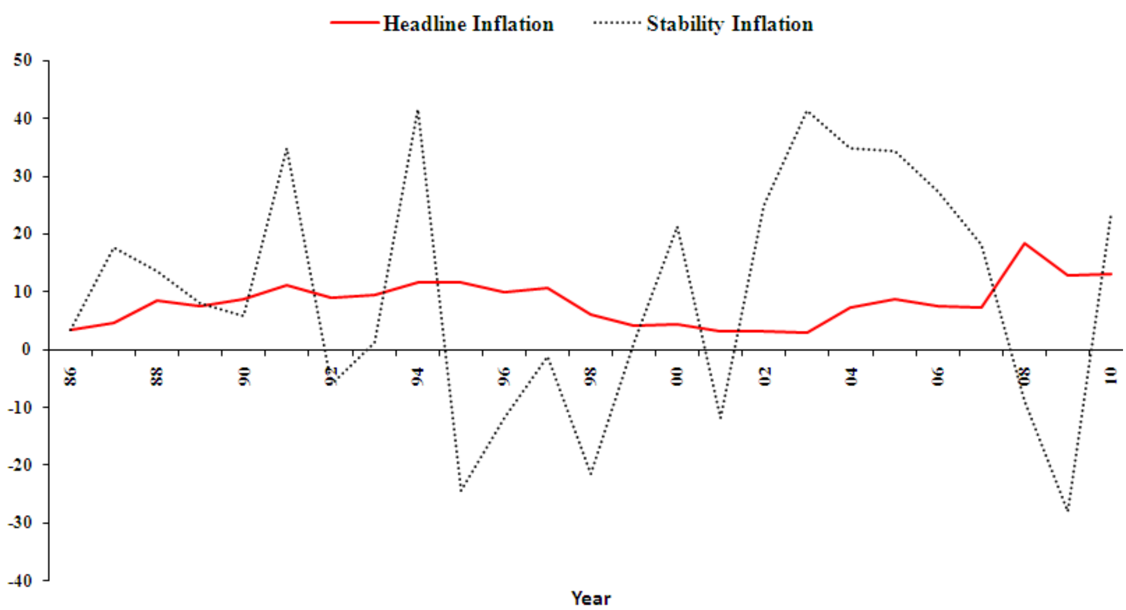


Figure 4.5: Comparison Consumer Price Inflation and Stability Price Inflation for Pakistan-Stock Prices as Component



Stability inflation is more irregular and non-systematic than headline inflation for both countries, as shown in figures (4.4) and (4.5). For both countries, the series of stability price inflation appears volatile and unstable. This is due to higher idiosyncratic shocks and large cyclical movements of stock price, which are the main characteristics of stock price. Results show the variance of output gap is smaller in the case of *SPI* than that drawn from *CPI*. However, estimated inflation from *SPI* is unpredictable and unreliable due to high noise. It is important to note that the figures for stock prices in parameter β_k would appear to support the optimisation approach, but that these values are so high that those in other sectors become comparatively negligible. Meanwhile, the magnitude of sector shocks is also comparatively very high, which does not favour this approach. Therefore, this study decomposes stock price into fundamental and bubble prices to check whether the *SPI* is a smoother and more reliable indicator than the computed actual stock prices.

4.6.2. Optimal Weights – Fundament Component of Stock Price

The trend (HP-filter) value of stock price is taken as a proxy for fundamental value of stock prices. This exercise is repeated for estimates of sectoral parameters and optimal weights for energy prices (for Malaysia, energy and housing), food prices, other goods prices and fundamental stock price for both countries, and displayed in table (4.4):

The value of parameter β_k for other goods is 0.23, which is higher than for all the other sectors. The variance of shocks estimated by $Var(\varepsilon_k)$ for other goods is also larger than all the other sectors. The combination of a large variance of shocks and a high consumption weight makes this a less desirable sector for use as a component of the stability price index. In combination with the result of zero optimal weight ω_k^C, this gives a clear message that the variance of shocks is a key indicator in the optimal choice of price index components. In addition, the stability price gives higher weight to fundamental stock prices, which show strong correlation with shocks to other goods prices. This is another reason to apply zero weight to other goods.

Table 4.4 - Parameters and Optimal Weights for Malaysia– Fundamental Stock Prices

Sector	λ_k	β_k	$Var(\varepsilon)$	δ_k	ω_k^{UC}	ω_k^{C}	ω_k^{UCU}	ω_k^{CU}
Housing & Energy	1	0.0672 (0.0458)	0.00010	0.214	2.59	0.34	-0.24	0.00
Food	1	0.1012 (0.0473)	0.00007	0.333	-0.55	0.10	-1.39	0.16
Other goods	0.5	0.2312 (0.152)	0.00042	0.453	-3.28	0.00	1.54	0.44
Fundamental	0.5	0.1055 (0.1725)	0.00028	0	2.24	0.56	1.09	0.39

The cyclical sensitive parameter 0.1055 for the fundamental stock price is larger than most of the other sectors, except for other goods and services. But the magnitude of the sectoral shock in the fundamental stock sector is about 50 percent less than the other goods sector. The combination of high sensitivity to the business cycle and low variance to sectoral shocks makes stock prices a desirable sector for inclusion in the stability price index. The price index that the central bank should target to maximise economic stability assigns most of its weight to the fundamental stock price, as reported in table (4.4). Fundamental stock prices, which have zero weight in the consumer price index, show a high responsiveness to the economy, low variance of shocks and very sluggish prices.

The column ω_k^{CU} represents the target weights required to set the correlation among shocks to zero. The target weight for stock price is about 0.39, while the target weight for housing & energy is zero. The large negative unconstrained weights ω_k^{UC} on the price of other goods as well as the negative weight on food price depends essentially on the nature of correlations among the estimated shocks. The result of the correlation matrix of shocks is presented in table 4.B4 (appendix 4.B). All the categories of the optimal weights give significant weight to the fundamental stock prices in the stability price index which the central bank should target in order to maximise economic stability in Malaysia. The zero weight of other goods prices in the *SPI* depends on the correlation among the shocks.

Table 4.5 - Parameters and Optimal Weights for Pakistan – Fundamental Stock Prices

Sector	λ_k	β_k	$Var(\varepsilon)$	δ_k	ω_k^{UC}	ω_k^{C}	ω_k^{UCU}	ω_k^{CU}
Energy	1	0.226 (0.723)	0.00258	0.073	0.08	0	0.06	0
Food	1	0.269 (0.197)	0.00081	0.403	-1.24	0.27	-1.16	0.11
Other goods	0.5	0.1303 (0.414)	0.00192	0.523	2.01	0.20	2.04	0.57
Fundamental	0.5	0.252 (0.4047)	0.00053	0	0.15	0.53	0.06	0.32

Table (4.5) presents the results for Pakistan. These results show that fundamental stock prices obtain higher weights in the target price index, due to the combination of the high procyclical sensitivity and lower variance of shock. Only the food sector shows a slightly higher sensitivity to the business cycle compared to the stock sector, but the larger magnitude of sectoral shocks and the complete flexibility of the food sector gives it smaller weighting than the stock prices sector in the stability price index. However, the last column of table (4.5) reports a higher target weight for other goods price which is mainly due to the correlations between the calculated shocks. The unconstrained sector weights ω_k^{UC} show smaller weights for the stock sector compared to the other goods sector.

The next step is to calculate the variance of the output gap for both countries according to both *SPI* and *CPI* respectively. Table (4.6) shows that the output gap variance is smaller when the stability price index (non-negativity constraint on weights) is used as a target instead of the consumer price index. For both countries, the variations in the output gap revealed by the stability price index are significantly smaller than those shown by the consumer price index. Hence, the improvement in economic stability is substantially higher when targeting the central bank stability price index rather than the consumer price index used to measure the cost of living.

Table 4.6 - Comparison: Variance of Output Gap – Fundamental Stock Price

Countries	Consumer Price Index	Stability Price Index
Malaysia	0.15864	0.02041
Pakistan	0.02760	0.01898

Finally, this study computes the headline inflation for Malaysia and Pakistan by using optimal weights (with constraint) for the whole time period. These results are presented in comparison to stability price inflation in figures (4.6) - (4.8). The output gap for both countries is reported in figures (4.7) - (4.9). Stability inflation is smoother than headline inflation for both countries. With reference to figures (4.6) and (4.8), speculative recommendations can be made regarding how monetary policy makers should react to stability price inflation in Malaysia and Pakistan.

Figure 4.6: Comparison Consumer Price Inflation and Stability Price Inflation for Malaysia-Fundamental as Component

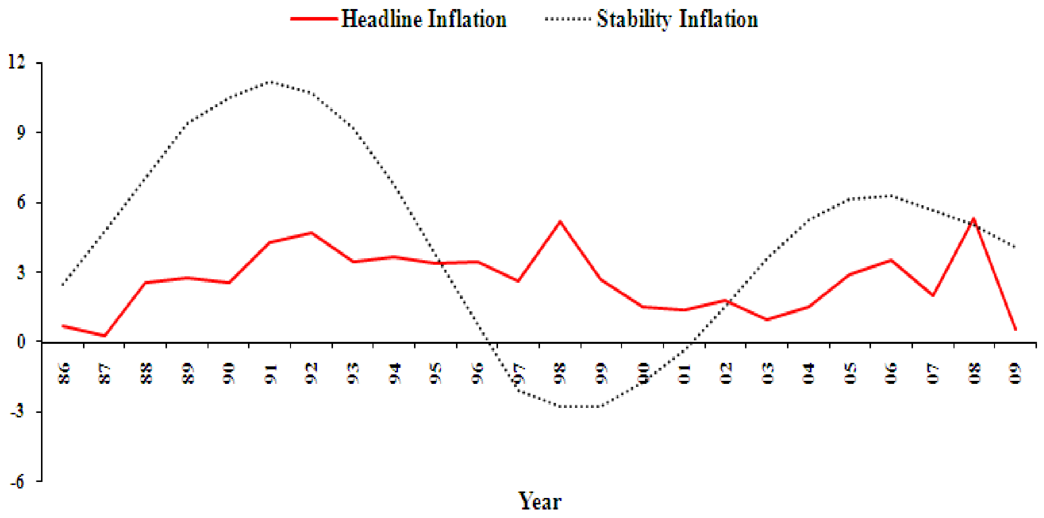


Figure 4.7: Output Gap - Malaysia

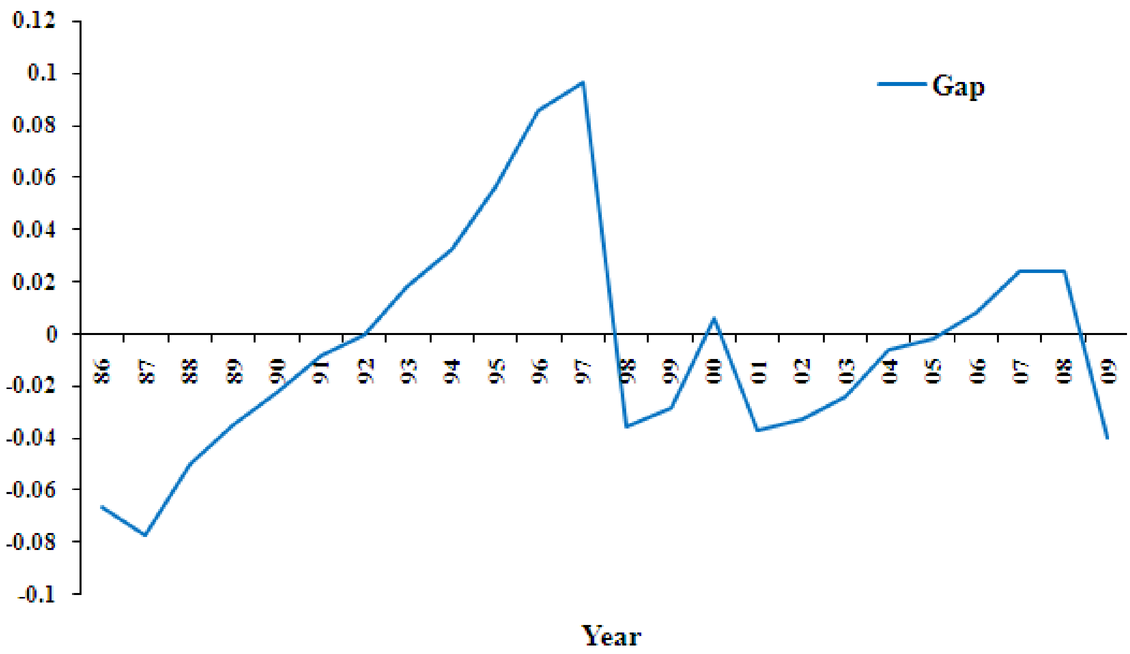


Figure 4.8: Comparison Consumer Price Inflation and Stability Price Inflation for Pakistan-Fundamental as Component

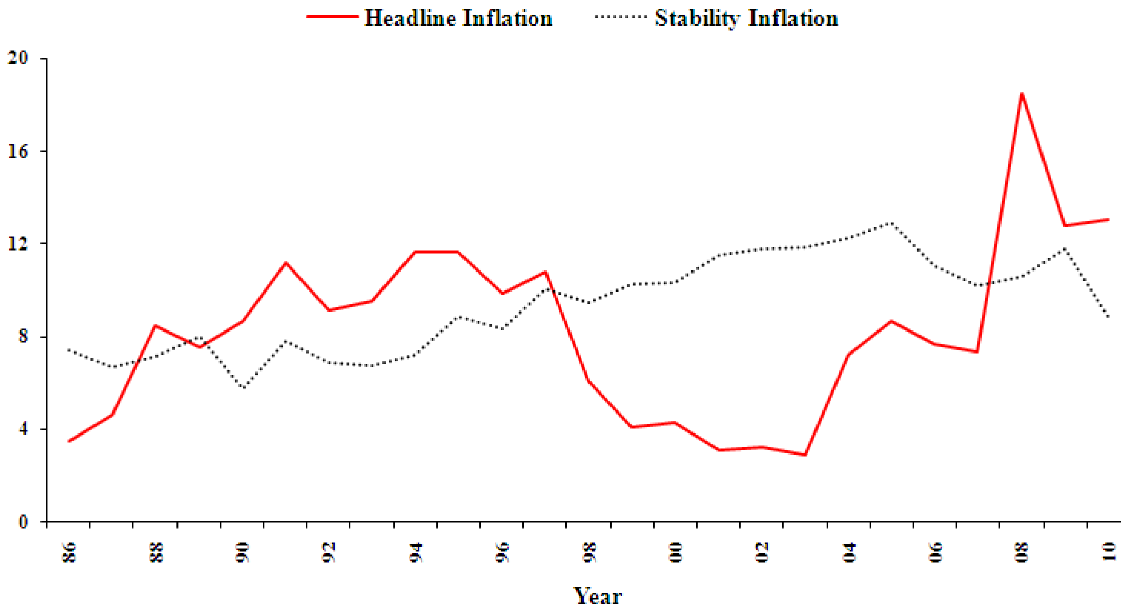
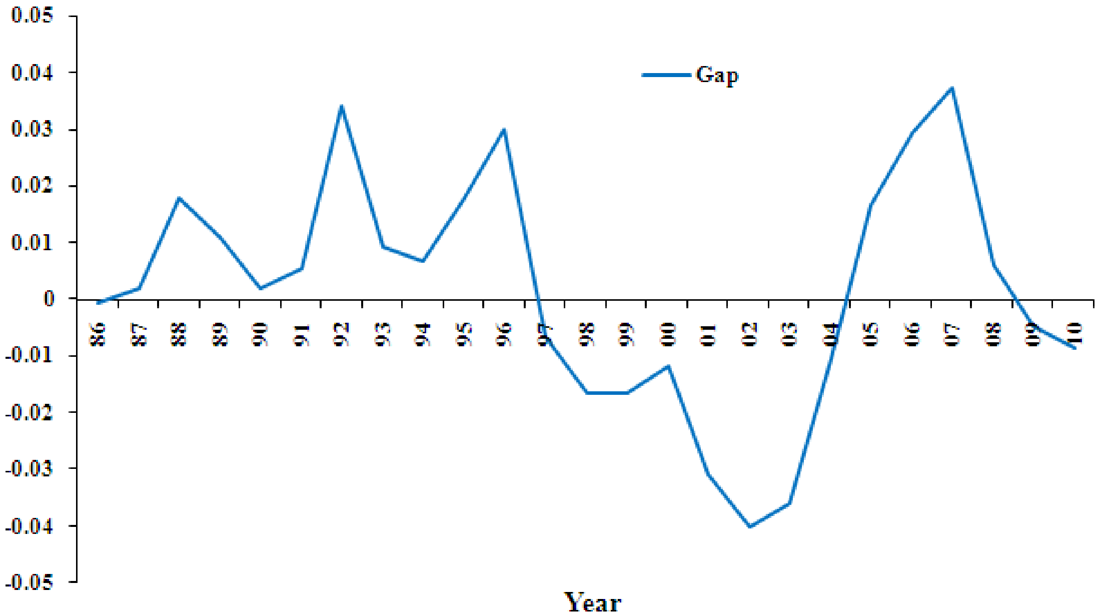


Figure 4.9: Output Gap - Pakistan



In the case of Malaysia, figure (4.6) shows the large divergence between stability inflation and headline inflation from the mid 1980s to the late 2000s. Stability inflation rose sharply from 1986 to 1990, while headline inflation remained relatively low. The growth rate of *SPI* turned negative from 1996-97. It can therefore be stated that monetary policy focusing on the stabilization of stability inflation would observe accelerating stock inflation during early 1990s. In this case, a contractionary policy should be implemented, slowing the money growth and raising interest rates. Such attention to *SPI* would have controlled the exuberance of the 1980s boom.

Looking at figures (4.6) and (4.7) it can seen that just before the Southeast Asian financial crisis the output gap in the Malaysian economy was at its maximum, and during the years of the crisis the computed stability price inflation was much lower than actual inflation. The period 1998-1999 was characterized by a stock market crash in Malaysia, which led to a huge decline in the stock prices. The main reason for negative stability inflation was that it received most of the weight from stock price. So it can be conjectured that at this peak of output gap, in a situation where stability inflation appears lower than headline inflation, the monetary authority can potentially avoid large fluctuations in output gap by varying the level of interest rates. The same hypothesis may be true in the case of Pakistan, where the intervention of the monetary authorities during the early years of the current century could have avoided the large fluctuation in output gap in 2008-2009, as shown in figure (4.9). It can be suggested that a contractionary policy in Pakistan in 2000-2006 would have prevented hyperinflation. However, this issue will not be addressed in the present study as the main objective here is to compute a price index which central banks can target to achieve minimum output volatility.

4.6.3. Optimal Weights –Bubble Component of Stock Price

For Malaysia the results for the four sectors; housing & energy prices, food prices, other goods and services and non-fundamental (bubble) stock prices are reported in table (4.7). The correlation matrix between the stocks is presented in appendix 4.B. Surprisingly the bubbles are extremely responsive to the business cycle, with the figure 18.53 approximately 80 times higher than for other sectors. One might suspect that the other sectors have little or no effect on the output gap[68]. The large sensitivity of the bubbles to the business cyclical is due to frequent booms and busts. Procyclicality of the bubbles gives them more weight than other sectors in the target price index. The magnitude of the shocks for bubbles is also much higher than the other sectors, and is about 1500 times more than the other goods sector. With reference to table (4.7), *SPI* gives a weighting of 0.57 to the stock price bubbles. The higher cyclical sensitivity of the bubbles is the main reason that they are chosen in the stability price index.

Table 4.7 - Parameters and Optimal Weights for Malaysia – Bubbles

Sector	λ_k	β_k	$Var(\varepsilon)$	δ_k	ω_k^{UC}	ω_k^{C}	ω_k^{UCU}	ω_k^{CU}
Housing & Energy	1	0.0672 (0.0458)	0.00010	0.214	0.16	0	0.06	0
Food	1	0.1012 (0.0473)	0.00007	0.333	-1.24	0	-1.26	0
Other goods	0.5	0.2312 (0.152)	0.00042	0.453	1.94	0.43	1.85	0.45
Bubbles	0.5	18.52551 (9.1133)	0.73296	0	0.14	0.57	0.35	0.55

[68] Branston and Groenewold (2004) decomposed stock prices into fundamental and speculative components using four alternative methods and found that both components have effects on the real economy through investment.

It is worth noting that the targeted stability price index dominated by bubbles is not useful for achieving the greatest economic stability. This is due to the fact that the bubbles are very volatile thus making the central bank price index unstable. Similar findings are reported for Pakistan where bubbles show a very large response to the output gap and large variance sector shocks compared to other sectors (see table 4.8). The results show that most of the optimal weighting in the stability price index is attributed to stock price bubbles, due to their high cyclical sensitivity. However, it is unreasonable to calculate a price index which is dominated by the bubbles, due to the very large magnitude of the variance of their sector shocks.

Table 4.8 - Parameters and Optimal Weights for Pakistan – Bubbles

Sector	λ_k	β_k	$Var(\varepsilon)$	δ_k	ω_k^{UC}	ω_k^{C}	ω_k^{UCU}	ω_k^{CU}
Energy	1	0.226 (0.723)	0.00258	0.073	-1.08	0.01	-2.26	0.00
Food	1	0.269 (0.197)	0.00081	0.403	-0.05	0.25	-0.01	0.18
Other goods	0.5	0.1303 (0.414)	0.00192	0.523	1.82	0	0.46	0.07
Bubbles	0.5	7.959 (4.494)	0.1937	0	0.32	0.74	2.82	0.76

Table (4.9) presents the variance of the output gap by using the parameters from the stock price bubble statistics. It shows that for both Malaysia and Pakistan the variance of the output gap calculated from the stability price index is smaller than that taken from the consumer price index.

Table 4.9 - Comparison: Variance of Output Gap – Bubbles

Countries	Consumer Price Index	Stability Price Index
Malaysia	0.15864	0.0206
Pakistan	0.02760	0.0209

The final exercise is to compute the stability price index which obtains most of its weighting from bubbles. The relative change in the consumer price index and the stability price index is presented in the Figures (4.10) and (4.11). Stability inflation is more volatile than the headline inflation, which shows that the reliability of the latter is higher. Maximum economic stability cannot be achieved by the central bank targeting the price index which includes bubbles, because stock price bubbles are uncertain and very difficult to predict. This is in line with the findings of Goodhart (2001) who argued that a target price index that gives higher weight to volatile stock prices becomes unreliable, unstable and inoperative.

Figure 4.10: Comparison Consumer Price Inflation and Stability Price Inflation for Malaysia-Bubble as Component

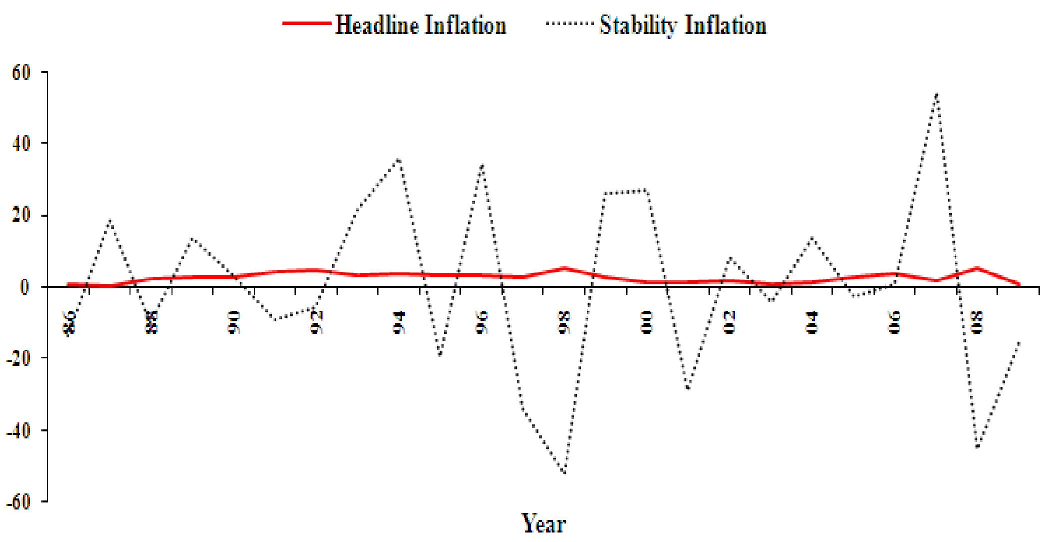
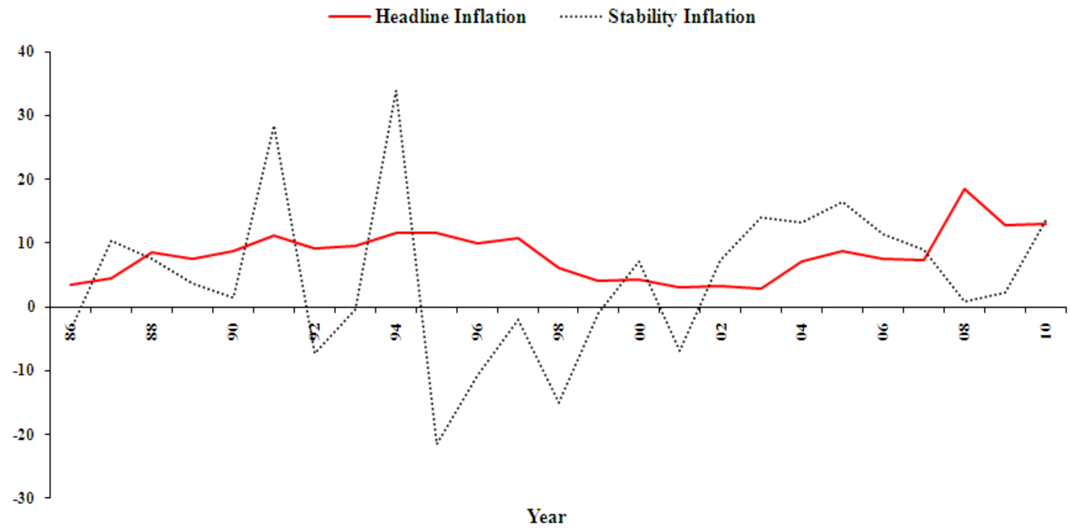


Figure 4.11: Comparison Consumer Price Inflation and Stability Price Inflation for Pakistan-Bubble as Component



Overall, this current chapter suggests that optimal policy consists of stabilizing a stability price index rather than a consumer price index, in order to maximise macroeconomic stability. To summarize the empirical analyses, optimal weights and parameters have been separately estimated for stock prices, fundamentals and bubbles along with energy, food and other goods prices. Findings reveal that the price index that the central bank should use to achieve the greatest stability in economic activities gives substantial weight to all categories of stock prices.

Compared to the use of bubble statistics, a stability price index that includes and gives significant weight to the fundamental stock prices is more stable and predictable. Therefore, the overall increase in output stability is higher from targeting the stability price index computed using the fundamental stock price as a component. However, stability inflation is volatile and unpredictable when the index gives most of its weight to the bubble component of stock price.

4.7. Conclusions

The results show that stock prices, and both their fundamental and bubble components, are afforded most of the optimal weight in central bank price indices. The increased stability in economic activities from targeting stability price index (*SPI*) is larger than from consumer price index (*CPI*) because the estimated variance of the output gap is smaller in the former than the latter. Our findings suggest that a central bank aiming to achieve minimum variance of the output gap should include fundamental stock prices as a component in the price index and attribute substantial weight to them when targeting inflation. This conclusion stems from the reality that the fundamental components of stock prices have very few idiosyncratic shocks compared to actual and its bubble components.

Furthermore, a central bank price index calculated from the fundamental stock price is much smoother and more reliable than one derived from actual or bubble stock prices. The movements in the fundamental are more systematic and permanent. Fundamental stock prices are more cyclically responsive than most other sectoral prices in the economy. Furthermore, compared to other procyclical prices, they are subject to fewer idiosyncratic shocks. For both countries moving from a policy of using the *CPI* to use of the *SPI*, the stability of output is generally seen to increase under the fundamental statistics.

In contrast, actual stock prices are extremely procyclical and experience very high idiosyncratic shocks compared to other sector prices, which makes stock prices an unfavourable sector to use in the stability price index. By including actual stock prices in the *SPI*, monetary policy would avoid the disruption to the price index caused by idiosyncratic shocks produced by transitory movements of stock prices. A price index that incorporates the actual stock prices is unstable, unreliable and unpredictable.

Because idiosyncratic shocks in actual stock prices are very high, the resulting price index shows high levels of fluctuation; this is the main reason that this study does not recommend the use of actual stock prices as a component in the stability price index. A similar interpretation holds true for bubble components of stock prices**.**

The variance of the output gap calculated from the stability price index as compared to the consumer price index is smaller when using the fundamental statistics, the actual stock price and bubble statistics in order. This evidence provides validity to the current approach with regards to macroeconomic stability by computing smaller variances in a country's output gap by using *SPI* rather than *CPI*. This also suggests that potential improvements in economic stability might be achieved by targeting *SPI*, rather than the traditional *CPI*. This approach is also attractive in the sense that a carefully constructed stability price index can combine different sectoral prices in such a way that the correlation between shocks among the various sectors is offset.

Considering the supportive and against arguments regarding the inclusion of asset price in price indices, which have been discussed earlier in this chapter, the arguments against this approach state that the assessment of asset prices depends on future expectations. Such expectations about asset prices are very difficult to measure, in that, the ex ante is not necessarily equivalent to the ex post. In contrast, the arguments in favour claim that monetary authorities should react to asset price movements to help minimise the risk of variations in output gap, and that asset price is an efficient indicator for predicting future inflation. The empirical results demonstrate that using the fundamental components in the overall price index does minimise the variations in output gap for both Malaysia and Pakistan. The results also show that the fundamental components have smaller sectoral shocks which make them a more useful predictive tool for authorities when implementing monetary actions through changes in interest rates.

The size of stock market in Pakistan is fairly small but is gaining prominence, thus lending increased weight to its role in the stability price index**.** The stock market in Malaysia is larger, as shown by the ratio of market capitalization to *GDP*, indicating the importance of its position in a stability price index designed to optimize monetary policy implementation. Furthermore, according to the recent increase in the relevance of stock market prices to the overall well-being of the global economy, *SPI* may be a very useful indicator for monetary policy implementation for the majority of countries in the world.

One potential concern about using *SPI* to maximise economic stability, while giving high weight to fundamental stock prices, is that this approach might not be realistic for countries with smaller stock markets. However, with improvement in empirical estimation techniques one can estimate accurate weight for stock prices in the overall price index**.** A possible extension of this chapter is that the number of sectors in the analysis can be increased (to include nominal wages, house prices, tradable and non-trade goods etc.) to estimate the stability price index for central bank targeting. It should be noted that increased numbers of sectoral prices would require a lengthy algebraic solution to the central banks' problem, presenting a considerable programming challenge.

To sum up, the empirical results from the estimated models allow the illustration of certain policy conclusions. Inflation targeting helps to provide macroeconomic stability and also implies that interest rates will tend to rise during asset price booms and fall during asset price busts. Hence, a monetary policy maker trying to monitor a stability price index will observe fundamental stock price fluctuations. For instance, in Malaysia during the Asian Financial Crisis of 1997-1998 stock prices fell quickly relative to other prices. Policy makers could have reacted by decreasing interest rates to counter falling stock prices, which would potentially have avoided large fluctuations in output. In contrast, if stock prices are increasing faster than other prices then the central bank should react by raising interest rates. Paying such attention to a stability price index should minimise the likelihood of future booms and busts in stock prices. In the case of Pakistan, it can be seen that in 2002 the output gap was at its minimum level and at its maximum in 2007. During the period 1999 to 2007 the computed stability price inflation was higher than the headline inflation, indicating that the central bank should have increased interest rates in order to control the stock price inflation. Monetary policy that focuses on the stabilization of inflation would have observed accelerating stock inflation, and targeting of the stability price index could have controlled the stock price boom from 2000 to 2006 by contractionary monetary policy, therefore preventing the most recent recession in Pakistan.

Chapter 5

Concluding Remarks

5.1. Summary and Conclusions

This thesis has conducted empirical analyses of the different measures of inflation and investigated how these relate to monetary policy in several developing countries in Asia, examining the implications of using different inflation measures for determining monetary policy decisions.

Chapter two adopts inflation real response (*IRR*) as an indicator to measure inflationary real effect in a situation where there are episodes of high inflation. *IRR* is defined as the difference between expected and output-neutral inflation. The study considers the cases of Indonesia, Malaysia and Pakistan, proceeding from the conjecture that if expected inflation exceeds output-neutral inflation than positive real effects are generated in periods after high inflation. Moreover, it is also hypothesised that when *IRR* is positive then a positive inflationary shock is more likely to stimulate output growth than when *IRR* is negative. Also, if *IRR* is negative, the expected real effect of a positive inflationary shock is smaller than when *IRR* is positive. In terms of the effect of short periods of high inflation, one significant and original contribution of this study is the use of bootstrapping confidence intervals to assess the variability of *IRR*. The bootstrapping method has not been used in any previous research to estimate the variability of the *IRR*. It enables the analysis to estimate confidence intervals, which will indicate whether there is a significant relationship between *IRR* and headline inflation.

The main finding in this respect is that for all the examined countries there is a significant positive relationship between inflation and *IRR*, particularly during episodes of high inflation. For all the investigated countries the bootstrapped results for the applied indicator are highly significant during high inflation crises. The bootstrapping evidence verifies the significantly positive relationship between headline inflation and *IRR*. This relationship is strongest in Pakistan, where *IRR* follows headline inflation during periods of increasing and decreasing inflation. Furthermore, in Pakistan periods of high inflation in 2008 were followed by a positive real effect in 2010. The relationship is less strong in the respective cases of Indonesia and Malaysia, but in each case there remains clear evidence of increased and positive *IRR* following episodes of high inflation, including hyperinflation. The results also show that drastic declines in *GDP* accompany periods of high inflation, but that recovery is quick and sustainable after such high inflation crises if *IRR* is positive. In the particular case of Indonesia, immediately after the high inflationary period in 1998-1999 there was an extraordinary rise in *GDP*, reaching about 20% in 2000. In Pakistan, there is evidence of a dramatic collapse in *GDP* growth during the high inflation crisis of 2008, and recovery in growth followed the reduction in inflation in 2009-2010. Likewise in Malaysia, after upward movements of inflation in 2009, there was an immediate increase in *GDP*. This supports the hypothesis that short periods of high inflation when *IRR* is positive do not have a damaging effect on growth.

Chapter three: the study imposes dynamic restrictions on a structure *VAR* model in order to identify structural shocks and their impact on macroeconomic variables for Indonesia, Malaysia, Pakistan, and Thailand. The cumulative impulse responses are estimated to analyse the dynamic relationship between the variables and also to observe the size and speed of these structural shocks' effects on macroeconomic variables. Variance decompositions are computed to assess the relative contribution of these shocks in explaining macroeconomic fluctuations. Moreover, the bootstrapping method is utilised to construct the confidence intervals for individual impulse responses, because this method allows for non-normality and also measures the statistically reliability of the estimated impulse responses. Confidence interval bands are used to verify the significance of the dynamic effects of different shocks on macroeconomic variables.

The empirical analysis presented in the process of addressing goals 3 and 4 is divided into two parts. Firstly, the dynamic effects on output and inflation of aggregate supply and demand and real oil price shocks are captured in the baseline model. Secondly, an alternative model is examined in which oil price, supply, real and nominal demand shocks are the main determinants of the macroeconomic fluctuations. The main reason for the use of the alternative model is that the effect of oil price shocks may be larger when considering prices in domestic currency rather than US dollars. A further significant contribution of the alternative model is the decomposition of demand shocks into real and nominal demand shocks, to accurately assess the fluctuations in macroeconomic variables in the selected countries. In order to check the robustness of the findings of baseline model, domestic real oil prices (oil price in domestic currency) are replaced in the alternative model by international real oil prices (oil price in US dollars), with the additional variable of real exchange rate.

For all four countries, the effect of oil price shocks on output is positive but statistically negligible in all horizons. Initially, a positive shock to real oil price leads to a decrease in domestic price in all countries. Nevertheless, after two to three quarters, domestic prices start to increase in response to the oil price shocks. However, the magnitude of the oil price shocks' effect is very small with respect to both output and prices. Furthermore, the effects of oil price shocks on exchange rate are negligible and are not related to any large fluctuations. These findings suggest that in all the examined countries oil prices account for only a relatively small portion of macroeconomic variation. They also provide clear evidence that oil price has a negligible effect on macroeconomic variables in the countries under consideration. The relatively small effect of oil price shocks on macroeconomic variables can be attributed to direct government control and providing subsidies on oil prices, which reduces the adverse effect of the price of oil on real activities. This enables the countries in this study to avoid the high inflation and decline in *GDP* which may otherwise be caused by international oil price hikes. Furthermore, oil exporting countries Indonesia and Malaysia experienced small gaps between domestic production and demand for oil, due to the decrease in oil production coupled with an increase in domestic demand for oil. The results also show that the effect of real oil price fluctuations on *GDP* and prices according to the alternative model are similar to those for the baseline model, in each country except Indonesia. In contrast to the baseline model, after two to three quarters, oil price shocks have a negative impact on economic activity in Indonesia.

As expected, in all countries aggregate supply shocks are a key source of fluctuations in output. Furthermore, aggregate demand (nominal) shocks are the main source of fluctuation in inflation except in the case of Indonesia. In terms of the real exchange rate, real demand shocks account for the majority of forecast error variance in all countries, again with the exception of Indonesia. In Indonesia, supply shocks are main source of variability in domestic prices and real exchange rate because its economy is highly dependent on exports. The study finds that supply shocks persistently increase output and decrease relative price levels, while nominal demand shocks temporarily increase output and permanently increase inflation. These results support the real business cycle theory in all the examined countries. For export dependent countries like Indonesia, Malaysia and Thailand, supply shocks lead to appreciation of real exchange rates. These findings suggest that trade sector output growth is higher than that in non-trade sectors in these countries. Additionally, supply shocks explain a larger portion of the movements in output, real exchange rate and price level, particularly in the case of Indonesia. In all countries, nominal demand shocks depreciate the real exchange rate in the short term. In Pakistan, the main source of variations in output, exchange rate and domestic prices are supply, real and nominal demand shocks respectively.

Chapter four investigates the weights assigned on different sectoral prices in measure of inflation that is used in stabilisation policy. The study further extends Mankiw and Reis (2003) optimisation approach to construct a stability price index (*SPI*) for central banks to target, by including the financial sector (stock prices) and consumer price index components, in order to minimise the variance of output gap which depends on price stability. The current study sets out to investigate the issue of choosing the right price index for the central bank to target, and recommends one which not only incorporates current costs of living but also includes stock prices. The approach is based on weights being assigned to different sectoral prices, to construct a price index dependent on sectoral parameters that differ from those applicable to the consumer price index. The set of target weights in a stability price index is a function of sector parameters including cyclical sensitivity, idiosyncratic shocks, consumption weight and price rigidities. In order to construct a price index to achieve maximum stability for economic activities, target weights are computed for four sectoral prices; stock, food, energy/housing and other goods. Uniquely, this study uses a generalized method of moments (*GMM*) to estimate the parameters for the model and derives a four-sector algebraic solution to the central banks' problem of identifying an appropriate target price index. The main reason to use *GMM* is that it employs orthogonal conditions which minimise the correlation between idiosyncratic shocks and explanatory variables. Additionally, the *GMM* is used to account for serial correlation in the shocks as well as for heteroskedasticity. Although this method succeeds in reducing the levels of correlation between shocks, these do remain higher than ideally would be hoped. Nonetheless, the present study finds acceptable results.

The parameters and optimal weights are estimated for three different combinations of sectoral prices for Malaysia and Pakistan, which provides a broader picture of the results thus leading to more robust and precise conclusions. Together with energy, food and other goods prices, the first model uses actual stock prices, the second uses the fundamental component of stock prices and the third uses the bubble component of stock prices. The empirical findings show that the figures for stock prices and their bubble components would appear to support the optimisation approach in terms of the cyclical sensitivity parameter, but that these values are so high that those in other sectors become comparatively negligible. Meanwhile, the variance of sector shocks is also comparatively very high, which conversely does not favour this approach. Although the actual stock prices and their bubble components are still given sizeable weights in the *SPI* (due to the fact that they are highly sensitive, with small consumption weight and high price rigidity), the resulting *SPI* appears noisy, demonstrating large and unpredictable fluctuations due to the large magnitude of idiosyncratic shocks.

In this context a further contribution of this thesis is to distinguish between fundamental and bubble components of stock prices. The evidence reveals that the fundamental component of stock prices shows high cyclical sensitivity and small idiosyncratic shocks compared to other sectors. Due to this desirable combination of high cyclical response and low variance shocks, the central bank should use an *SPI* that gives significant weight to fundamental stock prices in order to minimise output gap variance. According to the findings, the *SPI* computed from the fundamental stock price is much smoother and more predictable than that taken from actual stock prices and their bubble component. The evidence suggests that the central banks should include fundamental stock prices rather than actual or bubble stock prices as a component in the price index, because the stability achieved in economic activities is higher when using the former.

The variance of the output gap calculated from the stability price index as compared to the consumer price index is relatively small; suggesting potential improvement in economic stability might be increased when targeting *SPI* rather than *CPI*. The evidence also verifies the validity of this approach in terms of achieving output gap variance through changes in the weight applied to different sectors in the price index.

5.2. Policy Recommendations

Based on the results of chapter two, it is therefore suggested that the *IRR* indicator may potentially be utilised to set in advance the optimal times for monetary actions in the context of inflation targeting. From the perspective of monetary policy, if *IRR* is positive the climate for undertaking monetary policy action would appear favourable, because if monetary policy is expansionary then expected output growth is high and if monetary policy is contractionary then expected loss in output is small. It is hoped that this idea may contribute to addressing the problems of inflation-output trade-off and of attaining inflation control with minimal output loss. However, it should be noted that *IRR* is not a policy tool in these countries. Therefore it can be stated that the consideration of *IRR* as a means of monitoring monetary policy, and of the different critical hypothesis built in the present study, should be used by the central banks to set the optimal timing for monetary actions. By adopting *IRR* as an indicator, they will be better placed to control inflation with minimal output loss.

Indonesia has adopted a policy of inflation targeting since 2005, while Malaysia and Pakistan have not yet done so. Malaysia has experimented with targeting monetary condition indices based on both interest rates and exchange rates. Pakistan currently targets monetary aggregates, but is passing through the phase of switching from monetary aggregate targeting to inflation targeting. In Indonesia, positive *IRR* followed low inflation in the period covering 2009 and 2010. Therefore, the decline in interest rates set by the central bank in 2009-2010 may in time be seen to have a positive effect on output in 2011 and 2012. During the global economic crisis of 2008-2009, Malaysia went through a period of high inflation. However, this high inflation was closely followed by positive real effects, suggesting that economic growth in Malaysia for 2010-2011 would not be adversely affected by a policy decision to increase interest rates. In the case of Pakistan, positive real effect followed significant *GDP* growth during the period 2004 to 2007, which may be the result of active expansionary policy implemented by central bank measures in 2003-2004.

In chapter three empirical findings from the estimated models allow us to draw some policy implications. For all four countries, oil price shock does not have adverse effects on output, exchange rate and inflation. What became obvious in this study is that oil subsidisation has an important role in improving economic performance. This can be achieved by lessening the adverse effect of oil price shocks on macroeconomic variables. The policy implication of this result to government would be to allow its policy to stabilise domestic oil price through subsidisation and thus help enhance investment and growth. However, this has its consequences as governments transfer the cost burden of oil subsidies, raising taxes and increasing domestic and foreign borrowing to minimise the resultant budget deficit.

The findings further suggest that supply, real and nominal demand shocks have been the main sources of macroeconomic fluctuations in all countries during various economic crises; especially during the Asian financial crisis in 1997-1998 and the global economic crisis in 2008-2009. Such results have important implications, suggesting in particular that the identification and decomposition of supply and demand shocks are crucial. This enables better analysis of the effects of monetary and fiscal policy on the economy, which is in turn taken as a measure of progress of the growth and improvement of market mechanisms. Overall, for a fuller understanding of recent developments in the economies that have been considered, and in order to structure economic policies that aim at stabilizing the macroeconomy, the results of the current study should be carefully taken into account during the design and improvement of economic policies. This is particularly relevant for Southeast Asian countries, where supply shocks are the main source of variations in economic activities, which is consistent with the expectations for export dependant countries.

Regarding monetary policy implementation in chapter four; a policy maker trying to target a specific *SPI* according to this model would observe fundamental stock price movements. Meanwhile, inflation targeting implies that interest rates would tend to increase during asset price booms and fall during asset price busts. For example, as was the case in other Southeast Asian countries, Malaysian stock prices fell rapidly relative to other sectoral prices during the Asian Financial Crisis in 1997-1998. In this case, policy makers would have reacted by decreasing interest rates in order to counter the stock price decline. In contrast, if stock prices are seen to increase faster than other prices, then the central bank should react by raising interest rates, because giving such attention to a stability price index may avoid future stock price boom and bust. For Pakistan, during the period 1999 to 2007 the computed stability price inflation was higher than the headline inflation, indicating that the central bank should have increased interest rates in order to control the stock price boom. Monetary policy that focused on stability price inflation would have observed accelerating stock price inflation, and targeting of the stability price index could potentially have controlled the stock price boom from 2000 to 2006 by contractionary monetary policy, thereby preventing the most recent bout of inflation in Pakistan.

In the case of Malaysia, where the stock market is relatively large according to the ratio of market capitalization to *GDP*, it will be particularly important to calculate an appropriate stability price index in order to optimize the implementation of monetary policy. Although comparatively small at present, the stock market in Pakistan continues to grow, suggesting that its role in the stability price index will become more important in future.

5.3. Future Research

This thesis has a number of potential extensions for future research. In chapter 2, The Monte Carlo simulation can be used to show that this decomposition, *IRR*, is positively related to inflationary shocks, thus generating positive real effect and also identify the usefulness of *IRR* in cases of when the economy is prone to episodes of high inflation would be interesting. The Monte Carlo analysis can also be employed for forecasting of output gap based on *IRR* with some alternatives. But the issue here is how to generate artificial observations of inflation in such a way that the resulting inflationary series would resemble those within periods of a considerable high inflation. However, this issue is not the main objective of this thesis. Hence, it may serve my future research agenda.

This idea and indictor *IRR* can be estimated for more countries especially those that are suffering hyper inflation and have concern about the right timing of monetary policy actions. The methodology applied in this thesis, which involves computing the indicator from a two-variable *VAR* is fairly simple and can be further improved. An exploration based on a larger *VAR*, possibly involving monetary policy instruments, might generate more specific results for future research. Additionally, the results may be more accurate by using *GDP* growth instead output gap in estimation of *IRR*. But the problem facing the developing countries is that monthly data on output growth is generally not available or published.

Regarding chapter 3, in view of the examined short run impact of different structural shocks on macroeconomic variables in the Asian developing countries, an interesting extension to my analysis would be to discover how much the these variables are affected by changes in oil prices and the exchange rate in the long run. Additionally, Asian developing countries still apply heterogeneous exchange rate whose structures vary across a continuum varied of fixed to floating regime. To assess the reliability of the reform policies in the exchange rate regime, it is valuable to investigate the impact of exchange rate fluctuations on macroeconomic indicators. Furthermore, chapter 3 analysis could be addressed to verify possible asymmetric relationships between oil prices and the macroeconomic variables in Asian developing economies for future work.

The potential extension of chapter 4 is that the number of sectors in the analysis can be increased to estimate stability price index for central bank to target such as nominal wages, house prices, tradable and non-trade goods etc. However, analytical solution of the central bank problem with more sectoral prices is a mathematical challenge. Spending more time on analytical solution and programming, the optimisation approach in chapter 4 can include more sectoral prices in central bank price index. The method applied in this chapter which involves computing the fundamental stock prices from HP-filter, is fairly simple and can be further improved. Further development in the econometric technique to estimate sectoral parameters and optimal weights could be interesting contribution in future research.

Appendix Chapter 3

3. A. Data Description

All data series are quarterly seasonally adjusted. All variables are measured in natural logarithms. The quarterly real effective exchange rate of the Thailand is constructed by the quarterly average of monthly data. The monthly series of real effective exchange rate (2005=100) of the Thailand is taken from bank of Thailand. For Indonesia, the quarterly real effective exchange rate (2005=100) is obtained from bank for International Settlement. Whereas the quarterly real effective exchange rate (2005=100) of Malaysia and Pakistan is taken from International Financial Statistics (*IFS*) data base of *IMF*. Nominal *GDP*, *GDP* deflator and *CPI* for all countries data come from *IFS* with common base year (2005=100). While, nominal world oil price based as US dollar (2005=100) and *CPI* of US (2005=100) are obtained from *IFS*.

World Real Oil Price: Nominal oil price in United State (US) dollar basis is deflated by US consumer Price index (*CPI*).

Domestic Real Oil Price: Nominal oil price in US dollar converted to each countries local currency (price of 1$ in national currency) and deflated by each countries *CPI*.

Real Gross Domestic Product (*GDP*): Nominal *GDP* deflated by the corresponding *GDP* deflator.

Inflation Rate: Inflation is the quarterly changes in corresponding countries consumer price.

Real Effective Exchange Rate: The weighted average of a country's currency relative to an index or basket of other major currencies adjusted for the effects of inflation.

Appendix 3.B: Tables

Table 3.B1: Unit Root Test

Augmented Dickey-Fuller (ADF) Test					
Variable	**Notation**	**Indonesia**	**Malaysia**	**Pakistan**	**Thailand**
World Real oil Price	op_t^w	-1.4784	Same	Same	same
First Difference	Δop_t^w	-9.2855^{+++}			
Domestic Real Oil price	op_t^d	-1.773	-0.582	-0.950	-1.055
First Difference	Δop_t^d	-7.692^{+++}	-7.654^{+++}	-9.634^{+++}	-7.300^{+++}
Real *GDP*	y_t	-1.926	-3.106	-2.343	-2.220
First Difference	Δy_t	-7.142^{+++}	-7.293^{+++}	-5.320^{+++}	-5.802^{+++}
Real Effective Exchange Rate	E_t	-3.20^{+}	-1.879	-2.132	-2.122
First Difference	ΔE_t	-5.520^{+++}	-6.280^{+++}	-9.257^{+++}	-6.497^{+++}
Domestic Prices	p_t	-0.854	-2.121	1.253	-1.940
First Difference	Δp_t	-4.399^{+++}	-7.164^{+++}	-3.586^{+++}	-5.899^{+++}
Phillips-Perron (PP) Test					
Variable	**Notation**	**Indonesia**	**Malaysia**	**Pakistan**	**Thailand**
World Real oil Price	op_t^w	-1.135	Same	Same	Same
First Difference	Δop_t^w	-7.679^{+++}			
Domestic Real Oil price	op_t^d	-1.137	-0.772	-1.142	-0.969
First Difference	Δop_t^d	-8.359^{+++}	-6.845^{+++}	-9.194^{+++}	-6.367^{+++}
Real *GDP*	y_t	-1.523	-2.402	-2.165	-1.934
First Difference	Δy_t	-7.131^{+++}	-7.194^{+++}	-4.852^{+++}	-5.749^{+++}
Real Effective Exchange Rate	E_t	-2.597	-1.511	-2.075	-1.710
First Difference	ΔE_t	-6.749^{+++}	-6.167^{+++}	-9.192^{+++}	-6.366^{+++}
Domestic Prices	p_t	-0.824	-2.250	1.230	-2.036
First Difference	Δp_t	-4.511^{+++}	-7.038^{+++}	-6.446^{+++}	-5.419^{+++}

Note: Triple plus ($^{+++}$), double plus ($^{++}$) and a single plus ($^{+}$), respectively, indicate the significant at the 1%, 5% and 10% level. Constant and time trend are used for the variables at level. Only constant is included for all first at difference variables.

Table B_2: Cointegration Test Results with Trace and Maximum Eigenvalues Statistics

Indonesia						
	Trace Test			Maximum Eigenvalues		
Hypothesised No. of CE(s)	**Statistics**	**Critical Values 5%**	**Critical Values 1%**	**Statistics**	**Critical Values 5%**	**Critical Values 1%**
None	61.805	63.876	71.479	31.157	32.118	37.487
At most 1	22.648	42.915	49.363	10.260	25.823	30.834
At most 2	12.388	25.872	31.154	7.007	19.387	23.975
At most 3	5.381	12.518	16.554	5.381	12.518	16.554
Malaysia						
	Trace Test			**Maximum Eigenvalues**		
Hypothesised No. of CE(s)	**Statistics**	**Critical Values 5%**	**Critical Values 1%**	**Statistics**	**Critical Values 5%**	**Critical Values 1%**
None	56.892	63.876	71.479	28.852	32.118	37.487
At most 1	28.040	42.915	49.363	11.133	25.823	30.834
At most 2	16.907	25.872	31.154	9.830	19.387	23.975
At most 3	7.077	12.518	16.554	7.077	12.518	16.554
Pakistan						
	Trace Test			**Maximum Eigenvalues**		
Hypothesised No. of CE(s)	**Statistics**	**Critical Values 5%**	**Critical Values 1%**	**Statistics**	**Critical Values 5%**	**Critical Values 1%**
None	62.014	63.876	71.479	26.660	32.118	37.487
At most 1	38.354	42.915	49.363	17.969	25.823	30.834
At most 2	20.385	25.872	31.154	14.718	19.387	23.975
At most 3	5.667	12.518	16.554	5.667	12.518	16.554
Thailand						
	Trace Test			**Maximum Eigenvalues**		
Hypothesised No. of CE(s)	**Statistics**	**Critical Values 5%**	**Critical Values 1%**	**Statistics**	**Critical Values 5%**	**Critical Values 1%**
None	56.399	63.876	71.479	20.878	32.118	37.487
At most 1	35.521	42.915	49.363	15.521	25.823	30.834
At most 2	20.000	25.872	31.154	13.258	19.387	23.975
At most 3	6.741	12.518	16.554	6.741	12.518	16.554

Table 3.B3: Variance Decomposition of *GDP* and Prices in Indonesia

Quarters	Output				Inflation			
	OP	*EX*	*AS*	*AD*	*OP*	*EX*	*AS*	*AD*
1	5.760	39.315	22.367	32.558	9.808	28.222	31.516	30.454
2	3.506	18.837	54.007	24.116	6.829	18.061	54.646	20.463
4	4.821	22.577	49.533	23.070	5.604	15.480	66.049	14.867
6	4.753	22.888	49.013	23.345	5.487	17.959	61.994	14.560
8	4.707	22.704	49.422	23.167	5.397	17.670	62.419	14.513
10	4.707	22.712	49.414	23.161	5.392	17.777	62.370	14.462
14	4.705	22.712	49.426	23.157	5.390	17.807	62.352	14.452
18	4.705	22.714	49.425	23.156	5.390	17.810	62.345	14.451
24	4.705	22.714	49.425	23.156	5.390	17.810	62.350	14.451
30	4.705	22.714	43.425	23.156	5.390	17.810	62.350	14.451

Table 3.B4: Variance Decomposition of *GDP* and Prices in Malaysia

Quarters	Output				Inflation			
	OP	*EX*	*AS*	*AD*	*OP*	*ER*	*AS*	*AD*
1	14.032	21.405	58.034	6.529	20.222	0.413	1.007	78.358
2	14.073	20.558	58.643	6.726	18.490	1.722	2.900	76.888
4	13.048	24.410	51.876	10.667	17.945	7.455	4.054	69.937
6	13.125	24.390	51.814	10.627	17.896	8.283	4.607	69.212
8	13.127	24.406	51.809	10.654	17.896	8.301	4.613	69.189
10	13.128	24.408	51.807	10.655	17.896	8.312	4.618	69.173
14	13.128	24.408	51.807	10.656	17.897	8.317	4.619	69.167
18	13.128	24.408	51.807	10.656	17.897	8.317	4.619	69.167
24	13.128	24.408	51.807	10.656	17.897	8.317	4.619	69.167
30	13.128	24.408	51.807	10.656	17.897	8.317	4.619	69.167

Table 3.B5: Variance Decomposition of *GDP* and Prices in Pakistan

Quarters	Output				Inflation			
	OP	*EX*	*AS*	*AD*	*OP*	*ER*	*AS*	*AD*
1	6.468	5.267	86.104	2.161	11.717	29.967	4.321	53.995
2	4.636	3.793	89.950	1.622	9.848	24.848	5.823	59.481
4	4.278	3.349	91.129	1.244	10.077	25.553	6.723	57.647
6	4.058	3.366	91.267	1.191	9.171	25.725	6.498	58.605
8	3.996	3.918	91.211	1.277	9.197	25.897	6.459	58.405
10	3.980	3.506	91.153	1.302	9.118	25.912	6.454	58.525
14	3.975	3.538	91.145	1.333	9.114	25.912	6.454	58.521
18	3.975	3.543	91.143	1.338	9.113	25.912	6.454	58.521
24	3.975	3.543	91.143	1.339	9.113	25.912	6.454	58.521
30	3.975	3.543	91.143	1.339	9.113	25.912	6.454	58.521

Table 3.B6: Variance Decomposition of *GDP* and Prices in Thailand

Quarters	Output				Inflation			
	OP	*EX*	*AS*	*AD*	*OP*	*EX*	*AS*	*AD*
1	0.224	24.446	62.179	13.151	1.784	3.010	8.589	86.617
2	5.740	21.233	61.775	11.252	3.508	2.518	7.853	86.122
4	9.029	22.424	56.442	12.105	4.869	11.552	7.121	76.458
6	9.274	22.317	55.622	12.788	4.968	11.946	7.091	75.999
8	9.283	22.375	55.555	12.787	4.967	11.953	7.091	75.990
10	9.282	22.375	55.554	12.789	4.967	11.955	7.091	75.987
14	9.282	22.375	55.554	12.789	4.967	11.956	7.091	75.986
18	9.282	22.375	55.554	12.789	4.967	11.956	7.091	75.986
24	9.282	22.375	55.554	12.789	4.967	11.956	7.091	75.986
30	9.282	22.375	55.554	12.789	4.967	11.956	7.091	75.986

Table 3.B7: Variance Decomposition of Real Effective Exchange Rate

Quarters	Indonesia				Malaysia			
	OP	*EX*	*AS*	*AD*	*OP*	*EX*	*AS*	*AD*
1	0.372	2.209	95.812	1.608	0.020	73.707	25.960	0.313
2	1.071	13.842	83.108	1.979	2.353	67.489	29.703	0.454
4	1.231	16.115	76.690	6.834	8.363	65.666	28.285	0.685
6	1.354	15.244	76.290	7.212	8.383	61.256	28.111	2.250
8	1.389	15.144	75.817	7.271	8.368	61.182	28.145	2.305
10	1.390	15.477	75.796	7.291	8.366	61.189	28.129	2.316
14	1.391	15.502	75.796	7.315	8.367	61.187	28.127	2.319
18	1.391	15.498	75.796	7.316	8.367	61.187	28.127	2.319
24	1.391	15.497	75.796	7.316	8.367	61.187	28.127	2.319
30	1.391	15.497	75.796	7.316	8.367	61.187	28.127	2.319

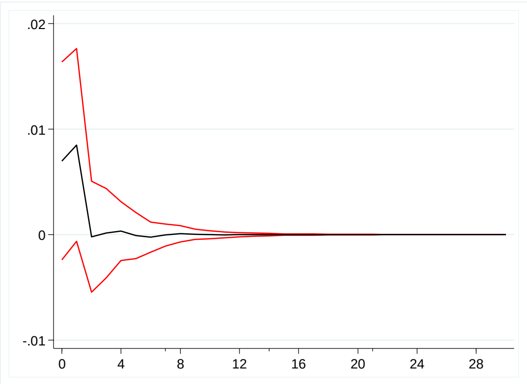
Table 3.B8: Variance Decomposition of Real Effective Exchange Rate

	Pakistan				Thailand			
Quarters	*OP*	*EX*	*AS*	*AD*	*OP*	*EX*	*AS*	*AD*
1	0.351	78.089	6.462	15.098	5.4693	56.717	37.805	0.0086
2	0.689	77.173	7.623	14.875	5.0361	55.954	38.089	0.9209
4	4.643	65.263	8.232	21.863	4.9920	54.637	38.006	2.3650
6	4.748	63.879	9.083	22.290	4.9874	54.518	37.914	2.5806
8	4.730	63.508	9.098	22.687	5.0022	54.502	37.876	2.6200
10	4.728	63.421	9.096	22.714	5.0020	54.506	37.869	2.6220
14	4.725	63.417	9.096	22.758	5.0020	54.507	37.869	2.6224
18	4.724	63.417	9.096	22.763	5.0020	54.507	37.869	2.6224
24	4.724	63.417	9.096	22.763	5.0020	54.507	37.869	2.6224
30	4.724	63.417	9.096	22.763	5.0020	54.507	37.869	2.6224

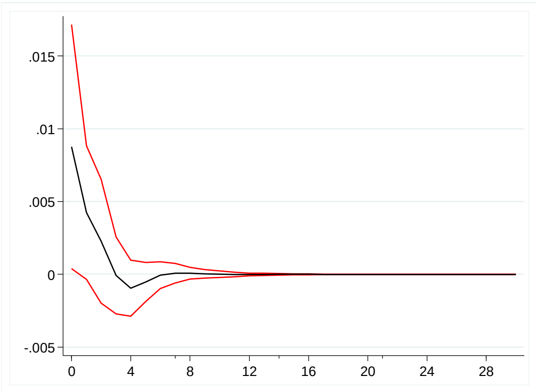
Appendix 3.C: Figures

Figure 3.C1: Effects of a Positive Oil price Shock on *GDP*

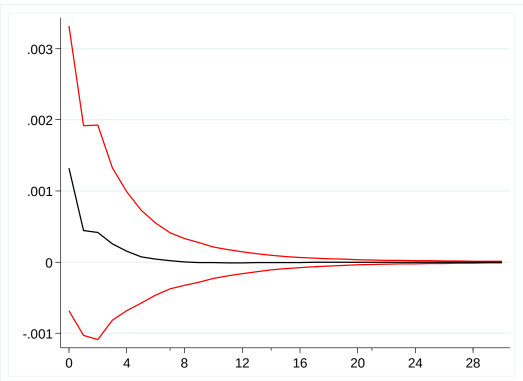
Indonesia



Malaysia



Pakistan



Thailand

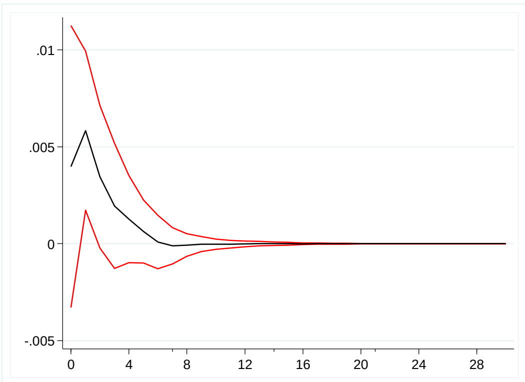
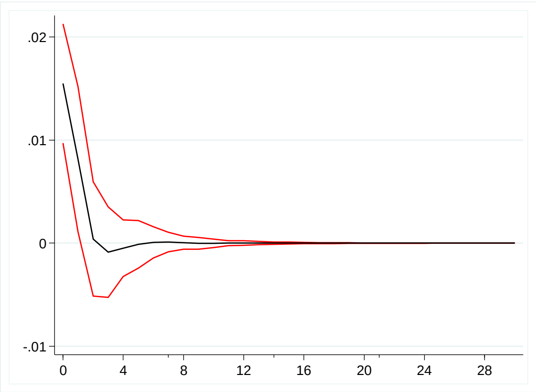
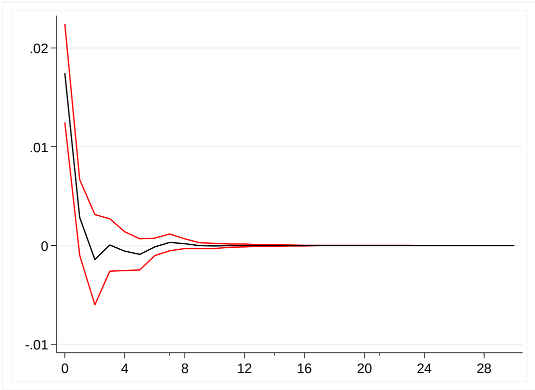


Figure 3.C2: Effects of a Positive Supply Shock on *GDP*

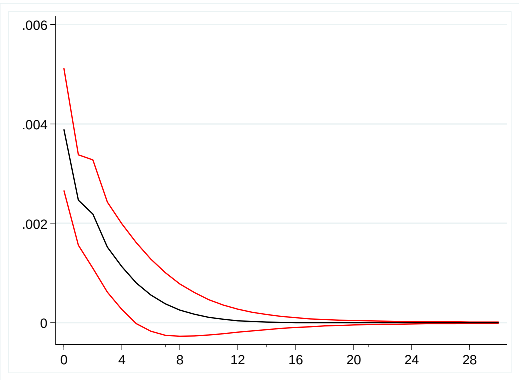
Indonesia



Malaysia



Pakistan



Thailand

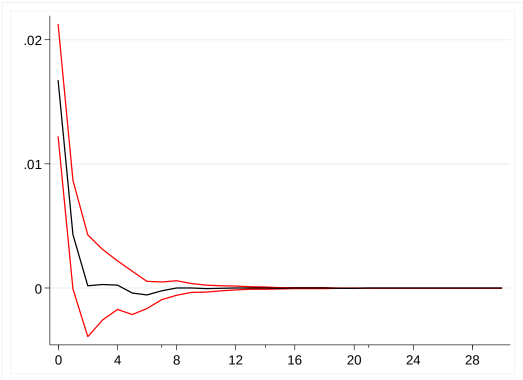
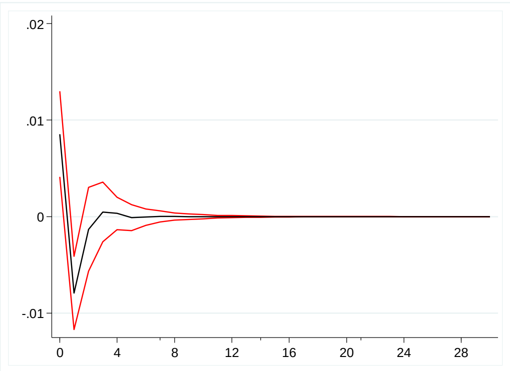
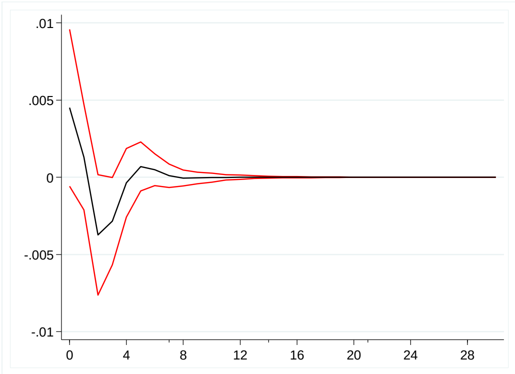


Figure 3.C3: Effects of a Positive Demand Shock on *GDP*

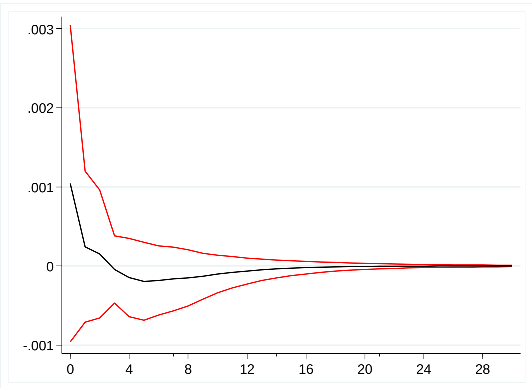
Indonesia



Malaysia



Pakistan



Thailand

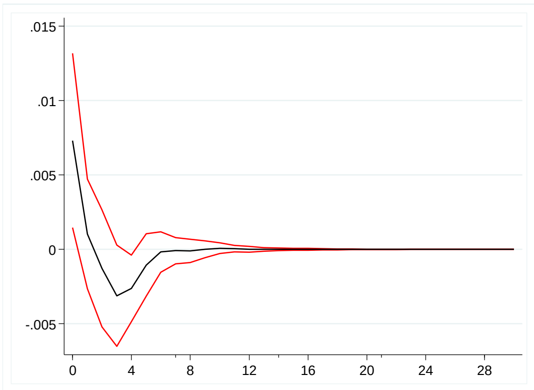
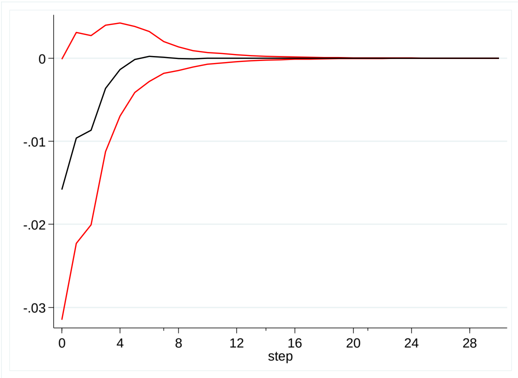
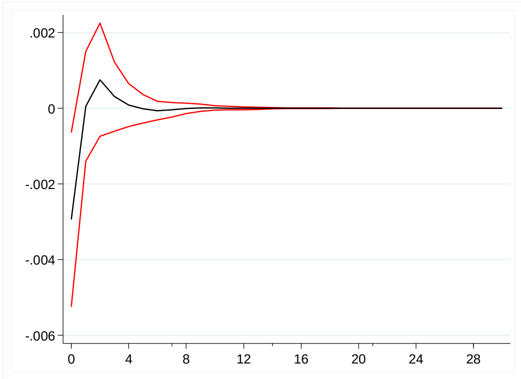


Figure 3.C4: Effects of a Positive Oil price Shock on Price Level

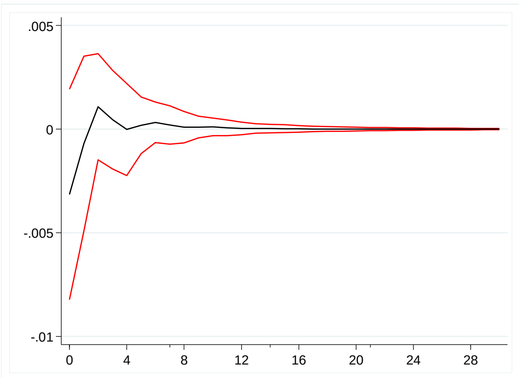
Indonesia



Malaysia



Pakistan



Thailand

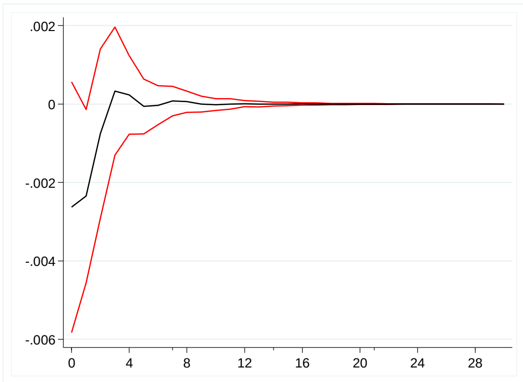
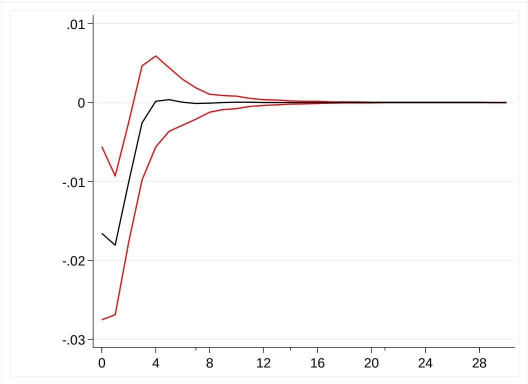
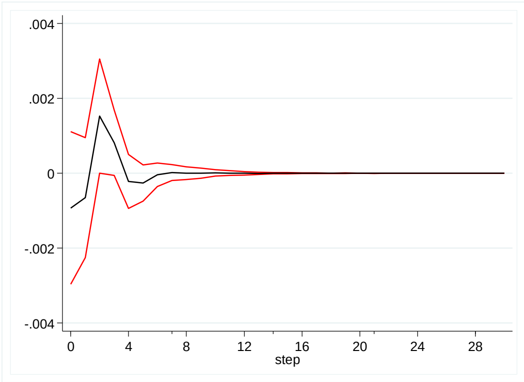


Figure 3.C5: Effects of a Positive Supply Shock on Price Level

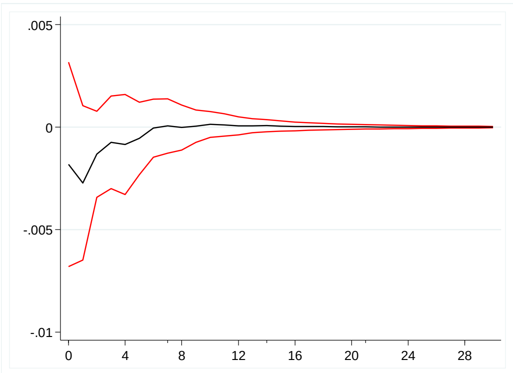
Indonesia



Malaysia



Pakistan



Thailand

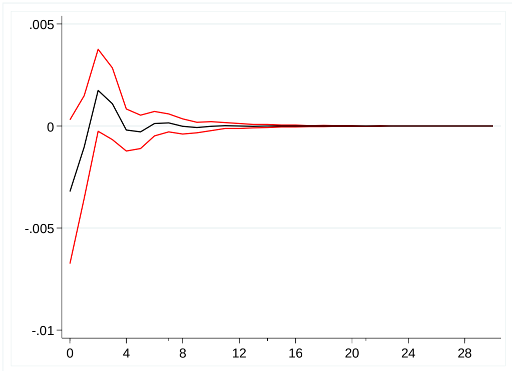
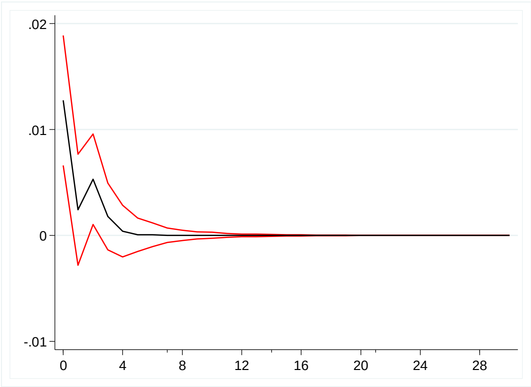
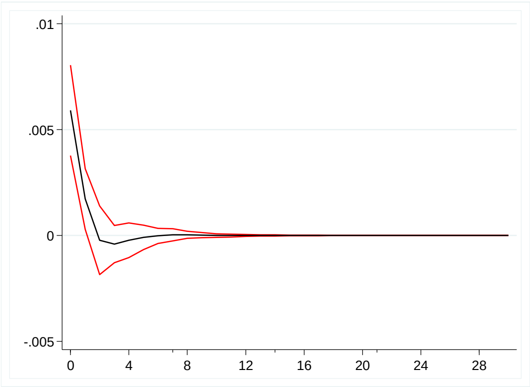


Figure C6: Effects of a Positive Demand shock on Price Level

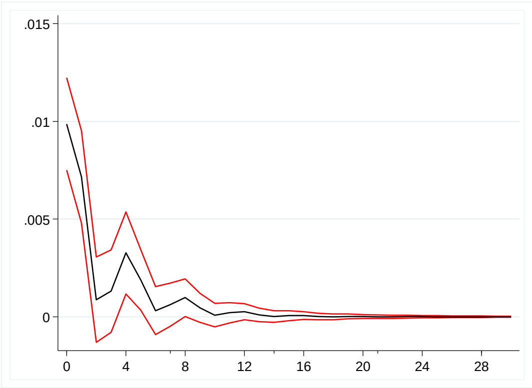
Indonesia



Malaysia



Pakistan



Thailand

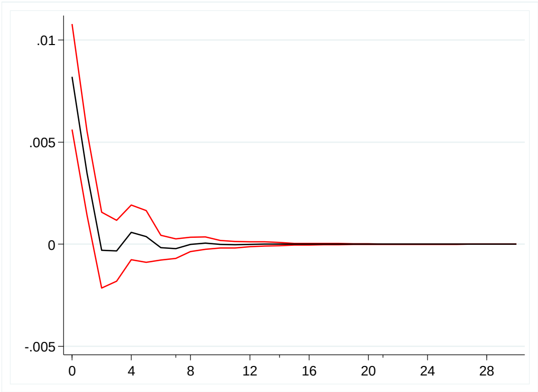
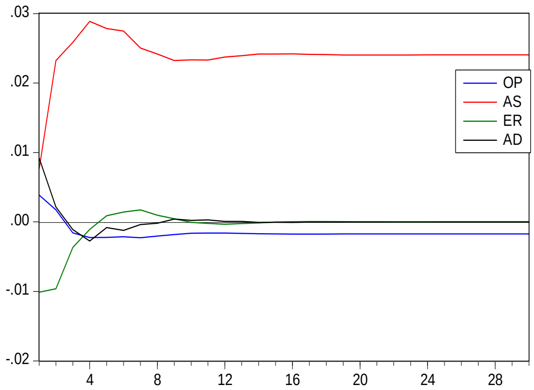
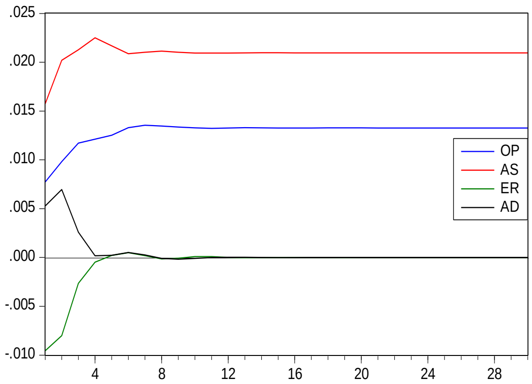


Figure 3.C7: Cumulative Dynamic Effects of Oil Price, Supply, Exchange Rate and Demand Shocks on *GDP*

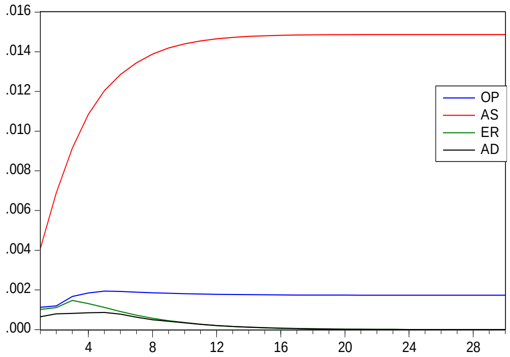
a. Indonesia



b. Malaysia



c. Pakistan



d. Thailand

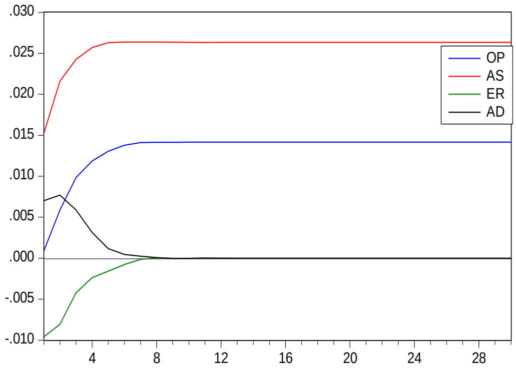
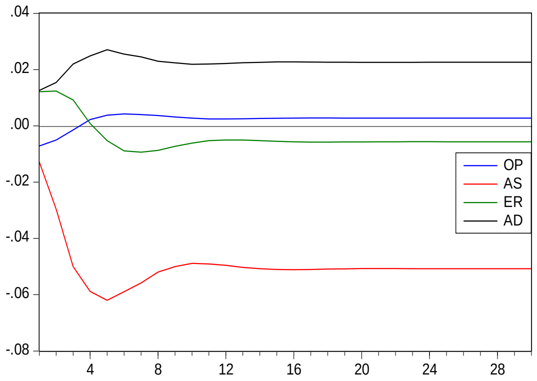
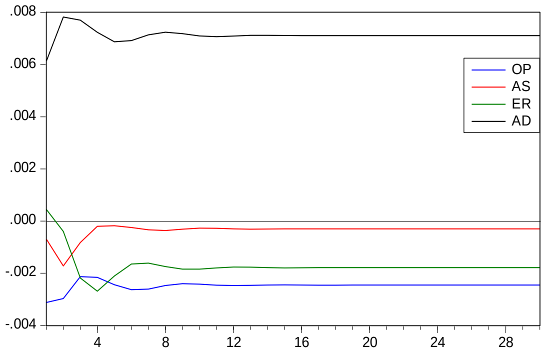


Figure 3.C8: Cumulative Effects of Oil Price, Supply, Exchange Rate and Demand Shocks on Price Level

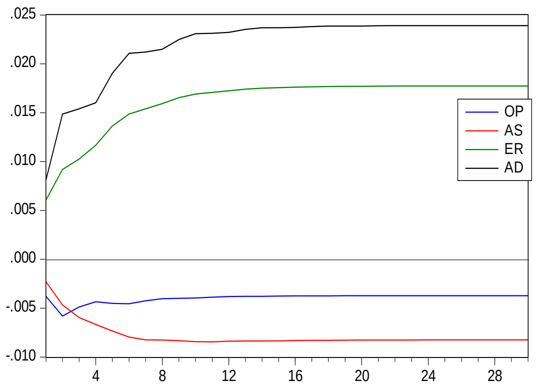
a. Indonesia



b. Malaysia



c. Pakistan



d. Thailand

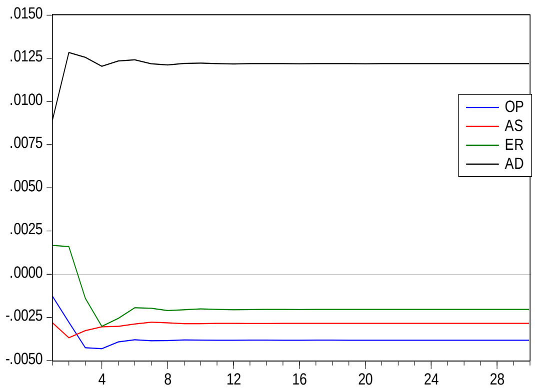
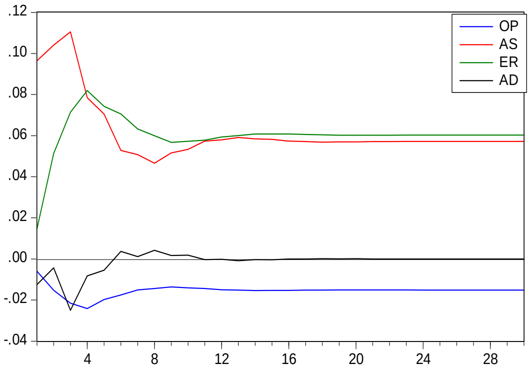
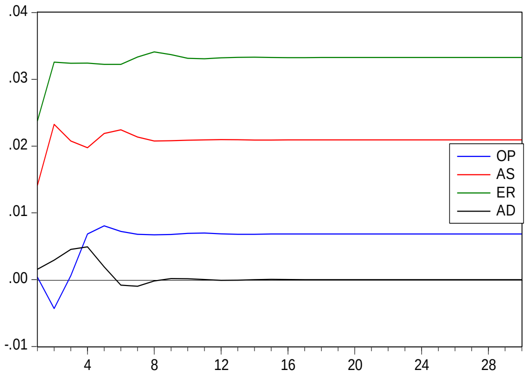


Figure 3.C9: Cumulative Effects of Oil Price, Supply, Exchange Rate and Demand Shocks on Real Exchange Rate

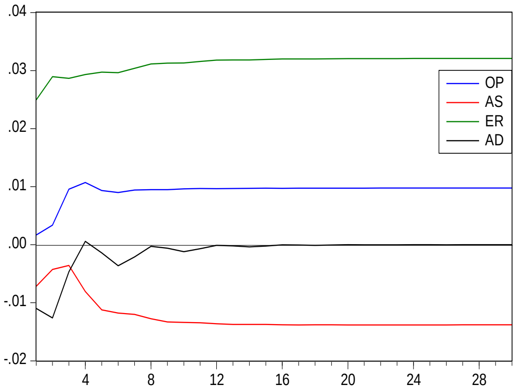
a. Indonesia



b. Malaysia



c. Pakistan



d. Thailand

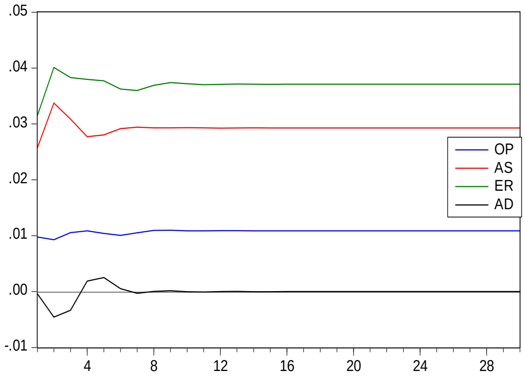
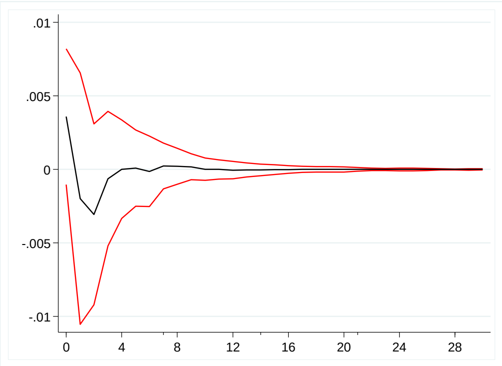
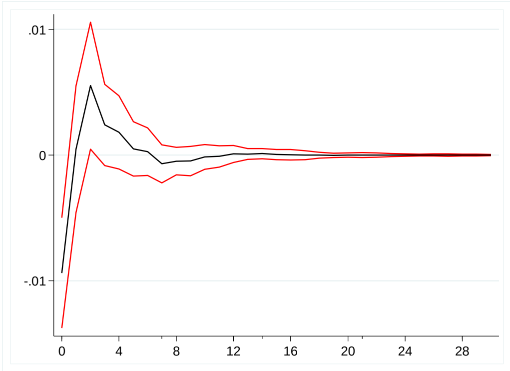


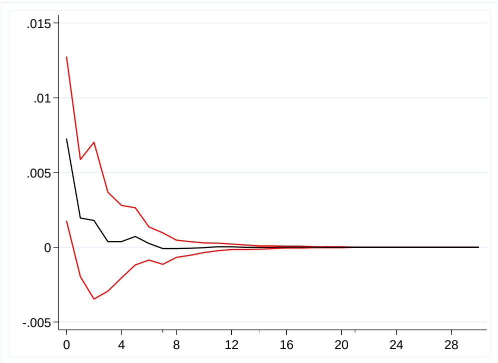
Figure C10: Effects of Oil Price and Exchange Rate (Real Demand) Shocks on *GDP*

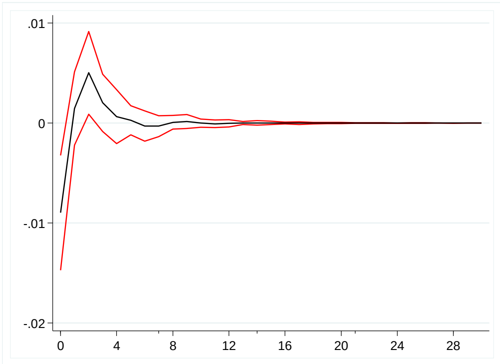
Indonesia



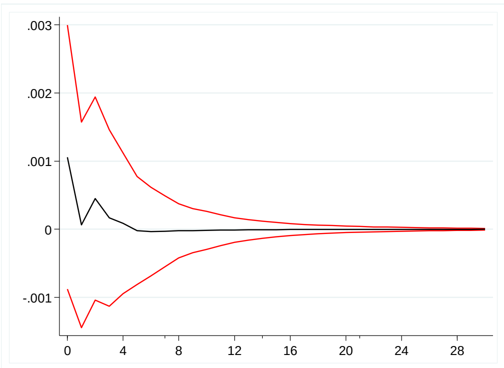


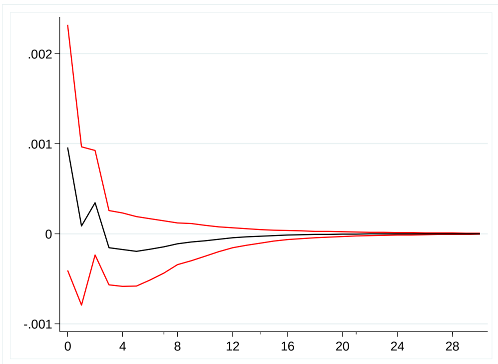
Malaysia





Pakistan





Thailand

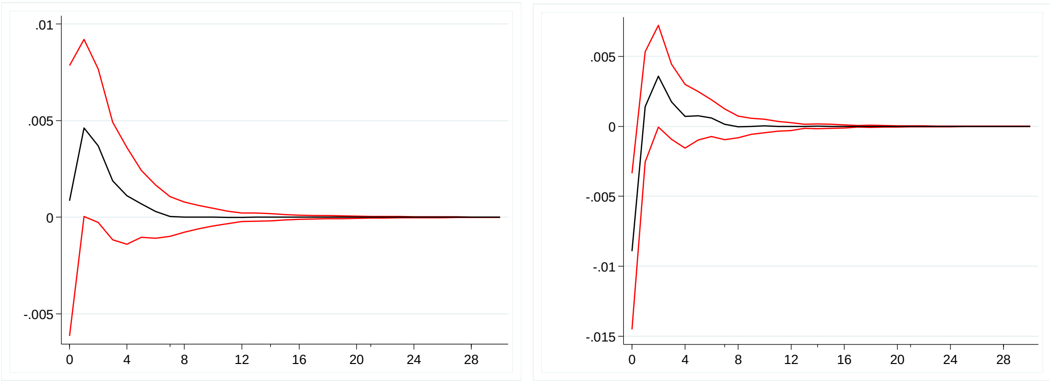
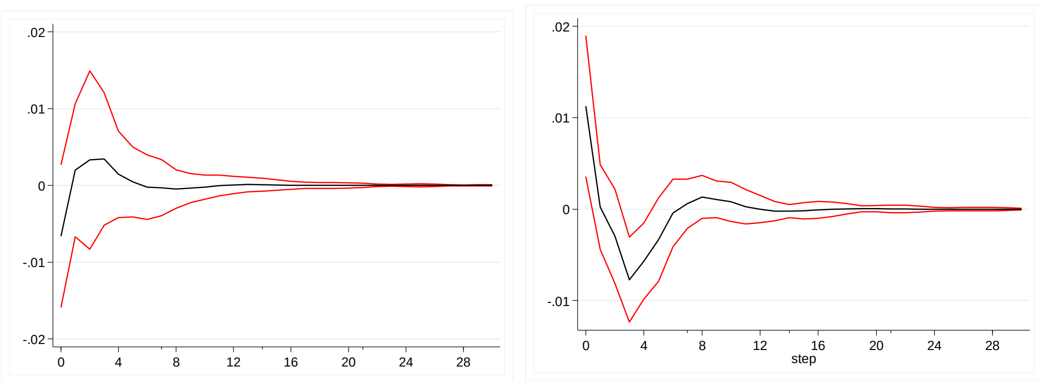
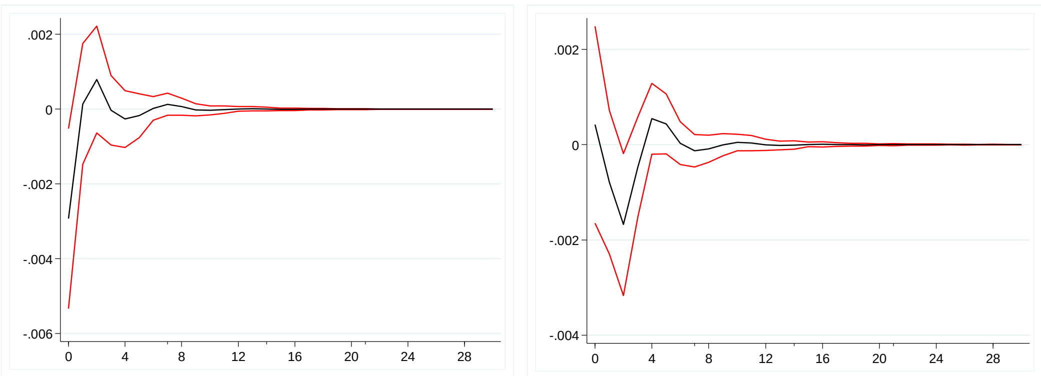


Figure 3.C11: Effects of Oil Price and Exchange Rate (Real Demand) Shocks on Price Level

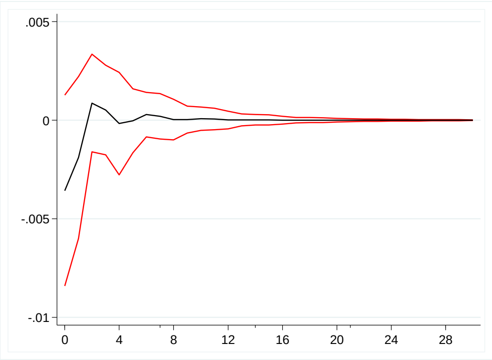
Indonesia

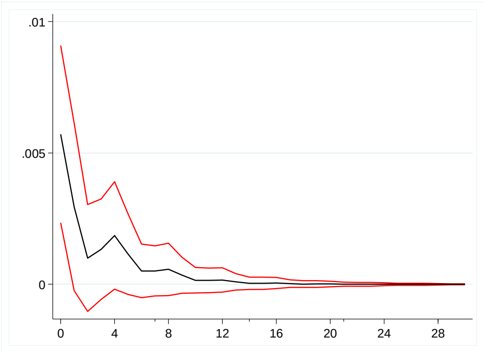


Malaysia

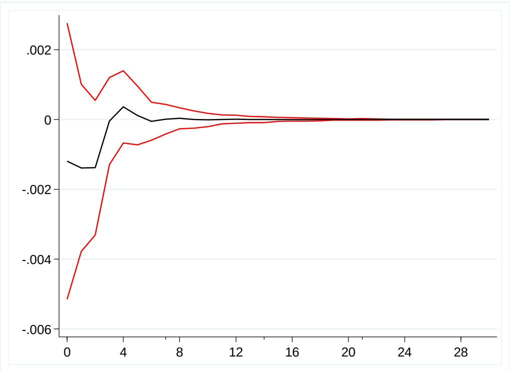


Pakistan





Thailand



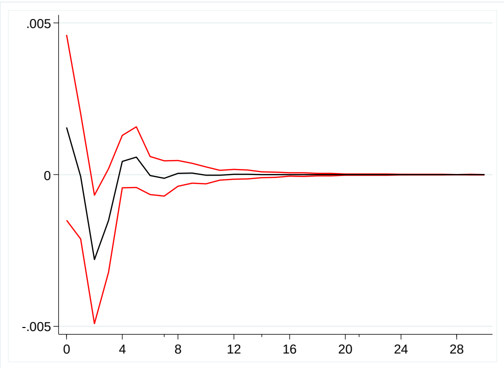
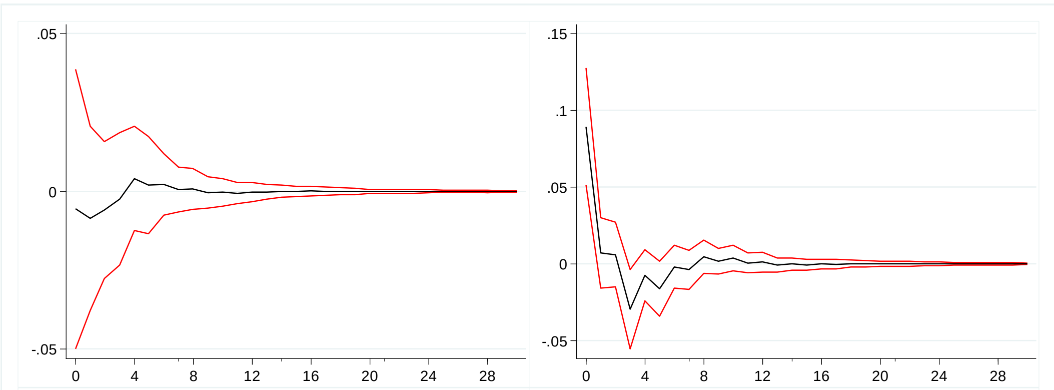


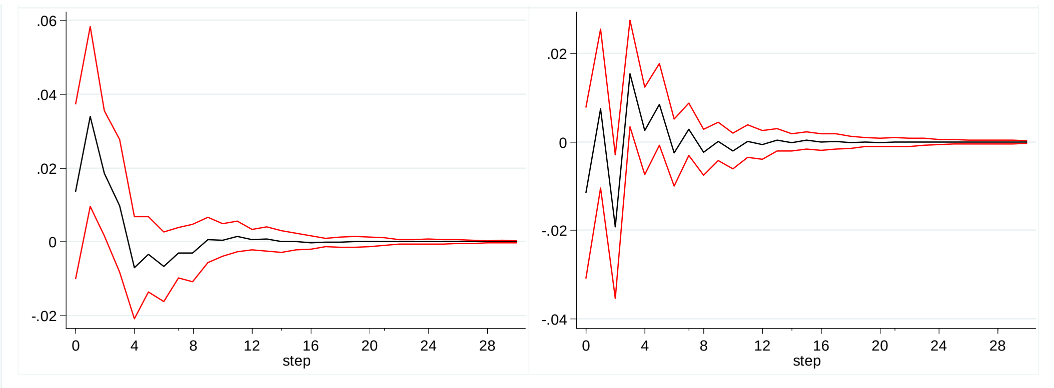
Figure 3.C12: Effects of Structural Shocks on Real exchange rate

Indonesia

Oil price shock **Supply shock**



Exchange rate (real Demand) shock **Demand (nominal) shock**



Appendix Chapter 4

4. A1. Four Sector Solutions for the Optimal Weights in the Stability Price Index

First step is to derive all variables as deviations from their mean value. This is called deviations form (disturb variable) of each variable and is denoted by letting tilde over the variables $\tilde{y} = y - E(y)$, $\tilde{p}_k = p_k - E(p_k)$, $\tilde{p} = p - E(p)$ and $\tilde{\varepsilon} = \varepsilon - E(\varepsilon)$. The expected value of all variable in the deviation form (tilde over) is zero. The model can be express as;

$$\tilde{p}_k^* = \tilde{p} + \beta_k \tilde{y} + \tilde{\varepsilon}_k$$

$$\tilde{p}_k = \lambda_k \tilde{p}_k^* + (1 - \lambda_k) E(\tilde{p}_k^*)$$

$$\tilde{p} = \delta_1 \tilde{p}_1 + \delta_2 \tilde{p}_2 + \delta_3 \tilde{p}_3 + \delta_4 \tilde{p}_4 \qquad (4.E1)$$

$$0 = \omega_1 \tilde{p}_1 + \omega_2 \tilde{p}_2 + \omega_3 \tilde{p}_3 + \omega_4 \tilde{p}_4 \qquad : \left(\sum_{k=1}^{K} \omega_k \tilde{p}_k = 0 \right)$$

Further, the model considers the four sectors in this derivation $(k = 1,2,3,4)$, weight average is equal to zero and sum of the weights must equal to one, the model is written as;

$$\tilde{p}_1 = \lambda_1 (\tilde{p} + \beta_1 \tilde{y} + \tilde{\varepsilon}_1), \qquad (4.E2)$$

$$\tilde{p}_2 = \lambda_2 (\tilde{p} + \beta_2 \tilde{y} + \tilde{\varepsilon}_2), \qquad (4.E3)$$

$$\tilde{p}_3 = \lambda_3 (\tilde{p} + \beta_3 \tilde{y} + \tilde{\varepsilon}_3), \qquad (4.E4)$$

$$\tilde{p}_4 = \lambda_4 (\tilde{p} + \beta_4 \tilde{y} + \tilde{\varepsilon}_4), \qquad (4.E5)$$

$$\tilde{p} = \delta_1 \tilde{p}_1 + \delta_2 \tilde{p}_2 + \delta_3 \tilde{p}_3 + (1 - \delta_1 - \delta_2 - \delta_3)\tilde{p}_4 \, , \tag{4.E6}$$

$$0 = \omega_1 \tilde{p}_1 + \omega_2 \tilde{p}_2 + \omega_3 \tilde{p}_3 + (1 - \omega_1 - \omega_2 - \omega_3)\tilde{p}_4 \, , \tag{4.E7}$$

Where, $\omega_4 = (1 - \omega_1 - \omega_2 - \omega_3)$ and $\delta_4 = (1 - \delta_1 - \delta_2 - \delta_3)$. Equations (4.E2) to (4.E5) are solved for equilibrium sectoral prices.

$$p_1^* = \frac{\begin{array}{l} \lambda_1\beta_1\tilde{y} + \lambda_1\varepsilon_1 - \lambda_1\lambda_4\beta_1\tilde{y} + \lambda_1\lambda_4\beta_1\delta_1\tilde{y} + \lambda_1\lambda_4\beta_2\delta_2\tilde{y} + \lambda_1\lambda_4\beta_1\delta_3\tilde{y} - \lambda_1\lambda_4\varepsilon_1 + \lambda_1\lambda_4\delta_1\varepsilon_1 + \\ \lambda_1\lambda_4\delta_2\varepsilon_1 + \lambda_1\lambda_4\delta_3\varepsilon_1 - \lambda_1\lambda_2\beta_1\delta_2\tilde{y} - \lambda_1\lambda_2\delta_2\varepsilon_1 - \lambda_1\lambda_3\beta_1\delta_3\tilde{y} - \lambda_1\lambda_3\delta_3\varepsilon_1 + \lambda_1\lambda_3\beta_3\delta_3\tilde{y} + \\ \lambda_1\lambda_3\delta_3\varepsilon_3 + \lambda_1\lambda_4\beta_4\tilde{y} - \lambda_1\lambda_4\beta_4\delta_1\tilde{y} - \lambda_1\lambda_4\beta_4\delta_2\tilde{y} - \lambda_1\lambda_4\beta_4\delta_3\tilde{y} + \lambda_1\lambda_4\varepsilon_4 - \lambda_1\lambda_4\delta_1\varepsilon_4 - \\ -\lambda_1\lambda_4\delta_2\varepsilon_4 - \lambda_1\lambda_4\delta_3\varepsilon_4 + \lambda_1\lambda_2\beta_2\delta_2\tilde{y} + \lambda_1\lambda_2\delta_2\varepsilon_2 \end{array}}{1 - \lambda_4 - \lambda_1\delta_1 - \lambda_2\delta_2 - \lambda_3\delta_3 + \lambda_4\delta_1 + \lambda_4\delta_2 + \lambda_4\delta_3} \tag{4.E8}$$

$$p_2^* = \frac{\begin{array}{l} \lambda_2\beta_2 y + \lambda_2\varepsilon_2 - \lambda_2\lambda_4\beta_2\tilde{y} + \lambda_2\lambda_4\beta_2\delta_1\tilde{y} + \lambda_2\lambda_4\beta_2\delta_2\tilde{y} + \lambda_2\lambda_4\beta_2\delta_3\tilde{y} - \lambda_2\lambda_4\varepsilon_2 + \lambda_2\lambda_4\delta_1\varepsilon_2 + \\ \lambda_2\lambda_4\delta_2\varepsilon_2 + \lambda_2\lambda_4\delta_3\varepsilon_2 - \lambda_1\lambda_2\beta_2\delta_1\tilde{y} - \lambda_1\lambda_2\delta_2\varepsilon_2 - \lambda_2\lambda_3\beta_2\delta_3\tilde{y} - \lambda_1\lambda_3\delta_3\varepsilon_2 + \lambda_2\lambda_3\beta_3\delta_3\tilde{y} + \\ \lambda_2\lambda_3\delta_3\varepsilon_3 + \lambda_2\lambda_4\beta_4\tilde{y} - \lambda_2\lambda_4\beta_4\delta_1\tilde{y} - \lambda_2\lambda_4\beta_4\delta_2\tilde{y} - \lambda_2\lambda_4\beta_4\delta_3\tilde{y} + \lambda_2\lambda_4\varepsilon_4 - \lambda_2\lambda_4\delta_1\varepsilon_4 - \\ \lambda_2\lambda_4\delta_2\varepsilon_4 - \lambda_2\lambda_4\delta_3\varepsilon_4 + \lambda_1\lambda_2\beta_1\delta_1\tilde{y} + \lambda_1\lambda_2\delta_1\varepsilon_1 \end{array}}{1 - \lambda_4 - \lambda_1\delta_1 - \lambda_2\delta_2 - \lambda_3\delta_3 + \lambda_4\delta_1 + \lambda_4\delta_2 + \lambda_4\delta_3} \tag{4.E9}$$

$$p_3^* = \frac{\begin{array}{l} \lambda_3\beta_3\tilde{y} + \lambda_3\varepsilon_3 - \lambda_1\lambda_3\beta_3\delta_1\tilde{y} - \lambda_1\lambda_3\delta_1\varepsilon_3 - \lambda_2\lambda_3\beta_3\delta_2\tilde{y} - \lambda_2\lambda_3\delta_2\varepsilon_3 - \lambda_3\lambda_4\beta_3\tilde{y} + \lambda_3\lambda_4\beta_3\delta_1\tilde{y} + \\ \lambda_3\lambda_4\beta_3\delta_2\tilde{y} + \lambda_3\lambda_4\beta_3\delta_3\tilde{y} - \lambda_3\lambda_4\varepsilon_3 + \lambda_3\lambda_4\delta_1\varepsilon_3 + \lambda_3\lambda_4\delta_2\varepsilon_3 + \lambda_3\lambda_4\delta_{43}\varepsilon_3 + \lambda_3\lambda_4\beta_4\tilde{y} - \\ \lambda_3\lambda_4\beta_4\delta_1\tilde{y} - \lambda_3\lambda_4\beta_4\delta_2\tilde{y} - \lambda_3\lambda_4\beta_4\delta_3\tilde{y} + \lambda_3\lambda_4\varepsilon_4 - \lambda_3\lambda_4\delta_1\varepsilon_4 - \lambda_3\lambda_4\delta_2\varepsilon_4 - \lambda_3\lambda_4\delta_3\varepsilon_4 + \\ \lambda_2\lambda_3\beta_2\delta_2\tilde{y} + \lambda_2\lambda_3\delta_2\varepsilon_2 + \lambda_1\lambda_3\beta_1\delta_1\tilde{y} + \lambda_1\lambda_3\delta_1\varepsilon_1 \end{array}}{1 - \lambda_4 - \lambda_1\delta_1 - \lambda_2\delta_2 - \lambda_3\delta_3 + \lambda_4\delta_1 + \lambda_4\delta_2 + \lambda_4\delta_3} \tag{4.E10}$$

$$p_4^* = \frac{\begin{array}{l} \lambda_4\alpha_4\tilde{y} + \lambda_4\varepsilon_4 - \lambda_3\lambda_4\alpha_4\delta_3\tilde{y} - \lambda_3\lambda_4\delta_3\varepsilon_4 - \lambda_1\lambda_4\alpha_4\delta_1\tilde{y} - \lambda_1\lambda_4\delta_1\varepsilon_4 - \lambda_2\lambda_4\alpha_4\delta_2\tilde{y} - \lambda_2\lambda_4\delta_2\varepsilon_4 \\ + \lambda_3\lambda_4\alpha_3\delta_3\tilde{y} + \lambda_3\lambda_4\delta_3\varepsilon_3 + \lambda_2\lambda_4\alpha_2\delta_2\tilde{y} + \lambda_2\lambda_4\delta_2\varepsilon_2 + \lambda_1\lambda_4\alpha_1\delta_1\tilde{y} + \lambda_1\lambda_4\delta_1\varepsilon_1 \end{array}}{1 - \lambda_4 - \lambda_1\delta_1 - \lambda_2\delta_2 - \lambda_3\delta_3 + \lambda_4\delta_1 + \lambda_4\delta_2 + \lambda_4\delta_3} \tag{4.E11}$$

Substituting equations (4.E8), (4.E9), (4.E10) and (4.E11) into equation (4.E7) and to solving for variable (y), in terms of the parameters $(\beta_k, \lambda_k, \delta_k, \omega_k)$ and the shocks (ε_k). Taking unconditional expectation of the square of output gap, the variance of output gap is obtained as a function of $\beta_k, \delta_k, \lambda_k, \omega_k$ and the variance of $E(\tilde{\varepsilon}_k)^2 = \sigma_k^2$ (but covariance's of the shocks are uncorrelated, i.e. $E(\varepsilon_k, \varepsilon_j = \sigma_{kj} = 0)$.

$$Var(\tilde{y}) = \frac{\begin{aligned}&[\sigma_1^2\{\lambda_1\omega_1 + \lambda_1\lambda_4\delta_1 - \lambda_1\lambda_4\omega_1 + \lambda_1\lambda_3\omega_3\delta_1 - \lambda_1\lambda_4\omega_3\delta_1 + \lambda_1\lambda_2\omega_2\delta_1 - \\ &\lambda_1\lambda_4\omega_2\delta_1 - \lambda_1\lambda_2\omega_1\delta_2 - \lambda_1\lambda_3\omega_1\delta_3 + \lambda_1\lambda_4\omega_1\delta_2 + \lambda_1\lambda_4\omega_1\delta_3\}^\wedge 2 + \\ &\sigma_2^2\{\lambda_2\omega_2 + \lambda_2\lambda_4\delta_2 - \lambda_2\lambda_4\omega_2 + \lambda_2\lambda_3\omega_3\delta_2 + \lambda_1\lambda_2\omega_1\delta_2 - \lambda_2\lambda_4\omega_3\delta_2 + \\ &\lambda_2\lambda_3\omega_2\delta_3 - \lambda_2\lambda_4\omega_1\delta_2 - \lambda_1\lambda_2\omega_2\delta_1 - \lambda_2\lambda_3\omega_2\delta_3 + \lambda_2\lambda_4\omega_2\delta_1 + \\ &\lambda_2\lambda_4\omega_2\delta_3\}^\wedge 2 + \sigma_3^2\{\lambda_3\omega_3 + \lambda_3\lambda_4\delta_3 - \lambda_3\lambda_4\omega_3 + \lambda_1\lambda_3\omega_1\delta_2 - \lambda_3\lambda_4\omega_1\delta_3 - \\ &\lambda_3\lambda_4\omega_2\delta_3 - \lambda_1\lambda_3\omega_3\delta_1 - \lambda_2\lambda_3\omega_3\delta_2 + \lambda_3\lambda_4\omega_3\delta_1 + \lambda_2\lambda_3\omega_2\delta_3\}^\wedge 2 + \\ &\sigma_4^2\{\lambda_4 + \lambda_3\lambda_4\omega_3 + \lambda_1\lambda_4\omega_1 + \lambda_2\lambda_4\omega_2 - \lambda_1\lambda_4\delta_1 - \lambda_2\lambda_4\delta_2 - \lambda_3\lambda_4\delta_3 - \\ &\lambda_4\omega_1 - \lambda_4\omega_2 - \lambda_4\omega_3 - \lambda_3\lambda_4\omega_3\delta_1 - \lambda_3\lambda_4\omega_3\delta_2 - \lambda_1\lambda_4\omega_1\delta_3 - \lambda_2\lambda_4\omega_2\delta_1 - \\ &\lambda_2\lambda_4\omega_2\delta_3 + \lambda_1\lambda_4\omega_2\delta_1 + \lambda_1\lambda_4\omega_3\delta_1 + \lambda_2\lambda_4\omega_1\delta_2 + \lambda_2\lambda_4\omega_3\delta_2 + \lambda_3\lambda_4\omega_2\delta_3 \\ &+ \lambda_3\lambda_4\omega_1\delta_3\}^\wedge 2]\end{aligned}}{\begin{aligned}&[\{\lambda_4\beta_4 + \lambda_1\omega_1\beta_1 + \lambda_2\omega_2\beta_2 + \lambda_3\omega_3\beta_3 - \lambda_4\omega_1\beta_4 - \lambda_4\omega_1\beta_4 - \lambda_4\omega_2\beta_4 - \lambda_4\omega_3\beta_4 + \\ &\lambda_1\lambda_3\omega_3\delta_1\beta_1 - \lambda_3\lambda_4\omega_3\delta_1\beta_4 + \lambda_2\lambda_3\omega_3\delta_2\beta_2 + \lambda_3\lambda_4\omega_3\beta_4 + \lambda_1\lambda_4\omega_1\beta_4 + \\ &\lambda_2\lambda_4\omega_2\beta_4 - \lambda_3\lambda_4\omega_3\delta_2\beta_4 + \lambda_1\lambda_2\omega_1\delta_2\beta_2 + \lambda_1\lambda_3\omega_1\delta_3\beta_3 - \lambda_1\lambda_4\omega_1\delta_4\beta_4 - \\ &\lambda_1\lambda_4\omega_1\delta_3\beta_4 + \lambda_2\lambda_3\omega_2\delta_3\beta_3 - \lambda_3\lambda_4\omega_3\delta_2\beta_4 + \lambda_1\lambda_2\omega_1\delta_2\beta_2 + \lambda_1\lambda_3\omega_1\delta_3\beta_3 - \\ &\lambda_1\lambda_4\omega_1\delta_4\beta_4 - \lambda_1\lambda_4\omega_1\delta_3\beta_4 + \lambda_2\lambda_3\omega_2\delta_3\beta_3 - \lambda_2\lambda_4\omega_2\delta_1\beta_4 + \lambda_1\lambda_4\delta_1\beta_1 - \\ &\lambda_1\lambda_4\omega_3\delta_1\beta_1 - \lambda_2\lambda_4\omega_3\delta_2\beta_2 + \lambda_1\lambda_2\omega_2\delta_1\beta_1 + \lambda_2\lambda_4\delta_2\beta_2 + \lambda_3\lambda_4\delta_3\beta_3 + \\ &\lambda_1\lambda_4\omega_2\delta_1\beta_4 - \lambda_2\lambda_4\omega_2\delta_3\beta_4 - \lambda_2\lambda_4\omega_1\delta_2\beta_2 - \lambda_3\lambda_4\omega_1\delta_3\beta_3 - \lambda_1\lambda_4\omega_2\delta_1\beta_1 - \\ &\lambda_3\lambda_4\omega_2\delta_3\beta_3 - \lambda_2\lambda_3\omega_3\delta_2\beta_3 + \lambda_3\lambda_4\omega_1\delta_3\beta_4 - \lambda_3\lambda_4\delta_3\beta_4 + \lambda_3\lambda_4\omega_2\delta_3\beta_4 - \\ &\lambda_2\lambda_3\omega_2\delta_3\beta_2 - \lambda_2\lambda_4\omega_2\beta_2 - \lambda_1\lambda_4\delta_1\beta_4 - \lambda_1\lambda_2\omega_2\delta_1\beta_2 + \lambda_1\lambda_4\omega_3\delta_1\beta_4 - \\ &\lambda_1\lambda_3\omega_3\delta_1\beta_3 + \lambda_2\lambda_4\omega_1\delta_2\beta_4 - \lambda_2\lambda_4\delta_2\beta_4 - \lambda_1\lambda_2\omega_1\delta_2\beta_1 + \lambda_2\lambda_4\omega_3\delta_2\beta_4 - \\ &\lambda_1\lambda_3\omega_1\delta_3\beta_1 + \lambda_2\lambda_4\omega_2\delta_1\beta_2 + \lambda_3\lambda_4\omega_3\delta_1\beta_3 + \lambda_1\lambda_4\omega_1\delta_2\beta_1 + \lambda_1\lambda_2\omega_2\delta_1\beta_2 + \\ &\lambda_3\lambda_4\omega_3\delta_2\beta_3 + \lambda_2\lambda_4\omega_2\delta_3\beta_2 + \lambda_1\lambda_4\omega_1\delta_3\beta_1 - \lambda_1\lambda_4\omega_1\beta_1 - \lambda_3\lambda_4\omega_3\beta_3\}^\wedge 2]\end{aligned}} \qquad (4.E12)$$

Given values for these parameters $(\beta_k, \delta_k, \lambda_k, \sigma^2)$ then minimise the variance of output gap with respect to the $\omega_1, \omega_2, \omega_3$ and ω_1, subject to the constraint that sum of weights are equal to one i.e. $\sum_{k=1}^{K}\omega_k = 1$ and probably imposing non-negative constraints $(\omega_k \geq 0)$. The desire optimal weights $\omega_1^*, \omega_2^*, \omega_3^*$ and ω_4^* can be obtained:

4. A2. Generalise Method Moments

The Generalise Method of moments (*GMM*) has been applied more frequently in financial economics. Because most data sets such as inflation, prices and stock prices are characterised by fat-tailed and skewed distributions in finance (Chausse; 2010). *GMM* does not require all information about the data and does not apply any restrictions on the distribution of the data. As a result, estimators computed from the *GMM* method are more consistent, efficient and are asymptotically normally distributed for the parameters of the models. In time series analysis, the *GMM* weighted matrix is used to account for serial correlation in the error terms of unknown form as well as for heteroskedasticity. In some cases, models experience misspecification because these have more moment's condition than the model parameters. *GMM* is more appropriate than other econometric methods to test the specification of the model. *GMM* is an instrumental variables process that reduces the correlation among the shocks.

The *GMM* estimator combines the moment conditions and parameters optimally when moment conditions are more than the parameters. It estimates the parameters by minimizing the sum of squares of the differences between true moments from sample moments. The *GMM* with moment conditions was used by Hansen (1982) who introduced and formalized generalized method of moments mainly with time series applications. It can be observed as a generalization of various other econometric estimation methods such as ordinary least square, instrumental variables or maximum likelihood. The theory and notation is the same as used by Hamilton (1994; Chapter 14).

Let us θ be a $(a \times 1)$ vector of coefficients with the true unknown parameter θ_0, w_t be a $(h \times 1)$ vector of random variables, and a $(r \times 1)$ vector valued function $h(\theta, w_t)$. $h(\theta, w_t)$

, can be observed as random variable from a model. Considers r described as sample orthogonality conditions;

$$g(\theta;Y_T)\equiv\frac{1}{T}\sum_{t=1}^{T}h(\theta,w_t) \qquad (4.E13)$$

Let Y_T is a $(Th\times 1)$vector $(w_T^{'}, w_{T-1}^{'},.......w_1^{'})'$ containing all the observations in a sample of size T and $g(\theta;Y_T)$denote the sample average of $h(\theta,w_t)$. Note that g: $R^a \longrightarrow R^r$. The idea behind *GMM* is to select θ based on bringing sample moments $g(\theta;Y_T)$as close as possible to the population moment of zero. The *GMM* estimator $\hat{\theta}$ is the value of θ that minimises the scalar with respect to the parameter θ;

$$Q(\theta;Y_T)=\left[g(\theta;Y_T)'W_T g(\theta;Y_T)\right] \qquad (4.E14)$$

Where $\{W_T\}_{T=1}^{\infty}$ is a positive definite $(r\times r)$weighting matrix which is in general a function of the data Y_T. If $a=r$, then the $g(\theta;Y_T)=0$. If instead the number of orthogonality conditions are more than the number of parameters $(r>a)$ then $g(\theta;Y_T)\neq 0$ in general. Under fairly general stationarity, continuity, and moment conditions, the value of $\hat{\theta}_T$ that minimises (4.E14) is a consistent estimate of θ_0 (see Hansen, 1982). While, the minimum asymptotic variance of the *GMM* estimator $\hat{\theta}_T$ is obtained by a proper choice of the weighting matrix W_T. The *GMM* estimator $\hat{\theta}_T$ is therefore defined as;

$$\hat{\theta}_T = \arg\ \min_{\theta}[g(\theta;Y_T)]'\ S^{-1}[g(\theta;Y_T)] \qquad (4.E15)$$

The optimal weighting matrix W_T in (4.E14) is the inverse of the asymptotic variance matrix $\left(S^{-1}\right)$.

$$V = \left\{DS^{-1}D'\right\}^{-1} \qquad (4.E16)$$

Where, V is the asymptotic variance and can be estimated using consistent estimators. This implies that we can treat $\hat{\theta}_T$ approximately as;

$$\hat{\theta}_T \approx N\left(\theta_0, \frac{\hat{V}_T}{T}\right) \qquad (4.E17)$$

Where, $\hat{V}_T = \left\{\hat{D}_T \hat{S}_T^{-1} \hat{D}_T'\right\}^{-1}$ and the $D_T' = \frac{\partial g(\theta; Y_T)}{\partial \theta'}\Big|_{\theta=\hat{\theta}_T}$. Since the vector holds no degenerate random variables, it spins out that a proper test of the overidentifying restrictions for the case when $r > a$ can be based on the fact that;

$$\left[\sqrt{T}.g\left(\hat{\theta}_T; Y_T\right)\right]' S^{-1}\left[\sqrt{T}.g\left(\hat{\theta}_T; Y_T\right)\right] \xrightarrow{L} \chi^2(r-a) \qquad (4.E18)$$

This is the Hansen test for overidentifying restrictions.

Appendix 4.B

Table 4.B1 - Parameters and Optimal Weights for Malaysia – Stock Prices

Sector	λ_k	β_k	$Var(\varepsilon)$	δ_k	ω_k^{UC}	ω_k^{C}
Housing & Energy	1	0.0672 (0.0458)	0.00010	0.214	0.30	0
Food	1	0.1012 (0.0473)	0.00007	0.333	-0.46	0
Other goods	0.5	0.2312 (0.152)	0.00042	0.453	2.59	0.59
Stock	0.7	6.5122 (1.2396)	0.05485	0	-1.43	0.41

Table 4.B2 - Correlation Matrix of Shock for Malaysia –Stock Prices

Sector	House-Rent & Energy	Food	Other goods	Stock Prices
House-Rent & Energy	1	-0.2382	-0.4296	0.0526
Food		1	-0.56622	0.1617
Other goods			1	-0.0597
Stock				1

Table 4.B3 - Correlation Matrix of Shock for Pakistan –Stock Prices

Sector	House-Rent & Energy	Food	Other goods	Stock Prices
House-Rent & Energy	1	-0.5047	0.3899	-0.1056
Food		1	-0.2151	-0.5390
Other goods			1	0.31072
Stock				1

Table 4.B4 - Correlation Matrix of Shock for Malaysia – Fundamental Stock Prices

Sector	House-Rent & Energy	Food	Other goods	Stock Prices
House-Rent & Energy	1	-0.2804	-0.4497	0.2409
Food		1	-0.5662	0.1026
Other goods			1	-0.3632
Fundamental				1

Table 4.B5 - Correlation Matrix of Shock for Pakistan – Fundamental Stock Prices

Sector	Energy	Food	Other goods & Services	Stock Prices
Energy	1	0.36136	0.6851	0.6236
Food		1	0.477224	0.187346
Other goods			1	0.3107
Fundamental				1

Table 4.B6 - Correlation Matrix of Shock for Malaysia – Bubbles

Sector	House-Rent & Energy	Food	Other goods	Stock Prices
House-Rent & Energy	1	-0.2804	-0.4496	0.3116
Food		1	-0.56	0.0076
Other goods			1	-0.2410
Bubbles				1

Table 4.B7 - Correlation Matrix of Shock for Pakistan – Bubbles

Sector	Energy	Food	Other goods & Services	Stock Prices
Energy	1	0.3614	0.6850	-0.0816
Food		1	0.4772	-0.4379
Other goods			1	-0.1139
Bubbles				1

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