

The HIS (Holistic Inflation Surveillance) Framework:
An Analysis of Inflation Dynamics during Periods of High Cost-Push Inflation**

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Abstract

As the economy evolves structurally, inflation surveillance becomes more challenging and necessitates refinement to the conventional surveillance framework. This paper highlights two main topics in the area of inflation surveillance and forecast: the common practices by other central banks; and the approach that Bank Negara Malaysia undertakes to supplement the conventional method given the country's inflation dynamic. The latter includes how Bank Negara Malaysia conducts its surveillance on knock-on effects (indirect spillover from increase in cost factors) and second-round effects to inflation, and complements the work-horse model for inflation forecast with additional statistical models.

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**The views expressed herein are solely those of the authors and do not necessarily reflect the views of Bank Negara Malaysia.

1. Introduction

Price stability has always been one of the important mandates, if not the most, for central banks to uphold. As such, many central banks choose to adopt the inflation targeting framework as the anchor for their monetary policy in ensuring that price stability is in check. Ensuring price stability is important to ensure that resources are efficiently allocated through rational decision-making. When prices are stable, firms and households are insusceptible to the risks of volatile price movements and subsequently able to allocate their resources efficiently. The environment of stable prices will enable firms to better plan their production and investment, as well as deciding on their selling prices. Similarly, household would be able to plan on their consumption and savings. The environment of low uncertainty will subsequently facilitate stronger economic growth.

However, with bouts of global commodity price shocks since 2000s, central banks are having difficulties in achieving their mandate of ensuring price stability. This could be partly due to the changes in inflation dynamics over the past decade, where the sources of inflationary pressures are no longer constrained to domestic factors, but also external factors. This warrants a comprehensive review of the conventional inflation surveillance and forecast framework. In light of this, Bank Negara Malaysia undertakes a different and more holistic surveillance approach, to supplement the conventional methods

2. Conventional methods of inflation surveillance

The foundation of conventional inflation surveillance framework is the concept of New Keynesian Phillips Curve (NKPC), in which inflation is determined by demand-pull factors, supply-push factors and inflation expectation. The typical inflation surveillance can be divided into three main activities, namely monitoring of various inflation indicators, forecasting of inflation path and trajectory and assessing the balance of risk of inflation.

i. Monitoring various inflation indicators.

Central banks typically monitor indicators to form a view on the potential sources of price pressure going forward. Identifying the source of inflation (*ex-ante*) is important as different source of price pressure warrants a different policy action. The inflation indicators can be grouped into three categories namely demand indicators, cost and supply indicators and inflation expectation indicators.

- a) **Demand indicators.** As inflation could accelerate when demand increases beyond the productive capability of an economy, many central banks keep a tight surveillance on demand conditions, particularly those from the households. Moreover, monetary policy has been well established as a demand management tool, while having limited influence on supply-driven inflation. Hence, to gauge the demand conditions, some of the demand indicators that central banks usually monitor are household consumption, investment activities, capacity utilisation and output gap¹. Another common demand indicator that central bank would assess is core inflation, which attempt to measure the underlying level of inflation. Due to the volatility of global commodity prices, headline inflation tends to mimic trend of commodity prices. As such, central banks will need to monitor the underlying inflationary pressure to gauge whether there is a broad-based increase in prices of other goods and services. That said, most central bank will keep close monitor on the movement of the core inflation, generally excluding prices of items that are volatile (i.e. perishable food items, administered prices, domestic fuel price) to analyse the impact of a price shock.

- b) **Cost and supply indicators.** Inflation could also increase from cost and supply factors following the decline in aggregate supply, which could be caused by natural disasters, adverse weather conditions or increased prices of inputs. A classic example of how cost and supply factors could affect domestic inflation is the movement in global commodity prices. For a country that does not have an energy subsidy in place, its domestic inflation is

¹ The Bank has seven measures of potential output namely the univariate linear trend, univariate state space, Hodrick-Prescott, multivariate Kalman filter, multivariate filter, structural vector autoregression and Cobb-Douglas production function.

susceptible to the movement in global commodity prices. The common cost and supply indicators that central bank monitor are global commodity prices, movement in key import partners' exchange rates and inflation, as well as producer price inflation.

- c) **Inflation expectations.** A price shock will have a transitory impact on inflation if inflation expectations of firms and consumers are well-anchored. In contrast, if a price shock leads to an increase and eventually unanchored inflation expectations, firms and consumers may change their investment and consumption behaviour, which could result in higher inflation. For example, workers might demand for higher wages due to rising expectations of inflation. If firms accommodate the wage demand, they will incur higher labour cost and eventually, raise prices to cope with the rising cost. In terms of indicators, central banks would monitor consumers' inflation expectation, forecast of inflation from analysts or professional forecasters and the term structure.

ii. Forecasting of inflation path and trajectory

As most central banks' objective is to keep inflation low and stable, the key components of monetary policy is dependent on the optimum inflation forecast (Svensson, 2005). Most central banks rely on econometric models to provide an inflation forecast and simulation. In most cases, central bank has a suite of models to forecast inflation within different forecast horizons.

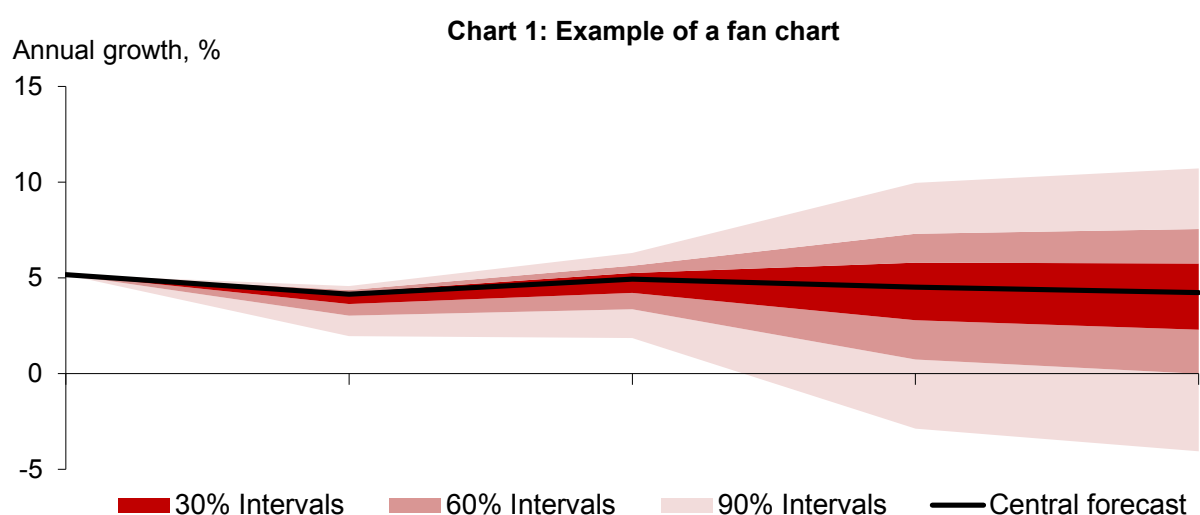
Table 1: Inflation forecasting models

Type of model	Forecast horizon	Explanation
Short-term model		
1. Nowcasting model	1 month ahead	The nowcasts uses high-frequency daily/weekly data to produce inflation forecast of one-month ahead
2. Univariate model (e.g. ARIMA model)	3-6 months ahead	Time series is expressed in terms of past values of itself plus current and lagged values of a 'white noise' error term (the moving average component)

Medium-term model		
3. Phillips Curve model	12-24 months ahead	A model that is based on theoretical foundation in which inflation is a function of its determinants comprising of inflation expectation, output gap and unemployment
4. VAR model	12-24 months ahead	A theoretical model that captures the linear interdependencies among variables
Long-term model		
5. Structural model /DSGE ² model	>24 months	Applied flow of fund concept or general equilibrium model that accounts for dynamic interrelationships between agents based on microeconomic foundations

iii. Assessing the balance of risk of inflation via fan chart

In addition to the point forecast that an inflation forecast model produce, central banks would also perform an analysis on the balance of risk to inflation (e.g. upside risk and downside risk to inflation) using fan charts³. The fan chart depicts the probability of various outcomes for inflation in the future. The term ‘fan chart’ was first introduced by the Bank of England in 1997 in its ‘Inflation Report’ to describe its best prevision of future inflation to the public.

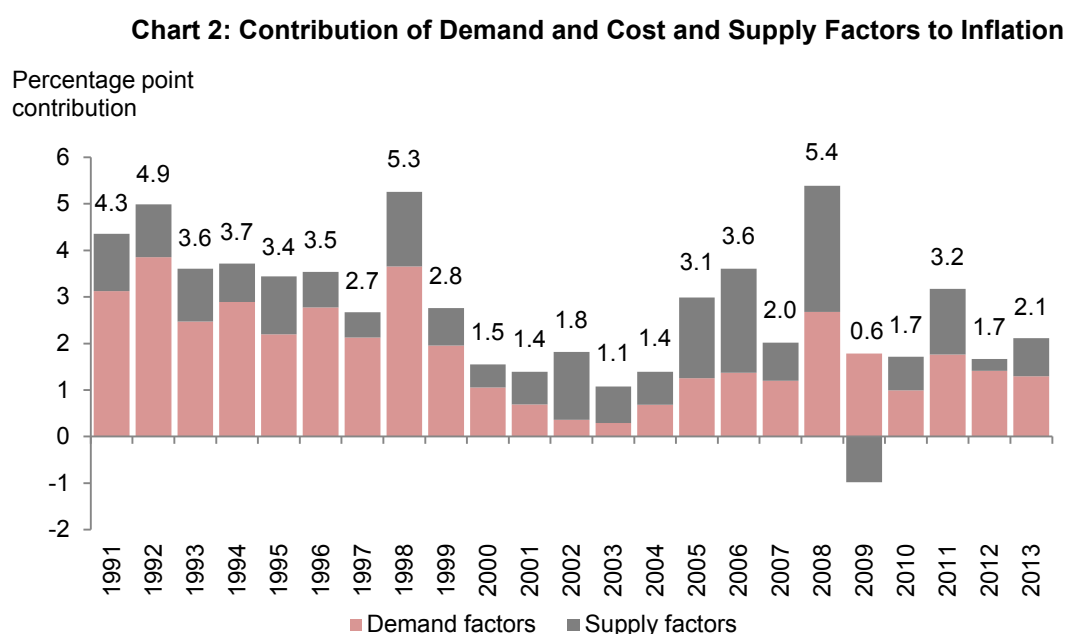


² DSGE model stands for Dynamic Stochastic General Equilibrium model

³ A fan chart is a line chart of possible future outcomes given various assumptions. As prediction become more uncertain, these forecast ranges spread out, creating a distinctive wedge or ‘fan’ shape.

3. Inflation surveillance in Malaysia

Historically, inflation in Malaysia has been low, with average inflation of 3% from 1957-2013. The relative roles of key inflation drivers and their dynamics have shifted over time as the structure of the economy and the behaviours of economic agents in Malaysia evolved. Since the early 2000s, cost and supply factors seem to be more dominant in driving inflation.

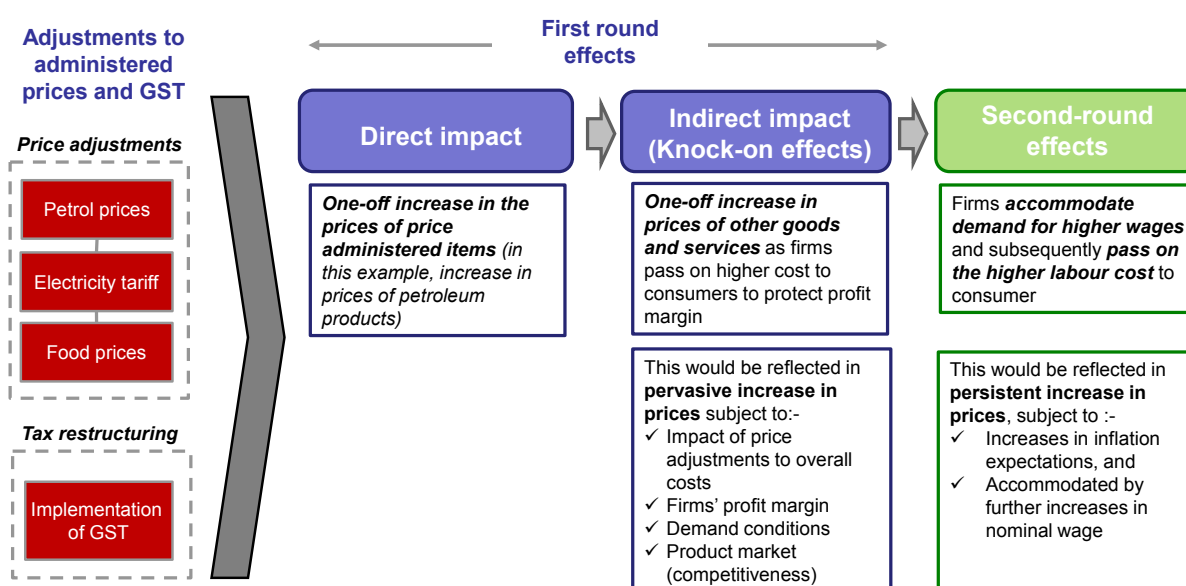


Source: Bank Negara Malaysia

Also, an important feature to note is that prices of basic necessities in Malaysia are mostly administered. Approximately 20% of items in the Consumer Price Index (CPI) basket are price-administered items, such as petroleum products, electricity tariff, cooking oil and wheat flour. As a result, when there is an upward adjustment made to the prices of administered items, prices would increase at a faster rate. As inflation in Malaysia is mainly driven by cost and supply factors, there is a pressing need to establish a more *“holistic inflation surveillance”* framework for policy analysis purposes. It is important to have a clear understanding of key drivers of inflation process and how they have evolved to ensure that appropriate policies are undertaken.

In order to better illustrate the “*holistic inflation surveillance*” framework, an example of price adjustment to petroleum products (fuel) and the subsequent impact on other CPI items is used. The framework is a two-fold process, where the first layer of analysis is on the **first-round effects** and, the second layer is on the **second-round effects** on inflation.

Chart 3: Illustration of the Holistic Inflation Surveillance (HIS) practiced by Bank Negara Malaysia



3.1. First-round effects

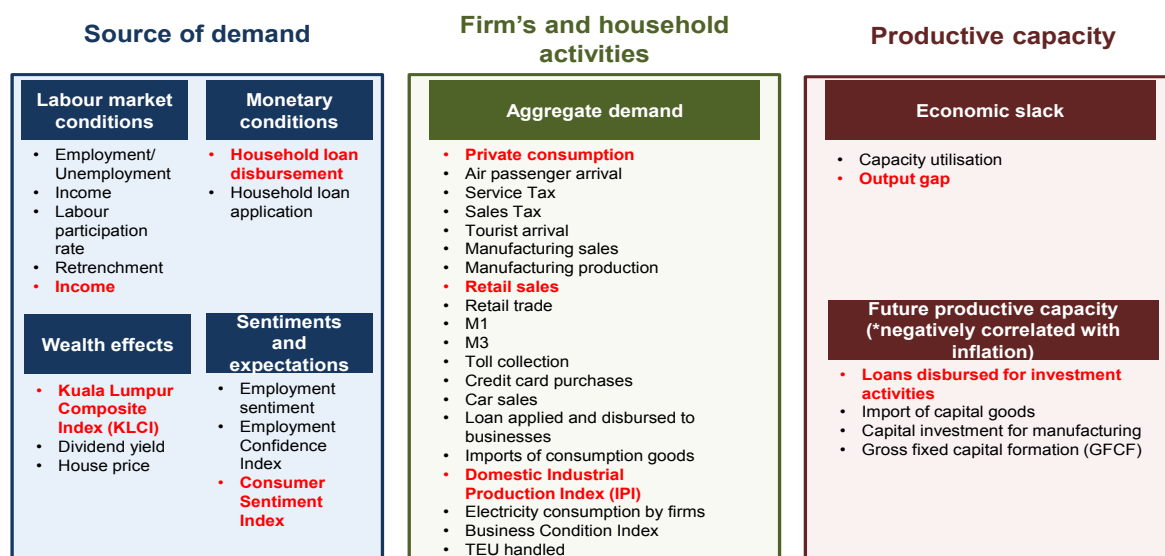
There are two types of first-round effects, namely the *direct effects* and the *indirect effects*, which are also known as the *knock-on effects*. The *direct effects* describe the price increase of the price-administered items in the CPI basket. Taking the adjustment to fuel prices as an example, the price increase for CPI fuel is the direct impact. Subsequently, as a result of higher transportation cost, firms producing other goods and services will face higher operating cost and lower profit margin. Hence, firms may raise the prices of their goods to maintain the same profit margin. This is known as the *knock-on effects*. The extent of which this knock-on effects on other goods and services in CPI would then be reflected in the pervasiveness of price increases of other goods and services in the CPI basket. The ability of firms to raise prices will be subject to several criteria, such as the **impact of price adjustments to**

overall costs, firms' net operating profit margin, demand conditions, product market (competitiveness) and other supply factors.

- i. **Impact of price adjustments to overall costs.** If transportation cost accounts for a large share in firms' total operating cost, it is more likely for firms to pass on some of the increase in transport cost to consumers. In order to develop a database on firms' cost structure, the Bank conducts annual and quarterly surveys on firms across various industries⁴. This information would facilitate in the estimation of the impact of adjustment to prices of petroleum products on firms' operating cost and subsequent impact on prices.
- ii. **Firms' net operating profit margin.** In general, firms operate in a profit-maximising manner. Hence, if firms' net operating profit margin is declining as a result of higher cost, it is more likely for firms to raise prices of their products to protect or maintain its desirable profit margin. The Bank performs an assessment on the net operating profit margin of about 300 listed companies in Malaysia.
- iii. **Demand conditions.** While firms may face higher operating costs due to rising transportation cost, they may not be able to raise prices if consumer demand is not strong or not sustainable. As such, the Bank institutes a framework to assess the demand conditions in the economy by monitoring a group of demand-related indicators. There are about 40 demand-related indicators based on their strength of relationship to core inflation, which are divided into three main blocks, namely the source of demand, the subsequent impact on consumers' and firms' activity, as well as firms' ability to enhance productive capacity to meet the demand (refer to chart 4).

⁴ The questionnaires also cover firms' intention to increase selling prices of their products and the magnitude of increase, if any, in order to protect their profit margin.

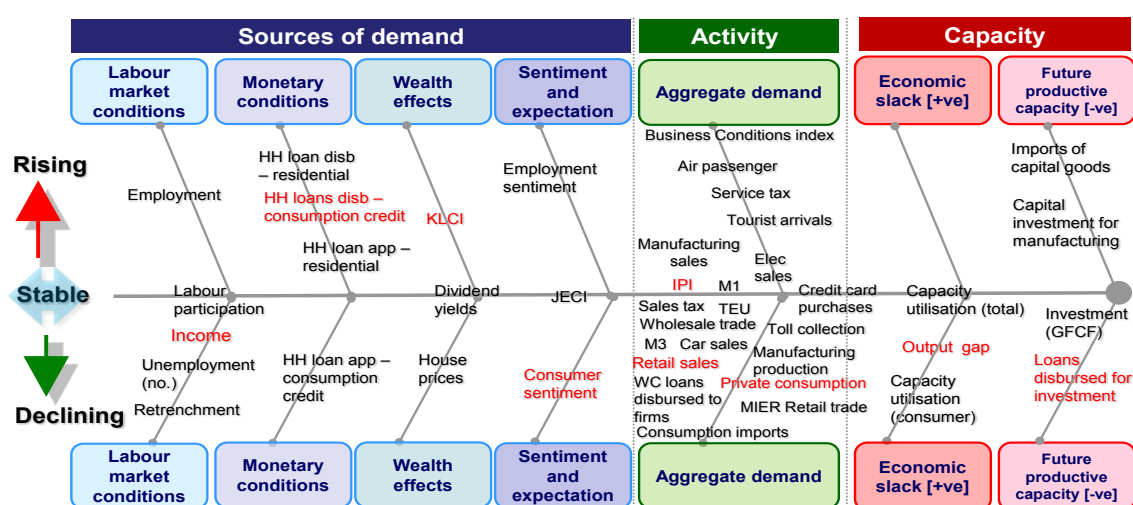
Chart 4: List of demand-related indicators



* **Red font** indicates key indicators which have robust relationship with core inflation

Demand pressure on inflation is assessed via a two-pronged approach. First, for every indicator, a comparison of its current 6-month average to its non-overlapping previous 6-month average will be made⁶. If there is any turning point in the recent observations, the prevailing trend will be assessed in terms of its persistency. Some judgement of the likely trend going forward is also incorporated. The assessment of all demand-related indicators is then summarised in an Ishikawa diagram (refer chart 5).

Chart 5: The Ishikawa Diagram

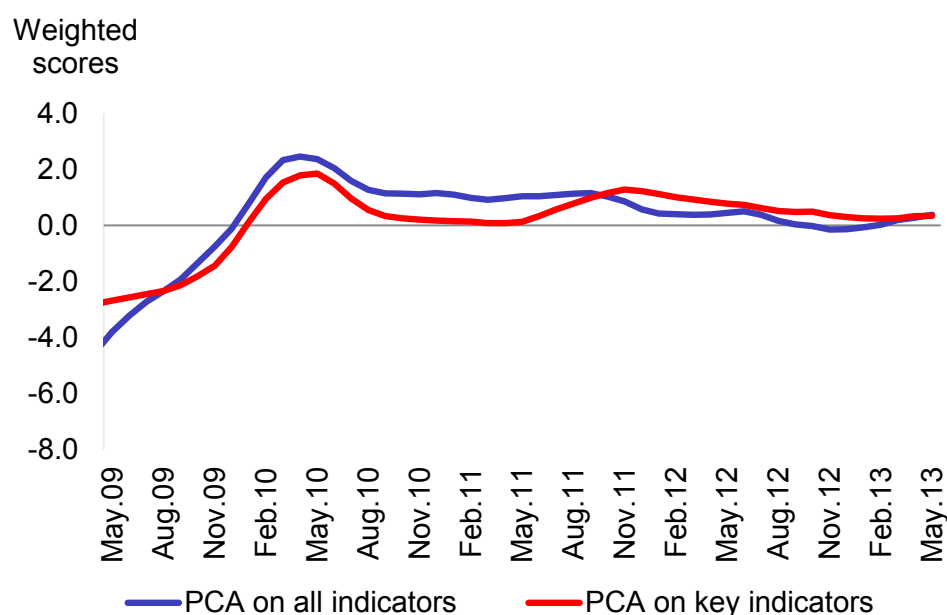


* Indicators in red font are key indicators i.e. have strong statistical relationship with core inflation

⁶ For example, if the current 6-month average growth in private consumption is higher than the previous 6-month average while exhibiting a rising trend after a decline (turning point), this is indicative of a rising demand pressure.

Second, the assessment is further enriched by performing a Principal Component Analysis (PCA) on all the indicators to capture the underlying movements in each group of indicators. The PCA is conditioned such that its scores must explain around 80% of the underlying common trend of these indicators (refer to chart 6).

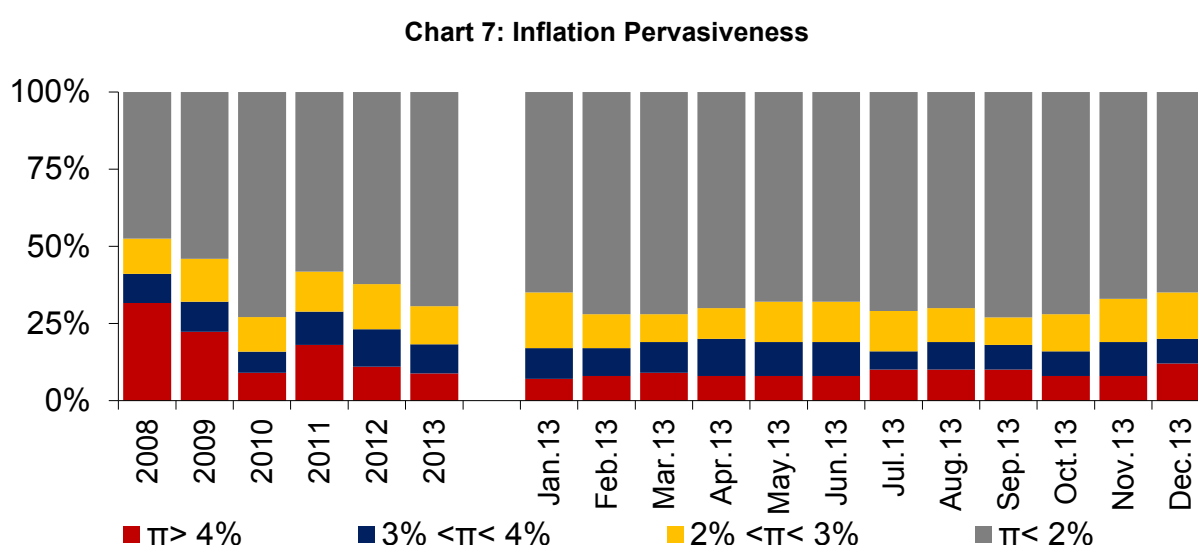
Chart 6: Principal Component Analysis (PCA)



Note: PCA captures the aggregated underlying trend of indicators

- iv. Product market (competitiveness and firms price setting behaviour).** In order to have a better understanding of the market structure and price setting behaviour in the product market, the Bank also conducts industrial engagement with firms and business associations. This enables the Bank to identify any risks to inflation should there be price adjustments to price administered items or any other supply shocks.
- v. Other supply factors.** Although most of the basic necessities are being subsidised by the Government, the Bank still monitors other indicators that could affect the prices of domestically produced goods and services such as global energy and food prices. Of importance, with the fiscal consolidation and subsidy rationalisation going forward, closer monitoring of these factors is imperative.

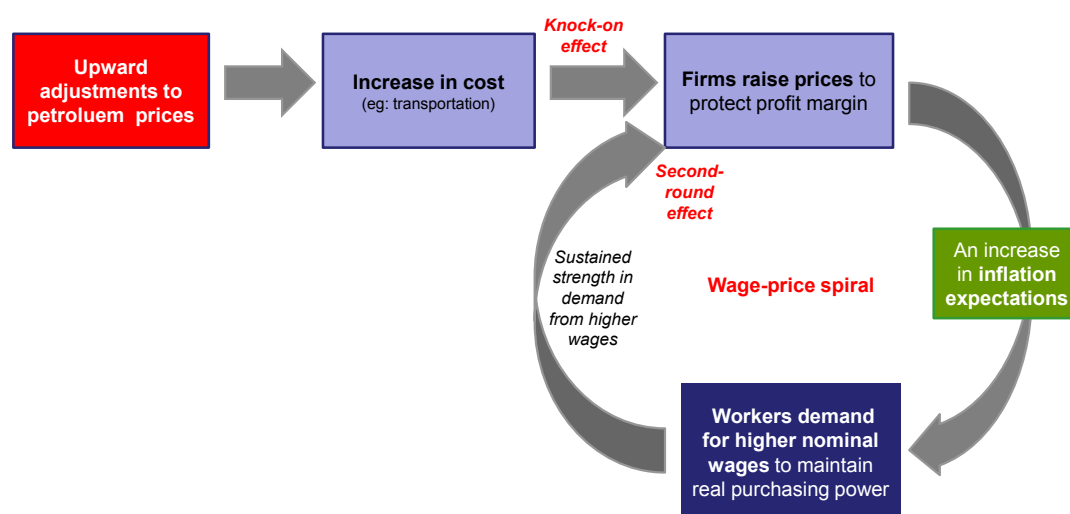
The Bank also monitors the pervasiveness of core inflation. Pervasiveness is measured by the number of core CPI items that are within specific inflation range. The CPI items are categorised into four groups namely; percentage of items registering inflation of less than 2%, between 2% and 3%, between 3% and 4%, and also inflation above 4%. Based on the Malaysia's historical average inflation rate of 3%, inflation is said to be more pervasive if there is higher number of items registering inflation above the historical average. This analysis is also complemented by making comparison with the increase in inflation pervasiveness during historical episodes of shocks.



3.2. Second-round effects

A strong inflationary pressure from first-round effects may subsequently result in a more broad-based price increases and consequently, lead to higher cost of living. This could subsequently raise inflation expectations which might result in demand for higher wages from worker. If firms accommodate the demand for higher wages, firms will face higher marginal cost due to the increase in labour cost. They will, in turn, have to resort to increasing the price of their goods and services, which could lead to *second-round effects* on inflation. In the absence of policy intervention, this process could go lead to further increase in prices of goods and services and trigger another round of wage increases, leading to even higher inflation. This process is commonly known as the wage-price spiral. At this stage, inflation will escalate and eventually lead to a decline in economic growth.

Chart 8: Transmission channel of first-round and second-round of inflation



There are two pre-conditions for the second-round effects on inflation to materialise. First, increase in *consumer inflation expectations* following the shocks from the first-round effects. As a result, *nominal wages* have to be adjusted in respond to higher inflation. Subsequently, *retail prices of goods and services* have to increase in respond to the adjustment to higher nominal wages. This will then lead to a persistent increase in inflation.

The Bank takes a two-pronged approach in the surveillance of second-round effects on inflation namely by monitoring various forward-looking indicators and assessing inflation persistence.

- i. **Monitoring various indicators.** Indicators under the Bank's surveillance include consumer sentiments, analysts' expectation on inflation, and wage and employment outlook.
 - a. **Consumer sentiments.** The information on consumer sentiments is collected through the Bank's Consumer Sentiment Survey (CSS). The survey coverage includes consumer price expectation for the next twelve months according to type of expenditure, households' financial condition, employment prospect and income prospect.

- b. **Analysts' expectation on inflation.** The Bank also monitors the analysts' inflation forecast to gauge their expectation on the future inflation path. This could be an important exercise as analysts' expectation on inflation seems to be a better gauge of the expectations that influence wage and price setting behaviour (Bernanke, 2007).
- c. **Wage and employment outlook.** As range of wage data is limited in Malaysia, the Bank gauges the strength of wage pressure based on survey evidence, particularly after a price adjustment to price-administered items. Strong wage pressures arising from price adjustments could induce second-round effects on inflation. This involves assessing the structural factors of wage determinants and timing of collective agreement (CA) through an annual survey on 100 firms from various industries.

ii. **Inflation persistence.** It is important to ensure inflation remain low and stable with low persistence. Lower inflation persistence will provide greater flexibility for monetary policy in managing inflation. In addition, it can also lower the risk of second-round effects on inflation from manifesting. To assess the persistence in inflation, an autoregressive model is estimated⁷.

$$\pi_t = \alpha\pi_{t-1} + \beta Z_t + \varepsilon_t$$

The α in the above equation represents a measure of inflation persistence. The higher the value of α , the higher the inflation persistence. This means that a shock will continue to have an impact on inflation for a prolonged period of time.

⁷ The model would also include other factors (Z) such as wage-bargaining power and firms' price setting behaviour. This information is available through surveys and industrial engagements conducted by the Bank.

4. CPI components analysis

For short-term forecasting, the Bank has relied on the CPI components analysis to supplement the current workhorse model. The CPI components analysis applies a bottom-up approach by forecasting the inflation of the disaggregated components of the CPI basket. The inflation forecast for these components are based on information from industrial engagement and verified anecdotal evidence. It also takes into account seasonal factors and base-effect. CPI components with insufficient information to be incorporated in the forecast model will be modelled purely by an auto-regressive (AR) model.

5. Gaps in the HIS Framework

Nevertheless, there remain gaps in our current surveillance framework. First, there is lack of comprehensive information on the labour market conditions. High frequency and granular data on wages and productivity are not available while the short time series data on employment sentiments may not be adequate to provide a conclusive finding. Second, as the survey on consumer sentiments was conducted beginning May 2013, the results were not sufficient to draw a definite conclusion on the changes in inflation expectations. Third, the current surveillance framework is not tested in a new inflation environment. The domestic price dynamics could exhibit a vast change as the Government embarked on new policies such as the minimum wage, subsidy rationalisation, and implementation of a new tax system. As an example, subsidy rationalisation could lead to prices of domestic goods and services become more susceptible to external factors such as global commodity prices.

6. Conclusion

The 1990s marked the period of “great moderation” as global inflation was relatively low and less volatile. However, the great moderation did not last long as the surge in global commodity prices in the 2000s led inflation to revert to its past behaviour of being elevated and volatile. Such rapid evolution of inflation dynamics necessitates central banks to regularly fine-tune the surveillance and forecast framework. For Malaysia in particular, the central bank focuses on a framework in which it segregates

the first-round effects (which focuses on inflation pervasiveness) and the subsequent second-round effects on inflation (which focuses on inflation persistence) arising from a price shock. The framework is also supplemented by the CPI component analysis as an inflation forecast tool. Recognising the ever-evolving nature of inflation dynamics, the Bank will continue to refine this framework to ensure it remains relevant and comprehensive in monitoring the changes in the determinants of inflation.

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