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Abstract

We examine how global commodity prices impact inflation dynamics in Malaysia following renewed global interest in the developments of commodity prices since the early 2000s. The contribution of the paper is twofold. First, we find that the pass-through from global commodity prices to headline inflation is small in size and the duration of the impact can last up to one year. Second, the results suggest that higher global commodity prices have generally not resulted in second-round effects, which were a global concern especially during the dramatic price increases between 2007 and 2008. A backward-looking Phillips curve estimates that the pass-through to core inflation is small in size and the duration can last up to half a year. Next, we find that headline reverts to core inflation but the converse does not hold. Finally, a standard VAR model shows that a shock to global commodity prices has no significant impact on core inflation. However, a shock to domestic fuel and food prices could have some impact on core inflation.

Keywords: Commodity prices, inflation, pass-through, second-round effects, Phillips curve

JEL Classification Numbers: E31, E37, E52, E58

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1 Introduction

In the paper, we estimate the relationship between global commodity prices (hereinafter GCP) and inflation dynamics in Malaysia based on the following three motivations. First, broad-based global commodity price movements in the 2000s – one source of higher headline inflation worldwide, especially between 2007 and 2008 – underpin the importance of understanding how global prices impact domestic prices.[1] Figures 1.1 and 1.2 highlight a stylised fact that fluctuations in GCP are closely associated with inflation developments in both advanced and developing countries, including Malaysia. In particular, Figure 1.3 pays closer attention to the movements of headline and core inflation in Malaysia against the dramatic movements of GCP. During the markedly volatile periods in the 2000s headline inflation recorded large deviations from core inflation, which illustrate that shocks to GCP could potentially create an adverse impact on domestic inflation dynamics.

Second, for highly open economies like Malaysia, global prices are expected to be a key determinant of domestic inflation, working primarily through the trade channel as the economy is highly integrated with the global value chains. In Malaysia's case, fluctuations in GCP are subsequently transmitted to domestic prices along the production chain given that imported commodities account for 34 percent of the PPI basket.[2] In particular, firms would start to pass on the increases in costs to consumers when they are no longer able to absorb the higher costs stemming from prolonged increases in GCP. For example, higher global price of corn raises the cost of chicken feed, which could subsequently increase the prices of food items in the CPI basket such as fresh meat and food away from home.

Third, more recent papers raise concerns on the likelihood of second-round effects in developing countries.[3] Although advanced countries provide the classical examples on how commodity shocks in the 1970s and 1980s could propagate into second-round effects, it is developing countries that are now more vulnerable given the following conditions: (i) a much larger share of food and energy in the CPI basket, where food alone can account for at least one third of the basket;[4] (ii) rising energy usage and intensity; and (iii) more

[1] See, for example, Bernanke (2008), and IMF (2008). Developments of global commodity prices are extensively documented in the literature and will not be covered here. See, for example, Filardo and Lombardi (2013), De Gregorio (2012), and Habermeier, Otker-Robe, Jacome, Giustiniani, Ishi, Vávra, Kisinbay, and Vazquez (2009).

[2] Based on the 2005 weights for PPI. Source: Department of Statistics Malaysia.

[3] See, for example, Anand, Ding, and Tulin (2014), Gelos and Ustyugova (2012), and Habermeier et al. (2009).

[4] In advanced countries, share of food and energy, each, in the CPI basket is relatively lower and is usually below or close to 10 percent. See, for example, Pedersen (2011) and Cecchetti and Moessner (2008).

robust economic performance such that inflationary pressures are driven by both demand- and supply-side factors. These factors also characterise the Malaysian economy: (i) food and energy account for nearly half of the weights in the CPI basket; (ii) growth of energy usage has averaged about 4 percent per annum since 1990 and is on a rising trend;[5] and (iii) economic growth has displayed a robust performance in the 2000s, with real GDP expanding between 5 to 7 percent each year. In sum, studies on the relationship between GCP and inflation are increasingly based on empirical research in developing countries and our paper fills the gap for Malaysia by providing several different aspects of the impact of GCP on inflation dynamics.[6]

Our paper makes the following contributions. We start by quantifying the pass-through from GCP to headline inflation using the conventional Phillips curve. The pass-through is considered small in size compared to other developing countries and can potentially last up to one year. When taken together with the initial conditions of low and stable inflation in Malaysia, global prices, thus far, pose a low risk to domestic inflation dynamics. Next, we find that second-round effects arising from GCP are largely absent. Second-round effects have no definite measure and are instead associated with the following three characteristics of a feedback loop: rising inflation expectations, a wage-price spiral and accelerating core inflation. Here, we do not examine inflation expectations and wage-price dynamics due to data constraints, but instead focus on core inflation using the following three approaches. First, the backward-looking Phillips curve indicates that pass-through from GCP to core inflation is small, with duration lasting up to half a year. Second, we find that headline reverts to core inflation but the converse does not hold. Although GCP created fluctuations in headline as well as deviations of headline away from core, there was little influence on the path of core inflation. This finding suggests that the likelihood of second-round effects is low and the shocks from GCP did not have a persistent impact on inflation dynamics in Malaysia, presumably because GCP did not feed into higher inflation expectations and a wage-price spiral that would subsequently create an acceleration in core inflation. Finally, we use a vector autoregressive (VAR) model to show that a shock to global commodity prices has no significant impact on core inflation. However, and perhaps more relevant, shocks to domestic commodity prices – both fuel and food – have some impact on core inflation.

[5]Measured using kg of oil equivalent per capita. Growth of energy usage averaged about 0.2 percent per annum since 1990 in advanced countries and the trend is declining over time for countries like the US. Source: World Bank.

[6]A branch has emerged in the literature to discuss the declining pass-through of GCP to inflation in advanced countries. Factors explaining the decline include: (i) more credible monetary policy; (ii) improved energy efficiency; (iii) deregulation in energy-related industries; and (iv) more flexible labour markets. See, for example, Fuhrer, Olivei, and Tootell (2009), and Blanchard and Gali (2008).

2 Data

Using a quarterly data set from 1992Q1 to 2013Q4, we examine three measures of global prices and four measures of domestic prices.[7] For global commodity prices, we use data from the International Monetary Fund (IMF): All Primary Commodity Price Index ($\pi^{global-all}$) and its two sub-components, Food Price Index ($\pi^{global-food}$) and Energy Price Index ($\pi^{global-energy}$).[8] Of interest, we re-weighted the five sub-components in the All Primary Commodity Price Index to closely reflect the commodities' relevance to Malaysia.[9] In particular, food is an important item for Malaysia's CPI basket and the transformation raised the weight from 11 percent in the original index to 50 percent in the re-weighted index. Domestic prices are measured using headline inflation (π^{head}) and core inflation (π^{core}).[10] We also examine domestic prices for food ($\pi^{dom-food}$) and fuel ($\pi^{dom-fuel}$). For simplicity, we only use one control variable that is the output gap ($ygap$), which is measured using a Hodrick-Prescott (HP) filter on real GDP.

3 Empirical Results

We present four pieces of regression-based evidence – with emphasis on the sample period in the 2000s – to reach two general conclusions; the pass-through from GCP to domestic inflation is low and there is, thus far, no conclusive evidence of second-round effects.[11]

In addition, we compare our results along two dimensions: against the results using the sample period in the 1990s, and in relation to existing studies. Of interest, we find that GCP and inflation have a time-varying relationship; we use rolling regressions (based on a fixed 10-year window) to trace out the relationship over time, implicitly accounting for changes – structural and cyclical – taking place in the economy. We find that the relationships are markedly different – largely absent in the 1990s (1993:2002) and showing up more strongly in the 2000s (2003:2013) – indicating that the nature of the relationship between GCP and inflation should not be considered an empirical regularity in the long run. Meanwhile, in relation to the literature, our paper generally supplements

[7] Except for output gap, which is computed as a percent of potential output, all data are computed as year-on-year change.

[8] The other three sub-components that make up the IMF All Primary Commodity Price Index have very limited influence on movements of headline inflation and their results are not reported here.

[9] The five sub-components in the IMF index are food, beverages, energy, metal and agriculture.

[10] We measure core inflation by excluding food and energy from headline inflation. Moreover, the results remain robust when using core inflation measured by excluding price-administered and volatile items from headline inflation. In Malaysia, price-administered and volatile items account for about a third of the CPI basket in 2010.

[11] We estimate the single equations using OLS and report the heteroskedasticity and autocorrelation consistent (HAC) standard errors.

the following papers: Filardo and Lombardi (2013), Gelos and Ustyugova (2012), IMF (2008) and Cecchetti and Moessner (2008). The first two papers focus on developing countries in the 2000s, while the other two papers examine samples with both advanced and developing countries from the 1990s to 2008.

3.1 Some pass-through to headline inflation

We quantify the relationship between GCP and headline inflation using a standard backward-looking Phillips curve in equation (1), which explains current inflation using lagged inflation, output gap and the fluctuations in GCP (π^x).[12]

$$\pi_t^{head} = \alpha + \sum_{i=1}^{a} \theta_i \, \pi_{t-i}^{head} + \sum_{i=1}^{b} \gamma_i \, ygap_{t-i} + \sum_{i=1}^{c} \kappa_i \, \pi_{t-i}^{x} + \varepsilon_t \tag{1}$$

where $x \in \{global - all, global - food, global - energy\}$.[13]

We report two types of pass-through: the sum of the coefficients for the GCP (pass-through $= \sum \kappa_i$) and the full pass-through taken relative to lags of inflation (full pass-through $= \frac{\sum \kappa_i}{1 - \sum \theta_i}$). We report the results for the baseline case without the output gap but will focus on the augmented case in equation (1).

As expected, the pass-through of GCP is markedly smaller in the augmented case compared to the baseline case and there is a notable increase in the adjusted-R^2, indicating that the output gap provides additional explanatory power for headline inflation. An essential component to the Phillips curve that captures the degree of slack in the economy or a proxy for demand-related shocks, the output gap is also a variable that is closely associated with the central bank's mandate of maintaining low and stable inflation for sustainable economic growth (Bank Negara Malaysia (2011)).

[12] See, for example, Filardo and Lombardi (2013), Rigobon (2010), Blanchard and Gali (2008), and Hooker (2002). In addition, following the high correlation between $global - food$ and $global - energy$, we do not include both variables in a single equation. The correlation between $global - food$ and $global - energy$ for the 2000s is high at 0.7, Due to endogeneity bias, it is likely that a portion of the pass-through from food is captured through energy prices. First, fluctuations in energy prices are larger, more timely and more efficient in capturing information about the economy. The information content in oil prices is, in part, driven by financialisation of oil, which created oil-related financial products with markets that are larger, deeper and more liquid. Baffes and Dennis (2013) claim that more than half of the fluctuations in food prices in the 2000s are accounted for by movements in oil prices, making oil prices useful in forecasting food prices. Second, oil is an input that feeds into the cost of production for food.

[13] The number of lags for equation (1) are chosen based on the SIC. For $global - all$, the SIC picks the following lags: $a = 1$; $b = 2$; and $c = 4$. For $global - food$, the lags are: $a = 1$; $b = 1$; and $c = 4$. For $global - energy$, the lags are: $a = 1$; $b = 1$; and $c = 4$.

According to the results in Table 1, fluctuations in $global - all$ have an impact on headline inflation. In the augmented case, the positive pass-through in the 2000s is statistically significant at the 10 percent level (column(3)) and can last up to one year.[14] The full pass-through implies that a 10 percentage point increase in $global - all$ is associated with higher headline inflation of 0.6 percentage point.

Results for the 2000s show that pass-through from $global - food$ is statistically significant and can also last up to one year (column(6)). In the augmented case, full pass-through for $global - food$ (0.01) is markedly lower than $global - all$ (0.06) and is considered small when we compare against existing studies. IMF (2008) reports that the full pass-through for global food prices is about 0.15 for developing countries and 0.05 for advanced countries. Gelos and Ustyugova (2012) also report that the median full pass-through for global food prices is 0.08 in developing countries and 0.02 in advanced countries. One interpretation is that pass-through for Malaysia is relatively small, in part reflecting favourable initial conditions – namely historically low inflation – as well as the presence of price controls and subsidies in the economy, a common characteristic of developing countries (Gelos and Ustyugova (2012)). It is also not surprising to find that the full pass-through of $global - energy$ is not statistically significant as domestic fuel prices are highly subsidised and administered in Malaysia (column(9)). IMF (2008) shows that the impact of global oil prices in developing countries is negligible. Again, this can be attributed to the presence of price control in developing countries and the relatively smaller share of energy in the CPI basket compared to food.

Of interest is the markedly different inflation dynamics when we examine the full sample period over the last 20 years; the 1990s stand in contrast to the 2000s as the pass-through of GCP is not statistically significant as reported in the F-statistic, except for $global - oil$, and all the results have the incorrect negative sign. To capture the time variation of the pass-through, we estimate the rolling regressions for equation (1) and plot the results in Figures 2.1 and 2.2 to illustrate that pass-through was absent in the 1990s. Moreover, in Figures 2.1 and 2.2, we note that the impact from $global - all$ is largest and emerges earliest. The pass-through from $global - food$ is smallest in terms of size and only shows a significant impact on headline inflation in the later part of the 2000s, in line with the developments of GCP as oil was leading the broad-based acceleration in prices while food only started to record a strong increase after 2005.

The 1990s is indeed different from the present. During that sample period, also known as the Great Moderation, annual fluctuations of GCP were modestly small; the shocks

[14] Global commodity prices Granger-cause current inflation as the coefficients are jointly different from zero under the F-test.

tend to be small, off-setting, temporary and idiosyncratic. As a result, there was little impetus for firms to change prices, which in turn limited the pass-through of GCP to domestic inflation dynamics. In addition, import content in the PPI was lower at 21 percent in 1989 compared to 34 percent in 2005. In contrast, commodity prices in the 2000s escalated on average 10 percent per annum and showed a completely different characteristic as prices increases were broad-based, persistent and more volatile, particularly during the dramatic swings in 2008 and 2011. It is likely that firms were not able to absorb the marked increases in production costs, subsequently leading to some pass-through to headline inflation.

It is worthwhile to highlight that the lags of inflation ($\sum \theta_i$) are statistically and economically significant in equation (1). In particular, the pass-through implies that a 1 percentage point increase in past inflation is associated with a 0.6 percentage point increase in current inflation (Table 1, column (3)). The results suggest that headline inflation is somewhat persistent and past shocks can have lingering effects on subsequent inflation dynamics.[15] Over time, however, the lags of inflation in the 2000s have a smaller coefficient than the 1990s, a welcome development for the inflation dynamics in Malaysia.

3.2 Weak pass-through to core inflation

Second-round effects are difficult to measure and we focus our assessment on the impact of GCP on core inflation given limited availability of data. A more thorough assessment of second-round effects – covering inflation expectations, the wage-price spiral as well as prevailing demand conditions – is currently beyond the scope of the paper.[16] Instead, we approach the question by estimating equation (2), which follows equation (1) but replacing headline with core inflation as the dependent variable.

$$\pi_t^{core} = \alpha + \sum_{i=2}^{a} \theta_i \, \pi_{t-i}^{core} + \sum_{i=1}^{b} \gamma_i \, ygap_{t-i} + \sum_{i=1}^{c} \kappa_i \, \pi_{t-i}^{x} + \varepsilon_t \quad (2)$$

where $x \in \{global - all, global - food, global - energy\}$.[17]

[15] Inflation persistence is an important factor for the propagation mechanism of shocks as it prolongs the duration of an initial shock through feedback loops. See Pedersen (2011) for a discussion.

[16] There is no data over an adequately long sample period to measure inflation expectations in Malaysia. In addition, there is weak evidence in the labour market to support a wage-price spiral often associated with classical episodes of second-round effects (e.g. wage-price spiral in the UK and US in the 1970s). Labour unions, wage bargaining and wage indexation to inflation are not prevalent in Malaysia. Another scope for future work is to estimate the wage-price Phillips curve like Fuhrer, Olivei, and Tootell (2009). However, this approach has recorded limited empirical success and tend to fit less well than the conventional Phillips curve.

[17] For each global price, the SIC picks the following lags: $a = 2$; $b = 2$; and $c = 2$.

Overall, there is very limited pass-through of GCP to core inflation in the 2000s: the full pass-through, as expected, is markedly lower than pass-through to headline inflation; the duration is also shorter with pass-through lasting about 6 months as the SIC picks a lag length of two quarters for the GCP. In Table 2, the augmented case shows that the impact of $global - all$ on core inflation is statistically significant but economically small (column (3)). A 10 percentage point increase in GCP is associated with a higher core inflation of 0.2 percentage point. Furthermore, the full pass-through on core inflation is about one third the size of the pass-through to headline inflation.[18] For $global - food$ and $global - energy$, the pass-through to core inflation is not statistically significant.

The time variation of the pass-through using rolling regressions for equation (2) is displayed in Figures 3.1 and 3.2. Again, the results show that the pass-through was largely absent in the 1990s. When comparing the pass-through from $global - all$ to core inflation and headline inflation (Figure 3.1 vs. Figure 2.1), the impact on core inflation, as expected, is highly lagging and is much smaller in size. However, we take note of the comparison between $global - food$ and $global - energy$; the pass-through to core inflation is larger for $global - food$ in terms of size and emerged earlier than $global - energy$, which is the opposite from the results displayed by headline inflation. This finding suggests that core inflation is perhaps more insulated from developments in global oil prices but more sensitive to global food prices. Although core inflation excludes food items, fluctuations in global food prices are likely to impact domestic food prices and consequently propagate to other items in core inflation. This fits into the argument that dynamics of food inflation is important to developing countries as discussed in Anand, Ding, and Tulin (2014) and Walsh (2011). Hence, a narrow focus on core inflation can be misleading and lagging for policymakers when trying to assess second-round effects as there is a risk of falling behind the curve. For developing countries, a more balanced view of inflation dynamics would need to account for the dynamics of food inflation, which are often described as volatile, persistent and have a tendency to propagate price increases in non-food items in the CPI basket. Of importance is the role of food inflation in anchoring inflation expectations of households as they purchase these items regularly. Of consequence, food can highly influence households' formation and anchoring of inflation expectations and subsequently feed into their wage demands to maintain their purchasing power. A case in point is India, as discussed in Anand, Ding, and Tulin (2014), whereby food inflation plays an important role in inflation dynamics, either helping to anchor or dis-anchor inflation expectations. In sum, developing countries need to be vigilant of food prices and to have a policy toolkit – going beyond monetary policy to include policies such as improving food production – to address the risk of second-round effects.

[18] For Malaysia, our results are closely in line with Filardo and Lombardi (2013), which reported that the pass-through to core inflation is about half the size compared to headline inflation.

3.3 Headline reverting to core inflation but not the converse

In assessing second-round effects, we also follow the approach in Cecchetti and Moessner (2008) to analyse the impact of global commodity prices on domestic inflation dynamics based on equations (3) and (4) and the results are presented in Table 3.[19] Taken together, the results from equations (3) and (4) indicate that there was no second-round effects in Malaysia during the commodity price shocks in the 2000s.

Equation (3) examines the question: Is headline reverting to core inflation? And our results show that headline is indeed reverting to core inflation.

$$\pi_t^{head} - \pi_{t-12}^{head} = \alpha + \beta(\pi_{t-12}^{head} - \pi_{t-12}^{core}) + \varepsilon_t \tag{3}$$

Deviations of headline from core inflation are often striking during periods of large fluctuations in commodity prices, and if headline is reverting to core, we would expect $\beta < 0$. Our results presented in Table 3 show that this is indeed the case as the coefficient β is statistically significant. Headline reverting quickly to core inflation provides an assuring signal that the increase in commodity prices has not lead to a persistent rise in headline inflation. This is consistent with results in Section 3.1, which show that pass-through of GCP to headline inflation is relatively small.

Put differently, if core inflation remains stable despite swings in GCP and headline inflation, as displayed in Figure 1.3, then headline is likely to converge to core inflation as the pass-through stemming from GCP did not propagate further and can be viewed as transitory such that firms were able to cope with the shocks. Of course, the reversion of headline to core inflation can be explained, in part, by the existence of the administered price mechanism helping to contain the pervasive propagation of GCP to domestic prices, although this would create further burden for fiscal policy.[20] In addition, adjustments that are made to prices of subsidised goods in response to developments of GCP tend to be undertaken in a gradual manner, enabling firms to manage potential increases in costs.

What about the speed of reversion? Gelos and Ustyugova (2012) report that the speed of reversion for advanced countries averaged at -1.1 in the 2000s, which is faster than the speed for developing countries at -0.8. For Malaysia, we estimate $\widehat{\beta} = -1.8$, not only faster than the average for developing countries, but also exceeding the average

[19] See also Filardo and Lombardi (2013), Rhee and Lee (2013) and Gelos and Ustyugova (2012). Equations (3) and (4) is a framework that is commonly used to provide a simple assessment of second-round effects.

[20] Approximately 20 percent of the CPI basket are price-administered items covering essential food items such as rice, flour, sugar as well as fuel products.

speed for advanced countries. Our results match up to Filardo and Lombardi (2013), which estimated the reversion speed for Malaysia to be close to -2.0 for the late 2000s (2006:2012). For most Asian countries, their results show that the speed is consistently negative as headline generally moves towards core inflation in the region. Filardo and Lombardi (2013) claim that the speed of reversion is due in part to improvements in maintaining price stability in the Asia region. Also, Gelos and Ustyugova (2012) put forth factors that could be associated with the speed of reversion. They find some evidence that a larger weight of food in the CPI basket and exchange rate stability tend to be associated with a slower speed. This claim is not applicable to Malaysia although the weight of food is relatively large (one third of the CPI basket) and the exchange rate somewhat stable. More likely, the high speed of reversion in Malaysia is due to the low inflation environment and the small pass-through of shocks, as shown earlier, which imply limited lingering effects of shocks.[21]

Equation (4) examines the converse question: Is core reverting to headline inflation? Our results show that core is not reverting to headline, in line with Figure 1.3 whereby core inflation continued to fluctuate between 1 to 2 percent despite the large swings in headline inflation in the sample period between late 2007 and early 2012.

$$\pi_t^{core} - \pi_{t-12}^{core} = \alpha + \delta(\pi_{t-12}^{core} - \pi_{t-12}^{head}) + \varepsilon_t \tag{4}$$

Core is not reverting to headline inflation if $\delta = 0$, while full reversion to headline occurs when $\delta = -1$. This ex-post estimation provides a signal to policymakers to monitor the surge in commodity prices as the shock may subsequently create second-round effects such that core accelerates towards headline inflation. In other words, when headline moves above core, there is a risk that a persistent rise in GCP (repeated shocks) would feed into higher inflation expectations and trigger a wage-price spiral and finally resulting in higher core inflation.

Table 3 presents some evidence that core is not reverting to headline in the 2000s as we test for no reversion in the null (H_0: $\delta = 0$).[22] We fail to reject the null and

[21]In addition, we check if there is further evidence that headline is *strictly* reverting to core by testing the following two hypotheses: (i) headline fully reverts to core (H_0: $\beta = -1$); (ii) headline fully reverts to core within one year ($H_0 : \beta = -1$ and $\alpha = 0$) ; and (iii) headline does not revert to core within one year ($H_0 : \beta = 0$ and $\alpha = 0$). For (i), we fail to reject the null hypothesis, indicating that headline does fully revert core. In (ii), we reject the null, suggesting that *full* reversion takes longer than a year. In (iii), we reject the null, indicating that there is some reversion of headline to core within a year.See Table 3 for the results.

[22]In addition, we follow Cecchetti and Moessner (2008) to test the following two hypotheses: (i) core does not revert fully to headline (H_0: $\delta = 0$ and $\alpha = 0$); and (ii) core fully reverts to headline within a year (H_0: $\delta = -1$ and $\alpha = 0$). Table 3 shows that our results are indeed in line with Cecchetti and Moessner (2008).

our results are in line with Filardo and Lombardi (2013) as the authors show that δ is not significantly different from zero for Malaysia while the results are more mixed across the other Asian countries. The results are also mixed in Gelos and Ustyugova (2012) as they find some evidence of second-round effects given that core is reverting to headline inflation in 37 countries out of 62 countries in their sample.

Turning to the rolling regressions in Figures 4.1 and 4.2, we point out the following. The coefficient δ has a tendency to be negative, which means that the speed of reversion from headline to core inflation is increasing over time from the 1990s to the 2000s. Meanwhile, the coefficient δ tends to be above zero in the 2000s indicating no incidence of core reverting to headline inflation despite swings in GCP and headline inflation.

We supplement our analysis of second-round effects using inflation expectations data from the Consensus Forecast monthly reports between January 2008 and December 2009, a period of high inflation that garnered global attention (Habermeier et al. (2009)). Inflation forecasts of analysts showed that inflation expectations were indeed well-anchored as plotted in Figure 1.4 for quarterly data and Figure 1.5 for annual data. Prior to the shock in GCP in the second half of 2008, quarterly inflation was expected to follow a low and steady path (orange line). However, expectations started to change when fluctuations in GCP took a dramatic turn; forecasts in September and December 2008 (yellow and blue line) showed that inflation was expected to accelerate and peak in 2H 2008 before falling back to a low and steady path in 2009 as shocks tapered out. Meanwhile, expectations for annual inflation showed that inflation for 2008 would accelerate from below 3 percent to peak at 6 percent; and inflation expectations for 2009 would peak close to 5 percent but was later revised downward dramatically. Meanwhile, inflation expectations for 2010 were low and steady below 3 percent. In sum, shocks from GCP were viewed as transitory for Malaysia and did not unanchor inflation expectations.

If pass-through is limited, as shown in sections 3.1 and 3.2, and inflation expectations are well anchored, deviation of headline from core has little impact on the dynamics of core inflation. Otherwise, shocks from GCP can potentially trigger second-round effects, especially when credibility of policymakers are not well established. To keep inflation expectations well anchored when combatting shocks from commodity prices, policymakers need to maintain credibility and remain committed to inflation stabilisation; a good framework without the accompanying governance and confidence in the institutions potentially runs the risk of second-round effects.[23]

[23]See, for example, Gelos and Ustyugova (2012) and Walsh (2011).

3.4 VAR: Core inflation seemingly unaffected by commodity shocks

Finally, we draw on the existing literature to examine the pass-through of GCP on domestic inflation dynamics using a three-variable recursive VAR model.[24] The VAR has some advantages over the single equation Phillips-curve estimation as we can decompose the shock along the price chain; starting with the most exogenous price shock – the GCP – and quantifying the impact on final prices through core inflation. In the first part, we study the impact of a global commodity price shock ($\pi^{global-all}$, $\pi^{global-food}$, and $\pi^{global-energy}$) on core inflation. The second part follows Pedersen (2011) to examine the impact of a domestic shock – namely the increase in domestic fuel price ($\pi^{dom-fuel}$) on other components of the CPI.

The baseline three-variable recursive VAR model is based on the Cholesky decomposition (VAR ordering: $\pi^{global-all}$, $ygap$, π^{core}).[25] The ordering implies that GCP affect all the other variables; output gap does not affect the GCP contemporaneously as these are exogenous prices determined in the international markets, but may potentially impact core inflation. Core inflation (positioned last in the ordering) is affected by all the other variables and does not affect any of the other variables contemporaneously.[26] All variables in the VAR are assumed to be stationary and the lag length of two is chosen to minimise the AIC.[27] The standard error bands of the impulse response functions (IRF) are obtained using a bootstrap of 300 replications.[28] The IRF illustrate the dynamic responses implied by the estimated VAR model and we can discuss the results of a shock on core inflation along four dimension: sign of impact, size of impact, duration of shock i.e. how long the shock persists, and the lag time for the shock to propagate into core inflation.

How did core inflation react to a positive shock in global commodity prices? We present our results in Figure 5 with the IRF spanning 8 quarters. All three types of commodity shocks have a positive immediate impact on core inflation but none are statistically significant (the lower standard error band includes zero). In other words, a shock to GCP has negligible impact on core inflation.

[24]See, for example, Blanchard and Gali (2008), De Gregorio, Landerretche, and Neilson (2007) and Hahn (2003).

[25]The identification of the structural shocks is recovered from the VAR residuals using the Cholesky decomposition of the variance-covariance matrix.

[26]As a robustness analysis, we could augment the baseline model to a four-variable VAR using the exchange rate, as commonly done in the literature. Results are robust to the inclusion of the nominal effective exchange rate ($NEER$) using the following two orderings where we switch between the output gap and the exchange rate i.e. (ordering: $\pi^{global-all}$, $ygap$, $NEER$, π^{core}) and (ordering: $\pi^{global-all}$, $NEER$, $ygap$, π^{core}).

[27]We perform the LM test to ensure that the residuals in the VAR are not correlated. The null of no serial correlation at lag order 2 cannot be rejected.

[28]Results are robust to higher replications and only the lower band is reported.

Of interest, we now examine how domestic fuel and food inflation impact core inflation. Figure 6 shows the IRF of an increase in domestic fuel prices in Malaysia using the VAR model with the following order: domestic fuel inflation ($\pi^{dom-fuel}$), which is treated as most exogenous, domestic food inflation ($\pi^{dom-food}$), and core inflation (most endogenous).[29] We follow Pedersen (2011) to impose the Cholesky identification strategy. The simple domestic set up works as follows: the initial shock on fuel price is first transmitted into food price – because of higher cost of production – and later to other prices, which is captured in core inflation.

Given a shock to fuel inflation (size of 7 percentage point, equivalent to one standard deviation), core inflation increases by close to 0.25 percentage point and the impact is only statistically significant when the shock occurs but is not significant thereafter, implying that the impact has a duration of less than one quarter before it dies out. By contrast, given a one standard deviation shock to domestic food prices (0.8 percentage point), the impact on core inflation follows a hump-shape; the impact has a larger size of 0.30 percentage point and is only statistically significant after one quarter, but is not significant thereafter, implying that the impact also has a duration of less than one quarter.

Notwithstanding the statistical significance, a fuel price shock yields an impact with duration of three quarters while a food price shock has an impact with duration of four quarters. Hence, a shock in food prices yields a larger cumulative impact on core inflation suggesting that there is more propagation to the other items in the CPI basket. Our results are in line with Pedersen (2011), who finds that a shock from food prices has a greater impact than fuel prices in developing countries. In particular, Pedersen claims that the pass-through to inflation is larger in size and the duration is longer for a food price shock relative to a fuel price shock, due mainly to the larger weight of food in the CPI basket. In Malaysia, food does indeed have a much larger weight, is subject to less controls and hence fluctuates more frequently, and is markedly more persistent than fuel prices.[30] As discussed earlier, it is important to pay close attention to food inflation because food can potentially be an important propagation channel to other domestic prices and inflation dynamics in Malaysia.[31]

[29] Results from the pair-wise Granger causality (GC) tests show that the energy and food categories are fairly exogenous relative to the other categories. Following Leon (2012), we show that across the 12 main categories in the CPI basket, the transport category (which includes fuel) Granger-cause seven other categories while food and non-alcoholic beverages Granger-cause six other categories, making these two categories fairly exogenous.

[30] Among the 12 categories in the Malaysian CPI basket, food is the single largest category with the following weights over time: 1967: 47 percent; 1980: 36 percent; 1990: 35 percent; 2005: 31 percent; and 2010: 30 percent. Fuel is about 8 percent of the CPI basket. Food inflation is also highly persistent when measured using a simple AR model.

[31] See, for example, Pedersen (2011) and Rangasamy (2009).

3.5 Limitations and Suggestions for Future Research

We document inflation dynamics in Malaysia using specifications that are partial equilibrium models. Naturally, an avenue for further research should entail a more structural Phillips curve, namely embedding a general equilibrium framework to provide more economic intuition that can explain channels of the changes taking place in the inflation dynamics.[32]

Future work could incorporate a more comprehensive study that considers the following: (i) non-linear pass-through; (ii) asymmetries; (iii) threshold effects of the impact of GCP on inflation; (iv) pass-through along the different stages of production and distribution, starting with the exchange rate, import prices, PPI, and consequently the CPI.[33] For instance, the baseline VAR model in the paper can be extended to study the prices along the supply chain to see how shocks are propagated from one stage to the next and compare the relative pass-through of each stage.

In addition, the paper largely excludes the explicit interaction across the different categories in the CPI. One potential area for further study is to use disaggregated data when assessing the propagation effects stemming from GCP (Leon (2012) and Pedersen (2011)). For example, Leon (2012) shows that disaggregated data is a useful approach to estimate inflation persistence and second-round effects for a given shock, whereby the interactions between the different categories in the CPI basket measure the extent of second-round effects. The author finds that while inertia is important during the initial periods of the shock, second-round effects can take place later as the main driver of inflation dynamics.

4 Concluding Remarks

Using various methodologies in the literature, we estimate the relationship between global commodity prices and inflation dynamics in Malaysia to document the pass-through in terms of size, duration and lag. Taken together, the empirical evidence yield consistent results to offer two general conclusions. First, global commodity prices have a positive pass-through to headline inflation in the 2000s, which makes global commodity prices a relevant determinant of inflation. However, global prices have a small impact on inflation dynamics with limited propagation thus far, coinciding with a period of subsidies for fuel and selected food items as well as a relatively low level of inflation that averaged at 3 percent over the last 20 years. Second, the episodes of surging global commodity

[32] See, for example, Anand, Ding, and Tulin (2014).

[33] Hooker (2002) estimates the pass-through of global oil prices for the US using a Phillips curve framework that allows for asymmetries, non-linearities and structural breaks.

prices in the 2000s have not lead to second-round effects in Malaysia.

However, low pass-through is in no way a permanent feature of an economy. In fact, policymakers recognise the risk that global commodity prices remain elevated – excluding the temporary setback due to the Global Financial Crisis – and continue to pay close attention to commodity prices, which are often leading indicators for prices of final goods and services. Arguably, conventional wisdom is for monetary policy to accommodate supply-side shocks. But multiple supply-side shocks can create high and persistent inflation that could trigger second-round effects and may warrant a policy response. In addition, commodity prices are particularly relevant to economies that are undergoing a transition period of subsidy rationalisation, like in the case of Malaysia. As the price mechanisms and market structures become more market driven, there is greater likelihood that global factors such as the movements of commodity prices, particularly for food and energy-related goods, become more important drivers of inflation. Going forward, we cannot completely rule out the risks stemming from commodity price shocks.

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Table 1: Pass-through of Global Commodity Prices to Headline Inflation
Results for Equation (1)

	All Commodities $\pi^{global-all}$			Food $\pi^{global-food}$			Energy $\pi^{global-energy}$		
	Full	1990s	2000s	Full	1990s	2000s	Full	1990s	2000s
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Pass-through $\sum \kappa_i$									
Baseline	0.0070	0.0102	0.0326	0.0013	-0.0048	0.0257	-0.0048	-0.0037	0.0197
Augmented	0.0019	-0.0021	0.0250	-0.0032	-0.0092	0.0053	-0.0087	-0.0074	0.0141
Full Pass-through $\frac{\sum \kappa_i}{1-\sum \theta_i}$									
Baseline	0.0374	0.0751	0.0836	0.0052	-0.0251	0.0675	-0.0161	-0.0168	0.0509
Augmented	0.0085	-0.0154	0.0595	-0.0153	-0.0712	0.0127	-0.0308	-0.0326	0.0325
Lags of π^{head} $\sum \theta_i$									
Baseline	0.8124	0.8646	0.6099	0.7512	0.8076	0.6192	0.7032	0.7799	0.6129
Augmented	0.7715	0.8662	0.5801	0.7891	0.8701	0.5840	0.7177	0.7730	0.5662
R^2**-adjusted**									
Baseline	0.7342	0.7600	0.7428	0.7341	0.8224	0.6853	0.7202	0.8222	0.7176
Augmented	0.7909	0.8288	0.8235	0.7565	0.8484	0.7336	0.7540	0.8660	0.7681
F-statistic and (p-value)									
Baseline	4.6335***	0.7501	9.3988***	1.6884	0.8758	1.0717	1.2211	0.9968	1.0953
	(0.0021)	(0.5649)	(0.0000)	(0.1613)	(0.4889)	(0.3844)	(0.3088)	(0.4231)	(0.3732)
Granger-causality	Yes	No	Yes	No	No	No	No	No	No
Augmented	7.9467***	0.4701	6.2463***	3.0071**	0.6550	2.5001*	2.3388*	2.4799*	1.8706
	(0.0000)	(0.7572)	(0.0007)	(0.0233)	(0.6276)	(0.0596)	(0.0628)	(0.0644)	(0.1375)
Granger-causality	Yes	No	Yes	Yes	No	Yes	Yes	Yes	No
N									
Baseline	84	40	44	84	40	44	84	40	44
Augmented	84	40	44	84	40	44	84	40	44

Note: The sample period for the 1990s cover 1993:2002 and the 2000s cover 2003:2013. The asterisk indicates the 10%(*), 5%(**), and 1%(***) significance level. The lags included in the equations are based on the SIC. The baseline case is a bivariate specification between inflation and GCP and the augmented case includes the output gap as a control.

Table 2: Pass-through of Global Commodity Prices to Core Inflation
Results for Equations (2)

	All Commodities $\pi^{global-all}$			Food $\pi^{global-food}$			Energy $\pi^{global-energy}$		
	Full	1990s	2000s	Full	1990s	2000s	Full	1990s	2000s
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Pass-through $\sum \kappa_i$									
Baseline	-0.0059	0.0038	0.0130	-0.0057	-0.0003	0.0136	-0.0044	-0.0018	0.0049
Augmented	-0.0066	0.0018	0.0073	-0.0069	-0.0085	0.0058	-0.0071	-0.0036	0.0006
Full Pass-through $\frac{\sum \kappa_i}{1-\sum \theta_i}$									
Baseline	-0.0339	0.0237	0.0225	-0.0330	-0.0018	0.0245	-0.0223	-0.0098	0.0091
Augmented	-0.0398	0.0130	0.0160	-0.0474	-0.0711	0.0106	-0.0367	-0.0202	0.0011
Lags of π^{core} $\sum \theta_i$									
Baseline	0.8247	0.8400	0.4238	0.8285	0.8319	0.4435	0.8015	0.8173	0.4611
Augmented	0.8354	0.8639	0.5462	0.8553	0.8811	0.4511	0.8080	0.8212	0.4789
R^2**-adjusted**									
Baseline	0.8509	0.8877	0.6039	0.8529	0.8810	0.5754	0.8439	0.8852	0.5805
Augmented	0.8695	0.8684	0.7634	0.8533	0.8649	0.6420	0.8570	0.8881	0.6645
F-stat and (p-value)									
Baseline	1.9076	1.0495	2.5162	1.2052	0.4435	1.6177	1.5009	0.8384	1.5141
	0.1176	0.3968	0.0578	0.3155	0.7762	0.1903	0.2102	0.5107	0.2181
Granger-causality	No	No	Yes	No	No	No	No	No	No
Augmented	12.8123	0.5997	10.2559	2.6190	1.6047	1.1342	2.5886	1.2861	1.7285
	0.0000	0.6657	0.0000	0.0413	0.1964	0.3555	0.0433	0.2961	0.1651
Granger-causality	Yes	No	Yes	Yes	No	No	Yes	No	No
N									
Baseline	84	40	44	84	40	44	84	40	44
Augmented	84	40	44	84	40	44	84	40	44

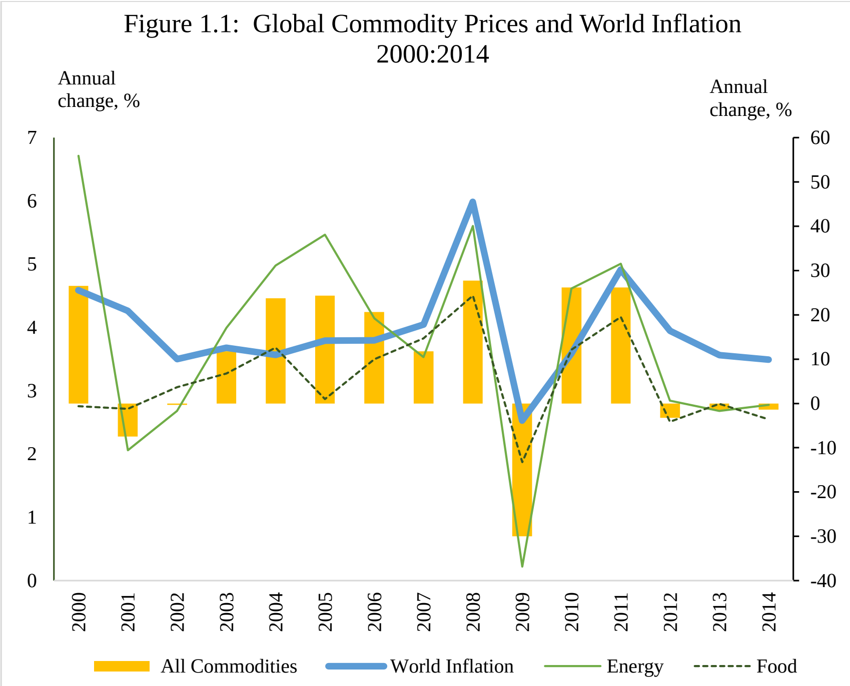
Note: The sample period for the 1990s cover 1993:2002 and the 2000s cover 2003:2013. The asterisk indicates the 10%(*), 5%(**), and 1%(***) significance level. The lags included in the equations are based on the SIC. The baseline case is a bivariate specification between inflation and GCP and the augmented case includes the output gap as a control.

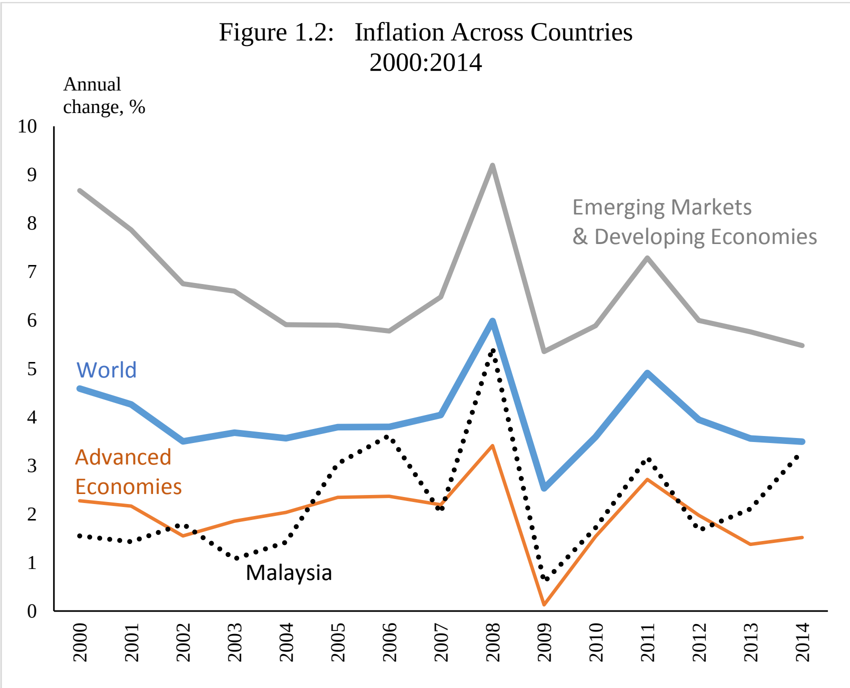
Table 3: Is Headline Reverting to Core? Is Core Reverting to Headline?
Results for Equations (3) and (4)

	Full (1)	1990s (2)	2000s (3)	
	Is Headline Reverting to Core?			Yes, evidence points to headline reverting to core
β	-1.3723*** 0.0019	-0.6213 0.2210	-1.8346*** 0.0000	Reject $H_0 : \beta = 0$ (headline does not revert to core) Expect $\beta < 0$ if headline reverts to core Results imply that β is significantly below 0
α	0.7379 0.0831	0.0008 0.9981	1.5919 0.0088	
R^2 N	0.3958 88	0.0801 44	0.6137 44	
$H_0 : \beta = -1$ F-statistic p-value	 0.7525 0.3881	 0.5733 0.4532	 4.6956** 0.0360	 Fail to reject H_0 (i.e. headline fully reverts to core)
$H_0 : \beta = -1$ and $\alpha = 0$ F-statistic p-value	 1.6923 0.1902	 0.3333 0.7184	 3.8545** 0.0290	 Reject H_0 (i.e. headline fully reverts to core within a year) Full reversion could take a longer time
$H_0 : \beta = 0$ and $\alpha = 0$ F-statistic p-value	 5.4107*** 0.0061	 0.8937 0.4168	 11.5988*** 0.0001	 Reject H_0 (i.e. headline does not revert to core within a year) Some reversion to core takes place within a year
	Is Core Reverting to Headline?			Yes, evidence points to core not reverting to headline
δ	0.2893 0.3291	-0.2065 0.7196	0.5296** 0.0193	Fail to reject $H_0 : \delta = 0$ Expect $\delta = 0$ if core not reverting to headline Results imply that core not reverting to headline
α	0.0634 0.8255	-0.2451 0.4763	0.3936 0.1919	
R^2 N	0.0616 88	0.0147 44	0.3236 44	
$H_0 : \delta = 0$ and $\alpha = 0$ F-statistic p-value	 0.8260 0.4412	 0.2584 0.7735	 3.0488* 0.0580	 Fail to reject H_0 (i.e. core not reverting to headline within a year)
$H_0 : \delta = -1$ and $\alpha = 0$ F-statistic p-value	 21.5306*** 0.0000	 2.3875 0.1042	 35.3118*** 0.0000	 Reject H_0 (i.e. core fully reverts to headline within a year)

Note: The sample period for the 1990s cover 1993:2002 and the 2000s cover 2003:2013. The asterisk indicates the 10%(*), 5%(**), and 1%(***) significance level.

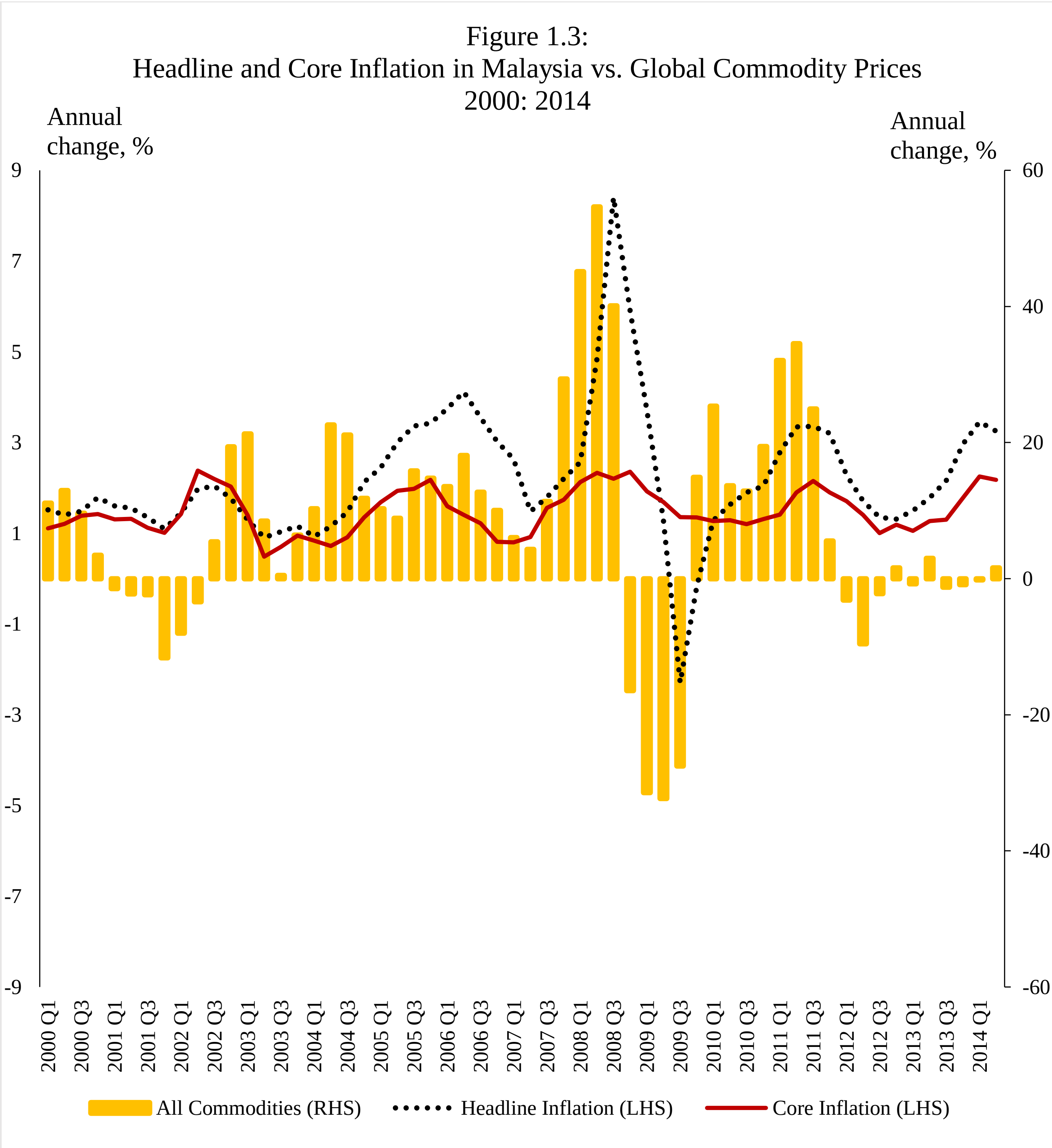
Figure 1.1 and 1.2:
Global Commodity Prices and World Inflation





Note: Annual data on prices computed as year-on-year change.
Inflation measured using the Consumer Price Index (CPI).
For Figure 1.1 World Inflation is measured on the LHS scale while the other data follow the RHS scale.
Source: IMF World Economic Outlook Database April 2014

Figure 1.3:
Inflation in Malaysia and Global Commodity Prices



Note: Annual data on prices computed as year-on-year change.
Source: IMF World Economic Outlook Database April 2014 and Bank Negara Malaysia.

Figure 1.4 and 1.5:
Consensus Forecast for Inflation in Malaysia

Figure 1.4:
Consensus Forecast of Quarterly Headline Inflation Path
for 2008 and 2009

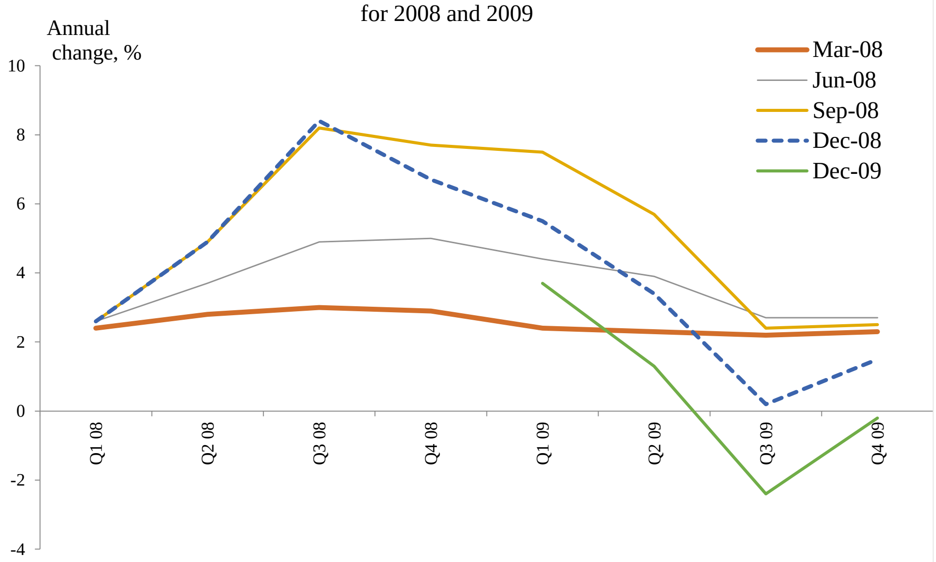
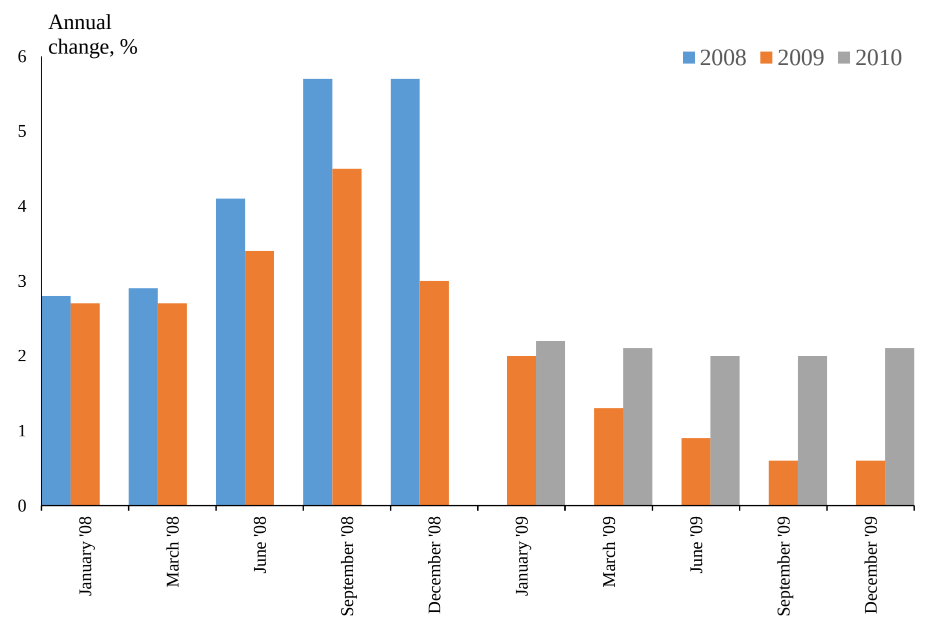


Figure 1.5:
Consensus Forecast of Annual Headline Inflation
for 2008, 2009 and 2010



Note: Monthly reports on headline inflation forecasts for Malaysia.
Source: Consensus Forecast

Figure 2.1 and 2.2:
Pass-through of Global Commodity Prices to Headline Inflation

Figure 2.1: Pass-through of Headline Inflation

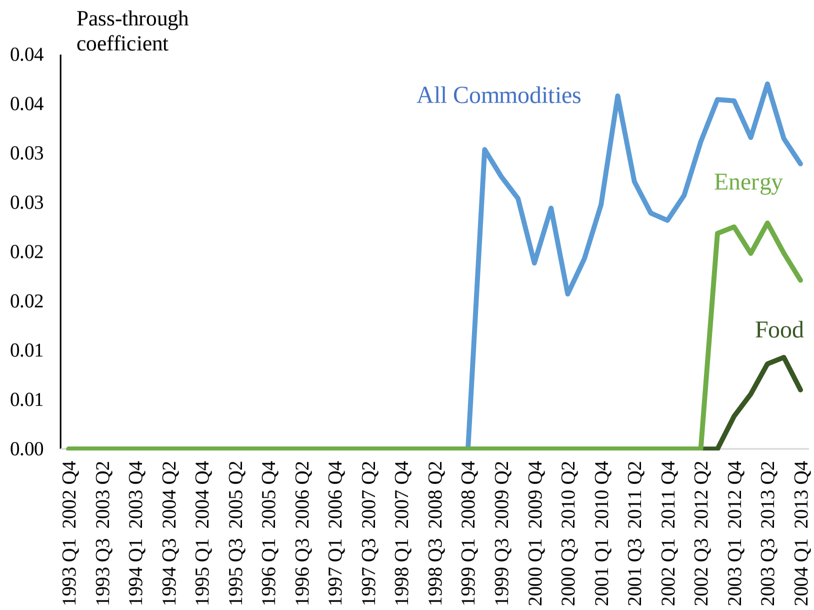
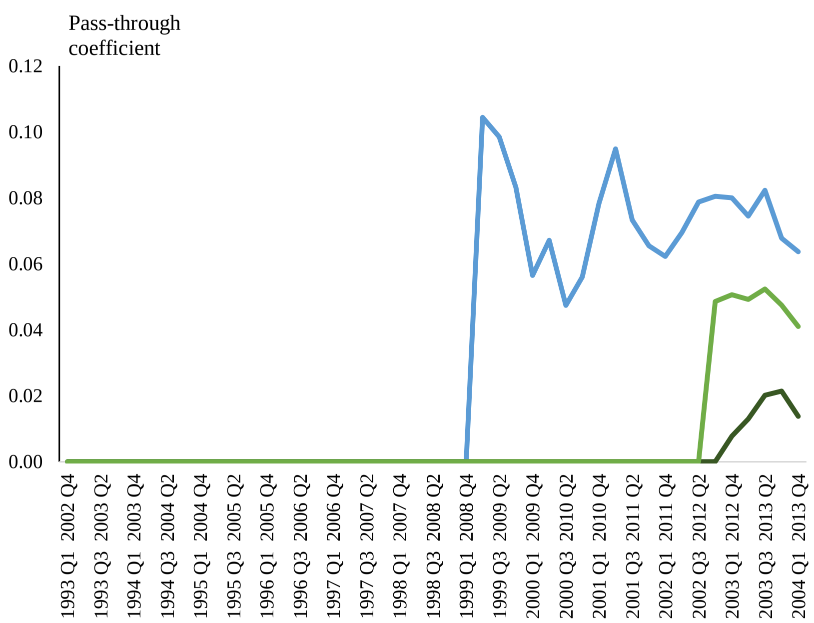


Figure 2.2: Full Pass-through to Headline Inflation



Note: Pass-through results that are not statistically significant
or have a negative impact are interpreted to have no impact on headline inflation.
Rolling regression with a fixed window of 10 years.
Figures 2.1 and 3.1 are using the same scale.
Figures 2.2 and 3.2 are using the same scale.

Figure 3.1 and 3.2:
Pass-through of Global Commodity Prices to Core Inflation

Figure 3.1: Pass-through to Core Inflation

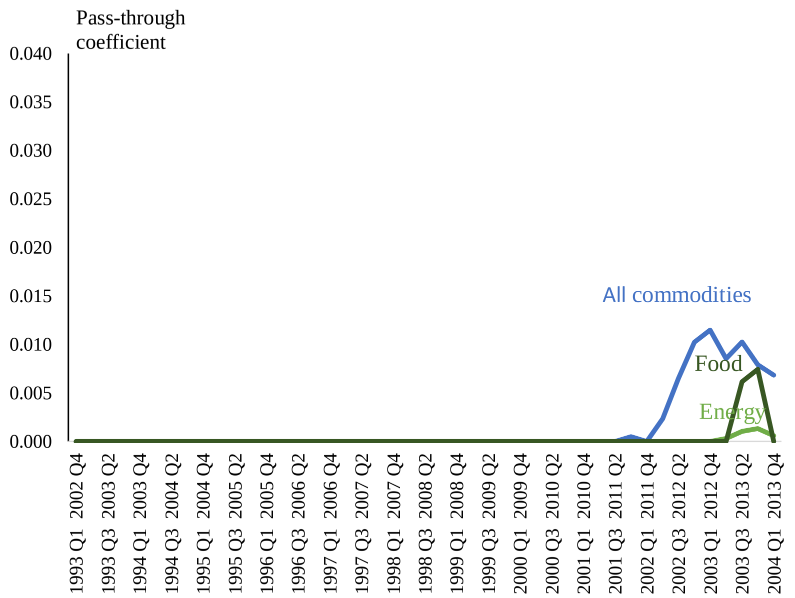
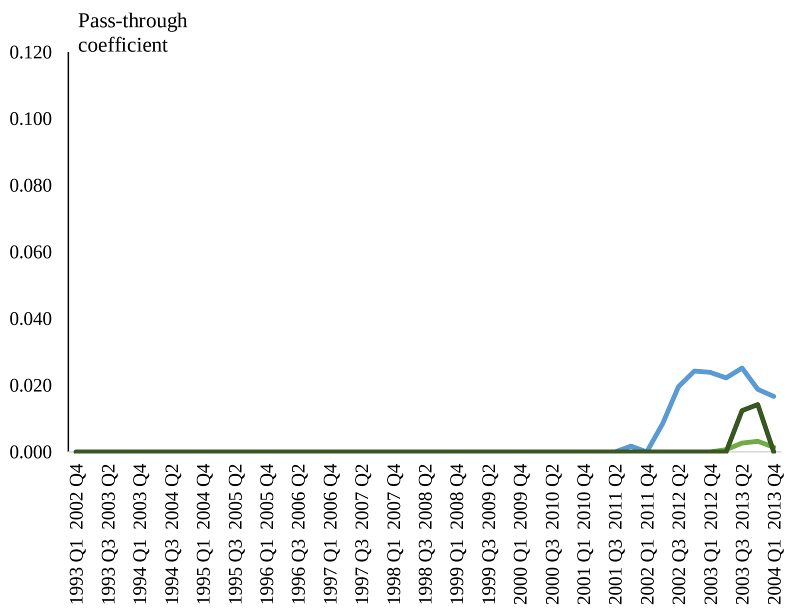


Figure 3.2: Full Pass-through to Core Inflation



Note: Pass-through results that are not statistically significant or have a negative impact are interpreted to have no impact on core inflation.
Rolling regression with a fixed window of 10 years.
Figures 2.1 and 3.1 are using the same scale.
Figures 2.2 and 3.2 are using the same scale.

Figure 4.1 and 4.2:
Headline Reverting to Core Inflation But Not the Converse

Figure 4.1: Headline reverting to Core
1993:2013

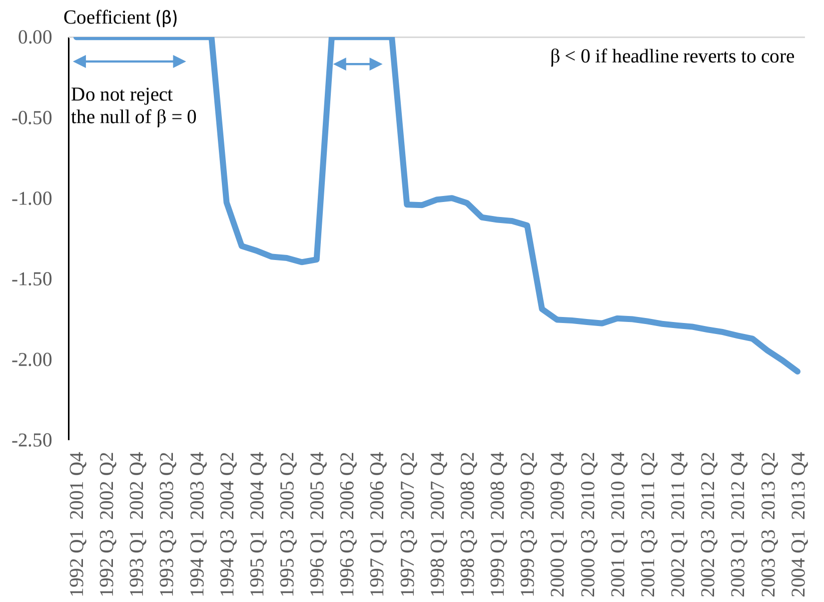
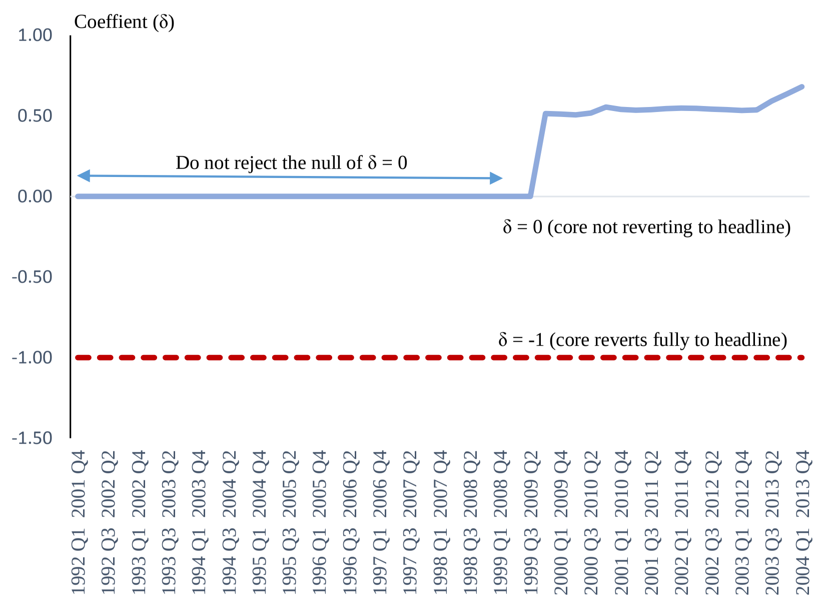
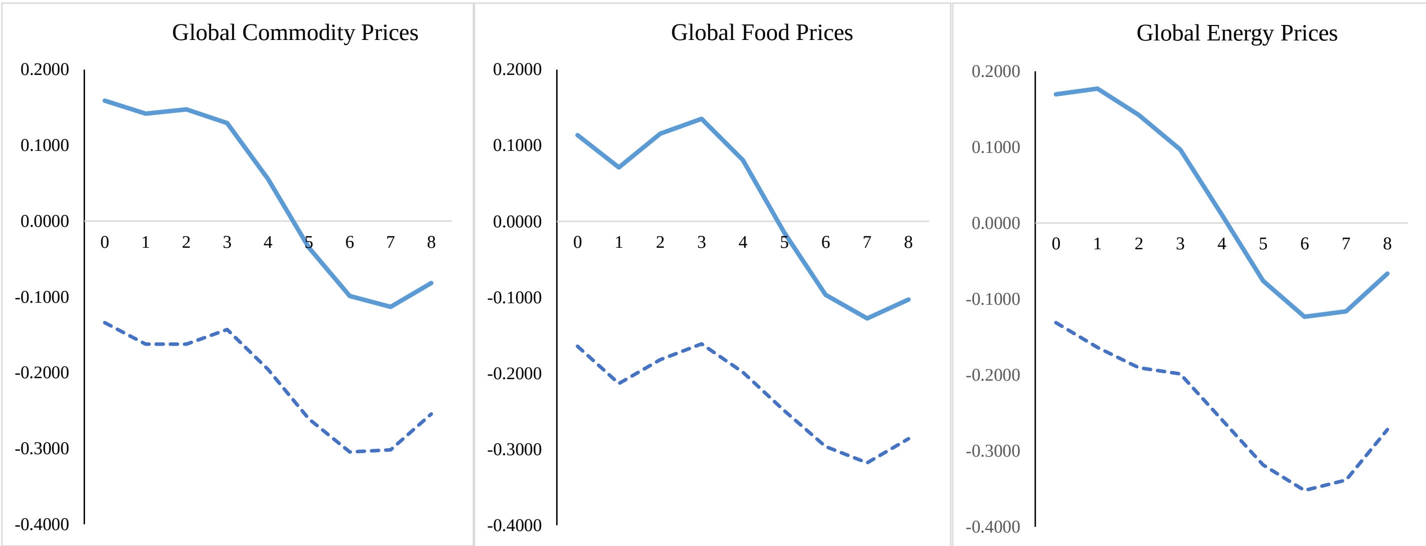


Figure 4.2: Core not reverting to Headline
1993:2013



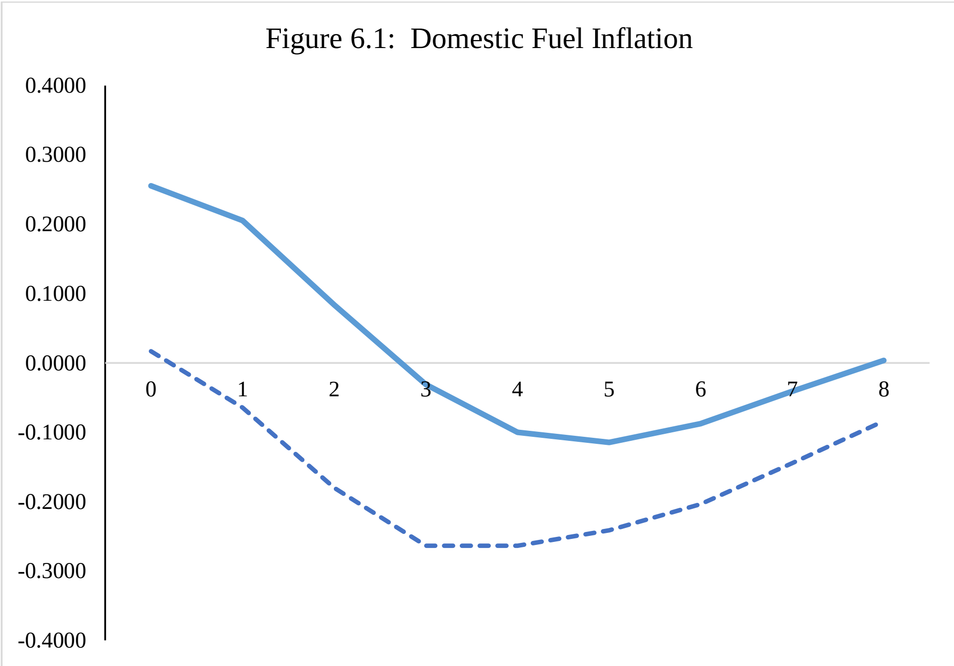
Note: Rolling regression with a fixed window of 10 years.

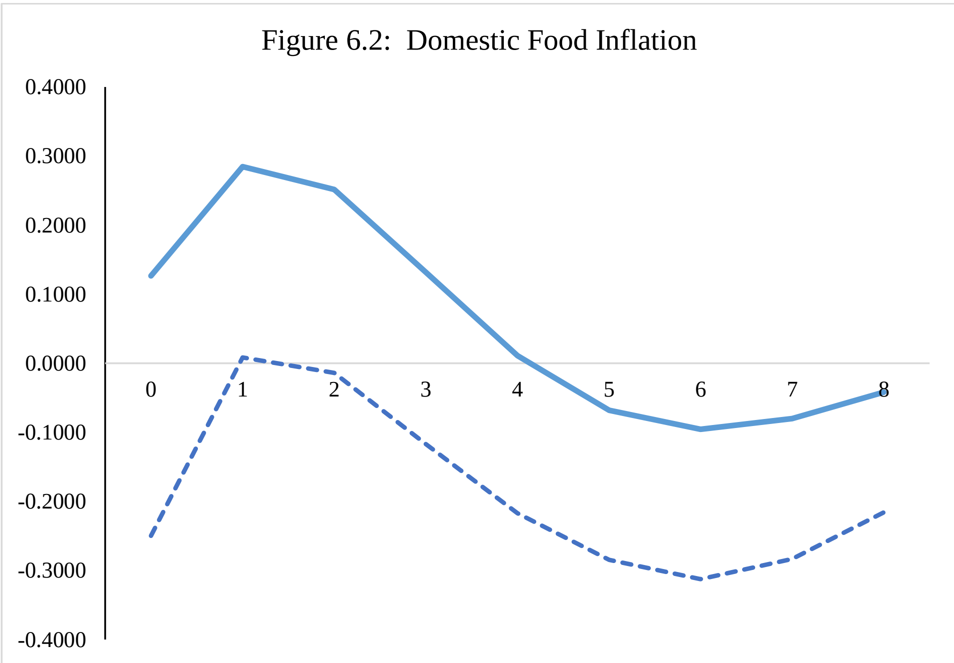
Figure 5:
IRF from VAR Analysis: How Shocks from Global Commodity Prices Impact Core Inflation



Note: The magnitude of the shock corresponds to one unit standard deviation of the global commodity price.
The dotted line denotes the lower standard error bands of the impulse response functions (IRF) obtained using a bootstrap of 300 replications.
The three-variable VAR ordering: $\pi^{global-commodity}$, $ygap$, π^{core}.
Each IRF spans 8 quarters.

Figure 6.1 and 6.2:
IRF from VAR analysis: How Shocks from Domestic Commodity Prices Impact Core Inflation





Note: The magnitude of a shock corresponds to one unit standard deviation.
The dotted line denotes the lower standard error bands of the IRF obtained using a bootstrap of 300 replications.
The three-variable VAR ordering: $\pi^{dom-fuel}$, $\pi^{dom-food}$, π^{core}.
Each IRF spans 8 quarters.