Box A[1]: Drivers of Inflation in the ASEAN+3 Economies

Introduction

Inflation in the ASEAN+3[2] generally diverged from that of advanced economies such as the US and the Eurozone in 2021 and into the early part of this year, remaining mild in the former while increasing steeply in the latter. The relatively benign inflation outturn in the ASEAN+3 occurred despite sharp increases in a range of commodities including oil, which are crucial imports for many of those economies. Since the middle of the year, however, inflationary pressure has begun to intensify in the region.

This Box seeks to investigate the drivers of inflation in the ASEAN+3 using several econometric approaches. First, it explores the role of global common factors in driving headline inflation. Second, it examines the impact of global oil price increases on CPI inflation, taking into consideration differences in economic structures and policy regimes. Third, it assesses the relative importance of external drivers of inflation vis-à-vis domestic factors over time, using a Phillips curve framework.

Inflation Synchronisation in the ASEAN+3

The role of common factors in driving inflation dynamics in the ASEAN+3 is first assessed using principal components analysis. Following Forbes (2019) and Ciccarelli and Mojon (2005), a global factor was extracted as the first principal component of headline CPI inflation rates for 59 economies over the period Q1 1970 to Q2 2022. Among the ASEAN+3 economies, only Indonesia, Japan, Korea, Malaysia, the Philippines, Singapore and Thailand have sufficiently long time-series data available to be included in the analysis.

The estimated global factor explains around 38% of the variation in headline inflation in the full sample. This compares with 32% for the ASEAN economies and 63% for the advanced economies[3], which include the Plus-3 economies of Japan (55%) and Korea (50%). The greater importance of the global factor in explaining inflation variation in the advanced economies, relative to the ASEAN economies, is indicative of a greater degree of inflation synchronisation in the former group, a result consistent with findings from Ha *et al.* (2019) and others in the literature.

To examine how the importance of international drivers of inflation in ASEAN has changed over time, the proportion of variance explained by the global factor in moving 5-year windows is computed as the R^2 values from regressions of inflation in each ASEAN economy on the factor and a constant. The results show that the proportion of variance explained by the global factor has risen markedly in the most recent window (Q1 2020 to Q2 2022), similar to the experience during the oil price spikes of the early 1970s, early 1980s and mid-2000s **(Chart A1)**. There is also a strong positive correlation between the global factor for inflation

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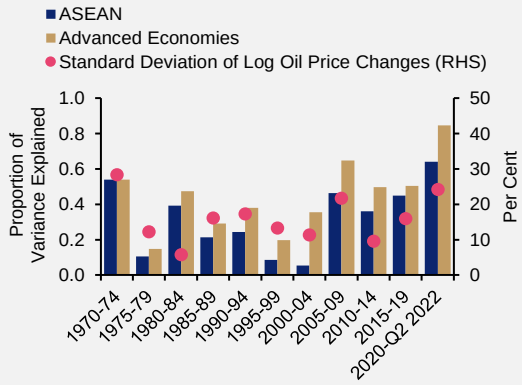
1 This Box is a collaborative project between economists in the ASEAN+3 Macroeconomic Research Office (AMRO) and EPG, MAS, and does not necessarily represent the official views of AMRO or MAS.

2 The ASEAN+3 region comprises the ten economies of ASEAN (Brunei, Cambodia, Indonesia, Laos, Malaysia, Myanmar, the Philippines, Singapore, Thailand and Vietnam) plus that of China, Hong Kong, Japan and South Korea.

3 The advanced economies are Australia, Austria, Belgium, Canada, Cyprus, Denmark, Finland, France, Germany, Greece, Iceland, Italy, Japan, Luxembourg, New Zealand, Norway, Portugal, South Korea, Spain, Sweden, Switzerland, United Kingdom, and the United States.

and world energy prices **(Chart A2)**, suggesting that inflation synchronisation across the ASEAN economies could be largely attributed to oil price shocks.

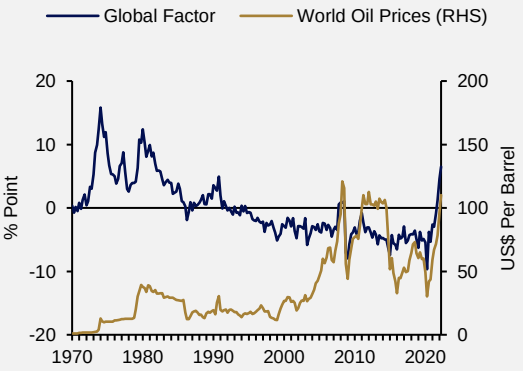
Chart A1 Share of Variance in Inflation Explained by Global Factors



Source: IMF and World Bank via Haver Analytics and EPG, MAS estimates

Note: The ASEAN economies are Indonesia, Malaysia, the Philippines, Singapore and Thailand. Advanced economies are defined in footnote 2 above. The share of variance explained is the average R^2 of regressions of CPI inflation on the estimated global factor and a constant for each economy.

Chart A2 Estimated Global Factor and World Oil Prices



Source: World Bank and EPG, MAS estimates

Note: World oil prices are the equally weighted average of Brent, Dubai and WTI crude oil prices.

How Do Oil Price Shocks Affect the ASEAN+3 Economies?

Next, the local projections method[4] is used to quantify the impact of global oil price shocks on domestic headline inflation in the ASEAN+3 economies. Following Choi *et al.* (2018), the following equation is estimated using monthly data for the ASEAN+3 economies over the period from January 2000 to the most recent month for which data is available in 2022[5]:

$$\pi_{i,t+h} = \alpha_i^h + \sum_{j=1}^{l} \gamma_j^h \pi_{i,t-j} + \beta^h(\delta_i \pi_t^{oil}) + \sum_{j=1}^{n} \theta_j^h(\delta_i \pi_{t-j}^{oil}) + \varepsilon_{i,t}^h$$

where π_i is headline inflation (y-o-y change in the CPI) in economy i, π^{oil} is the y-o-y change in the global oil price, δ_i is the transportation weight in the CPI basket in economy i (a proxy for the share of oil in total consumption), α_i^h are economy fixed effects for horizon h, γ_j^h captures the persistence of CPI year-on-year inflation over the previous j months for horizon h, β^h is the impact of global oil prices on domestic inflation for each future period h, and θ_j^h is the impact of global oil prices over the previous j months on domestic inflation for horizon

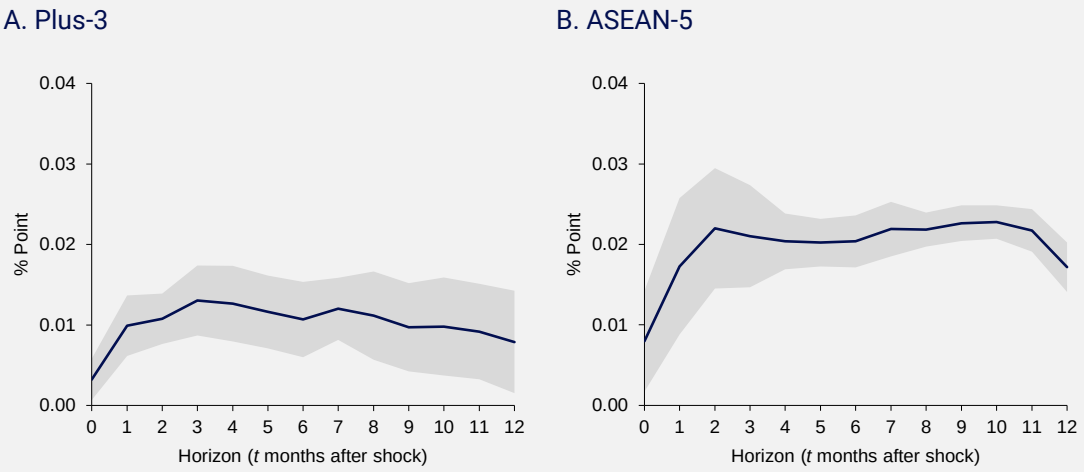
4 Local projections is a methodology for the estimation of impulse responses without specification and estimation of the underlying multivariate dynamic system proposed by Jordà (2005) as a flexible alternative to vector autoregressions (VARs). The central idea involves estimating local projections at each period of interest rather than extrapolating into increasingly distant horizons from a given model, as it is done with VARs.

5 The panel regressions include monthly data from January 2000 to August 2022 for all the ASEAN+3 economies except for Brunei and Cambodia (to June 2022) and Myanmar (to April 2022).

h.[6] Separate regressions are estimated for the different monthly horizons ($h = 1, \dots, 12$). The interaction term of the transport share in each economy's CPI basket and the global oil price shock is added to the regression to identify average effect of global oil prices on inflation while controlling for cross-country heterogeneity.

The results indicate that a 1% point y-o-y increase in oil prices raises the region's y-o-y headline inflation by 0.02% point on average over the next 12 months.[7] This implies that the rise in crude oil prices over January to July 2022 by a monthly average of 60% y-o-y would boost the region's headline inflation by about 1.2% points within the first year of the shock. However, the impact of oil price shocks on inflation varies across economies in the region. Inflation in BCLMV (Brunei, Cambodia, Lao PDR, Myanmar, and Vietnam) is most affected by global oil price inflation—a 1% point increase in oil prices y-o-y will lead to an average 0.026% point rise in CPI inflation in these economies. The inflation response to a global oil price shock is smaller in the ASEAN-5 (Indonesia, Malaysia, the Philippines, Singapore, and Thailand)—averaging about 0.021% point—and even less in the Plus-3 (China, Hong Kong, Japan, and Korea) at about 0.011% point **(Chart A3)**. Hence, the 60% y-o-y rise in crude oil prices on average over January to July 2022 would increase CPI inflation by 1.5% points in BCLMV, compared with 1.2% points in the ASEAN-5 and 0.6% point in the Plus-3.

Chart A3 Impact of an Oil Price Shock on Domestic Headline Inflation by Economy Group



Source: National authorities and World Bank via Haver Analytics and AMRO staff estimates

Note: The chart shows the response of headline inflation to a 1% point increase in global oil prices. The solid line is the impulse response function and the shaded region represents the 90% confidence band. The x-axis shows the number of months after the shock.

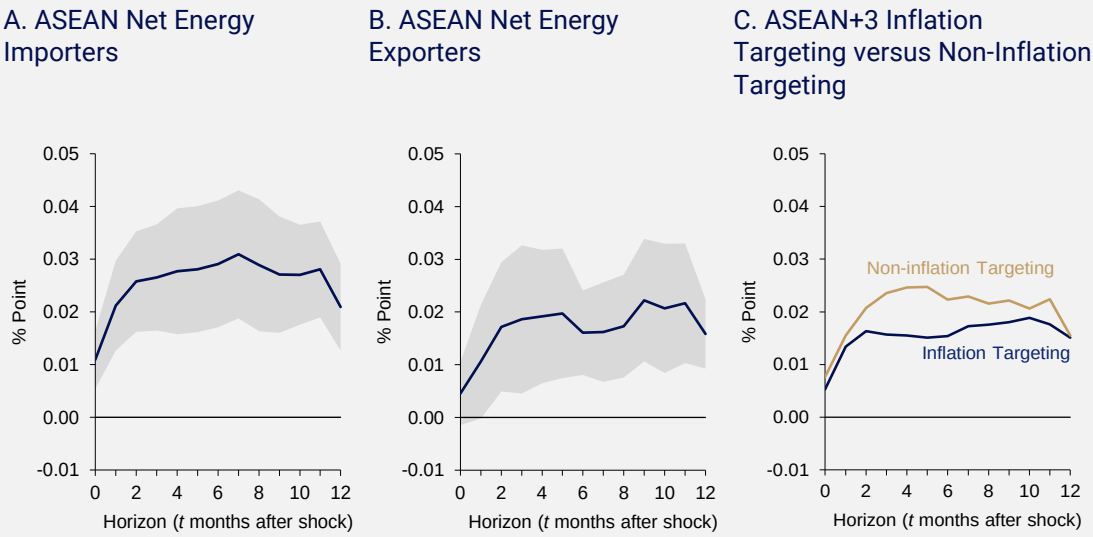
Specifically, the energy trade balance can partly explain the variation in the size of the impact within ASEAN. When the sample of ASEAN economies was divided into two groups—net energy importers (Cambodia, the Philippines, Singapore, Thailand, and Vietnam) and net

6 To address the concern that global oil prices and domestic inflation might be jointly affected by unobserved factors that are not included in the equation, a regression of global oil prices on a global demand indicator (US industrial production) was estimated and the residuals were used as π^{oil} in the above equation. The estimation results of this robustness check were similar to the baseline estimates.

7 The result is in line with the literature. Both Carrière-Swallow *et al.* (2022) and Choi *et al.* (2018) find that a 1% increase in global oil prices leads to an increase in domestic inflation of about 0.02% point. The former analysis was based on monthly data for 46 economies over the period 1992–2021 while the latter used annual data for 72 countries over the period 1993-2015. Results in Choi *et al.* (2018) also suggest that the impact of global oil price shocks on inflation has declined over time.

energy exporters (Brunei, Lao PDR, Indonesia, Malaysia, and Myanmar)—the results indicate that inflation in net energy importers is more sensitive to oil price shocks than inflation in net energy exporters. Consumers in net energy exporters generally face lower retail fuel prices, as governments can channel at least some of the increased fiscal revenue from higher energy prices to subsidise the retail cost of fuel. Consequently, the pass-through to domestic CPI would be less than that in net energy importers. A 1% increase in global oil price inflation y-o-y leads to an increase in CPI inflation of about 0.027% point on average in the first year for net energy importers, while the corresponding estimate for net energy exporters is about 0.018% point **(Charts A4.A and A4.B)**. Consequently, the 60% y-o-y increase in crude oil prices over January to July 2022 is projected to translate into an increase in CPI inflation of 1.6% points for net energy importers and 1% point for net energy exporters.

Chart A4 Impact of an Oil Price Shock on Headline Inflation by Economy Characteristics



Source: National authorities and World Bank via Haver Analytics and AMRO staff estimates

Note: The chart shows the response of y-o-y headline inflation to a 1% point y-o-y increase in global oil prices. The solid line is the impulse response function and the shaded region represents the 90% confidence band. The x-axis shows the number of months after the shock. ASEAN net energy exporters are Brunei, Indonesia, Lao PDR, Malaysia and Myanmar. ASEAN net energy importers are Cambodia, the Philippines, Singapore, Thailand, and Vietnam. The ASEAN+3 economies with inflation targets are Indonesia, Japan, Korea, the Philippines and Thailand.

The impact of oil price shocks on domestic inflation also appears to be smaller in economies with inflation targeting regimes. The ASEAN+3 economies were divided into two groups according to whether they operate an inflation targeting monetary policy regime, and regressions similar to the above were run on each group.[8] The rise in domestic headline inflation is almost the same at the earlier and later horizons for both groups. In the intervening months, however, the increase in inflation in non-inflation targeting economies is higher than that in inflation targeting ones **(Chart A4.C)**. The results suggest that inflation targeting can have a role to play in helping to reduce the average inflation impact stemming from an oil price shock.

[8] According to the IMF's *Annual Report on Exchange Arrangements and Exchange Restrictions 2021*, the ASEAN+3 economies with inflation targeting frameworks are Indonesia, Japan, Korea, the Philippines and Thailand.

Phillips Curve Decomposition

To study the relative importance of domestic conditions and global factors in shaping price dynamics in the region, a Phillips curve is estimated for a panel of the five founding ASEAN members[9] over Q1 2000 to Q2 2022. The specification used is a variant of the hybrid New Keynesian Phillips curve in Forbes (2019):

$$\pi_{i,t} = \alpha_i + \beta_1 \pi_{i,t-1} + \beta_2 \pi^e_{i,t} + \beta_3 \tilde{y}_{i,t} + \sum_{k=1}^{4} \gamma_k \, \Delta reer_{i,t-k} + \gamma_5 \Delta commodity_{i,t} + \varepsilon_{i,t}$$

where the dependent variable $\pi_{i,t}$ is the seasonally adjusted, annualised quarter-on-quarter rate of headline inflation in country i at time t. $\pi_{i,t-1}$ is lagged inflation, a proxy for backward-looking expectations and $\pi^e_{i,t}$ represents expected inflation. $\varepsilon_{i,t}$ denotes an error term. As in Forbes (2019), CPI inflation forecasts from the bi-annual IMF *World Economic Outlook* are interpolated to a quarterly frequency and used as a measure of forward-looking inflation expectations.[10] Economic slack is measured by the output gap $\tilde{y}_{i,t}$ constructed by applying the Hodrick-Prescott filter on seasonally adjusted real GDP for each country.

To capture the effects of external shocks on domestic inflation, the model is augmented with commodity prices and exchange rates. $\Delta reer_{i,t}$ is the annualised log difference of the real effective exchange rate published by the BIS, where $\Delta reer_{i,t} > 0$ indicates an appreciation of a country's real exchange rate against its trading partners. Four lags of the real effective exchange rate are included to account for the lagged pass-through of currency fluctuations to consumer prices (Forbes, 2019). $\Delta commodity_{i,t}$ denotes the annualised log difference of country-specific import price indices published by the IMF that are constructed by weighting the international prices of a comprehensive set of commodities by country import shares on a rolling basis (Gruss and Kebhaj, 2019).

Results of the specification are reported in **Table A1**. The estimated Phillips curve coefficients are of the expected sign and statistically significant. In line with the findings of Garcia *et al.* (2018), who estimated individual country-level Phillips curves with time-varying parameters for the same sample of ASEAN countries, the estimates suggest that inflation dynamics in the region have a forward-looking orientation. The coefficient on expected inflation is large ($\widehat{\beta_2}$=0.688) compared to inflation persistence ($\widehat{\beta_1}$=0.154), which is consistent with their inference that improvements in monetary policy frameworks after the Asian Financial Crisis have allowed ASEAN central banks to credibly influence inflation by anchoring expectations. In a structural break analysis using a larger panel comprising both advanced and emerging market economies, Kamber *et al.* (2020) similarly find evidence that the estimated weight of forward-looking inflation expectations in a cross-country hybrid Phillips curve has increased over the past two decades and link it to the decline in the long-run mean of inflation over time across the economies in their sample.

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[9] They are Indonesia, Malaysia, the Philippines, Singapore and Thailand. The analysis is limited to these countries as data unavailability for the other ASEAN members would significantly shorten the length of the balanced panel. Estimating the Phillips Curve using cross-country panel data permits identification of average effects across countries with the added benefit of increased statistical power. This is an important advantage given the mixed results of country-level studies assessing the role of global variables in determining domestic inflation (Ha *et al.*, 2019; Lodge and Mikolajun, 2016).

[10] However, one-year-ahead instead of five-year-ahead forecasts are used as they are more consistent with the time horizon in the original formulation of the New Keynesian Phillips curve.

Table A1 ASEAN-5 Phillips Curve Estimates

	Coefficient	Standard Error	*P*-value
Lagged Inflation ($\pi_{i,t-1}$)	0.154	0.053	0.045
Expected Inflation ($\pi^{e}_{i,t}$)	0.688	0.156	0.012
Output Gap ($\tilde{y}_{i,t}$)	0.483	0.151	0.033
Commodity Import Prices ($\Delta commodity_{i,t}$)	0.029	0.008	0.051
$\Delta reer_{i,t-1}$	−0.057	0.008	0.002
$\Delta reer_{i,t-2}$	−0.001	0.008	0.891
$\Delta reer_{i,t-3}$	−0.030	0.013	0.088
$\Delta reer_{i,t-4}$	−0.020	0.006	0.027

Source: BIS and IMF via Haver Analytics and EPG, MAS estimates

Note: The above are the results from a dynamic panel regression estimated using a Generalised Method of Moments (GMM) approach on a balanced panel with 450 observations. Following the Arellano-Bond 1-step procedure (Arellano and Bond, 1991), three lags of the dependent variable are used as instruments in the difference equation. Although the J-statistic rejects the over-identifying restrictions, the Arellano-Bond serial correlation test statistics indicate that endogeneity arising from serial correlation is less of a concern. Robust standard errors clustered at the country level are reported above.

Consistent with theory, higher commodity import prices and real exchange rate depreciations are correlated with higher domestic inflation. The coefficient on commodity prices, however, is less precisely estimated, perhaps because the sample contains both net commodity exporters and importers. However, its magnitude is within the range of existing estimates of the impact of a contemporaneous increase in world oil prices on inflation in the literature (Forbes, 2019; Lodge and Mikolajun, 2016). A 1% rise in commodity import prices increases inflation by around 0.03% point in the same quarter on average across countries.[11] Notably, the coefficient on the domestic output gap remains large and statistically significant even with the inclusion of exchange rates and commodity prices.[12] This suggests that while global factors have some explanatory power for inflation dynamics, they do not obviate the role of domestic slack as a determinant of inflation.

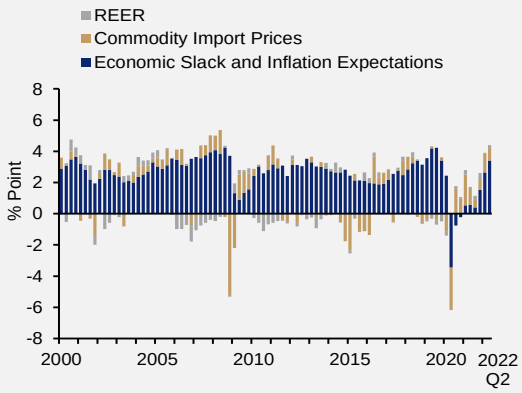
Lastly, the estimated coefficients are used to decompose inflation in each of the five countries into contributions from domestic and external drivers. Overall, commodity import prices and real exchange rates tend to play a larger role around the turning points of global business cycles and episodes of heightened volatility in commodity or financial markets. Notably, the Global Financial Crisis in 2008-09 and the more recent COVID-19 crisis were both marked by sharp declines in commodity prices at the outset that lowered inflation and subsequent recoveries in commodity prices that had the opposite effect. The supply-driven collapse in oil prices over 2015−16 also led to a period of persistent disinflation in the region (Garcia *et al.*, 2018) while the depreciation of regional currencies during the "Taper Tantrum" in 2013 exerted upward pressure on inflation. Nevertheless, economic slack and inflation

[11] Replacing trade-weighted commodity import prices with world oil prices yields a smaller estimated coefficient ($\hat{\gamma}_5$=0.012) consistent with the immediate response of headline inflation to oil price shocks estimated using local projections in the preceding section.

[12] As global economic activity and commodity prices are tightly coupled (Cunningham and Smith, 2019; Sussman and Zohar, 2018), variation in domestic output gaps due to global demand is likely to be captured in part by commodity prices as well. Excluding real exchange rates and commodity import prices, the coefficient on the output gap is larger (0.566), suggesting that there is indeed some overlap.

expectations are relatively more important drivers of domestic inflation in the sample of ASEAN countries considered **(Chart A7)**.

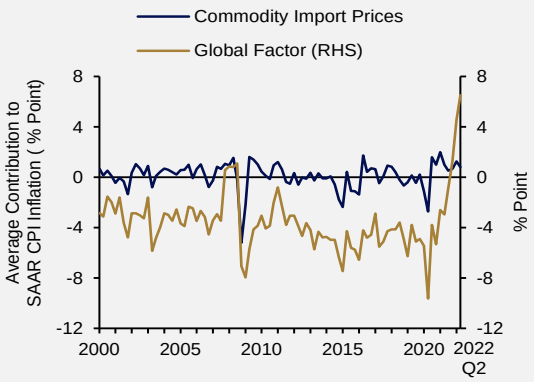
Chart A7 Contributions of Domestic and External Factors to CPI Inflation



Source: BIS and IMF via Haver Analytics and EPG, MAS estimates

Note: Using the coefficients in Table A1, the effects of changes in lagged inflation are attributed to previous movements in explanatory variables by recursively substituting for the inflation persistence term $\pi_{i,t-1}$. The average of contributions to annualised CPI inflation across the five ASEAN countries are presented above. "Domestic Drivers" is the sum of contributions from the output gap and expected inflation. Contributions from the lagged REER terms are summed.

Chart A8 Contribution of Commodity Import Prices to CPI Inflation and Global Factor



Source: BIS and IMF via Haver Analytics and EPG, MAS estimates

The contribution of commodity import prices to inflation has moderated since H2 2021, following the sharp pickup in commodity prices from depressed levels in 2020 amid supply disruptions and resurgent demand **(Chart A8)**. Meanwhile, the global factor has trended upwards, pointing to a sustained pickup in headline inflation driven by the rapid diminishing of economic slack in many countries following a strong post-pandemic rebound in activity. This suggests that domestic drivers of inflation have increased in importance as post-COVID recoveries gain traction and domestic output gaps close, even as commodity prices come off highs in the first half of 2022. The contribution of forward-looking inflation expectations to inflation has also risen in this most recent period, although it remains well within historical averages.

Sum-up

Global factors are important determinants of headline inflation in the region, with world energy prices in particular driving a significant part of the co-movement in inflation among the ASEAN+3 economies. The impact of oil price shocks on headline inflation in the region varies by both economic structure and policy regime: oil price shocks have a smaller effect on inflation in net energy exporters compared to net energy importers and appear to generate a more muted inflation response in inflation-targeting regimes. Notwithstanding the empirical relevance of external factors to inflation dynamics, Phillips curve estimates suggest that inflation expectations and economic slack remain the primary drivers of headline inflation in a subset of ASEAN countries. The findings suggest that inflation expectations have been

largely well-anchored since 2000, perhaps reflecting greater central bank credibility in the region after the Asian Financial Crisis.

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