AMRO
ASEAN +3 MACROECONOMIC RESEARCH OFFICE

Analytical Note

Fueling Inflation in ASEAN+3: The Rising Price of Energy[1]

September 15, 2022

"Higher energy prices act like a tax."

John W Snow
US Treasury Secretary, 2003–2006

I. Introduction

1. **The Russia-Ukraine war has sent shockwaves throughout world energy markets.** Russia is one of the largest producers and exporters of natural gas, crude oil, and coal in the world. As economic sanctions on Russia have escalated due to the war, cutbacks in Russian exports and market expectations of supply shortages have led to soaring prices for fuels across the world. Since the start of the war in February 2022, global prices of crude oil and natural gas have risen to their highest levels in more than a decade and the price of coal is at an all-time high.

2. **Escalating energy prices are putting upward pressure on global inflation.** In the United States, inflation surged to a 40-year high in March 2022 as gasoline prices soared. In the euro area, inflation shot up to a record 8.9 percent in July, propelled by higher energy prices fueled by the war in Ukraine. Despite slowing activity, the International Monetary Fund (IMF) expects inflation in 2022 to reach 6.6 percent in advanced economies and 9.5 percent in emerging market and developing economies—levels that represent "a clear risk for current and future macroeconomic stability" (Gourinchas 2022).

3. **This note examines the impact of rising global energy prices on inflation in the ASEAN+3 region.** Sections II and III provide some background on the global energy sector, price trends for oil, gas, and coal since the start of the war, and ASEAN+3 economies' exposure to the global energy trade. Section IV discusses the relation between global energy prices and inflation in ASEAN+3 economies. Section V concludes.

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II. The Global Energy Landscape

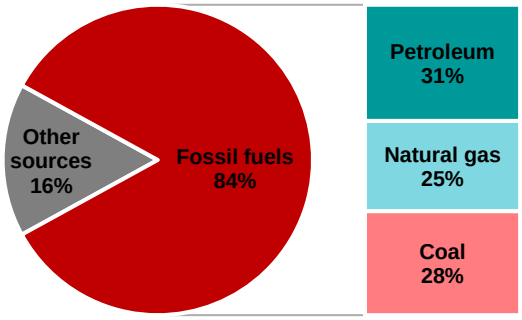
4. **Global energy production is predominantly sourced from fossil fuels**—oil, gas, and coal (Figure 1).[2]

- **Oil:** The bulk of the world's petroleum is produced by the 13 members of the Organization of the Petroleum Exporting Countries (OPEC) together with a group of 10 non-OPEC countries—all 23 collectively known as OPEC+ (Figure 2).[3] Russia is a member of OPEC+, as are two ASEAN countries: Brunei and Malaysia.[4] OPEC+ countries manage oil production by setting production targets; they meet every month to decide how much crude oil to sell on the world market at the prevailing benchmark price (Box 1). Outside OPEC+, key centers of crude oil production include North America and the North Sea. The world's top five crude oil exporters in 2021 were Saudi Arabia, Russia, Iraq, Canada, and the United States (Figure 3). Crude oil is mostly transported in pipelines or oil tankers.

- **Gas:** The top producer of natural gas in the world is the United States, followed by Russia. Before the war, Russia was the world's leading exporter of gas, followed by the United States, Qatar, Norway, and Australia (see Figure 3). Most of the world's natural gas is delivered by pipeline. Natural gas is also transported on ships in the form of liquefied natural gas (LNG).

- **Coal:** China is the world's largest producer of thermal coal (see Figure 2). However, most of China's coal production is consumed domestically. The largest exporters of thermal coal are Australia, Indonesia, Russia, the United States, and South Africa (see Figure 3). Traded coal is mainly transported by ship or overland (by rail).

Figure 1. World: Energy Production by Source, 2019
(Percent share of total)



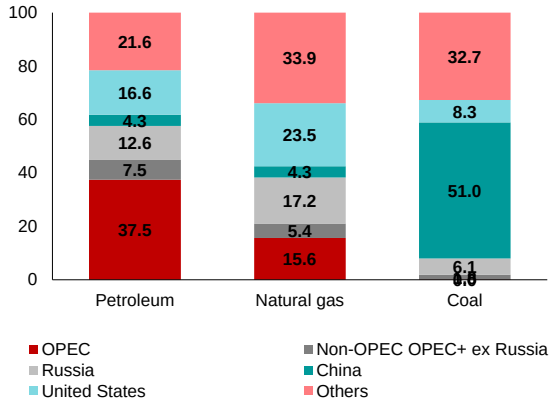
Source: US Energy Information Administration; and AMRO staff calculations.
Note: "Petroleum" includes crude oil and petroleum products that are produced from the processing of crude oil and other liquids at petroleum refineries, from the extraction of liquid hydrocarbons at natural gas processing plants, and from the production of finished petroleum products at blending facilities. "Other sources" include nuclear energy and renewable energy e.g., wind, solar energy, and hydropower.

[2] "Crude oil" and "petroleum" are often used interchangeably to indicate hydrocarbon fossil fuels. Petroleum products (e.g., gasoline and distillates such as diesel fuel and heating oil, and jet fuel) are fuels made from crude oil and hydrocarbons contained in natural gas. Natural gas contains many different compounds, including methane (the largest component) and smaller amounts of natural gas liquids and nonhydrocarbon gases. Thermal coal is burned for steam to run turbines to generate electricity.

[3] The 13 OPEC members are: Algeria, Angola, Congo, Equatorial Guinea, Gabon, Iran, Iraq, Kuwait, Libya, Nigeria, Saudi Arabia, United Arab Emirates, and Venezuela. The 10 non-OPEC oil producers are Azerbaijan, Bahrain, Brunei, Kazakhstan, Malaysia, Mexico, Oman, Russia, South Sudan, and Sudan.

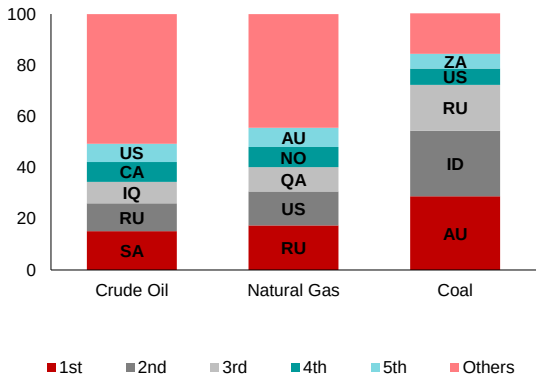
[4] Indonesia joined OPEC in 1962, suspended its membership in January 2009, reactivated its membership in January 2016, and suspended its membership in November 2016.

Figure 2. World: Major Fuel Producers, by Fuel Type, 2019
(Percent share of total in volume)



Source: US Energy Information Administration; and AMRO staff calculations.
Note: OPEC = Organization of the Petroleum Exporting Countries (Algeria, Angola, Congo, Equatorial Guinea, Gabon, Iran, Iraq, Kuwait, Libya, Nigeria, Saudi Arabia, United Arab Emirates, and Venezuela). "Non-OPEC OPEC+ ex Russia" = Azerbaijan, Bahrain, Brunei, Kazakhstan, Malaysia, Mexico, Oman, South Sudan, and Sudan. "Petroleum" includes crude oil and petroleum products that are produced from the processing of crude oil and other liquids at petroleum refineries, from the extraction of liquid hydrocarbons at natural gas processing plants, and from the production of finished petroleum products at blending facilities.

Figure 3. World: Major Fuel Exporters, by Fuel Type, 2021
(Percent share of total in volume)



Source: OPEC Annual Statistical Bulletin; BP via CEIC; and AMRO staff calculations.
Note: AU = Australia; CA = Canada; IQ = Iraq; NO = Norway; QA = Qatar; RU = Russia; SA = Saudi Arabia; US = United States; ZA = South Africa.

Box 1. Oil, Gas, and Coal Benchmark Prices

Oil. Crude oil is the most traded commodity in the world. Market participants not only buy and sell physical quantities of oil, but also trade contracts for the future delivery of oil. The two most commonly traded contracts of crude oil in global markets are Brent and West Texas Intermediate (WTI). Brent refers to oil that is produced in the Brent oil fields and other sites in the North Sea. Brent crude is used to price over three-quarters of the crude oil produced globally (Wittner 2020). WTI crude is sourced from the United States and is seen as the benchmark in the Western hemisphere. The standard 42-gallon oil barrel (bbl) is used in the United States as a measure of crude oil and other petroleum products; elsewhere, oil is commonly measured in cubic meters or tonnes (metric tons).

Gas. Gas hubs are virtual or physical marketplaces where participants can transfer the title of natural gas already present in the transmission system to other market participants. In the United States, Louisiana's Henry Hub is the most well-known natural gas hub and it is used as a domestic and global benchmark for natural gas futures traded on the New York Mercantile Exchange. In Europe, the Netherlands' Title Transfer Facility (TTF) is the main hub and benchmark price for natural gas, similar to Brent crude for pricing oil markets. The Japan Korea Marker is the benchmark price for spot physical cargoes of LNG delivered ex-ship into Japan, Korea, China, and Taiwan Province of China. The standard volume unit of measurement for natural gas contracts is million British thermal units (MMBtu).

Coal. Australia, Colombia, and South Africa are recognized as the three terminal markets that determine global thermal coal prices.

5. **Global energy prices have surged since the start of the Russia-Ukraine war** (Figure 4).

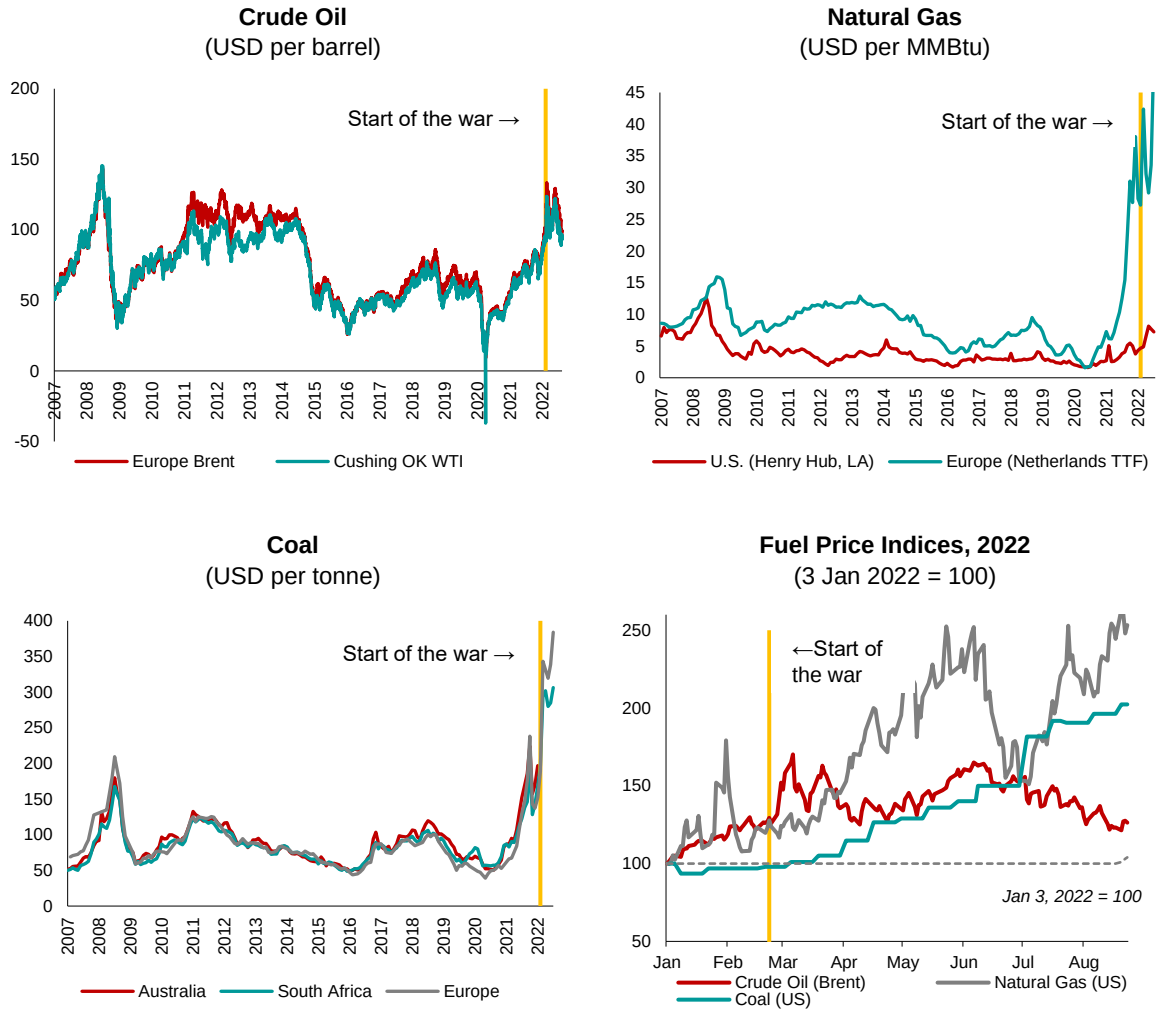
- **Oil**: The start of the war in February led to a surge in crude oil prices as fears were triggered of a disruption to energy exports. The benchmark Brent crude price reached a record high of USD138 per barrel on 8 March 2022—the highest level since 2008. Initially, Russian energy supplies were largely spared from sanctions—except for an export ban on oil refinery equipment from the European Union (EU)—but the exclusion of Russian banks from the SWIFT network made overall commodity trading with Russia more difficult, and concerns about future sanctions being imposed on Russia's oil exports exacerbated the supply-side worries (Pande 2022). Crude oil prices declined in April due to stock release actions from US oil reserves; rose in May on the sixth round of EU sanctions on Russia; and fell again in June and July as the global economic outlook worsened (IEA 2022).

- **Gas**: The increase in crude oil prices triggered by the war was mirrored in the price of natural gas, a close substitute for crude oil, and an energy source that is typically produced from the same oil fields (American Petroleum Institute, n.d.). Netherlands Title Transfer Facility (TTF) gas prices increased after the war broke out, reflecting Europe's dependence on Russian gas and low storage levels. TTF gas prices hit a record high in March and stayed at high levels in May and June as Russia cut off gas supply to some EU countries. European gas prices hit a record high again in July due to further supply cuts and growing market uncertainty. Meanwhile, Henry Hub prices climbed to their highest level in May since 2008 due to the surge in LNG demand from Europe.

- **Coal**: European coal prices rose sharply after the war broke out as concern over further disruptions from Russia amplified ongoing supply tightness in the market. Buyers also became concerned about sourcing Russian-origin cargoes even though they were not initially included in the sanctions list. This came amid extremely tight spot availability from other sources, leading to higher coal prices globally. The EU's decision to ban coal imports from Russia starting in August 2022 pushed coal prices up even further.

6. **While the war may have sparked the recent increase in energy prices, other factors have also been at play.** Supply-side factors which played a role in affecting energy prices this year include: geopolitical tensions and military conflicts, such as the ongoing civil unrest in Libya; weather-related factors, such as floods in Australia; labor shortages (in Australian coal mines) and labor actions (e.g., strike in an Australian LNG facility); and other disruptions such as rail constraints in South Africa, an explosion in a large US LNG exporting facility, and so on. At the same time, global demand for energy has been rising following the resumption of economic activities as COVID-19 mobility restrictions were lifted in many parts of the world.

Figure 4. World: Fuel Prices



Source: U.S. Energy Information Administration, World Bank, Intercontinental Exchange, and Wall Street Journal via Haver Analytics.
Note: MMBtu = metric million British thermal units. TTF = Title Transfer Facility. USD = US dollar. WTI = West Texas Intermediate.

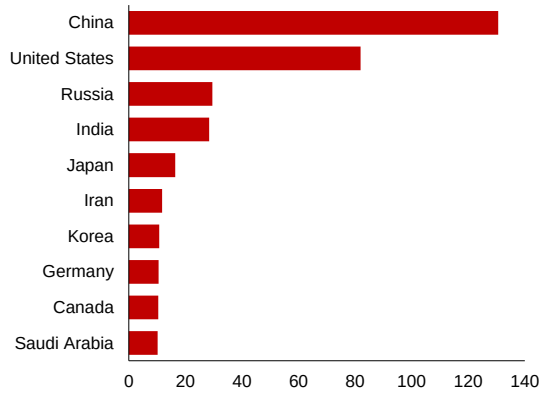
7. **Global energy prices are expected to stay high for the rest of 2022 and in 2023.** Natural gas prices are expected to soar in the winter given Russia's decision to shut down the main supply pipelines to Europe. Oil prices could be supported by stronger demand from the recovering global economy and consumers switching from natural gas to oil. Soaring natural gas prices will also increase demand for coal. The U.S. Energy Information Administration (EIA) forecasts the spot price of Brent crude oil will average USD102.1 per barrel and the Henry Hub natural gas price will average USD7.54 per MMBtu in the second half of 2022 (EIA 2022). The World Bank forecasts that European gas prices will average USD34.0 per MMBtu in 2022, and that energy prices will remain high in 2023 (Guénette and Khadan 2022). The price forecasts are subject to a high degree of uncertainty, including how sanctions on and countersanctions by Russia unfold and OPEC+ production decisions.

III. ASEAN+3 Energy Consumption and Trade

8. **The Plus-3 economies are among the world's largest consumers of energy** (Figures 5 and 6). China is the world's biggest energy consumer. As noted earlier, it consumes (and also produces) most of the world's coal (see Figure 6). Japan and Korea are

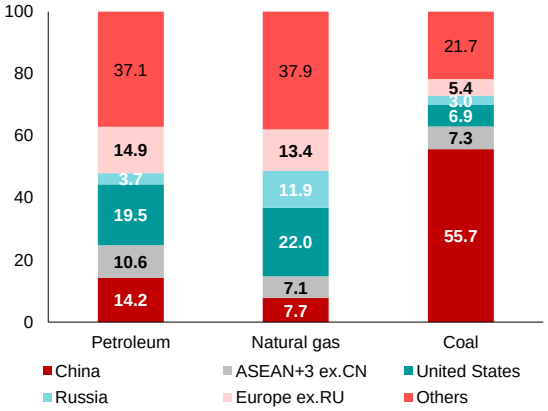
also among the world's top ten energy consumers, although they produce a relatively small share of their energy consumption domestically.

Figure 5. World: Top Ten Energy Consumers, 2019
(Quadrillion BTUs)



Source: U.S. Energy Information Administration; and AMRO staff calculations.
Note: BTU = British thermal unit.

Figure 6. World: Major Energy Consumers, by Fuel Type, 2019
(Percent share of global energy consumption in volume)



Source: US Energy Information Administration; and AMRO staff calculations.
Note: ASEAN+3 = Brunei, Cambodia, China, Hong Kong, Indonesia, Japan, Korea, Lao PDR, Malaysia, Myanmar, the Philippines, Singapore, Thailand, and Vietnam. CN = China. RU = Russia. "Petroleum" includes crude oil and petroleum products that are produced from the processing of crude oil and other liquids at petroleum refineries, from the extraction of liquid hydrocarbons at natural gas processing plants, and from the production of finished petroleum products at blending facilities.

9. **Energy consumption in the ASEAN+3 region relies more on coal than other forms of energy.** More than half of the region's energy consumption is sourced from coal—compared to about a quarter of the world's energy consumption—mainly reflecting the energy mix in China. Other ASEAN+3 economies—Cambodia, Hong Kong, Indonesia, Japan, Korea, Thailand, the Philippines, and especially Singapore—have a larger share of oil in their energy mix, while Brunei depends more on natural gas (Figure 7).

10. **Most ASEAN+3 economies are net energy importers; only five are net energy exporters.** Among the net energy-importing economies, Singapore, has no domestic energy production, while others have domestic production but not enough for consumption.[5] The five ASEAN+3 economies that are net energy exporters are: Brunei (petroleum products and natural gas); Indonesia (mostly coal); Malaysia and Myanmar (mostly natural gas); and Lao PDR (mostly hydropower) (Figure 8).

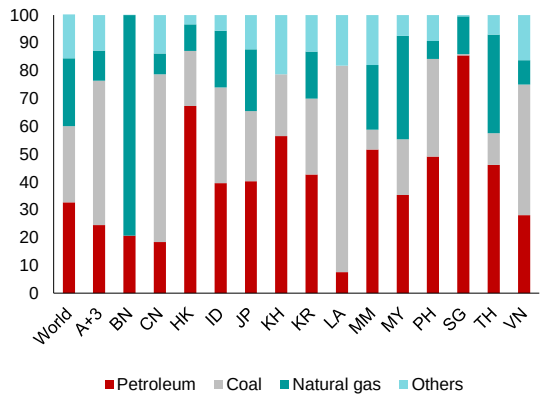
- **Oil:** Cambodia, Japan, Korea, Myanmar, the Philippines, and Singapore import almost all of their oil consumption. China, Indonesia, Thailand, and Vietnam have some domestic oil production and import the rest of their consumption. Malaysia's production is almost enough for its consumption, but its imports are still larger than its exports (Box 2). Only Brunei is a net exporter of oil (Figure 9).

[5] Russia is a major supplier of fuel (crude oil, coal, and gas) to some ASEAN+3 economies. See Hinojales and Zhao (2022) for a discussion of the impact of the war in Ukraine on ASEAN+3 fuel imports from Russia.

- **Gas:** Japan, Korea, and Singapore import almost all of their gas consumption. China and Thailand produce some natural gas domestically and import the rest of their gas consumption. Vietnam's production is enough for its consumption, but it imports more than it exports. Brunei, Indonesia, Malaysia, and Myanmar produce more natural gas than their domestic needs and are thus net exporters (see Figure 9).

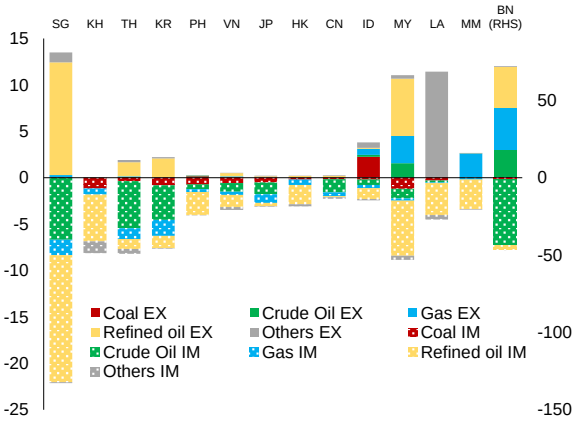
- **Coal:** Japan, Korea, Malaysia, and Thailand import almost all of their coal consumption. The Philippines and Vietnam do not produce enough coal for their consumption and import the rest. China and Lao PDR consume most of the coal that they produce. Only Indonesia is a net exporter of coal (see Figure 9).

Figure 7. ASEAN+3: Energy Consumption by Fuel Type, 2019
(Percent share of consumption in volume)



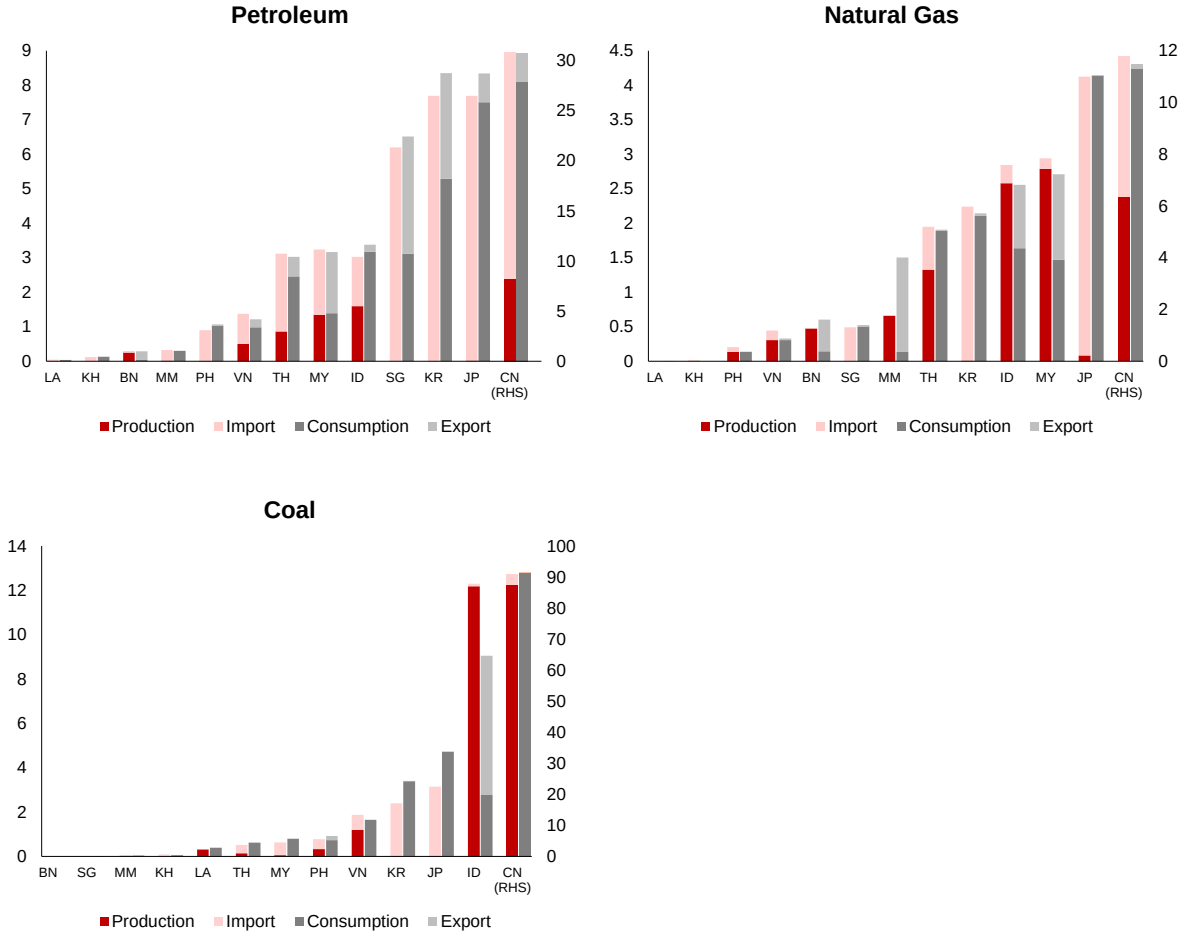
Source: U.S. Energy Information Administration; and AMRO staff calculations.
Note: A+3 = ASEAN+3; BN = Brunei; CN = China; HK = Hong Kong; ID = Indonesia; JP = Japan; KH = Cambodia; KR = Korea; LA = Lao PDR; MY = Malaysia; PH = Philippines; SG = Singapore; TH = Thailand; and VN = Vietnam. "Petroleum and other liquids" includes crude oil and petroleum products that are produced from the processing of crude oil and other liquids at petroleum refineries, from the extraction of liquid hydrocarbons at natural gas processing plants, and from the production of finished petroleum products at blending facilities.

Figure 8. ASEAN+3: Exports and Imports of Fuel
(Percent of GDP)



Source: Global Trade Atlas, ASEANStat, and AMRO staff calculations.
Note: Crude oil, gas, coal, and refined oil refer to HS 4-digit codes 2709, 2711, 2701, and 2710 respectively.
BN = Brunei; CN = China; HK = Hong Kong; ID = Indonesia; JP = Japan; KH = Cambodia; KR = Korea; LA = Lao PDR; MM = Myanmar; MY = Malaysia; PH = the Philippines; SG = Singapore; TH = Thailand; and VN = Vietnam. EX = exports; IM = imports.

Figure 9. ASEAN+3: Energy Production, Consumption, and Trade, by Fuel Type, 2019
(Quadrillion BTUs)



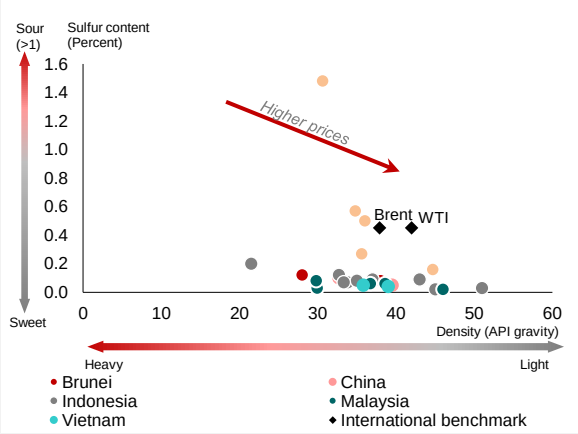
Source: Energy Information Administration via Haver Analytics; Global Trade Atlas; and AMRO staff calculations.
Note: BTU = British thermal unit. BN = Brunei Darussalam; CN = China; HK = Hong Kong; ID = Indonesia; JP = Japan; KH = Cambodia; KR = Korea; LA = Lao PDR; MM = Myanmar; MY = Malaysia; PH = the Philippines; SG = Singapore; TH = Thailand; and VN = Vietnam. The sum of production and imports may not be equal to the sum of consumption and exports due to changes in stock, re-classification (some imports are re-classified as feedstocks for further processing in the refinery without delivery to final consumers), or statistical discrepancies.

Box 2. Not All Crude Oils are the Same

ASEAN+3 oil producers produce high quality crude oils that typically trade at a premium to the international benchmark crude oils. The crude oils produced by Brunei, Indonesia, Malaysia, and Vietnam are "sweeter" (i.e., have a lower sulfur content) and/or "lighter" (i.e., have a lower density) than Brent and West Texas Intermediate (WTI) crudes, the current international benchmarks for oil prices (see Box 1) (Figure 2.1).

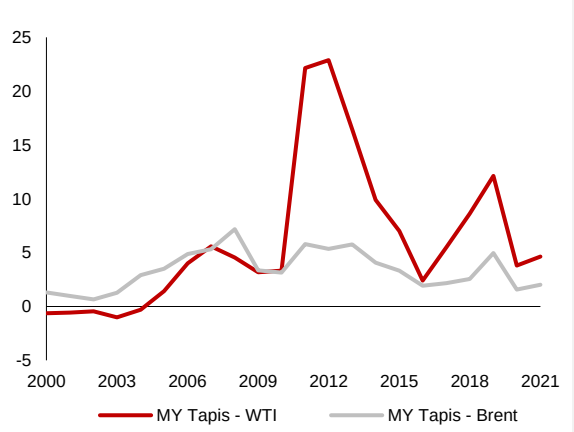
Malaysia's Tapis crude oil, for example, is trading at a positive margin to Brent and WTI crude oils. (Figure 2.2). Malaysia exports its premium quality sweet crude oil and imports lower-quality crude oil—mainly from Saudi Arabia—for refining thus gaining from the positive price margin (Figure 2.3).

Figure 2.1. Selected ASEAN+3: Density and Sulfur Content of Crude Oil Produced
(Percent; API gravity)



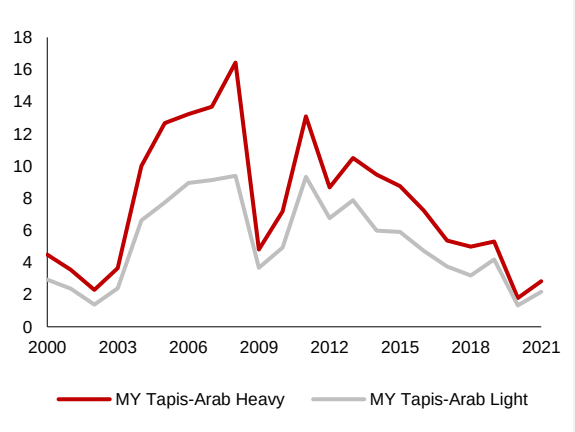
Source: McKinsey & Company.
Notes: API = American Petroleum Institute. API gravity is a commonly used index of the density of crude oil or refined products. Economies are denoted by color in the chart. Some economies produce more than one grade of crude oil, hence there can be multiple dots of the same color in the chart.

Figure 2.2. Malaysia: Oil Price Differentials vis-à-vis Benchmarks
(USD per barrel)



Source: OPEC via CEIC; and AMRO staff calculations.
Note: MY = Malaysia; ID = Indonesia.

Figure 2.3. Malaysia: Oil Price Differentials vis-à-vis Saudi Arabia
(USD per barrel)

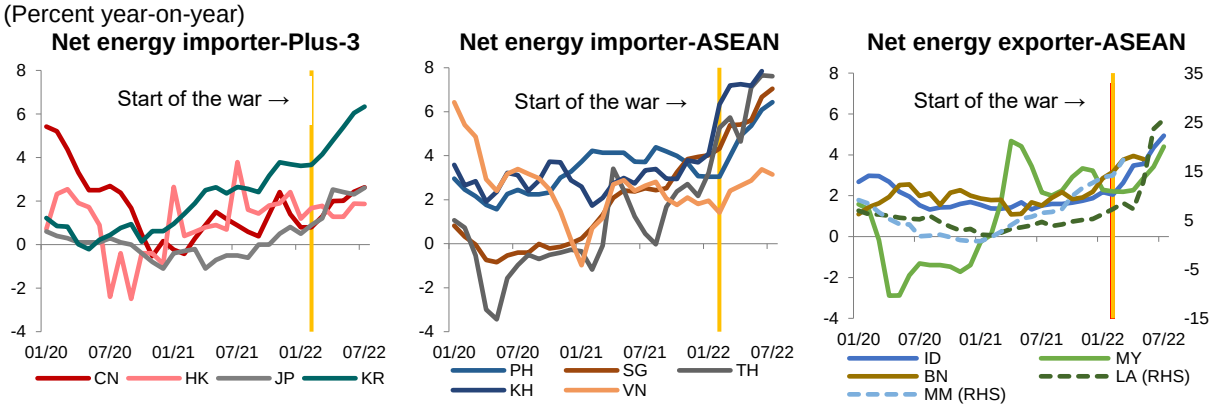


Source: OPEC via CEIC; and AMRO staff calculations.
Note: MY = Malaysia; ID = Indonesia.

IV. Impact of Rising Global Energy Prices on Inflation in ASEAN+3

11. **Are rising global energy prices pushing up headline inflation in ASEAN+3 economies?** Like in other regions of the world since February 2022, all ASEAN+3 economies have seen an increase in consumer price inflation, albeit in different degrees. Among the Plus-3, inflation in Korea has reached record highs while inflation in Hong Kong has been moderate. Among ASEAN economies, inflation has been rising steadily in Indonesia, Malaysia, and Vietnam; more sharply in Cambodia, the Philippines, Singapore, and Thailand; and very sharply in Lao PDR (Figure 10).[6]

Figure 10. ASEAN+3: Consumer Price Inflation
(Percent year-on-year)



Source: National authorities via Haver Analytics; and AMRO staff calculations.
Note: BN = Brunei; CN = China; HK = Hong Kong; ID = Indonesia; JP = Japan; KH = Cambodia; KR = Korea; LA = Lao PDR; MM = Myanmar; MY = Malaysia; PH = the Philippines; SG = Singapore; TH = Thailand; and VN = Vietnam. Data for China, Hong Kong, Japan, Indonesia, Korea, Lao PDR, Malaysia, the Philippines, Singapore, Thailand, and Vietnam are up to July 2022; for Cambodia, up to June 2022; for Brunei, up to May 2022; and for Myanmar, up to March 2022.

12. **Global energy prices can be an important driver of movements in the consumer price index (CPI)**. The extent to which global energy prices affect the CPI depends on factors such as weight of energy and energy-intensive goods and services (e.g., transport) in the consumer price basket and the degree of pass-through of fuel import prices to domestic retail prices on the supply side; as well as the strength of aggregate demand—for example, the start of the war in Ukraine coincided with post-pandemic economic reopening in many economies, which introduced a boost in aggregate demand and a separate driver of inflation pressure on top of escalating energy prices. A principal components analysis suggests that global energy prices are a key driver of headline inflation in some ASEAN+3 economies (see Appendix 1 for details).

13. **Indeed, oil price shocks contribute positively and significantly to CPI inflation in the ASEAN+3 region, although the estimated impact varies across economies.** Estimates for the ASEAN+3 economies suggest that a 10 percent (year-on-year) increase in global oil prices increases year-on-year headline CPI inflation by about 0.2 percentage point, on average, in the first year (Figure 11) (see Appendix 2 for details). This is similar to the results in Carrière-Swallow and others (2022).[7] As oil price shocks can denote year-on-year

[6] Consumer price inflation in Lao PDR jumped to more than 25 percent in July 2022 mainly due to currency depreciation.

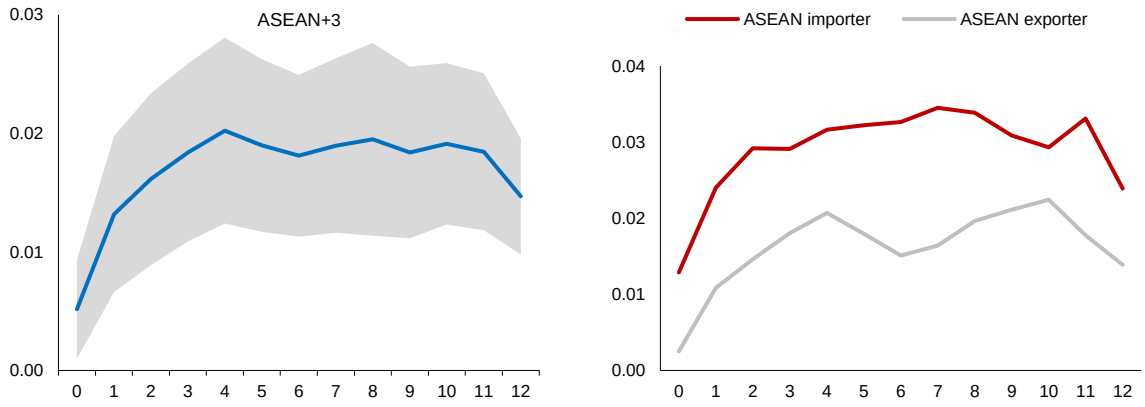
[7] Using monthly data for 46 economies over the period 1992–2021, Carrière-Swallow and others (2022) find that a one standard deviation increase in oil prices (10.8 percentage points) leads to an increase in inflation of about 0.2 percentage points, with about 90 percent of the impact materializing within four months. On the other hand, Choi and others (2018), using a different sample (annual data for 72 countries over the period 1970–2015), find that a 10 percent increase in the global oil price typically increases domestic inflation by 0.4 percentage points in the short term (i.e. in the year of the oil price shock), and becomes statistically insignificant two years after the shock.

increases of more than 50 percent, the estimated impact on CPI inflation could be larger than 1 percentage point over 12 months.

- Oil price shocks have a bigger impact on inflation in net energy importers than in energy exporters. Separate panel regressions on a group of five net energy importers and a group of five net energy exporters show that the difference between the impulse response functions of the two groups becomes as large as 0.02 percentage point after six months and stays at about 0.01 percentage point (see Figure 11).

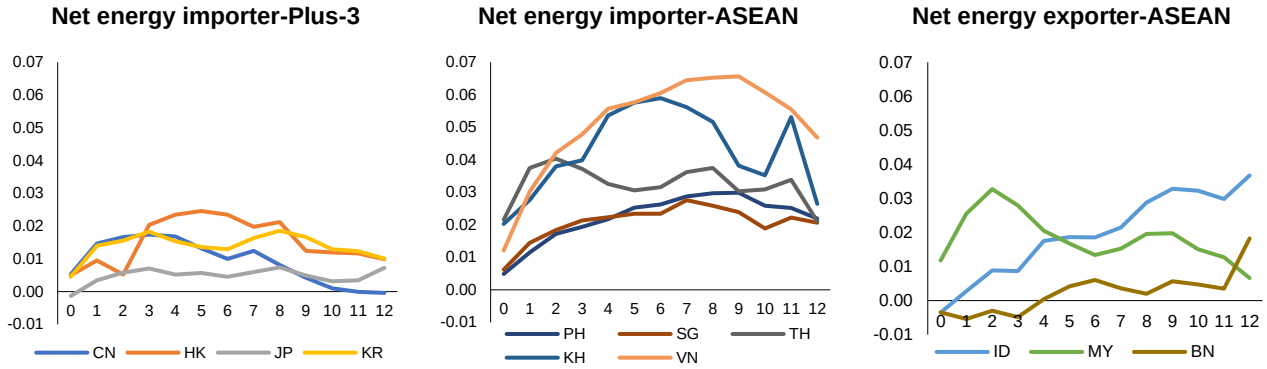
- Country-by-country regressions show that the impact of an oil price shock on headline inflation is bigger in Cambodia, the Philippines, Thailand, Singapore, and Vietnam, compared with Brunei, Indonesia, and Malaysia, possibly related to the latter group's net energy-exporter status. The impact is the largest in Cambodia and Vietnam, at around 0.06 percentage points. The impact of an oil price shock on headline inflation in the Plus-3 economies is moderate, possibly due to their economic size which could influence world oil demand and prices (Figure 12).

Figure 11: Impulse Response of CPI Inflation to an Oil Price Shock
(Percentage points)



Source: National authorities via Haver Analytics; and AMRO staff estimation.
Note: Regressions use monthly data from January 2000 to the most recent month available for each economy in 2022.
The left panel shows regressions on 14 ASEAN+3 economies. The solid line is the impulse response function and the shaded area indicates 90 percent of confidence bands. T=0 denotes the month of the shock. The right panel shows the estimation for five net energy exporters (Cambodia, the Philippines, Singapore, Thailand, and Vietnam) and five net energy importers (Brunei, Indonesia, Lao PDR, Malaysia, and Myanmar).

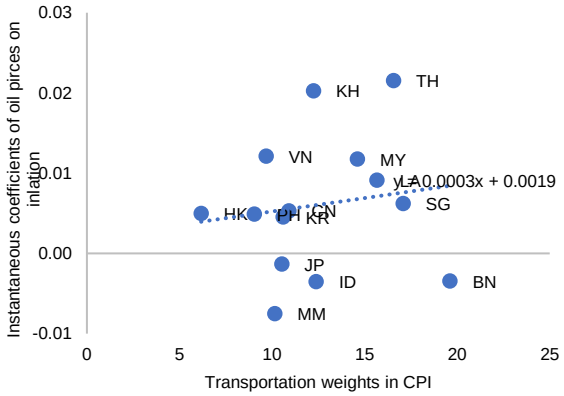
Figure 12. Selected ASEAN+3: Impulse Response of CPI Inflation to an Oil Price Shock
(Percentage points)



Source: National authorities via Haver Analytics; and AMRO staff estimation.
Note: BN = Brunei Darussalam; KH = Cambodia; CN = China; HK = Hong Kong; ID = Indonesia; JP = Japan; KR = Korea; MY = Malaysia; PH = the Philippines; SG = Singapore; TH = Thailand; and VN = Vietnam.
Regressions using monthly data from January 2000 to the most recent month available for each economy in 2022.

14. **The different responses of CPI inflation to an oil price shock can be partly explained by differences in the importance of energy and energy-intensive goods and services in the CPI basket**, especially for net energy importing economies. The higher the weight of these goods and services in the CPI basket, the stronger one would expect the passthrough of oil prices to the CPI to be. This is generally borne out in the data using the transport category as a proxy for energy and energy-intensive goods and services (Figure 13).

Figure 13: ASEAN+3: Transport Weights in the CPI Basket and the Impact of an Oil Price Shocks on Inflation
(Percentage points; percent)



Source: National authorities via Haver Analytics; and AMRO staff estimation.
Note: CPI = consumer price index. The vertical axis measures the instantaneous coefficients (β^0) for each economy. That means, the effects of oil prices on CPI inflation at time t=0.

15. **Some ASEAN+3 economies have used fiscal policy measures to help blunt the impact of high energy prices on headline inflation, at least temporarily.** Most of the region's oil exporters have a price stabilization mechanism that compensates ("subsidizes") producers for keeping domestic prices unchanged when world oil prices go up. Among the region's energy importers, some (e.g., Japan) have introduced new subsidies or extended existing subsidies for fuel products like gasoline and diesel, and some (e.g., Korea and

Thailand) have lowered fuel taxes (Table 1).[8] As global energy prices continue to rise, however, such policies may become harder to sustain as their budgetary costs escalate.[9]

Table 1. Selected ASEAN+3: Fiscal Policy Measures to Reduce the Impact of Rising Energy Prices on Headline Inflation in 2022

Economy	Policy measure(s)
Indonesia	• In May 2022, the government provided additional energy subsidies of IDR74.9 trillion and additional compensation of IDR275 trillion for the state energy firm and utility to keep some energy prices (including subsidized petrol and diesel and some power tariffs) unchanged amid rising global energy prices.
Japan	• In April 2022, the government extended the "temporary" subsidy to oil wholesalers for fuel products (e.g., gasoline, kerosene, gasoil, and fuel oil) that was introduced in January 2022 until the end of September. The subsidy is reviewed weekly based on crude oil price movements; the amount has risen from JPY3.4 per liter at the start to as high as JPY38.8 per liter (week of 9–15 June).
Korea	• In March 2022, the government extended the tax cut of 20 percent on fuel products (e.g., gasoline, diesel fuel, and liquified petroleum gas) that was in place since November 2021 until the end of July. The fuel tax cut was subsequently increased to the legal maximum of 30 percent (for May–July), and the legal maximum was later increased to 37 percent (for July–December).
Malaysia	• In August 2022, the government indicated that its subsidy bill for petrol, diesel, and liquefied petroleum gas would increase to RM38.3 billion in 2022 (from RM13.2 billion in 2021), and that it would spend RM6.5 billion in subsidies to ensure no increase in the electricity tariff in 2022.
The Philippines	• In June 2022, the government announced the temporary removal of a 7 percent duty on coal imports, a key fuel in power generation.
Thailand	• In May 2022, the government increased the THB3 per liter excise tax cut on diesel (that was introduced in mid-February 2022) to THB5 per liter and extended it until the end of July. The government has been using subsidies to keep the retail price of diesel below THB35 per liter. • In June 2022, the government decreased the levy on gasohol 91 and gasohol 95 from THB1.02 per liter to THB0.09 per liter and increased the subsidy on gasohol E20 from THB0.12 per liter to THB0.94 baht per liter to bring down the retail price of gasohol products.
Vietnam	• In April 2022, the government reduced environmental protection taxes on petroleum products (e.g., gasoline, diesel, kerosene) until the end of the year.

Source: Various media reports; AMRO staff compilation.

V. Conclusion

16. **Soaring global energy prices triggered by the war in Ukraine are putting upward pressure on inflation in the region.** Headline CPI inflation in all ASEAN+3 economies has risen in recent months, reaching multi-year highs in some economies such as Korea, the Philippines, and Thailand. The empirical analysis presented in this note suggests that energy prices are an important driver of inflation in most economies in the region, especially for those that are net energy importers with a high share of energy-intensive goods and services (e.g., transport) in their consumption basket.

17. **Fiscal policy measures such as price subsidies and tax cuts on fuel products are helping to prevent a sharper increase in inflation in some economies, but these measures are costly and should be more targeted.** The budgetary cost of fuel subsidies will not be sustainable if global energy prices stay high or continue to climb—even for net

[8] Some economies have allowed fuel prices to rise but increased social assistance payments to cushion the impact on businesses and households. For example, the Philippines' fuel subsidy program extended cash grants to drivers and operators of public utility vehicles, tricycles, and delivery riders.

[9] For example, in August 2022, Thailand's Energy Regulatory Commission approved an 18 percent increase in the price of electricity for the September-December quarter due to the rising price of imported LNG used for the country's power generation. Indonesia raised subsidized fuel prices by about 30 percent in the beginning of September 2022. Malaysia is proposing to introduce a new mechanism of targeted subsidies to rein in their energy subsidy budgets.

energy exporters (which typically have generous blanket subsidies). Subsidy reform—e.g., targeting assistance to those most affected by rising fuel prices—should be implemented to reduce the fiscal burden (Amaglobeli and others 2022). In economies where inflation is broadening (or threatening to broaden) to core prices, monetary policy should be tightened to mitigate the risk of ratcheting up inflation expectations and wages.

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Appendix 1. Estimating the Role of Global Common Factors Driving Headline Inflation in ASEAN+3

To identify common global factors driving consumer price (headline) inflation, we follow IMF (2018) and Chua, Rao, and Sharma (2022) and apply a principal components analysis to cross-country data on inflation. The 35 economies in our sample are: Bangladesh, Belgium, Brazil, Canada, China, Colombia, Egypt, France, Germany, India, Indonesia, Iran, Italy, Japan, Korea, Mexico, the Netherlands, Nigeria, Pakistan, Philippines, Poland, Romania, Russia, Saudi Arabia, Singapore, South Africa, Spain, Sweden, Switzerland, Taiwan China, Thailand, Turkey, the United Kingdom, the United States, and Vietnam. These economies account for about 85 percent of global GDP.

Each economy's de-meaned total inflation $(\pi_t - \bar{\pi}_t)$ can be decomposed into a common component (βf_t) and an idiosyncratic component (e_t):

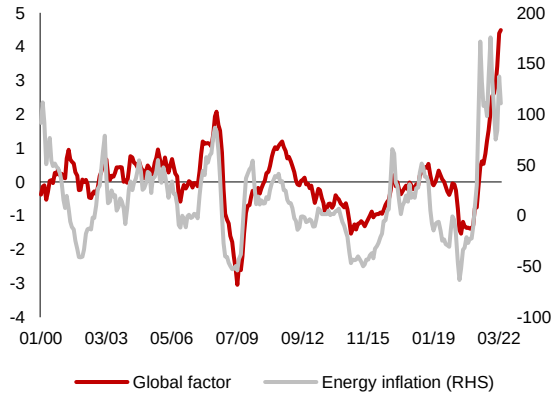
$$\pi_t - \bar{\pi}_t = \beta f_t + e_t$$

where f is a $(K \times 1)$ vector of factors; and β is an $(N \times K)$ matrix representing the weight of each common factor in each economy's inflation; $K =$ number of factors and $N =$ number of economies (35). Inflation is measured by the year-on-year percentage change in the monthly consumer price index (CPI), from January 2000 to May 2022.

Three global factors explain 63 percent of the variance in headline inflation in the full sample: the first common factor explains 35 percent of the total variance and the second and third common factors explain 20 percent and 8 percent, respectively. These common factors are statistical constructs, but they can be associated with key global variables that might affect global inflation. Factor 1, in particular, fits well with the behavior of global energy prices—the correlation of this global factor with world energy inflation (measured by the IMF's energy price index) is as high as 0.72 in the sample period (Figure 1.1)

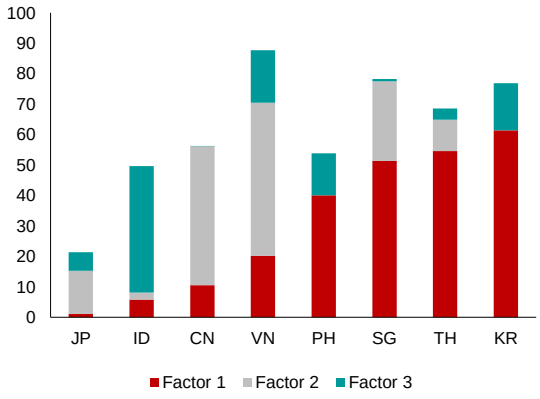
For the ASEAN+3 economies in our sample, Factor 1 explains 40–60 percent of the variation in headline inflation in Korea, the Philippines, Singapore, and Thailand, suggesting that global energy prices are an important driver of headline inflation in those economies (Figure 1.2).

Figure A1.1: Estimated Global Factor and World Energy Inflation
(Units; percent year-on-year)



Source: IMF Primary Commodity Prices and AMRO staff estimation.

Figure A1.2: ASEAN+3: Variability of Inflation Explained by Global Common Factors
(Percent of total variance)



Source: CEIC; and AMRO staff estimation.
Note: Factors 1, 2, and 3 are the three biggest factors in our principal component analysis.

Appendix 2. Estimating the Impact of a Global Oil Price Shock on Headline Inflation in ASEAN+3

Following Choi and others (2018), we estimate the impact of global oil price inflation on headline inflation using the local projection method. For each horizon h, the following equation is estimated for the 14 ASEAN+3 economies using monthly data from January 2000 to the latest month available for each economy in 2022:

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

where:

π_i: year-on-year percent change in CPI for country *i*;
h: response horizon in months;
α_i: country i fixed effect;
π_t^{oil}: year-on-year percent change in oil price in month t;
δ_i: transportation weight in CPI basket of country i (as a proxy for the share of oil in country i's consumption basket);
γ_j: persistence of CPI year-on-year inflation over the previous j months;
β^h: the impact of global oil prices on domestic inflation for each future period h;
θ_j: the impact of global oil prices on domestic inflation over the previous j months.

The number of lags, l and n, were both chosen to be equal to 3, but the results are robust to the choice of lag length. The equation is estimated for each horizon $h = 0, 1, \ldots, 12$ using the ordinary least squares estimator. We estimate heteroskedasticity-robust standard errors clustered at the country level to account for cross-sectional dependence in the error term $\epsilon_{i,t}^h$. As we include δ_i to control for cross-country heterogeneity in identifying the average effect of global oil prices, the impulse response functions are obtained by multiplying the estimated coefficients β^h with $\bar{\delta}$, the average of δ_i. The confidence bands are constructed using the standard deviations of the coefficients β^h estimated for each horizon h.

Table A2.1. Variables, Definitions, and Sources of Data

Variables	Definition	Frequency	Sources
Headline CPI inflation	% year-on-year	Monthly	National authorities via Haver Analytics
Global oil price inflation	% year-on-year of the average of Brent, Dubai, and WTI spot prices	Monthly	World Bank via Haver Analytics
Transportation weights in CPI basket	% share	Monthly	National authorities via CEIC