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The Global Factors Driving Common Inflation In ASEAN

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ABSTRACT

Purpose: This study investigates the comovements of inflation across ASEAN countries and identifies the global factors driving the common inflation dynamics of the region.

Design/methodology/approach: The study uses a two-step approach. The dynamic latent factor model is first employed to estimate the common inflation of the region in the period between 2000Q1 and 2022Q2. In the second step, a bound test approach to autoregressive distributed lag (ARDL) methodology is employed to estimate the model of common inflation, which is constructed based on the aggregate supply - aggregate demand (AS-AD) framework. **Findings:** The study finds a common factor of inflation across ASEAN countries. The analysis of variance decomposition indicates the significant role of common inflation in the variations of individual countries' inflation. World economic growth, oil price change, non-fuel commodity price change, and trade openness are the main drivers of ASEAN common inflation in both short and long terms.

Research limitations/implications: The study focuses mainly on supply-side factors, although some demand-side factors are involved. Future studies should pay more concerns on the trade linkages among regional countries and the similarities in goals in the region.

Originality/value: The study examines the common inflation component across ASEAN countries, which has not been sufficiently investigated. It also evaluates the drivers at the global level of common inflation, which has limited empirical evidence.

Keywords: Inflation comovements, Dynamic factor model, Global factors, ARDL, ASEAN

I. Introduction

The issue of comovements in inflation across economies has been of great interest in recent years, as the comovements of inflation are recognised to be a global phenomenon. In literature, the explanation for this phenomenon relies on the analytical framework of the aggregate supply-aggregate demand (AS-AD) model. When countries are more open and interconnected with each other, aggregate supply and demand could be driven by common factors such as regional economic cycles, commodity price shocks, similar monetary policy targets, etc., leading to similarities in price fluctuations.

In the first stage of finding empirical evidence, studies focus on ascertaining the existence of a common inflation component and estimating its contribution to inflation variance across countries. The methodology of dynamic factor model is the most widely used to identify common components by various approaches in terms of country coverages, inflation measures,

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data frequencies, level of disaggregation, and studied periods (see Beck et al., 2009; Ciccarelli & Mojon, 2010; Förster & Tillmann, 2014; Monacelli & Sala, 2009; Mumtaz & Surico, 2012; Neely & Rapach, 2011). Common components defined as global inflation or regional inflation have been documented in most studies, although their contributions to the inflation variance of individual countries are controversial. These results show the growing trend of inflation synchronisation at regional and global levels and the higher importance of shared external factors in explaining national inflation dynamics.

The more sophisticated aspects of common inflation have been explored by employing various methodologies recently. For example, Tiwari et al. (2021) apply the wavelet analysis to indicate the multi-scale nature of inflation covariation in the African sub-region and its linkages to developed countries. Kang et al. (2020) find evidence of time-dependent variation in the strength of comovements between inflation cycles across countries by implementing dynamic conditional correlations and a wavelet measure of cohesion. Kiselev & Zhivaykina (2020) separate the common effects at the sectoral price level and examine the importance of these price changes for domestic inflation dynamics.

This study investigates the comovements of inflation across ASEAN countries and explores the global factors driving the ASEAN common inflation. The study contributes to the current literature in several ways. First, it examines the common inflation component across ASEAN countries, which has not been sufficiently investigated. ASEAN countries have taken important milestones towards higher intra-and extra-regional integration in recent years, including the establishment of the ASEAN economic community, which has officially created a common regional market since 2015. Intra-trade in the region accounts for about 21 percent of total exports and imports of goods, while the share of total trade to GDP is 99.8 percent in 2021. Members of the region also share the common largest trading partners such as China, the U.S., Japan, and Korea. Kang et al. (2020) recently investigates inflation cycle synchronisation

among five ASEAN countries; however, the authors approach the pairwise causality, thus, explain the inflation similarities between two countries in each estimation. Thus, the issue of regional inflation is still an open question in ASEAN. Second, this study evaluates the drivers at the global level of common inflation, which has limited empirical evidence. Álvarez et al. (2021) previously explain the inflation comovements of developed countries by determinants based on the theory of Philips curves. This study is different in some points. We place more focus on developing countries having similar economic and geographical conditions to decrease the problem of heterogeneity among countries. The previous study analyses developed countries in different regions and indicates this problem in the degree of interconnectedness by type of product. In addition, both supply-side and demand-side determinants of inflation are taken into account to capture the characteristics of a common regional market and the external shock to the region. Finally, the previous study uses two alternative measures of comovement to assess the observed inflation interdependence for each country, decomposed by panel data estimation. In this study, we first identify the common inflation of ASEAN by the dynamic factor model. Then we explain the dynamics of common inflation with global variables by employing the autoregressive distributed lagged (ARDL) methodology.

The paper is structured as follows. Section 2 reviews literature related to inflation comovements. Section 3 describes methodology with a two-step approach. Section 4 shows the results of estimation and discussions. The last section contains some conclusions of the study.

II. Literature Review

A. Demand-side and supply-side determinants of common inflation

The movements of inflation are theoretically explained by the framework of the AS-AD model.

Accordingly, factors driving aggregate supply and demand are considered to be the causes of price fluctuation. In open economies, aggregate demand and supply are driven not only by domestic factors but also by the same external factors that generate similarities in inflationary performance across countries.

On the demand side, the similarities of the economic cycle among economies could lead to inflation comovements as domestic inflation responds to changes in aggregate demand (Álvarez et al., 2021). Empirical studies (such as Backus et al., 1992; Kose et al., 2003) indicate a world-common factor is the main source of volatility for aggregate demand in most countries, which plays a superior role in explaining fluctuations in economic activity compared to the region-specific factor. However, evidence for the world business cycle as a driver of inflation comovements is an active debate. Andrle et al. (2013) indicate a strong relationship between inflation and output at business cycle frequency in the Euro area, although the relationship is not apparent at first sight. The study suggests inflation lags the cycle in output by roughly half of its variance. Contrarily, Eickmeier & Pijnenburg (2013) examining the global dimension of inflation in 24 OECD countries between 1980 and 2007 indicate the common component of changes in the output gap causes an unclear impact on inflation. Anderton et al. (2009) document the impact of the output gap on the inflation of OECD economies but also demonstrate the size of this impact is diminishing over time. Explanations for the weaker relationship between global output and inflation could rely on the effects of globalisation and changes in monetary policy, which are also two other drivers of inflation comovements.

It has been argued recently that globalisation leads to inflation correlations across countries through trade channels. (see Benigno & Faia, 2016; Bernanke, 2007; Borio & Filardo, 2007; James, 2022). Trade integration allows goods from low-production cost countries, predominantly developing countries and emerging markets, to enter numerous markets, leading to a reduction in import prices worldwide as a result. The growing importance of the global value chain in intermediate goods and services also increases international competitive pressures on domestic price setting and supports the convergence of inflation rates across countries (Álvarez et al., 2021; Forbes, 2019). Helbling et al. (2006) document that the decrease in inflation since the 1980s was driven by the penetration of goods from developing countries. Anderton et al. (2009) also show that import prices of manufactures in the Euro area decreased by about 2 percentage points each year between 1996 and 2007 because of a higher proportion of imports from low-cost countries in total imports. The study also emphasises that the role of import prices in the inflation fluctuation in this region has been growing. Similarly, Koske et al. (2010) indicate the sensitivity of inflation in OECD countries to domestic economic conditions has declined, whereas the sensitivity of inflation to foreign economic conditions has risen, working through import prices.

The similarity of views and goals related to inflation policy is another driver of inflation interconnectedness. Ciccarelli & Mojon (2010) argue two potential channels through which central banks around the world have similar views. First, monetary authorities may share common international pressures or similar top pressures, such as price stability, through discussions in formal meetings and conferences. A prominent inflation control policy used by one central bank could become typical and be followed by other central banks. For example, inflation-targeting monetary policy was applied in many economies in the 1990s, following the UK (Ciccarelli & Mojon, 2010; Mumtaz & Surico, 2012). The average inflation rate has dropped from 12.6% to 4.4% after these countries formally adopted inflation targeting (Lee, 2010; Mishkin & Schmidt-Hebbel, 2007)

Second, the endogenous equilibrium mechanism could make the central banks of countries in the same region or at the same level of development converge on relative outcomes of inflation management, as the public would be more willing to accept a higher inflation rate than the established inflation target if neighbouring countries perform equivalently high ones. Since independent central banks determine the level of domestic output in the long run, the importance of this driver to inflation interconnectedness is reinforced (Neely & Rapach, 2011; Woodford, 2013).

On the supply side, price shocks of internationally tradable commodities are potential drivers of inflation comovements (Ciccarelli & Mojon, 2010). When these commodities are involved in the consumer baskets of many economies or used as intermediates for the production of goods in consumer baskets, inflation in these economies will be undeniably affected. For example, oil price shocks in 1973 and 1979 massively induced higher production costs, causing many economies to suffer high inflation over these years. The rises in oil and food prices are argued to be the main elements of higher global inflation between the start of 2008 and mid-2008 (Cecchetti & Moessner, 2008). Various empirical studies show the effects of oil price changes on domestic inflation in low- and high-oil-dependency countries (such as Sek et al., 2015). In a global-sample study, Sekine & Tsuruga (2018) indicate transitory impact of commodity price shocks on inflation in 144 countries.

Some other theories also discuss the comovements of inflation. The New Keynes Phillips curve model suggests similar drivers that link inflation developments across countries, including commodity prices, business cycles, and inflation expectations (Álvarez et al., 2021). The comovements in these determinants may lead to interdependence in the inflation rates of different countries. Besides, the monetary approach to the exchange rate and balance of payments also analyses whether a central bank following a fixed exchange rate regime may lose independence to decide domestic inflation levels (Copeland, 2014). Similarly, countries adopting a fixed exchange rate regime would experience inflation pressure when facing an increase in capital inflows (Chan, 2015; Calvo et al., 1993). This implies the inflation correlation between domestic and partner countries.

B. Previous studies investigating common inflation

In the preliminary stage of finding empirical evidence of inflation comovements, studies focus on examining common inflation factors across economies, most of which employ the factor model developed by Stock & Watson (2011). Ciccarelli & Mojon (2010) study the inflation of 22 OECD economies from different regions between 1960 and 2003. Using a latent factor model for quarterly data, the study finds 70 percent of inflation fluctuations in OECD countries are explained by a common factor defined as global inflation. When domestic inflation deviates from global inflation, it will quickly move towards global inflation due to the robust error correction mechanism.

Neely & Rapach (2011) also investigate the similarities in the inflation performance of 64 economies over the period 1951-2009. The study employs a dynamic latent model to decompose inflation into world, regional, and national factors. Estimating the factor model by Bayesian method, the authors find the global and regional factors, respectively, account for 35 percent and 16 percent of the inflation volatility, while the national factor explains the remaining 49 percent. Estimation results also indicate that the contributions of these factors to inflation fluctuations vary across countries. Global and regional factors' contributions to inflation fluctuation are higher in developed countries than in developing countries.

Mumtaz & Surico (2012) approach the issue of inflation comovements with respect to the characteristics of global inflation. The study uses quarterly data from 11 developed economies in the period between 1996 and 2004 and a dynamic latent factor model comprising world and country-specific factors estimated by the Bayesian method. Results evidence that inflation, inflation volatility, and inflation persistence are in a declining trend that simultaneously occurs with an increase in similarities in the evolution of inflation across economies.

Förster & Tillmann (2014) provide new evidence of the more important role of country-specific factor in inflation fluctuation. This finding challenges the results of the dominant contribution of global factor found by previous studies (i.e., Neely & Rapach, 2011; Ciccarelli & Mojon, 2010). The study uses quarterly consumer price index (CPI) data from 101 countries from 1996 to 2011. By employing the hierarchical factor model, the study decomposes the CPI series into four factors: a global factor, a factor specific to a given sub-section of the CPI, a country group factor (industrial or emerging economies), and a country-specific factor. Results indicate countryspecific factor account for two thirds of overall inflation volatility across countries.

Unlike the above studies, which use the aggregate data on CPI inflation, Monacelli & Sala (2009) and Beck et al. (2009) use disaggregate data samples to find evidence of a common inflation factor. Monacelli & Sala (2009) analyze 948 CPI series in four OECD economies (including the US, Germany, France, and the UK) from 1991 to 2004 and find a common factor explaining 15 percent or 30 percent of the price index variance of each economy, depending on the data transformation. Meanwhile, Beck et al. (2009), using monthly data on Eurozone economies between 1996 and 2004, indicate a regional factor explaining 50 percent of price variability.

Recent studies investigate more sophisticated aspects of the common inflation phenomenon. Álvarez et al. (2021) use the new Keynesian Phillips curve to explore the determinants of inflation interconnectedness across developed countries since 2000. The study finds a high degree of inflation comovements, which are highest for Euro area countries. Therefore, the study suggests strong trade links and a common view of monetary policy can explain the high correlated inflation rates. However, the study only shows empirical evidence on the role of business cycle and external prices to inflation comovements across countries.

Kiselev & Zhivaykina (2020) estimate the global price component of international price comovements by employing a dynamic hierarchical factor model. The study decomposes CPI inflation in 29 countries into a global factor, a price change shock at product group level, a price change shock at product subgroup level, and an idiosyncratic component. These common factors are found to explain around 40 percent of the overall CPI variance for all countries and 30 percent for Russia. Regarding global factor, the study shows a weak correlation with CPI inflation but indicates the importance of energy and food markets as channels through which global inflation operates.

Tiwari et al. (2021) contribute to the literature by applying wavelet analysis to investigate inflation comovements between nine African countries and their bilateral trade linkages with five developed economies at different frequencies. The study indicates that inflation rates co-move across frequencies, and co-vary strongly with each other at low frequencies. The study also suggests trade linkages are the channel of inflation comovements in Africa, as inflation rates are explained largely by inflation in advanced trading partners.

Kang et al. (2020) explore the inflation cycles at the regional level among five ASEAN countries. The study employs the DCC method to examine pairwise causality between inflation rates and a wavelet coherence method for estimating inflation cycle synchronisation across different frequencies. The study finds evidence of time-dependent variation in the strength of comovements between inflation cycles across countries. In addition, by using the spillover network index model, the study also identifies the positive network causality between inflation cycles and inflation integration across the ASEAN countries.

III. Methodology

We use a two-step approach to investigate the determinants of inflation comovements across ASEAN countries. First, we use a dynamic latent factor model to estimate the common inflation of ASEAN countries, which reflects the comovements of inflation across member countries. Second, we construct a model of ASEAN common inflation to examine its main determinants.

A. Estimation of common inflation factor

Following most studies, this study also employs the dynamic latent factor model developed by Kose et al. (2003). In the form of a state space model (SSM), equation (1) shows the inflation of each ASEAN country is determined by a common factor and its idiosyncratic noise.

$$P_{i,t} = \beta_i^c f_t^c + \epsilon_{i,t} \tag{1}$$

In which $P_{i,t}$ (1xN) is inflation of country i (i = 1, 2, ..., N), f_t^c (1xN) is a latent variable representing the common inflation factor of ASEAN countries, β_i^c are factor loadings measuring the impact of the common factor on inflation of country i, $\varepsilon_{i,t}$ is idiosyncratic noise of country i.

Equation (1) is signal equation indicating the relationship between a latent variable (i.e. f_t^c) and an observable variable (i.e. $P_{i,t}$). Equation (1) implies f_t^c could influence on inflation dynamics of all countries with various directions and degrees, depending on the sign and magnitude of β_i^c . Factor loadings vary across countries, reflecting member countries respond differently to common global drivers of inflation.

State equations of f_t^c and $\mathcal{E}_{i,t}$ are autoregressive processes expressed respectively in equations (2) and (3).

$$f_t^c = \theta_1^c f_{t-1}^c + \theta_2^c f_{t-2}^c + \dots + \theta_q^c f_{t-q}^c + u_t^c$$
(2)

where $u_t^c \sim N(0, \sigma_r^2)$ and $E(u_t^c u_{t-k}^c) = 0$ for $k \neq 0$.

$$\epsilon_{i,t} = \theta_{i,1}\epsilon_{i,t-1} + \theta_{i,2}\epsilon_{i,t-2} + \dots + \theta_{i,p}\epsilon_{i,t-p} + u_{i,t}$$
(3)

where $u_{i,t} \sim N(0, \sigma^2)$ and $E(u_{i,t}u_{i,t-k}) = 0$ for $k \neq 0$.

In equation (2) and (3), q is the order of autoregressive processes of the common factor, and p is the order of autoregressive process of idiosyncratic noises. Following Neely & Rapach (2011), we set q and p equal to two (2), as orders higher than two usually have negligible or insignificant impacts. Similar to Stock & Watson (2011), we also assume that shocks

in (2) and (3) are uncorrelated contemporaneously at all leads and lags.

As the common factor is unobservable, we follow previous studies (e.g., Gregory et al., 1997; Stock & Watson, 1989) to use the Kalman filter to estimate model parameters by maximum likelihood, then the Kalman smoother to extract efficient estimates of latent common factors. In equation (1), neither signs nor magnitudes of factors and factor loadings are identified, as multiplying a factor by any number and dividing its loading by the same number would produce the same equation (Del Negro et al., 2008). Following Kose et al. (2003), signs of factor loadings are normalised by a setting positive restriction for one loading of each factor. The loading of Vietnam is restricted to be positive due to our interest. Following Stock & Watson (1993), we assume shock variances of the common factor (i.e. σ_c^2) are constant and equal to one (1) in order to normalise magnitude. The sign and magnitude normalisations do not have any economic content and do not affect any economic inference (Neely & Rapach, 2011). As final inference results from the Kalman filter depends on the initial values of the state variables (Casals & Sotoca, 1997), we follow Harvey (1993) to determine the initial state by employing the diffuse approach. The diffuse approach assumes the initial state of factor is arbitrary and has infinite (∞) variance, thus, this approach is appropriate when there is no information about the initial state (Durbin & Koopman, 2013; Zivot et al., 2004).

The estimated results of model (1) would show the values of the common factor and its impact on inflation of ASEAN countries but cannot indicate its contribution to the inflation fluctuation of each country. We continue to decompose the variance of inflation into variances of common factors attached to magnitudes of factor loadings and idiosyncratic noise.

$$var(P_{i,t}) = \left(\beta_i^c\right)^2 var(f_t^c) + var(\epsilon_{i,t}) \tag{4}$$

Equation (4) implies that the inflation variance $var(P_{i,i})$ of country i (i = 1, 2, ...N) depends on

the variance of the common factor $var(f_t^c)$, its loadings $((\beta_i^c)^2)$, and the variance of the idiosyncratic noise of country i $(\epsilon_{i,t})$. The extent to which common factor influences the inflation variation of each country is measured by computing their contribution to the total variation in each country's inflation rate as expressed in (5), in which *w* represents contribution.

$$w_i^c = \frac{\left(\beta_i^c\right)^2 var(f_t^c)}{var(P_{i,l})} \tag{5}$$

ASEAN countries involved in this study include Indonesia, Malaysia, the Philippines, Singapore, Thailand, and Vietnam, coded as ID, MY, PH, SG, TH, and VN, respectively. The selection of countries replies mainly on their large contribution to the regional trade share and investment and their availability of high frequency data. Specifically, they account for more than 75 percent of total ASEAN annual intra-trade and more than 92 percent of total foreign direct investment inflow annually. Quarterly year-on-year inflation from 2000Q1 to 2022Q2 from International Financial Statistics is used for estimation. All inflation series are demeaned to have zero means.

B. Model of ASEAN common inflation

To identify the drivers of ASEAN common inflation generated from the previous step, we employ the methodology of ARDL with the bound test approach developed by Pesaran et al. (2001) to construct the model of common inflation based on the AS-AD framework. ASEAN common inflation is driven by world output growth (WG_t), oil price change (OP_t), non-oil commodity price change (CP_t), and trade openness of the ASEAN region (TO_t).

$$\Delta f_{t}^{c} = a + b T + \sum_{j=1}^{p_{1}} c_{j} \Delta WG_{t-j} + \sum_{j=0}^{p_{2}} d_{j} \Delta OP_{t-j} + \sum_{j=0}^{p_{3}} e_{j} \Delta CP_{t-j} + \sum_{j=0}^{p_{4}} e_{j} \Delta TO_{t-j} + \theta_{1} WG_{t-1} + \theta_{2} OP_{t-1} + \theta_{3} CP_{t-1} + \theta_{4} TO_{t-1} + \epsilon_{t}$$
(6)

In model (6), the common inflation is generated from the estimation of the dynamic latent factor model in the first step. World output growth (WGt) is represented by the year-on-year growth of OECD countries from OECD statistics. High-frequency database from OECD countries involves the largest number of countries, which are also the main trading partners of ASEAN countries. Oil price change (OP_t) is calculated as the quarterly percentage change of Brent oil from International Financial Statistics. Similarly, non-oil commodity price change (CP_t) is calculated as the quarterly percentage change of the non-fuel price index taken from the IMF's database of primary commodity prices. Trade openness (TO_t) of the ASEAN region is calculated as the ratio of total foreign trade to GDP of the region in logarithms. Due to the limitation of data availability, we use quarterly data for the period between 2012Q1 and 2022Q2 for estimation. Our estimation procedure is similar to that of Jehangir et al. (2020).

IV. Results and Discussions

A. The common inflation of ASEAN

We employed the methodologies of Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) to examine the stationarity of inflation series. Table 1 summarises the results of the unit root test using these methodologies. According to the ADF test, the

Table 1. Results of the ADF and PP tests for the stationarity of country inflation series

Variables	ADF test statistic	PP test statistic
P_ID	-5.038***	-3.915**
P_MY	-1.339	-2.028**
P_PH	-3.505***	-3.036***
P_SG	-2.240	-2.193**
P_TH	-0.878	-1.822*
P VN	-0.855	-1.756 *

***, **, * denote the 1%, 5% and 10% level of significance respectively.



Source: Author's calculation

Figure 1. Common inflation factor and inflation in ASEAN countries

inflation series of all countries are non-stationary at level except for Indonesia and the Philippines. However, according to the PP test, the inflation series of all countries are stationary at level, I(0). This result allows us to estimate the factor model using the traditional Kalman method mentioned above (Stock & Watson, 2011).

Figure 1 shows the movements of the estimated common factor and inflation of ASEAN countries that share similar fluctuations. This common factor reflects the inflation comovements of ASEAN countries. The upward trend post-Asian financial crisis of the common factor and inflation of ASEAN countries ceases in the fourth guarter of 2008, when the global financial crisis (GFC) comes. The common factor and inflation in all countries fall sharply in the following years; some countries, such as Thailand, Malaysia, and Singapore, even experience deflation. The common factor and ASEAN inflation surges again in 2010-2011. However, since 2012, the common factor and inflation of ASEAN countries have decreased gradually and fluctuated around a lower level than in the sub-period before the GFC. The common factor and ASEAN inflation fall to the lowest rates in 2020 when the COVID-19 pandemic breaks out. In the last two years of the period, the common factor and ASEAN inflation increase dramatically.

The estimated results of factor loadings with respect to individual countries and the variance decomposition analysis are summarised in Table 2. The loading coefficients of the common factor of all countries are positive (> 0) and vary across countries. The difference in factor loadings implies that ASEAN

	Loading coefficient of common factor	Contribution of common factor	
IN	0.968*** (0.116)	49.492	
MY	0.459*** (0.092)	62.405	
PH	0.492** (0.215)	49.568	
SG	0.345** (0.161)	20.773	
TH	0.501*** (0.101)	45.035	
VN	1.469*** (0.158)	44.932	
Log likelihood Total parameters Diffuse priors		-504.408 20 0	

Table 2. Loading coefficients of common factor and contribution of common factor to inflation variations in ASEAN countries

Note: ***, ** and * denote 1%. 5% and 10% level of significance respectively; standard errors are in parenthesis () Source: Authors' calculation

countries respond differently to the impact of common drivers of inflation. By comparison, the common factor loading of Vietnam is the largest (1.469), followed by the factor loading of Indonesia (0.968). The factor loadings of Malaysia, the Philippines, and Thailand are equivalent at around 0.5, while that of Singapore is the lowest (0.345). This result indicates the more powerful impacts of common inflation determinants on Vietnam's inflation. Various studies on the impact of external shocks such as oil prices, and food prices on consumer prices in ASEAN (see, for example Jongwanich et al., 2019; Jongwanich & Park, 2008) also show Vietnam is affected by these external shocks at a higher degree than other ASEAN economies.

The variance decomposition indicates the contribution of common inflation to the variations in inflation in ASEAN countries. On average, the common factor explains 45.384 percent of ASEAN inflation variation, which strongly supports Neely and Rapach (2011). The previous study indicates 51 percent of inflationary fluctuation in 64 economies is explained by a common factor; however, the figure is lower in emerging and developing countries because their trade and capital transactions with the world economy are not as large as those of developed countries. The contribution of the common factor to inflation variations is equivalent for Indonesia, Philippines, Thailand, and Vietnam, ranging from 44.932 percent to 49.568 percent. Meanwhile, a common factor explains Malaysia's higher inflation variations at 62.405 percent and narrowly explains the variations of inflation in Singapore (20.772 percent).

B. The drivers of ASEAN common inflation

The results of the unit root test by ADF and PP methods in Table 3 show that variables of common factor and global variables are stationary series at the 1 percent level of significance except for TO_t . However, TO_t is stationary at first difference level according to both the ADF and PP tests. Thus, it is appropriate to estimate the short-run and long-run determinants of ASEAN common inflation by employing the bound test approach to the ARDL methodology.

Table 4 summarises the results of the cointegration test and the estimation of the determinants of ASEAN common inflation in both short and long terms. The hypothesis of no cointegration relationship is rejected at the 1 percent significance level. In the long run, the inflation comovements of ASEAN countries are significantly determined by world economic growth, change in world oil prices, change in non-oil commodity prices, and the trade openness of the region. In the short run, ASEAN common inflation

 Table 3. Results of the ADF and PP tests for the stationarity of global variables

	ADF t-stat	PP t-stat
f_t^c	-4.071***	-2,32*
WGt	-11.839***	-12.072***
OPt	-8.134***	-8.066***
CPt	-5.837***	-5.667***
TO_t	-1.548	-1.519
D(TO _t)	-2.661*	-3.907***

Note: ***, ** and * denote 1%, 5%, and 10% level of significance respectively Source: Authors' calculation

Bound test	F-statistic		t-statistic		
ARDL(4, 4, 2, 0, 1)	9.822***			-6.671***	
x <i>i</i> : <i>i</i> :	WG	OP		СР	ТО
Long-run estimation –	1.210*	0.030*	1	0.241***	- 0.092***
Short-run estimation	D(f ^c)	D(WG)	D(OP)	D(CP)	D(TO)
t		0.214***		0.027*	0.007
t-1	0.203**	-0.801			-0.097*
t-2	0.161*	0.100			
t-3	0.291***	0.116**			
EC _{t-1}				-0.309***	
Adjusted R2				0.641	
F-stat				12.867	
LM (2): F-stat (Prob)		0.302 (0.740)			
LM (4): F-stat (Prob)		0.705 (0.592)			
Breusch-Pagan-Godfrey: F-stat (Prob)		1.003 (0.465)			
Ramsey: F-stat (Prob)				0.265 (0.609)	
Durbin-Watson stat				1.889	
NY	1 100/ 1 1 6				

Table 4. Results of the bound test for cointegration and estimations of long-run and short-run relationship

Note: ***, ** and * denote 1%. 5% and 10% level of significance respectively Source: Authors' calculation

is driven by lags of itself, lag of world economic growth, simultaneous change in commodity prices, and the openness of the region. The impact directions of global determinants are consistent in both the short and long terms. ASEAN common inflation is positively associated with world economic growth, world oil prices, and non-oil commodity price changes while being negatively correlated with trade openness. The error correction term is negative and statistically significant at the 1% level, confirming the existence of long-run relationships between the variables. With an adjustment degree of 30.9 percent, ASEAN common inflation will return to its long-term trend after three quarters of deviating from long-term equilibrium levels. The high adjusted R square reflects the explanatory power of the ARDL model for the behaviour of ASEAN inflation commovements. Besides, the results of diagnostic tests at the end of Table 4 indicate that the estimated ARDL model is well behaved. The CUSUM and CUSUM squared tests also confirm the stability of the estimated parameters (Figure 2).

The estimated result indicates the global business cycle plays a crucial role in ASEAN common inflation. In the long run, an increase in global economic growth causes ASEAN common inflation to increase significantly. In the short run, higher global economic growth leads to higher ASEAN common inflation after three quarters. The common inflation of ASEAN is driven by the world economic cycle as ASEAN countries increasingly enhance their integration through trade and financial channels. Extra-ASEAN trade accounts for a higher proportion of ASEAN's total trade compared to the share of intra-ASEAN trade in total trade (Table 5). Similarly, inward FDI flows to ASEAN are also increasing, and non-ASEAN



Source: Authors' calculation

Figure 2. Results of CUSUM and CUSUM of square tests

Table 5. Intra- and extra-ASEAN trades and flows of inward foreign direct investment

	2000	2008	2016	2021
Total trade (billion USD)	833	1901	2240	3341
- Intra (%)	20.039	24.779	24.829	21.311
- Extra (%)	79.961	75.221	75.171	78.689
as % GDP	-	90.180	86.254	99.8
Flows of inward FDI (billion USD)	21,809	49,013	119,975	179,215
- Intra (%)	6	18	18	13
- Extra (%)	94	82	82	87

Source: ASEAN Secretariat (2022)

countries are the largest FDI investors in the region, accounting for 86 percent of total annual FDI inflows on average. The links between the ASEAN economy and the global economy are much more intimate, as major partners of ASEAN are the leading economies of the world that have significantly widespread impacts on the global economy, such as the US, Japan, and China. In addition, the close economic relationship with the leading economies not only connects the world economic cycle with the ASEAN economic cycle but also transmits inflation fluctuations from these countries to ASEAN countries. Osorio & Unsal (2013) demonstrate that Asian inflation is directly influenced by the spillover effects of China's demand-pull inflation, as China accounts for a large proportion of total imports in the region, especially ASEAN countries, which are more influenced than other Asian countries.

More interconnectedness between ASEAN and the world through trade linkages also reflects the region's higher openness. Higher trade openness decreases ASEAN common inflation in both short and long terms. This result complies with the argument that more open economies have steeper Phillips curves (Romer, 1993; Temple, 2002). Total trade in ASEAN as a percentage of GDP is on an increasing trend. By the end of 2021, the ratio of total trade to GDP is nearly 100 percent, implying that the size of international economic transactions is equivalent to the economic scale of the ASEAN region.

The common inflation of ASEAN is heavily influenced by movements in non-oil commodities and oil prices. The upward trend in the 2002-2008 period, the sharp increase in 2010, the gradual downward trend from 2012, and the dramatic rise since 2021 of ASEAN inflation are highly associated with the evolution of world commodity prices. Food prices have a considerable impact on ASEAN common inflation because food accounts for a large share of the consumer basket in ASEAN. Oil prices affect ASEAN inflation since oil is the main source of energy in ASEAN countries. Oil consumption accounts for 50 percent of the total energy consumption of ASEAN economies; in Singapore, this figure is more than 87 percent (Jongwanich et al., 2019). In addition, ASEAN countries, except Malaysia, are oil importers.

V. Conclusions and Policy Recommendations

The rapid integration process in both internal and external regional dimensions of ASEAN economies has increased interconnectedness among regional members and the region's dependence on global conditions. As a result, ASEAN countries could have similar economic performances because they share similar conditions or are influenced by the same external shocks. This study investigates the comovements of inflation rates in ASEAN countries and identifies the crucial sources driving common inflation in the region by using a two-step approach.

Using quarterly inflation data from six ASEAN countries in the period between 2000Q1 and 2022Q2, the study employs Kalman methodology to estimate the dynamic factor model. The study does find a common factor that reflects the common inflation of the region. The impact of the common inflation on the inflation of individual countries is diverse across countries, which partly explains the different inflation levels in ASEAN countries. In addition, this result implies ASEAN countries respond differently to the impacts of common sources of inflation depending on macroeconomic conditions and policy responses in each country. The analysis of variance decomposition shows the significant role of common inflation in the variations in inflation in ASEAN countries. The common inflation can explain 45.384 percent of ASEAN inflation variations on average. While Indonesia, the Philippines, Thailand, and Vietnam share the equivalent importance of common inflation to their inflation, Malaysia shows a higher contribution of common inflation, and Singapore shows a lower contribution of common inflation to inflation variance.

In the second step, a model of ASEAN common

inflation is constructed based on the AS-AD framework. The study employs the ARDL with bound test approach to examine the global determinants of ASEAN inflation in both short and long terms in the period between 2012O1 and 2022O2. The results indicate that ASEAN common inflation is positively associated with world economic growth, change in world oil prices, and change in non-oil commodity prices, and negatively correlated with trade openness in the long run. In the short run, ASEAN common inflation depends on lags of itself in 3 quarters, a 3-quarter lag of world economic growth, a simultaneous change of world oil prices, and a 1-quarter lag of non-oil commodity price change. The impact signs of all determinant factors in the short run are consistent with those in the long run.

The results of this study suggest a great role for global factors in the inflation dynamics of countries in the ASEAN region, thus, implying a less important role for domestic factors in macroeconomic performance at the same time. Models of the inflation dynamics of individual countries in the ASEAN region should place sufficient weight on global variables. The price stabilisation policies of ASEAN countries should take into account the fluctuations of these global variables, especially the global business cycle and commodity and energy prices. In addition, the importance of global factors for inflation variations varies significantly across countries, which raises the need for comprehensive explanations.

The study focuses mainly on supply-side factors, although some demand-side factors are involved. Future research should focus more on the structures of trade linkages among regional countries in terms of products or the similarities of policy goals in the region, such as the inflation target and fiscal deficit. The examination of these demand-side factors can improve the understanding of regional inflation behaviour from the inside, which reflects the characteristics of interconnectedness and policies in the region.

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