# External Shocks and Regime Shift of ASEAN Economies

Inpong Luanglath*

*Received: March 17, 2023 Revised: September 27, 2023 Accepted: October 6, 2023*

## Abstract

This paper studied the effects of external shocks on the ASEAN economies. In this non-parametric study, we analyzed three regimes: GDP growth, interest, and exchange rates. We examined 677 weeks of spot exchange rates of ten currencies, thirty years of inflation and GDP growth rates in the ASEAN and tested their volatility to show regime shift. We employed the Dirac delta function to detect impulse response to external shocks. For GDP growth in the ASEAN, Brunei, Indonesia and Singapore are least affected by external shocks. However, all ASEAN countries are vulnerable to exchange rate regime shift ($p < 0.0422$). Cambodia ($p = 0.0681$), Laos ($p = 0.1379$) and Vietnam ($p = 0.0599$) faced the risk of regime change in inflation compared to the group average of $p = 0.5154$. We recommend stakeholders to use China as an economic buffer because it shows a high level of stability in all three regimes that we examined. The large size of China's economy, high purchasing power, and stable currency of China may help ASEAN countries to reduce the effect of shocks from western markets.

**Keywords:** ASEAN, China, Dirac Delta Function, Economic Buffer, Exchange Rate, Exogenous Shock, External Shock, GDP, Impulse Response, Inflation

* International College, Bangkok University
9/1 Moo 5, Phaholyothin Road, Khlong Nueng, Khlong Luang, Pathum Thani 12120, THAILAND.
E-mail: Inpong.l@bu.ac.th

# ผลกระทบภายนอกและการเปลี่ยนแปลงระบอบการปกครองของเศรษฐกิจอาเซียน

อินทร์พงษ์ หลวงราช*

*รับวันที่ 17 มีนาคม 2566 ส่งแก้ไขวันที่ 27 กันยายน 2566 ตอบรับตีพิมพ์วันที่ 6 ตุลาคม 2566*

## บทคัดย่อ

บทความนี้ศึกษาผลกระทบของผลกระทบภายนอกต่อเศรษฐกิจอาเซียน ในการศึกษาแบบไม่อิงพารามิเตอร์นี้ เราได้วิเคราะห์ระบอบการปกครอง 3 รูปแบบ ได้แก่ การเติบโตของ GDP ดอกเบี้ย และอัตราแลกเปลี่ยน เราตรวจสอบอัตราแลกเปลี่ยนทันที 677 สัปดาห์ของสิบสกุลเงิน อัตราเงินเฟ้อ 30 ปีและอัตราการเติบโตของ GDP ในอาเซียน และทดสอบความผันผวนเพื่อแสดงการเปลี่ยนแปลงระบอบการปกครอง เราใช้ฟังก์ชัน Dirac delta เพื่อตรวจจับการตอบสนองของแรงกระตุ้นต่อแรงกระแทกภายนอก สำหรับการเติบโตของ GDP ในอาเซียน บรูไน อินโดนีเซีย และสิงคโปร์ได้รับผลกระทบจากปัจจัยภายนอกน้อยที่สุด อย่างไรก็ตาม ทุกประเทศในอาเซียนมีความเสี่ยงต่อการเปลี่ยนแปลงของอัตราแลกเปลี่ยน ($p < 0.0422$) กัมพูชา ($p = 0.0681$) ลาว ($p = 0.1379$) และเวียดนาม ($p = 0.0599$) เผชิญกับความเสี่ยงจากการเปลี่ยนแปลงระบอบการปกครองในด้านเงินเฟ้อเมื่อเทียบกับค่าเฉลี่ยของกลุ่มที่ $p = 0.5154$ เราแนะนำให้ผู้มีส่วนได้ส่วนเสียใช้จีนเป็นกันชนทางเศรษฐกิจ เนื่องจากจีนมีความมั่นคงในระดับสูงในทั้งสามระบอบที่เราตรวจสอบ ขนาดเศรษฐกิจที่ใหญ่ของจีน กำลังซื้อสูง และค่าเงินที่มีเสถียรภาพของจีนอาจช่วยให้ประเทศในอาเซียนลดผลกระทบจากแรงสั่นสะเทือนจากตลาดตะวันตกได้

**คำสำคัญ:** อาเซียน จีน ฟังก์ชัน Dirac Delta กันชนเศรษฐกิจ อัตราแลกเปลี่ยน ผลกระทบจากภายนอก ผลกระทบจากภายนอก GDP การตอบสนองต่อแรงกระตุ้น เงินเฟ้อ

* วิทยาลัยนานาชาติ มหาวิทยาลัยกรุงเทพ
เลขที่ 9/1 หมู่ 5 ถนนพหลโยธิน ตำบลคลองหนึ่ง อำเภอคลองหลวง ปทุมธานี 12120
อีเมล: Inpong.l@bu.ac.th

## Introduction

The purpose of this paper is to examine the economic effect of two external shocks received by the ASEAN economies. These shocks were COVID-19 pandemic and economic sanctions against Russia after the ware in Ukraine which led to the rise in food and fuel costs. The COVID-19 pandemic measures were imposed in 2020-2021 and the ASEAN economies experienced the effect of the restrictive market condition under pandemic control measures. The rising in food and fuel costs after economic sanction against Russia in the first quarter of 2022 presently exerting inflationary pressure on the global economy.

In this paper, we are using China as a proxy country to explore the role of China as a regional and global economic powerhouse that could serve as a buffer market for the ASEAN countries. China's economy boasts a mammoth size of 17.46 trillion US dollars and a population of 1.402 billion people with per capita income of 12,359 US dollars. As such China is a market that could help absorb the effect of external shock against ASEAN. The Western market, for instance, US and EU area, are vulnerable and sensitive to negative shocks. China, on the other hand, exhibits steady growth path despite the ups and downs of the global economy. China's large population and significant purchasing power of its people represent an undeniable alternative market to the West. China and the ASEAN are in the same geographical location; this makes the larger market in China the more attractive and should not be overlooked as a trading partner. In this paper, we urge stakeholders in the ASEAN to rethink trade strategy and policy aiming for closer ties with China as a potential buffer against the effects of exogenous shocks.

There is a practical logic why the ASEAN Economic Community (AEC) should consider China as an important trading partner. Although there ASEAN countries are trading with China now, these trading activities are bilateral trade activities. ASEAN claims to have established an economic community (AEC), but to date the AEC had yet made significant impact on ASEAN's trading in the regional or global market place. There is a significant level of trade between ASEAN and China. According to Chinese official acknowledgement, it was reported that:

> "In 2021, the trade volume of goods between China and ASEAN was US$878.2 billion, reaching a year-on-year increase of 28.1%. Among them, China's exports to ASEAN were US$483.69 billion, reaching a year-on-year increase of 26.1%; imports from ASEAN were US$394.51 billion, reaching a year-on-year increase of 30.8%. ASEAN has become China's largest trading partner for the second consecutive year. Vietnam, Malaysia and Thailand are China's top three trading partners in ASEAN."--- Brief Status of China-ASEAN Economic and Trade Cooperation in 2021.

Economic relationship between China and the ASEAN is two-ways. In 2021, ASEAN's invested US$10.58 billion in China. The top three ASEAN countries investing in China were Singapore, Thailand and Malaysia. However, these economic activities still needs further development and promotion. The potential for ASEAN-China trade is greater when what had been achieved so far. In face of the current risk in the global economy, the ASEAN as a single unit as embodied in the AEC should realign itself with China as trading partners. The most recent lessons of risk exposure from COVID-19 pandemic in 2020-2021 and the fall out of economic sanction against Russia in 2022 made clear that ASEAN is exposed to real risk of external shock as evidence by the swing of its GDP growth rate in Figure 1 below.

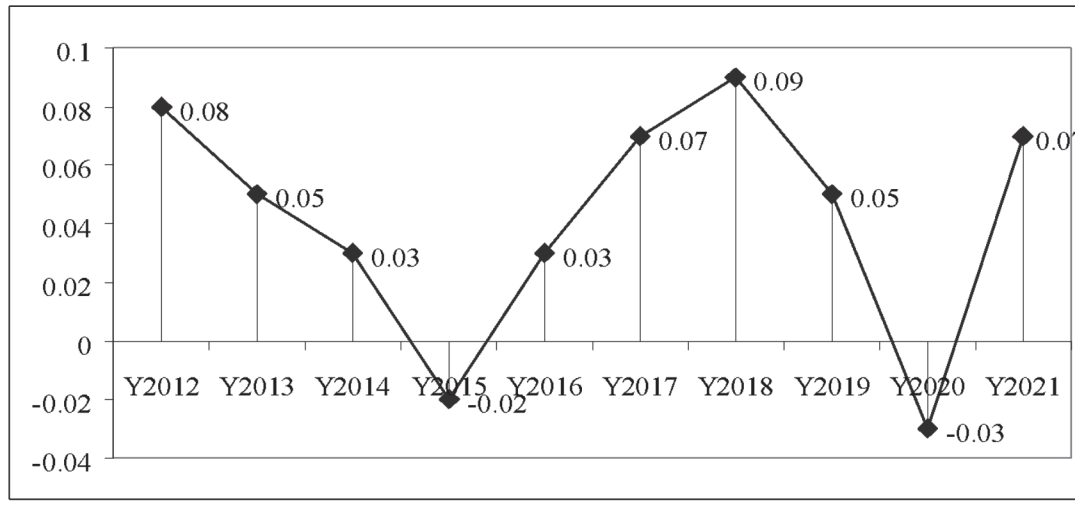


**Figure 1:** Year-to-year Change ASEAN's Economic Growth Rates Resulted from External Shocks 2012-2021

*Source:* IMF Annual Report. World Economic Outlook, 2021. The above figures are determined by: (growth Y2 – growth Y1) / growth Y1. Table 1, infra.

In Figure 1, we note two sharp drops in GDP growth in the ASEAN economy; there was one sharp drop in 2015 and another drop in 2020; both resulted from external shocks. In 2014, Russia annexed the Crimea from Ukraine. This action was followed by the imposition of economic sanctions against Russia. As the result, the Ruble was devalued and there was a loss of confidence in the Russia economy. The second cause of the 2014-2015 crisis was the drop in crude oil price by 50%. Crude oil was Russia's main export. A reduction in oil prices also led to the loss in the Russian economy (Viktorov and Abramov, 2020). A second drop in the GDP growth in ASEAN came in 2020; this drop was due to the COVID-19 pandemic. The lesson learned from these two recent crises raise the question of what can ASEAN do in order to reduce risk of external shock? We attempt to answer this question by asserting that ASEAN needs an economic buffer against the instability of western market. We urge ASEAN stakeholders to seriously consider China as an economic buffer by increasing two-ways trading between ASEAN and China. This is not an advocacy of China hegemony in Southeast Asia. This is a practical economic policy orientation for effective risk management to lessen the effect of exogenous shock.

The study of the effect exogenous shock on the ASEAN economy is an interesting research topic because ASEAN has a combined population of 665.17 million people and an economy worth 3 trillion US dollars. The economic health of the ASEAN region contributes to the health of the global economy and conversely poor economic performance of the ASEAN could also send a shock wave to its trading partners, especially major economies, such as China, Japan, US and EU area. This paper intends to raise awareness about the important role play by ASEAN in the global economy. Our study of the effect exogenous shock on the ASEAN economy turns to vector autoregressive (VAR) modeling.

The purpose of this paper is to examine the effect of COVID-19 pandemics upon economic growth on ASEAN countries. The Association of Southeast Asian Countries (ASEAN) is composed of ten countries: Brunei, Burma (Myanmar) Cambodia, Timor-L'este, Indonesia, Laos, Malaysia, Philippines, Singapore, Thailand, and Vietnam. ASEAN has a common market call ASEAN Economic Community (AEC). The AEC market is valued at $7,188.00 million in 2020, and is projected to reach $15,842.00 million by 2028. Among major markets, such as Japan, US, EU, India and China, the AEC ranks third largest market size in terms of population (638.624 million). It has been touted as an emerging and fast growing market in Southeast Asia. However, the coming of COVID-19 pandemics has

dampened economic growth in the AEC. This paper examines the effect of COVID-19 pandemic as an economic shock upon the AEC.

The UN Secretary General reported that COVID-19 created "unparalleled economic shock" and that "unemployment has skyrocketed. Temporary business closures are becoming permanent. Rebuilding to pre-crisis levels of employment and output may take years" (COVID-19: 'Unparalleled economic shock', 2021). The AEC shares the effect of this economic shock from COVID-19. Table 1 below shows the dip in GDP growth trends in the pandemic period (2020-2022).

**Table 1:** GDP Year-to-year Percentage Change in the AEC 2012-2021

| Country | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 |
|---|---|---|---|---|---|---|---|---|---|---|
| Brunei | 0.03 | (0.05) | (0.05) | (0.24) | (0.12) | 0.06 | 0.12 | (0.01) | (0.11) | 0.31 |
| Cambodia | 0.10 | 0.08 | 0.10 | 0.08 | 0.11 | 0.11 | 0.11 | 0.10 | (0.07) | 0.04 |
| Indonesia | 0.03 | (0.00) | (0.03) | (0.03) | 0.08 | 0.09 | 0.03 | 0.07 | (0.05) | 0.09 |
| Laos | 0.14 | 0.17 | 0.11 | 0.08 | 0.11 | 0.07 | 0.06 | 0.04 | 0.00 | 0.03 |
| Malaysia | 0.06 | 0.03 | 0.05 | (0.12) | (0.00) | 0.06 | 0.12 | 0.02 | (0.08) | 0.10 |
| Myanmar | 0.09 | 0.03 | 0.04 | (0.01) | (0.04) | 0.02 | 0.09 | 0.03 | 0.18 | (0.18) |
| Philippines | 0.12 | 0.08 | 0.05 | 0.03 | 0.04 | 0.03 | 0.06 | 0.09 | (0.04) | 0.07 |
| Singapore | 0.06 | 0.04 | 0.02 | (0.02) | 0.03 | 0.08 | 0.10 | (0.00) | (0.09) | 0.11 |
| Thailand | 0.07 | 0.06 | (0.03) | (0.02) | 0.03 | 0.10 | 0.11 | 0.07 | (0.08) | 0.09 |
| Vietnam | 0.14 | 0.09 | 0.09 | 0.02 | 0.06 | 0.10 | 0.09 | 0.08 | 0.05 | 0.07 |
| **MEAN** | **0.08** | **0.05** | **0.03** | **(0.02)** | **0.03** | **0.07** | **0.09** | **0.05** | **(0.03)** | **0.07** |
| **SD** | **0.04** | **0.06** | **0.06** | **0.10** | **0.07** | **0.03** | **0.03** | **0.04** | **0.09** | **0.12** |

*Source:* World Economic Forum Report 2022
https://www.imf.org/en/Publications/WEO/weo-database/2022/April/download-entire-database

The mean growth rate for the AEC took a dip in 2020 with a negative growth of -0.03%. There had been similar economic shock from the recent financial crisis in 2015 corresponding to the Chinese stock market crash. These two events are comparable in terns if their effect on the GDP growth rate in the AEC. The year 2015 was also the mark of the AEC integration. The initial -0.02% dip in 2015 may have been attributed to the intra-regional shock from the integration. The question we ask is whether COVID-19

presents a significant shock for the AEC as a regional market and for the individual country in the AEC? These research questions are interesting because it helps answer the question of 'how resilient is the AEC economy in face of exogenous shock'?

The last shock experience by the AEC was in 2015, the year of its economic integration as an economic community. It took the region 3 years to regain its losses in 2015. The second shock came as the result of COVID-19; if the growth repeats the same pattern, we should expect the AEC to regain its prior growth trend by 2023. However, unlike the shock in 2015, coincided with the Chinese stock market crash and the AEC integration, the COVID-19 shock is a sustained exogenous event. Conventionally, economic shock is short burst of external disturbance that the market may absorb and rebound to its so-called long-term equilibrium. However, with sustained presence of external disturbance as COVID-19, the effect may lead to regime change altogether. A further research issue presented in this paper is to speculate whether the economic effect of COVID-19 should be classified as an economic shock of regime change?

Significant breaks in the behavior of economic time series, associated with events such as financial crises (Jeanne and Masson, 2000; Cerra, 2005); or abrupt changes in government policy (Hamilton, 1988; Sims and Zha, 2004, Davig, 2004) is called regime switching. Traditionally, economists look at erupt changes that led to changes in asset prices as indicator for regime switching (Ang and Bekaert, 2003; Garcia, Luger, and Renault, 2003; Dai, Singleton, and Wei, 2003). However, little work has been done on whether non-economic factor, such as a disease outbreak (COVID-19) and warfare (Ukraine war 2022) could lead to regime switching. This paper intends to tackle this research question and fill the gap in the literature.

## Literature Review

Economic shock is defined as unexpected exogenous event that affects the economy. The study of the effect of external shock is generally accomplished by impulse response function (IRF). If the response is reactive, it is considered endogenous to macroeconomic variables; these variables include output, consumption, investment, and employment (Hamilton, 1994). These endogenous responses from exogenous shock occur after experiencing the shock. The shock could be positive or negative; thus, impulse response may be categorized into types of responses that are targeting the positive or negative shock (Hatemi-J, 2014).

The quantitative model used in IRF is vector autoregression (VAR). VAR is a stochastic model used to generalize a single-variable autoregressive model by allowing for multivariate time series. For example, in this study, we look at economic growth over time as a response to the COVID-19 or Russian-Ukraine military conflict. Generally, VAR model is theory bound by macroeconomic theoretical framework; however, there has been suggestion that VAR could be theory-free and could be used for purely statistical testing of a proposed hypothesis (Sims, 1980). We present the structural VAR below:

$$B_0 y_t = C_0 + B_1 y_{t-1} + B_2 y_{t-2} + ... + B_p y_{t-p} + \varepsilon_t \quad (1)$$

where $c_0$ is a $k \times 1$ vector of constants, $B_i$ is $a\ k \times k$ matrix for $i = 0, ..., p$ and $e_t$ is a $k \times 1$ vector of error terms. The main diagonal terms of the $B_0$ matrix with the coefficients on the $i^{th}$ variable in the $i^{th}$ equation) are scaled to 1. The condition for the error matrix follows: (i) $E(e_t) = 0$ every error term has mean zero; (i) $E(e_t e'_t) = \Omega$, covariance matrix of the error term is $k\ x\ k$ denoted as $\Omega$; and (iii) $E(e_t, e^t_t\text{-}k) = 0$, for non-zero k there should be no serial correlation for the error term. In a reduced form, (1) is rewritten in terms of the inverse of $B_0$ :

$$y_t = \frac{1}{B_0} C_0 + \frac{1}{B_0} B_1 y_{t-1} + \frac{1}{B_0} B_2 y_{t-1} + ... + \frac{1}{B_0} B_p y_{t-p} + \frac{1}{B_0} \varepsilon_t \quad (2)$$

where $\frac{1}{B_0} C_0 = c$ , $\frac{1}{B_0} B_i = A_i, i = 1,..., p$ , and $\frac{1}{B_0} \varepsilon_t = e_t$ . The pth order of the reduced form of VAR may be obtained, thus:

$$y_t = C + A_1 y_{t-1} + A_2 y_{t-2} + ... + A_p y_{t-p} + e_t \quad (3)$$

As the data used in this paper is time dependent, the VAR model is subjected to unit root testing. The unit root test is accomplished by the Dickey-Fuller test (Dickey and Fuller, 1979).

The Dickey-Fuller test for unit root considers the stochastic process: $Y_i = \varphi Y_{i-1} + \varepsilon_i$ where $|\phi| = 1$ and $\varepsilon_i$ is white noise. If $|\phi| = 1$, we have what is called a unit root. In particular, if $\phi = 1$, we have a random walk (without drift), which is not stationary. In fact, if $|\phi| = 1$, the process is not stationary, while if $|\phi| < 1$, the process is stationary. If $|\phi| > 1$ the process increases over time. This process is a first-order autoregressive process, AR(1). The Dickey-Fuller test determines whether the process has a unit root.

The first step is to calculate the first difference: $Y_i - Y_{i-1} = \varphi Y_{i-1} + \varepsilon_i - Y_{i-1}$ which is simplified as: $Y_i - Y_{i-1} = (\varphi - 1)Y_{i-1} + \varepsilon_i$. By using delta operator where $\Delta Y_i = Y_i - Y_{i-1}$ and $\beta = (\varphi - 1)$, the above notation could be written as: $\Delta Y_i = \beta Y_{i-1} + \varepsilon_i$ where $\beta = 0$ and so the test for $\phi$ is transformed into a test that the slope parameter $\beta = 0$. Thus, we have a one-tailed test (since $\beta$ cannot be positive) where H0: $\beta = 0$ (equivalent to $\phi = 1$); and H1: $\beta < 0$ (equivalent to $\phi < 1$). Note that if $\beta = (\varphi - 1)$ it means that $\phi = 1 + \phi$ where $\phi$ is the slope coefficient for the AR model. The null hypothesis states that there the time series is not stationary; there is a unit root. The alternative hypothesis asserts that the data is stationary. The Dickey-Fuller test is used to test for unit root. There are three scenarios in Dickey-Fuller test: (i) Type 0 with no constant, no trend: $\Delta Y_i = \beta_1 Y_{i-1} + \varepsilon_i$; (ii) Type 1 with constant, no trend: $\Delta Y_i = \beta_1 + \beta_1 Y_{i-1} + \varepsilon_i$; and (iii) Type 2 with constant and trend: $\Delta Y_i = \beta_0 + \beta_1 Y_{i-1} + \beta_2 i + \varepsilon_i$.

Stochastic trend may cause the presence of unit root. Stochastic trend is one that can change in each run due to the random component of the process (Enders, 2010); a random walk always has a stochastic trend and the presence of unit root. The drift of the intercept (a0), for instance, shows the presence of unit root and proves that the time series is not a stable process (Campbell and Perron, 1991). Therefore, one way of testing for process stability is to look to the potential drift of the intercept (Dolado, Jenkenson, and Sosville-Reviero, 1990). Elder and Kennedy (2001) advocated the use of prior knowledge of the growth of the increase or decrease of the process and suggest F and T tests. Some approach for unit root test suggest the use of simulation (Hacker and Hatemi-J, 2010), or information criterion (Hacker, 2011). In this paper, we employed the Dickey-Fuller test and used $|\phi| = 1$ as a reference threshold.

The conceptual framework for VAR model is constrained by the unit root testing. Unit root is the evidence that the time series data is not stable in a sense that the long-run

equilibrium changes over time. This change makes the proposed VAR a poor predictive function. However, in this study of economic shock we expect that unit root will be present and the unit root will serve as an indicator to prove that the system is affected by the shock. COVID-19 pandemic and the war in Ukraine are negative shocks which effect the economies in the ASEAN countries. The pandemic reduces economic activities in the country for almost two years from 2020 to 2021; it was not until 2022 that the ASEAN started to emerge from the pandemic shock. In 2022, the global economy was sent into another shock by the war in Ukraine. Following economic sanctions against Russia, food and fuel prices rose; global inflation started to set in by mid-2022. VAR model help us to see a long-run time series from prior time period up until the shock point in 2021 for COVID-19 pandemic and 2022 for Ukraine war and international sanction against Russia. These two shock waves represent exogenous shocks that affect the ASEAN economies. By looking at the GDP growth rates, exchange rates, and fuel prices, we expect to see impulse response from endogenous factors to exogenous shock in the ASEAN region.

The general use of time series modeling is to obtain a predicting model under autoregressive (AR) method. However, in this paper, we used AR as a tool to provide use with a predictive function from which we could verify that there is a unit root. Unit root is an indicator that the time series data is not stationary. Data stationary is a stochastic process whose unconditional joint probability distribution does not change when shifted in time (Gagniuc, 2017). Stationary in time series data means stability. The presence of unit root means that the system is not stable. In this paper, we want to prove that the effects of shock cause the system to become unstable. This instability is proved by the existence of unit root in the time series. Therefore, our concern is to verify that unit root exists in AR(1); we are not seeking to adjust any lag periods in order to obtain a stationary process. The use of VAR to proof long-run trend and data stability through the use of unit root testing are well researched. However, to use the same modeling and testing for a different purpose is a novel approach to time series analysis. In this paper, we are using VAR model to verify a break in time series and we employed unit root testing to prove the significant effect of the exogenous shock in the ASEAN economies. This new use of existing econometrics is a contribution to the literature in economic research for the ASEAN economies.

**Regime shift in macroeconomics**

A regime is a characteristic behavior of a system that is maintained by mutually reinforced process. A GDP growth, for instance, is a complex system that is mutually maintained and reinforced by four components, namely, consumption (C), government spending (G), investment (I) and net trade (Export - Import). We try to answer whether the current COVID-19 pandemics causes a regime shift in the GDP growth rate in the ASEAN countries. Regime switching is defined as erupt and persistent in the structure and function of a system (Lwontin, 1969; Holling, 1973; Scheffer et al. 2001; and Biggs et al., 2009).

There are two types of regime switching: (i) threshold, and (ii) Markov models. According to Tong (1983), regime shift results from the change in the level of observed variables that exceeds an unobserved threshold. On the other hand, regime change may also come about according to Markov chain Goldfeld and Quandt (1973), Cosslett and Lee (1985), and Hamilton (1989). Threshold models attest that regime change may come from smooth change through internal process. For example, in GDP changes, the change of a country's economic development as seen through its GDP level may result from growth over time, i.e. an underdeveloped economy graduated to a developing economy. This type of change is indicated by threshold model. However, a second type of change may come from erupt external shock (Scheffer et al., 2001; Scheffer and Carpenter, 2003; and Beusner et al., 2003). In this paper, we are looking into the external shock brought about by the COVID-19 pandemic and ask whether such sustained shock, since 2019 to the present, cause regime change in economic growth among the ASEAN countries.

There are many attempts to define regime shifts in the literature. In explaining regime shift, Collie *et al.* wrote that:

> "Three different types of regime shift (smooth, abrupt and discontinuous) are identified on the basis of different patterns in the relationship between the response of an ecosystem variable (usually biotic) and some external forcing or condition (control variable). The smooth regime shift is represented by a quasi-linear relationship between the response and control variables. The abrupt regime shift exhibits a nonlinear

> relationship between the response and control variables, and the discontinuous regime shift is characterized by the trajectory of the response variable differing when the forcing variable increases compared to when it decreases (i.e., the occurrence of alternative "stable" states)." (Collie, J., et al., 2004)

According to Collie et al., regime shift is represented by low frequency but high amplitude event. It means that the frequency of the shock is less frequent but with each occurrence, the effect of the shock is big. Alternatively, regime shift may also be seen as an establishing of alternative state in relations to the referenced threshold level. According to Walker and Meyer (2004), "a regime shift involving alternate stable states occurs when a threshold level of a controlling variable in a system is passed, such that the nature and extend of feedbacks change, resulting in a change of direction (the trajectory) of the system itself. A shift occurs when internal processes of the system ... have changed and the state of the system ... begins to change in a different direction, toward a different attractor." In marine biology, this process may take up to 5 years to affect a regime shift (Norström et al., 2009). However, for an economic system the time required for regime shift under sustained exogenous shock, such as that of a pandemic, discussion in the literature is lacking.

In this paper, we will use Walker and Meyer's hypothesis of threshold model to test several regimes among the ASEAN countries individually and the ASEAN as a single economic community had experienced regime shift as the result of external shocks: COVID-19 pandemics and Russian-Ukranian war of 2022. The regimes that we will examine include GDP growth, inflation, and exchange rates.

**Detecting regime shift**

There are many possible methods used to detect regime shift, these methods include average standard deviates, principal component analysis, or artificial neural networks (Sonderegger, et al., 2009; and Anderson, et al., 2009). Other tools include dynamic models (Guunealp and Barlas, 2003; Saysel and Barlas, 2001) bayesian belief networks (Wooldridge et al., 2005), Fisher information (Karunganithi et al., 2008), and fuzzy cognitive maps (Kok, 2009). Common analytical approach to regime shift consists of defining the regime, and detecting shift. In this paper, we employed autoregressive model

to inflation rates, exchange rate, oil prices, and GDP growth rate in order to verify regime change. We use statistical threshold of significance level to measure the response to shock. The threshold employed in this study is p = 0.10 which is consistent with the 10% band used by central banks for purposes of monitoring changes in exchange rates and implement intervention measures.

Regime shift or regime change occurs when there is a lack of resilience in the system (Folke et al., 2004). There had been claims that the ASEAN economy is resilient. In face of economic crisis, the ASEAN economy took and hit and rebound. In order for regime shift to occur, there is a weakening of the internal process that resulted in the loss of stability of the system. As a whole, the ASEAN economy may still show a goof feedback to exogenous shock; however, when looking at individual countries, some countries may show internal weakness could not stabilize its own system in face of prolonged external shocks. According to Scheffer and Carpenter (2003), regime shifts may come in three forms: smooth, abrupt or discontinuous. Coolie et al. (2004) explained that smooth change comes from a quasi-linear relationship between fast and slow processes; abrupt change is a non-linear relationship among fast and slow variables. Discontinuous change resulted when one of the variable changes at a faster rate. In our study of the ASEAN economy, detecting system shift must go beyond the examination of the GDP growth rates. The expansion or retraction of an economy is due to many factors. In this case study, we looked at inflation and exchange rate as additional factors.

In detecting regime shift, we may look at hysteresis as evidence of permanent change of the regime. Hysteresis is a phenomenon characterized by persistence of the effects after the initial causes giving rise to the effects are removed (Cross, 1993). For example, after negative shock unemployment remains higher even when the economy returns to normality (Blanchard and Summers, 1986). The regime shift in inflation and exchange rates in Laos and Myanmar may be explained by hysteretic phenomenon. These two ASEAN countries showed similar experience. Laos had its local currency traded against the US dollar at 8,500 LAK per one US dollar for a long period. However, after the COVID-19 the rate stood at 15,000 LAK/USD and still devalued further even after ASEAN had recovered from the pandemic. Another evidence of hysteresis in the ASEAN is Myanmar's valuation of its currency (MMK). In 2012, Myanmar pegged its currency to the IMF's SDR and equated MMK at 6.40 MMK per SDR; this imposition of SDR as

a reference rate was seen by the market as a negative shock. In the subsequent months when the SDR was removed, the Myanmar currency bounced back to 850 MMK per US dollar. If regime shift in some ASEAN countries is hysteretic, it would be difficult to bring the economy back to its growth path.

In this paper, the theoretical framework for detecting regime shift is examined by the Dirac delta function. In impulse response concept, the exogenous shock, such as COVID-19 pandemic, economic crisis or Russian-Ukraine war, is an impulse or signal from outside. The economy is the system that responds to this signal, i.e. external shock. For instance, the dip in the year-to-year changes in GDP growth illustrated in Figure 1 is an example of impulse response to outside stimuli. We model the external shock to the system under the Dirac delta function.

The Dirac delta distribution is the unit impulse function; it is a generalized distribution over the real numbers, whose value is zero everywhere except at zero, and whose integral over the entire real line is equal to one. Assume that the economy at its normal state, without shock, is a function with zero shock everywhere on the number line where the number line representing a time series. When the shock is introduced, there is an impulse response (Arfken & Weber 2000; Dirac 1930; and Gelfand & Shilov 1966-1968).

We assume that prior to shock and reasonably near in time for the shock disturbance, the data series were normally distributed. Recall that the probability density function for the normal distribution is given by:

$$f(x) = \frac{1}{\sigma\sqrt{2\pi}} \exp\left( -\frac{1}{2}\left( \frac{x-\mu}{\sigma} \right)^2 \right) \tag{4}$$

By incorporating the Dirac delta function, for probability density f(x) of a discrete distribution, i.e. probability of the shock (0, 1) consists of x = {x1, ..., xn} with corresponding probabilities of p1, ..., pn, the probability density function with Dirac's delta function for the shock becomes:

$$g(x) = \sum_{i=1}^{n} p_i \delta(x - x_i) \tag{5}$$

We used the notation g(x) to differentiate the normal probability density function f(x) from the Dirac delta function interface. The Dirac delta function is a limit as $a \to 0$ where zero is the center of a distribution of the response (impulse response) to the shock, i.e. without the shock, there is no response; therefore, $a \to 0$. The response sequence is zero-centered distributions given by:

$$\delta_a(x) = \frac{1}{|a|\sqrt{\pi}} \exp(-x/a)^2 \tag{6}$$

The value of a could only be $a \to 0$ but not equal to zero. If $a = 0$, it means there is no impulse response; it follows that there is no response because there is no shock. If there is shock or $a \neq 0$ there is a shock. The assumption that the impulse response portion of the line number creates a normal distribution predicates upon the fact that the economic infrastructure or production capacity of the economy has the ability for self correction and return to its position prior to shock. Under this argument, if the economy has poor productive capacity, the assumed normality of the impulse response in $\delta a(x)$ will break down enter a state of exponential decline and ultimately enters a state of economic chaos. This extreme case may follow a general exponential decline pattern: $N(t) = N_0 e^{-\lambda t}$ where N(t) is the quantity at time t; this may be equated GDP growth, N0 is the initial quantity at time t = 0, and λ is the constant decay or disintegration rate. This extreme condition may have described the loss of currency value of Germany in 1923, Zimbabwe in 2008-2009, Venezuela in 2018, and Sri Lanka in 2022. In this paper, we do not observe such extreme case, for the most part the impulse response by ASEAN countries to external shocks had been temporary so that the condition $a \to 0$ holds. The determination of a in the delta function is given by:

$$\delta(x) = \lim_{n \to \infty} \frac{1}{2\pi} \frac{\sin\left[\left(n + \frac{1}{2}\right)x\right]}{\sin\left(\frac{1}{2}x\right)} \tag{6}$$

Note that the Dirac function, when incorporated into the continuous probability distribution function, is actually a discrete probability. The expression below is a mixture distribution. Assumed that the discrete frequency that returns a normal distribution is

defined by the Laplace Rule of succession: $p = (s + 1) / (n + 2)$. The portion or segment of the data set whose distribution is normal is considered a condition where there is no shock. The remaining of the discrete frequency is $q = 1 - p$. The mixture distribution may be written as:

$$f(x) = P\frac{1}{\sqrt{2\pi}}\exp\left(\frac{-x^2}{2}\right) + Q\delta(x - x_i) \tag{7}$$

For a random variable that is transformed by continuous differentiable function $Y = g(x)$ the density function of $Y$ is written as:

$$f_Y(y) = \int_{-\infty}^{+\infty} f_X(x)\delta(y - g(x)dx \tag{8}$$

In this paper, the variable that we looked at, such as GDP growth rate, interest rate, inflation, or any type of economic time series, we can defined such series as $Y = g(x)$ with a density function of $fY = (Y)$. We use the Dirac delta function as the basis for detecting regime shift. As a tool for detection, the impulse response under the Dirac delta function is that the response will follow a normal distribution pattern. If the response breaks this assumption, then there is an evidence of regime shift. Significance testing of the shift is accomplished by the F test.

## Data and Methodology

We used the following data for our study of regime change and the effect of external shocks on the ASEAN economy: (i) inflation rates, (ii) exchange rate, (iii) oil prices, and (iv) GDP growth rate. Inflation indicates an increase in price level. When the price level increases unexpectedly, it may serve as an indicator of shock. ASEAN's economy is largely dependent on international trade, especially trading with major economies such as the US, EU area, Japan and China. Global inflation followed the war in Ukraine may effect import prices and affect intra-ASEAN growth. A second indicator of stability of the economy is the exchange rate.

The valuation of the local currency against the major currency of trading partner, such as US dollar, may serve as an indicator of stability and effectiveness of monetary policies in the ASEAN. In this study, we used the exchange rate to gauge how the local economies in the ASEAN community respond to two major events: COVID-19 pandemic and the war in Ukraine and its economic consequences after sanctions are imposed on Russia. Third, we saw the increase in oil prices after sanctions were imposed on Russia in 2022. The increase in fuel prices also led to increase in food prices and other primary input costs. The spike increase in oil prices indicates an external shock. This shock may have an effect on the overall production of the economy. ASEAN is a net oil importer; by using world oil price as an indicator for economic shock we can verify its effect on the economy.

Lastly, GDP growth rate is used as the macroeconomic indicator in response to external shock. ASEAN has ten countries; we examined economic growth through the GDP growth rates of ten countries. Normally, GDP growth rate following a long-term growth trend that is very stable; even id there is an exogenous shock, the effect of the shock is temporary, as we have seen in series of financial crisis. The GDP growth depends on the infrastructure and productive capacity of the country. Therefore, temporary shock normally does not lead to regime change. However, it is a good indicator to provide the level of the effect of the shock through the dip in the GDP growth rate.

**Data characteristics**

As a region, the ASEAN had an average expected GDP growth of 4.14 ± 1.37 in 2022 and this growth is churned away by inflation at a rate of 6.43 ± 3.98. In real term, the GDP in the ASEAN failed by -2.29%. By its nature, the GDP is expected to growth every year. External shocks such as global financial crisis, COVID-19 or the Russo-Ukranian war of 2022 exert temporary effect on the economies. We noted this observation in Figure 1 where the GDP growth in the ASEAN saw a dip followed each external shock (Russian financial crisis 2014-15 and COVID-19). In about three years after the event, the GDP growth returns to its original path. Since the GDP is expected to grow as a natural phenomenon of economic expansion in every country. Under our framework of regime shift, this constant growth may be classified as a constant shift. This type of shift is known as stochastic drift.

Global inflation is 9.10% during the third quarter of 2022 while the ASEAN is expected to have 6.43%. Since the ASEAN has uniform economic policy, each member country is left to deal with inflation by their own policy tools. We note that Laos (12.80%) and Myanmar (13.82%) are two countries that experienced the highest inflation rates among the group in 2022. Inflation rate of these two countries are higher that the global inflation rate.

**Table 2:** ASEAN Economic Data Characteristics during Critical Periods

| ASEAN Countries | GDP Growth 2022 | Inflation 2022 | Average Exchange Rate | | |
|---|---|---|---|---|---|
| | | | 2020 | 2021 | 2022 |
| Brunei | 3.70 | 3.20 | 1.38 | 1.34 | 1.36 |
| Cambodia | 4.50 | 7.20 | 4,073.94 | 4,057.38 | 4,047.39 |
| Indonesia | 5.01 | 3.55 | 14,530.58 | 14,295.88 | 14,404.00 |
| Laos | 3.80 | 12.80 | 9,060.39 | 9,739.55 | 15,000.00 |
| Malaysia | 5.00 | 2.80 | 4.20 | 4.14 | 4.25 |
| Myanmar | 2.00 | 13.82 | 1,367.69 | 1,631.32 | 1,811.30 |
| Philippines | 6.50 | 5.40 | 49.57 | 49.27 | 51.88 |
| Singapore | 3.70 | 5.60 | 1.38 | 1.34 | 1.36 |
| Thailand | 2.20 | 7.10 | 31.30 | 32.03 | 33.50 |
| Vietnam | 5.03 | 2.86 | 23,235.85 | 22,930.48 | 22,880.24 |
| ASEAN | 4.14 ± 1.37 | 6.43 ± 3.98 | | | |

The worrisome economic conditions of Laos and Myanmar are also seen through the exchange rate for the past three years. At the midst of COVID-19 pandemic in 2020, the Lao currency was trading at 9,060.39 per US dollar and by 2022, it was trading at 15,000 LAK/USD. The LAK had been devalued by 65.56% in two years. In the same period, Myanmar's currency lost 32.48% of its value. We tested these two currencies for regime shift since it exceeds the 10% threshold of exchange rate managed float band.

Table 2 represents a preliminary look at the context of the most recent and current shock; from the COVID-19 pandemic to the Russian-Ukrainian war. For this paper, we examine 677 weeks of exchange rates to verify the stability of the exchange rate regime and test for potential regime shift among ASEAN countries. Additionally, for inflation

and GDP growth rates, we also looked at a period of 30 years to allow a long-term perspective of data trends.

**Regime shift detection testing**

If regime shift could be summarized as a break from the long-run equilibrium path, then a shift could be detected in two ways: (i) consistent breaking away from older path as evidenced by significant change in the slope of the predictive function, and (ii) a string of data set is separated into two distinct segment, a comparison of these two segments confirm that there are significant differences. To verify shift under the first method, a times series autoregressive model may be used. In autoregressive, evidence of regime shift may be seen through unit root testing. The existence of unit root and larger lap periods suggest that the underlying fundamental basis for autoregressive time series modeling no longer bears fruit. Thus, the breaking down of the time series model is an evidence of regime shift. In the second method, data set bifurcation allow us to compare two subsets of data with equal or unequal length ($n_1 = n_2$ or $n_1 \neq n_2$), significant difference between the two segment may be achieved by the F statistic.

For non-parametric testing of statistical significance, we employed the F test by finding the ratio of the variances prior to the shock and during the shock where impulse response was expected. For instance, during the 2015 financial crisis and the Russian-Ukranian war in 2022. The F test for non-parametric case is given by: F = var1 / var2. After identifying the shock periods and the impulse response, we obtained the significance level by comparing the observe value of F to the theoretical value of F for the each regime and country in ASEAN. Recall that we examined: GDP growth, inflation, and exchange rates.

**Findings and discussion**

We detected a constant shift in the GDP. By its nature the GDP grows and the increase in the growth rate moves away from the long-term equilibrium over time. This is true for the ASEAN and for all countries in the world. The second regime that we examine for regime shift was inflation. We found that in some countries in the ASEAN, inflation is becoming a serious problem. As a regime, Laos and Myanmar experienced regime shift in inflation. The Lao economy is dependent on imports, weak exchange

rate and global inflation made it impossible to control domestic price level. Since 2020 Laos had experienced regime shift in inflation. The remaining eight ASEAN economies experience inflation but not to the point where domestic inflation became a regime shift. The third regime we examined was exchange rate. The majority of the ASEAN currencies fluctuate within controllable band. However, since 2020 Laos began to experience severe devaluation of its currencies. Although the cause of this extreme devaluation ((15,000-8,500)*100 = 76.47%) of almost 80% had caused a significant exchange rate regime shift. Myanmar and Cambodia also experienced similar devaluation.

We organized our findings and discussion into two sections. In section 4.1, we reported the stability of the ASEAN economic under external shock by looking at the GDP, inflation and exchange rates. Our findings show that as a region, ASEAN is susceptible to external shock because much of its economic activities depend on international trade. As such, any crisis in the global market will have an effect in ASEAN economy. We also examined individual countries in the ASEAN and found that, certain countries are more vulnerable to exogenous shock. These countries included Laos and Myanmar. In section 4.2, we examined ASEAN's need for international trade buffer against external shock by looking at China as a proxy buffer. The size and purchasing power of China may offer a practical alternative buffer economy for ASEAN countries.

**Shock and stability of the ASEAN economy**

We examined ASEAN as a group of ten economies. We looked at four indicators: GDP growth rates, inflations rate, trade balance, and interest rate. Using the Dirac delta function as the detector for impulse response and found that the ASEAN show no significant threat from the current external shock in 2022: global inflation and the Russo-Ukranian war. In Table 3 below, all indicators show probability of less that 0.50. We used 10% band to allow fluctuation within the group where the mean value of the Dirac delta function is used to verify the significance level.

The indication of impulse response shows how the economies responded to the exogenous shock. Significance test in Table 3 shows that all economies in the ASEAN region had impulse response to the external shock but the response was not significant during the period of Oil crisis in 2015, COVID-19 pandemic and Russian-Ukranian war of 2022. We found the lack of response in three regimes for the ASEAN region: GDP growth

(p = 4404), inflation (p = 4013), trade balance (p = 4013) and interest rate (p = 4013). The current global inflation rate stands at 9.10% and the intra-regional inflation in the ASEAN is 6.43 +/-3.98 for the first quarter of 2022. On the surface, this may seem innocuous. However, some countries in the ASEAN experienced inflation higher than the group's average. For instance, in the second quarter of 2022, inflation in Laos rose to 12.80%; and 14.60% for Myanmar. In both countries, monetary officials do not actively intervene to stem the tide of inflation.

**Table 3:** Impulse Response among Three Main Economic Indicators

| ASEAN Indicators | $\delta(x)$ Mean ± SD | P* (s+1)/(n+2) | Q 1 – P | Z(p,q)** DeMoivre-Laplace | F(z)*** Prob. |
|---|---|---|---|---|---|
| GDP growth | 2.26 ± 1.05 | 0.33 | 0.67 | (0.13) | 0.4404 |
| Inflation | 1.87 ± 0.74 | 0.25 | 0.75 | (0.17) | 0.4013 |
| Trade balance | 4.38 ± 7.72 | 0.25 | 0.75 | (0.18) | 0.4013 |
| Interest rate | 2.63 ± 1.44 | 0.17 | 0.83 | (0.23) | 0.4013 |

* Threshold defined by 10% band for limit of fluctuation. **Z(p,q) is determined by the DeMoivre-Laplace Theorem: $Z = (x - np)/\sqrt{npq}$. ***F(z) is the percentage probability read from the Z table.

Although in Table 3 we reported that there are two dips in GDP growth rate changes in responses to western market shocks: one shock in 2015 as a consequence of the global oil price drop and another shock in 2021 as the result of the COVID-19 pandemic, our findings in Table 3 indicate that the shock did not rise to regime shifting effect. Although these two shocks represented economic crisis for the region, experience have shown that the GDO growth returns to its expected growth path within three years. In Table 3, we did not include exchange rates because there are ten different currencies in the ASEAN traded against the US dollar. We looked at the exchange rate for individual country and report them in Table 4.

In Table 4, we examined 677 weeks of spot rate of exchange rates among the ten currencies in the ASEAN and tested which currency had under gone exchange rate regime shift. Once the noticeable shift detection is made by the Dirac delta function, we proceeded to calculate the significance level under the F test. Shock is the external

stimuli, a stable or capable economy is one that could effectively create an impulse response. This impulse response under the Dirac delta function may be seen through P success under the LaPlace Rule. The failure to muster an impulse response when faced with external shock is Q. Under this detection method, among the ten ASEAN countries, there are three countries that are responsive to external shock. These countries are Brunei (Q = 0.80), Indonesia (Q = 0.79) and Singapore (Q = 0.77). Higher level of Q in this case means that there is an effective response using 10% fluctuation band or 90% confidence interval where the critical value is Z = 1.28. A high level of response also means higher vulnerability to the effect of external shock.

**Table 4:** Detecting Response to Shocks in Exchange Rates for ASEAN Currencies

| ASEAN Countries | $\delta(x)$ Dirac Delta Mean ± SD | | P Impulse Resp. | Q Lack Resp. | 2015 Shock | | 2022 Shock | |
|---|---|---|---|---|---|---|---|---|
| | | | | | F | Prob | F | Prob. |
| Brunei | 1.63 | 0.77 | 0.20 | 0.80 | 1.76 | 0.0920 | 4.16 | 0.0210 |
| Cambodia | 5.25 | 27.74 | 0.03 | 0.97 | 2.08 | 0.0750 | 6.05 | 0.0070 |
| Indonesia | 12.17 | 119.38 | 0.01 | 0.99 | 3.73 | 0.0270 | 36.98 | 0.0000 |
| Laos | 5.91 | 71.15 | 0.00 | 1.00 | 75.14 | 0.0000 | 1.54 | 0.1070 |
| Malaysia | 1.11 | 0.54 | 0.21 | 0.79 | 2.79 | 0.0470 | 4.78 | 0.0140 |
| Myanmar | 9.34 | 98.44 | 0.01 | 0.99 | 7.43 | 0.0035 | 5.87 | 0.0080 |
| Philippines | 9.93 | 79.43 | 0.04 | 0.96 | 3.08 | 0.0400 | 21.43 | 0.0000 |
| Singapore | 1.61 | 0.78 | 0.23 | 0.77 | 1.78 | 0.0920 | 4.24 | 0.0200 |
| Thailand | 4.98 | 12.99 | 0.04 | 0.96 | 2.92 | 0.0440 | 6.51 | 0.0050 |
| Vietnam | 5.15 | 60.60 | 0.00 | 1.00 | 8.48 | 0.0019 | 7.78 | 0.0026 |

Table 4 explored two global crises: 2015 financial crisis caused by the oil price drop, and the Russian-Ukrainian war in 2022 that caused commodity prices and inflation to rise. Every country in the ASEAN were vulnerable to these two crises even under a stricter confidence of 0.95; in our threshold setting, we used the 10% band to allow manage float exchange rate to vary, and could still find significance of the shocks under 0.90 confidence interval. The average p-value for the shock of 2015 financial crisis was 0.0422 ± 0.04 and for the Russian-Ukranian war shock was 0.0185 ± 0.03. The ASEAN currencies are vulnerable to external shocks. The risks of exchange rate volatility

are discussed in the literature. Exchange rate volatility is costly to the domestic economy through its direct and indirect effects on households and firms (Obstfeld and Rogoff, 1995). Research in EU countries revealed that exchange rate volatility has a negative impact on economic growth (Schnabl, 2008). At firm level, research also showed that exchange rate volatility has a significant growth reducing effect on manufacturing firms (Demir, 2013). In order to reduce their risk of exposure to exchange rate volatility, the ASEAN countries should consider diversify their foreign exchange reserve. We recommend a stable currency, such as the Chinese RMB as a potential anchor currency.

The second regime we examined was inflation. We used the US, China and world inflation rates over a period of 30 years as reference group. Unit root testing for times series data of these three data sets shows that China inflation rate is stationary at level, and the US and world inflation rates were near stationary with root indicator at 1.0045 and 1.0017, where 1.00 is the threshold point for stationary. We have conducted the same testing for data stationary for the ten countries in the ASEAN. We found that inflation pattern is stationary for Indonesia, Malaysia, and Vietnam. However, other countries (Brunei, Cambodia, Laos, Myanmar, Philippines, Singapore, and Thailand) showed non-stationary inflation rates over time. The quality of fit of the AR(1) model is determine by AIC indicator. The lower the AIC value the better the fit of the model. In this study only Indonesia that displayed high value of AIC (3.86).

China's inflation is data stationary with a unit root indication of 0.9988. Stationary inflation rate in times series AR(1) model means that China manages its domestic inflation effectively. This finding implies that, China is a good economic buffer zone against potential risk of inflation from the US and world economies. The US and world inflation time series showed that they are not stationary ($\phi$ = 1.0045 and 1.0017, respectively).

**Table 5:** Inflation Unit Root Testing and Model Fit Evaluation under AIC for AR(1)

| Country | Time (yrs)* | Slope | Unit Root ($\phi$) | AIC | RMSE |
|---|---|---|---|---|---|
| Brunei | 40 | 0.00180 | 1.0018 | -5.1131 | 0.0085 |
| Cambodia | 27 | 0.00031 | 1.0003 | -2.262 | 0.0373 |
| Indonesia | 62 | -0.00570 | 0.9943 | 3.8628 | 1.0241 |
| Laos | 33 | 0.00330 | 1.0033 | 0.5454 | 0.1605 |
| Malaysia | 62 | -0.00032 | 0.9997 | -3.9525 | 0.0179 |
| Myanmar | 60 | 0.00430 | 1.0043 | -0.9712 | 0.0843 |
| Philippines | 61 | 0.00017 | 1.0002 | -1.7861 | 0.0566 |
| Singapore | 61 | 0.00150 | 1.0015 | -3.1945 | 0.0262 |
| Thailand | 62 | 0.00002 | 1.0000 | -3.0923 | 0.0276 |
| Vietnam | 26 | -0.00370 | 0.9963 | -2.5504 | 0.0311 |

* Inflation rates availability varies by years per source of data; where *.* is country name. https://www.worlddata.info/asia/*.*/inflation-rates.php

Using the slope of AR(1) as the basis for calculating the Dirac delta, we verified the significant shift of the inflation rate regime for the ASEAN countries. There are three countries that are threatened by inflation regime shift; these countries are Cambodia, Laos and Vietnam. The threshold used for shift indication is the 10% band of fluctuation ($Z^* = 1.28$). If the fluctuation band is allow to fluctuation at 20%, two additional countries would be included in the inflation regime shift group: Thailand and Malaysia. The summary of this finding is presented in Table 6.

**Table 6:** Inflation Regime Shift in ASEAN

| Country | Time (yrs)* | Slope | Delta | Z | Prob. |
|---|---|---|---|---|---|
| Brunei | 40 | 0.00180 | 127.06 | (0.59) | 0.2451 |
| Cambodia | 27 | 0.00031 | 86.35 | (1.41) | 0.0681 |
| Indonesia | 62 | -0.00570 | 192.13 | 0.73 | 0.7670 |
| Laos | 33 | 0.00330 | 104.98 | (1.03) | 0.1379 |
| Malaysia | 62 | -0.00032 | 196.24 | 0.82 | 0.7940 |
| Myanmar | 60 | 0.00430 | 187.84 | 0.65 | 0.7420 |
| Philippines | 61 | 0.00017 | 193.11 | 0.75 | 0.7730 |
| Singapore | 61 | 0.00150 | 192.84 | 0.75 | 0.7730 |
| Thailand | 62 | 0.00002 | 196.25 | 0.82 | 0.7940 |
| Vietnam | 26 | -0.00370 | 83.08 | (1.48) | 0.0599 |

The ASEAN Economic Community (AEC) proclaims to create a common market among the ASEAN countries. The so-called "economic community" remains unequal in terms of economic development. The late members (Cambodia, Laos, Myanmar and Vietnam) lack the economic strength to face the effects of external shocks. These countries are more vulnerable to exogenous shocks, such as financial crisis, global inflation, or pandemics. Older ASEAN member countries may have adequate productive capacity to cushion themselves through crisis; nevertheless, they are also vulnerable to the effects of external shock due to their high level of dependence on western market for export markets. The needs for a buffer economy in the region deserve serious consideration. This paper urges stakeholders to consider a large economy that could serve as an export market and help to provide cushion against western market shocks. China is large enough to serve this buffer function. The currently global financial system depends on the US dollar for international trade. When the US experiences economic problem, such inflation in 2022 and the raising of interest rates by the Federal Reserve, the entire ASEAN loses its economic value and trade advantages due to rising value of the US dollar and the corresponding devaluation of the local currencies. If the ASEAN economies change its trade outlook to balance the US dollar with China's RMB, this type of dollar shock would be cushioned by the RMB. The strength and stability of the RMB makes the idea of using China was an economic buffer for the ASEAN the more attractive.

**ASEAN's need for international economic buffer against external shock**

We note that when there is dip in the GDP growth rate, the decrease endures for a period of three years and it also takes another three years to reclaim its regional baseline. In conventional time series modeling, this would have been an evidence of integration at lag period of 3 years. For example, in Fig. 1, there was a financial crisis in 2014-2015 caused by the Russian sanction post-Crimean annexation and oil price drop of 2014; this lowest point in 2015 started the decline three years earlier. The ASEAN growth started to decline in 2012. Likewise, the most recent minimal point in 2020 was a result of the COVID-19 pandemic that started in 2019. This case took only one year to see the rapid decline in 2020 and then by 2021 the ASEAN was on its way to recovery. The 2008 crisis had its lowest point in 2009 and recovery was regained in 2010; that crisis lasted three years. In 2001, we saw the Dotcom bubble burst but ASEAN was not affected. The Asian financial crisis of 1997 saw its regain in 2000; a period of three years was required for recovery. It can be generalized that, it normally takes ASEAN three years to recover from economic crisis. With the exception of the Asian financial crisis of 1997, economic crisis that affected the ASEAN economies had its origin outside of the ASEAN market. This evidence ASEAN's lack of resistance to external shock. A claim of ASEAN economic resilience is not meaningful because the bouncing back of the economy after crisis is due to the intrinsic and fundamental infrastructure of the economy. Specifically, economic output affects the demand for the production output from ASEAN but did not affect the productive capacity of the ASEAN. In the context of regime change, in general economic crisis does not lead to regime change because the productive capacity of the economy is untouched by the crisis. While the crisis may decrease demand for output from ASEAN, the productive capacity in ASEAN is not affected because these assets are in place and ready for production when and if demand is presented. However, the current situation that we face since 2020 is back-to-back global crisis. First, the global economy was faced with COVID-19 pandemic that spun the global economy into crisis in 2020; upon recovery in 2021 another crisis was present in the beginning of 2022---Ukrainian war. The sanctions against Russia wreak havoc on the global economy by causing the increase in fuel and food prices. By mid 2022, the war in Ukraine still rages and sanctions against Russia deepens. The World Bank warns of the possibility of global inflation. The US is also on the verge of recession with inflation stood at 8.6%. How would this global market

condition affect ASEAN's economic health? It is a foregone conclusion that ASEAN economies will be adversely affected. If 2022 is the middle of crisis, we should expect to see the bottom of this depression in 2023 and, from prior pattern of recovery, ASEAN should start to see recovery in 2025. Coincidentally, ASEAN's community vision statement targeted the year 2025 to achieve its aim:

> "Our ASEAN Economic Community by 2025 shall be highly integrated and cohesive; competitive, innovative and dynamic; with enhanced connectivity and sectoral cooperation; and a more resilient, inclusive, and people-oriented, people-centred community, integrated with the global economy." Statement no. 9, p. 15.

In face of the current crisis in 2022, it is likely that the ASEAN Economic Community will miss most of its economic targets:

> "A highly integrated and cohesive regional economy that supports sustained high economic growth by increasing trade, investment, and job creation; improving regional capacity to respond to global challenges and mega trends; advancing a single market agenda through enhanced commitments in trade in goods, and through an effective resolution of non-tariff barriers; deeper integration in trade in services; and a more seamless movement of investment, skilled labour, business persons, and capital ..." Statement no. 10.1, p. 15.

Economic "cohesiveness" might not be achieved because there is no unified policy to tackle external shocks. For example, there is no uniform policy to tackle the problem of inflation in the cost of food and fuel in 2022. ASEAN's aim to improve regional capacity to respond to global challenges is recognition that there is a lack of regional and cohesive plan of action to respond to global challenges. One critical challenge faced by all ASEAN member countries in 2022, in the midst of global inflation and recession, is left to individual member state to deal with the challenge. There is no regional response. Laos, for instance, faces near economic collapse with its excessive devaluation of its currency and rising inflation. Myanmar is another ASEAN country that faces serious problem.

The seriousness of Myanmar's economic declined was best underscored by the World Bank's warning:

> "After the sharp decline in incomes and employment observed across the economy, available indicators suggest domestic demand remains very weak. At the same time, supply-side constraints persist and some have worsened in recent months. Access to kyat liquidity, credit, and foreign currency remains severely constrained. A sharp exchange rate depreciation in September 2021 has raised import prices across the economy, including of fuel and other critical inputs to production, increasing transport costs." (World Bank, 2022).

The ASEAN Economic Community lacks unified economic policy for the group. Although there is a common goal to reap economic benefits from the economic community; however, when it comes to policy tools to achieve such goals, the ASEAN countries still cannot withstand external shock from the western market. This paper offers the concept of "economic buffer" zone as a physical market to help adsorb the effects of external shocks from western markets, i.e. US, and EU area. We propose the alignment of trade and increase economic activities between the ASEAN and China. China can serve as an economic buffer for the ASEAN economies.

We are also aware of the argument that, in an analogy to political buffer, the buffer state will end up in being conquered by greater contesting powers (Fazal, 2004). Likewise, by re-aligning trade policies and activities with China, one or more states or the entire ASEAN market may come under the influence of or being dependent upon China. This possibility may be balanced by retaining trade relationships with western market. The problem with the current dependent on the Western market is that ASEAN has no way of lessening the effect of western economic crises. By including China into its trade portfolio, the ASEAN could better minimize the treats from shocks in western markets.

We find support to our proposed economic buffer within the ASEAN. Brunei pegs with currency on the Singapore dollar in order to prevent any negative shocks from the international market on its currency. This practice had been successful for Brunei because relative to Brunei, Singapore has larger economy and the most stable currency in

the ASEAN. Other forms of economic buffer could also be seen outside of the ASEAN. For instance, the following countries opted for the US dollar as the official currency: Ecuador, El Salvador, Zimbabwe, Micronesia, and Panama. In these countries, the US dollar is used as the buffer against the devaluation of the local currency. By adopting the US dollar, the value of the currency depends on the US economy. Assuming that the US economy is stable, the US dollar serves as an efficient buffer and the worry of exchange rate fluctuation is eliminated. Likewise the proposed economic buffer using China as a market, ASEAN will access a market with a size of 19.91 trillion US dollars. In additional to the physical market, ASEAN must denominate their trade with China in RMB and move away from USD as medium of exchange. Larger market and stable currency offers a potential economic buffer that can help ASEAN from feeling the heat of economic crisis in the western market. This proposed buffer market will also address the problem of lacking unified voice in economic policy among ASEAN states.

Under Markowitz' modern portfolio theory, the use of different assets in the portfolio us a better risk management tool than holding one kind of assets (Markowitz, 1952). Presently, the ASEAN predominantly exports its products to the western markets, i.e. US and EU area. More recently, trade and investment activities between China and the ASEAN had increase. However, these activities are limited to bilateral basis. Although they had been classified as ASEAN-China trade and investment activities, there is no unified policy. The current ASEAN-China trade and investment activities remained informal and bilateral. They should be codified into formal arrangement so that China will become a strategic partner for ASEAN countries. As an economic buffer for the ASEAN, China will help balance ASEAN's economic dependence in western markets and help lessen the effect of shock by western market fluctuation.

At the end of 2021, ASEAN's export figure to the US was 15.20% and to China was 15.7%. According to this figure, this appears to be a well-balanced portfolio. However, all trades are denominate in US dollars. Even exports to China are also denominated in US dollars. In addition to shifting the market focus to China, part of the buffer must also be foreign currency reserves holding in RMB so that ASEAN countries could avoid the risk associated with US dollar. In this same period, the US accounts for 7.7% and China 23.5% for imports into the ASEAN (ASEAN Key Figures, 2021). The ASEAN runs 7.80% trade deficit with China. In order to rely on China as a buffer against western market shock, the ASEAN

must work to achieve balance of trade and de-dollarize its trade with China. A less risky currency for trade is the Chinese RMB which had been stable over the long run.

At this exploratory stage of the idea of using China as an economic buffer zone, we recommend the following macro-policy direction:

1. *Unified trade policy towards China.* ASEAN must have unified trade policy whereby China is used as an alternative and supplemental market to the US and EU area. As such, China is a regional economic balancer allowing the ASEAN to be more independent from western market and, thus, distance itself from the economic and financial shocks from western market.

2. *Adoption of RMB and de-dollarization in regional trades.* ASEAN must have unified practice of using the Chinese RMB as a currency of choice in international trade. This denomination of trade in RMB will allow the ASEAN to be independent from the US dollar and free the local currencies from the active intervention by the US Federal Reserve. For instance by mid-2022, the US Federal Reserve had raised interest more then seven times. This rise of interest rate in the US had caused several currencies in the ASEAN to devalue. For instance, the Thai Baht, Myanmar Kiat, Laotian Kip, and Vietnamese dong had loss value against the US dollar. In turn, the devaluation of the local currencies in response to the rising interest rate in the U.S., exposes the ASEAN economies to further risk. If the ASEAN had increase trade with China and the trade activities are denominated in RMB, the devaluation of the local currencies in the ASEAN in 2022 would have been less significant. This loss is preventable had the ASEAN found an effective buffer against the effect of the financial and economic turmoil of the west.

3. *Common ASEAN monetary policy goals.* Common monetary policy in the ASEAN is necessary for holding the Chinese RMC as a foreign exchange holding. Presently, RMB is one of the five main currencies in the IMF's basket of currency of Special Drawing Rights. RMB constitutes 12.28% of that basket compared to 43.38% by USD, 29.31% by EUR, 7.59% by JPY, and 7.44% by GBP. By including the Chinese RMB into their foreign exchange reserves, the ASEAN economies could avoid the risk of unnecessary currency devaluation risk. China's currency is stable. Exchange rate stability is characterized by the lack of significant fluctuation. The fluctuation is significant at $p > 0.10$ for a 10% allowable band of fluctuation for managed float. By examining the RMB traded against

the US dollar in the past 677 weeks, we found that RMB stays without its central limit within 5.56% which is well within the limit of 10% of managed float exchange rate regime. Since 1994, China pegged its RMB to the US dollar at a rate of 8.28 to one dollar. In 2022, the RMB was trading 6.45 ± 0.15 against the dollar.

## Conclusion

This paper intended to answer the question of whether exogenous shock may lead to regime change in the local economy. We examined ASEAN as an economic unit and also looked at individual member states. ASEAN as a 'cohesive' unit, regime change may be absent; however, among individual states, we saw that Cambodia, Laos and Vietnam are vulnerable to regime changes in inflation. In the exchange rate regime, all ASEAN countries are exposed to the risk of exchange rate fluctuation because they are heavily dependant on US dollar for their exchange rate reserves holding. We recommend ASEAN stakeholders to consider China as a potential economic buffer against western market shocks.

## References

Arfken, G. B.; Weber, H. J. (2000). Mathematical Methods for Physicists (5th ed.), Boston, Massachusetts: Academic Press, ISBN 978-0-12-059825-0, p. 84.

Andersen, T., et al. (2009). Ecological thresholds and regime shifts: approaches to identification. *Trends Ecol. Evol, 24*, 49-57.

Ang, Andrew, and Geert Bekaert. (2002). International Asset Allocation with Regime Shifts. *Review of Financial Studies, 15*, 1137-1187.

ASEAN COMMUNITY VISION 2025. (2022). statement no. 9, p. 15. https://www.asean.org/wp-content/uploads/images/2015/November/aec-page/ASEAN-Community-Vision-2025.pdf Accessed: July 7, 2022

ASEAN KEY FIGURES 2021; p. 43. https://www.aseanstats.org/wp-content/uploads/2021/12/ASEAN-KEY-FIGURES-2021-FINAL-1.pdf. Accessed: July 18, 2022.

Beisner, B., et al. (2003). Alternative stable states in ecology. *Front. Ecol. Environ. 1*, 376-382.

Biggs, R., et al. (2009). Turning back from the brink: Detecting an impending regime shift in time to avert it. *P. Natl Acad Sci USA, 106,* 826-831.

Blanchard, Olivier J.; Summers, Lawrence H. (1986). Hysteresis and the European Unemployment Problem. *NBER Macroeconomics Annual. 1*, 15-78. JSTOR 3585159.

Campbell, J. Y.; Perron, P. (1991). Pitfalls and Opportunities: What Macroeconomists Should Know about Unit Roots. *NBER Macroeconomics Annual, 6*(1), 141-201. doi:10.2307/3585053. JSTOR 3585053. https://dash.harvard.edu/bitstream/handle/1/3374863/campbell_pitfalls.pdf?sequence=2

Cerra, Valerie, and Sweta Chaman Saxena. (2005). Did Output Recover from the Asian Crisis? *IMF Staff Papers, 52,* 1-23.

Collie, J., et al. (2004). Regime shifts: can ecological theory illuminate the mechanisms? Prog. *Oceanogr, 60,* 281-302.

Collie, J., et al. (2004). Regime shifts: can ecological theory illuminate the mechanisms? Prog. *Oceanogr, 60*, 281-302.

COVID-19: 'Unparalleled economic shock' threatens development hopes and gains https://www.un.org/es/desa/covid-19-%E2%80%98unparalleled-economic-shock%E2%80%99-threatens-development-hopes-and-gains (Accessed: March 7, 2022).

Cosslett, S. R. and L.-F. Lee. (1985). Serial Correlation in Discrete Variable Models. *Journal of Econometrics, 27,* 79-97.

Cross, Rod. (1993). On the Foundations of Hysteresis in Economic Systems. *Economics and Philosophy. 9*(1): 53-74. doi:10.1017/S0266267100005113.

Davig, Troy. (2004). Regime-Switching Debt and Taxation. *Journal of Monetary Economics, 51*, 837-859.

Demir, F. (2013). Growth under exchange rate volatility: Does access to foreign or domestic equity markets matter?. *Journal of Development Economics, 100*(1), 74-88. https://doi.org/10.1016/j.jdeveco.2012.08.001

Dickey, D. A.; Fuller, W. A. (1979). Distribution of the Estimators for Autoregressive Time Series with a Unit Root. *Journal of the American Statistical Association, 74*(366), 427-431. doi:10.1080/01621459.1979.10482531. JSTOR 2286348.

Dirac, Paul. (1930). *The Principles of Quantum Mechanics* (1st ed.), Oxford University Press; §22 The d function.

Dolado, J. J.; Jenkinson, T.; Sosvilla-Rivero, S. (1990). Cointegration and Unit Roots. *Journal of Economic Surveys, 4*(3), 249-273. doi:10.1111/j.1467-6419.1990.tb00088.x. hdl:10016/3321.

Elder, J.; Kennedy, P. E. (2001). Testing for Unit Roots: What Should Students Be Taught?. *Journal of Economic Education, 32*(2), 137-146. CiteSeerX 10.1.1.140.8811. doi:10.1080/00220480109595179. S2CID 18656808.

Enders, Walter. (2010). *Applied Econometric Time Series* (3rd ed.). New York: Wiley, pp. 206-215. ISBN 978-0470-50539-7.

Fazal, Tanisha M. (2004-04-01). State Death in the International System. *International Organization, 58*(2), 311-344. doi:10.1017/S0020818304582048. ISSN 1531-5088. S2CID 154693906.

Folke, C., et al. (2004). Regime Shifts, Resilience, and Biodiversity in Ecosystem Management. *Annu. Rev. Ecol. Evol. Syst, 35*, 557-581.

Gagniuc, Paul A. (2017). *Markov Chains: From Theory to Implementation and Experimentation.* USA, NJ: John Wiley & Sons, pp. 1-256. ISBN 978-1-119-38755-8.

Gelfand, I. M.; Shilov, G. E. (1966-1968), Generalized functions, vol. 1-5, Academic Press, ISBN 9781483262246; Volume I, §1.1.

Goldfeld, S.M. and R.E. Quandt. (1973). A Markov Model for Switching Regressions. *Journal of Econometrics, 1*, 3-16.

Guneralp, B., and Barlas, Y. (2003). Dynamic modelling of a shallow freshwater lake for ecological and economic sustainability. *Ecological Modelling 167*, 115-138.

Hacker, R. S.; Hatemi-J, A. (2010). The Properties of Procedures Dealing with Uncertainty about Intercept and Deterministic Trend in Unit Root Testing, CESIS Electronic Working Paper Series, Paper No. 214. Centre of Excellence for Science and Innovation Studies, The Royal Institute of Technology, Stockholm, Sweden. https://ideas.repec.org/p/hhs/cesisp/0214.html

Hacker, Scott. (2010). The Effectiveness of Information Criteria in Determining Unit Root and Trend Status. Working Paper Series in Economics and Institutions of Innovation. Stockholm, Sweden: Royal Institute of Technology, CESIS - Centre of Excellence for Science and Innovation Studies. 213. https://ideas.repec.org/p/hhs/cesisp/0213.html

Hamilton, J. D. (1989). A New Approach to the Economic Analysis of Nonstationary Time Series and the Business Cycle. *Econometrica, 57*, 357-384.

Hamilton, James D. (1994). Difference Equations. *Time Series Analysis.* Princeton University Press. p. 5. ISBN 0-691-04289-6.

Hatemi-J, A. (2014). Asymmetric generalized impulse responses with an application in finance. *Economic Modelling, 36*, 18-2. doi:10.1016/j.econmod.2013.09.014.

Holling, C. S. (1973). Resilience and stability of ecological systems. *Annual Review of Ecology and Systematics, 4*, 1-23.

Karunanithi, A. T., et al. (2008). Detection and Assessment of Ecosystem Regime Shifts from Fisher Information. *Ecol. Soc, 13,* 15.

Kok, K. (2009). The potential of Fuzzy Cognitive Maps for semi-quantitative scenario development, with an example from Brazil. *Global Environmental Change, 19,* 122-133.

Levene, Howard. (1960). Robust tests for equality of variances, In Ingram Olkin; Harold Hotelling; et al. (eds.). *Contributions to Probability and Statistics: Essays in Honor of Harold Hotelling,* Stanford University Press, pp. 278-292.

Lewontin, R. (1969). Meaning of Stability. *Brookhaven Sym Biol, 13*.

Markowitz, H. M. (March 1952). Portfolio Selection. *The Journal of Finance, 7*(1), 77-91. doi:10.2307/2975974. JSTOR 2975974.

Norström, A., et al. (2009). Alternative states on coral reefs: beyond coral–macroalgal phase shifts. *Mar. Ecol. Prog. Ser, 376,* 295-306.

Obstfeld, M., and Rogoff, K. (1995). Exchange rate dynamics redux. Journal of Political Economy. *Journal of Political Economy,* 1995, *103*(3), 624-60. https://doi.org/10.1086/261997

Olivier, J. and Masson, P. (2000). Currency Crises, Sunspots, and Markov Switching Regimes. *Journal of International Economics, 50*, 327-350.

Saysel, A. K., and Barlas, Y. (2001). A dynamic model of salinization on irrigated lands. *Ecological Modelling, 139*, 177-199.

Scheffer, M., Carpenter, S., Foley, J. A., Folke, C., and Walker, B. (2001). Catastrophic Shifts in Ecosystems. *Nature, 413*, 591-596. doi:10.1038/35098000

Scheffer, M., and Carpenter, S. (2003). Catastrophic regime shifts in ecosystems: linking theory to observation. *Trends Ecol. Evol, 18*, 648-656.

Scheffer, M., and Carpenter, S. (2003) Catastrophic regime shifts in ecosystems: linking theory to observation. *Trends Ecol. Evol, 18*, 648-656.

Schnabl, G. (2008). Exchange rate volatility and growth in small open economies at the EMU periphery. *Economic Systems, 32*(1), 70-91. https://doi.org/10.1016/j.ecosys.2007.06.006

Sims, Christopher, and Tao Zha. (2004). Were There Switches in U.S. Monetary Policy?, working paper, Princeton University.

Sims, Christopher. (1980). Macroeconomics and Reality. *Econometrica, 48*(1): 1-48. CiteSeerX 10.1.1.163.5425. doi:10.2307/1912017. JSTOR 1912017.

Sondereggeг, D. L., et al. (2009) Using Sizer to detect thresholds in ecological data. Front. *Ecol. Environ, 7*, 190-195.

Viktorov, Ilja; Abramov, Alexander. (2020). The 2014-15 Financial Crisis in Russia and the Foundations of Weak Monetary Power Autonomy in the International Political Economy. *New Political Economy, 25*(4), 487-510. doi:10.1080/13563467. 2019.1613349. S2CID 181478681.

Walker, B., and Meyers, J. (2004). Thresholds in ecological and socialecological systems: a developing database. *Ecol. Soc, 9*, 3.

Wooldridge, S., et al. (2005). Precursors for resilience in coral communities in a warming climate: a belief network approach. *Mar Ecol-Prog Ser, 295*, 157-169.

World Bank. (2022). Myanmar Economic Monitor, January 2022: Contending with Constraints.

World Bank, Washington, DC. © World Bank. https://openknowledge.worldbank.org/ handle/10986/36889 License: CC BY 3.0 IGO. https://openknowledge.worldbank. org/handle/10986/36889Accessed: July 7, 2022

Zimmermann, Donald W. (2004). A note on preliminary tests of equality of variances. *British Journal of Mathematical and Statistical Psychology, 57*(1), 173-81. doi:10.1348/000711004849222.