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RESEARCH PAPER

Assessing the Impact of Financial Stress Shock Volatility in the USA on the Exchange Rates of Emerging Economies

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ABSTRACT

This study examines the influence of the USA's Financial Stress Index (FSI) on the Exchange Market Pressure Index (EMPI) of ASEAN countries, focusing on how both positive and negative FSI shocks affect exchange rates under different market conditions. Global financial stress causes currency volatility, which threatens investor confidence, trade competitiveness, and economic stability in emerging economies. The research uses a non-linear Vector Autoregressive (VAR) model to analyze the asymmetric relationship between FSI shocks and EMPI in Indonesia, Malaysia, Singapore, and Thailand, categorizing the effects into low, normal, and high exchange market pressure regimes. The study finds that both positive and negative FSI shocks affect the exchange rates of ASEAN countries, with high-pressure regimes amplifying the risks of currency crises. Policymakers should focus on understanding financial stress transmission, strengthening domestic financial systems, and developing proactive risk management strategies to mitigate the adverse effects of global financial volatility.

KEYWORDS Currency Devaluation, Emergency Countries, Exchange Market Pressure Index (EMPI), Financial Stress, Non-Liner

Introduction

Achieving global financial stability is now more imperative than ever, driven by the adverse impacts of the 2008-2009 global financial crises. A pressing requirement has emerged to create robust financial and economic indicators capable of signaling threats to financial markets, preventing the recurrence of such crises. Exchange market pressure (EMP) has drawn significant interest as an indicator of financial and economic crises and has been the subject of numerous scholarly investigations. (Akram & Byrne, 2015; Aizenman & Binici, 2016; Polat & Ozkan, 2019; Patnaik, Felman, & Shah, 2017). Academics have also developed financial stress indices that take a more comprehensive approach to the financial system that accounts for systemic hazards. The scientific literature has introduced theories that prove that there exists an impact of financial shocks on the economy of a country (Adam, Benecká, & Matějů, 2018; Polat and Ozkan, 2019). Another perception of research suggests that financial stress can have a character in their disposition that is transmitted across nations, and from this viewpoint, the spread of financial crises has been studied by (Balakrishnan, Danninger, Elekdag, & Tytell, 2011; Vermeulen, Hoeberichts, Vašíček, Žigraiová, Šmídková,, & Haan, 2015). A recent observation made by Zhang, Yan, & Tsopanakis, 2018 illustrates that larger economies are more interconnected than smaller economies and they are more likely to be affected by the same economic events. Apostolakis, Giannellis, & Papadopoulos (2019) and Evgenidis and Tsagkanos (2017) demonstrate that financial stocks were shown to have asymmetric impacts, suggesting that country-specific characteristics are significant when discussing financial shocks.

Ishrakieh et al., (2020) suggest that government policies, capital controls, and exchange rate regimes serve as predictors to assess the impact of financial shocks on a country's exchange rate. The specified nations are not under the Wall category when it comes to capital restrictions as they imply inflation-targeting regimes that do not have a fixed exchange. Therefore, it is possible to eliminate the impact of policy frameworks on the relationship between financial stress and EMP. Regarding the empirical application, the data for FSI of developed countries has been taken from the Office of Financial Research. The changes in the EMPI ($empi_t$) of selected ASEAN countries due to the financial stress shocks to the exchange rate can transform into the likelihood of a currency devaluation for the ASEAN countries. The EMP index, developed by Patnaik et al. (2017), quantifies the fluctuations in currency rates that would have transpired without central bank interventions. In this study, I observe the asymmetric effects of the FSI on the EMP for Indonesia, Malaysia, Singapore, and Thailand. The conversion index coefficient (ρ) is calculated to reflect the variation in the exchange rate resulting from a $1,000 million central bank intervention, covering the period from January 1, 2000, to November 30, 2019.

The asymmetrical effects of the FSI on the EMP index can differ across different EMP-regimes of emerging economies. This study employs a precise categorization of exchange market pressure in emerging nations, dividing it into three quantiles: low, medium, and high. The bullish and bearish market conditions signifies the fluctuations in the exchange rates of emerging market currencies. Therefore, a typical market signifies a state where there is neither bearish nor bullish movement in the market and the fluctuations observed in the currency rate have minimal influence on the stock exchange.

This study explores the potential impact of the FSI in the USA on the EMPI of ASEAN economies, focusing on whether financial stresses in advanced economies can lead to currency devaluation in emerging ASEAN nations, specifically Indonesia, Malaysia, Singapore, and Thailand. The research contributes to existing literature by investigating whether the monetary policy stance and financial conditions in developed economies play a significant role in driving changes in the EMPI of emerging ASEAN markets. Additionally, the study examines the effects of both positive and negative shocks across low, medium, and high EMPI regimes using non-linear VAR models and quantile-based regression. To capture any asymmetric effects, the study employs the coefficient of quantile slope equality test and Impulse Response Functions (IRFs).

Literature Review

The spillover effect created by the global financial crisis of 2008-09 highlights the global transmission effect of the monetary policy framework but also the toxic relationship between financial stress and its effect on all the countries, and as a result, it is reasonable to conclude that monetary policy frameworks and financial stress are interconnected (Floro and Roy, 2017). According to Mezghani et al., (2024) from 2007 to 2020, financial stress influences oil market-GCC stock and bond hedging. Oil hedges stock markets but not bond markets during positive financial stress. While hedging reduces portfolio risk, notably during the pandemic, and enhances performance under positive and negative financial stress. Kyriazis et al., (2023) used TVP-VAR to examine how geopolitical uncertainty, inflation, currency rates, and exports affect key advanced and growing countries and are examined under normal market conditions and the COVID-19 epidemic. Geopolitical concerns affect inflation through currency rate swings in the US, South Korea, and Brazil. Inflation, currency value, and exports affect geopolitical concerns in Russia throughout the conflict. Aboura and Roye (2017) examined the consequences of financial stress by using 17 financial sector variables from different financial markets and developed a FSI for France. The results dictated that low economic activity was linked to high financial stress. It was also observed that concerning economic dynamics, a decrease in financial stress did not improve economic activity, which shows that financial stress is asymmetric. While the aforementioned annals support that financial stress has a strong influence on the financial sectors, it is argued by Vašíček et al. (2017) that macroeconomic factors particular to that country can provide better results in analyzing the changes due to financial instability.

Valerio et al., (2022) examines how financial stress affects advanced and developing nations' economic development and monetary stability and created a financial stress index to detect stress events. Financial stress has a greater influence on economic growth in industrialized nations than developing ones, according to the research. Financial stress lowers developing market interbank interest rates

Cipollini and Mikaliunaite (2020) observed that the propagation of financial stress can occur within interconnected markets such as the Eurozone and periphery countries. The author states that there is no significant relationship between macroeconomic uncertainty and financial instability in the Eurozone. However, spillover effects occur in the presence of financial stress. Roncagliolo and Blas (2021) observed that financial stress affects economic progress and financial security differently in rich and developing countries. As developed nations are more financially integrated than underdeveloped ones which makes them more vulnerable to financial system fluctuations.

Scientific literature explains the significant effect of financial pressure on financial markets and macroeconomic segments on a global scale. Chen and Semmler (2018) applied the VAR model containing multiple regimes to find the effect of financial stress on different levels of financial instability. It concluded that financial shocks can have a negative effect on the financial markets of another financially unstable country. On a different spectrum, Das et al., (2018) proposed that the transference of shocks from financial markets can have limitations and that each positive and negative shock can have a diverse effect in different countries. Hammoudeh et al., (2022) used an error correction model to examine the correlations between Saudi Riyal (SAR) exchange market pressure, CDS spreads, total assets reserve, and oil prices from 2008 to 2018. The short-run study demonstrates that foreign reserves lower SAR pressure and delayed SAR pressure affects current pressure. The quantile ARDL model shows substantial connections, particularly at extreme quantiles, with reserves lessening pressure.

Gupta, Kanda, & Tiwari (2019) implied that the linear regression models are not reliable in finding indications when it comes to estimating the impact of the FSI on the West Texas Intermediate oil returns in the US. His finding using a non-linear conditional DCC-MGARARH model with structural breaks dictates that the FSI was able to make predictions on oil returns and its volatility. They claimed that although certain indicators have a significant ability to predict economic development but they do not have a strong association with systematic risk.

While taking into account earlier findings in the literature, I looked at how financial stress in USA affected the EMP of Indonesia, Malaysia, Singapore, and Thailand. Adam et al. (2018) Adam made a significant point that linear models lack the correct technique that may help in examining the link between financial stress and market volatility, not only for domestic markets but also for foreign markets. Dong et al., (2023) examined how the COVID-19 shock and pharmaceutical economic depression affected Chinese systemic financial risks, focusing on monetary policy stabilization economic instability and observed that traditional monetary policy works better in low-risk times but less in high-risk situations like the epidemic. COVID-19 diminishes the efficacy of monetary policy on output growth and price stability, with short-term gains but long-term volatility. Guo et al., (2023) studied the trade liberalization and ffinancial systematic risks in 24 countries from 2003 to 2019 using the coefficient of variation approach and a panel threshold model. Middle- and low-income countries have bigger financial contagion risks than high-income ones. The study indicates that nations adapt liberalization intensity to local conditions and develop regulatory structures to regulate cross-border capital flows.

However, my study takes into account the FSI shock of USA on the EMP of other nations. Additionally, another aspect added to this study is how multi-regime affects the relationship between the EMPI of emerging countries and the FSI of USA. In contrast to previous studies my research has divided the EMP regimes into three categories within the quantile model and the effect of the FSI variable is split into positive shocks and negative shocks to augment the effect of asymmetry. My study is focused on the stabilizing/destabilizing impacts of FSI of USA on the EMP of ASEAN economies.

Hypotheses

H1: The primary hypothesis of this study is whether fluctuations in the FSI have a significant asymmetric influence on the EMPI, leading to either the stabilization or destabilization of currencies, or triggering currency crises in the emerging nations under investigation.

H2: EMPI of emerging countries exhibits an asymmetric response to both positive and negative shocks in the U.S. Financial Stress Index (FSI) across low, medium, and high-pressure regimes.

H3: There is an asymmetry in the coefficients of the Impulse Response Functions (IRFs) and the quantile slope-based analysis.

Material and Methods

Data and data sources

This study employs quantitative approach where data is analyzed applying statistical methods to arrive at outcomes or results. Analysis is conducted applying objective measures (Butt & Yazdani, 2023; Tajammal & Butt, 2024; Akhtar et al., 2024). We collected monthly data on the ASEAN countries from January 2000 through November 2019. Data on the Forex rate, stock exchange index, and consumer price index which is a proxy for inflation are obtained from the World Bank database. Supplementary data for this research paper is available online. The data sources used for FSI is from financialresearch.gov and EMPI is from macrofinance.nipfp.org.in

Killian and Vigfusson (2011), non-linear VAR model is used in this study which differs from traditional linear and symmetrical data analysis. Each non-linear VAR model is defined as $(fsi_t, empi_t)$ for FSI and EMPI, respectively. The censored variables in the non-VAR model, as outlined in equations (1)(2), can be estimated as follows

$$x_t = b_{10} + \sum_{i=1}^{p} b_{11,1}x_{t-i} + \sum_{i=1}^{p} b_{12+1}y_{t-i} + \varepsilon_{1,t} \quad (1)$$
$$y_t = b_{20} + \sum_{i=1}^{r} b_{21,}x_{t-i} + \sum_{i=1}^{r} b_{22,1}y_{t-i} + \sum_{j=1}^{r} g_{21,1}x_{t-i}^{+} + \varepsilon_{1,t} \quad (2)$$

The initial equation is a linear VAR model demonstrating how x^t influences y^t The second equation expands on this by incorporating both x^t and x_t^+ as factors affecting $y^{t.}$ This setup facilitates the analysis of how y^t responds to both positive and negative changes in $x^{t.}$ Additionally, the model can be extended to include nonlinear dynamics and censored variables. In the context of the regression model framework, the data developing process of xt may be seen as either asymmetrical and symmetrical.: $x_t = a_1 + \varepsilon_{1,t}$. The replacement of negative values of of x_t with zero produces a censored variable x^+_t, which may be denoted as $x_t^+ = \begin{cases} x_t^+ & x_t > 0 \\ 0 & x_t \leq 0 \end{cases}$, as outlined by the following set of equations below:

$$s_t = b_{10} + \sum_{k=1}^{p} b_{11,is_{t-k}} + \sum_{k=1}^{p} b_{12,i}\lambda_{t-k} + \varepsilon_{1,t} \quad (3)$$
$$\lambda_t = b_{20} + \sum_{k=1}^{p} b_{21,i}s_{t-k} + \sum_{k=1}^{p} b_{22,k}\lambda_{t-k} + \sum_{k=1}^{p} g_{21,k}s_{t-k}^{+} + \varepsilon_{2,t} \quad (4)$$

In this framework, s_t represents the variable for which asymmetric impacts are examined, and *p* specifies the lag order of the VAR model. The vector λt includes the variables potentially affected by s_t , while the intercept and dummy variables are captured by the vectors b10 and b20, respectively. The vectors b12 and b22 contain the coefficients corresponding to the changes in s_t and g_{21} represents the coefficient of the censored variable. The residual vectors are denoted by $\varepsilon_{1,t}$ and $\varepsilon_{2,t}$. In this study, the nonlinear VAR models are applied to data from selected ASEAN countries to estimate the positive and negative effects of the FSI on the EMPI. The nonlinear VAR model is presented as $(fsi_t, empi_t)$ for FSI and EMPI, respectively, where fsi_t^+ represents the positive values of FSI (negative values are set to zero). The censored variables approach assumes that only increases in St have an effect on the other variables in the model. Furthermore, this study also explores the interactions between FSI and EMPI, providing a contrast to the simpler linear regression models typically used and is shown as:

$$empi_t = \beta_0 + \beta_1 fsi_t + \omega_t \quad (5)$$

In equation (5) of the model, the dependent variable is $empi_t$ which is an endogenous variable represents the EMPIs of Indonesia, Malaysia, Singapore, and Thailand. The fsi_t represents the FSI of USA. Finally, ωt denotes random error in the model. In this study, the rise and fall of the $empi_t$ indicate the appreciation/depreciation of the domestic currency of the country using the index, which is computed by the method constructed by (Patnaik et al., 2017. the ρ factor used for conversion in equation (2) converts the intervention into a measure that estimates the change prevented in the exchange rate as a percentage of change.

$$empi_t = \%\Delta ex_t + \rho_t I_t \quad (6)$$

Where %Δex_t is the % change in the foreign exchange rate and I_t is the intervention calculated in 1,000 million dollars. Accordingly, the coefficient of conversion (ρ_t) represents a variation in the exchange rate that associates with interventionist action of 1,000 million dollars. This factor is the measure of the percentage of prevented change. Given this, ρ_t is estimated as 2.5% when the foreign exchange rate makes a change of 2.5% to a 1,000 million dollars intervention in the foreign exchange market, the coefficient of conversion is calculated as:

$$\rho_t = \left(\frac{\text{var}(\Delta ex_t)}{\text{var}(I_t)}\right)^{1/2} \qquad (7)$$

In this case, if the EMPI is positive then there is stress on the exchange rate due to the pressure of devaluation on the currency and vice versa. Concerning equation (5) the fsi_t denotes the FSI of ASEAN countries under study, which exhibits either positive or negative values in response to fluctuations in financial stress levels.

The importance of asymmetry with respect to interaction between macroeconomic and financial variables has increased as this relationship is investigated further in literature. Therefore I have also added the aspect of asymmetry between FSI and EMPI. For this model the fsi_t generated into positive and negative impacts and fsi_t^+ = max (fsi_t, 0) and fsi_t^- = min(fsi_t, 0) and they have been included in equation (5)

$$empi_t = \beta_0 + \beta^+ fsi_t^+ + \beta^- fsi_t^- + \varpi_t \qquad (8)$$

In terms of the magnitude and direction of the coefficients of the relevant variables, the models (5) and (8) allowed me to determine if FSI shocks that are positive or negative have distinct effects on the EMP. Also the framework for the quantile regression is also derived from model (5) and (8). Quantile regression is employed to examine how positive or negative shocks to fsi_t might affect $empi_t$ across different pressure regimes in the exchange market—specifically low, medium, and high-pressure states. This model focuses on estimating the conditional τth quantile of the dependent variable, allowing for a more nuanced understanding of the impact at various points of the distribution.

$$Q_{y_t}(\tau/x_t) = \alpha(\tau) + x_t' t\beta(\tau) \qquad (9)$$

Equation (9) $Q_{y_t}(\tau/x_t)$ is the conditional quantile τth of the dependent variable EMPI while in the model $\alpha(\tau)$ is the intercept which is dependent on τ. The vectors x_t in the model serve as a representative of the explanatory variables and $\beta(\tau)$ is the vector of coefficients relating to the quantile level. In the conditional quantile, the *th* quantile coefficients of the distribution assist in determining the effects the variables have on each other in the model. The residuals in equation (9) are attained by computing the factors for that specific quantile as $\hat{\varepsilon}_t(\tau) = y_t - x_t'\hat{\beta}(\tau)$. The standardized residuals of the corrected model to the degrees of freedom are the ratios of residuals of the standard deviation. The estimations from this approach are defined in equation (10) which are applied to resolve the minimization problem. Nusair and Olson (2019) made the deduction that conditional quantile's weighted deviancies from minimizations can be expressed as:

$$\min_k \sum_t \left(p_\tau y_t - a(\tau) - x_t'\hat{\beta}(\tau)\right) \qquad (10)$$

Where ρτ relates to a weighting that can be explained for any τ ϵ (0,1); as in (11).

$$\rho_t(v_t) = \begin{cases} \tau v_t & \text{if} \quad v_t \geq 0 \\ (\tau - 1)v_t, & \text{if} \quad v_t < 0 \end{cases} \qquad (11)$$

Where $\xi_t = q_t - \alpha^\tau - x_t'\beta^\tau$ is described as the weighted model by minimalizing the sum of the residuals. Hence, positive and negative residuals weight τ/1- τ. In equations (9-11), the quantile models can correspond to the OLS models to study the effects of the FSI of the USA on the EMPIs of emerging nations. The importance of asymmetry with respect to the interaction between macroeconomic and financial variables has increased as this relationship is investigated further in the literature. Therefore, I have also added the aspect of asymmetry between FSI and EMPI. For this model, the fsi_t is generated into positive and negative impacts while fsi_t^+ is produced by the negative values to 0 along with the assumption that only an increase in FSI has an effect on EMP in the model and fsi_t^+ = max (fsi_t, 0) and fsi_t^- = min(fsi_t, 0) and they have been included in equation (7). The measure of the coefficients of the variables in the model assists to determine if the positive/negative FSI fluctuations have distinct effects on the EMP. The CPI, ER and SMI are control variables in this model.

$$Q_{y_t}\left(\frac{\tau}{x_t}\right) = \alpha_0^\tau + \alpha_1^\tau fsi_t + +\alpha_2^\tau CPI_t + \beta_3^\tau ER_t + \beta_4^\tau SMI_t \qquad (12)$$

$$Q_{y_t}\left(\frac{\tau}{x_t}\right) = \beta_0^\tau + \beta^{\tau+} fsi_t^+ + \beta^{\tau-} fsi_t^- + \beta_1^\tau CPI_t + \beta_2^\tau ER_t + \beta_3^\tau SMI_t \qquad (13)$$

The analysis uses nine quantiles, ranging from τ = 0.10 to 0.90, which are categorized into three regimes based on FSI pressure in the exchange market: low FSI pressure (τ = 0.10 to 0.30), medium FSI pressure (τ = 0.40 to 0.60), and high FSI pressure (τ = 0.70 to 0.90). Specifically, low and high FSI pressures indicate that changes in the EMPI fall within the lower or upper quantiles, respectively. In contrast, medium FSI pressure suggests that the factors influencing changes in the EMP within the foreign exchange market are relatively moderate.

Results and Discussion

Table 1 displays the descriptive statistics for the FSI_{usa} and other variables. The observations are daily frequency. The time period selected is from January 1, 2000 to November 31, 2019.

Table 1
Descriptive Statistics

	fsi_t^{usa}	$empi_t^{id}$	cpi^{id}	er^{id}	smi^{id}	$empi_t^{my}$	cpi^{my}	er^{my}	smi^{my}
Mean	0.41	-0.32	100.09	96.02	94.06	-0.58	100.28	95.45	93.76
Median	-0.35	-0.47	99.62	95.58	101.80	-0.84	100.19	96.41	100.30
Maximum	10.56	17.09	156.79	116.85	184.94	21.53	122.77	105.46	154.69
Minimum	-1.77	-18.05	43.89	78.07	11.49	-17.85	80.37	83.60	39.28
Std. Dev.	2.03	4.44	34.53	7.59	55.98	4.67	13.59	5.21	33.45
Skewness	1.85	0.03	0.02	0.31	-0.16	0.74	0.13	-0.51	0.01
Kurtosis	7.80	5.14	1.74	2.96	1.41	7.01	1.71	2.36	1.73
Jarque-Bera	365.78	45.70	15.89	3.80	26.39	181.99	17.22	14.47	16.02
Probability	0.00	0.00	0.00	0.15	0.00	0.00	0.00	0.00	0.00

	$empi_t^{sg}$	cpi^{sg}	er^{sg}	smi^{sg}	$empi_t^{th}$	cpi^{th}	er^{th}	smi^{th}
Mean	-0.80	101.96	100.82	90.83	-1.11	98.39	96.32	130.81
Median	-0.84	100.17	98.08	101.49	-0.95	100.15	99.07	114.18

Maximum	14.93	117.03	113.49	133.10	14.02	114.64	114.81	261.10
Minimum	-10.18	86.19	89.06	35.26	-12.70	77.67	81.96	28.10
Std. Dev.	3.31	11.96	7.92	30.37	4.07	12.90	8.66	71.86
Skewness	0.71	0.01	0.07	-0.42	-0.07	-0.29	-0.19	0.17
Kurtosis	5.84	1.27	1.43	1.65	3.66	1.55	1.95	1.61
Jarque-Bera	100.64	29.77	24.75	25.06	4.46	24.21	12.38	20.37
Probability	0.00	0.00	0.00	0.00	0.11	0.00	0.00	0.00

Unit Root test

Unit root tests were performed on time series data to determine stationarity in the non-linear time series model. This test determines the best model specification (Table 2). Table 2 shows that Dickey-Fuller & Philips-Perron tests reject the null hypothesis and indicate that the variables are stationary. No co-integration test is needed, and their long-term interactions with these vectors cannot be examined. The literature acknowledges that many macroeconomic research utilize nonlinear models because macroeconomic variables may have nonlinear effects.

Table 2
Unit root tests

Variables	ADF test		PP test	
$empi_t^{my}$	-8.81	(0)	8.91	(5)
$empi_t^{id}$	-12.02	(0)	-12.00	(2)
$empi_t^{sg}$	-5.52	(6)	-13.32	(5)
$empi_t^{th}$	-5.22	(6)	-11.59	(5)
fsi_t^{usa}	-2.76	(0)	-2.76	(0)

Note: "The Newey-West bandwidth dictates the selection of bandwidth for the PP test using the Barlet kernel estimation method while the ADF test dictates the number of the lags to be selected under the Akaike information criterion (AIC). The critical values for the intercept of ADF and PP test are 3.47 for 1%, 2.88 for 5%, and 2.58 for 10%.

The BDS Test

The BDS test of (Brock et al. 1996) was executed to ascertain whether there is a nonlinear relationship between the variables. The results demonstrated no presence of nonlinearities (Table 3).

Table 3
BDS Test Results

Dimensions	p-values of the BDS test				
	fsi_t	$empi_t^{id}$	$empi_t^{my}$	$empi_t^{sg}$	$empi_t^{th}$
2	0.00	0.05	0.00	0.00	0.00
3	0.00	0.03	0.00	0.00	0.00
4	0.00	0.03	0.00	0.00	0.00
5	0.00	0.01	0.00	0.00	0.00
6	0.00	0.02	0.00	0.00	0.00

Note: the distance value for this test is 0.7. For more details, relating BDS test, refer to Brock et al. (1996).

Nonlinear Granger Causality Test

BDS and nonlinear Granger causality tests were conducted at 10% significance. AIC is 1, 2 and bandwidth is 1.5 for this model's non-linear Granger Causality test lag order set. The FSI and EMPI had asymmetric effects (Table 4). The coefficients associated with the preceding independent variable values are not statistically significant after setting the model to address Diks and Panchenko (2006) nonlinear Granger Causality test non-stationarity.

Table 4
Nonlinear Granger Causality Test Results

Vector	No. of lags	(fsi_t does not cause $empi_t^{id}$)	($empi_t^{id}$ does not cause fsi_t)
($fsi_{t,}$, $empi_t^{id}$)	1	12.19[1]	25.57[1]
	2	13.90[1]	31.78[1]
		(fsi_t does not cause $empi_t^{id}$)	($empi_t^{my}$ does not cause fsi_t)
($fsi_{t,}$, $empi_t^{my}$)	1	3.51[1]	27.72[1]
	2	4.99[1]	33.38[1]
		(fsi_t does not cause $empi_t^{id}$)	($empi_t^{sg}$ does not cause fsi_t)
($fsi_{t,}$, $empi_t^{sg}$)	1	2.38[1]	24.30[1]
	2	2.74[1]	30.22[1]
		(fsi_t does not cause $empi_t^{id}$)	($empi_t^{th}$ does not cause fsi_t)
($fsi_{t,}$, $empi_t^{th}$)	1	8.82[1]	26.03[1]
	2	10.30[1]	32.32[1]

Note: The p values are in square brackets and the number of lags used in the test is from 1 to 8

Impulse Response Functions

The correlation between FSI and EMPI is assessed by the Impulse Response Functions (IRF) test, as described by Killian and Vigfusson (2011). The outcomes of the IRF analysis are presented in Figures 1 through 4. The IRF results indicate that disturbances to the FSI may exert a symmetric influence on the EMPI. Both positive and negative alterations in FSI are shown to affect the EMPI, possibly augmenting or diminishing the probability of a currency crisis in these nations.

The IRFs depicted in Figures 1 to 4 are generated inside the VAR model framework, demonstrating the impacts of shocks with a two-standard deviation based on Cholesky decomposition. The results demonstrate that positive FSI shocks result in a short-term rise in the EMPI, and the impulse response analysis corroborates the findings of Apostolakis et al. (2019), revealing a worldwide transmission impact of financial stress on financial and macroeconomic variables. According to Evgenidis and Tsagkanos (2017), this effect is often detrimental in the near run, influencing the economic indicators of the affected nations.

The influence of financial stress in advances nations on developing economies can vary, shaped by several macro-prudential factors. The influence of FSI on EMPI is determined by the exchange rate system and capital constraints enacted by certain nations. FSI shocks can produce varying consequences according on whether the market is in a bullish, bearish, or neutral condition.

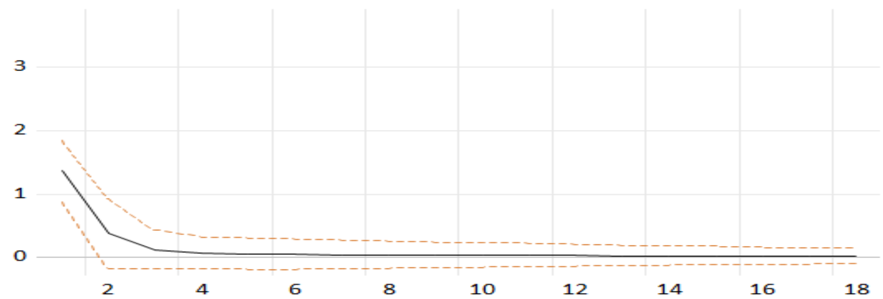

Figure 1 Reactions to VAR model shocks and both positive and negative shocks

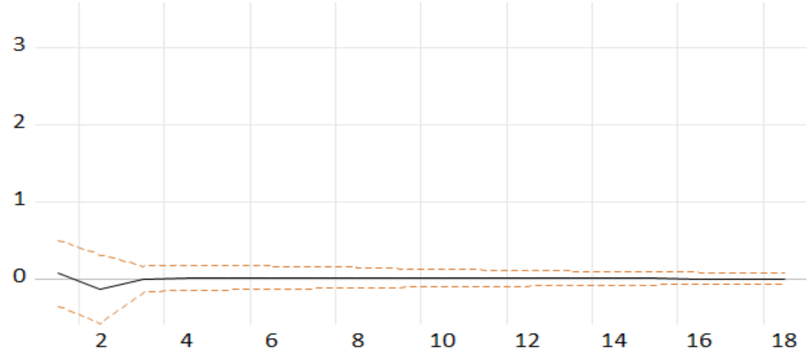

Figure 2: Reactions to VAR model shocks and both positive and negative shocks

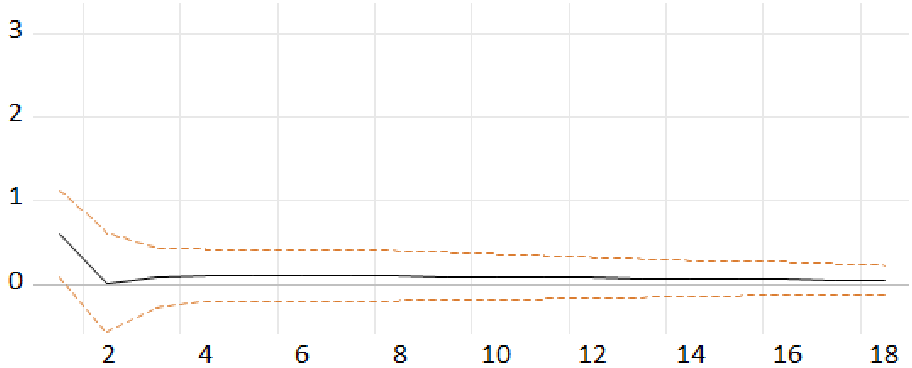

Figure 3: Singapore: Reactions to VAR model shocks and both positive and negative shocks

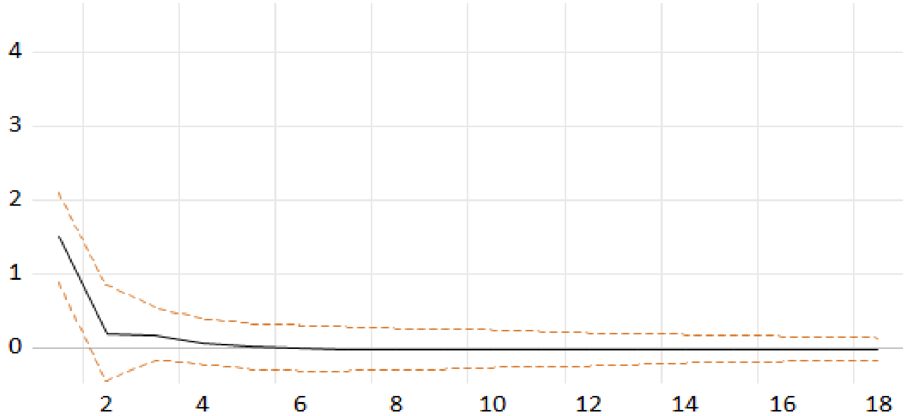

Figure 4: Thailand: Reactions to VAR model shocks and both positive and negative shocks

Quantile Unit Root Test

To evaluate the stationary properties of variables, the test for quantile unit root test has been applied and the results are presented in Table 5. The variables are stationary at levels.

Table 5
Quantile unit root test

τ	p-values of the Quantile unit root test				
	fsi_t	$empit_{id}$	$empit_{my}$	$empit_{sg}$	$empit_{th}$
0.1	**0.01**	**0.00**	**0.00**	**0.01**	**0.00**
0.2	**0.00**	**0.00**	**0.00**	**0.02**	**0.00**
0.3	**0.03**	**0.00**	**0.00**	**0.02**	**0.00**
0.4	**0.01**	**0.01**	**0.00**	**0.01**	**0.00**
0.5	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
0.6	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
0.7	**0.03**	**0.00**	**0.00**	**0.00**	**0.00**
0.8	**0.03**	**0.00**	**0.02**	**0.00**	**0.00**
0.9	0.06	**0.04**	**0.00**	**0.00**	**0.00**

Note: The highlighted values indicate that the series is stationary at the 5% significance threshold.

Quantile Regression (asymmetric model)

The Quantile analysis demonstrates the negative effect of increase in the FSI of the USA under different EMP regimes and macroeconomic variables, on the EMPI of developing nations as presented in Table 6. It was observed that during the high EMP regime, the increase in the FSI shocks lead to the rise in the EMPI of the ASEAN countries. The p-values of fsi_t^+ and fsi_t^- for the countries are significant at 0.9 quantile level. Although the impact of fsi_t^+ on Singapore's EMPI is not significant at the 0.7 and 0.8 quantiles. This outcome indicates that, even during elevated EMP of Singapore, the FSI of developed nations does not precipitate a depreciation of their domestic currency. According to Ozcelebe (2020) this behavior suggests that due to current account surplus in this country, reduces the adverse external shocks of FSI.

Furthermore, it also reveals that the increase in FSI of USA does not have an impact on the EMPI of emerging countries if the EMP of these countries is low. As a consequence, it is assumed that there is a probability that an increase in financial stress from developed countries can trigger a currency risk in Indonesia, Malaysia, Singapore, and Thailand and this is also connected to financial volatility concerning the exchange market of the respective country. Since financial instability is represented in relation to EMP.

The quantile regression show the decrease in the fsi_t^- of USA has a significant impact on the normal and high quantiles at 5% significance. Likewise, the data suggest that heightened financial stress adversely impacts times characterized by elevated EMP. But the level of the impact of financial stress during a low EMPI regime can differ from country to country in emerging economies.

The findings indicate that at a 5% significance level, the decrease in fsi_t^- of Indonesia and Thailand shows that the domestic currency can come under pressure to depreciate and the EMPI of Indonesia can increase (for 0.4, to 0.5 quantile), and Thailand (for 0.4 to 0.5 quantile). This result can be analyzed as representing that a decrease in financial stress and a surplus of liquidity of financial assets in advanced economies can improve the financial assets of emerging countries, which is reflected in a decline in the value of the assets denominated in their respective currencies (thai bhat and rupiah. Ozcelebi, (2020) observed similar results above for China and Russia which showed that any political tension with USA or trade wars could result in decrease in capital investments in these countries. The financial assets of Singapore can be positively affected by the decrease in fsi_t^- in a low EMP regime as capital investments from advanced economies can improve the financial conditions of emerging economies. In the case of Malaysia, it can be presumed that the capital investment inflows to Malaysia due to the decrease in financial stress in the USA do affect the EMP during all regimes.

The results from regression show that the financial assets of Singapore cannot be considered as an alternative investment for foreign investors from advanced economiesIt is possible that Singapore may have a spillover impact from the excess liquidity in advanced countries. Furthermore, this study reveals that capital inflows can have a positive effect to decrease financial stress in Singapore. It may be inferred that Capital flow restrictions will not serve as a successful policy for this country. Furthermore, a high-interest rate strategy may attract capital inflows to the economy; yet, it is essential to acknowledge the potential risk of precipitating a debt crisis (Tng, 2017).

Table 6
The estimation results for the quantile regression models (asymmetric model)

	Low EMP regime Indonesia			**Normal EMP regime Indonesia**			**High EMP regime Indonesia**		
Variables	**0.1**	**0.2**	**0.3**	**0.4**	**0.5**	**0.6**	**0.7**	**0.8**	**0.9**
fsi_t^-	0.54	0.61	0.62	1.05	0.95	1.21	1.30	1.32	1.69
	0.00	**0.04**	0.07	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
fsi_t^+	-0.03	-0.03	0.09	0.21	0.38	0.66	0.65	0.59	0.70
	0.92	0.94	0.81	0.54	0.18	**0.02**	**0.00**	**0.05**	**0.02**
cpi^{th}	0.71	0.78	0.66	1.01	0.69	0.69	0.82	0.89	1.22
	0.01	**0.02**	0.06	**0.00**	**0.01**	**0.01**	**0.00**	**0.01**	**0.00**
er^{th}	-0.01	-0.01	0.01	-0.03	-0.01	0.01	-0.01	-0.05	-0.07
	0.87	0.90	0.90	0.60	0.89	0.87	0.78	0.33	0.09
smi^{th}	0.00	0.01	0.00	0.00	0.00	-0.01	-0.01	-0.01	-0.01
	0.32	0.39	0.83	0.61	**0.02**	0.11	**0.00**	**0.03**	**0.00**
	Low EMP regime Malaysia			Normal EMP regime Malaysia			High EMP regime Malaysia		
fsi_t^-	0.05	0.43	0.57	0.65	0.70	0.74	0.60	0.95	1.53
	0.90	0.21	**0.00**	**0.00**	**0.00**	**0.00**	**0.02**	**0.01**	**0.00**
fsi_t^+	0.21	0.46	0.50	0.56	0.60	0.58	0.43	0.64	1.32
	0.59	0.11	**0.00**	**0.00**	**0.00**	**0.00**	**0.05**	**0.03**	**0.02**
cpi^{my}	0.17	0.20	0.25	0.25	0.22	0.28	0.29	0.34	0.30
	0.41	0.23	**0.02**	**0.01**	**0.03**	**0.01**	**0.03**	**0.02**	0.43
er^{my}	0.31	0.21	0.18	0.14	0.09	0.09	0.05	-0.03	-0.09
	0.05	0.12	**0.05**	0.07	0.24	0.27	0.49	0.76	0.70
smi^{my}	-0.10	-0.05	-0.03	-0.02	-0.01	0.00	0.00	0.05	0.06
	0.02	0.13	0.19	0.25	0.74	0.91	0.95	0.13	0.29
	Low EMP regime Singapore			Normal EMP regime Singapore			High EMP regime Singapore		
fsi_t^-	-0.52	-0.11	0.09	0.14	0.28	0.40	0.50	0.63	0.83
	0.04	0.66	0.73	0.58	0.21	**0.04**	**0.04**	**0.00**	**0.00**
fsi_t^+	-0.79	-0.56	-0.44	-0.37	-0.10	-0.08	0.07	0.22	0.57
	0.00	**0.01**	**0.07**	0.11	0.62	0.68	0.75	0.34	**0.00**
cpi^{sg}	**0.60**	**0.87**	0.99	0.99	0.78	0.99	0.89	0.93	0.53
	0.03	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	0.11
er^{sg}	-0.21	-0.22	-0.32	-0.36	-0.31	-0.42	-0.36	-0.43	-0.23
	0.25	0.07	**0.04**	**0.03**	**0.04**	**0.00**	**0.02**	**0.00**	0.24
smi^{sg}	-0.04	-0.06	-0.06	-0.06	-0.03	-0.05	-0.04	-0.04	0.00
	0.02	**0.00**	**0.00**	**0.00**	**0.04**	**0.00**	**0.01**	**0.09**	0.84
	Low EMP regime Thailand			Normal EMP regime Thailand			High EMP regime Thailand		
fsi_t^-	0.35	0.17	0.28	0.45	0.40	0.32	0.48	0.73	1.70
	0.37	0.46	0.38	**0.04**	**0.03**	0.14	**0.10**	**0.05**	**0.01**

fsi_t^+	0.41	0.33	0.43	0.72	0.71	0.73	0.87	1.21	2.27
	0.27	0.13	0.15	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
cpi^{th}	0.03	-0.01	-0.02	-0.06	-0.08	-0.12	-0.10	-0.12	-0.15
	0.65	0.82	0.71	0.10	**0.05**	**0.00**	**0.03**	**0.02**	**0.04**
er^{th}	0.09	0.01	-0.07	-0.13	-0.13	-0.13	-0.11	-0.08	-0.10
	0.34	0.93	0.39	**0.04**	**0.05**	**0.03**	0.12	0.26	0.39
smi^{th}	-0.07	-0.03	-0.01	-0.02	-0.03	-0.04	-0.06	-0.09	-0.08
	0.17	0.39	0.81	0.49	0.25	0.15	0.08	**0.01**	0.14

Quantile Slope Equality Test

The slope equality test in (Table 7) suggest that the effect of FSI of USA on EMPI is not symmetric. This result aligns with our findings from the previous quantile regression results. Even if the results from Quantile regression are not in accordance with results from the non-linear Var model, according to Ozcelebi (2020) this behavior can occur due to change in EMP which can affect FSI has on EMPI of a country. This is why the results of each country are not similar to each other under the different EMP regimes (Adam et al. 2018). The asymmetric impact of FSI and EMPI due to EMP regimes change suggests that the determinants of financial stability in each emerging nation may influence the transmission of financial stress from developed countries to their foreign exchange markets (Vašíček, et al., 2017).

Table 7
Quantile slope equality test (asymmetric model)

	Indonesia							
Variables	0.1, 0.2	0.2, 0.3	0.3, 0.4	0.4, 0.5	0.5, 0.6	0.6, 0.7	0.7, 0.8	0.8, 0.9
fsit-	0.75	0.95	**0.04**	0.59	0.14	0.56	0.95	0.36
fsi_t^+	0.98	0.66	0.58	0.38	0.11	0.96	0.76	0.68
cpi^{th}	0.81	0.63	0.10	0.09	0.99	0.44	0.74	0.33
er^{th}	0.99	0.71	0.32	0.47	0.63	0.52	0.23	0.58
smi^{th}	0.72	0.33	0.42	0.23	0.57	0.75	0.53	0.26
	Malaysia							
Variables	0.1, 0.2	0.2, 0.3	0.3, 0.4	0.4, 0.5	0.5, 0.6	0.6, 0.7	0.7, 0.8	0.8, 0.9
fsi_t^+	0.24	0.52	0.52	0.63	0.64	0.38	0.13	0.12
fsi_t^-	0.39	0.80	0.60	0.66	0.82	0.28	0.28	0.16
cpi^{my}	0.87	0.66	0.95	0.63	0.27	0.96	0.57	0.89
er^{my}	0.43	0.72	0.44	0.24	1.00	0.55	0.20	0.77
smi^{my}	0.14	0.27	0.58	0.19	0.47	0.82	**0.02**	0.80
	Singapore							
Variables	0.1, 0.2	0.2, 0.3	0.3, 0.4	0.4, 0.5	0.5, 0.6	0.6, 0.7	0.7, 0.8	0.8, 0.9
fsi_t^+	**0.05**	0.26	0.77	0.32	0.34	0.51	0.40	0.30
fsi_t^-	0.22	0.43	0.65	**0.05**	0.84	0.28	0.34	**0.05**
cpi^{sg}	0.23	0.53	1.00	0.18	0.14	0.50	0.84	0.13
er^{sg}	0.92	0.40	0.67	0.57	0.22	0.56	0.54	0.20
smi^{sg}	0.19	0.77	0.81	**0.06**	0.23	0.78	0.80	**0.02**
	Thailand							
Variables	0.1, 0.2	0.2, 0.3	0.3, 0.4	0.4, 0.5	0.5, 0.6	0.6, 0.7	0.7, 0.8	0.8, 0.9
fsi_t^+	0.76	0.59	0.11	0.94	0.90	0.38	0.11	**0.03**
fsit-	0.55	0.61	0.38	0.70	0.55	0.37	0.31	**0.05**

cpi^{th}	0.42	0.78	0.22	0.51	0.16	0.62	0.52	0.62
er^{th}	0.28	0.16	0.23	0.84	0.83	0.66	0.50	0.84
smi^{th}	0.35	0.41	0.72	0.43	0.62	0.39	0.19	0.92

Note: The data provide the p-values associated with the null hypothesis for the slope equality test. The values that are emphasized indicate that the null hypothesis was rejected at a level of 5% significance.

Discussion

This study aimed to assess the impact of the Financial Stress Index (FSI) in the USA on the exchange market performance index (EMPI) of ASEAN economies. Employing two quantitative methods, the analysis investigated a potential asymmetric relationship between the FSI in the USA and the EMPI of ASEAN countries. The BDS test by Brock et al. (1996) was used to determine whether the association between FSI and EMPI could be estimated using nonlinear models. For this purpose, the non-parametric causality test by Diks and Panchenko (2006) was applied. The results revealed that financial stress shocks from the USA significantly impact the EMPI performance of Indonesia, Malaysia, Singapore, and Thailand. To explore this further, the nonlinear VAR model of Killian and Vigfusson (2011) was applied, detecting a nonlinear association between financial stress and EMPI in these countries. Impulse response analysis showed that positive and negative shocks in the FSI increase or decrease the pressure on the exchange market of the respective nations.

Quantile regression analysis demonstrated the asymmetric effects of the FSI on EMPI across low, normal, and high-EMP regimes for each country. An elevated EMP adversely impacts the exchange markets of emerging economies, creating pressure on currency rates and potentially leading to currency devaluation. This was particularly evident in Indonesia, Malaysia, Singapore, and Thailand, with Singapore displaying some resilience. Its export-based economy appeared to buffer it against foreign financial pressures. Moreover, the study observed that as funding conditions in advanced countries tighten due to interest rate hikes, capital initially flows toward emerging markets. However, when EMP regimes in these countries are high, capital outflows occur, exacerbating exchange market pressure. The impact of reduced FSI on EMPI was more pronounced in low-EMP regimes, particularly benefiting Indonesia, Malaysia, and Thailand. Conversely, global monetary policy shifts or financial environment improvements in developed nations could adversely affect these countries by devaluing assets in domestic currencies and reducing demand.

Conclusion

The findings suggest that financial stress shocks from the USA have a differential and asymmetric impact on the EMPI of ASEAN economies, depending on the EMP regime and the unique economic and financial structures of each country. Singapore demonstrated notable resilience during low-EMP regimes, distinguishing itself as less susceptible to financial stress from the USA. The Financial Stress Index (FSI) was observed to be low during economic booms and high during recessions, with foreign financial shocks having short-term adverse effects on the EMP of all studied nations. The impulse response function (IRF) analysis highlighted a sharp decline in EMPI during the first and second quarters following financial stress shocks, followed by a gradual recovery. These results align with previous studies, such as those by Ozcelebi (2019), Balakrishnan et al. (2009), and Polat and Ozkan (2019), which emphasize the heightened sensitivity of emerging economies to financial volatility during crises in developed nations. Strong financial systems in developing economies may mitigate investment declines and reduce vulnerability to financial stress originating in advanced economies.

Implications of the Study and Future Directions

This study urges Policymakers to implement measures, such as strengthening financial systems and enhancing risk management, to mitigate the adverse effects of financial pressure on their economies. Additionally, the study emphasizes the importance for investors to consider exchange rate market volatility and its impact on stock returns. The results can be heavily influenced by monetary policies, macroeconomic and financial conditions of the country which can give conflicting results or have the opposite effect on the results desired.

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