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HOW DOES FINANCIAL MARKET STRESS RESPOND TO SHOCKS IN GLOBAL ECONOMIC ACTIVITY AND EXCHANGE RATE STABILITY? A STRUCTURAL VAR APPROACH

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Abstract

The study examines the response of financial market stress to innovations in global economic activity and the exchange rate in emerging and advanced market economies during the period 2006Q1 and 2020Q4. This is achieved by means of time series econometric analysis. The impulse response function estimated through structural factorization indicates that financial market stress responds positively towards its own innovations and to innovations in global economic activity. In contrast, financial market stress responds negatively to a one standard deviation in the exchange rate in the long run albeit the response is neutral in the short run. The findings from the variance decomposition show that in advanced market economies, a larger fraction of the discrepancies in financial market stress are explained by its own innovations followed by innovations in global economic activity, whereas in emerging market economies, a larger proportion of the discrepancies in financial market stress are explained by its own innovations followed by innovations in the broad exchange rate. Given the findings, the study recommends strong coordination between monetary policy and fiscal policy to ensure that overall economic activity is optimized and maintained in the long run. Monetary authorities have a role to play in ensuring price and exchange rate stability while fiscal authorities have the tools to realize minimal budget deficits and optimal debt management.

Keywords: Financial Stress, Exchange Rate Stability, Global Economic Activity, Emerging Markets

1. Introduction

The financial sector is an important part of the economy and impacts on the lives of all citizens of a country. Individuals make use of financial services to conduct economic transactions, save and preserve wealth for future aspirations, retirement needs as well as unforeseen events. Financial services also contribute to economic growth, job creation, building of key infrastructure and sustainable development. Despite this, the financial sector also introduces risks to the economic

system and hence it is a widely held view that financial markets should be well regulated and stable. Many definitions of financial stability exist in literature, however in this study we follow Gadanecz and Jayaram (2009) who define financial stability as the absence of excessive volatility, stress or crises. Financial stability issues began to receive special focus after the global financial crisis of 2007-2008 due to their macroeconomic implications and cross boarder effects amongst other things. Global imbalances in saving and consumption between different parts of the world during the crises were characterized by large savings in emerging economies such as China flowing into industrialized economies such as the United States (US), United Kingdom (UK) and the Eurozone. The surplus of funds fueled an unsustainable level of debt-financed consumption in some advanced economies, coupled with rapid rises in asset prices. In emerging countries, financial stability problems are often not only connected to internal shocks, but also external shocks enhanced by the globalization impact (Golovnin and Oganesian, 2018).

Exchange rate fluctuations influence price dynamics and determine the debt burden of borrowers as large amounts of debt in these emerging countries is denominated in foreign currency and foreign exchange assets constitute a large portion of domestic savings (Golovnin and Oganesian, 2018). The recent crisis has demonstrated that economies are interconnected, hence, vulnerabilities in the financial system of one country can easily spread across national borders. Promoting global economic stability was identified by the International Monetary Fund (IMF) as an essential remedy or way to prevent financial crises, large swings in economic activity, high inflation as well as a great volatility in financial markets. Global economic instability can increase uncertainty, discourage investment, impede economic growth, and hurt living standards. Recognizing the need for coordinated efforts to secure global financial and economic stability, many countries have committed to important obligations of preventing a similar crisis in the future. Policy makers and academics around the globe have become increasingly concerned with what causes financial instability as well as what could be done to prevent it. Regulatory reforms adopted by international policy makers over the past decade can be categorized into micro and macro prudential regulation.

International reform of micro prudential regulation has focused on four key areas: capital, leverage, liquidity, and resolution, while macroprudential regulation focused on three areas namely: macroprudential capital buffers; stress-testing; and shadow banks (Haldane *et al.* 2017). Against this backdrop, the study considers the nexus between global economic activity, exchange rates stability and financial stability in emerging markets and advanced economies. The study extends on existing literature, which uses the financial stress index (FSI) to understand the channels of financial transmission. Furthermore, the nexus between global economic activity, exchange rate stability and financial stability remains relatively underexplored in financial literature. Some studies in literature have focused more on the link between financial stability and other variables such as competition in the banking sector, financial sector regulation and supervision as well as monetary stability to mention a few (e.g., Allen and Gale, 2004; Hesse and Cihak, 2007) rather than specifically on the link between the three variables. Another strand of literature focused on the link between financial stress and economic activity of individual countries such as United states (US), France, Germany (e.g., Aboura and van Roye, 2017; Ferrer *et al.* 2018). To the best of our best knowledge, very little attention has been paid specifically to the effect of global economic activity and exchange rate stability on financial stability. This study contributes towards closing this gap in literature.

The rest of the paper is structured as follows: Section 2 presents both theoretical and empirical literature review whereas Section 3 includes data and methodology. Section 4 explains the results and discuss them thoroughly. Finally, Section 5 concludes the paper with recommendations.

2. Literature review
2.1. Theoretical literature

In order to prevent the occurrence of financial instability, policy makers need to understand the underlying causes. As documented in Mishkin (1997), there are two major institutional differences between the financial markets of developed economies and emerging market economies, which

leads to different propagation mechanisms for financial instability between the two different sets of countries. Firstly, in developed countries where inflation expectations are often low, debt contracts are for a long duration. Advanced economies often retain strong currencies and thus most debt contracts are denominated in domestic currency. In contrast, most emerging market economies have domestic currencies that experience substantial fluctuation in values and are thus riskier. Many of the debt contracts in emerging market economies are denominated in foreign currencies. Notwithstanding the above, the initial impetus for financial instability may be the same for both developed and emerging market economies. Mishkin (1997) identified four factors that help initiate financial instability: increase in interest rates, increase in uncertainty, asset market effects on balance sheet, and problems in the banking sector.

When market interest rates increase to substantially high levels, there is a high probability that lenders may lend to bad credit risk (adverse selection), since it is only the borrowers with higher risk investments projects that are likely willing to borrow at higher interest rate. The increase in the chances of adverse selection may incentivize lenders to reduce the number of loans they provide, possibly leading to a decline in lending which will in turn have a negative effect on economic activity and investment. Financial markets behave in line with the optimism or pessimism of investors. Uncertainty in these markets can be as a result of recessions, political instability, stock market crush which potentially makes it difficult for a lender to identify good from bad credit risks. The increase in uncertainty may result in information asymmetry and worsen the adverse selection problem.

The strength of the balance sheet of both financial and nonfinancial institutions has an effect on the degree of the asymmetric information problem. The deterioration of these balance sheets worsens adverse selection, moral hazard problem and therefore may promote financial instability (Lütkepohl *et al.* 2001). Furthermore, banks have a very important role in financial markets since they are well-suited to engage in information-producing activities that facilitate productive investment for the economy. A decline in the ability of banks to engage in financial intermediation and make loans may lead directly to a decline in investment and economic activity. In addition to the above, emerging market economies face additional potential shock, which increases the likelihood of financial instability. Institutions in emerging countries raise funds by issuing debt denominated in foreign currencies.

2.2. Empirical literature

This section discusses the empirical evidence on the effects of global economic activity and exchange rate stability on financial stability/financial stress, discussing how exchange rate fluctuations and conditions in the global economy affect key variables in the financial sector. There is a dearth of literature on the nexus between global economic activity, exchange rate stability and financial stability. Existing studies have mostly focused on the relationship between financial stability and other variables such as banking sector competition, financial sector regulation, and monetary stability and has been silent with regards to the link between global economic activity, exchange rate and financial stability.

2.2.1. Global economic activity and financial stability

As noted by the Bank for International Settlements (BIS) (2011), weaker macroeconomic conditions reduce the revenues and profits of businesses (including banks) and the incomes of households, which results in households' and businesses' net worth increasing more slowly or in some cases decreasing. In addition, weaker business revenues and household incomes push up borrowers' default probabilities, which in turn weaken the position of banks' balance sheets. The strength of bank balance sheets is important because it influences their ability to extend credit, while the strength of the borrowers' balance sheets influences default rates, which in turn affects the strength of bank balance sheets (BIS, 2011). Lai *et al.* (2012) suggest that financial stress can be as a result of global factors such as changes in commodity prices, GDP growth and interest rates, as well as country specific factors such as the degree of openness and macroeconomic vulnerabilities. Similarly, Park and Mercado (2013) investigated the determinants of financial

instability in emerging market economies. Using the FSI for a panel of 25 emerging countries, it is concluded that both global and domestic factors affect FSI. Higher global interest rates tend to increase domestic financial stress suggesting that the tightening of conditions in international credit markets can have adverse effects on domestic financial conditions in emerging market economy (Park and Mercado, 2013). Higher global GDP growth reduces domestic financial stress, suggesting that as global demand conditions improve, financial stress declines. Sound domestic macroeconomic conditions also have mitigating effect on domestic financial stress. Furthermore, results of their study show that current account surplus, fiscal surplus, and higher foreign exchange reserves lower domestic financial stress.

Among these domestic indicators, fiscal surplus was found to significantly lower domestic FSI across specifications, implying that fiscal space of the country or its ability to increase domestic spending during episodes of financial market turmoil plays an important role in lowering domestic financial stress (Park and Mercado, 2013). Another strand of literature has focused on the effects of financial stress on real economic activity (manly output & inflation) of nations. Amongst these is a research paper by van Roye (2011) which looked at the effects of financial stress on economic activity in Germany and the Euro area. The study estimates a small Bayesian vector autoregressive (VAR) model and concludes that an increase in financial stress has an adverse effect on GPD growth. Results of the study reveals that 15% of the variation in GDP is attributable to financial stress in Germany while this number is slightly higher at 30% for the Euro area (van Roye, 2011).

Aboura and Roye (2017) examined the nexus between financial stress and economic activity in France. The authors employ 17 financial variables from different market segments and extracted common stress components by means of a dynamic approximate factor model. The model was estimated with a maximum likelihood and expectation-maximization algorithm allowing for mixed frequencies and an arbitrary pattern of missing data. Using a Markov-Switching Bayesian VAR, the study shows that while high financial stress is strongly linked with low or subdued economic growth and activity, episodes of low financial stress have a negligible effect on economic dynamics (Aboura and Roye, 2017). Ferrer *et al.* (2018) considered the interactions between financial stress and economic activity in the US. As measures of economic activity, the study employed growth rate of industrial production, real GDP growth rate, inflation rate, unemployment rate and 10-year treasury rates. A number of FSI indices were employed including the Kansas City Financial Stress Index (KCFSI) and St. Louis Financial Stress Index (STLFSI) and Cleveland Financial Stress Index (CFSI). Results of the study show an adverse effect of financial stress on economic activity since the onset of the subprime mortgage crisis in 2007. This shows that financial stress is more severe during periods of financial turmoil (Ferrer *et al.* 2018).

2.2.2. Exchange rate and financial stability

There is still a dearth of empirical studies on the effect of exchange rate stability on financial stability/stress. Some of the earliest literature around this area includes studies by McKinnon (1988) and Eichengreen (1997). The former considered the impact of monetary and exchange rate policies on financial stability while the latter focused on implications of international monetary arrangements for the stability of the banking system. A more recent attempt by Fornaro (2015) looked at the relationship between financial crises and exchange rate policy. The study achieves this by evaluating the performance of different exchange rate policies in sudden stop-prone economies. The key element of the analysis is a precautionary externality arising from frictions in international credit markets, which creates a trade-off between price and financial stability. Results of the study show among other things a depreciation in exchange rate during financial crises has a positive impact on welfare because the stimulus provided by a depreciation sustains asset prices (Fornaro, 2015). On another study, Stoica and Ihnatov (2016) examined the link between exchange rate regimes and financial stability using annual data from a sample of 135 countries grouped by their level of economic development. Results of the study support the view that the flexibility of exchange rate regimes should be reduced in order to sustain financial stability. Golovnin and Oganesian (2018) studied the nexus between financial stability indicators and exchange rate in Russia. As financial stability indicators, study made use of non-performing loans

for banking sector and stock market index dynamics for the stock market. Results of the study show that non-performing assets negatively depend on exchange rate while stock market index dynamics is determined by money supply, interest rates and exchange rates fluctuations.

3. Data and methodology

The study made use of quarterly time series data spanning from 2006Q1 to 2020Q4. The data was collected from reliable databases including the Federal Reserve Bank of Dallas, St. Louis Federal Reserve and Office of Financial Research. By following recent studies including Gersl and Hermanek (2007), Park and Mercado (2013), Stoica and Ihnatov (2016), Ferrer *et al*. (2018), our empirical model can be expressed as:

$$y_t = \beta_0 + \beta_1 EXR_t + \beta_2 GEAI_t + \varepsilon_t \tag{1}$$

where y_t is the dependent variable represented by the financial stress index. This includes the emerging markets financial stress index, advanced markets (Japan and European Union) financial stress index and the United States financial stress index. EXR is the nominal broad exchange rate, $GEAI$ is the global economic activity index developed by Kilian (2009), ε_t is the error correction term.

The study employed a multiple regression analysis. Several pre-estimation tests were conducted prior to the regression analysis. This included descriptive analysis and unit root analysis. The variables were examined for unit root by means of the Augmented Dickey Fuller unit root test (Dickey and Fuller, 1979). The next step of analysis involved estimating the structural Vector autoregression model. The choice of technique was to account for structural breaks in the financial system. Three models were estimated, for emerging market economies, advanced economies (Japan and European Union) and for the United States. This is primarily because the United States is not included in the financial stress index for advanced economies. The impulse response function and variance decomposition were later performed through structural factorization to evaluate the response of the financial market stress to innovations in global economic activity and exchange rate stability. Given that econometric analysis is prone to errors, the estimated model was assessed for autocorrelation and heteroscedasticity.

4. Findings and discussions

This section documents findings from the econometric tests performed. This includes pre-estimation tests, cointegration, residual diagnostics and impulse response. The findings are discussed in line with recent empirical studies.

4.1. Descriptive analysis

Our pre-estimation analysis included performing descriptive analysis. This was done to examine the individual characteristics of the variables of interest. The results are provided in Table 1.

The financial stability index for advanced economies averaged 0.05 between 2006/Q1 and 2020/Q4 while the corresponding standard deviation amounted to 2.39 during the same period. Similarly, the financial stability index for the United States had a mean value of 0.01 and standard deviation of 2.01 between 2006Q1 and 2020Q4. In contrast, the financial stability index for emerging market economies averaged -0.01 between 2006/Q1 and 2020/Q4 while the corresponding standard deviation equated to 0.45. The lower mean values and standard deviations indicate that the data points are less spread out. In respect of the exchange rate, we find that the mean and standard deviation in advanced economies, emerging markets and the United States have higher values, implying that the data points are more spread out.

Table 1. Descriptive statistics

	AE FSI	EM FSI	US FSI	EXR AE	EXR EM	EXR US	GEAI
Mean	0.05	-0.01	0.01	101.60	92.92	106.69	-0.31
Maximum	11.08	2.14	9.84	119.32	105.64	122.70	185.31
Minimum	-2.30	-0.76	-1.63	85.59	82.94	93.64	-146.22
Std. Dev.	2.39	0.45	2.01	11.08	6.06	8.22	75.06
Skewness	2.39	1.97	2.73	0.24	-0.12	0.09	0.74
Kurtosis	10.19	10.95	11.98	1.46	1.79	1.61	2.95
Sum	3.11	-0.10	0.04	6096.08	5575.25	6401.87	-18.49

Note: AE FSI – advanced economies financial stress index, EM FSI – emerging economies financial stress index, US FSI – United States Financial Stress Index, EXR AE – advanced economies nominal broad exchange rate, EXR EM – emerging economies nominal broad exchange rate, EXR US – United States nominal broad exchange rate, GEAI – Global Economic Activity Index

4.2. Stationarity analysis

The unit root analysis was conducted by means of the Augmented Dickey Fuller test and the results are given in Table 2. The purpose of the unit root test is to evaluate the variables for unit root and determine the order of integration.

Table 2. Stationarity test (ADF)

|	Intercept	Trend & Intercept	Order
FSI AE	-2.41	-2.82	
D (FSI AE)	-3.60*	-3.49**	| (1)
FSI EM	-3.61*	-3.54**	| (0)
FSI US	-2.37	-2.79	
D (FSI US)	-4.08*	-4.00*	| (1)
EXR AE	-1.29	-2.71	
D (EXR AE)	-5.21*	-5.15*	| (1)
EXR EM	-1.54	-1.91	
D (EXR EM)	-5.93*	-6.03*	| (1)
EXR US	-1.63	-2.66	
D (EXR US)	-5.19*	-5.18*	| (1)
GEAI	-2.27	-3.02	
D (GEAI)	-7.97*	-7.90*	| (1)

Note: * and ** denote statistical significance at the 1% and 5% level, respectively.

The variables were examined for unit root at intercept and trend and intercept. From the analysis, only the emerging markets financial stress index was found to be stationary at level. The rest of the variables, including the global economic activity index and nominal broad exchange rate in emerging markets, advanced markets and the United States were found to be stationary after first differencing.
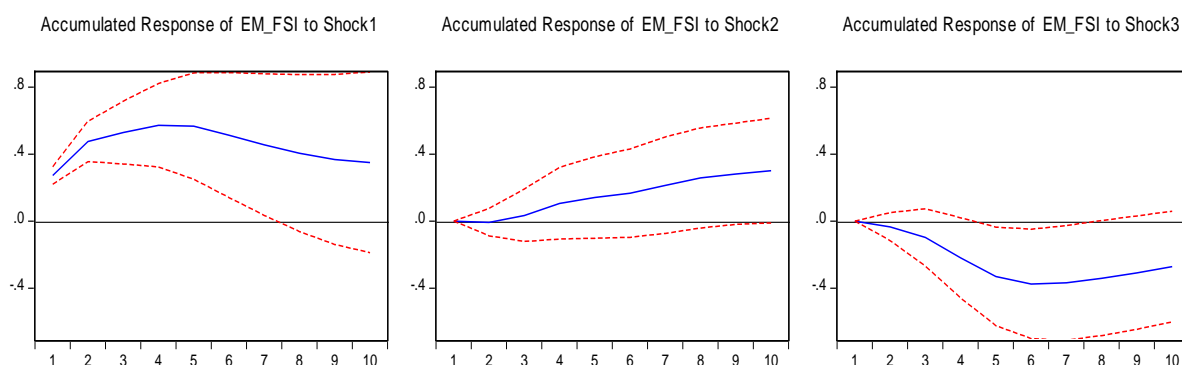
4.3. Impulse response

The impulse response function was estimated through structural factorization to account for structural shocks in the financial system. The primary goal of impulse responses is to determine the response of endogenous variables to a one standard deviation. The results for advanced economies, emerging economies and the United States are illustrated in Figures 1-3, respectively.

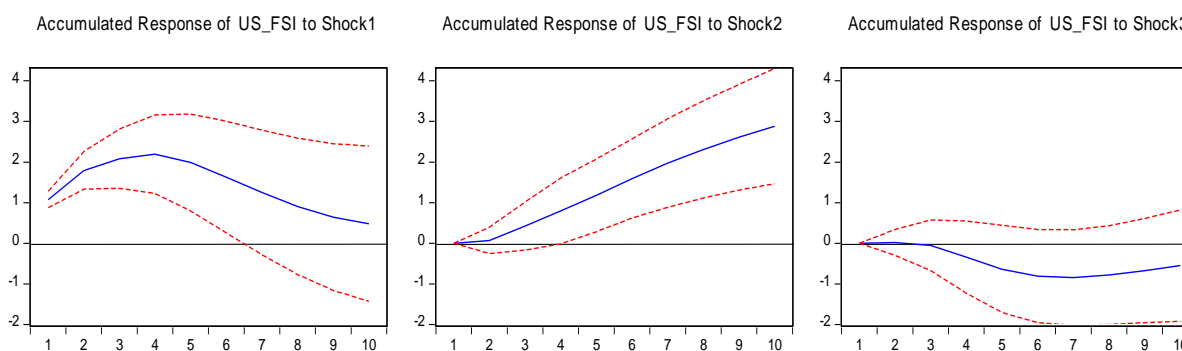Accumulated Response to Structural VAR Innovations ± 2 S.E.
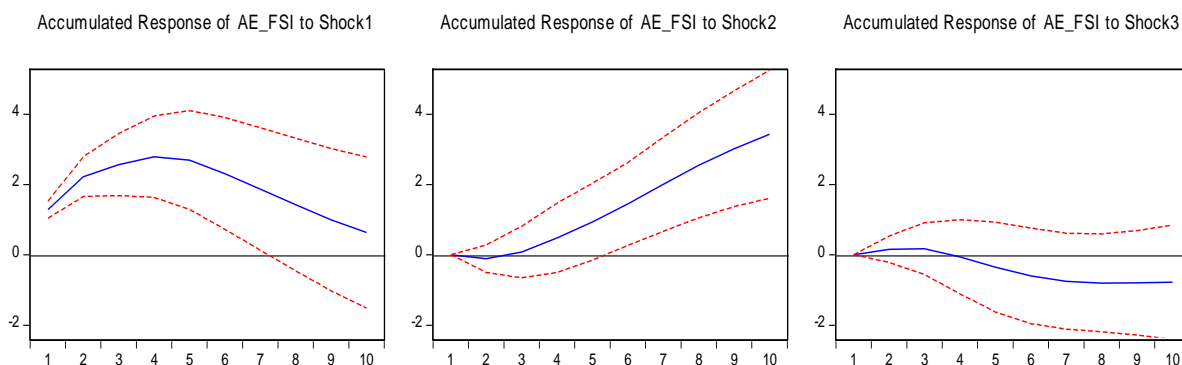
Figure 1. Impulse responses (Advanced economies)

Accumulated Response to Structural VAR Innovations ± 2 S.E.

Figure 2. Impulse responses (Emerging economies)

Accumulated Response to Structural VAR Innovations ± 2 S.E.

Figure 3. Impulse responses (United States)

The general finding is that financial market stress responds positively to shocks in global economic activity and negatively to shocks in exchange rate stability. This implies that enhancements in global economic activity result in a more stable financial market whereas a deterioration in global economic activity would result in a more volatile financial market. In contrast, we find that financial market stress responds negatively to shocks in the broad exchange rate. A positive shock in the exchange rate translates into a more stable financial market while a negative shock to the exchange rate translates into an unstable financial market. These findings are in line with Golovnin and Oganesian (2018), who found that exchange rates have a negative influence on financial stability in Russia.

4.3.1. Advanced economies

In Japan and Europe, financial market stress responds positively to its own innovations in the short run and long run although the magnitude of response deteriorates overtime. Similarly, the financial market stress responds positively to innovations in global economic activity at an increasing rate between the short run and long run. On the contrary, the response financial market stress to a one standard deviation in the exchange rate was found to be positive in the short run but negative in the long run. Notably, the size of response in the financial market stress to shocks in the exchange rate is relatively larger than the size of response to shocks in global economic activity.

4.3.2. Emerging markets

A similar trend was observed in emerging markets. For example, the financial market stress responds positively to its own innovations and innovations in global economic activity although the response is relatively smaller in magnitude compared to advanced economies. Likewise, the response of financial market stress to a one standard deviation in exchange rates was found to be negative in the short run and long run.

4.3.3. United States

The United States is no exception. Findings from the impulse response function revealed that the financial market stress responds positively to its own innovations both in the short run and long run. In respect of global economic activity, we find that the response of financial market stress to a one standard deviation in global economic activity is muted in the short run but positive in the long run. On the contrary, the financial market stress responds negatively to shocks in the exchange rate in the long run albeit the response is neutral in the short run.

4.4. Variance decomposition

In line with impulse responses, the variance decomposition was executed to measure forecast errors of each variable in relation to its own shock. The results are provided in Table 4.

Table 4. Variance decomposition

P	AE_FSI	GEAI	EXR_AE	EM_FSI	GEAI	EXR_EM	US_FSI	GEAI	EXR_US
1	100.00	0.00	0.00	100.00	0.00	0.00	100.00	0.00	0.00
2	98.52	0.47	1.01	98.98	0.04	0.97	99.69	0.28	0.02
3	97.29	1.74	0.96	94.38	1.40	4.22	92.87	6.88	0.26
4	90.29	7.12	2.59	81.63	4.66	13.71	83.05	12.63	4.32
5	82.28	12.76	4.97	74.87	5.03	20.10	75.31	17.29	7.41
6	75.95	18.03	6.02	74.08	5.25	20.67	70.89	21.52	7.59
7	71.10	23.09	5.80	73.56	6.41	20.03	68.88	24.19	6.92
8	67.94	26.79	5.26	72.86	7.28	19.87	67.55	25.91	6.54
9	66.15	29.01	4.85	72.40	7.49	20.11	66.13	27.29	6.57
10	64.94	30.48	4.58	71.75	7.62	20.64	64.76	28.46	6.78

4.4.1. Advanced economies

The variance decomposition analysis indicates that in the short run (3 years), 97% of the variations in the financial stress index are explained by its own shock. In the medium term, however (6 years), only 75% of the variations in the financial stress index are explained by its own shocks while 18% of the variations are explained by shocks in global economic activity and 6% of the variations by shocks in the broad exchange rate. In the long run (10 years), a larger

proportion (65%) of the variations in the financial stress index remain explained by its own shocks while 30% of the variations in the financial stress index are explained by shocks in global economic activity and 5% by shocks in the exchange rate. Similar results were likewise obtained by Taylor (2015), who found that shocks in financial market stability are largely explained by shocks in global economic activity than in the exchange rate.

4.4.2. Emerging markets

In respect of emerging markets, the findings revealed that in the short run (3 years), 94% of the variations in the financial stress index are explained by its own shocks while 1.4% and 4.2% of the variations are explained by shocks in global economic activity and broad exchange rate, respectively. In the long run (10 years), a huge chunk (72%) of the discrepancies in the financial stress index are still explained by its own innovations while only 7.6% of the discrepancies in the financial stress index are explained by innovations in global economic activity. The share of exchange rate shocks in explaining discrepancies in the financial stress index is relatively higher than the share of global economic activity shocks at least in the long run. Shocks in the exchange rate explain 21% of the variations in financial market stress.

4.4.3. United States

In the United States, 71% of the variations in financial market stress are explained by its own shocks in the medium term (6 years) while 21% and 8% of the discrepancies in financial market stress are explained by shocks in global economic activity and the broad exchange rate, respectively. These findings are in line with Jeremy (2012), who analyzed monetary policy as a financial stability regulation in the United States. Over the long term (10 years), a large fraction (65%) of the variations in financial market stress are still explained by its own innovations, followed by innovations in global economic activity (28%) and broad exchange rate (7%).

4.5. Residual analysis

The last step of analysis involved evaluating the residuals of the estimated model for autocorrelation and heteroskedasticity. The Vector autoregression technique is vulnerable to autocorrelation and thus performing residual diagnostics is necessary under this econometric approach. The findings are presented in Table 5.

Table 5. Residual diagnostic tests

	Advanced Economies		Emerging Markets		US	
	Obs*R-squared	Prob. Chi-Square	Obs*R-squared	Prob. Chi-Square	Obs*R-squared	Prob. Chi-Square
Autocorrelation	33.58	0.60	24.71	0.92	38.68	0.37
Heteroskedasticity	166.85	0.09	153.95	0.27	158.66	0.19

The autocorrelation test indicates that the estimated models for the advanced market economies, emerging market economies and United States do not suffer from autocorrelation. This is because the corresponding probability values of the chi-square are greater than 5%. As such, the null hypothesis of autocorrelation is rejected against the alternative hypothesis of no autocorrelation. Equally, the white heteroskedasticity test reveals that the estimated models for advanced market economies, emerging market economies and the United States do not suffer from heteroskedasticity. This is indicated by the corresponding probability values of the chi-square, which are above 5% in all models.

5. Conclusion and recommendations

The study examines the response financial market stress to innovations in global economic activity and the exchange rate in emerging market economies and advanced economies during the period 2006Q1 and 2020Q4. This is achieved by means of time series econometric analysis. This includes unit root analysis, structural Vector autoregression, impulse response function and variance decomposition. The impulse response function estimated through structural factorization indicates that financial market stress responds positively towards its own innovations and innovations in global economic activity. In contrast, financial market stress responds negatively to a one standard deviation in the exchange rate at least in the long run albeit the response is neutral in the short run. The findings from the variance decomposition shows that in advanced market economies, a larger fraction of the discrepancies in financial market stress are explained by its own innovations followed by innovations in global economic activity, whereas in emerging market economies, a larger proportion of the discrepancies in financial market stress are explained by its own innovations followed by innovations in the broad exchange rate. The estimated residuals are likewise examined for autocorrelation and heteroskedasticity. Given the findings, the study recommends strong coordination between monetary policy and fiscal policy to ensure that overall economic activity is optimized and maintained in the long run. Monetary authorities have a role to play in ensuring price and exchange rate stability while fiscal authorities have the tools to realize minimal budget deficits and optimal debt management.

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