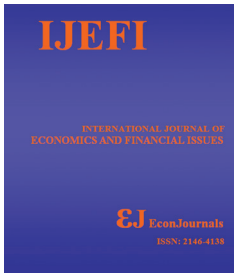

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Malaysian Financial Stress Index and Assessing its Impacts on the Economy

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ABSTRACT

The study further investigates the link between the constructed financial stress index (FSI) and overall economic activity. We approximate the co-movement of the identified financial and economic factors into a single index using the principal component analysis. The combine variables explain about 60% of the total variation in the Malaysian FSI and practically captured the known key aspects of financial stress in Malaysia. The study further applies asymmetric causality and structural vector autoregressive to distinguish between causality in good and bad times and examine the structural impulse responses in changes in the economic activity arising from the shocks in financial stress. The study reveals that changes in the Malaysian FSI (MFSI) negatively affects the economic activity of Malaysia whereas, changes in the economic activity is positively related to the MFSI. Furthermore, the asymmetric causality indicates that high financial stress affect the economic activity during economic recession but economic activity irrespective of whether in boom or recession does not influence the MFSI. However, using the growth rate of foreign trade to proxy economic activity indicates that MFSI influences economic activity irrespective of good or bad times. Nevertheless, economic activity measured using GFD also affect MFSI during the period of economic recession. This also shows that the indicators employed in the construction of the index are the near approximation of the FSI for Malaysia due to its ability to reflect the available information included in the index. The study concludes with policy implications based on the behavior of the MFSI.

Keywords: Economic Indicators, Financial Crisis, Malaysian Financial Stress Index
JEL Classifications: C43, G01, O47

1. INTRODUCTION

The construction of financial stress index (FSI) become imperative as a result of the repeated incidences of financial crises. In emerging economies like Malaysia, the episodes of the financial crises occurred often enough (Hong et al., 2010; Tng and Kwek, 2015). It is further argued that the episode of financial crises are associated with prolonged process of recovery compared to other forms of recessions (Reinhart and Rogoff, 2014). The recent noticeably obvious episode is the mid-1980's fiscal profligacy regarded as a prime mover of the Malaysian commodity shock vulnerability coupled with the capital market liberalization of the early 1990s as well as the domestic credits accumulated by the Malaysian banking sector (Athukorala, 2010). However, the most significant financial crises in the history of Malaysian economy is the 1997 Asian financial crisis. This contracts the economic activities by a very sharp decline which raises the Malaysia's financial stress to reach its highest level starting from the early 1996 up until 1997. This also raises the Malaysia's financial stress.

The novelty of this study is that unlike the study of Balakrishnan et al. (2011) and Tng and Kwek (2015) who followed Illing and Liu (2006) measurement of FSI, our study is carried out using data of an emerging Asian Economy, Malaysia including other economic measures such as trade finance and external debt as emphasized in Cevik et al. (2013) in addition to most of the measures used in Illing and Liu (2006). The significance of including the economic indicators include addressing various aspects of financial stress especially those related to external debt and trade finance in emerging and developing economies. This

is similarly emphasized in Cevik et al. (2013). Furthermore, the study uses longer sample data and applies asymmetric causality to distinguish between causality in good and bad times and structural vector autoregressive (SVAR) to examine the structural impulse responses in changes in the economic activity arising from the shocks in financial stress.

The rest of the paper is structured into the following components; Section 2 presents literature review on financial stress, Section 3 deals with methodology, Section 4 presents results and discussions, Section 5 discusses the relationship between the Malaysian FSI (MFSI) and Malaysian economic activity and finally, Section 6 concludes the paper and offers policy implications of the study.

2. LITERATURE REVIEW

Financial system stability and economic growth have close and versatile relationship, which also highlights the importance to continuously assess and monitor the condition of a financial system (Siņenko et al., 2013). There are increasing efforts on improving the assessment and monitoring tools to create mechanisms for effective mitigation and prevention of systematic risk in order to sustain financial stability. Earlier studies (Demirgüç-Kunt and Detragiache, 1998; Berg and Pattillo, 1999; Kaminsky and Reinhart, 1999; Disyatat, 2001) identify common antecedent factors from historic crisis episodes to examine the factors that may cause financial instability. For example, Demirgüç-Kunt and Detragiache (1998) determine the factors associated with the emergence of systematic banking crisis, using multinomial logit model.

Nonetheless, these studies are subject to drawbacks thus are ineffective to measure the episodes of financial stress (Illing and Liu, 2006; Balakrishnan et al., 2011). First of all, these studies measure the occurrence of a crisis as a simple zero-one binary variable, whereby no crisis takes the value of zero and presence of crisis takes the value of one, instead of providing the intensity of crisis and near-miss events. Note that a country that takes the value of zero does not necessarily signify low financial stress. Secondly, earlier studies are paying more attention to banking, currency and debt crises, but pay little attention to securities-market stress (Cevik et al., 2013).

On the other hand, Kaminsky (1999) examines the empirical evidence on currency crises and develops an early warning indicator (EWI) to predict a potential crisis. The system involves monitoring the evolution of a number of economic indicators that tend to systematically behave differently prior to a crisis. Whenever an indicator exceeds a certain threshold value, it alarms that a potential currency crisis may take place. Empirical results show that the variables that are effective in predicting currency crisis include exports, deviations of the real exchange rate from trend, the ratio of broad money to gross international reserves, output and equity prices. As robustness, the indicator is tested for the Asian crisis, which point out clear signs of distress as early as 18 months before the currency collapse.

In recent years, increasing number of studies has shifted focus to developing FSI, a single composite indicator (Illing and Liu, 2006; Hakkio and Keeton, 2009; Balakrishnan et al., 2011; Cevik et al., 2013 and Cevik et al., 2013). FSI is an alternative continuum and contemporaneous measure used to evaluate and monitor the condition of a financial system. Additionally, FSI is claimed to address the weakness inherent in models that use EWIs by improving the reference variable. The indicator is a continuous dependent variable of high frequency, constructed by aggregating several indicators including the equity markets, bond markets, foreign exchange markets, and the banking sector (Illing and Liu, 2006). However, there are also studies that focus only on sector specific intensity of crisis, such as the banking stress index derived by Hanschel and Monnin (2005) that measure the intensity of banking crisis in Switzerland.

In addition, there are considerable attempts to derive FSI for emerging countries. Balakrishnan et al. (2011) not only proposes FSI for developing countries, but also examine the transmission channels of financial stress between advanced and developing countries. The FSI is constructed using the same methodology as Cardarelli et al. (2011). Domestic FSI of an emerging economy is claimed to be influenced by financial stress in developed economies as well as gross domestic product growth, interest rate, degree of financial and trade linkages and other domestic macroeconomics vulnerabilities (Balakrishnan et al., 2011). Results confirm that financial crises in advanced financial systems pass through to emerging markets and the degree of pass through is dependent on the depth of financial linkages between the two. On the other hand, Park and Mercado (2014) examine the channels of financial transmission in emerging market economies. Using FSI of 25 emerging markets in Asia and Europe, they conclude that domestic financial stress not only increases by advanced economies FSI, but also regional and non-regional emerging market FSIs.

As for the specific variables used to measure financial stress, the emphasis is on banking sector, foreign exchange, debt, and equity markets, being the four most important credit channels in most countries (Illing and Liu, 2006; Yiu et al., 2010; Balakrishnan et al., 2011). Nonetheless, it is argued that financial markets alone is not enough to gauge financial stress of emerging markets since there are additional sources of financial stress such as external debt and sovereign risk (Cevik et al., 2013) and trade credit (Cevik et al., 2013; Cevik et al., 2013; Rey, 2009).

3. METHODOLOGY

Following Hakkio and Keeton (2009), Cevik et al. (2013) and Cevik et al. (2013) the study constructs a MFSI using financial stress variables.

3.1. Banking Sector Crises/Risk

This is an inability of banks to meet their internal obligations due to actual or incipient bank failure (Bordo, 1986). It is also related to bank failures that lead to systemic exhaustion of either all or most part of its capital (Caprio and Kilingbiel, 1996). However, it is argued that there is no general acceptable definition of banking crisis and that the features are usually country specific (Illing and Liu, 2006). The BSF index is constructed using data on assets and liabilities of banking sector. This includes data on real commercial

bank deposit (CBD), real claims on domestic private sector (CDP) and real foreign liabilities of banks (FLB). The index is constructed based on Equation 1 as follows:

$$\left[\frac{\Delta CBD_t - \mu\Delta CBD}{\sigma\Delta CBD}\right] + \left[\frac{\Delta CDP_t - \mu\Delta CDP}{\sigma\Delta CDP}\right] + \left[\frac{\Delta FLB_t - \mu\Delta FLB}{\sigma\Delta FLB}\right] \quad (1)$$

$$BSF_t = \frac{}{3}$$

Where, Δ denotes a difference operator denoting changes in the series over 12-months period. The symbols μ and σ represent mean and standard deviation of the series under consideration. It is hypothesized that a decrease in the index shows increase in the banking sector riskiness (Balakrishnan et al., 2011; Cevik et al., 2013).

3.2. Currency Market Volatility

The study calculates the Exchange Market Pressure Index (EMPI) to measure the degree of exchange rate pressure. The EMPI has been proposed by Girton and Roper (1977) and widely used in the literature. The series is calculated following Balakrishnan et al. (2011) and Cevik et al. (2013) among others as follows:

$$EMPI_t = \frac{\Delta exc_t - \mu\Delta frv}{\sigma\Delta exc} - \frac{\Delta frv_t - \mu\Delta frv}{\sigma\Delta frv} \quad (2)$$

Where, Δ represents 12-months changes in exchange rate and international reserve. exc is the exchange rate series, frv denotes foreign reserve excluding gold. The notations, μ and σ symbolize mean and standard deviation of the exchange rate and international reserve.

3.3. Stock Market Crises/Risk

Stock market risk is another vital components of financial stress, especially in developing countries. The advantage of using the stock market return risk is that its conditional variance is used in pricing derivatives, hedging and calculating risk measures (Cevik et al., 2013). The volatility is measured based on Equation 3 and 4 below:

$$SMR_t = Y_t'\vartheta + \varepsilon_t \quad (3)$$

$$\sigma_t^2 = \omega + \alpha\varepsilon_{t-1}^2 + \beta\sigma_{t-1}^2 \quad (4)$$

Where, SMR_t is the stock market index for time t, Y' includes a vector of constant and autoregressive terms of the stock market return. σ^2 is the conditional variance and ε^2 represents the autoregressive conditional heteroskedasticity term.

3.4. Money Market Spread

This measures the liquidity of the financial market. The money market usually supplies banks with short terms credits. It is identified in the literature that financial stress increases when money market becomes illiquid. The illiquidity in the money market leads to the financial market distortion (Cevik et al., 2013). This study includes bid-ask spread in the foreign exchange rate in the process of constructing the MFSI. The money market spread or bid-ask spread is calculated as:

$$Spread = \left\{\frac{[AP - BP]}{[\frac{AP + BP}{2}]}\right\} * 1 \quad (5)$$

Where, AP and BP are the ask and bid prices respectively. Due to non-availability of data on bid and ask prices, the study employs highest and lowest prices for foreign exchange to proxy bid and ask prices respectively. This is in line with similar previous studies such as Cevik et al. (2013).

3.5. Sovereign Bond Risk

In an emerging economy like Malaysia, changes in risk perception by investors leads to short-term capital flows. Therefore, following Balakrishnan et al. (2011); Cevik et al. (2013), the study uses 10-years government bond yield and 10-years US Treasury Bond yield in constructing the MFSI. The sovereign risk spread can be used as an important measure of risk perception in the economy. This is measured as a difference between 10-years Malaysian government bond and US Treasury Bond yield as follows:

$$\text{Sovereign Bond Risk} = GBY_t - USB_T \quad (6)$$

Where, GBY and USB indicate monthly 10-years Malaysian government bond yield and monthly 10-years U.S. Treasury Bond yield respectively. The subscript *t* denotes time period, which represents monthly frequency in this study.

3.6. External Debt

It has been argued in the literature that external debt constitute one of the important financial stress indicators especially in developing economies (Abiad, 2003; Bussiere and Fratzcher, 2006). In this study, we proxy external debt using 12-months growth rate of external liabilities. The rate is calculated using Equation 7 as follows:

$$EXDGR = \left(\frac{EXL_t - EXL_{t-1}}{EXL_{t-1}}\right) * 100 \quad (7)$$

In Equation 7, EXDGR stands for external debt growth rate. EXL_t and EXL_{t-1} are the current and previous external liabilities respectively. The value, 100 is multiplied by the fraction to arrive at the percentage change.

3.7. Trade Finance

Trade finance is also another component of the financial stress suggested in Rey (2009) especially for developing and emerging economies. Following Thomas (2009) and Cevik et al. (2013), trade finance is measured using net financial flows as a proxy variable. The study employs net financial flows to account for foreign direct investment related trade and multinational intra-firm related finance which are excluded in alternative trade finance measure such as short-term credit (Ronci, 2004).

3.8. Credit Stress

This study follows the measurement adopted in Cevik et al. (2013) to proxy credit stress. This is the use of rate of growth on claims on the private sector. The growth rate is calculated based on Equation 8:

$$\text{Credit Stree} = \left(\frac{CPS_t - CPS_{t-1}}{CPS_{t-1}}\right) * 100 \quad (8)$$

Where, credit stress is calculated as growth of claims on private sector. Therefore, CPS_t and CPS_{t-1} are the current and previous claims on private sector respectively. We arrived at the percentage changes by multiplying the fraction by 100 as in Equation 8.

3.9. Data

The study employs data from various sources to construct the overall FSI. Monthly data spanning 1991:1 to 2015:8 were collected on money market interest rate, international reserve, foreign exchange rate, domestic currency credits, 10-years government bonds yield, external medium and long term debt securities, base currency in circulation, claims on the private sector, external liabilities, commercial banks deposit, foreign liability of banks and interest rate 3-months treasury bills from Bank Negara Malaysia (BNM). Industrial production, merchandise imports and exports data are taken from the Department of Statistics, Malaysia whereas, data on net financial flows, banking sector and stock market indices are collected from the Bank for International Settlement. 10-years US bonds interest rate yields and claims on domestic private sector are generated from the Federal Reserve of US and International Financial Statistic respectively.

4. RESULTS AND DISCUSSIONS

4.1. Aggregation of the Components

According to Hakkio and Keeton (2009) financial stress usually works toward variable convergence whereas, other factors lead to deviation of the variables from one another. This scenario is examined using correlation analysis presented in Table 1. The table presents the correlation coefficients among the selected variables over the study period. The coefficients show approximately an average value of 52%. This indicates that although the variables move together within a certain boundary however, they do not move at the same speed and horizon. Furthermore, the coefficients are not highly correlated, ranging from 0.03 to 0.70. This further implies that the series will independently contribute to the construction of the MFSI.

To precisely approximate the co-movement of the variables, the study follows the popular methodology of principal component analysis (PCA) employed in the similar previous studies such as Hakkio and Keen (2009), Cevik et al. (2013), Cevik et al. (2013) to combine the identified financial and economic variables into a single FSI for Malaysia.

4.2. PCA

The PCA is a descriptive and explanatory method of reducing the original large number of variables collected from a single population in to a lower non-correlated or orthogonally synthesized factors or variables. It scientifically visualizes and correlates variables among statistical units. The weights of the variables used in the PCA for this study are presented in Table 2. Prior to the component aggregation, the study standardized all variables by subtracting their mean from the contemporaneous value and dividing by their standard deviation. This is carried out to directly assess the magnitude of the coefficients. Furthermore, the standardization of the data prevents the problems of unit of measurement and variation bias. The PCA is calculated based on the following procedure:

$$\hat{Y}_{ij} = \hat{e}_{ij}X_1 + \hat{e}_{ij}X_2 + \ldots + \hat{e}_{ip}X_p \quad (9)$$

Where, represents a function of the standardized constructed variables for every j component. are the regression coefficients of the random standardised variables, X_1, X_2,…, X_p in each of the components. X_i is a vector of variables such as banking sector fragility index, EMPI, stock market volatility, government bond spread, external debt, trade finance and credit stress. The principal components equal to the number of the random vector of variables. The first component specifies the coefficients of the constructed variables to maximize it variance and obtain a unique number subject to the constraint of equating the sum of the squared coefficients to unity. The process is similarly repeated in the second and subsequent components to account for the remaining variation as much as possible subject to the constraint that the correlation

Table 1: Correlation coefficients for MFSI series

???	BSFI	EMPI	SMV	SBR	DEBT	TRADE	CREDIT
BSFI	1.000						
	-						
EMPI	0.131**	1.000					
	(0.025)	-					
SMV	−0.151***	−0.360***	1.000				
	(0.009)	(0.000)	-				
SBR	−0.140**	0.404	−0.066	1.000			
	(0.016)	(0.455)	(0.261)	-			
DEBT	0.313***	−0.032	−0.703	0.119**	1.000		
	(0.000)	(0.579)	(0.210)	(0.042)	-		
TRADE	0.028	−0.114**	0.118**	−0.120**	−0.691	1.000	
	(0.631)	(0.051)	(0.044)	(0040)	(0.906)	-	
CREDIT	0.516***	0.078	−0.064	−0.012	0.104*	−0.602	1.000
	(0.000)	(0.177)	(0.271)	(0.848)	(0.073)	(0.290)	-

Source: Authors' computation. ***.** and * indicate significance level at 1%, 5% and 10% respectively. The values in parenthesis are the probability values of the pairwise correlation coefficients. The notations BSFI, EMPI, SMV, SBR, DEBT, TRADE and CREDIT represent the constructed variables, banking sector fragility index, exchange market pressure index, stock market volatility, government bond risk, external debt, trade finance and credit stress respectively. MFSI: Malaysian financial stress index

values of the first and second as well as subsequent components are all equal to zero. This ensures that there exist no correlation among the principal components. We estimate various combinations of series with numerous grouping in the PCA to arrive at the index with high explanatory power of the total variance. The coefficients of the individual constructs are obtained from the Eigen vector of the PCA correlation matrix. The results of the PCA are presented in Table 2.

The results of the standardized PCA coefficients indicate the impact of one-standard-deviation shock in the components on the overall MFSI. The result shows that MFSI increases as a result of increase in banking sector fragility index, EMPI, stock market volatility, external debt and credit stress. In other words, the result shows that during excessive financial stress, the Malaysian banking sector becomes more fragile; the stock market becomes more volatile; the pressure on the domestic currency increases; external liabilities raises and claims on the private sector (credit stress) grew over time. Furthermore, the weights of the variables reveal that the magnitude of the Malaysian financial stress is mainly driven by the fragility of the banking sector. Similar result is found in Cevik et al. (2013) for Bulgaria and Russia. This is followed by claims on the private sector (credit stress) and external debt. The least component that increases the magnitude of the financial stress in Malaysia is the exchange rate pressure index. This might be as a result of the managed floating exchange rate regime of the country which does not fully allow the currency prices to be solely determined by the market forces.

The coefficients of the components are in most cases in line with a prior expectations. However, the result on the external debt component contradicts the findings of Cevik et al. (2013) and Cevik et al. (2013) who found that short term debt is negatively related to FSI for Turkey, Bulgaria, Czech Republic, Hungary, Poland and Russia. The present study proxies external debt by external liabilities and found a positive relationship in Malaysia. Perhaps, this might be related to the perception and concern of the market participants about Malaysia's debt sustainability which is anticipated to affect the solvency of the country's financial sector, thereby increase in the abnormal workings of the financial system. Moreover, the result is in line with the findings of Reinhart et al. (2012) who conclude that external debt is one of the factors that retard growth of a given economy.

The components jointly explained about 60% of the total variation in the FSI. Thus, the financial stress is determined to be the key player in the co-movement of the components used in the construction process. However, the result of the PCA are only descriptive and are not used for testing hypotheses. Furthermore, the performance of the constructed index is assessed by its ability to indicate the established episodes of financial stress and how it affects the economic activity of a country. Figure 1 shows the plots of the MFSI and possible events that occurred during the period under study.

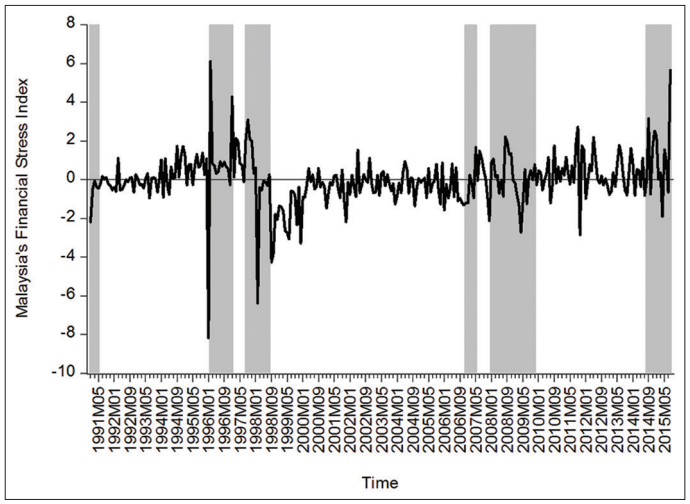
The graph of the MFSI (Figure 1) indicates the historic recessions that occurred in the economy from the period of 1991M1 to 2015M8. Figure 2 shows the plots of the MFSI and its standard deviation threshold line to identify the high episodes of financial stress in Malaysia.

Table 2: PCA results

Components	Weight/Coefficient
BSFI	0.619
EMPI	0.291
SMV	0.330
GBS	−0.128
External debt	0.356
Trade finance	−0.083
Credit stress	0.523
Total variance explained	59.83%

Source: Authors' computation. BFSI: Banking sector fragility index, SMV: Stock market volatility, GBS: Government bond spread, PCA: Principal component analysis, EMPI: Exchange market pressure index

Figure 1: The Malaysia's Financial Stress Index. Shaded areas are recessions



The graphs show that the MFSI has been consistently volatile over the period of our study. The first obvious shock that is captured in the sample period is the spill over effect of the mid-1980's fiscal profligacy which is regarded as the prime mover of the Malaysian commodity shock vulnerability coupled with the capital market liberalization of the early 1990s as well as the domestic credits accumulated by the Malaysian banking sector (Athukorala, 2010). However, the most significant episode in the history of Malaysian economy is the renowned Asian financial crisis. This is significantly captured in Figure 1. The event started in 1996 which leads to shrink in the Malaysian economic growth as a result of the speculative deals in the exchange rate market, fell in foreign inflow of investments, excessive capital outflows, reasonable decrease in the Kuala Lumpur Stock Exchange's composite index and low external debt exposure of banking sector. This contracts the economic activities by a very sharp decline which raises the Malaysia's financial stress to reach its highest level sometimes in the early 1996 up until 1997.

Furthermore, the MFSI also captured the Malaysia's ability to absorb the shocks of the Asian financial crisis which started from the last part of 1998 to the early part of 1999. This is not unrelated to the implementation of pegged exchange rate, capital control measures, suspension of central limit order book trading, budget

deficits, low interest rate and export orientation adopted by the BNM. These measures kept the MFSI mostly below zero with deviations within the same regime until 2007 when share prices declined as a result of the global financial crisis. This affects export and other financial sectors of the economy which dragged down the economic growth and raises the financial stress in the country. Nevertheless, the menace of the 2007-2009 financial crisis was not as severe as that of 1997-1998 Asian financial crisis at least for Malaysia. This is due to the improved resilience of the Malaysia's financial sector and its limited exposure to the US collateral debt obligations coupled with the immediate response of the Malaysian monetary policy to the shock.

Moreover, the current Malaysia's currency depreciation leads to declining consumer and investors' confidence thereby raising capital flight. This also raises the FSI above the threshold starting from the last part of 2014 and contracts the recorded sustainable economic growth. However, the algorithm fails to capture only one high financial stress which is above the standard deviation threshold level. These periods are approximately defined to be January 2012 and September of the same 2012.

5. FINANCIAL STRESS AND ECONOMIC ACTIVITY

Under this section, the study investigates the empirical relationship between Malaysia's FSI and economic activity, proxied by the 12-months growth rates of industrial production index and foreign trade. Foreign trade is measured as the sum of merchandize exports and imports. Previous studies basically examine the link between the financial variables and the real sector using financial variables such as financial leverage, bank capital channels and stock prices uncertainty. The financial leverage deals with the effect of credit provided by debtors' collateral on the real economic activities whereas the bank capital channels relate to the deleveraging of the banking sector as a result of bank capital erosion during financial stress. This is argued to contract credit facilities by the banking sector which in turn affect investment and economic growth (Cardarelli et al., 2011; Cevik et al., 2013) among others. However, it is highlighted that the impact of financial stress on the real economy is still a debatable and inconclusive issue in both literature and policy circles (Cardarelli et al., 2011).

Although the relationship between FSI and real sector is widely studied in the literature, the present study accounts for the existence of structural breaks in the data generating process and further distinguishes the relationship between the MFSI and economic activity in both good and bad times. Moreover, the study employs longer sample data from the emerging South East Asian economy, Malaysia.

On the other hand, the asymmetric Granger causality is estimated to find out whether MFSI is helpful in predicting/influencing economic activity or otherwise and vice versa. The advantage of using the asymmetric causality over the asymptotic Granger causality is that, the present method distinguishes the influence of one series on another under good and bad times. Another obvious reasons for the use of asymmetric causality are associated with the size distortion, independence of nuisance parameter estimates and spurious conclusion based on the asymptotic distribution of the traditional Granger causality (Guru-Gharana, 2012; Toda and Yamamoto, 1995).

5.1. Unit Root Analysis

The study employs the Lee and Strazicich (2013) minimum LM test with one structural break to account for the existence of structural break in the data generating process. The test is break point independent and nuisance invariant under the alternative hypothesis. It shows neither size nor location dependence and unaffected by incorrect estimation irrespective of the existence or otherwise of break (Lee and Strazicich, 2013). Table 3 indicates that all series are stationary at level under the trend model. This shows that the growth rate of industrial production index, foreign trade and MFSI are found to be trend stationary with structural break. In this study, the break point λ is computed as TB/T and found not beyond λ = 0.1 in all cases. Therefore, the critical values displayed in Table 3 is appropriately employed for testing the null hypotheses of unit root with structural break. Furthermore, the trend break points are found statistically significant and represent the known structural changes of Asian financial crisis for the growth rate of industrial production index and MFSI as well as global financial crisis for the growth rate of foreign trade. The test further proved the existence of financial stress in Malaysia as presented in Figures 1 and 2. The result of the LS test enable us to estimate a stationary SVAR and causality in the cumulative sum of positive and negative changes in the series.

Table 3: Lee and Strazicich one-break minimum LM Unit Root Test

	Model A					Model C				
Variable	$\hat{k}$	$\hat{}$	$\hat{t}_{\gamma j}$	Test statistic	λ	$\hat{k}$	$\hat{T}_B$	$\hat{t}_{\gamma j}$	Test statistic	λ
GIPI	12	1994:06	2.015**	−2.319	0.007	12	1998:08	−9.233***	−9.215[A]	−0.003
GFD	12	2011:12	0.029	−5.310[A]	0.001	12	2008:09	4.654***	−6.776[A]	0.017
MFSI	12	1994:08	1.309	−1.742	0.005	12	1996:12	−7.074***	−7.335[A]	−0.025
Critical values		1%	5%	10%						
Model A		−4.239	−3.566	−3.211						
Model C		−5.110	−4.500	−4.210						

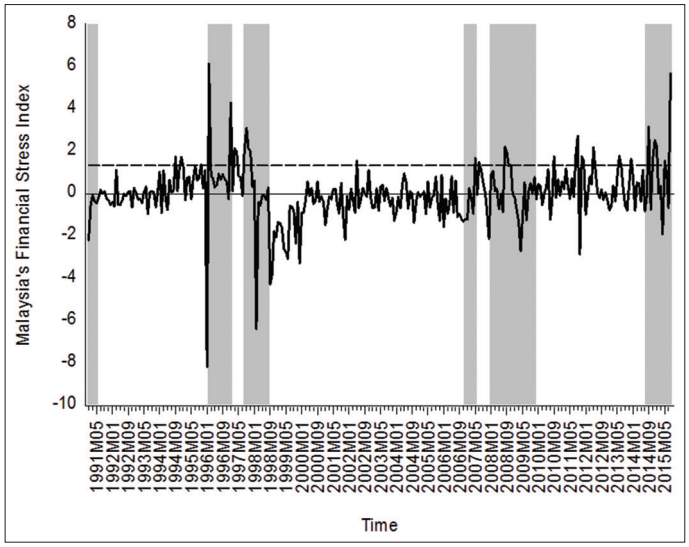
Model B is omitted following Lee and Strazicich (2003; 2013). They argue that most of the economic time series can be adequately described by model A or C. $\hat{k}$ is the optimal number of lagged first-difference terms included in the unit root test to correct for serial correlation. $\hat{T}_B$ denotes the estimated break points. $\hat{t}_{\gamma j}$ is the t value of DT_{jt}, for j=1. λ represents the critical value break points. See Lee and Strazicich (2013) for the critical values. A, B and C indicates significance of the LM test statistics at 99%, 95% and 90% critical level, respectively. While ***.** and *indicates the two-tailed significance level of the break date at 99%, 95% and 90% respectively. LM: Lagrange multiplier

5.2. Asymmetric Causality Test and Bootstrap Procedure

The asymmetric causality test and leverage bootstrap critical values are generated with GAUSS using the program procedure developed by Hatemi-J (2012). The critical values are generated based on the underlying empirical data through bootstrap simulation. The iteration is conducted 10,000 times and MWALD t-statistics are estimated after every iteration to determine the upper quantile of the bootstrapped distribution of the MWALD t-statistics in order to generate 1%, 5% and 10% bootstrapped critical values. Finally, the raw data rather than the bootstrapped one is utilized to calculate the MWALD statistics. The hypothesis of no Granger causality is rejected if the MWALD statistics calculated using the original data is greater than the bootstrapped critical values. The results of the asymmetric causality test is presented in Table 4.

The asymmetric causality result presented in Table 4 reveals that MFSI causes economic activity measured using the 12-months growth rate of industrial production index during the bad times without any evidence of feedback causality or causation in the good time. This result reveals that high financial stress affect the economic activity during the recession but economic activity irrespective of regime (boom or recession) does not influence MFSI. This is in line with Van Roye (2014) who concludes that financial stress below a certain threshold does not affect economic activity in Germany. Furthermore, the result is similar to that of Davig and Hakkio (2010) who found that financial stress had a stronger effect on the economy during distress regime. Moreover, Claessens et al. (2008) also found that recession after high financial stress are more severe compared to other forms of recessions.

Figure 2: High episodes of Financial Stress Index in Malaysia. Shaded areas are Recessions; ---------- Threshold level



However, using an alternative variable (12-months growth rate of foreign trade, GFD) to proxy economic activity indicates that MFSI influences economic activity irrespective of good or bad times. Nevertheless, economic activity measured using GFD also affect MFSI during the period of economic recession. This might be explained by the relationship between GFD and balance of payment, net financial flows and short-terms credit which are suggested to proxy trade finance, a component that determines financial stress of a given economy (Ronci, 2004; Thomas, 2009). Nonetheless, the dynamic nature of relationship between Malaysia's FSI and economic activity is presented using impulse response function in the following sub-section.

6. CONCLUSIONS AND POLICY IMPLICATION

The study constructs MFSI using both financial and economic variables for the period spanning 1991:1 to 2015:08. The variables include financial, such as banking sector fragility index, stock market volatility, EMPI, money market spread, government bond spread, and credit stress as well as, economic factors like the 12-months growth rates of external debt and trade finance. We investigate the impact of the constructed FSI on the Malaysian economic activity. Furthermore, the study forecasts the MFSI.

The study applies principal components analysis to aggregate the MFSI, and asymmetric causality to distinguish between causality in good and bad times and examine the structural impulse responses in changes in the economic activity arising from the shocks in financial stress. The plots of the index indicate that the MFSI captured the historic financial stress episodes that exist in the sample. This makes the MFSI a vital indicator of the real economic activity in the country. Furthermore, the asymmetric causality indicates that high financial stress affect the economic activity during economic recession but economic activity irrespective of whether boom or recession does not influence the MFSI. However, using the growth rate of foreign trade to proxy economic activity indicates that MFSI influences economic activity irrespective of good or bad times. Nevertheless,

Table 4: Asymmetric causality and bootstrap simulation

Null hypothesis	MWALD t-statistics	Leverage bootstrap		
		1% Bootstrap CV	5% Bootstrap CV	10% Bootstrap CV
$MFSI^{+} \not\Rightarrow GIPI^{+}$	2.508	11.364	6.338	4.563
$MFSI^{-} \not\Rightarrow GIPI^{-}$	4.824*	10.940	6.317	4.613
$GIPI^{+} \not\Rightarrow MFSI^{+}$	2.568	14.126	6.933	4.693
$GIPI^{-} \not\Rightarrow MFSI^{-}$	4.255	11.070	6.378	4.619
$MFSI^{+} \not\Rightarrow GFD^{+}$	19.717***	12.169	6.499	4.683
$MFSI^{-} \not\Rightarrow GFD^{-}$	6.068*	10.264	6.326	4.687
$GFD^{+} \not\Rightarrow MFSI^{+}$	3.466	11.067	6.369	4.719
$GFD^{-} \not\Rightarrow MFSI^{-}$	4.700*	10.212	6.176	4.685

AQ1 ***. **, and * represent rejection of the null hypotheses at 1%, 5% and 10% significance level respectively, with reference to bootstrap simulated critical values. The symbol $\not\Rightarrow$ represents Granger non-causality, MFSI: Malaysian Financial Stress Index

economic activity measured using GFD also affect MFSI during the period of economic recession.

The implication is that increase in banks failure to meet up their internal obligations due to excess insolvency, increase non-performing loans and high money withdrawals will lead to procyclicality of debt stocks which reduces the credit facility of the financial sector and greatly affect the economic activity. On the other hand, the prolonged manage floating exchange rate regime also leads to a significant loss in international reserve, rise in interest rate and domestic currency overheating in the exchange rate market. More so, perception and concern of the market participants about Malaysia's debt sustainability which is anticipated to affect the solvency of the country's financial sector, also increase the abnormal workings of the financial system. Likewise, the current Malaysia's currency depreciation leads to declining consumer and investors' confidence thereby raising capital flight. Furthermore, the increasing stock market risk, growth rate of external liabilities and claims on the private sector can also affect the financial stability which in turn deteriorate the level of economic activity in Malaysia.

Therefore, the study suggests that the monetary authority should ensure financial stability in the economy. This should directly deal with creditworthiness of the financial sector through providing sufficient credits to solve the usual problem of insolvency in the financial sector. Policies should be tailored towards export orientation especially when the financial stress is related to external sources. This will lead to more demand for the domestic currency and increase in the external reserves. However, some financial stress components are specific to particular indicators, meaning that when financial stress arise from stock market volatility for instance, the authorities should focus more on stock market stability than other components of the financial stress.

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