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Spill-over Effect of US Sub-Prime Crisis on ASEAN-5 Stock Markets

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This paper examines the spill-over effect of US sub-prime crisis on ASEAN-5 stock market returns. Given the stationarity of the variables at level, we estimate the impact of stock returns in response to the US financial conditions using pooled, fixed effect, random effect and instrumental variable techniques. Our findings show that increasing volatility of US stock returns reduces ASEAN-5 stock market return.

Field of Research: ASEAN-5 stock markets, contagion spill-over effect

1. Introduction

In the age of massive globalization, economies become increasingly integrated. Globalization involves the liberalization of financial markets, which can be in the form of removal of capital barriers to investment. This platform provides easier entrance to one country's capital market that leads to financial market integration. Financial leverage mushroomed at unprecedented manner, thus making these economies vulnerable to financial vagaries. For example, the US sub-prime crisis has caused the stock markets worldwide to plunge to their lowest. The situation deteriorated further when giant financial institutions such as the Lehman Brothers, Goldman Sachs, JP Morgan, Citibank and the Bank of America broke down following the economic recession in the US. Subsequently, this phenomenon leads to a contraction in the industrial sector as well as an increase in the unemployment growth rate. Unfortunately, the crisis in the US does not stop there; it spreads from one country to another via various channels such as via trade, financial markets, bank lending or monetary transmission mechanism. This event is arguably known as 'contagion'. Against this background, this study primarily examines the impact of the US sub-prime crisis and its spill over effect on the ASEAN-5 stock market (Malaysia, Singapore, Thailand, Philippines and Indonesia).

This study contributes to the literature in the following manner. First, we provide a more recent estimate on the impact of the global financial crisis emanating from the US sub-prime mortgage failure on the stock market returns of ASEAN-5. We reiterate the fact that the financial channel is one of the most important channels for transmission of financial turbulence from one country to another. In fact, the financial vagaries in the US had affected most of the countries in the Asian region due to immense trade, investments and financial links. Second, instead of engaging in the controversies of the estimation of contagion or interdependence, we use the

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volatility of the S&P 500 (*VIX*) to capture the effect of a downturn in the stock market in the US towards the stock returns. Both *VIX* and the 2008-2009 crisis dummy (*D08*) capture the impact of shift-contagion. In addition, our study relies on panel data techniques to estimate the general magnitude and sign of the impact of the crisis which differs from existing studies on Asian stock market which are normally time series in nature and focuses on correlation amongst stock markets. Results suggest that the more volatile the stock market is in the US, the lower the stock returns in ASEAN-5, which implies that ASEAN-5 stock market may not be a worthy destination if the aim of investors is to diversify their portfolio in the event of crises.

The organization of this paper is structured as follows. The next section discusses the related literature as well as the theoretical framework. The third section describes the methodology, followed by the empirical findings and discussion. The final section concludes the paper.

2. Theoretical Framework and Literature Review

The root of the theoretical framework for the interaction between the stock market and macroeconomic activity is based on the Arbitrage Pricing Theory (APT) developed by Ross (1976). In modern research, this theory is augmented to incorporate integration with foreign market, resulting from arbitrageurs who trade stocks internationally. This gives rise to the evolution of international APT. Whilst the association between the stock market and macroeconomic activities has been widely researched, a standardized set of macroeconomic variables is subjected to empirical research. Macroeconomic variables selected to examine the determinants of stock market tend to differ slightly across studies. In general, Ibrahim and Aziz (2003), Booth and Booth (1997), Wongbangpo and Sharma (2002), Chen (2003), Chen et al. (2005), Maysami and Koh (2000), and Mukherjee and Naka (1995) advocate that the rate of inflation, money supply, interest rates, industrial production, reserves, and exchange rates are important macroeconomic factors in explaining the stock market movement.

Interest rates, money supply, reserves and exchange rates can be categorized as monetary policy stances that affect the stock market. Hence, any changes in these monetary policy variables may have important ramifications on the financial sector of the economy. For instance, restrictive policies via higher interest rates or discount rates would make cash flows worth less after being discounted. This would reduce the attractiveness of investment, therefore, shrinking the value of stock returns. From the 'substitution effect' hypothesis, a raise in the rate of interest increases the opportunity cost of holding cash, which later on leads to a substitution effect between stocks and other interest bearing securities like bonds. In summary, both the restrictive policy and the substitution effect hypothesis suggest that interest rate should be inversely related to stock market return. The common proxies for interest rate include treasury bills rates and the interbank rates as employed by Mukherjee and Naka (1995), Maysami and Koh (2000), and Hooker (2004). Alternatively, Chen et al. (2005) adopt the yield spread to measure the term structure effect on the Taiwanese hotel stock returns. The yield spread is estimated based on the difference between the 10-year government bond yield and the 3-month treasury bills rate. Their result shows that yield spread is not a significant determinant for stock prices.

This could be due to the point highlighted by Mukherjee and Naka (1995) who contend that changes in both short and long term rates are expected to affect the discount rate in a similar way.

Other important monetary policy tools include money supply and inflation. According to Fama (1981), an increase in money supply leads to an increase in discount rates which in turn, lowers the price of stock, thus resulting in a negative effect on the economy. However, Mukherjee and Naka (1995) argue that if an increase in money supply leads to economic expansion via increased cash flows, stock prices would benefit from economic growth led by such expansionary monetary policy. In the case of Japan, their study shows that money supply is positively related to stock market. Similarly, Maysami and Koh (2000) supported the view of Mukherjee and Naka (1995) for both long and short run dynamic interaction between money supply and stock returns for the case of Singapore. Apart from interest rate and money supply, inflation may also influence the movement of stock prices. Asprem (1989) suggests that inflation should theoretically be positively related to stock return if stocks provide a hedge against inflation. However, empirical studies by Barrows and Naka (1994), Chen et al. (1986) and Chen et al. (2005) conclude that inflation affects the stock market in a negative manner. Under normal circumstances, a rise in expected inflation rate tends to lead to restrictive monetary policies, which would have negative effects on stock prices. However, in countries with rampant price control or where price stability is one of their macroeconomic objectives, the impact of inflation should be insignificant.

With the intensification of economic integration in the form of foreign direct investment and trade, a number of studies have looked into the 'exchange rate channel' of monetary policy transmission. Empirical studies on the stock market-exchange rate nexus show mixed results. Aggrawal (1981) finds that exchange rates have positive effects on the stock market. In contrast, Soenen and Hennigar (1988) discover an inverse relationship. Using three different exchange rate measures - real effective exchange rate, nominal effective exchange rate and RM/US$ - Ibrahim (2000) suggests that there is no long run relationship between stock market and exchange rates in a bi-variate setting for Malaysia. However, in a multivariate setting with the addition of money supply and reserves, long run relationship between the stock market and exchange rate is evident. From a slightly different perspective, Pan et al. (2007) show that a depreciation of the local currency makes exports less expensive and may lead to an increase in foreign demand and sales for the firms. The 'exchange rate channel' by Pan et al. (2007) is consistent with the 'flow oriented' exchange rate model, introduced by Dornbusch and Fisher (1980). Accordingly, the exchange rate movements initially affect the international competitiveness and trade position, followed by the real output of the country, and finally affects the current and future cash flows of companies, which can be inferred from the stock price movements. To recap, an appreciation (depreciation) of a local currency leads to a decrease (increase) in the firm value of exporting firms, and the opposite applies for the importing firms. Adler and Dumas (1984) show that even domestic firms with minimal international activities can still be affected by the exchange rate movements if their input prices, output prices, or product demand depend on the fluctuation of exchange rate.

In events where exchange rate depicts no significant relationships with stock returns, researches often rely on the fluctuation of the real exchange rate or the exchange rate volatility. Exchange rate volatility provides additional information as it captures the exchange rate risk (Barrell and Pain, 1996; Sekkat and Varoudakis, 2000; Serven, 2003) and unanticipated external shocks. Volatile movements of the real exchange rate may signal increasing uncertainty. In the event of depreciation, investors who made profits may end up making losses if the amount of profit could not offset the losses from currency depreciation. Exchange rate volatility also entails additional costs to investors when hedging becomes necessary to assuage the fluctuations in the currency.

Finally, the level of real economic activity is also crucial in determining the stock prices and stock market returns. The real economic activity is normally captured by the gross domestic product (GDP). Data on GDP, however, is normally available on annual basis, and at best, on quarterly basis. Hence, the industrial production index (IPI) has been widely used as a measure for real economic activity. Studies by Geske and Roll (1983), Fama (1990), Koutoulas and Kryzanowski (1996), and Kearney and Daly (1998) exhibit a positive relationship between industrial production and stock prices. On the other hand, Sadorsky (2003) fail to establish significant relationships between industrial production and stock prices. One apparent reason is that the salient features of the technology industry may have contributed to the insignificant result. The aforementioned studies generally adopt time series techniques to investigate long and short term relationship between the stipulated variables.

Whilst most aforementioned studies adopt the time-series techniques to investigate the long-term and short-term relationship between macroeconomic variables and stock return, the current research employs the panel regression techniques in exploring a specific issue after controlling for the macroeconomic variables. For example, Smimou and Karabegovic (2010) study the impact of economic freedom on the equity return for the Middle East and North African countries for the year 2000-2007 using annual data. Meanwhile, Bali and Cakici (2010) make a comparative study of the impact of market risk, total risk and unsystematic risk on the equity return between twelve developing and twenty three developed countries from 1973-2006 using monthly data. Uno and Hayashida (2009) investigate how four different tax cuts affect the revitalization of the ailing Japanese and US stock market from the period of 1989-1999. Finally, Gregoriu and Kontonikas (2010) explore the influence of inflation on stock return for sixteen OECD countries over the period 1970–2006 using monthly data. With the same spirit, this study seeks to investigate the spill-over effects of the US subprime crisis on the ASEAN-5 stock market returns.

Against this background, we empirically test the relationship between the ASEAN-5 stock returns vis-à-vis the recent financial crisis along with other control variables. To ensure parsimony in modelling, we limit the control variables to six macroeconomic items – industrial production index to capture wealth effect, money supply, reserves and interest rates to represent monetary policy stances, inflation and exchange rate volatility to capture external shocks. Accordingly, the following empirical model is tested,

$$R_t = f(VIX, D08, IPI, MS, RES, INT, ERV)$$

where R_t, *VIX, D08, IPI, MS, RES, INT* and *ERV* denote stock market return, contagion or spill-over effect, 2008-2009 crisis dummy, industrial production index, money supply, reserves, interest rates and exchange rate volatility respectively.

3. Methodology

Our sample covers the original members of ASEAN-5 which comprise of Malaysia, Singapore, Indonesia, Thailand and the Philippines. The data covers the post Asian financial crisis period ranging from 2000 to 2009. This range is chosen to specifically capture the effect of the recent global economic crisis originating from the US sub-prime crisis. Since our *T > N*, the original monthly data is transformed into quarterly data centred 4-point moving averages to deal with possible seasonality and to smooth out irregular components of the data. Stock return is defined as,

$$r_t = ln\ (P_t / P_{t-1}) \times 100$$

where, P_t is the stock index at quarter *t* and P_{t-1} is the closing price for the previous quarter. The returns of all series are calculated as the logarithmic difference in the average quarterly closing price. *VIX* captures the net impact of the global financial shocks (Ozatay et al., 2009). Both data on stock return and *VIX* are obtained from Datastream.

Data on industrial production index *(IPI),* money supply *(MS)*, reserves *(RES)* and the real effective exchange rate *(ER)* are obtained from the International Financial Statistics, IFS (2010). *IPI, MS* and *RES* are expressed as percentage growth to ensure stationarity of the data. Exchange rate volatility *(ERV)* is estimated based on GARCH (*1,1*) as follows:

$$ER_t = \ln(ER_t / ER_{t-1}) \times 100$$

where, ER_t is the index at quarter t and ER_{t-1} is the closing price for the previous quarter. The exchange rate volatility is calculated as the logarithmic difference in the average end of period exchange rate. The conditional mean equation with an autoregressive process can be modelled as $r_t = a_0 + a_1 r_1 + e_t$ where, $e_t / I_{t-1} \sim n(0, h_t)$. The conditional variance which depends on one lagged squared errors and one-lagged conditional variances is $h_t = \mu + \alpha e_{t-1}^2 + \beta h_{t-1}$ where $\alpha > 0$ and $\beta > 0$. ER_t is the return conditional on past information, which is proxied by ER_{t-1}. μ, α and β are parameters to be estimated. I_{t-1} is the information set at time *t-1*, e_t is the stochastic error conditional on I_{t-1} and is assumed to be normally distributed with zero mean and conditional/time varying variance, h_t. The ARCH term (e_{t-1}^2) is the information from the previous period measured as the lag of squared residual from the mean equation. The GARCH term (h_{t-1}) is the last period's forecast variance. The next section discusses the empirical strategy and results.

4. Empirical Findings and Discussion

Prior to the conventional empirical testing, the order of stationarity is examined via panel unit-root test. Unit-root analysis in stock prices allows us to identify whether the shock to stock prices is temporary or permanent in nature. Stationary stock prices imply a temporary shock where prices will revert to its original trend in the long run. From a practical perspective, if the stock return is stationary, following past behavior and trading would imply that one can estimate future movements in stock prices. Hence, the investors can strategize to earn abnormal returns. This study draws on five panel unit root tests based on LLC (Lin, Levin and Chu, 2002), Breitung, IPS (Im, Pesaran and Shin, 2003), Fischer's panel ADF and panel PP to examine the stationarity issue. The IPS test allows for heterogenous parameters and serial correlation when *T* is sufficiently large and converges to the standard normal distribution. The LLC test on the other hand, assumes parameter homogeneity; hence, it does not account for heterogeneity bias in the data. Three variations of the panel unit root tests are reported in Table 1 with stationarity at level are confirmed for all variables except *VIX* and *ERV*. However, both variables are stationary based on either panel ADF or panel PP. Hence, we infer all variables are stationary at level since both panel ADF and PP unit root tests are relatively more powerful compared to LLC or IPS tests.

Given that the variables in this study are stationary at level, we proceed with the panel regression analysis. In a static panel data setting, the empirical relationship is defined as,

$$R_{it} = \alpha + x_{it}^{'}\beta + u_{it} \qquad i = 1,.....,N; \quad t = 1,....,T \tag{1}$$

where *R* represents stock return, $x_{it}^{'}$ is the $1 \times K$ matrix of explanatory variables, β is the $K \times 1$ matrix of coefficients with *i* and *t* representing ASEAN-5 countries and time dimensions. u_{it} could be a one-way or two-way error components defined as, $u_{it} = \mu_i + v_{it}$ and $u_{it} = \mu_i + \lambda_t + v_{it}$ respectively with μ_i representing the unobservable individual effects, λ_t denotes the unobservable time effect and v_{it} captures the remaining stochastic disturbance term. We adopt the instrumental variables (IV) or two-stage least square (2SLS). First, equation (1) is transformed using first-differencing to remove unobserved country specific effects. 2SLS essentially uses instrumental variables in the transformed model which restricts the initial moment conditions, R_{it}, to be uncorrelated with the subsequent error terms, plus assumes that the error terms are serially uncorrelated. The instruments should be highly correlated with the transformed lagged dependent variables, uncorrelated with the transformed error term and requires a panel of $T \geq 3$.

Table 1: Panel Unit Root Tests at Level

	With intercept and trend				
	LLC	Breitung	IPS	Panel ADF	Panel PP
R	0.85	2.60	-4.58*	38.34*	66.43*
	(0.80)	(0.99)	(0.00)	(0.00)	(0.00)
IPI	-7.73*	-4.80*	-8.78*	79.47*	183.06*
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
MS	-5.62*	-5.47*	-5.88*	50.37*	122.18*
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
RES	-5.16*	-5.05*	-5.28*	44.91*	78.88*
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
VIX	-1.72**	-0.49	0.10	6.78	9.73
	(0.00)	(0.31)	(0.54)	(0.75)	(0.46)
ERV	1.35	1.04	-0.02	11.65	47.75*
	(0.91)	(0.85)	(0.49)	(0.31)	(0.00)
INT	0.24	-0.25**	-3.38*	48.39*	128.25*
	(0.59)	(0.01)	(0.00)	(0.00)	(0.00)

Notes: LLC – Levin, Lin & Chu (2002), IPS – Im, Pesaran & Shin (2003). *, * and *** denote significance level at 1%, 5% and 10%. *p*-values in are parentheses. The results are consistent when we choose either 'with intercept only' or 'without intercept or trend'.

With reference to Table 2, VIX affects the ASEAN-5 stock return negatively ranging between -0.27 to -0.33. Such results imply that the increase in volatility in the US stock market lowers the return of the ASEAN-5 stocks. Results also indicate the importance of the financial channel namely stock market in the transmission of shocks from the US to ASEAN-5. In the event of a crisis, the financial channel especially the stock market is bound to react the fastest compared to other channels. Coupled with herd behaviour by certain investors imitating the actions of informed investors, a plunge in stock return is almost suspected. In the case of the recent crisis in the US, withdrawal of fund from overseas portfolio investment is one of the fastest means for investors to cover their losses in the US. As expected, the sub-prime crisis dummy negatively affects stock return across all models. Further, our results indicate that *IPI* is inversely related to stock return, while *RES* and *ERV* have positive impact on stock return. These results suggest the relevance of monetary policy tools which would be particularly useful during turbulent periods such as the recent 2008-2009 financial vagaries. Adequate reserves for instance, are crucial to cope with the outflow of portfolio investments in the presence of external shocks. Therefore, the authorities should ensure monetary policy congruence especially in the event of crises.

Table 2: Two-Stage Least Square Results

	None Effect Model	Fixed Effect Model	Random Effect Model
Constant	0.21*	0.23*	0.19*
	(0.00)	(0.00)	(0.00)
VIX	**-0.32***	**-0.33***	**-0.27***
	(0.00)	**(0.00)**	**(0.00)**
SUBPRIME	**-0.10***	**-0.10*****	**-0.10*****
CRISIS	**(0.00)**	**(0.09)**	**(0.09)**
GIPI	-0.40***	-0.45***	-0.42***
	(0.09)	(0.06)	(0.07)
GRES	0.48**	0.465**	0.45**
	(0.02)	(0.03)	(0.04)
INT	-0.00	-0.00	-0.00
	(0.58)	(0.33)	(0.39)
ERV	2.76**	2.48***	2.60**
	(0.05)	(0.06)	(0.03)
R-Squared	0.21	0.22	0.19
F-Statistics	7.97*	5.19*	8.92*
	(0.00)	(0.00)	(0.00)
D.W	1.82	1.86	1.81
Observations	192	192	192

5. Conclusion

Our findings support the work of Didier et al. (2008), suggesting that financial contagion is still applicable in the current situation. The results suggest that small countries like the ASEAN-5 cannot avoid the transmission of financial vagaries into their market, thus the ASEAN-5 stock market may not be a worthy destination if the aim of investors is to diversify their portfolio. However, reserves and exchange rate volatility can be used to assuage the detrimental effects of such exogenous shocks. In other words, the interplay of monetary policy variables and an increase of the exchange rate risks are potential tools to alleviate the negative impact of a crisis. Notwithstanding the evidence of the spill-over effect of the US stock markets on the ASEAN 5 markets, this study does not cater for the impact of regulatory control on the financial crisis. As the US sub-prime crisis started due to uncontrolled supply of credit as well as lax regulatory policy, the ASEAN countries may have tighter regulation than the US market. Hence, some of the spill-over effects could be resisted by those regulatory regimes which could lessen the spill-over effect. This issue is a good avenue for future research.

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