# CONTAGION EFFECTS OF US FINANCIAL CRISIS ON INDONESIA

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## Abstract

This research analyzes the contagion effects of the US financial markets on Indonesian financial markets during the 2008 global financial crisis. It specifically investigates whether the slump in the US stock prices directly produced a slump in Indonesian stock prices, or indirectly through the slump in regional stock prices. It also examines whether the slump spilled over into rupiah exchange rate. Using Vector Autoregression and Vector Error Correction Model, the paper finds direct contagion effect of the US financial crisis into Indonesian stock markets. It also finds both direct and indirect contagion effect of the US financial crisis into foreign exchange market.

**Keywords:** Contagion, stock price, exchange rate, financial crisis
**JEL classification numbers**: G12, G15

## Abstrak

Penelitian ini menganalisis pengaruh *contagion* dari pasar keuangan Amerika Serika (AS) pada pasar keuangan Indonesia selama krisis keuangan global 2008. Penelitian ini secara khusus menyelidiki apakah kemerosotan harga saham AS langsung mengakibatkan penurunan pada harga saham Indonesia, atau secara tidak langsung melalui kejatuhan harga saham regional. Paper ini juga menguji apakah kemerosotan tersebut juga mempengaruhi nilai tukar rupiah. Menggunakan model *Vector Autoregression* dan model Koreksi Kesalahan, penelitian ini menemukan pengaruh *contagion* langsung dari krisis keuangan AS ke pasar saham Indonesia. Penelitian ini juga menemukan adanya pengaruh *contagion* langsung dan tidak lagsung dari krisis keuangan AS ke pasar valuta asing.

**Keywords:** Pengaruh contagion, harga saham, kurs, krisis keuangan
**JEL classification numbers**: G12, G15

## INTRODUCTION

Over the past decade the Indonesian financial markets have been increasingly integrated into the world financial markets. This comes as no surprise because Indonesia is an open economy that heavily engages in international trades of both goods and services and financial assets. This, in itself is not a bad thing, but may increase the risk of contagion effect. A shock to financial markets in a part of the world quickly infects Indonesian financial markets (World Bank, 2009).

Importantly, Indonesia is open to capital flows since its capital account has been liberalized even since the early 1980s. Like other emerging markets, Indonesia greatly relies on capital inflows as one source of development funds. However, this makes Indonesia vulnerable to a sudden reversal of capital that can create financial instability. Foreign funds invested in Indonesian financial markets are prone to sudden reversals provoked by negative sentiments that develop in the markets. The reversals can be massive due to herding

behavior. This will inevitably bring down the prices of financial assets as well as the currency (Bank Indonesia, 2008a,b).

The 2008 global financial crisis (GFC) is a case in point. No one would argue that the 2008 global financial crisis was originated in the US, the most unlikely country to be hit by a full-fledging financial crisis. This crisis happened due to sharp decline in the price of subprime mortgage securities, abruptly ending several years of price bubble. The burst of the bubble was precipitated by widespread defaults in the mortgage loans extended to people with doubtful creditworthiness due to their reliance on "non-income non-job activities or NINJA" (Anonim, 2008).

The burst quickly sent shockwaves to financial markets across the globe since the securities are widely traded. Many investors from Wall Street to London, from Sydney to Hong Kong, Singapore and Tokyo, have these securities in their assets in a significant proportion. The price drop, therefore, has drastically cut the value of their assets, putting these financial institutions in difficulties. Some companies, prominent examples being Bear Stern and Lehman Brothers, had to file for bankruptcy due to their failure to attract fresh funds to save their financial trouble.

The crisis quickly dried up liquidities in the interbank markets, sending the borrowing interest rates to a record high and leading to a significant cut in the lending capacity of commercial banks. This inevitably left many companies without sources of finance for working capital or refinancing debts. Taken together, all those factors and the prospect of an economic slump unstoppably sent tremors to the trading floors of stock exchanges around the glob. Nearly all composite indices around the world plunged.

Without exception, the Indonesia Stock Exchange (IDX) Composite Index fell nearly 50 percent within less than three months –the biggest collapse in history. In late August 2008 the Index was at 2165.9, but by late October the same year the Index plunged to a mere 1111.[1] Similarly the Rupiah significantly weakened against the US dollar. This surely prompts a question as to why Indonesia was infected by the crisis, while subprime mortgage securities were arguably absent in the balance sheets of Indonesian financial institutions.

There is a strong indication that foreign investors held a disproportionate share of Indonesian stocks. Therefore, the massive sales by these investors, thirsty of cash to repay their debts, inevitably brought down the Index. According to the annual report of *PT Kastodian Sentral Efek Indonesia* (2008), foreign investors owned 67 percent of shares traded in the IDX, equivalent to Rp 436.30 trillion. When the sudden reversal happened, following the collapse of Lehman Brothers, the IDX index fell uncontrollably, prompting the authority to suspend the trade on October 6, 2008. This is reflected in the decline of foreign ownership from 66.3 percent in December 2008 to 63.2 percent in August 2008 (Bank Indonesia, 2008a,b).

Abimanyu et al. (2008) attributed the event to acts by investors to secure their funds or their herding behavior fearing that the crisis would quickly spread to countries with strong financial link to the US. Mishkin (2009) blames the increased risk associated with the increased uncertainty in the assets' returns as the main factor behind this panic. Because risk is one of the factors affecting asset demands, the global increase in risk urged investors to adjust their portfolios by evacuating their funds from the perceived riskier emerging markets to save haven assets, namely cash and US T-bills. This inevitably plunged the IDX index and the currency.

The intensified financial globalization is characterized by increased integration of global capital and financial markets

[1] www.yahoofinance.com

where cross-border transactions increasingly dominate the markets. Krugman (2009) notes a major portion of stocks in a typical country is increasingly in the hands of foreign investors. In the aftermath of the 1997 Asian crisis American investors' control of foreign assets amounted to 57 percent of GDP, but it more than doubled, 128 percent, in 2007. As a result a shock to stock markets and bank panic in a country quickly spreads to other countries within days or even hours.

Bordo (2008) points out that while financial crises before globalization largely resulted from pressures on liability side of bank balance sheets by panic depositors rushing to withdraw their money, current crises mostly arise from shocks to the asset side of financial and non-financial institutions owing to drops in financial assets' prices. Thus the collapse of subprime mortgage securities drastically reduced the asset's value of many financial and non-financial institutions laden with these securities in their balance sheets, thereby deteriorating their networths. All scrambling to avoid further losses, massive selloff in the US financial and stock markets and around the world, including Indonesia, was inevitable due to cross-border ownerships.

Financial contagions have been the focus of empirical studies recently. Yuko and Ito (2004) investigate the contagion through the movements in exchange rates and stock prices among eight countries in East Asia during the 1997-1999 financial crisis. They found that exchange rates and stock prices are strongly correlated both within each country and between countries. Their finding also shows that the stock price in a country tends to be influenced more by exchange rates and stock prices in other countries than by domestic exchange rate.

Santoso et al. (2009) find contagion between Indonesia, Australia, US, England, Germany, Japan, Korea, Hong Kong, China, Taiwan, India, Philippines, Singapore, and Malaysia. The contagion especially is established between Indonesia and countries in East Asia that include Japan, Taiwan, Korea, Hong Kong, and India. They conclude further that the effect of the 2008 GFC on Indonesia is not a direct one but through Asian capital markets that have a direct link to the US markets. Indonesia is identified as a *shock absorber*, instead of *shock transmitter*, of advanced countries (Japan, Australia, Germany, England, and US).

Markwat et al. (2008) investigate how the fall in stock prices in a country is spread to the closest regional markets and then to the global markets by way of domino effects. Using six countries in Latin America (Argentina, Brazil, Chile, Columbia, Mexico, and Venezuela) and six Asian countries (India, Korea, Malaysia, Philippines, Taiwan, and Thailand) they find a strong case for the fall in the global stock prices to be precipitated by the fall in the local and regional markets, not the other way round. Again their finding also shows that stock prices affect exchange rates within a country and between countries.

Investigating whether the composition of capital inflows determines the severity of the crisis, Tong and Wei (2009) find that emerging economies with capital inflows dominated by portfolio investments and short-term debts before the crisis experienced much worse liquidity contraction than those largely dependent on long-term direct investments. Thus openness to foreign portfolio investments can be dangerous for the financial markets during crisis times.

Tjahjawandita et al. (2009) examine whether geographical distance plays a role in the contagion of the 2008 GFC. They conclude that the farther away a country is from the ground zero country (the epicenter of the crisis) the smaller is the degree of its recession owing to the crisis. Instead they find one of three factors –external, financial, and public or domestic sectors– most responsible for the recession. In particular variables such as GDP, M2 and fiscal bal-

ance are found to be good predictors of the recession.

Mendoza and Quadrini (2009) study the link between the effect of shocks to bank assets on their prices and inter-country contagion due to financial turbulences. Two observations show financial globalization playing a strong role in the 2008 GFC. First, more than half of the increased debts of non-financial sectors in the US since mid 1980s have come from foreign debts. Second, the collapse of sub-prime mortgage securities has spread throughout the world through financial institutions and asset markets. Thus financial globalization has made it possible for a crisis-ridden major economy to spread the crisis to other countries, thereby precipitating a global financial crisis through quick sequential collapse of financial assets' prices.

Rose and Spiegel (2009) investigate the causes and effects of the 2008 GFC using the multiple indicator multiple cause (MIMC) model. Focusing on the international linkages and employing GDP, stock prices, country credit rating, and exchange rates, they find that countries that hold the much depreciated US financial securities are vulnerable to the GFC through financial channel. Likewise, exporting countries to the US experienced recessions through trade channel.

This paper attempts to investigate the mechanism by which the 2008 US financial crisis was transmitted to Indonesian financial markets that experienced enormous pressure culminating in March 2009. The research questions to be answered are as follows. (1) Is there any indication of contagion effect that goes from US Stock Prices to Indonesia Stock Prices? (2) Do US Stock Prices affect Rupiah exchange rate directly or indirectly through Indonesia Stock Prices? (3) Does the contagion effect go from the US Stock markets directly to Indonesian markets or indirectly through the regional markets?

## METHODS

This paper employs daily data from 1 January 2008 to 30 November 2008 taken from *Yahoofinance* website. The range is selected because it contains the most fluctuated prices in both the US and Asian markets. The variables include rupiah exchange rate expressed in IDR/USD (*KURS*), Indonesia Stock Price (*IHSG*), US Dow Jones Composite Average (*DJA*) representing US stock prices, and Singapore Strait Times Index (*STI*) representing regional stock prices. To analyze the data and answer the proposed research questions, the paper estimates a Vector Autoregression (VAR) model A typical VAR is a time series model employed to analyze a dynamic relationship between variables. It is a system of equations consisting of a set of endogenous variables where each equation contains each endogenous variable regressed on a same set of lagged endogenous variables.

As a routine step, before estimating a time series model a unit root test is conducted to determine the data stationarity and whether the VAR should be estimated in level or differenced so as to avoid possible spurious regressions. If the test result shows that the data are stationary the VAR is estimated in level. Otherwise it is estimated in differenced if the variables are not cointegrated.

However if, through another test, the variables are found to be cointegrated a Vector Error Correction Model (VECM) is estimated. A VECM is a VAR with cointegration restriction representing a long run equilibrium equation among variables. Cointegrated non stationary variables estimated in VAR that ignores cointegration equation likely result in consistent but not efficient parameters.

Three VARs will be estimated. The first and second VARs include the same three variables: KURS, IHSG, and DJA but with different periods. While the first covers the full sample, 1 January 2008 to 30 November 2008, the second covers 1 January 2008 to 31 March 2008 only. The split

is intended to determine whether the contagion, if confirmed, applies both inside and outside the time of crisis. The implementation of unit root test finds that all the data are not stationary in level and stationary after being differenced once. However, a cointegration test suggests no cointegration among variables even at 10 % significance level. These results are true for both samples. Therefore the first and second VARs are estimated in differenced log where cointegration equation is excluded. Both VARs are as follows[2].

$$
\begin{aligned}
DLog\ (KURS)_{1t} &= \beta_{01} + \sum_{i=1}^{p} \beta_{i1} DLog\ (KURS)_{t-i} \\
&\quad + \sum_{i=1}^{p} \alpha_{i1} DLog\ (IHSG)_{t-i} \\
&\quad + \sum_{i=1}^{p} \gamma_{i1} DLog\ (DJA)_{t-i} + e_{1t} \\
DLog\ (IHSG)_{t} &= \beta_{02} + \sum_{i=1}^{p} \beta_{i2} DLog\ (IHSG)_{t-i} \\
&\quad + \sum_{i=1}^{p} \alpha_{i2} DLog\ (KURS)_{t-i} \\
&\quad + \sum_{i=1}^{p} \gamma_{i2} DLog\ (DJA)_{t-i} + e_{2t} \\
DLog\ (DJA)_{3t} &= \beta_{03} + \sum_{i=1}^{p} \beta_{i3} DLog\ (DJA)_{t-i} \\
&\quad + \sum_{i=1}^{p} \alpha_{i3} DLog\ (KURS)_{t-i} \\
&\quad + \sum_{i=1}^{p} \gamma_{i3} DLog\ (IHSG)_{t-i} + e_{3t}
\end{aligned}
\qquad (1)
$$

In the third VAR an extra variable, Singapore Strait Time Index (STI), is added to the previous VAR, so that it has four variables. A cointegration test reveals that they are cointegrated at 5%. This implies that the appropriate model for the third VAR is Vector Error Correction Model (VECM), which is the following.

$$
\begin{aligned}
DLog\ (KURS)_{1t} &= \beta_{01} + \phi_1 ect_{t-1} \\
&\quad + \sum_{i=1}^{p} \beta_{i1} DLog\ (KURS)_{t-i} \\
&\quad + \sum_{i=1}^{p} \alpha_{i1} DLog\ (IHSG)_{t-i} \\
&\quad + \sum_{i=1}^{p} \gamma_{i1} DLog\ (DJA)_{t-i} \\
&\quad + \sum_{i=1}^{p} \gamma_{i1} DLog\ (STI)_{t-i} + e_{1t} \\
DLog\ (IHSG)_{t} &= \beta_{02} + \phi_2 ect_{t-1} \\
&\quad + \sum_{i=1}^{p} \beta_{i2} DLog\ (IHSG)_{t-i} \\
&\quad + \sum_{i=1}^{p} \alpha_{i2} DLog\ (KURS)_{t-i} \\
&\quad + \sum_{i=1}^{p} \gamma_{i2} DLog\ (DJA)_{t-it} \\
&\quad + \sum_{i=1}^{p} \gamma_{i2} DLog\ (STI)_{t-i} + e_{2} \\
DLog\ (DJA)_{3t} &= \beta_{03} + \phi_3 ect_{t-1} \\
&\quad + \sum_{i=1}^{p} \beta_{i3} DLog\ (DJA)_{t-i} \\
&\quad + \sum_{i=1}^{p} \alpha_{i3} DLog\ (KURS)_{t-i} \\
&\quad + \sum_{i=1}^{p} \gamma_{i3} DLog\ (IHSG)_{t-i} \\
&\quad + \sum_{i=1}^{p} \gamma_{i3} DLog\ (STI)_{t-i} + e_{3t} \\
DLog\ (STI)_{4t} &= \beta_{04} + \phi_4 ect_{t-1} \\
&\quad + \sum_{i=1}^{p} \beta_{i4} DLog\ (DJA)_{t-i} \\
&\quad + \sum_{i=1}^{p} \alpha_{i3} DLog\ (KURS)_{t-i} \\
&\quad + \sum_{i=1}^{p} \gamma_{i3} DLog\ (IHSG)_{t-i} \\
&\quad + \sum_{i=1}^{p} \gamma_{i3} DLog\ (STI)_{t-i} + e_{3t}
\end{aligned}
\qquad (2)
$$

where

| | | |
|---|---|---|
| Dlog(*KURS*) | is | IDR/USD |
| Dlog(*IHSG*) | is | IDX composite index |
| Dlog(*DJA*) | is | Dow Jones Composite Average |
| Dlog(*STI*) | is | Strait Time Index (Singapore) |
| $ect_{t-1}$ | is | Error correction term (residual of the cointegration equation) or |
| $ect_{t-1}$ | is | $Log(KURS)_{t-1} - \theta_0 - \theta_1 Log(IHSG)_{t-1} - \theta_2 Log(DJA)_{t-1} - \theta_3 Log(STI)_{t-1}$ |
| $\beta, \alpha, \phi, \gamma$ | is | constants, and |
| $e$ | is | standard error. |

[2] A test to determine the optimum number of lags suggests 2 lags for the first and 1 lag for the second.

It is a common practice to call (1) unrestricted VAR and (2) restricted VAR. In (1) the analysis of the significant effect of each independent variable on the dependent variable uses *t* test. Since the data are in daily frequency a significant effect of a one-period lagged independent variable on the dependent variable means a yesterday change in the independent variable causes a change in the dependent variable today. This indeed captures the actual dynamics of financial markets that fluctuate and affect one another daily or even hourly. The use of lag makes it possible to determine that the causality runs from the independent variables to the dependent variable. This is also true for the significant effect of the overall dependent variables on the dependent variable determined based on *F* test.

One main advantage of VAR over a single equation analysis is it reveals the simultaneous interaction among variables using impulse response analysis. It examines how a current shock to the standard deviation of a particular endogenous variable affects each of other endogenous variables in the following periods. So, one-time shock to a variable determines a path of movements of other variables in the following periods.

Another analytical tool is variance decomposition that gives information as to how the variance of every endogenous variable comes about. It informs the proportion of the variance that comes from the variable itself and those that come from other variables. Thus, it can be known which variable(s) contribute the most (or the least) to movements in a variable over time.

In the VECM, a part from impulse response and variance decomposition analyses, long run equilibrium and short run adjustment analyses are employed. While the former is represented by the cointegration equation the latter is provided by the coefficient on error correction term, $\phi$. The error correction term, *ect*, is nothing but the residual of the cointegration equation. Once it is positive the system is out of long run equilibrium and the value of the dependent variable, the exchange rate (*KURS*), overshoots. For the system to return to equilibrium $\phi < 0$ should be the case. It means overshooting exchange rate yesterday ($ect_{t-1} > 0$) tends to decline and bring the system back to equilibrium. The magnitude of $\phi$ determines how many days it takes for the system to return to equilibrium.

## RESULTS DISCUSSION

The estimated first and second VARs are used to answer the first two research questions, while the estimated VECM is used to answer the last question in particular, and also the first two questions. The estimation is conducted with the help of Eviews software package. The results are as follows.

### Contagion Effects of US Stock Market on Indonesian Stock Market

Figure 1 shows a positive relationship between US Dow Jones Composite Average (*DJA*) and Indonesian stock prices (*IHSG*). However it does not say which causes what. The data analysis result using the first VAR clarifies this issue and is as follows.

$$
\begin{aligned}
\text{Dlog}(IHSG) = {} & -0.000 - 0.245\ \text{Dlog}(KURS)_{t-1} \\
& (-0.106) \qquad (-2.658) \\
& - 0.152\ \text{Dlog}(KURS)_{t-2} \\
& (-1.710) \\
& + 0.063\ \text{Dlog}(IHSG)_{t-1} \\
& (1.333) \\
& + 0.013\ \text{Dlog}(IHSG)_{t-2} \\
& (0.280) \\
& + 0.332\ \text{Dlog}(DJA)_{t-1} \\
& (7.749) \\
& + 0.043\ \text{Dlog}(DJA)_{t-2} \\
& (0.934) \\
F = 14.045 \quad & p = 0.008
\end{aligned}
\tag{3}
$$

We can see that only two independent variables significantly influence *IHSG*. As expected, *DJA* positively affects *IHSG* with one-day lag, but not two-day lag. Thus, yesterday increase in *DJA* is followed by today increase in *IHSG*. Interes-

tingly, the previous day change in *IHSG* itself has no effect on today change in *IHSG*. One might suspect that this result only holds in the sample that includes crisis time. However, as seen below, the estimation of the sub sample corroborates this result. Hence, Indonesian stock index is more sensitive to changes in US stock price index than to its own past; a fall in *DJA* quickly infects *IHSG* only in one day.

$$\begin{aligned} \text{Dlog}(IHSG) &= 0.000 \\ &\quad (1.029) \\ &\quad + 0.019\ \text{Dlog}(KURS)t\text{-}1 \\ &\quad (0.089) \\ &\quad + 0.013\ \text{Dlog}(IHSG)t\text{-}1 \\ &\quad (0.230) \\ &\quad + 0.612\ \text{Dlog}(DJA)t\text{-}1 \\ &\quad (7.824) \end{aligned} \qquad (4)$$

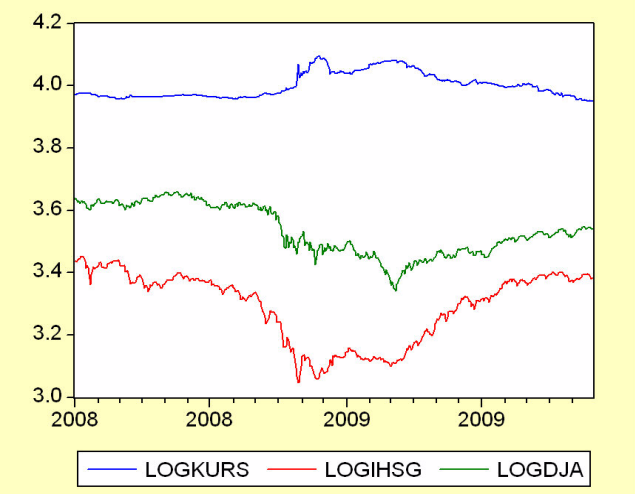
$F = 21.600 \quad p = 0.006$

In regards the exchange rate, it influences the stock index in time of crisis only. Yesterday depreciation of rupiah in crisis time causes stock prices to decline today. This means depreciation during crisis times, which usually is enormous, scares investors off domestic stock market. But it does not the case during normal times where depreciation is normally not excessive.

Similar result is produced by the estimated VECM[3]. Putting seven lags in the independent variables, only the first lag of both exchange rate (*KURS*) and US stock price (*DJA*) influences *IHSG* with exactly the same signs as in the first VAR. Both *IHSG* itself and *STI* in all lags have no influence on *IHSG*.

Figure 2 shows the response of Indonesian stock price to a shock to other variables. The response may be instant or with lag and continues through time. Figure 1 shows response of *IHSG* to a positive shock to *DJA*. It can be seen that one-time increase in *DJA* causes *IHSG* to increase after day one, reach maximum and start declining on day two and return to baseline on day four. The estimated variance decomposition, reported in Table 1, shows the variance of *IHSG* is explained fully (100%) by itself on the first day, while on the second and third day only 81.41% of the variance is explained by itself, 15.12% and 3.43% by *DJA* and *KURS* respectively.

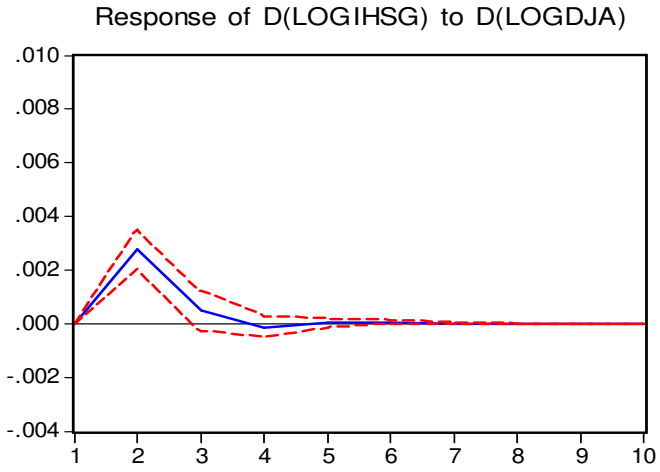
Overall results imply that there is sufficient support for the contagion effect of US stock market on Indonesian stock market.




Source: Eviews Estimation Results.

**Figure 1:** Daily *IHSG*, *DJA* and Exchange Rate

[3] For space reason the complete results are not presented here and can be obtained by contacting the author.




Source: EViews estimation results.

**Figure 2:** Impulse Response of *IHSG*

**Table 1:** Variance Decomposition D(log*IHSG*)

| Period | S.E. | D(log*KURS*) | D(log*IHSG*) | D(log*DJA*) |
|---|---|---|---|---|
| 1 | 0.006489 | 4.097977 | 95.90202 | 0.000000 |
| 2 | 0.007092 | 3.432407 | 81.40643 | 15.16117 |
| 3 | 0.007116 | 3.438651 | 81.41598 | 15.14537 |

Source: Data estimation.

**Do US Stock Prices Affect Exchange Rate of Rupiah Directly or Through Indonesian Stock Prices?**

Figure 1 also shows that the exchange rate, *KURS*, is negatively related to both US and Indonesian stock prices, *DJA* and *IHSG* respectively. It is quite possible that *KURS* and *IHSG* influence each other. But *DJA* only influences *KURS*, not the reverse. As for the former the previous result has shown that *KURS* influences *IHSG* during crisis times only. The data analysis provides the answer and the result from the full sample VAR estimation is as follows.

$$
\begin{aligned}
\text{Dlog}(KURS) = {} & -0.000 \\
& (-0.585) \\
& -0.142\ \text{Dlog}(KURS)t\text{-}1 \\
& \quad (-3.093) \\
& -0.124\ \text{Dlog}(KURS)t\text{-}2 \\
& \quad (-2.773) \\
& -0.074\ \text{Dlog}(IHSG)t\text{-}1 \\
& \quad (-3.112) \\
& -0.055\ \text{Dlog}(IHSG)t\text{-}2 \\
& \quad (-2.437) \\
& -0.157\ \text{Dlog}(DJA)t\text{-}1 \\
& \quad (-7.347) \\
& -0.015\ \text{Dlog}(DJA)t\text{-}2 \\
& \quad (-0.625)
\end{aligned}
\qquad (5)
$$

$F = 14.045 \quad p = 0.008$

It can be seen that all independent variables, except Dlog $(DJA)_{t-2}$, significantly influence the dependent variable. Unlike *IHSG*, yesterday and the day before depreciation of rupiah causes appreciation of rupiah today. This means if rupiah depreciates today people expect it to appreciate tomorrow because they think today's depreciation is excessively off equilibrium and the market soon makes adjustment. Interestingly, yesterday fall in both *IHSG* and *DJA* results in rupiah depreciation today. The result from the subsample estimation also corroborates this.

As noted before, a significant portion of Indonesian stocks are held by foreign investors. The collapse of subprime mortgage securities drastically reduced the value of their assets, seriously damaging their

networth. This provoked selloffs in stock markets in the US and around the world, including Indonesia, by investors to avoid further losses and reduce their debts (*deleveraging*). Since foreign investors have to exchange a massive amount of proceeds in rupiah for US dollar, rupiah inevitably tumbled. This explains how a fall in *IHSG* yesterday produces rupiah depreciation today.

This story implies that a fall in *DJA* is indirectly responsible for rupiah depreciation, because the fall in *IHSG* is caused by the fall in *DJA*. However, looking at the estimation result, a fall in *DJA* is also directly responsible for rupiah depreciation. It turns out that there is another avenue, not captured in the model, through which US stock prices influence rupiah exchange rate. A significant amount of foreign funds were invested in Indonesian Government bond (*SUN*) and Bank Indonesia Certificate (SBI). Figure 3 shows outstanding foreign ownership of both *SUN* and *SBI* during 2008. Bank Indonesia (2009a,b) notes that during the second semester of 2009 there was a massive outflow of foreign funds from *SUN*, Rp 25.2 trillion, and SBI, 6.7 trillion. This undoubtedly put an enormous depreciationary pressure on rupiah during the crisis. This explains how *DJA* influences rupiah exchange rate directly.

The estimation of VECM provides similar results. The estimated long run equil brium equation is as follows.

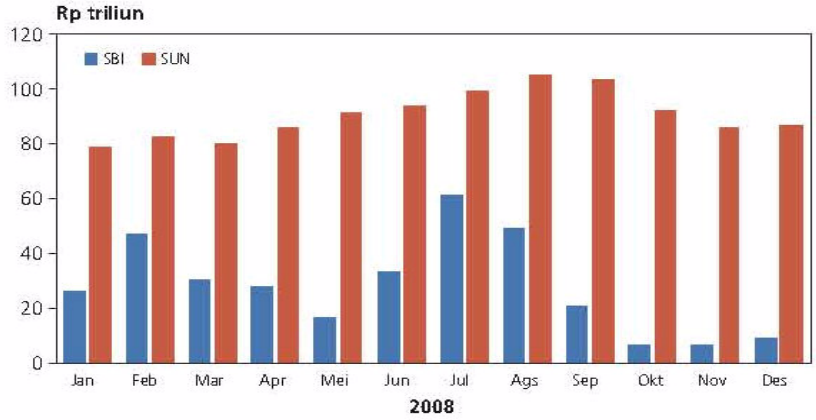
$$\begin{aligned}\log(KURS) = & -4.543 \\ & -0.578 \log(IHSG) \\ & \quad (-2.519) \\ & -0.614 \log(DJA) \\ & \quad (-2.919) \\ & +1.366 \log(STI) \\ & \quad (3.647)\end{aligned} \qquad (6)$$

It can be seen that all independent variables significantly influence the dependent variable. The coefficient on each independent variable captures elasticity, namely the percentage change in the dependent variable arising from one percent change in an independent variable, holding other variables constant, so that the the equilibrium is maintained. For example, other things equal, 1 % fall in *IHSG* disturbs the equilibrium exchange rate. In order to achieve a new equilibrium state, the exchange rate should depreciate by 0.1%. Similarly, 1% fall in *DJA* makes exchange rate out of equilibrium and it needs to depreciate by 0.6% to reach a new equilibrium, holding other variables constant.

As for Singapore Strait Time Index (*STI*), unlike *IHSG* and *DJA*, its influence on rupiah exchange rate is positive. A fall in *STI* produces appreciation of rupiah. Holding other variables constant, 1% falls in *STI* prompts rupiah exchange rate to go off equilibrium and reach a new equilibrium after appreciating by 1.4%. It might be the case that investors perceive Singapore stock market as a substitute for Indonesia stock market. A fall in *STI* urges investors to move their funds from Singapore market to Indonesia market, making rupiah appreciate.

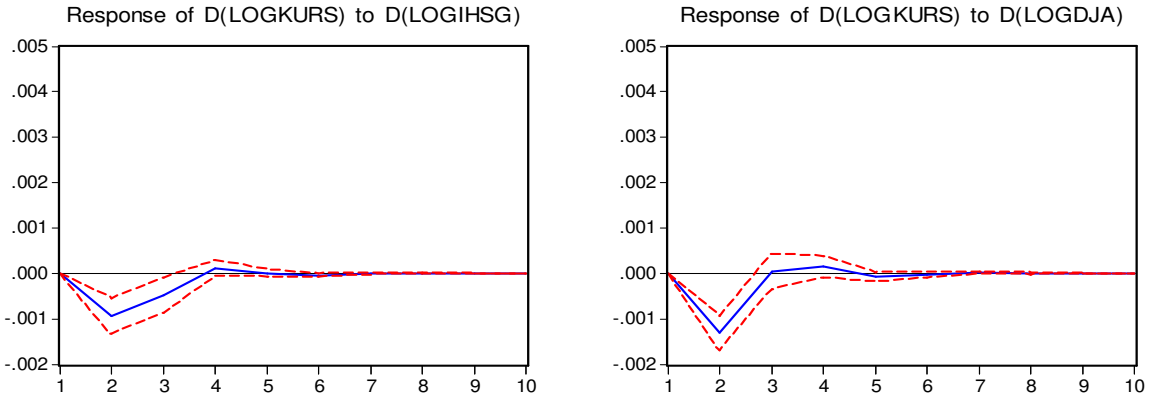
The equilibrium exchange rate is also found to be stable as shown by the estimated short term adjustment coefficient, $\phi_1 = -0.08$, significant at 5%. This means if rupiah depreciates, thereby deviating from its equilibrium, it will appreciate to return to equilibrium. It takes roughly 12.5 days for rupiah to return to its long run equilibrium state.

Figure 4 shows the impulse response of rupiah exchange rate to *IHSG* and *DJA*, based on estimated VAR. It corroborates the above results. A one-time increase in *IHSG* or *DJA* induces rupiah to appreciate on day one and peak on day two. However, while the *IHSG*-induced appreciation takes 2 days to return to baseline, the DJA-induced appreciation takes only one day. Thus the latter is more short-lived than the former.




Source: Bank Indonesia (2009a,b).

**Figure 3:** Foreign Ownership of *SUN* and *SBI* in 2008




Source: EViews estimation results.

**Figure 4:** Impulse Response of *KURS* to *IHSG* and *DJA*

**Table 2**: Variance Decomposition of D(log*KURS*)

| Variance Decomposition of D(log*KURS*): | | | | |
|---|---|---|---|---|
| Period | S.E. | D(log*KURS*) | D(log*IHSG*) | D(log*DJA*) |
| 1 | 0.004018 | 100.0000 | 0.000000 | 0.000000 |
| 2 | 0.004365 | 86.26993 | 4.650152 | 9.079915 |
| 3 | 0.004399 | 85.25778 | 5.792581 | 8.949642 |

Source: EViews estimation results.

Table 2 shows decomposition of *KURS* variance. On the first day 100% of the variance comes from *KURS* itself. While on the second day 86.3% of *KURS* variance is due to itself, 4.6% and 9.1% result from *IHSG* and *DJA* respectively, on the third day 85.3% comes from itself, 5.8% and 8.9% contributed by *IHSG* and *DJA* respectively.

Overall, contagion from US stock market to rupiah exchange rate is both direct, through SUN and SBI market, and indirect, through Indonesia stock market.

**Does the Contagion from the US Stock Market Directly to Indonesian Market or Indirectly Through Regional Markets**?

Table 3 reports the results of estimated VECM. Here Singapore Strait Time Index (*STI*) is incorporated as a proxy for regional stock markets. Regarding the movements in *IHSG*, the result corroborates the previous

result. Only one-day lagged changes in exchange rate and in *DJA* produce the change in *IHSG* with exactly the same sign in the coefficients as before. In contrast a change in STI regardless of the lag has no effect on the change in *IHSG*. This means *DJA* influences *IHSG* directly, not through *STI*.

This result is supported by variance decomposition of *IHSG* reported in Table 4. *STI* contributes negligible portion, 0% and 0.28%, on the second and third day respectively to the variance of *IHSG*. The estimated impulse response analysis, shown by Figure 5, also provides reinforcement. A positive shock to *STI* induces *IHSG* to increase with a long lag, only after 3 days. Two or three days is too a long time for these two markets with a very close proximity to affect each other. In contrast *IHSG* immediately responds positively to a positive shock to *DJA*.

Table 2 also reports the estimated equation where *STI* becomes the dependent variable. As expected *STI* responds to the change in *DJA* with one and two days lags and in itself with one day lag only. The change in *IHSG* does not produce any change in *STI*.

Therefore overall, the contagion from the US stock market into Indonesian stock market is direct, not through regional markets.

**Table 3:** A Part of Estimated VECM

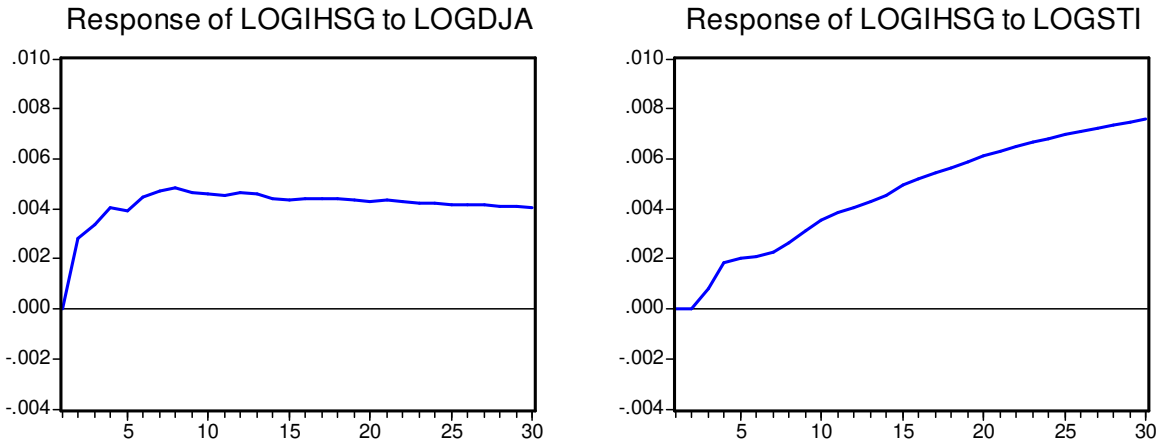
| Error Correction: | D(log*IHSG*) | D(log*STI*) |
|---|---|---|
| D(logKURS(-1)) | -0.253 | -0.062 |
| | [-2.616] | [-0.657] |
| D(log*KURS*(-2)) | -0.112 | -0.040 |
| | [-1.149] | [-0.416] |
| D(log*IHSG*(-1)) | 0.071 | -0.052 |
| | [ 1.287] | [-0.970] |
| D(log*IHSG*(-2)) | -0.039 | 0.012 |
| | [-0.705] | [ 0.224] |
| D(log*DJA*(-1)) | 0.379 | 0.374 |
| | [ 8.084] | [ 8.101] |
| D(log*DJA*(-2)) | 0.074 | 0.197 |
| | [ 1.387] | [ 3.764] |
| D(log*STI*(-1)) | -0.082 | -0.149 |
| | [-1.337] | [-2.475] |
| D(logSTI(-2)) | 0.015 | -0.006 |
| | [ 0.236] | [-0.098] |
| *C* | -0.000 | -0.000 |
| | [-0.170] | [-0.221] |
| | $F = 4.650$ | $F = 3.302$ |
| | $p = 0.008$ | $p = 0.008$ |

Source: EViews estimation results.

**Table 5:** Variance Decomposition of log*IHSG*

| Variance Decomposition of log*IHSG* | | | | | |
|---|---|---|---|---|---|
| Period | S.E. | log*KURS* | log*IHSG* | log*DJA* | log*STI* |
| 1 | 0.007857 | 4.337593 | 95.66241 | 0.000000 | 0.000000 |
| 2 | 0.012249 | 4.991391 | 89.66476 | 5.343589 | 0.000261 |
| 3 | 0.015699 | 4.850798 | 87.05715 | 7.816604 | 0.275450 |

Source: EViews estimation results.




Source: EViews estimation results.

**Figure 4:** Impulse Response of *IHSG*

## CONCLUSION

From the overall analyses it can be inferred that during the 2008 global financial crisis there was a contagion effect from the US stock market to Indonesian stock market. A slump in the Dow Jones Composite Average was followed by a slump in Indonesia stock index, almost immediately, or at least within one day. This contagion is a direct one where the regional markets do not serve as transmitter of the crisis.

The results also show that the fall in Indonesian stock prices in turn induced enormous rupiah depreciation. Since the fall in Indonesian stock prices is due to the slump in US stock prices, there is also a contagion from the US stock market to Indonesian foreign exchange market through Indonesian stock market. However the results also indicate that part of the contagion is direct, not taking Indonesian stock market as its conduit Instead it could also reach the foreign exchange market through the bond market where government bonds (*SUN*) and Bank Indonesia certificates (*SBI*) are traded.

## REFERENCES

Anonim (2008), *Memahami Krisis Keuangan Global Bagaimana Harus Bersikap*, Available at www.depkominfo.go.id, Accessed on 1 Januari 2009.

Bank Indonesia (2008a*), Laporan Kebijakan Moneter Bank Indonesia Triwulan IV-2008,* Biro Kebijakan Moneter Direktorat Riset Ekonomi dan Kebijakan Moneter, Jakarta.

Bank Indonesia (2008b), *Kajian Stabilitas Keuangan - Maret 2008*, Bank Indonesia, Jakarta.

Bank Indonesia (2009a), *Kajian Stabilitas Keuangan - Maret 2009*, Bank Indonesia, Jakarta.

Bank Indonesia (2009b), *Kajian Stabilitas Keuangan - September 2009*, Bank Indonesia, Jakarta.

Bank Indonesia (2009c), *Laporan Neraca Keuangan Bank Indonesia 2009*, Bank Indonesia, Jakarta.

Bordo, M.D. (2008), "An Historical Perspective on the Crisis of 2007-2008", NBER Working Paper, No. 14569, December.

Krugman, P. (2009), *The Return of Depression Economics and The Crisis of 2008*, W.W. Norton, New York.

Markwat, T., E. Kole, and D. van Dijk (2008), *Contagion as Domino Effect in Global Stock Markets*, Unpublished Paper, Econometric Institute, Erasmus University Rotterdam, September.

Mendoza, E.G. and V. Quadrini (2009), "Financial Globalization, Financial Crises and Contagion," NBER Working Paper, No. 15432, October.

Mishkin, F.S. (2009), "Is Monetary Policy Effective during the Financial Crises?" NBER Working Paper No. 14678, January, National Bureau of Economic Research, Cambridge.

Rose, A.K and M.M. Spiegel (2009), "Cross-Country Causes and Consequences of the 2008 Crisis: International Linkages and American Exposure," NBER Working Paper, No. 15358, September.

Santoso, W., B. Santoso, I. Rulina, and E. Derianto (2009), "Dampak Contagion Risk pada Pasar Modal Indonesia," *Kajian Stabilitas Keuangan*, Maret 2009, Bank Indonesia, Jakarta.

Tjahjawandita, A., T.D. Pradono, and R. Rinaldi (2009), "Spatial Contagion of Global Financial Crisis," Economics and Development Studies Working Paper No. 200906, Department of Economics, Padjadjaran University.

Tong, H. and S-J. Wei (2009), "The Composition Matters: Capital Inflows and Liquidity Crunch during a Global Economic Crisis," NBER Working Paper, No. 15207, July.

World Bank (2009), "Definitions and Causes of Contagion," available at http://www1.worldbank.org/economicpolicy/managing%20volatility/contagion/definitions.html.