

Foreign Trading and Market Volatility in Indonesia

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This paper provides evidence on the benefits and potential risks associated with foreign equity investment. The market volatility in Indonesia is examined in relation to different types of transactions by foreign and local investors. Foreign selling has a significant impact on market volatility throughout the sample period, even though foreign investors are net buyers of Indonesian stocks and foreign selling accounts for only 13% of daily trading. On the other hand, transactions among foreign investors account for 26% of daily trading but do not affect local market volatility. The large orders placed by foreign institutional investors improve local market depth and liquidity. The results clearly demonstrate that different types of transactions have different impact on market volatility, and using aggregate foreign flows or net foreign flows may produce biased results.

Comments are welcome

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I. Introduction

In recent years, many studies have examined the impact of foreign investors, often large financial institutions, on small emerging stock markets. It remains a highly contested issue among policymakers as well as researchers. Some have suggested that “large inflows leave a country exposed to the latest mood of Wall Street traders” (Sachs, Tornell, and Velasco, 1996), and foreign portfolio investments are not in the best interest of emerging economies (Bhagwati, 1998). Others point to the benefits of financial liberalization and foreign participation. De Santis and Imrohorglu (1997), Bekaert and Harvey (1997, 1998, 2000), Errunza (1999), Henry (2000), and Kim and Singal (2000) all find market opening to be associated with higher returns, stable or lower volatility, improved market efficiency, lower cost of capital, lower asset concentration, and higher economic growth.

This study contributes to the discussion on financial market liberalization by taking a closer look at a small emerging market, Indonesia. While most studies focus on the impact of the broader, one-time financial liberalization, this study examines the impact of day-to-day foreign trading on local market volatility long after the initial market liberalization. Although liberalization implies foreign participation, their impacts are not necessarily the same. There are several important features in the early years of market liberalization: First, financial liberalization often includes a wide range of policy measures for financial development and regulation as well as macroeconomic and exchange rate stabilization¹. Second, foreign investors are buying into the local market, which increases risk sharing and local asset value. Third, foreign participation is low relative to the overall market activity. All three features help to explain previous finding of stable or lower volatility after liberalization. The impact of foreign trading is like to be different when foreign investors have accumulated substantial

¹ Bekaert and Harvey (2000) find that the event of liberalization is associated with higher volatility, but the increase is offset by financial and macroeconomic factors, resulting in a slightly lower volatility after liberalization.

local assets and local knowledge and when foreign trading accounts for a significant portion of local market activity.

Another feature of this study is that market impact of foreign trading is examined in relation to four types of transactions by foreign and local investors: trading among foreign investors, foreign sales to local investors, foreign purchases from local investors, and trading among local investors. Although it has been well established in market microstructure theory that different investors and types of transactions have differential price impact due to asymmetric information, previous studies of market liberalization have not been able to distinguish the impact of different foreign transactions due to data limitation. As shown in the paper, not only foreign and local investors have different market impact, different transactions by foreign investors have different market impact. The study is able to identify the types of foreign transactions that are beneficial to the local market and the type that carries the most risk.

There are two major findings in the paper. First, although there is a strong positive relationship between volatility and aggregate daily trading, three out of the four types of transactions mentioned above did not contribute to market volatility for most of the sample period. In particular, transactions among foreign investors have much larger sizes (5-8 times) than those among local investors, but have no impact on market volatility. Large orders placed by foreign institutions allow large trades to take place with minimum market impact, therefore are beneficial to local institutional investors and local market development. The finding provides new evidence on the benefits of foreign participation: improved local market depth and liquidity. It also indicates homogeneous beliefs among foreign investors and is consistent with other studies on herding by foreign investors.

Second, foreign selling to Indonesian investors has a dominant impact on market volatility before and during the Asian crisis, and remains a significant factor after the crisis.

The positive relation between volatility and volume was largely driven by this particular type of transactions that accounted for only 13% of daily trading and 23% for foreign trading. The local market was extremely sensitive to foreign selling, even though foreign investors were net buyers in Indonesia throughout the sample period. When such a small portion of foreign trading is the only significant factor affecting market volatility under a variety of market conditions, it represents a significant risk for the stability of the local market and should be a major concern for policymakers and researchers. The finding confirms the importance of maintaining foreign investor confidence and points to the need for developing domestic financial institutions. It also indicates that neither the net capital inflow nor the aggregate foreign trading are representative of the potential impact of foreign participation.

The analyses demonstrate the importance of identifying the sources of transactions in order to understand the volatility-volume relationship in financial markets. Different components of trading volume have different information content thus different market impact. When the total daily trading is decomposed into the four trading categories, the adjusted R^2 of the estimated volatility-volume relations rises by an average of 19%, higher than the 14.5% rise from further decomposition into expected and unexpected components. In this regard, this study is in the same spirit as Daigler and Wiley (1999) who examine the relation between futures market volatility and trading by floor traders (exchange members) and off-exchange investors.

The next section provides a theoretical underpinning for the empirical examination of the relationship between market volatility and foreign transactions. The data set is described in section III, with a brief summary of foreign participation in Indonesia. Section IV presents the choice of volatility estimators and the estimation procedure for the relationship between market volatility and different types of transactions. The estimation results are discussed in section V. The final section offers some concluding remarks.

II. The Effect of Foreign Trading on Local Market Returns and Volatility

Foreign investors have distinct characteristics compared to local investors in emerging markets. They are typically financial institutions² with large capital endowments, well-diversified portfolios, and sophisticated investment technologies. On the other hand, most domestic investors in emerging markets, especially in Asia, are small individual investors (see Brown and Otsuki, 1993). The following is a brief discussion on why and how foreign participation may affect local share prices and volatility.

A. *Foreign Investors and Local Market Returns*

There are several reasons why foreign participation may affect local share prices. First, foreign participation broadens the investor base in the local market, increases demand for and liquidity of domestic shares. In an equilibrium asset-pricing model where each investor is limited to a subset of stocks, Merton (1987) shows that broadening investor base increases risk sharing, reduces the required return on capital, and increases share prices. In the case of market liberalization, foreign participation increases the local-market investor base, thus increases the market value of local firms. The increased risk sharing, sometimes called the “base broadening” effect, provides an important theoretical underpinning of the benefit of market liberalization (Clark and Berko, 1997). Furthermore, new investors may use a different pricing benchmark than the existing investors. Foreign investors are likely to evaluate local risks in an international context, while most local investors do not have access to international markets due to limited capital and investment expertise. The effect on the pricing of local assets is not immediately clear, depending on the relative positions of the local and international benchmark portfolios in the return-risk space.³

² Kim and Wei (1999) show that over 99% of foreign holdings of Korean stocks are by foreign institutions.

³ This is different from the case where foreign investors face ownership limits, resulting in a price premium for foreign investors (see Eun and Janakiraman, 1986, and Bailey, Chung, and Kang, 1999). Eun et al. (2000) examine the pricing of closed-end country funds under such asymmetry in market access.

Second, foreign investors may have private information on future returns in emerging markets. Large institutions have more capacity and experience in systematically collecting and processing economic information. Recent studies show that individual investors tend to pay attention to one-off, extreme events and ignore systematic statistical information (Odean, 1998, 1999). Using a sample of stocks from Singapore and Thailand, Bailey and Mao (1999) find “evidence consistent with foreign investors enjoying superior information generating and processing ability, an advantage that is equivalent to creating private information.” Froot et al (2000) demonstrate that transactions by the institutional clients of the State Street Bank & Trust have significant forecasting power for future emerging-market returns.

Third, foreign investment flows may affect local stock prices even if foreign investors do not possess information.⁴ The flows may be driven by changes in investor sentiment unrelated to fundamentals, causing local prices to rise or fall. Prices exhibit reversals after such pressure has subsided. Clark and Berko (1997) do not find such reversals in Mexico and reject the price-pressure hypothesis in favor of the permanent base-broadening effect. Even when the initial price changes are not driven by foreign investments, foreign investors are often positive feedback traders who buy when prices rise and sell when prices fall⁵. Dornbusch and Park (1995) argue that such trading may cause bubbles and crashes in local markets. However Choe et al. (1999) show that such trading by foreign investors in Korea represents efficient price adjustments and does not destabilize the market.

B. Foreign Trading and Market Volatility

The above discussion suggests that foreign trading is likely to affect local market returns. However, it does not necessarily increase local market volatility. There are three

⁴ The case against foreign investors having better information is motivated by the observed “home bias” in international asset allocation. Frankel and Schmukler (1996), Brennan and Cao (1997), Kang and Stulz (1997), and Bhattacharya et al. (1999) all find evidence consistent with foreign investors being less informed than domestic investors.

⁵ See Bohn and Tesar (1996), Choe et al. (1999), Kim and Wei (1999), and Froot et al. (2000).

types of transactions involving foreign investors: foreign purchases from local investors, foreign sales to local investors, and transactions among foreign investors. Each type of transactions has different implications on market volatility.

Foreign purchases from local investors represent good news about the local market: increased investor base, positive information about local stocks, and increased investor confidence and demand. Such transactions should have limited impact on market volatility, and may even help to reduce market uncertainty. This is especially the case in the first few years after market liberalization when foreign are buying into local markets, and is consistent with findings of stable or lower market volatility after liberalization by De Santis and Imrohoroglu (1997), Bekaert and Harvey (1997, 2000), and Kim and Singal (2000). In the case of Indonesia, the evidence from this study indicates that foreign purchases do not have any impact on market volatility.

Foreign sales to local investors have the opposite effect from foreign purchases: reduced investor base, bad news about local stocks or economy and reduced investor confidence and demand. It has been well documented, first by Black (1976), that negative shocks have a much stronger effect on volatility than positive shocks. Therefore foreign sales should have a strong effect on market volatility. Evidence from Indonesia shows that foreign sales to Indonesian investors have a significant impact on local market volatility.

Trading among foreign investors does not represent changes in investor base or capital flows. Its impact is likely to come from dispersion of information/belief among foreign investors about the local market and economy. Geographical, cultural, and language diversity of foreign investors may result in such dispersion (see evidence in Coval and Moskowitz, 1999, and Grinblatt and Keloharju, 2000). On the other hand, the international markets are increasingly being dominated by a few large financial institutions with similar information sources and decision-making procedures, resulting in significant herding in their

investment decisions.⁶ In this case, foreign investors are more likely to trade with local investors when driven by new information or market sentiment. Trading among foreign investors is likely to be driven by liquidity and is unlikely to cause market volatility.

The above discussion assumes that investors, especially local investors, are aware of the overall direction of foreign trading. In Indonesia, the Jakarta Automated Trading System (JATS) actually provides a code indicating whether an order is submitted by an Indonesian (I) or foreign (A) investor. It is unclear whether such disclosure improves market efficiency or increases volatility. Even without such disclosure, however, local investors may have the ability to extract some information on foreign trading within a reasonable time period. As shown in the next section, in Indonesia, and probably in most small emerging markets, large orders are mostly placed by foreign (institutional) investors. Therefore the direction of large orders can be used as an indicator of the direction of foreign trading.

III. Data and Preliminary Analysis

The data for this study are from 1 January 1996 to 30 June 2000, including daily open, high, low, and closing values of the Jakarta Composite Index (JCI), as well as daily trading activities in four categories: trading among foreign investors (FF), foreign sales to domestic investors (FS), foreign purchases from domestic investors (FB), and trading among domestic investors (DD). Within each category, trading is measured by the number of shares, rupiah value, and the number of transactions.

The data set allows for improvement upon previous studies that use indirect measures of foreign presence in emerging markets, such as the date of financial liberalization, and the number of country funds, etc. Some studies use monthly equity flows from the United States which may have a different dynamics from the overall flows (see Table 2 of Choe et al.

⁶ Kim and Wei (1999) find that offshore investors of Korean stocks are influenced by a handful of English newspapers. Many studies have found evidence of herding among foreign investors.

1999). U.S. flows often do not go directly to the target market, causing problems in measuring flows into individual markets⁷. This data are recorded at the exchange where transactions take place, sharply reducing the measurement error on foreign trading⁸. The four types of transactions provide a more complete description of foreign behavior than the net equity flows used in previous studies.

A. Dating the Financial Crisis in Indonesia

The sample period from 1996 to mid-2000 covers the Asian financial crisis period. It is sensible to distinguish foreign trading during the Asian crisis from periods before and after the crisis. Table 1 summarizes the start and the end of the crises in Indonesia. The dating is based on large changes in exchange rate and the stock market index in Figure 1.

The JCI had a strong bull run in the first half of 1997. It collapsed on 5 August 1997, followed by the flotation of rupiah on August 14. So the starting date of the crisis is set to 5 August 1997.⁹ The end of the crisis in Indonesia is set to early October 1998. Figure 1 indicates that the JCI hit a low of 261 on 6 October 1998 before a strong and sustained rebound during the rest of the year and into the second quarter of 1999. The IDR/USD exchange rate had begun to recover from its worst level in mid-1998 and had a significant surge in the second week of October with the stock market rise. Even though in October 1998 there was significant uncertainty related to emerging markets in Russia and South America as well as in Asia, the worst of the Asian crisis was clearly over, the markets and the economies have begun to recover. Alternative dates for the crisis period are tested in section V. The results are not qualitatively different.

⁷ For example, Hong Kong is often used as a booking center for other markets in South-East Asia, thus exaggerating its importance as a target market. If a UK subsidiary of a US fund purchases equities in emerging markets, the investments are unrecorded. Howell (1993) estimates that around US\$25 billion of US gross equity flows are not recorded in each year.

⁸ Foreign investors pay 20% on dividends and capital gains while domestic investors pay 15%. Brokers have to code each transaction with the client identity being domestic or foreign. There is no obvious incentive for brokers to mislead the exchange. However, if an Indonesian investor invests in a US fund which in turn invests in Indonesian stocks, the trades by the US fund is classified as foreign trades.

B. Foreign Equity Trading in Indonesia

Indonesia opened its equity market relatively early in 1989. By 1996, foreign investors have acquired 28% of the market capitalization, and are very active on the JSX. Figure 2 indicates the percentage of daily trading value in each of the four trading categories. Table 2 reports daily trading summary before, during and after the Asian crisis. There are several important characteristics in foreign trading in Indonesia. First, there has been a significant foreign presence on the JSX. In early 1996, over 50% of daily trading value on the JSX were among foreigners, and over 80% involved foreign investors. For the whole sample, 26% of daily trading value were among foreign investors, with an additional 31% involving foreign investors either buying or selling. High foreign turnover is also found in the Philippines, where foreign funds accounted for 15% of market capitalization in early 1997 and 70% of turnover (East Asia Analytical Unit, 2000). It is also consistent with the findings of Tesar and Werner (1995) in several developed markets.

Second, foreign investors have been net buyers in Indonesia throughout the sample period. As shown in Figure 3, the accumulative foreign net purchase has been increasing over the sample periods with several large jumps associated with privatization or regulatory changes¹⁰. Table 2 indicates that on average, foreign investors are net buyers of 5% of daily trading value. Evidence from other crisis countries¹¹ also indicates substantial equity capital inflows during the crisis period, which contradicts the reported massive capital outflows. The finding suggests that different forms of capital flows may have different dynamics, especially during financial crises, and should be examined separately in research and policy discussions.

⁹ See Penttinen (2000) for a discussion on the so-called peso problem before the actual devaluation.

¹⁰ For example, the large jump in foreign holding on 11 December 1996 was the result of the government selling its holding of 388 million shares of PT.Telekomunikasi Indonesia Tbk. Most shares were purchased by foreign investors, increasing foreign share holding by 29% on the day. In May 1999, the government increased the foreign ownership limit on Indonesian banks to 99%.

¹¹ Data from the Stock Exchange of Thailand indicate that foreign investors were net buyers of 64 billion baht of Thai stocks during the crisis. Kim and Wei (1999) report that foreign holdings in Korea increased from 7.06 to 8.58 trillion won between November 1997 and June 1998. Barth and Zhang (1999) also report that “the declining of investment [by U.S. funds] was largely due to value compression, rather than withdrawal of investment from Asian markets.”

Third, the average size of transactions among foreign investors has been increasing throughout the sample period. It is over five times of that among local investors in shares, and close to nine times in rupiah value. It is also significantly larger than transaction sizes between foreign and domestic investors. It is relatively infrequent that large orders placed by two foreign investors are matched against each other. Most often they are filled by small orders from local investors. An important issue addressed by this study is whether large trades among foreign investors improve local market liquidity or cause market disturbances.

Fourth, the percentage of daily trading among foreign investors declined over the sample period, with a brief rebound in the first quarter of 1999. Together with the rise in the average transaction size among foreign investors, the evidence is consistent with smaller foreign investors leaving the market during and after the Asian crisis. For the whole sample, trading between foreign and Indonesian investors remained relatively stable as percentages of daily trading. Foreign selling to Indonesian investors was the smallest of the four types of transactions in terms of shares and rupiah value. However, it has a dominant effect on market volatility as shown later.

IV. The Estimation Procedure

A. Choice of Volatility Estimators

In order to examine the impact of different types of transactions on market volatility, it is critical to have accurate measures of daily volatility. As pointed out by Anderson and Bollerslev (1998), daily return-based volatility estimators are extremely noisy even though they are unbiased. High frequency intraday data are required for the construction of more accurate ex-post volatility measurements. Given that the only intraday data on the JCI are the daily opening, high, low, and closing values, I opt to use two volatility estimators based on opening, closing, and intraday extreme values. Wiggins (1992) demonstrates that volatility

measures based on extreme values are more efficient than those based on closing prices. Andersen and Bollerslev (1998) show that the efficiency of extreme-value based estimators is similar to that of intraday sample variance based on 2-3 hour returns.

The first estimator is constructed by Parkinson (1980):

$$(1) \quad V_P = \frac{1}{4 \ln 2} [\ln(\text{high}) - \ln(\text{low})]^2$$

It is a variation of the commonly used log-difference of daily high-low. Parkinson shows that it is approximately 5 times more efficient than the traditional variance estimator based on deviations from the mean. The second estimator is proposed by Garman and Klass (1980):

$$(2) \quad V_{GK} = \frac{1}{2} [\ln(\text{high}) - \ln(\text{low})]^2 - (2 \ln 2 - 1) [\ln(\text{close}) - \ln(\text{open})]^2$$

When prices do not display any time trend, Garman and Klass show that this estimator is very close to being the minimum-variance unbiased estimator of daily volatility. The no-trend assumption is reasonable when the relevant time period is short, and/or the drift is small compared to the volatility level. Rogers et al. (1994) show that V_{GK} is relatively efficient even when prices have stable trends.

B. Market Impact of Expected and Unexpected Trading

Previous studies (e.g. Bessembinder and Seguin, 1993, Daigler and Wiley, 1999) of volatility-volume relationship have pointed out the differential effects of the expected and unexpected trading activities. Let $A_{t,k}$ represent daily trading in category k , $k = \text{FF, FS, FB, DD}$. The logarithm of the number of shares, rupiah value, or the number of transactions is used for $A_{t,k}$ to reduce the impact of extreme observations. The expected component of $A_{t,k}$, $A_{t,k}^e$, is estimated using a time trend t , past trading $A_{t-j,k}$, past returns r_{t-j} and volatility V_{t-j} :

$$(3) \quad A_{t,k}^e = \alpha + \beta \times t + \sum_{j=1}^{10} \gamma_j A_{t-j,k} + \sum_{j=1}^{10} \phi_j r_{t-j} + \sum_{j=1}^{10} \theta_j \ln(V_{t-j})$$

The time variable is included to capture the trend in Figure 2. The unexpected component is the difference between the actual and expected trading $A_{t,k}^u = A_{t,k} - A_{t,k}^e$. As in Bessembinder and Seguin (1993), I do not attempt to find an ideal model for each of the four types of transactions, but instead choose an arbitrarily long autoregressive process. Experiments with longer lags do not show qualitative differences.

The relationship between market volatility and different types of transactions is estimated through the following regression:

$$(4) \quad \ln(V_t) = \alpha + \sum_{j=1}^{10} \beta_j \ln(V_{t-j}) + \sum_{j=1}^6 \gamma_j D_{t,j} + \sum_k \lambda_k A_{t,k}^e + \sum_k \delta_k A_{t,k}^u + \varepsilon_t$$

where daily volatility V_t is measured by V_P and V_{GK} . The logarithm of daily volatility is used so that the dependent variables and the residuals in the regressions are not restricted to be positive. Lagged volatility is included to capture the volatility clustering effect. A relatively large number of lags are used to ensure that the residuals are not serially correlated and the estimated coefficients of the lagged dependent variables are unbiased. Four day-of-the-week dummies, together with the constant term, are used to account for possible day-of-the-week effect. A holiday dummy is also included. In addition, a dummy variable for extremely large foreign purchases is set to one if the daily foreign net purchase is 3 standard deviations above the average. $A_{t,k}^e$ and $A_{t,k}^u$ are the expected and unexpected trading calculated above, $k = FF, FS, FB, DD$. All t-statistics are based on the Newey-West (1987) heteroskedasticity and autocorrelation consistent covariance with 4 lags, corresponding to the fourth root of the sample sizes. Given the potential structural breaks caused by the Asian crisis, I focus on the results for the sub-periods, but also report the results for the full sample.

V. Empirical Results

A. Volatility – Trading Relationship

Before implementing the above estimation procedure, I first examine the correlation among the four types of transactions to assess the potential problem of multicollinearity. The correlation coefficients across different types of transactions are reported in Table 3. The expected trading has an average correlation coefficient of 0.69, higher than the average of 0.44 for the unexpected trading. Trading is less correlated after the crisis than before and during the crisis. Trading among domestic investors and trading among foreign investors have the lowest correlation across all four types of transactions. Overall, the correlation across different types of trading is not very high. Ninety-nine out of the 108 correlation coefficients are below 0.8, with only two above 0.9. When the expected components are aggregated into one variable, $A_t^e = \sum_k A_{t,k}^e$, $k = \text{FF, FS, FB, DD}$, the coefficients of the unexpected components are stable and qualitatively the same.

The estimation results are reported in Table 4 using the Parkinson volatility estimator and Table 5 using the Garman-Klass estimator. The impacts of different types of transactions are significantly different. First, trading among foreign investors (FF) has no impact on market volatility, even though it accounts for the largest percentage of foreign trading value for most of the sample period, and has much larger transaction sizes than trades involving local investors¹². As discussed in section II, such transactions will not affect volatility when foreign investors have similar information about the local market. The characteristics of such trading, large and infrequent trades with minimum market impact, make it similar to block trading in mature markets, even though all trades are carried out on the same electronic trading system on the JSX. These large orders are most likely to be limit orders, as large

¹² There is only one exception out of 18 cases for different subperiods and volatility estimators reported in Tables 4 and 5.

market orders can be executed automatically in a wide price range. They increase market depth and allow local investors to execute large orders with reduced price impact. As Table 2 shows, trades between foreign and local investors are 50-150% larger than trades among local investors. The finding indicates that foreign participation is beneficial to domestic institutions and market development.

Second, before and during the Asian crisis, unexpected foreign selling to domestic investors was the only significant factor contributing to market volatility in Indonesia. It remains an important factor after the crisis. This result is significant given that foreign sales to domestic investors account for only 13-14% of daily trading during the sample period, and less than a quarter of daily foreign trading. Although selling in general indicates bad news and higher volatility, foreign selling appears to contain worse news than domestic selling. Foreign investors as large institutions may have better information than local investors do and their selling is likely to cause market volatility. Alternatively, large foreign institutions may be perceived to have better information and are followed by local investors, exaggerating their market impact. The disclosure of order submission by local or foreign investors may help exacerbate such reputation effect.

Third, foreign purchases from domestic investors did not affect market volatility. Foreign purchases represent capital injection and increasing market confidence. The result demonstrates the asymmetric effect of purchases and sales on market volatility. There were eleven days when the foreign net purchase dummy was set to one, one each before and during the crisis. The coefficients of the dummy variable are not reported here. Of the eleven days, only the one before the crisis on 11 December 1996 was positive and highly significant for both V_P and V_{GK} and for all three trading activity measures. However, it is unclear whether the volatility was driven by government selling of a large company or by foreign purchases of the company. The foreign purchase dummy was not significant during and after the crisis.

Fourth, there is some evidence that the expected trading among local investors was negatively related to market volatility before the crisis, when local investors only accounted for 26% of daily trading value. Dennis and Strickland (2000) show that on days with high market volatility, individual investors generally do not trade as much as institutions. It is financial institutions, especially mutual funds, who “blink in volatility markets”. However, after the crisis, trading among local investors accounted for 55% of trading value and almost 80% of daily transactions, thus it is not surprising to see it having a strong market impact.

In summary, unexpected foreign selling was the most significant factor contributing to market volatility in Indonesia. Trading among foreign investors and foreign purchases from local investors do not contribute to market volatility. After the crisis, trading among Indonesian investors became the largest component of daily trading and has the largest market impact. There is not a consistent pattern in the significance of the day-of-the-week and holiday dummies across different indices and sub-periods. The lagged volatilities are always highly significant, indicating strong volatility clustering, especially during the crisis.

B. Improvement in Goodness of Fit

Following Dailger and Wiley (1999), I examine the improvements in explanatory power from decomposing aggregate trading into four types of transactions among foreign and domestic investors. Table 6 reports the adjusted R^2 for the volatility-trading estimation of equation (4) using three levels of aggregation of daily trading: (a) the aggregate trading volume, value, and the number of trades; (b) trading volume, value, and the number of trades in the four types of transactions; and (c) the complete model with expected and unexpected components of the four types of transactions. Moving from (a) to (b) improves the adjusted R^2 by an average of 17.5% for the Parkinson estimator and 19% for the Garman-Klass estimator. Further decomposition of the four types of transactions into the expected and unexpected components raises the adjusted R^2 by an average of 25.8% for the Parkinson

estimator and 14.6% for the Garman-Klass estimator. Thus a significant portion of the improvements in the adjusted R^2 comes from the decomposition of aggregate trading into four categories. The results clearly demonstrate that different types of transactions have different impact on market volatility, and aggregation of trading loses information and reduces the explanatory power of the volatility-trading relationship.

C. Effects of Transaction Sizes

Jones et al. (1994) suggest that “trade size has no information beyond that contained in the frequency of transactions”. However, Chan and Fong (1999) reaffirm the significance of trade size in the volatility-volume relation on the NYSE and the NASDAQ. Therefore I examine the impact of trade size in each of the four trade categories. The average transaction size in each category, calculated from daily trading value and the number of trades, is decomposed into the expected and unexpected components using equation (3). The joint impact of the number of trades and transaction size is then estimated.

Almost all coefficients of the size variables are not significant. There are 48 coefficients for expected and unexpected sizes in four categories in three subperiods with two volatility estimators. Only two coefficients¹³ are significant at 5% level. Including the average trade sizes to the regression does not affect the significance of the number of trades when using the Parkinson estimator. When using the Garman-Klass estimator, two coefficients, previously not significant, became significant at 5%¹⁴. For both volatility estimators, the adjusted R^2 s became slightly lower before and during the crisis after including the average trade sizes. The evidence indicates that the daily average trade size does not have additional explanatory power in the case of Indonesia.

¹³ For the Parkinson estimator, the unexpected FS after the crisis has a t-statistic of 2.58. For the Garman-Klass estimator, the expected FB during the crisis has a t-value of -2.08.

¹⁴ The unexpected trades among domestic investors before the crisis, which had a t-statistic of -1.79 in Table 5, became significant with a t-statistic of -1.98. The unexpected foreign purchases after the crisis, which had a t-statistic of -1.74, became significant with a t-value of -2.16.

D. Alternative Divisions of Subperiods

To check the sensitivity of the results, three alternative sets of dates are used for the Asian crisis: (1) moving the starting date forward to July 1, 1997, the day Thai baht was floated; (2) moving the ending date to the end of October 1998 when the rupiah bounced back to Rp7450 per US\$; (3) moving the ending date to the end of 1998. In all three cases, the main conclusions hold, i.e., trading among foreign investors has little impact on market volatility, foreign sales were a significant factor contributing to local market volatility, and trading among local investors did not affect market volatility until after the crisis. The results are available from the author.

VI. Conclusion

A new finding of this study is that trading among foreign investors does not cause local market volatility in Indonesia. The market is extremely sensitive to foreign selling to local investors, which is the sole source of market volatility for much of the sample period. The results demonstrate the significant market impact, both positive and negative, of foreign investors, especially foreign institutions. Large orders placed by foreign institutions improve market depth and liquidity, which is important for the growth of local institutions and markets. The growth of local institutions and markets is the best way to reduce the risk associated with foreign selling.

Another important implication of this study is that not all foreign investments are the same. Foreign investments in emerging market debt and equity may flow in opposite direction under certain market conditions. Different types of foreign transactions may have opposite impact on local market liquidity and volatility. Research and policy discussions should examine each type of investments and transactions individually. Using aggregate flows or net flows may produce biased results.

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Table 1: Dating the Asian Crisis

	Sub-period	Sample Size
Before Crisis	1996.1.1 – 1997.8.3	390
During Crisis	1997.8.4 – 1998.10.6	290
After Crisis	1998.10.7 – 2000.6.30	426
Full Sample	1996.1.1 – 2000.6.30	1106

Table 2: Daily Trading Summary

	FF	FS	FB	DD
<i>Before Crisis</i>				
Number of Shares (%)	29	16	19	36
Rupiah Value (%)	42	14	18	26
Number of Trades (%)	14	18	17	51
Shares per trade (000)	40	16	21	12
Value per trade (m. rp)	134	32	46	22
<i>During Crisis</i>				
Number of Shares (%)	16	19	16	49
Rupiah Value (%)	28	16	18	38
Number of Trades (%)	7	17	13	63
Shares per trade (000)	69	31	36	22
Value per trade (m. rp)	139	30	44	19
<i>After Crisis</i>				
Number of Shares (%)	10	11	17	62
Rupiah Value (%)	15	12	18	55
Number of Trades (%)	2	9	10	79
Shares per trade (000)	194	43	52	25
Value per trade (m. rp)	247	42	56	20
<i>Full Sample</i>				
Number of Shares (%)	14	14	17	55
Rupiah Value (%)	26	13	18	43
Number of Trades (%)	6	13	12	69
Shares per trade (000)	104	30	36	19
Value per trade (m. rp)	177	35	49	20

Note: FF = trading among foreign investors, FS = foreign selling to domestic investors, FB = foreign buying from domestic investors, DD = trading among domestic investors.

Table 3: Cross-correlation of the Expected and Unexpected Number of Trades on the JSX

	FF-FS	FF-FB	FF-DD	FS-FB	FS-DD	FB-DD
<i>Before Crisis:</i>						
Expected Shares	0.902	0.892	0.848	0.866	0.923	0.858
Unexpected Shares	0.385	0.367	0.158	0.330	0.394	0.303
Expected Value	0.760	0.775	0.648	0.772	0.837	0.771
Unexpected Value	0.345	0.325	0.154	0.356	0.324	0.306
Expected Trades	0.790	0.796	0.657	0.722	0.843	0.801
Unexpected Trades	0.484	0.530	0.245	0.476	0.502	0.603
<i>During Crisis:</i>						
Expected Shares	0.734	0.781	0.505	0.700	0.642	0.745
Unexpected Shares	0.450	0.488	0.450	0.536	0.711	0.639
Expected Value	0.771	0.827	0.527	0.774	0.698	0.719
Unexpected Value	0.425	0.481	0.393	0.641	0.774	0.679
Expected Trades	0.795	0.772	0.314	0.701	0.393	0.594
Unexpected Trades	0.594	0.643	0.478	0.436	0.404	0.445
<i>After Crisis:</i>						
Expected Shares	0.721	0.725	0.565	0.695	0.772	0.709
Unexpected Shares	0.334	0.207	0.257	0.293	0.542	0.482
Expected Value	0.586	0.721	0.321	0.742	0.841	0.648
Unexpected Value	0.348	0.261	0.177	0.414	0.568	0.508
Expected Trades	0.573	0.639	-0.085	0.627	0.548	0.518
Unexpected Trades	0.527	0.575	0.313	0.345	0.523	0.643

Note: FF = trading among foreign investors, FS = foreign selling to domestic investors, FB = foreign buying from domestic investors, DD = trading among domestic investors.

Table 4: Regression of Parkinson Volatility Estimates on the Expected and Unexpected Components of Four Types of Transactions

	FF ^e	FS ^e	FB ^e	DD ^e	FF ^u	FS ^u	FB ^u	DD ^u	Adj R ²
<i>Before Crisis</i>									
Number of Shares	-0.426	0.397	0.109	-0.286	0.102	0.594	0.0001	0.030	0.120
<i>t-statistic</i>	-0.95	1.38	0.47	-1.26	0.60	2.65**	0.0001	0.17	
Rupiah Value	-0.322	0.472	-0.073	-0.292	0.073	0.921	-0.045	0.022	0.160
	-0.94	2.23*	-0.35	-1.67	0.47	4.10**	-0.34	0.14	
Number of Trades	-1.03	1.06	0.486	-0.720	0.053	1.52	0.071	-0.380	0.172
	-1.41	2.45*	1.19	-2.67**	0.15	4.46**	0.24	-1.35	
<i>During Crisis</i>									
Number of Shares	0.206	-0.284	0.137	-0.294	0.260	0.383	-0.008	0.166	0.292
<i>t-statistic</i>	1.10	-1.21	0.59	-1.40	2.11	2.43*	-0.06	1.01	
Rupiah Value	0.129	-0.134	0.163	-0.347	0.223	0.642	-0.125	-0.029	0.293
	0.59	-0.53	0.62	-1.45	1.51	3.45**	-0.91	-0.16	
Number of Trades	-0.083	-0.068	0.535	-0.526	-0.354	0.911	0.128	0.096	0.297
	-0.24	-0.14	1.27	-1.43	-1.18	2.84**	0.37	0.30	
<i>After Crisis</i>									
Number of Shares	-0.168	0.266	0.197	-0.183	0.036	0.176	0.143	0.745	0.310
<i>t-statistic</i>	-1.51	1.47	1.75	-1.82	0.56	1.96*	1.30	4.40**	
Rupiah Value	-0.051	0.201	0.070	-0.152	0.028	0.714	0.149	0.591	0.389
	-0.46	0.95	0.47	-1.31	0.37	5.43**	1.28	3.53**	
Number of Trades	-0.115	0.444	0.289	-0.251	0.354	0.625	-0.053	1.018	0.380
	-0.77	1.45	1.38	-1.50	1.97*	3.42**	-0.31	4.70**	

Note: FF = trading among foreign investors, FS = foreign selling to domestic investors, FB = foreign buying from domestic investors, DD = trading among domestic investors. The asterisks ** and * indicate significance at 1%, and 5% respectively.

Table 5: Regression of Garman-Klass Volatility Estimates on the Expected and Unexpected Components of Four Types of Transactions

	FF ^e	FS ^e	FB ^e	DD ^e	FF ^u	FS ^u	FB ^u	DD ^u	Adj R ²
<i>Before Crisis</i>									
Number of Shares	-0.461	0.363	0.117	-0.206	0.065	0.572	-0.1	-0.114	0.111
<i>t</i> -statistic	-1.19	1.4	0.52	-1.1	0.38	2.56**	-0.74	-0.71	
Rupiah Value	-0.287	0.479	-0.05	-0.264	0.014	0.969	-0.188	-0.101	0.143
	-0.85	2.42*	-0.24	-1.72	0.09	3.86**	-1.50	-0.73	
Number of Trades	-0.883	1.17	0.365	-0.695	-0.149	1.41	-0.172	-0.511	0.150
	-1.23	2.83**	0.90	-2.6**	-0.52	4.3**	-0.61	-1.79	
<i>During Crisis</i>									
Number of Shares	0.101	-0.068	0.079	-0.225	0.131	0.380	0.031	0.192	0.306
<i>t</i> -statistic	0.55	-0.30	0.35	-1.08	1.18	3.2**	0.26	1.25	
Rupiah Value	0.021	0.104	0.038	-0.221	0.084	0.561	-0.087	0.082	0.304
	0.10	0.43	0.15	-0.98	0.65	3.62**	-0.71	0.52	
Number of Trades	-0.024	0.131	0.231	-0.281	-0.34	0.881	0.014	0.187	0.314
	-0.07	0.28	0.63	-0.84	-1.28	3.33**	0.05	0.64	
<i>After Crisis</i>									
Number of Shares	-0.181	0.256	0.239	-0.149	0.02	0.128	0.101	0.678	0.269
<i>t</i> -statistic	-1.69	1.51	2.11*	-1.48	0.32	1.46	0.94	4.24**	
Rupiah Value	-0.01	0.144	0.123	-0.113	-0.036	0.654	0.064	0.502	0.319
	-0.09	0.68	0.77	-0.98	-0.49	4.83**	0.55	2.95**	
Number of Trades	-0.10	0.398	0.339	-0.203	0.263	0.616	-0.294	1.00	0.327
	-0.69	1.38	1.65	-1.28	1.51	3.67**	-1.74	4.37**	

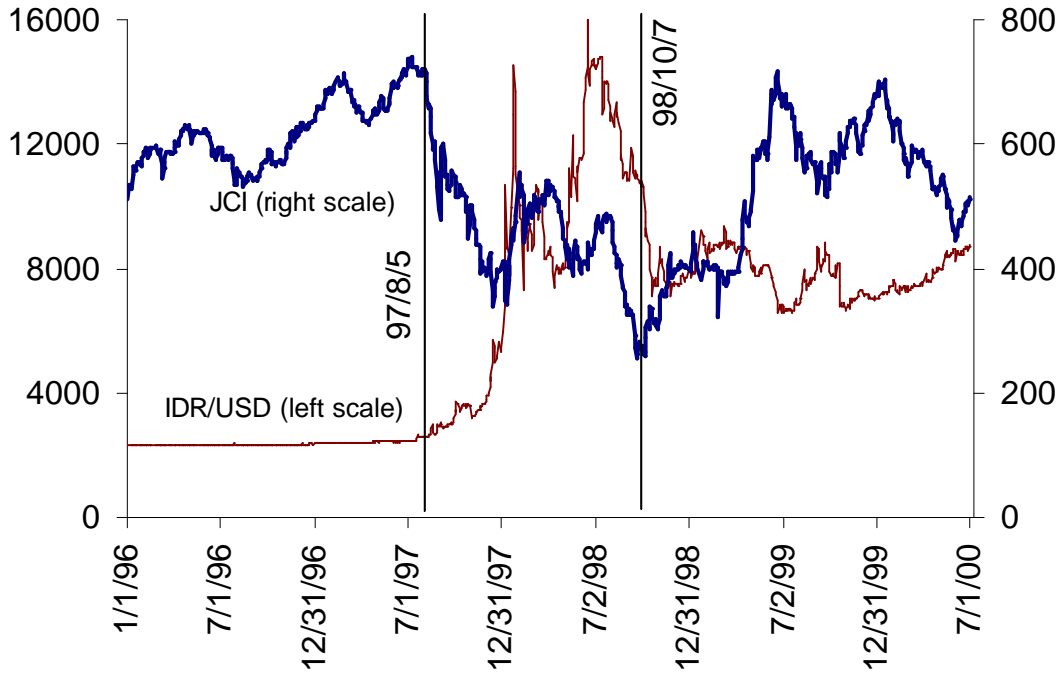
Note: FF = trading among foreign investors, FS = foreign selling to domestic investors, FB = foreign buying from domestic investors, DD = trading among domestic investors. The asterisks ** and * indicate significance at 1%, and 5% respectively.

Table 6: Adjusted R² for Volatility-Trading Regressions

This table reports changes in the adjusted R² of the volatility-trading regressions when trading is decomposed into different components. The dependent variable is the log-value of daily volatility estimates. The basic independent variables are the lagged volatilities, and day-of-the-week and holiday dummies. In addition, column (a) uses only aggregate trading of the day; column (b) uses the four types of transactions together with the dummy for large foreign purchases; column (c) uses the complete model specified in equation (4), which include the expected and unexpected components of the four types of transactions, with the dummy for large foreign purchases.

	Total Trading (a)	Four Categories (b)	% Increase (b/a)-1	Complete Model (c)	% Increase (c/b)-1
<i>The Parkinson Estimator V_P</i>					
<i>Before Crisis</i>					
Number of Shares	0.101	0.099	-2	0.120	21.2
Rupiah Value	0.107	0.123	15	0.160	30.1
Number of Trades	0.104	0.148	42.3	0.172	16.2
<i>During Crisis</i>					
Number of Shares	0.228	0.235	3.1	0.292	24.3
Rupiah Value	0.219	0.238	8.7	0.293	23.1
Number of Trades	0.229	0.251	9.6	0.297	18.3
<i>After Crisis</i>					
Number of Shares	0.207	0.229	10.6	0.310	35.4
Rupiah Value	0.209	0.280	34	0.389	38.9
Number of Trades	0.223	0.304	36.3	0.380	25
Average			17.5		25.8
<i>The Garman-Klass Estimator V_{GK}</i>					
<i>Before Crisis</i>					
Number of Shares	0.104	0.108	3.8	0.111	2.8
Rupiah Value	0.108	0.134	24.1	0.143	7.5
Number of Trades	0.104	0.149	43.3	0.150	0.7
<i>During Crisis</i>					
Number of Shares	0.239	0.264	10.5	0.306	15.9
Rupiah Value	0.234	0.272	16.2	0.304	11.8
Number of Trades	0.240	0.281	17.1	0.314	11.7
<i>After Crisis</i>					
Number of Shares	0.202	0.209	3.5	0.269	28.7
Rupiah Value	0.196	0.245	25	0.319	30.2
Number of Trades	0.208	0.268	28.8	0.327	22
Average			19.1		14.6

Figure 1: The Jakarta Composite Index and the IDR/USD Exchange Rate



**Figure 2: Percentage of Daily Trading Value on the JSX
40-day moving average**

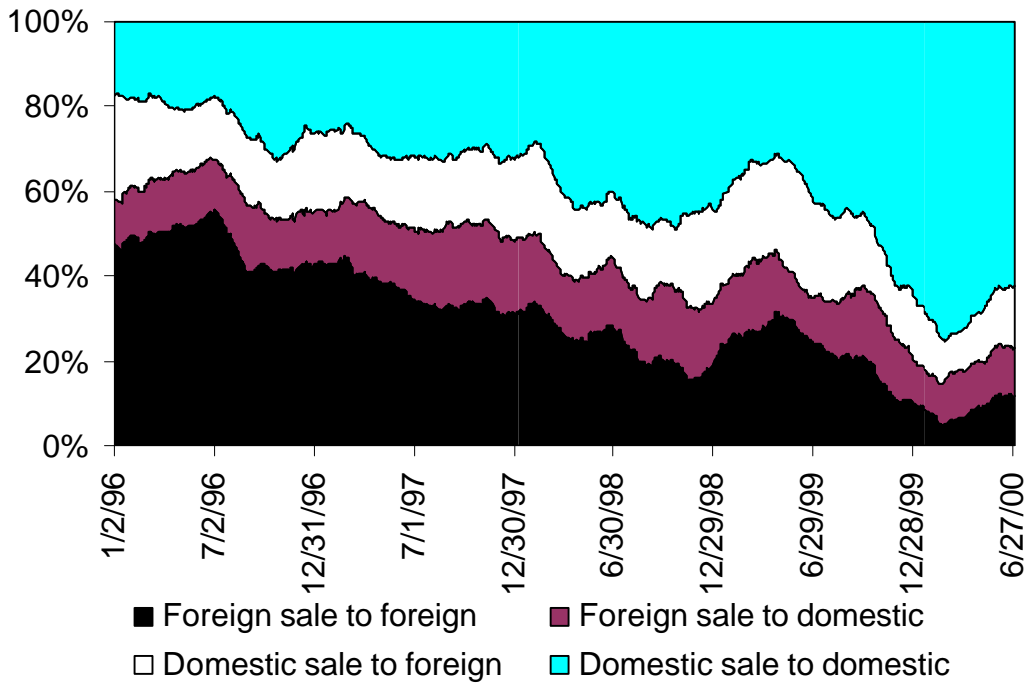


Figure 3: Foreign Net Purchase on the JSX
(Billion rupiah)

