Foreign Equity Flow and Stock-Return Volatility: Evidence from the İstanbul Stock Exchange

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Abstract

In this study, we examine the impact of foreign equity flow on the aggregated stock-return volatility. By using the foreign equity flow to detect the volatility impacts on stock returns, we eliminate several problems that arise in previous literature, such as the imprecision involved in dating the liberalization and in detecting effective foreign participation. Furthermore, rather than analyzing the return volatility of a market portfolio, as previous studies did, we use the aggregated total volatility of stock returns. Our aggregated volatility measure is independent of the correlation of the stock returns and therefore is a pure measure of the return volatility of a typical stock in a country. We also attempt to find out the channels through which foreign equity flow affects the aggregated total volatility. For this purpose, the aggregated return volatility of stocks is decomposed into its components in a modified market model that accounts for the partially segmented, partially integrated nature of emerging markets. Under this model, we derive the global, local, and idiosyncratic volatility components for the aggregated total volatility. The results show that an equity inflow has a decreasing impact on aggregated stock return volatility, whereas an equity outflow has an increasing impact. We also show that net equity flow affects the aggregated total volatility through the aggregated idiosyncratic and local volatility.

Keywords: return volatility, foreign equity flow, market integration, volatility decomposition

JEL classification codes: F36, G15

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1. Introduction

The increasing liberalization of many stock exchanges and the developments in computer and telecommunications technologies in the last few decades have eased the flow of international capital, which in turn, has lead to growing foreign investor participation in local markets. Although the effects of foreign investor participation on local stock exchanges have attracted a lot of attention among researchers, the majority of research concentrates on the impact of foreign participation on stock returns[1]. On the other hand, there are few studies that investigate the relationship between foreign investor participation and stock return volatility[2]. While some studies document that foreign investor participation cause excess volatility (Bae et al., 2004 and Li et al., 2004), others disagree with this result and show that either foreign investor participation does not affect return volatility systematically (Howe and Madura, 1990; Kim and Signal, 2000; and Umutlu et al., 2007) or that it reduces volatility (De Santis and İmrohoroğlu, 1997 and Hargis, 2002). Clarifying the relationship between foreign investor participation and stock return volatility is crucial, because any possible adverse effects may lead governments to employ regulatory shifts over foreign equity investments, especially in emerging markets.

The main motivation behind analyzing foreign investor participation in emerging equity markets is the change in market dynamics when shifting from a segmented market to an integrated market[3]. As the foreign funds flow into the local capital

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[1] Among many others, see Errunza and Losq (1989), Foerster and Karolyi (1999), Errunza and Miller (2000), Domowitz et al. (1997), Eun and Janakiramanan (1986), and Varela and Lee (1993).

[2] In these studies, foreign investor participation is associated with stock market liberalization, the introduction of the first ADR or country fund, stock market openness, or foreign equity funds.

[3] In the seminal works of Solnik (1974) and Stehle (1977), a market is considered to be integrated when there are no barriers to international capital flows. In the review study of Bekaert and Harvey (2002),

markets, and thus the local markets become more integrated into global capital markets, the exposure of local assets to local and global factors changes. As one of the consequences, the components of the volatility and the volatility induced by these factors might be subject to change in the transition from a segmented market to an integrated one.

A number of studies associate foreign investor participation with financial liberalization and analyze the behavior of the return volatility of local market indexes in event windows around the liberalization date[4]. The core implicit assumption in these studies is that liberalization occurs at a single point in time. There are two major drawbacks to these studies. First, financial liberalization is a gradual process rather than an event (Edison and Warnock, 2003; Bekaert and Harvey, 2002a; and Bekaert et al., 2003), and its intensity changes over time (Bae et al., 2004). Thus, ignoring the continuous character of financial liberalization and treating it as a one-time event may lead to erroneous conclusions about the effects of foreign investor participation. Second, analyzing the market-index variance can be misleading, because a change in the variance of a portfolio may be due to changes in the covariances of the stocks forming the portfolio, without an accompanying change in their variances. In another line of studies, foreign equity flows are used to assess the effects of foreign participation in emerging markets (Choe et al., 1999; Froot et al., 2001; Bekaert et al., 2002b; and Wang, 2007). Among these studies, the ones that concentrate on volatility also examine market index; thus, these might contain the problem discussed above. Different from previous studies, Li et al. (2004) demonstrate a relationship between

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financial integration is defined as the free access of foreigners to local capital markets and of local investors to foreign capital markets.

[4] See Bekaert and Harvey (1997, 2000), Kim and Singal (2000), De Santis and Imrohoroglu (1997), and Huang and Yang (2000).

return variation and stock market openness. Although they capture the time-varying nature of liberalization, because the openness measure enables the detection of the degree of financial liberalization through time, it does not explain whether the documented relationship is a result of the transactions of incoming or outgoing foreign equity investments.

In this study, we first investigate the impact of foreign equity flow on the aggregated total volatility of stock returns and then explore the channels through which the foreign equity flow transmits its impact onto the aggregated total volatility. By using the foreign equity flow to detect the volatility impacts on stock returns, we eliminate several problems that arise in previous literature, such as the imprecision involved in dating the liberalization and in detecting effective foreign participation. We extend the volatility decomposition of Campbell et al. (2001) in a modified market model framework. In this model, the returns of individual stocks are affected by both local and global factors, and thus, the partial segmentation/partial integration paradigm[5] is followed. We show that aggregated total volatility can be decomposed into local, global, and idiosyncratic volatility. After this volatility decomposition, we are able to examine through which components the aggregated total volatility is affected. Although there are studies that analyze the relationship between volatility and foreign equity funds, this is the first study to investigate the mechanisms through which foreign equity flow affects aggregated total volatility. Furthermore, rather than analyzing the return volatility of a market portfolio, as previous studies did, we use the aggregated total volatility of stocks and its components. A possible problem in the previous literature on the return volatility of market index is that it is not clear

[5] Bekaert and Harvey (1995), Adler and Qi (2003), and De Jong and De Roon (2005) point out that markets are neither fully segmented nor fully integrated.

whether a change in the total volatility of a portfolio is due to a change in the variances of the stocks, in the covariances between stocks, or both. On the other hand, our aggregated volatility measure is independent of the correlation of the stocks and therefore is a pure measure of the return volatility of a typical stock in a country.

The rest of the article is organized as follows: In section 2, volatility decomposition is introduced. Section 3 describes the data and the methodology. In section 4, the relationship between aggregated total volatility and net flow is analyzed. Section 5 extends the analysis to include the volatility components. Some robustness checks are presented in section 6. The final section concludes our study.

2. Volatility Decomposition in a Modified Market Model

We extend the method of volatility decomposition first introduced by Campbell et al. (2001) and improved by Ferreire and Gama (2005) to a modified market model, where the return of stock *i* belonging to country *l* is taken to be driven by the return of both the global market portfolio and local market portfolio in period *t*. The partially segmented, partially integrated nature of many emerging markets is represented by this model. It is assumed that the return on the global market portfolio is the weighted averages of the local market portfolios, i.e., $\Sigma_l w_{lt} R_{lt} = R_{wt}$ and that the return on the local market portfolio is assumed to be the weighted average return of individual stocks in the country, that is $\Sigma_i w_{it} R_{ilt} = R_{lt}$. In addition, each local market portfolio contributes to the systematic risk of the global market portfolio commensurable with its covariance with the global market portfolio. More specifically,

$$\tilde{R}_{lt} = \beta_{lw} \tilde{R}_{wt} + \tilde{\varepsilon}_{lt} . \quad (1)$$

The modified market model in an international framework is formulated as

$$\tilde{R}_{ilt} = \beta_{iw}\tilde{R}_{wt} + \beta_{il}\tilde{\varepsilon}_{lt} + \tilde{\varepsilon}_{ilt} \tag{2}$$

where $\beta_{iw} = \mathrm{cov}(\tilde{R}_{wt}, \tilde{R}_{it}) / \mathrm{var}(\tilde{R}_{wt})$; $\beta_{il} = \mathrm{cov}(\tilde{\varepsilon}_{lt}, \tilde{R}_{it}) / \mathrm{var}(\tilde{\varepsilon}_{lt})$; and $\tilde{R}_{lt} = \sum_{i \in l} w_i \tilde{R}_{it}$.

Note that

$$\sum_i w_i \beta_{iw} = \mathrm{cov}(\tilde{R}_{wt}, \sum_{i \in l} w_i \tilde{R}_{it}) / \mathrm{var}(\tilde{R}_{wt}) = \mathrm{cov}(\tilde{R}_{wt}, \tilde{R}_{lt}) / \mathrm{var}(\tilde{R}_{wt})$$

$$= \mathrm{cov}(\tilde{R}_{wt}, \beta_{lw}\tilde{R}_{wt} + \tilde{\varepsilon}_{lt}) / \mathrm{var}(\tilde{R}_{wt}) = \beta_{lw} .$$

Similarly,

$$\sum_i w_i \beta_{il} = \mathrm{cov}(\tilde{\varepsilon}_{lt}, \sum_{i \in l} w_i \tilde{R}_{it}) / \mathrm{var}(\tilde{\varepsilon}_{lt}) = \mathrm{cov}(\tilde{\varepsilon}_{lt}, \tilde{R}_{lt}) / \mathrm{var}(\tilde{\varepsilon}_{lt})$$

$$= \mathrm{cov}(\tilde{\varepsilon}_{lt}, \beta_{lw}\tilde{R}_{wt} + \tilde{\varepsilon}_{lt}) / \mathrm{var}(\tilde{\varepsilon}_{lt}) = 1 .$$

In volatility decomposition, covariance and beta-free components are aimed to be reached so that estimation of these parameters, which may not be constant over time, is eliminated. For this purpose, a variant of the market-adjusted model is used, as suggested by Campbell et al. (2001), as the following:

$$\tilde{R}_{ilt} = \tilde{R}_{wt} + \tilde{\varepsilon}_{lt} + \varepsilon_{ilt} . \tag{3}$$

Here, the return on stock i of country l is modeled to be the sum of return on the global market portfolio, a country specific shock, and a firm-specific residual.

Equating (2) to (3) produces the following equality that shows in which channel the two equations are connected

$$\varepsilon_{ilt} = (\beta_{iw} - 1)\tilde{R}_{wt} + (\beta_{il} - 1)\tilde{\varepsilon}_{lt} + \tilde{\varepsilon}_{ilt} \,. \tag{4}$$

Taking the variance of (3) yields

$$\text{var}(\tilde{R}_{ilt}) = \text{var}(\tilde{R}_{wt}) + \text{var}(\tilde{\varepsilon}_{lt}) + \text{var}(\varepsilon_{ilt}) + 2\,\text{cov}(\tilde{R}_{wt}, \varepsilon_{ilt}) + 2\,\text{cov}(\tilde{\varepsilon}_{lt}, \varepsilon_{ilt}) \,. \tag{5}$$

Inserting (4) into (5) for covariance terms only yields

$$\begin{aligned} \text{var}(\tilde{R}_{ilt}) = {} & \text{var}(\tilde{R}_{wt}) + \text{var}(\tilde{\varepsilon}_{lt}) + \text{var}(\varepsilon_{ilt}) + 2\,\text{cov}(\tilde{R}_{wt}, (\beta_{iw} - 1)\tilde{R}_{wt} + (\beta_{il} - 1)\tilde{\varepsilon}_{lt} + \tilde{\varepsilon}_{ilt}) \\ & + 2\,\text{cov}(\tilde{\varepsilon}_{lt}, (\beta_{iw} - 1)\tilde{R}_{wt} + (\beta_{il} - 1)\tilde{\varepsilon}_{lt} + \tilde{\varepsilon}_{ilt}) \,. \end{aligned} \tag{6}$$

Rearranging (6),

$$\text{var}(\tilde{R}_{ilt}) = \text{var}(\tilde{R}_{wt}) + \text{var}(\tilde{\varepsilon}_{lt}) + \text{var}(\varepsilon_{ilt}) + 2(\beta_{iw} - 1)\,\text{var}(\tilde{R}_{wt}) + 2(\beta_{il} - 1)\,\text{var}(\tilde{\varepsilon}_{lt}) \,. \tag{7}$$

Taking the weighted averages of (7) over *i* drops the last term

$$\begin{aligned} \sum\nolimits_{i \in l} w_i \,\text{var}(\tilde{R}_{ilt}) = {} & \text{var}(\tilde{R}_{wt}) + \text{var}(\tilde{\varepsilon}_{lt}) + \sum\nolimits_{i \in l} w_i \,\text{var}(\varepsilon_{ilt}) + 2\,\text{var}(\tilde{R}_{wt})\left(\sum\nolimits_i w_i \beta_{iw} - 1\right) \\ & + 2\,\text{var}(\tilde{\varepsilon}_{lt})\left(\sum\nolimits_i w_i \beta_{il} - 1\right) \\ = {} & (2\beta_{lw} - 1)\,\text{var}(\tilde{R}_{wt}) + \text{var}(\tilde{\varepsilon}_{lt}) + \sum\nolimits_{i \in l} w_i \,\text{var}(\varepsilon_{ilt}) \end{aligned}$$

$$\sigma^2_{alt} = \sigma^2_{wt} + \sigma^2_{\varepsilon_{lt}} + \sigma^2_{\varepsilon_{ilt}} \tag{8}$$

where $\sigma^2_{alt} = \sum_{i\in l} w_i \operatorname{var}(\tilde{R}_{ilt})$, $\sigma^2_{wt} = (2\beta_{wl} - 1)\operatorname{var}(\tilde{R}_{wt})$, $\sigma^2_{\varepsilon_{lt}} = \operatorname{var}(\tilde{\varepsilon}_{lt})$, and $\sigma^2_{\varepsilon_{ilt}} = \sum_{i\in l} w_i \operatorname{var}(\varepsilon_{ilt})$.

The aggregated return volatility of stocks in a country is a representation of the return volatility of a typical firm in the particular country. Equation (8) shows that the total volatility of a typical firm in a country is composed of global, local, and aggregated idiosyncratic volatility. Next, we proceed in the same manner to reach the volatility components for a typical firm in the global market portfolio. Taking the weighted averages of (8) over *l* yields the following

$$\sum_l w_l \sum_{i\in l} w_i \operatorname{var}(\tilde{R}_{ilt}) = \operatorname{var}(\tilde{R}_{wt}) + \sum_l w_l \operatorname{var}(\tilde{\varepsilon}_{lt}) + \sum_l w_l \sum_{i\in l} w_i \operatorname{var}(\varepsilon_{ilt})$$

$$\sigma^2_{awt} = \sigma^2_{gt} + \sigma^2_{lt} + \sigma^2_{\varepsilon t} \tag{9}$$

where $\sigma^2_{awt} = \sum_l w_l \sum_{i\in l} w_i \operatorname{var}(\tilde{R}_{ilt})$, $\sigma^2_{gt} = \operatorname{var}(\tilde{R}_{wt})$, $\sigma^2_{lt} = \sum_l w_l \operatorname{var}(\tilde{\varepsilon}_{lt})$, and $\sigma^2_{\varepsilon t} = \sum_l w_l \sum_{i\in l} w_i \operatorname{var}(\varepsilon_{ilt})$.

Thus covariance and beta-free representation of volatility decomposition is established for an average firm in the global market portfolio. In assessing the impact of the foreign equity funds, we are particularly interested in aggregated volatilities of individual stocks rather than the volatility of a local market portfolio. The reason is that country index volatility is not only composed of individual stock return variances but also of the pairwise covariances of stock returns constituting the index. Therefore, studies analyzing the return volatility of country indices do not fully explain the behavior of average stock return volatility. The aggregated volatility used in this study clearly demonstrates the effects of external factors on the return volatility of an average stock.

Although the volatility components expressed in equation (9) are beta and covariance-free, and thus, estimation problems of these parameters are eliminated, it is difficult, if not impossible, to estimate the volatilities of all stocks in the global index. Moreover, equation (9) gives information about an average firm in the global index, but we know that important heterogeneity exists among firms across the countries. Regulations about foreign ownership and the involvement of foreigners exhibit substantial variation, even in countries in the same region. Most importantly, in this study we are mainly interested in the effects of foreign equity flows on the average return volatility of stocks. Therefore, we confine our empirical implementation to the estimation of equation (8), which provides information about an average stock return volatility in a country.

3. Data and Methodology

Our main data sources in this study are the Standard & Poor's Emerging Markets Database (EMDB), Datastream, and İSE. Our data comprise returns of stocks that are listed in the S&P/IFC (Standard & Poor's/International Finance Corporation) Global index of Turkey over the period January 1997 to June 2006. During each month in the research period, monthly return variances of firms listed in the S&P/IFC Global Index of the EMDB are computed by using the daily adjusted closing prices. The IFC Global (IFCG) Index aims to represent the whole local market. Index-constituent firms are chosen to reflect the local market best, and therefore, the composition of the index is subject to change over time. All IFCG Index firms form our sample. In calculating the weighted averages of return variances, the weights are based on the market capitalizations of the indexed firms, which are also extracted from the EMDB. The return variance of global index, σ_{wt}^2 of equation (8), is computed by using the closing prices of the global index drawn from Datastream. The closing prices of the local index (İSE-100) come from EMDB. Our main focus of interest in this study is foreign participation in emerging stock exchanges; we obtained the values of the monthly purchases and sells by foreign investors from the İSE (İstanbul Stock Exchange). We define a monthly flow variable, *Netflow*, as the difference between the values of foreign purchases and sells, normalized by the total equity market capitalization. In the regressions that aim to assess the impact of net foreign flows on the aggregated volatility and its components, several volatility determinants[6] are controlled for. For instance, the stock market development variable, *Size*, which is defined as the capitalization of the stock market relative to the country's GDP, is used to account for the effect of the development stage of the stock market on the volatility. As a market becomes more developed and mature, it is likely that the volatility reduces, which is the case for developed markets. Another source of volatility may be from the liquidity effects, and the turnover ratio (*TO*) of the local index, in terms of value traded, is included as a control variable in explaining the volatility. The data for the control variables are taken from EMDB, except for GDP data. GDPs are obtained from the Central Bank of the Republic of Turkey.

3.1. Estimation of Volatility and Volatility Components

We proceed with the details of the estimation procedure of the volatility and its components. In the following sections, s refers to days over which returns are calculated, and t refers to the month in which the volatility estimates are constructed.

[6] See Bekaert and Harvey (2000), for a set of explanatory variables for volatility at the aggregate level.

Because we deal with stocks in one stock exchange, namely the İSE, the country subscript, l, refers to Turkey only and is dropped from the aggregation processes for the sake of simplicity in the following equations. The monthly volatility of a stock is computed as

$$\mathrm{var}(\tilde{R}_{it}) = \sum\nolimits_{s \in t} (R_{is} - \mu_i)^2 \quad (10)$$

where μ_i is the mean of the stock return over the sample.

The weighted averages of return volatilities of all stocks in the IFCG index in month t forms the aggregated volatility measure for that month.

$$\sum\nolimits_i w_i \,\mathrm{var}(\tilde{R}_{it}) = \sum\nolimits_i w_i \left(\sum\nolimits_{s \in t} (R_{is} - \mu_i)^2 \right). \quad (11)$$

The weight for each firm is the ratio of its market capitalization to the total market capitalization of all firms in month t. Figure 1 shows the time variation of aggregated return volatility where returns are calculated both in dollars and in local currency (YTL). The volatile times appearing on the graph correspond to major economic crises that Turkey experienced: one in 1999, one in 2001, and exchange-rate turbulence in 2006. Figure 1 shows that the aggregated volatility measure does a good job in capturing the average volatility.

< Insert Figure 1 about here>

The components of the aggregated volatility expressed in equation (8) are estimated in a similar fashion. For instance, the monthly global volatility, which is denoted as *Global*, is computed as

$$Global = \hat{\sigma}_{wt}^2 = (2\hat{\beta}_{lw} - 1)(\sum_{s \in t} (R_{ws} - \mu_w)^2) \tag{12}$$

where $\hat{\beta}_{lw}$ is the estimated regression coefficient of equation (1), and μ_w is the mean of the global index return.

Local volatility, the variance of local index return that is isolated from the global index return, is computed by summing up the squares of the country-specific residuals of equation (1) within period t. More explicitly, it is computed as

$$Local = \hat{\sigma}_{\varepsilon_{lt}}^2 = \sum_{s \in t} \hat{\varepsilon}_s^2 \ . \tag{13}$$

For estimating the idiosyncratic volatility component, first, we sum up the squares of the firm-specific residuals of equation (3) for each firm within period t:

$$\hat{\text{var}}_{\varepsilon_{it}} = \sum_{s \in t} \hat{\varepsilon}_{is}^2 \ . \tag{14}$$

Next we aggregate equation (14) over firms in a market, in order to reach value-weighted idiosyncratic volatility estimates, as follows:

$$Idiosyncratic = \hat{\sigma}_{\varepsilon_{it}}^2 = \sum_i w_{it} \ \hat{\text{var}}(\varepsilon_{it}) \ . \tag{15}$$

Some descriptive information for the volatility measures, net flow data, and control variables are provided in Table 1. A high variation of *Netflow* during the research period is observed. The mean of the ratio of net equity flow to market capitalization is 0.0017, while the standard deviation is 0.0120, which is more than ten times the mean. Inspection of the mean levels of the volatility components reveal that the maximum contribution to the total volatility is made by the *Local*. *Idiosyncratic* makes the second largest contribution. *Global* is a very small portion of the total volatility.

Figure 2 shows the time variation of volatility components as a percentage of total volatility through time. It is observed that total volatility is dominated by the idiosyncratic volatility and especially by the local volatility. As stated previously, Turkey experienced a few crises in the last decade. The impact of these crises on the overall economy was severe. The crises show their effect as an increase in the aggregated total volatility, but most importantly, the fraction of the total volatility that is represented by the local market volatility increased during these times. Because the crises systematically affect all the firms, it is reasonable to observe such an increase in the share of the local volatility during the crisis periods, in Figure 2. On the other hand, the contribution of the global volatility to total volatility is limited. However, Figure 2 shows that it increased its share slightly, after 2001. This increase in global volatility is consistent with the increased foreign participation in the İSE during the last five years. As the foreign investors more heavily trade in the İSE, it is expected that the İSE will become more integrated with the global market and that the volatility, due to the global factors, will increase.

< Insert Figure 2 about here>

Another issue is to check how well the proposed volatility components represent the aggregated total volatility. For this purpose, we compare the aggregated total volatility to the summation of the volatility components. Note that the aggregated total volatility and its components are computed independently, and thus, we have two series for aggregated total volatility: the first series is obtained by the direct computation of equation (11), whereas the second series is obtained indirectly by summing up the computed volatility components. Location-difference tests are performed to determine if the direct measure of volatility is systematically different than the indirect measure. As we work with variances, deviations from normality may arise. We take this issue into account by performing a nonparametric test in addition to the parametric mean difference t-test. A non-parametric Wilcoxon Mann-Whitney test is employed to test the null hypothesis that the aggregated volatility is identically distributed with respect to the median for both series. The results of these tests, along with the Pearson correlation coefficient between the series, are presented in Table 2.

< Insert Table 2 about here>

The non-parametric Wilcoxon Mann-Whitney test shows that the null hypothesis cannot be rejected. For the parametric t-test, the null hypothesis that the difference of the means of the two series is different than zero is not rejected either. Moreover, the correlation coefficient of a magnitude of 0.96 depicts a strong association between the series. These results suggest that the aggregated total volatility is satisfactorily decomposed into its constituents.

4. Aggregated Total Volatility and Net Flow

In this part, we empirically test the hypothesis that the net equity flow does not affect the aggregated total volatility of stocks. The weighted average of return volatilities of stocks in the Global Index of Turkey, $\sum_{i \in I} w_i \operatorname{var}(\tilde{R}_{it}) = \sigma_{at}^2$, is regressed on the *Netflow*, which is defined as the difference between the equity inflow and the outflow divided by the equity market capitalization. The relationship between the aggregated total volatility and the *Netflow* is analyzed under the control of some volatility determinants. More specifically, the following regression equation is estimated:

$$\hat{\sigma}_{at}^2 = \alpha_I + \beta_1 Netflow_t + \beta_2 Size_t + \beta_3 TO_t + \eta_t \,. \tag{16}$$

We are mainly interested in the coefficient of *Netflow.* We use the Generalized Method of Moments (GMM) to estimate the model. GMM does not make any distributional assumptions, such as normality, and this issue is especially important in our study, as we deal with volatilities. Moreover, GMM allows series to be conditionally heteroscedastic and autocorrelated. Volatility may exhibit different patterns as the stock market becomes more developed and mature. With this in mind, we include the *Size* control variable measured by the total market capitalization of the stock market to the GDP, aiming to reflect the level of market development. Moreover, we account for the effects of liquidity measured by the turnover ratio, *TO*, of the stock market in examining the average stock return volatility.

Furthermore, the lagged value of the aggregated total volatility is included as an explanatory variable in order to account for a possible persistence in volatility. We estimate this dynamic model again in a GMM framework by using the one-period lags of the other explanatory variables as the instrumental variables. The extended regression model is of the following form:

$$\hat{\sigma}_{at}^2 = \alpha + \beta_1 Netflow_t + \beta_2 Size_t + \beta_3 TO_t + \beta_4 \hat{\sigma}_{at-1}^2 + \upsilon_t \,. \qquad (17)$$

Table 3 presents the estimation results of the regression of aggregated total volatility on the *Netflow*, along with some control variables. Panel A of the table provides the results of the regression model (16) and some other models in which the control variables enter into the regression equation in different combinations. In the first column of Panel A of Table 3, a highly significant negative effect of *Netflow* on aggregated total volatility is observed. The negative coefficient for the *Netflow* provides important insights for the impact of equity flows on the volatility. When the *Netflow* is positive in value, i.e., foreign investors are net buyers of local stocks (and thus, foreign funds inflow), there is a negative relationship between inflows and volatility. In other words, net equity inflows reduce volatility. On the other hand, when the *Netflow* is negative in value, i.e., foreign investors are net sellers of local stocks (and thus, foreign funds outflow), there is positive relationship between outflows and volatility, because the multiplication of the negative coefficient with the negative *Netflow* variable results in a positive impact on volatility. This means that net equity outflows increase volatility. This result is persistent when the control variables are included as explanatory variables in different combinations.

In Panel B of Table 3, the regression results of the models including the lagged dependent variable are presented. Under these specifications, *Netflow* preserves its negative significant effect on the aggregated total volatility again, and its impact is not affected by the inclusion of the control variables. These findings reveal that when foreign equity funds inflow, aggregated volatility decreases; when the foreign equity funds outflow, aggregated volatility increases.

< Insert Table 3 about here >

5. Further Analysis on Volatility Components

After analyzing the total volatility of stocks, our next concern is to examine in which channels the net flow affects aggregated total volatility. Equation (8) shows that the average total volatility of stocks in a country is composed of systematic components, such as global and local volatility and by the unsystematic component, idiosyncratic volatility. In an attempt to determine whether net flow affects aggregated total volatility through the volatility components, we regress each of these three components on the *Netflow*. One strong channel of influence may be idiosyncratic volatility. Existing literature documents that aggregated idiosyncratic volatility exhibits an increasing trend over time (see Campbell et al., 2001), and its relationship, particularly with institutional ownership is investigated (Xu and Malkei, 2003 and Morck et al., 2004). In emerging markets, foreign investors hold a significant portion of the traded stocks[7], and they are the emerging-market counterparts of a developed market's institutional investors. Like institutional investors, foreign investors may be better informed about the stocks that they invest, and they tend to process the revealing information for these stocks quickly. In such a case, total return volatility may change, even if the systematic volatility components remain the same. Thus, foreign equity flows may show their effects on aggregated idiosyncratic volatility. In order to study the possible effect of net flow on aggregated idiosyncratic volatility, we run the following regression equation:

[7] For instance, foreign investors held 59% of the total number of stocks in the İSE, and their market capitalization reached 72% of the total market capitalization, as of October 2007.

$$Idiosyncratic_t = \alpha_I + \alpha_1 Netflow_t + \alpha_2 Size_t + \alpha_3 TO_t + \alpha_4 Idiosyncratic_{t-1} + \xi_t \,. \qquad (18)$$

The results of the regression equation (18) and some other specifications are presented in Panel A of Table 4. Indeed, we observe a strong negative impact of *Netflow* on *Idiosyncratic* for all specifications. As in the case for aggregated total volatility, this impact is robust to the inclusion of the control variables. Unlike aggregated total volatility, aggregated idiosyncratic volatility is positively affected by *Size*. As the level of market development increases, the aggregated idiosyncratic volatility also increases. This result is consistent with the studies of Campbell et al. (2001) and Xu and Malkiel (2003) in which the aggregated idiosyncratic volatility is shown to have an increasing trend in developed markets.

The second channel of impact may be due to the local factors. Aggarwal et al. (1999) show that volatility in emerging markets mainly stems from the local factors. Our findings provide evidence in favor of their results. For instance, in Figure 2, it is observed that the main source of aggregated total volatility is local volatility, in Turkey. As a dominant constituent of the total volatility, local volatility is a likely channel through which the effect of net flow emerges. Therefore, we examine the relationship between the *Local* and the *Netflow* in several specifications. The results are presented in Panel B of Table 4. As expected, a strong negative impact of *Netflow* on the *Local* is detected.

Finally, we check whether the global volatility contributes to the observed relationship between aggregated total volatility and net flow. We regress the *Global* only on the *Netflow* and omit the other control variables used before. The reason is that these are local market-specific variables, and they are not relevant to the global volatility. Some other global factors, such as changes in the oil prices or global events like the September 11 attacks, may induce global volatility, but the determinants of global volatility are beyond the scope of this study. We focus on the relationship between *Global* and the *Netflow*. The results in Panel C suggest that even when the *Netflow* enters into the regression equation alone, it cannot explain the *Global.* Thus, we conclude that net flow affects aggregated volatility through idiosyncratic and local volatilities.

< Insert Table 4 about here>

5.1. Some Econometric Issues

The volatility components used as the dependent variables in the regression analyses above are derived from the modified market model, which uses the orthogonalized returns. In the volatility decomposition method, global market portfolio return is taken to be the base, and the local market portfolio return is orthogonalized with respect to the global market portfolio return. Clayton and Mackinnon (2003) point out an overpurging problem in such an orthogonalization process. In our case, this problem means that if stock return volatility is driven to some extent by factors that are common to local and global effects, then the effects of these common factors are attributed only to global factors, and the effects of the local factors are overpurged. In order to handle this potential problem, we change the order of the orthogonalization process, and take the local index return as the base, this time. New versions of volatility components are obtained with this order of orthogonalization, giving more emphasis to local factors. In the Appendix, it is shown that the global and local volatilities turn out to be $\text{var}(\tilde{\varepsilon}_{wt})$ and $\text{var}(\tilde{R}_{lt})$, respectively[8]. Although the equation of idiosyncratic volatility remains the same, it is obvious that it differs in value from the former one, because the residuals are model specific. In our empirical implementations, we also use this set of volatility components as dependent variables in the regression analyses. Thus, we can assess whether our results are affected by the potential overpurging problem.

Table 5 provides the results of the regression of the dependent variables, which are constructed under the alternative order of orthogonalization, on the *Netflow* and the control variables. Again, in each panel, a different dependent variable (*Idiosyncratic*, *Local*, and *Global*) is examined. Under this order of orthogonalization, *Netflow* preserves its negative significant impact on the *Idiosyncratic* and *Local*. This impact is not affected by the inclusion of the control variables. On the other hand, a significant relationship between the *Global* and *Netflow* is not detected, which is also the case for the former order of orthogonalization. These findings are qualitatively the same as the ones of the previous section. Therefore, the effect of the *Netflow* on the volatility is independent of the order of orthogonalization. Thus, the potential overpurging problem does not seriously affect our results.

< Insert Table 5 about here >

6. Robustness Checks

Our aggregated idiosyncratic volatility measure is derived from the modified market model, and therefore, our results may be subject to the criticism that the conclusions drawn are model dependent. In order to asses the robustness of the results for aggregated idiosyncratic volatility in Tables 4 and 5, we use a model-independent

[8] The details of the volatility decomposition in this setting can be found in the Appendix.

measure of aggregate idiosyncratic volatility proposed by Bali et al. (2008). They base their argument on the mean-variance portfolio theory and the concept of gain from portfolio diversification. They define a non-diversified portfolio in which the correlations among the stocks equal one. Such a portfolio contains both the systematic risk and idiosyncratic risk of individual stocks. On the other hand, they consider a fully diversified portfolio, such as the stock market index. Because the idiosyncratic risk is eliminated in a fully diversified portfolio, the total risk of this portfolio is due to the systematic risk of the stocks in the portfolio. They define the new measure of average idiosyncratic volatility as the difference between the variance of the non-diversified portfolio and the variance of the fully diversified portfolio. In their study, it is shown that the variance of the non-diversified portfolio equals

$$\sigma_{pt}^2 = \left(\sum_i w_{it}\sigma_{it}\right)^2 \tag{19}$$

where σ_{it} is the standard deviation of the return of stock *i*, and w_{it} is the weight of stock *i* in the portfolio. The variance of the fully diversified portfolio is taken to be the market variance, $\mathrm{var}(R_{mt})$. The new measure of model-independent idiosyncratic risk is then

$$\sigma_{\varepsilon t}^2 = \left(\sum_i w_{it}\sigma_{it}\right)^2 - \mathrm{var}(R_{mt})\,. \tag{20}$$

We use this new measure to see whether our results are sensitive to the definition of idiosyncratic volatility. We form a value-weighted portfolio composed of the stocks in the IFCG index of Turkey as the non-diversified portfolio, and we use the İSE 100 index as the fully diversified portfolio. We repeat our tests with the alternative definition of idiosyncratic volatility, and the results are presented in Table 6. We still observe a sharp negative significant effect of *Netflow* on the *Idiosyncratic*. This effect persists under the control of explanatory variables. Thus, our finding of a negative significant relationship between *Idiosyncratic* and *Netflow* is replicated with a model-independent measure of idiosyncratic volatility.

< Insert Table 6 about here >

6. Conclusion

It is important to understand the costs and benefits of foreign investor participation in stock exchanges, as this issue has crucial policy implications, especially for governments. The most important cost that is thought to be brought by foreign investors is the increase in return volatility in emerging markets. We specifically investigate the role of foreign equity flow on the aggregated total volatility and its components in the İSE.

We decompose the return volatility of stocks under a modified market model. We demonstrate that the volatility components for aggregated total volatility can be categorized into global, local, and idiosyncratic volatility. We use these volatility components to understand in what ways foreign equity flow affects aggregated total volatility. Unlike previous studies, we examine the aggregated return volatility of individual stocks rather than the return volatility of the market portfolio, enabling us to construct a pure measure of average return volatility for stocks in a country. Thus, our results are not affected by the correlations between the stocks in a portfolio.

The results show that aggregated total volatility is negatively related to the foreign equity flow, even after controlling for market development, liquidity, and volatility persistency effects. This finding suggests a two-way impact of foreign equity flow on the aggregated total volatility. While a positive net equity flow (inflow) has a decreasing impact on aggregated stock return volatility, a negative net equity flow (outflow) has an increasing impact. It is also found that net equity flow shows its effect on the aggregated total volatility through the aggregated idiosyncratic and local volatility. Similar results are obtained with the alternative order of orthogonalization in the volatility decomposition process and with the alternative model-independent definition of idiosyncratic volatility.

References

Adler, M. and Qi, R., 'Mexico's integration into the North American capital market', Emerging Markets Review, Vol. 4, 2003, pp. 91-120.

Aggarwal, R., Inclan, C. and Leal, R., 'Volatility in emerging stock markets', Journal of Financial and Quantitative Analysis, Vol. 34, 1999, pp. 33-55.

Alexander, G., Eun, C. and Janakiramanan, S., 'Asset pricing and dual-listing on foreign capital markets: A note', Journal of Finance, Vol. 42, 1987, pp. 151-158.

Alexander, G., Eun, C. and Janakiramanan, S., 'International listings and stock returns: Some empirical evidence', Journal of Financial and Quantitative Analysis, Vol. 23, 1988, pp. 135-151.

Bae, K., Chan, K. and Ng, A., 'Investibility and return volatility', Journal of Financial Economics, Vol. 71, 2004, pp. 239-263.

Bali, T. G., Cakici, N. and Levy, H., 'A Model-Independent Measure of Aggregate Idiosyncratic Risk', forthcoming in *Journal of Empirical Finance*.

Bekaert, G. and Harvey, C., 'Emerging equity market volatility', *Journal of Financial Economics,* Vol. 43, 1997, pp. 29-78.

Bekaert, G. and Harvey, C., 'Foreign speculators in emerging equity markets', *Journal of Finance*, Vol. 55, 2000, pp. 565-613.

Bekaert, G. and Harvey, C., 'Research in emerging markets finance: Looking to the future', *Emerging Markets Review,* Vol. 3, 2002, pp. 429-448.

Bekaert, G., Harvey, C. and Lumsdaine, R., 'Dating the integration of world capital markets', *Journal of Financial Economics,* Vol. 65, 2002a, pp. 203-249.

Bekaert, G., Harvey, C. and Lumsdaine, R., 'The dynamics of emerging market equity flows', *Journal of International Money and Finance,* Vol. 21, 2002b, pp. 295-350.

Bekaert, G., Harvey, C. and Lundblad, C., 'Equity market liberalization in emerging markets', *Journal of Financial Research,* Vol. 26, 2003, pp. 275-299.

Campbell, J. Y., Lettau, M., Malkiel, B. G. and Xu, Y., 'Have individual stocks become more volatile? An empirical exploration of idiosyncratic risk', *Journal of Finance,* Vol. 56, 2001, pp. 1-43.

Choe, H., Kho, B. and Stulz, R. M., 'Do foreign investors destabilize stock markets? The Korean experience in 1997', *Journal of Financial Economics,* Vol. 54, 1999, pp. 227-264.

Clayton, J. and Mackinnon, G., 'The relative importance of stock, bond and real estate factors in explaining REIT returns', *Journal of Real Estate Finance and Economics,* Vol. 27, 2003, pp. 39-60.

De Jong, F. and De Roon, F. A., 'Time-varying market integration and expected returns in emerging markets', *Journal of Financial Economics*, Vol. 78, 2005, pp. 583-613.

Durnev, A., Morck, R., Yeung, B. and Zarowin, P., 'Does greater firm-specific return variation mean more or less informed stock pricing?', *Journal of Accounting Research,* Vol. 41, 2003, pp. 797-836.

Eun, C. and Janakiramanan, S., 'A model of international asset pricing with a constraint on the foreign equity ownership', *Journal of Finance,* Vol. 41, 1986, pp. 897-914.

Errunza, V. and Losq E., 'International asset pricing under mild segmentation: theory and test', *Journal of Finance,* Vol. 40, 1985, pp. 105-124.

Ferreira, M. A. and Gama, P. M., 'Have world, country, and industry risks changed over time? An investigation of the volatility of developed stock markets', *Journal of Financial and Quantitative Analysis,* Vol. 40, 2005, pp. 195-222.

Froot, K. A., O'Connell P. G. J. and Seasholes, M. S., 'The portfolio flows of international investors' *Journal of Financial Economics,* Vol. 59, 2001, pp. 151-193.

Hargis, K., 'Forms of foreign investment liberalization and risk in emerging markets', *Journal of Financial Research,* Vol. 25, 2002, pp. 19-38.

Howe, J. S. and Madura, J., 'The impact of international listing on risk implications for capital market integration', *Journal of Banking and Finance,* Vol. 14, 1990, pp. 1133-1142.

Huang, B. and Yang, C., 'The impact of financial liberalization on stock price volatility in emerging markets', *Journal of Comparative Economics,* Vol. 28, 2000, pp. 321-339.

Kim, H. and Singal, V., 'Stock market openings: Experience of emerging economies', *Journal of Business,* Vol. 73, 2000, pp. 25-66.

Li, K., Morck, R., Yang, F. and Yeung, B., 'Firm-specific variation and openness in emerging markets', *Review of Economics and Statistics,* Vol. 86, 2004, pp. 658-669.

Wang, J., 'Foreign equity trading and emerging market volatility: evidence from Indonesia and Thailand', *Journal of Development Economics,* Vol. 84, 2007, pp. 798-811.

Xu, Y. and Malkiel B. G., 'Investing the behavior of idiosyncratic volatility', *Journal of Business,* Vol. 76, 2003, pp. 613-644.

Appendix

Because there is the potential for an overpurging problem for the local factors under the introduced order of orthogonalization in Section 2, the global index return is now isolated in a component that is not correlated with the local index return through the following linear regression:

$$\tilde{R}_{wt} = \beta_{wl}\tilde{R}_{lt} + \tilde{\varepsilon}_{wt} \quad . \tag{A1}$$

The modified market model is now formulated as

$$\tilde{R}_{ilt} = \beta_{iw}\tilde{\varepsilon}_{wt} + \beta_{il}\tilde{R}_{lt} + \tilde{\zeta}_{ilt} \tag{A2}$$

where $\beta_{il} = \text{cov}(\tilde{R}_{ilt}, \tilde{R}_{lt}) / \text{var}(\tilde{R}_{lt})$, $\beta_{iw} = \text{cov}(\tilde{R}_{ilt}, \tilde{\varepsilon}_{wt}) / \text{var}(\tilde{\varepsilon}_{wt})$, and $\tilde{R}_{lt} = \sum_{i \in l} w_i \tilde{R}_{ilt}$.

Note that $\sum_{i \in l} w_i \beta_{il} = \text{cov}(\sum_{i \in l} w_i \tilde{R}_{ilt}, \tilde{R}_{lt}) / \text{var}(\tilde{R}_{lt}) = \text{cov}(\tilde{R}_{lt}, \tilde{R}_{lt}) / \text{var}(\tilde{R}_{lt}) = 1$.

Similarly, $\sum_{i} w_i \beta_{iw} = \text{cov}(\sum_{i} w_i \tilde{R}_{ilt}, \tilde{\varepsilon}_{wt}) = \text{cov}(\tilde{R}_{lt}, \tilde{\varepsilon}_{wt}) = 0$ because $\tilde{R}_{lt}$ and $\tilde{\varepsilon}_{wt}$ are orthogonal by construction.

A similar version of Campbell et al.'s (2001) market-adjusted model is introduced as follows:

$$\tilde{R}_{ilt} = \tilde{R}_{lt} + \tilde{\varepsilon}_{wt} + \zeta_{ilt} \, . \tag{A3}$$

Equating (A2) to (A3) produces the following equality that shows in which channel the two equations are related:

$$\zeta_{ilt} = \tilde{R}_{lt}(\beta_{il} - 1) + \tilde{\varepsilon}_{wt}(\beta_{iw} - 1) + \tilde{\zeta}_{ilt}\ . \tag{A4}$$

Taking the variance of (A3) yields

$$\text{var}(\tilde{R}_{ilt}) = \text{var}(\tilde{R}_{lt}) + \text{var}(\tilde{\varepsilon}_{wt}) + \text{var}(\zeta_{ilt}) + 2\,\text{cov}(\tilde{R}_{lt}, \zeta_{ilt}) + 2\,\text{cov}(\tilde{\varepsilon}_{wt}, \zeta_{ilt})\ . \tag{A5}$$

Now, inserting (A4) in (A5) for covariance terms only and rearranging results in the following:

$$\text{var}(\tilde{R}_{ilt}) = \text{var}(\tilde{R}_{lt}) + \text{var}(\tilde{\varepsilon}_{wt}) + \text{var}(\zeta_{it}) + 2(\beta_{il} - 1)\,\text{var}(\tilde{R}_{lt}) + 2(\beta_{iw} - 1)\,\text{var}(\tilde{\varepsilon}_{wt})\ . \tag{A6}$$

Aggregating (A6) over i in country l yields the following aggregate level volatility decomposition after necessary cancellations:

$$\begin{aligned}\sum\nolimits_{i\in l} w_i\,\text{var}(\tilde{R}_{ilt}) &= \text{var}(\tilde{R}_{lt}) - \text{var}(\tilde{\varepsilon}_{wt}) + \sum\nolimits_{i\in l} w_i\,\text{var}(\zeta_{ilt}) \\ &= \sigma^2_{lt} - \sigma^2_{\varepsilon_{wt}} + \sigma^2_{rt}\end{aligned} \tag{A7}$$

where $\sigma^2{}_{lt}$ is the return variance of the local market portfolio, $\sigma^2{}_{\varepsilon_{wt}}$ is the return variance of the component of the global market portfolio that is isolated from local effects, and $\sigma^2{}_{rt}$ is the aggregated firm-specific residuals obtained from the market-adjusted model in (A3). Equation (A7) summarizes the aggregated total volatility decomposition of an average stock in a local market portfolio.

Estimation details of the volatility components in (A7) can be summarized as follows: The return variance of the local index is computed as

$$Local = \hat{\sigma}_{lt}^2 = \sum_{s \in t} (R_{ls} - \mu_l)^2 \quad \text{(A8)}$$

where μ_l is the mean of the local index return. The variance of global index return that is isolated from the local index return is computed by summing up the squares of the world-specific residuals of equation (A1) within period t. More explicitly, it is computed as

$$Global = \hat{\sigma}_{\varepsilon_{wt}}^2 = \sum_{s \in t} \hat{\varepsilon}_{ws}^2 \ . \quad \text{(A9)}$$

For estimating the idiosyncratic volatility component, first we sum up the squares of the firm-specific residuals in equation (A3) for each firm within period t:

$$\hat{\text{var}}_{\zeta_{ilt}} = \sum_{s \in t} \hat{\zeta}_{is}^2 \ . \quad \text{(A10)}$$

Next we aggregate equation (A10) over the firms in a market, to reach value-weighted idiosyncratic volatility estimates,

$$Idiosyncratic = \hat{\sigma}_{\zeta_{ilt}}^2 = \sum_{i \in l} w_{it} \ \hat{\text{var}}(\zeta_{ilt}) \ . \quad \text{(A11)}$$

In the regression analysis framework, we use the volatility components as dependent variables to understand the impact channels of net equity flow.

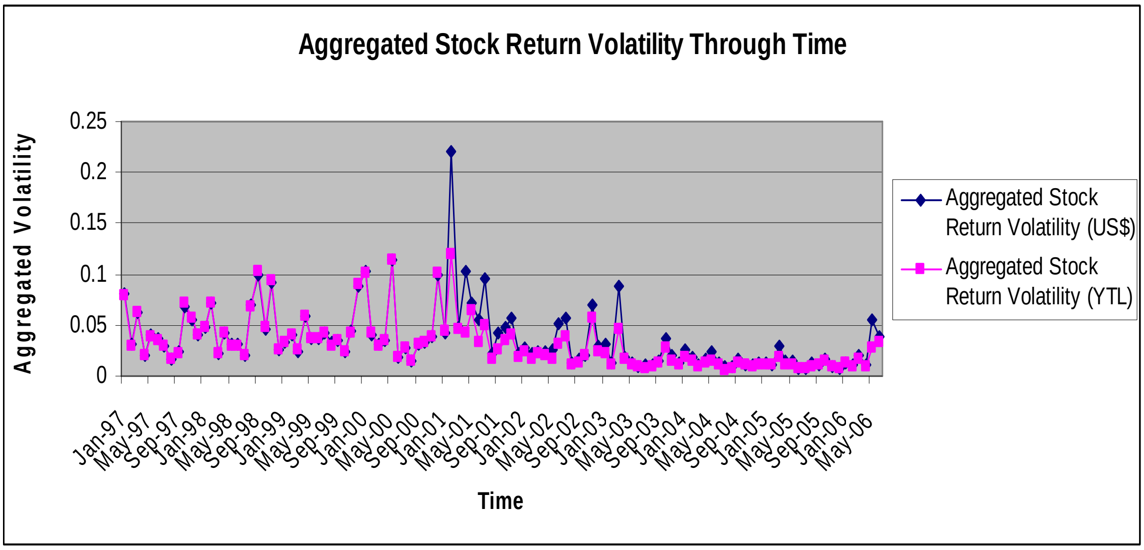

Figure 1. Aggregated Volatility through time. Weighted average of stock return volatility computed both in dollars and in local currency (YTL).

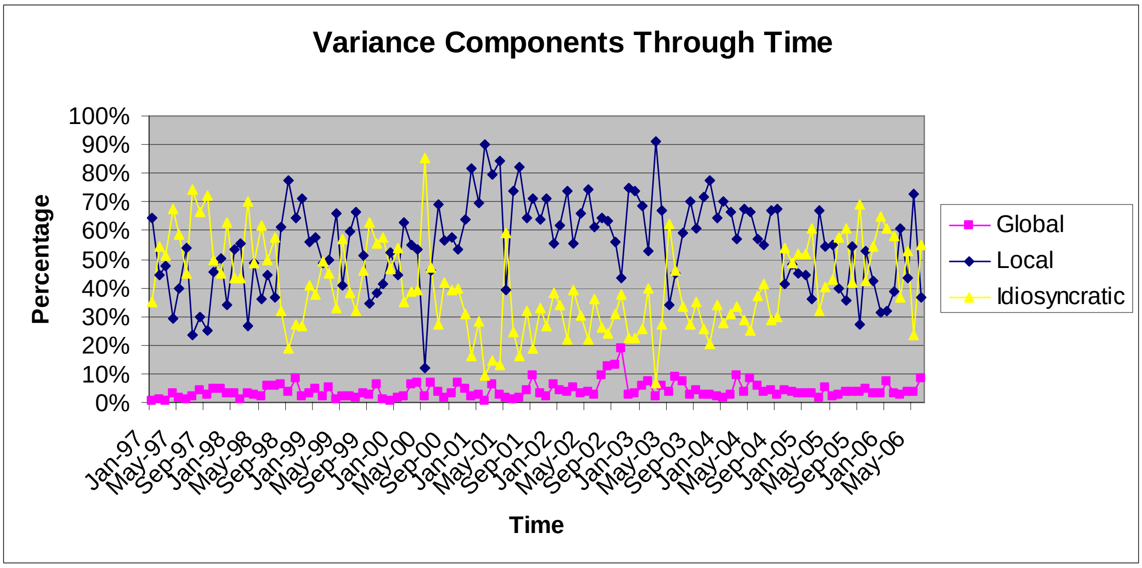

Figure 2. Proportion of Volatility Components. Time variation of volatility components as a percentage of total volatility through time.

Table 1
Descriptive Statistics

Aggregated Total Volatility is the weighted average of monthly return volatilities of stocks in the S&P/IFCG Index of Turkey. *Global* is defined as $(2\hat{\beta}_{lw}-1)\hat{\sigma}^2_{wt}$ where $\hat{\beta}_{lw}$ is the beta of the country index return with respect to the global index return, and $\hat{\sigma}^2_{wt}$ is the monthly return variance of the global index. *Local* is the monthly residual variance of the following regression equation: $\tilde{R}_{lt}=\beta_{lw}\tilde{R}_{wt}+\tilde{\varepsilon}_{lt}$. *Idiosyncratic* is the aggregated residuals variance, where residuals are obtained by the model, $\tilde{R}_{ilt}=\tilde{R}_{wt}+\tilde{\varepsilon}_{lt}+\varepsilon_{ilt}$. *Netflow* is the difference between the values of the total purchases and the sells of foreigners normalized by the total market capitalization of the market. *Size* is the total market capitalization of the stock market to the GDP, and it reflects the level of market development in terms of size. *TO* is the turnover ratio of the stock market in terms of value traded and accounts for the liquidity effects.

	Mean	Std. Dev.	Median
Aggregated Total Volatility, σ^2_{at}	0.0387	0.0324	0.0293
Global	0.0013	0.0011	0.0010
Local	0.0236	0.0273	0.0164
Idiosyncratic	0.0144	0.0132	0.0115
Netflow	0.0017	0.0120	0.0027
Size	0.2925	0.1121	0.2707
TO	0.1417	0.0531	0.1344

Table 2

Comparison of Direct and Indirect Measures of Aggregated Total Volatility

A non-parametric Wilcoxon Mann-Whitney test is employed to test the null hypothesis that the aggregated total volatility is identically distributed with respect to the median for both series. A parametric t-test is used to test the null hypothesis that the difference of the means of the two series is zero.

	Mean	Median	Correlation Coefficient
Direct Measure	0.0387	0.0293	
Indirect Measure	0.0422	0.0325	
t-statistics (difference)	0.7794	1.1677	
			0.9650

Table 3

Aggregated Total Volatility and the Net Flow

In Panel A, the following baseline regression model is estimated by GMM: $\hat{\sigma}^2_{at} = \alpha_l + \beta_1 Netflow_t + \beta_2 Size_t + \beta_3 TO_t + \upsilon_t$.

The results of some other regression models in which the control variables enter with several combinations are also presented. σ^2_{at} is the weighted average of monthly return volatilities of stocks in the S&P/IFCG Index of Turkey. *Netflow* is the difference between the values of the total purchases and sells of foreigners normalized by the total market capitalization of the market. *Size* is the proportion of total market capitalization of the stock market to the GDP, and it reflects the level of market development in terms of size. *TO* is the turnover ratio of the stock market in terms of value traded and accounts for the liquidity effects. In Panel B, one period lagged dependent variable is added as an explanatory variable to control for volatility persistency, and dynamic regressions are performed. The t-statistics are given in parentheses. *, **, and *** represent 10%, 5%, and 1% significance levels, respectively.

Panel A:
Lagged dependent variable is not included as an explanatory variable

Netflow	-0.8596***	-0.8345***	-0.8415***	-0.8224***
	(-4.4556)	(-4.0327)	(-4.3447)	(-3.8819)
Size		0.0158		0.0126
		(0.5346)		(0.4198)
TO			0.0623	0.0593
			(1.4906)	(1.3697)
c	0.0402***	0.0355***	0.0313***	0.0280***
	(10.0960)	(4.2128)	(5.1401)	(2.9802)
Ad. R^2	0.0933	0.0881	0.0957	0.0894

Panel B:
Lagged dependent variable is included as an explanatory variable

Netflow	-0.9508***	-0.9114***	-1.0257***	-0.9393***
	(-3.8186)	(-3.6550)	(-4.2235)	(-3.7974)
Size		0.0221		0.0264
		(0.7148)		(0.8566)
TO			0.0643*	0.0625
			(1.6936)	(1.5439)
$\sigma^2_{a,t-1}$	0.0030	-0.0747	-0.0192	-0.1219
	(0.0174)	(-0.3491)	(-0.1047)	(-0.5557)
c	0.0377***	0.0349***	0.0285***	0.0253**
	(4.7791)	(4.0064)	(2.9563)	(2.5143)
Ad. R^2	0.0877	0.0520	0.0710	0.0147

Table 4

Volatility Components and the Net Flow

In Panel A, the results of the regressions of the aggregated idiosyncratic volatility on the previously defined control variables are presented. Regression models are estimated by GMM. *Idiosyncratic* is the aggregated residuals variance where residuals are obtained by the model, $\tilde{R}_{ilt} = \tilde{R}_{wt} + \tilde{\varepsilon}_{lt} + \varepsilon_{ilt}$, taking the global factors as the base. In Panel B, the dependent variable is *Local*, and it is the monthly residual variance of the following regression equation: $\tilde{R}_{lt} = \beta_{wl}\tilde{R}_{wt} + \tilde{\varepsilon}_{lt}$. In Panel C, *Global* is used as the dependent variable and is defined as $(2\beta_{wl} - 1)\sigma^2_{wt}$ where $\hat{\beta}_{wl}$ is the beta of country index return with respect to global index return, and $\hat{\sigma}^2_{wt}$ is the monthly return variance of the global index. The t-statistics are given in parentheses. *, **, and *** represent 10%, 5%, and 1% significance levels, respectively.

Panel A: Dependent Variable is Aggregated Idiosyncratic Volatility, *Idiosyncratic*				
Netflow	-0.3843***	-0.3348***	-0.3337***	-0.4972***
	(-2.8863)	(-3.4205)	(-3.4236)	(-3.6136)
Size		0.0312**	0.0309**	0.0453**
		(2.2255)	(2.2063)	(2.0647)
TO			0.0055	-0.0093
			(0.2955)	(-0.4128)
$Idiosyncratic_{t-1}$				-0.4124
				(-1.6080)
c	0.0150***	0.0058	0.0051	0.0090**
	(9.5562)	(1.6481)	(1.2334)	(2.0668)
Ad. R^2	0.1137	0.1751	0.1681	-0.0642
Panel B: Dependent Variable is Local Volatility, *Local*				
Netflow	-0.5630***	-0.5872***	-0.5751***	-0.6158***
	(-3.2039)	(-3.1589)	(-3.1668)	(-2.7310)
Size		-0.0153	-0.0185	-0.0154
		(-0.7105)	(-0.8971)	(-0.8310)
TO			0.0592**	0.0566**
			(2.1211)	(2.6145)
$Local_{t-1}$				0.0598
				(0.2970)
c	0.0246***	0.0291***	0.0216***	0.0164*
	(6.7498)	(4.5901)	(3.1334)	(1.6992)
Ad. R^2	0.0526	0.0480	0.0527	0.0534
Panel C: Dependent Variable is Global Volatility, *Global*				
Netflow	-0.0301	-0.0054		
	(-1.1797)	(-0.0643)		
$Global_{t-1}$		1.4580		
		(0.8639)		
c	0.0042***	-0.0018		
	(5.0748)	(-0.2452)		
Ad. R^2	-0.0040	-0.3461		

Table 5
Volatility Components and the Net Flow under the Alternative Order of Orthogonalization

In Panel A, the results of the regressions of $\hat{\sigma}^2_{\zeta_{it}}$ on the previously defined control variables are presented. Regression models are estimated by GMM. $\hat{\sigma}^2_{\zeta_{it}}$ is the aggregated idiosyncratic volatility of stocks in a month. Idiosyncratic volatility is the residuals variance where residuals are obtained by the model, $\tilde{R}_{ilt} = \tilde{R}_{lt} + \tilde{\varepsilon}_{wt} + \zeta_{ilt}$, taking the local factors as the base. In Panel B, $\hat{\sigma}^2_{lt}$ is the dependent variable, and it is the monthly return variance of the local index. In Panel C, $\hat{\sigma}^2_{\varepsilon_{wt}}$ is used as the dependent variable, and it is the monthly residual variance of the following regression equation: $\tilde{R}_{wt} = \beta_{wl}\tilde{R}_{lt} + \tilde{\varepsilon}_{wt}$. The t-statistics are given in parentheses. *, **, and *** represent 10%, 5%, and 1% significance levels, respectively.

Panel A: Dependent Variable is Aggregated Idiosyncratic Volatility, $\hat{\sigma}^2_{\zeta_{it}}$				
Netflow	-0.4441***	-0.3932***	-0.3925***	-0.5921***
	(-3.0028)	(-3.5656)	(-3.5802)	(-3.8622)
Size		0.0321**	0.0319**	0.0479*
		(2.0682)	(2.0557)	(1.9699)
TO			0.0034	-0.0071
			(0.1734)	(-0.2968)
$\hat{\sigma}^2_{\zeta_{it-1}}$				-0.4090
				(-1.6221)
c	0.0172***	0.0076*	0.0072	0.0106**
	(9.9527)	(1.9366)	(1.5774)	(2.3981)
Ad. R^2	0.1333	0.1891	0.1819	-0.0716
Panel B: Dependent Variable is Local Volatility, $\hat{\sigma}^2_{lt}$				
Netflow	-0.6109***	-0.6420***	-0.6307***	-0.6428***
	(-3.7018)	(-3.7948)	(-3.7783)	(-3.1881)
Size		-0.0196	-0.0226	-0.0194
		(-0.9540)	(-1.1329)	(-1.1678)
TO			0.0553*	0.0489**
			(1.9632)	(2.2600)
$\hat{\sigma}^2_{lt-1}$				0.1144
				(0.6062)
c	0.0247***	0.0304***	0.0235***	0.0168*
	(6.7480)	(4.9189)	(3.4029)	(1.8478)
Ad. R^2	0.0638	0.0618	0.0650	0.0774
Panel C: Dependent Variable is Global Volatility, $\hat{\sigma}^2_{\varepsilon_{wt}}$				
Netflow	-0.0302***	-0.0148		
	(-3.8131)	(-1.1178)		
$\hat{\sigma}^2_{\varepsilon_{wt-1}}$		0.7573**		
		(2.3281)		
c	0.0015***	0.0004		
	(9.3994)	(0.8206)		
Ad. R^2	0.0826	0.2565		

Table 6

Alternative Definition of Aggregated Idiosyncratic Volatility and the Net Flow

The regression models, where $\hat{\sigma}^2_{\varepsilon_{it}}$ is the dependent variable, are estimated by GMM. $\hat{\sigma}^2_{\varepsilon_{it}}$ is the weighted average of monthly firm-specific return volatilities of stocks in a country. $\hat{\sigma}^2_{\varepsilon_{it}}$ is calculated by the difference between the variance of the non-diversified portfolio and the variance of the diversified portfolio as suggested by Bali et al. (2007). The t-statistics are given in parentheses. *, **, and *** represent 10%, 5%, and 1% significance levels, respectively.

Netflow	-0.2276**	-0.1949**	-0.1957**	-0.3841***
	(-2.3671)	(-2.4763)	(-2.4814)	(-2.6582)
Size		0.0206*	0.0208*	0.0304*
		(1.9048)	(1.9333)	(1.7496)
TO			-0.0040	-0.0211
			(-0.2351)	(-0.6657)
$\hat{\sigma}^2_{\varepsilon_{it-1}}$				-0.5598
				(-1.2168)
c	0.0116***	0.0055*	0.0060	0.0107
	(8.7631)	(1.8020)	(1.4706)	1.4311
Ad. R^2	0.0736	0.1234	0.1159	-0.52226

Executive Summary

Mehmet Umutlu, Levent Akdeniz, and Aslihan Altay-Salih, ***Foreign Equity Flow and Stock-Return Volatility: Evidence from the İstanbul Stock Exchange***

Increasing stock market openings, the removal of barriers to international capital flows, and high returns in emerging markets in addition to the benefits of international diversification have led foreign investors to trade heavily in emerging markets' stock exchanges in the last few decades. Today, foreign investors in emerging markets play the role of institutional investors in developed markets and hold the significant portion of the traded stocks. Therefore, assessing the impact of foreign investor participation on local stock exchanges is now one of the most important issues for emerging markets. Foreign investor participation in emerging stock exchanges can have positive and negative effects. On the positive side, it is documented that foreign investor participation lowers the cost of capital, which, in turn, leads more projects to be profitable, and thus spurs economic growth. On the negative side, foreign funds are blamed for being very sensitive to the changes in local conditions and thus causing excess volatility in local markets. However, there is no consensus among researchers on the relationship between foreign investor participation and return volatility. A clear understanding of this relationship is important, because it has implications for governments. For instance, Malaysia imposed restrictions on foreign capital after large amounts of foreign capital left the country during the Asian financial crisis.

In the literature, foreign investor participation is handled in several ways. A number of studies associate foreign investor participation with financial liberalization and analyze the behavior of the return volatility of local market indexes in event windows around the liberalization date. These studies implicitly assume that liberalization occurs at a single point in time. There are two major drawbacks to these studies. First, financial liberalization is a gradual process rather than an event. Thus, ignoring the ongoing nature of financial liberalization and treating it as a one-time event may lead to erroneous conclusions about the effects of foreign investor participation. Second, analyzing the return variance of market index can be misleading, because a change in the variance of a portfolio may be due to changes in the covariances of the stocks forming the portfolio, without an accompanying change in their variances. Some other studies use foreign equity flows to assess the effects of foreign participation in emerging markets. However these studies also examine return volatility of market index; thus, they might contain the problem discussed above. Interestingly, no study attempts to make a distinction between the transactions of incoming or outgoing foreign equity investments in analyzing the impact of foreign equity investments on stock-return volatility.

In this study, we first investigate the impact of foreign equity flows on the aggregated total volatility of stock returns in the Turkish Stock Exchange, where the market capitalization of foreign holdings exceeds 70% of the total market capitalization. We then explore the channels through which the foreign equity flow transmits its impact onto the aggregated total volatility. By using the foreign equity flows to detect the volatility impacts on stock returns, we eliminate several problems that arise in previous literature, such as the imprecision involved in dating the liberalization and in detecting effective foreign participation. We extend the volatility decomposition of Campbell et al. (2001) in a modified market model framework. In this model, the returns of individual stocks are affected by both local and global factors, and thus, the partial segmentation/partial integration paradigm is followed. We show that stock-return volatility can be decomposed into local, global, and idiosyncratic volatility. After this volatility decomposition, we are able to examine through which components the total volatility is affected. Although studies exist that analyze the relationship between volatility and foreign equity fund, this is the first study to investigate the mechanisms through which foreign equity flow affects total volatility. Furthermore, rather than analyzing the volatility of a market portfolio, as previous studies did, we use the aggregated total volatility of stocks and its components. A possible problem in the previous literature on the volatility of market index is that it is not clear whether a change in the total volatility of a portfolio is due to a change in the variances of the stocks, in the pairwise covariances between stocks, or in both. On the other hand, our aggregated total volatility measure is independent of the correlation of the stocks and therefore is a pure measure of the return volatility of a typical stock in a country.

We find that aggregated total volatility is negatively related to the foreign equity flows, even after controlling for market development, liquidity, and volatility persistency effects. This finding suggests a two-way impact of foreign equity flow on the aggregated total volatility. While a positive net equity flow (inflow) has a decreasing impact on aggregated stock return volatility, a negative net equity flow (outflow) has an increasing impact. We also find that net equity flow shows its effect on the aggregated total volatility through the local and the aggregated idiosyncratic volatility. We find similar results with the alternative order of orthogonalization in the volatility decomposition process and with the alternative model-independent definition of idiosyncratic volatility.