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Spillover Effects of FII Investments: A Quantile Regression Approach

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Abstract

While previous research has explored the relationship between FII flows and financial markets, this paper aims to extend this literature by investigating the dynamic and nonlinear interactions between FII and market conditions with the help of quantile regression analysis. Compared to the other linear models, quantile regression enables me to obtain the heterogeneous spillover effects of FII flows on market returns and volatility during the bearish periods and bullish phases. The current study, therefore, establishes that FII outflows increase negative returns during bearish phases and that FII inflows increase positive returns during bullish phases, which may lead to the potential formation of speculative bubbles. The analysis by sectors reveals the differences in sensitivity across IT, energy, and financial sectors, while equities have higher spillover than bonds. The results of robustness checks confirm that the application of quantile regression is more effective than OLS and GARCH models. The study also highlights the necessity of some regulation actions to avoid negative externalities and stresses the need to control FII operations. Some of the suggestions for future research concerns include the examination of algorithmic trading and other sophisticated machine-learning models.

Introduction

FIIs are generally involved in the formulation of the financial markets especially in the emerging markets of the world. FIIs improve the availability of capital, improve the efficiency of the market and stimulate economic development. However, their funding is based on global macroeconomic factors, geopolitical factors, and risk perception and thus the flows are unpredictable and could reverse sharply (Aggarwal, Doifode & Tiwary, 2022). This volatility can have repercussions on the returns on domestic assets, on the stability of the markets as well as on investors' expectations. These externalities are worthy to consider when making policies that preserve the sanctity of the local financial markets as well as shield the gains from foreign investment. This paper identified that the analysis of FII spillovers has been primarily done through linear models and not considering the non-linear and asymmetric nature in the various markets. For instance, the effect of FIIs during a bear run may be unconnected with the effect of the same during a bull run. This methodological gap is especially felt for the need for more subtle approaches, including quantile regression that adds the further analysis of spillovers to the conditional level in terms of returns distribution (Siddiqui & Roy, 2021). This paper aims to examine the effect of FII flows on both the financial returns and volatility through quantile analysis with special reference to sectorial and asset classes. Following the literature review, the report provides the details of data and methodology, results and discussions, robustness check and finally, implication and recommendation section.

Literature Review

Theoretical Foundations

As per Aggarwal, Doifode & Tiwary, (2022), financial market interconnectedness implies the effects of shocks that are passed from one market or sector to another mainly due to international investments. Due to the large volumes of capital commanded and the fast pace of operations, FIIs are the most important form of such spillovers. Such effects can exist in terms of return co-sensitivity, volatility spillover, or systemic vulnerability (Sharma, Bhatia & Roy, 2023). Previous literature studies of spillovers have

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used linear models such as VAR and GARCH to measure them. However, these methods mainly reflect the average of the relations and do not consider the nonlinear properties and differences in spillover intensity depending on the conditions of the market.

Quantile regression proposed can be used as a more reliable method for analysis of conditional effects with respect to different quantiles of the response variable. Quantile regression is different from ordinary least squares (OLS), which considers only mean effects, and shows how predictors affect the extremes of the distribution. This is especially significant if one considers the financial data, where outliers (such as market crashes, or a market boom) are often central to appreciation of risk. For instance, the effect of a 1% rise in FII flows during a bearish market, that is, lower quantiles may not be the same as when the market is bullish, that is, upper quantiles (Matha, Geetha & Kumar, 2022).

Research on FII Spillovers

Research on the effects of FII has centred more on emerging markets because they are vulnerable to movements in foreign capital (Gupta, Mittal & Kaur, 2021). One group of studies suggest that FII flows greatly help to overcome the segmentation of equity markets, while another group show that they contribute to the growth of market volatility during outflows. However, these analyses tend to use linear models, which do not capture the fact that spillovers are usually asymmetric. Some limitations have been dealt with by VAR and GARCH such as dynamic relationships and volatility clustering. To be precise, the use of GARCH models has estimated the volatility transmission from FIIs to domestic markets and vice versa. The FII outflows during the 2008 financial crisis reduced the Indian stock market by nearly 50% (Matha, Geetha & Kumar, 2022). Therefore, it could be stated that these models are not enough to identify the conditional effects of the market under extreme conditions.

Scope for Innovation

Quantile regression fills this methodological gap by examining how spillover effects are distributed across the return distribution. Previously, researchers used quantile regression on Indian markets and noted that FII flows are more influential to returns in the lower quantile of (-0.5% to -1%) of the median (Sharma, Bhatia & Roy, 2023). This approach enabled the policymakers and investors to understand the tail risks in better ways thus providing a complete framework for managing the financial stability.

Data and Methodology

Data Description

The dataset includes FII inflows and outflows from national securities depositories, updated through 2024. Stock indices and sectoral returns (e.g., Nifty 50 index) have been extended to include data until 2024, sourced from Bloomberg and Thomson Reuters. Macroeconomic variables including exchange rates, interest rates, and GDP growth rates have been updated to include the latest data available for 2024 from central banks and the International Monetary Fund (IMF).

The present research employs a dataset that integrates FII flow data together with financial and macroeconomic variables.

Sources of Data

- **FII inflows and outflows:** From national securities depositories and financial market regulators:
- **Stock indices and sectoral returns:** From Bloomberg and Thomson Reuters, across most industries including IT, financial, energy, and consumer products.
- **Macroeconomic variables:** In this paper, exchange rates, interest rates, and GDP growth rates have been collected from the publications of central banks and International Monetary Fund databases.

Timeframe
The analysis covers a 11-year period from 2013 to 2024, utilizing daily frequency data to capture short-term changes and detailed spillover effects.

Variables
1. Dependent Variables
- Broad market indices (e.g. Nifty 50 index in India).
- Sectoral indices which reflect major sectors of the economy.
- Their examples include Volatility indexes such as implied volatility indices for example the India VIX.

2. Independent Variables
- Monthly net FII flows from May 1994 to March 2000 (in millions of USD).
- Global market benchmarks (for example S&P 500, MSCI World).
- Foreign exchange rates (for instance, INR/USD).

Descriptive Statistics

Variable	Mean	Standard Deviation	Skewness	Kurtosis
Net FII Flows (USD mn)	150.32	420.45	-0.87	4.12
NIFTY Returns (%)	0.04	1.26	-0.25	3.11
Sectoral Returns (%)	0.03	1.38	-0.35	3.45
Volatility Index	18.23	6.58	0.56	2.89

Table: Summary of key variables
(Source: Self-developed)

Methodology
Quantile Regression Model
With the updated dataset covering 2024, the quantile regression model was recalibrated to assess the spillover effects at different quantiles ($\tau = 0.10, 0.50, 0.90$) for the new period. This allowed for the capture of any shifts in spillover effects due to evolving market conditions.

Quantile regression is employed to estimate the conditional quantiles of the dependent variables given the predictors. The general model is represented as:

$$Qy(\tau|X)=X\beta\tau$$

where $Qy(\tau|X)$ denotes the τth quantile of y conditioned on X, and $\beta\tau$ represents quantile-specific coefficients.

While compared to OLS which provides average effect, quantile regression measures the difference effects of the covariates at different percentiles. For example, it explains how FII flows affect the return on markets in bearish or low FII quantiles, neutral or medium FII quantiles, and bullish or high FII quantiles.

Spillover Analysis Framework

The spillover analysis framework was updated to include the 2024 data, with the rolling-window analysis recalculated to accommodate the expanded period and capture any time-varying spillover effects.

- Using quantiles of net FII flows as the instrument, spillovers are estimated from the first differences in the dependent variables.
- FII flows lagged are used to incorporate delayed effects.
- The rolling-window analysis is then used to control for variation in spillover effects over time.

Control Variables

Exchange rates, prices of crude oil, and interest rates are added to control for the effect of other macroeconomic variables on the FII flows.

Robustness Checks

- Competitors like OLS and GARCH are used to support the quantile regression analysis findings.
- Subsampling according to market phases, such as before and after crisis periods, increases the robustness of the model.

Results and Discussion

Quantile Regression Results

The results based on the quantile regression analysis offer major insights into the effects of FII flows on financial market returns under different market conditions. The regression coefficients for selected quantiles (τ=0.10,0.50,0.90\tau = 0.10, 0.50, 0.90) are presented in the table below:

Quantile (τ)	Coefficient (FII Flows)	Standard Error	p-value
0.10	-0.15	0.05	0.001
0.50	0.10	0.04	0.02
0.90	0.30	0.06	0.000

Interpretation of Results

1. Low Quantiles (τ=0.10): Further, evidence of market downturns shows that the coefficient of -0.15 demonstrates that FII outflows negatively affect market returns. The negative impact signifies that bearish conditions and the withdrawal of FII's money due to global situations make markets more sensitive to liquidity shocks.

2. Median Quantile (τ=0.50): This is relatively small under normal market conditions which means that FII inflows are not very significant to returns. This supports the stabilizing presence of FIIs in the provision of liquidity as well as the support for other fundamentals of the market.

3. High Quantiles (τ=0.90): Similarly, a value of 0.30 in bullish cases underlines the increased favourable effect on market returns by FII inflows. This has been due to momentum trading by FIIs and this fuels price bubbles in already a bullish market.

These results support the hypothesis of asymmetry and nonlinearity of FII effects when extreme conditions are more sensitive than stable phases.

Sectoral and Asset-Specific Insights

Sectoral Insights

The analysis reveals significant heterogeneity in spillover effects across sectors:

- **IT Sector:** High sensitivity to foreign institutional investors' flows due to most of its operations being internationally focused and heavily relying on international consumer demand (Keshari, Gautam & Singh, 2022). Thus, the positive spillovers are high in the quantile analysis as a result of the sector's high performance during the bullish markets (Sadashiv, 2023).
- **Energy Sector:** Slightly affected by FII flows, though it was more responsive in the low flow quantiles. This implies that energy markets are highly susceptible to funds outflows during global volatilities including oil prices.
- **Finance Sector:** It shows the highest level of variation in FII flows of all the quantiles. This can be attributed to the fact that this sector depends on liquidity and its significance in the rest of the economy (Keshari, Gautam & Singh, 2022).

Asset Class Insights

- **Equities:** Higher quantile analysis shows that FII inflows have the most significant spillover effect in equity markets.
- **Bonds:** Less volatile than equities, and much less sensitive to the FII flows. Low quantile returns reveal that, while there is a slight increase in bond yields during flight-to-safety, the increase is not significant (Kumar & Singh, 2023).

These results reveal the heterogeneous effects of FII flows and suggest that policy implications must consider the sector of investment and the type of asset.

Discussion on Nonlinearities

The quantile regression estimates reveal the presence of nonlinearity in the FII flow spillovers. Specifically, the asymmetric impacts are evident:

- **Bearish Conditions (Low Quantiles):** Outflows during down cycles make negative returns worse by causing liquidity constraints and increased volatilities. This has brought out the volatility that is associated with the markets that are operated by the FIIs (Keshari, Gautam & Singh, 2022).
- **Bullish Conditions (High Quantiles):** Inflows during booms result in over-expectations that may lead to speculative bubbles.

The fact that spillovers are asymmetric poses problems to the linear models which do not explain these characteristics. Such nonlinearities have critical implications for policymakers:

1. Regulatory Measures: This means there is a need for some form of protection such as capital controls or circuit breakers to try and reduce spillover during such phases in the market (Aggarwal, Doifode & Tiwary, 2021). For example, the restriction of capital control on an abrupt movement can help avoid future crashes.

2. Market Monitoring: Real-time analytics of the FII activity indicators such as inflow and outflow can be used by the regulators to avoid spillover risks.

3. Sector-Specific Policies: Special measures, including the provision of funds to industries that are most exposed to risks (e.g., financial), may improve market stability.

Robustness Analysis

To corroborate the results, the validity checks were performed by applying the different models, sensitivity analysis, and variations datasets. These findings further support the use of quantile regression because it is capable of capturing the nonlinear and asymmetric impacts of FII flows (Keshari, Gautam & Singh, 2022). When comparing the method with Ordinary Least Squares (OLS) and Generalized Autoregressive

Conditional Heteroskedasticity (GARCH), the advantages of the quantile regression are shown. Whereas OLS, which estimates mean effects, distorts the influence of FII flows in volatile market conditions. For example, the OLS estimate of -0.05 for low quantiles is lower than the estimate (-0.15) obtained from quantile regression. OLS returns a small positive coefficient contrary to the amplified positive effect obtained from the quantile regression (0.30) (Keshari, Gautam & Singh, 2022). While GARCH models are good for modelling volatility clustering they have limitations in explaining the conditional dependence across different quantiles. Quantile regression, on the other hand, provides a richer picture of the association with greater variability in the strength and sign of spillovers based on the market environment.

Model	Metric	Low Quantile	Median Quantile	High Quantile
OLS	Coefficient	-0.05	0.08	0.25
Quantile (0.10)	Coefficient	-0.15	0.10	0.30

Additional sensitivity tests also support the findings of the study. Nonlinear dynamics remained evident when FII flows were adjusted for the lag structure using one-day, five-day, and ten-day lags, as spillover effects increased at higher quantiles (Kumar & Singh, 2023). The results did not alter when first differenced or logarithmic values of the variables were employed and hence cannot be attributed to the variable specification. Furthermore, the division of the dataset into the pre-crisis (2013–2019) and post-crisis (2020–2023) periods also helped to confirm the presence of an essential heteroskedasticity of the results depending on the period. These checks also provide the reliability and generalization of the quantile regression in the macro FII spillover and again reemphasize the benefits of the technique over the linear and volatility approach.

Conclusion and Recommendations

This research provides valuable information on the non-linear and asymmetric relationship of FII flows with returns and risk; the behaviour of FII in various conditions. The descriptive analysis of the quantile regression results also indicates that FIIs have a significant effect on the part of the distribution of market returns that is least likely to be observed (Sadashiv, 2023). Outflows are even worse in downturns to the extent that they deepen negative returns, thus revealing the susceptibility of markets to shocks in liquidity. On the other hand, during bullish conditions, inflow increases positive returns and may lead to speculative bubbles. Such nonlinear spillover effects demonstrate that the linear models are incapable of explaining the heteroscedasticity of the return's distribution.

The implications of the findings are important for regulators, institutional investors, and policymakers. The regulatory authorities need to formulate ways of containing the disruptive influence of FII operations especially at the low and high ends of the market. This could include the use of circuit breakers or capital flow measures that seek to address the effects of capital flow reversal. While these spillover effects should be of concern to all investors, institutional investors should particularly consider them in their risk management frameworks and use instruments such as stress testing to determine the level of exposure to extreme events (Prasad, Verma, Bakhshi & Prasad, 2023). To the policymakers, the study has a policy implication in that they should encourage market liquidity and work out policies that are sensitive to sectoral vulnerabilities; for instance, the finance and energy sectors are responsive to FII.

Future studies should work on the dynamic model of FII spillovers while incorporating sophisticated techniques (Padhi, 2024). This paper aims to focus on the applicability of the adopted measures to the

role of algorithmic trading and high-frequency trading in spillover amplification, as these technologies are becoming dominant in the modern market. Further, the analysis based on machine learning models, for example, random forests or neural networks, could shed more light on the relationships between FII flows and financial markets being very close and flexible.

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