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JEL Classification: G12, C15

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THORSTEN LEHNERT*

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ABSTRACT

Daily mutual fund trading activities generate non-fundamental price pressure on aggregate stock prices and, therefore, significant flow-induced return patterns in the short-run. Short sellers systematically exploit these patterns and trade strongly in the opposite direction to these flows. Options markets offer an alternative route of taking directional positions. In this paper, using daily aggregate US equity fund flows, I propose an alternative test of the price pressure hypothesis and empirically investigate flow-induced trading activity in index options. Overall, I find strong empirical evidence for directional trading in index option prices. In line with the temporary price pressure hypothesis, the flow-induced bearish trading activity is price destabilizing and leads to a significant drop in risk-neutral skewness; hence, positive flows induce expectations about future negative returns. This negative relationship is, firstly, caused by inflow-induced price pressure, secondly, associated with the unexpected component (based on same-day flows), but not with the expected component (based on prior days' trading), and, thirdly, is only present for short-term options.

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1. Introduction

The temporary price pressure hypothesis suggests that large flows into equity mutual funds pushes equity prices up if equity demand is not fully elastic. Given that flows are highly persistent, short-sellers are expected to trade against the temporary mispricing and, therefore, they trade in the opposite direction to these flows. As a result, lagged positive flows should predict negative returns. However, the empirical evidence is mixed.

Early studies like Warther (1995), Fant (1999) and Edelen and Warner (2001) find no empirical evidence of a negative relation between flows and future returns. Using aggregate daily flows to equity mutual funds from TrimTabs, Edelen and Warner (2001) find a weak relation between flows and subsequent daily returns. Interestingly, the negative autocorrelation of flows reported in Edelen and Warner (2001) is in sharp contrast to the typically positive autocorrelation found in other studies (e.g. Goetzman et al. (2002)). Even if flows and returns are positively correlated, it could mean that they react to the same information. However, Goetzman and Massa (2003) show supporting evidence for the hypothesis of causality from flows to returns. They find a strong contemporaneous correlation between funds inflows and S&P market returns, but no evidence for positive feedback trading. Still, it is unclear if the arrival of flow information and fund managers' trading activity is correlated. By analyzing intraday volatility, Cao et al. (2008) show that fund managers have access to flow information during a trading day, and trade based on that flow information. Intraday volatility decreases (increases) over the trading day, as fund managers receive additional information about fund inflow (outflows).

In recent years, Ben-Rephael et al. (2011) and Arif et al. (2015) find support for the temporary price pressure hypothesis. Using aggregate daily flows to equity mutual funds in Israel, Ben-Rephael et al. (2011) show that mutual fund flows create temporary price pressure that is subsequently corrected. Their flows are positively auto-correlated and correlate with equity market returns. Approximately one-half of the initial price change is reversed within ten days. The empirical findings of Arif et al. (2015) suggest that short-sellers trade strongly in the opposite direction to these flows. They find that the ability of short-sellers trades to predict stock returns is up to 3 times greater when fund flows are in the opposite direction. However, does the trading activity originate from the options market or the equity lending market? Recently, Lin and Lu (2015) study the interaction identified in the literature between equity short selling and put options trading. Short-sale costs can influence put options trading activity, because higher short-sale costs may drive investors with negative private information or a long position to hedge from the equity lending market to the put options market. They conclude that the two markets are substitutes for one another for informed traders.

Prior studies provide no direct guidance on how flow-induced trading affects the index options market at the daily level. Ex ante, at the aggregate level, a case might be made for either a positive or a negative correlation, or no correlation at all. For example, if mutual fund trading pressure results in temporary price dislocations that are anticipatable by short sellers, do short sellers systematically exploit these patterns not only in the equity market, but does their trading also affect the options market? In this paper, using daily aggregate US equity fund flows, I propose an alternative test of the price pressure hypothesis and empirically investigate flow-induced trading activity in index options. The options market is in particular interesting to study, because option prices reflect expectations of market participants about future returns. For example, bearish options trading resulting in a negative shift in risk-neutral skewness would suggest that market participants expect stock prices to fall in the future. This negative shift can be a result of increased put option trading (e.g. causing an increase in out-of-the-money put option implied volatility) or a decrease in call option trading (e.g. causing a decrease in out-of-the-money call option implied volatility). Overall, I find strong empirical evidence for directional trading in index option prices. In line with the temporary price pressure hypothesis, the flow-induced bearish trading activity in index options leads to a significant drop in risk-neutral skewness; therefore, positive flows amplify expectations about future negative returns. This negative relationship is, firstly, caused by inflows into funds, secondly, associated with the unexpected component (based on same-day flows), but not with the expected component (based on prior days' trading), and, thirdly, is only present for short-term options.

The negative relation between mutual fund flows and risk-neutral skewness can be originated from the options market or the equity lending market. For example, when lots of short sellers are shorting as found in Arif et al. (2015), high lending fees lead to a high hedging cost for the put options market makers. The put options market makers might have to increase the prices of puts (and the bid-ask spreads), which results in higher implied volatility and lower risk-neutral skewness. It this case it would mean that via the put options market making channel, the negative relation between mutual fund flow and risk-neutral skewness would be driven by the short sellers. Therefore, I find strong support for the results presented in Arif et al. (2015). The remainder of the paper is organized as follows. Section 2 discusses related literature. In Section 3, I describe the data and methodology. Section 4 presents my empirical results on the relationship between mutual fund trades and risk-neutral moments. Section 5 concludes with a summary of key results.

2. Related Literature

Prior studies suggest that mutual funds trading activities generate non-fundamental price pressure on aggregate stock price that revert in the short-term. Shares of mutual funds are typically held by (unsophisticated) retail investors, which are vulnerable to fluctuating market conditions. As a result, in bullish markets, equity mutual funds experience inflows and managers need to quickly equitize their net inflows. In bearish markets, they are experiencing outflows and managers are vulnerable to redemption pressure and reduce their positions. Given that retail investors are prone to herding, the directional trading of mutual funds is correlated, and their collective actions can generate short-term price pressure on aggregate stock prices. Upward price-pressure, in case of correlated net inflows, leads to subsequent negative returns and downward price-pressure, in case of correlated net outflows, leads to subsequent positive returns. Therefore, the direction of mutual fund trades may be predictable, because of the price pressure problem associated with “crowded trades”, even at the daily market level.

Ben-Rephael et al. (2011) find strong support for the “temporary price pressure hypothesis” regarding mutual fund flows: Mutual fund flows create temporary price pressure that is subsequently corrected. They find that flows are positively autocorrelated, and are correlated with market returns. Their main finding is that approximately one-half of the price change is reversed within 10 trading days. Frazzini and Lamont (2008) use mutual fund flows as a measure of individual investor sentiment for different stocks, and find that high sentiment predicts low future returns. Lou (2012) proposes and test a capital-flow-based explanation for the persistence of mutual fund performance. He constructs a measure of demand shocks to individual stocks by aggregating flow-induced trading across all mutual funds, and document a significant, temporary price impact of such uninformed trading. Shive and Yun (2013) find that patient traders profit from the predictable, flow-induced trades of mutual funds. In anticipation of a 1%-of-volume change in mutual fund flows into a stock next quarter, institutions in the same 13F category as hedge funds trade 0.29–0.45% of volume in the current quarter. The effect is stronger when quarterly mutual fund portfolio disclosure is required and among hedge funds with more patient capital.

At the same time, by using mid-sized trades and by clustering in round amounts, mutual funds attempt to disguise their trades in order to reduce price impact. Alexander and Peterson (2007) find that NYSE and Nasdaq trades increasingly cluster on multiples of 500, 1,000, and 5,000 shares. This type of clustering varies over time and across stocks, and tends to increase with the level of trading activity. Medium-sized rounded trades tend to have greater relative price impact than large rounded trades. They argue that trade-size clustering is consistent with the actions of stealth traders who tend to use medium-sized rounded transactions in an attempt to hide their trades. Results of Chakravarty (2001) suggest that medium-size trades are associated with a disproportionately large cumulative stock price change relative to their proportion of all trades and volume. The source of this disproportionately large cumulative price impact of medium-size trades is trades initiated by institutions.

Mutual fund managers appear to be well informed about flow information. They receive flow information provided by their transfer agent prior to the close of a trading day, and the information has some predictability (Edelen and Warner (2001)). Oftentimes, fund managers have informal arrangements with their transfer agent, who is expected to inform fund managers about unusually large individual transactions by mid-afternoon. Further, institutional investors in a fund often give a one-day advance notice for large wire transfers. This common practice helps fund managers to predict flow and subsequent returns. Edelen and Warner (2001) find a stronger relation between market return and flow in the afternoon than in the morning. The results of Cao et al (2008) suggest that fund managers have access to flow information prior to the end of a trading day, and trade based on that flow information. Intraday volatility decreases over the trading day, as fund managers receive additional information about fund inflow. On the other hand, intraday volatility increases as fund managers learn about outflow during a typical day. Hence, the relation between intraday volatility and inflow (outflow) becomes weaker (stronger) from morning to afternoon.

In contrast to retail investors, short sellers are highly sophisticated investors. Dechow et al. (2001) investigate why firms with low ratios of fundamentals (such as earning and book values) to market values are known to have systematically lower future stock returns. They document that short-sellers position themselves in the stock of such firms, and then cover their positions as the ratios mean-revert. Their evidence is consistent with short-sellers using information in these ratios to take positions in stocks with lower expected future returns. Engelberg et al. (2012) find that a substantial portion of short sellers' trading advantage comes from their ability to analyze publicly available information. They show that the well-documented negative relation between short sales and future returns is twice as large on news days and four times as large on days with negative news.

Boehmer et al. (2008) construct a long daily panel of short sales using proprietary NYSE order data. From 2000 to 2004, shorting accounts for more than 12.9% of NYSE volume, suggesting that shorting constraints are not widespread. As a group, these short sellers are well informed. Heavily shorted stocks underperform lightly shorted stocks by a risk-adjusted average of 1.16% over the following 20 trading days (15.6% annualized). My study builds on the empirical work by Arif et al. (2015). They show that daily mutual fund flows are highly persistent and price-destabilizing, and short-sellers trade strongly in the opposite direction to these flows. The ability of short seller trades to predict stock returns is up to 3 times greater when mutual fund flows are in the opposite direction. The resulting wealth transfer from mutual funds to short sellers is most pronounced for high-mutual-fund-held, low-liquidity firms, and is much larger during periods of favourable market conditions.

Options markets offer an alternative route of taking directional positions. Theoretically, informed traders can choose between short sales and put options when establishing short positions. Prior work shows that both short sales and put options contain information about future stock prices and that bearish options trading and equity short selling are assumed to be substitutes (see e.g. Lamont and Thaler (2003) and Ofek et al. (2004)). In a related paper, Lin and Lu (2015) study the interaction identified in the literature between equity short selling and put options trading. Short-sale costs can influence put options trading activity because higher short-sale costs may drive investors with negative private information or a long position to hedge from the equity lending market to the put options market. As a result, put options bid-ask spreads and trading volume may increase with short-sale costs. Higher short-sale costs also raise the hedging costs of market makers in issuing put options, which will, ceteris paribus, reduce the put options trading volume and increase put options bid-ask spreads because of the inward-shift of the put option supply. They find that, in general, the put options bid-ask spread and put options trading volume both increase with the equity lending fee, which indicates that the outward shift of the demand curve dominates the inward shift of the supply curve in the options market. This finding is consistent with the notion that the two markets are substitutes for one another for informed traders. In line with this notion, I propose an alternative test of the temporary price pressure hypothesis and empirically investigate flow-induced trading activity in index options.

3. Data and Descriptive Statistics

Fund Flows

Daily Data on mutual funds are obtained from TrimTabs. I focus on a particular time period (January 2000 until December 2004), which is ideal for my purpose, because it is exactly preceding the regulation SHO period recently analysed in Arif et al. (2015). In June 2004 the SEC approved a short-sale pilot period (January 3, 2005 until July 6, 2007), during which all short-initiated stock trades must be reported. My data set is based on information from on average 1625 funds that report net asset values (NAVs) and total net assets (TNAs) to TrimTabs on a daily basis. Based on this information, TrimTabs calculates flows on day t for each fund i as $f_{i,t} = TNA_{i,t+1} - TNA_{i,t} \frac{NAV_{i,t+1}}{NAV_{i,t}}$. However, I apply a series of rigorous checks and filters to remove any kind of error in the original data[1].

Goetzman et al. (2002) analyse the TrimTabs funds and find that nearly all of the funds report on-time, while only less than 5% of funds report "late". Therefore, I assume that assets are determined pre-flow and compute my own flows on day t for each fund i from total assets and NAVs (see Cao et al. (2008) for details). Finally, I only retain all flows of domestic equity funds (706 funds) according to Wiesenberg and Morningstar information. Based on these flows, I construct value-weighted average flows per day. The mean and median daily fund flows are slightly negative, because funds experienced a significant outflow after the burst of the internet bubble in early 2000. As a result, a bit more than half of the daily flows are outflows. In line with Arif et al. (2015), preliminary analysis suggests that directional mutual fund flows are highly persistent for up to five lags, before and after controlling for lagged market returns. The time series of flows is stationary and the distribution is only slightly left-skewed.

S&P500Futures and Options

I obtain S&P 500 futures data from the Commodity Research Bureau (CRB) and index options data from OptionMetrics. Using index futures data, I aim to control for the trading activity in, and returns of the underlying index. It is common practice in the empirical index option pricing literature to use European options on the S&P 500 index (symbol: SPX). The market for S&P index options and futures is the most active index options and futures market in the world. The last trading day is the third Friday of the expiration month if that is an exchange trading day; otherwise, it is the first possible day prior to that Friday.

[1] See Goetzman and Massa (2002), Chalmers et al. (2001), Greene and Hodges (2002) for a detailed discussion.

I follow Barone-Adesi et al. (2008) and Bams et al. (2009) in filtering the original options data. For liquidity reasons, I only consider closing prices of out-of-the money put and call SPX options for each trading day. I obtain options data from OptionMetrics for the period January 2000 – December 2004. The bid-ask midpoint prices are taken. In line with Bollen and Whaley (2004), I exclude options with absolute call deltas below 0.02 or above 0.98 because of distortions caused by price discreteness. The delta of a European-style call option is

$$delta_C = N\left(\frac{ln(Se^{r\tau}/K) + 0.5\sigma^2\tau}{\sigma\sqrt{\tau}}\right) \tag{1}$$

where S is the dividend-adjusted index level (S*-PV(D)), K is the exercise, σ is the implied volatility of the option, r is the risk-free interest rate corresponding to the time to maturity (τ) of the option. Table 1 presents the moneyness categories according to Bollen and Whaley (2004) that I use for the subsequent analysis.

[Table 1]

The underlying S&P 500 index level, dividend yields and the term structure of zero-coupon default-free interest rates are also provided by OptionMetrics. On each day, I fit a functional form with curvature to the term structure in order to obtain the interest rate that matches the maturity of the option. I price the options by using the dividend-adjusted underlying S&P level.

Summary statistics

Table 2 summarizes the trading activity in S&P 500 index options over the January 2000 to December 2004 sample period. The total number of contracts traded in each moneyness category is reported. Overall, nearly 86 million out-of-the-money contracts were traded in the 5 years-period, roughly one third of them are calls and two thirds are puts. Comparing across moneyness categories, trading volume for calls is greatest for out-of-the money calls (category 4), followed by deep out-of-the money calls (category 5). Relatively symmetric, trading volume for puts is greatest for out-of-the money puts (category 2), followed by deep out-of-the money puts (category 1). Around 20% of the trading volume is in at- or near-the-money options, either slightly out-of-the money calls or slightly out-of-the money puts. This evidence is consistent with the use of S&P 500 index puts as portfolio insurance by equity portfolio managers. Given that I look at the post internet bubble period, it is not surprising that out-of-the money put options dominate my sample. Table 2 contains the average implied volatilities of the S&P 500 index options over the period January 2000 to December 2004. As the results in the table show, the index implied volatilities are monotonically decreasing across the delta categories.

[Table 2]

The average implied volatility of the category 1 options (deep out-of-the-money puts) is 28.4 percent, around 12 percent higher than the average implied volatility of category 5 options (deep out-of-the-money calls), 16.6 percent.

4. Mutual Fund Flows and Index Options Trading

Estimating the implied volatility surface

For the empirical analysis, I first use a modification of the prominent ad-hoc Black-Scholes model of Dumas, Fleming and Whaley (1998) to estimate the daily implied volatility surface of index options. The aim is to use all available information content in index option prices and to investigate the time series of risk-neutral skewness. I fit a modified ad-hoc Black-Scholes model to all out-of-the-money put and call option contracts on a given day and subsequently obtain the desired functional form for the implied volatility surface. This strategy successfully eliminates some of the noise from the data (see Christoffersen et al. (2010)). As indicated in Bollen and Whaley (2004), it is industry practice to quote Black-Scholes volatilities by option delta. Therefore, I allow each option to have its own Black-Scholes implied volatility depending on the call options delta and time to maturity τ. I use the following functional form for the option-implied volatility[2]:

[2] I have also used other specifications for the functional form that are frequently used in the literature (replacing delta by exercise price K or moneyness K/F, where F is the forward rate, but the results are robust to these changes.

$$IV_{i,j} = \alpha_0 + \alpha_1 delta_{C\,i,j} + \alpha_2 delta_{C\,i,j}^2 + \alpha_3 \tau_j + \alpha_4 \tau_j^2 + \alpha_5 delta_{C\,i,j}\,\tau_j \qquad (2)$$

where IV_{ij} denotes the implied volatility and $delta_{C,i,j}$, the delta of a call option for the i-th exercise price and j-th maturity, defined in Equation (1)[3]. τ_j denotes the time to maturity of an option for the j-th maturity. It is common practice to estimate the parameters using standard OLS. For every call option delta and maturity, I can compute the implied volatility and derive option prices using the Black-Scholes model. For example, the implied volatility for an ATM short-term call option with 1 month maturity can be derived by setting delta equal to 0.5 and time to maturity τ equal to 1/12.

Calculating risk-neutral skewness

In order to characterize the dynamics in the option market, I decompose the cross-section of index option prices into the moments of the risk-neutral distribution. Bakshi et al. (2003) derive a model-free measure of risk-neutral skewness ($Skewness_t(\tau)$) based on all options over the complete moneyness range for a particular time to maturity τ,

$$Skewness_t(\tau) = \frac{e^{r\tau}W_t(\tau) - 3\mu_t(\tau)e^{r\tau}V_t(\tau) + \mu_t^3(\tau)}{\left(\sqrt{e^{r\tau}V_t(\tau) - \mu_t^2(\tau)}\right)^3} \qquad (3)$$

$$\mu_t(\tau) = e^{r\tau} - 1 - \frac{e^{r\tau}}{2}V_t(\tau) - \frac{e^{r\tau}}{6}W_t(\tau) - \frac{e^{r\tau}}{24}X_t(\tau)$$

$$V_t(\tau) = \int_S^{+\infty} \frac{2\left(1 - \ln\left(\frac{K}{S_t}\right)\right)}{K^2} c_t(\tau, K)dK + \int_0^S \frac{2\left(1 + \ln\left(\frac{S_t}{K}\right)\right)}{K^2} p_t(\tau, K)dK$$

$$W_t(\tau) = \int_S^{+\infty} \frac{6\ln\left(\frac{K}{S_t}\right) - 3(\ln\left(\frac{K}{S_t}\right))^2}{K^2} c_t(\tau, K)dK - \int_0^S \frac{6\ln\left(\frac{S_t}{K}\right) - 3(\ln\left(\frac{S_t}{K}\right))^2}{K^2} p_t(\tau, K)dK$$

$$X_t(\tau) = \int_S^{+\infty} \frac{12\ln\left(\frac{K}{S_t}\right) - 4(\ln\left(\frac{K}{S_t}\right))^3}{K^2} c_t(\tau, K)dK + \int_0^S \frac{12\ln\left(\frac{S_t}{K}\right) - 4(\ln\left(\frac{S_t}{K}\right))^3}{K^2} p_t(\tau, K)dK$$

[3] For put options, I use the corresponding call delta in the implied volatility regression.

The parameters correspond to the ones introduced in Equation (1). C and P refer to call and put prices. Again, rather than averaging the implied volatilities of all contracts that are closest to one particular maturity (e.g. 1 month), I derive the Bakshi et al. (2003) moments using the estimated implied volatility surface and the corresponding call and put prices. This strategy successfully ensures that the time series of risk-neutral moments is less noisy and contains less outlier.

The Relation of fund flows and risk-neutral skewness

I now examine the contemporaneous relation between daily changes in risk-neutral skewness (RS) and fund flows (MF). I hypothesize that in line with the temporary price pressure hypothesis, the inflow-induced trading activity in index options leads to a negative shift in risk-neutral skewness; therefore, positive flows amplify expectations about future negative returns. The shift can be cause by an increase in prices of out-of-the-money and/or a decrease in prices of out-of-the-money calls. Therefore, an overall measure of risk-neutral skewness is used. Given that I expect to find short-term effects, we, initially, focus on short-term options with time to maturity of 1 month, but, as a robustness check, I also investigate long-term options with time to maturity of 6 months. Table 3 reports results of a regression of RS on selected contemporaneous variables[4].

[Table 3]

In line with Arif et al. (2015) and Lin and Lu (2015), I use the following controls in my regressions: the daily change in the average relative bid-ask spread [(Ask_p-Bid_p)/$Midpoint_p$] of out-of-the-money puts (category 1+2); the daily change in the relative bid-ask spread [(Ask_c-Bid_c)/$Midpoint_c$] of out-of-the-money calls (category 4+5); daily log-change of out-of-the-money put volumes (traded contracts, category 1+2); the daily log-change of out-of-the-money call volumes (traded contracts, category 4+5); daily log-changes of index futures volumes; and the daily change in the average ratio between the futures' daily high-and-low price difference and the daily high price [(High-Low)/High].

[4] I standardize my dependent and explanatory variables for ease of presentation and comparison.

Results suggest that RS is strongly negatively related to MF contemporaneously (Columns (1) and (2)). This relation is robust across various model specifications. Higher net purchases by mutual funds are associated with trading activity in S&P500 index options that leads to negative shifts in risk-neutral skewness, or, in other words, amplified expectations about future negative returns, even after controlling for the underlying index futures return (Ret) [5]. For example, a positive (negative) unit standard deviation shock in flow generates an initial day decline (increase) of 0.035 standard deviation of skewness. The coefficient on the interaction term (Ret*MF) is also negative, suggesting that the drop in risk-neutral skewness is even stronger when flows and returns are in the same direction; however, the relationship is insignificant. Adding a lagged dependent variable and other option control variables does not alter these results. Figure 1 shows an example of the impact of an inflow shock on the risk-neutral skewness.

[Figure 1]

I visualize the impact by plotting the fitted implied volatility smirk before and after a 1.5 standard deviation shock in fund inflows on a particular day in my sample period. An implied volatility smirk that is more skewed refers to a more negative risk-neutral skewness. After an inflow shock, the implied volatility of out-of-the-money puts (calls) increases (decreases), while the at-the-money implied volatility might even decrease, like it is the case here.

In the following, I explore the effect of the expected and unexpected MF components on RS (Columns (2) to (7)). In particular, I regress MF on five lags of MF and Ret and define expected mutual fund flows (ExpMF) as the fitted value from the regression. The residual from this regression is the unexpected mutual fund flows (UnexpMF). Thus, ExpMF captures the expected amount of MF flow based on information available at the beginning

[5] On each day, I fit a functional form with curvature to the term structure of futures prices in order to obtain the futures price that matches the desired maturity, here 1 month. This standardized time series of futures prices forms the basis for the return calculations.

of each day, while UnexpMF captures the unexpected MF component, based on new same-day information. If RSs are responding primarily to expected MF flows that are predictable in advance, I would expect a significantly negative coefficient on ExpMF. Conversely, if DSs are reacting primarily to same-day MF trades, the loading on UnexpMF should dominate. Interestingly, results show that only the coefficient on UnexpMF is significantly negative (Columns (3) and (4)), while the coefficient on ExpMF is insignificant (Columns (5) and (6)), indicating that index options respond to unexpected components of mutual fund trading. A unit standard deviation shock in unexpected flow predicts a decline (increase) 0.049 standard deviation of concurrent skewness. Moreover, adding ExpMF as an additional explanatory variable does not improve the adjusted R-Squared (Column (7)). The insignificant effect of ExpMF suggests that RS is not sensitive to flows that were anticipatable by the beginning of trading each day. However, the economic and statistical significance of UnexpMF shows that same-day fund trades induce trading activity in the index option market, which leads to a drop in RS.

Inflows vs. Outflows

I next investigate whether the directional trading activity in index options is more pronounced when mutual funds are experiencing inflows (funds are net byers) or outflows (funds are net sellers). It is well possible that RS is more affected when funds generate price pressure because of inflows, but RS is not sensitive to flows when funds generate price pressure because of outflows.

[Table 4]

In Table 4, I also control for the sign of MF, UnexpMF and ExpMF in the regression analysis. The separation of inflow from outflow reveals several interesting results. Indeed, when funds generate price pressure because of inflows (funds are net buyer), I find that bearish options trading activities result in negative drops in risk-neutral skewness. In contrast, if funds are net seller (experience outflows), results are insignificant (Columns (1) and (2)). Additionally, the impact of inflows is more than 2 times stronger compared to inflows. A unit standard deviation shock in inflow (outflow) predicts a decline (increase) of 0.049

(0.021) standard deviation of concurrent skewness (Column (1)). Furthermore, RSs are responding primarily to unexpected MF inflows that are not predictable in advance, indicated by a significantly negative coefficient on $UnexpMF_{inflows}$. Conversely, RSs are not reacting to predictable MF trades based on previous-day information; the loading on $ExpMF_{inflows}$ is insignificant (Columns (3) to (7)).

Short- vs. Long-term

In the following, I test if my findings are consistent with MF herding leading to price destabilization in the short-run (Puckett and Yan (2013)), but does not have long-lasting implications for longer-term future returns. Indeed, results in Table 5 are in line with this reasoning: The flow-skewness relationship for longer-term options is insignificant.

[Table 5]

Other Risk-Neutral Moments

I now examine the contemporaneous relation between daily changes in risk-neutral volatility (RV) and MF. Similar to risk-neutral skewness, annualized risk-neutral volatility on day t for a particular time to maturity τ, is defined as

$$Volatility_t\ (\tau) = \sqrt{\frac{1}{\tau}\left(e^{r\tau}V_t(\tau) - \mu_t^2(\tau)\right)} \tag{4}$$

The parameters correspond to the ones introduced in Equation (1) and (3). Table 6 reports results of a regression of RV on selected contemporaneous variables.

[Table 6]

In line with Cao et al. (2008), results suggest that RV is strongly negatively related to MF contemporaneously. For example, a positive (negative) unit standard deviation shock in flow generates an initial day decline (increase) of 0.045 (0.044) standard deviation of volatility (Column(1)). This relation is robust across various model specifications. Higher net purchases (sales) by mutual funds are associated with trading activity in S&P500 index options that leads to a decrease (increase) in overall risk-neutral volatility. This is not contradicting my previous results on risk-neutral skewness. As can be seen in Figure 1, a flow-induced negative shift in risk-neutral skewness can be a result of increased put option trading (e.g. causing an increase in out-of-the-money put option implied volatility) or a decrease in call option trading (e.g. causing a decrease in out-of-the-money call option implied volatility). Together with an observed decrease in at-the-money implied volatility, it is not surprising that the overall effect on my model-free measure of risk-neutral volatility is also negative. Furthermore, the effects for inflows are stronger compared to the ones for outflows, independent of the particular specification (Columns (1) and (2)). However, interestingly, the coefficient on the interaction term (Ret*MF) is positive, suggesting that when flows and returns are indeed in the same direction, RV significantly increases. Again, adding a lagged dependent variable and other option control variables does not alter these results.

Furthermore, I explore the effect of the expected and unexpected MF components on RV. In line with my previous results, only the coefficients on UnexpMF are significantly negative, while the coefficient on ExpMF is typically insignificant, indicating that index options respond primarily to unexpected components of mutual fund trading (Columns (3) to (6)). Moreover, adding ExpMF as an additional explanatory variable only marginally improve the adjusted R-Squared (Column (7)). The insignificant effect of ExpMF suggests that RV is not sensitive to flows that were anticipatable by the beginning of trading each day. However, the economic and statistical significance of UnexpMF shows that same-day fund trades induce trading activity in the index option market, which significantly affects RV. Again, the effects for inflows are stronger compared to the ones for outflows. A unit standard deviation shock in unexpected inflow (outflow) predicts a decline (increase) of 0.079 (0.043) standard deviation of concurrent volatility (Column (3)). Therefore, my findings for the options market confirm the results for the stock market presented in Cao et al. (2008), who also report a negative flow-volatility relationship of average magnitude 0.06.

In contrast to my findings for RS, the results presented in Table 7 suggest that flows still affect long-term RVs.

[Table 7]

Results are weaker compared to the short-term results, however, they do not qualitatively change. This suggests that the flow-volatility relationship follows a different channel compared to the flow-skewness relationship.

I now investigate the contemporaneous relation between daily changes in risk-neutral kurtosis (RK) and MF. Given the prior evidence, one could hypothesize that the flow-induced trading activity in index options also affects expectation of market participants to observe extreme returns, and, therefore, has a positive effect on risk-neutral kurtosis. Similar to risk-neutral skewness, risk-neutral kurtosis on day t for a particular time to maturity τ, is defined as

$$Kurtosis_t(\tau) = \frac{e^{r\tau}X_t(\tau) - 4\mu_t(\tau)e^{r\tau}W_t(\tau) + 6e^{r\tau}\mu_t^2(\tau)\,V_t(\tau) - 3\mu_t^4(\tau)}{[e^{r\tau}V_t(\tau) - \mu_t^2(\tau)]^2} \tag{5}$$

The parameters correspond to the ones introduced in Equation (1) and (3). Table 8 reports results of a regression of RK on selected contemporaneous variables.

[Table 8]

Results suggest that RK is strongly positively related to net purchases of mutual funds (inflows) contemporaneously, but not to net sales (outflows). For example, a positive (negative) unit standard deviation shock in flow generates an initial day increase (decline) of 0.038 (0.014) standard deviation of kurtosis (Column (1)). This relation is robust across various model specifications. Higher net purchases by mutual funds are associated with trading activity in S&P500 index options that leads to an increase in RK. This is in line with my prior empirical evidence on RS. Again, the effects for inflows are much stronger compared to the ones for outflows, independent of the particular specification. However, interestingly, the coefficient on the interaction term (Ret*MF) is not different from zero, suggesting that when flows and returns are indeed in the same direction, the effect on RK is not significantly different (Column (2)). Again, adding a lagged dependent variable and other option control variables does not alter these results.

Furthermore, I explore the effect of the expected and unexpected MF components on RK. In line with my previous results, only the coefficients on UnexpMF are significantly positive, while the coefficient on ExpMF is typically insignificant, further indicating that index options respond primarily to unexpected components of mutual fund trading (Coumns (2) to (6)). Moreover, adding ExpMF as an additional explanatory variable only marginally improve the adjusted R-Squared (Column (7)). The typically insignificant or marginally significant effect of ExpMF suggests that RK is not sensitive to flows that were anticipatable by the beginning of trading each day. However, the economic and statistical significance of UnexpMF shows that same-day fund trades induce trading activity in the index option market, which significantly affects RK. Again, the effects for inflows are much stronger compared to the ones for outflows. A positive (negative) unit standard deviation shock in unexpected flow generates an initial day increase (decline) of 0.071 (0.019) standard deviation of kurtosis (Column (3)).

[Table 9]

Furthermore, I again test if my findings are consistent with MF herding leading to price destabilization in the short-run (Puckett and Yan (2013)), but does not have long-lasting implications for longer-term future returns. Indeed, results in Table 9 are in line with this reasoning: The flow-kurtosis relationship for long-term options is insignificant.

5. Conclusions

The temporary price pressure hypothesis suggests that large flows into equity mutual funds pushes equity prices up if equity demand is not fully elastic. Given that flows are highly persistent, short-sellers are expected to trade against the temporary mispricing and, therefore, they trade in the opposite direction to these flows. As a result, lagged positive flows should predict negative returns. Arif et al. (2015) find that the ability of short-sellers trades to predict stock returns is up to 3 times greater when fund flows are in the opposite direction. When lots of short sellers are shorting as found in Arif et al. (2015), high lending fees lead to a high hedging cost for the put options market makers. As a result, the put options market makers increase the prices of puts. In line with this argument, Lin and Lu (2015) find evidence that the lending market and the equity options market are substitutes for one another for informed traders.

In this paper, using daily aggregate US equity fund flows, I propose an alternative test of the price pressure hypothesis and empirically investigate flow-induced trading activity in index options. Overall, I find strong empirical evidence for directional trading. In line with the temporary price pressure hypothesis, the bearish flow-induced trading activity in index options leads to a significant drop in risk-neutral skewness; therefore, positive flows induce expectations about future negative returns. This negative relationship is, firstly, caused by inflows into funds, secondly, associated with the unexpected component (based on same-day flows), but not with the expected component (based on prior days' trading), and, thirdly, is only present for short-term options. My results on other risk-neutral moments are in line with these findings.

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Table 1. Definition of Moneyness Categories (Bollen and Whaley (2004)).

This table defines five different moneyness categories (Bollen and Whaley (2004)) related to the delta of each option. I exclude options, which have absolute deltas below 0.02 or above 0.98. Daily option data are from OptionMetrics and cover the period January 2000 to December 2004.

Delta Category	Labels	Range
1	Deep in-the.money call Deep out-of-the-money put	$0.875 < \Delta c \leq 0.98$ $-0.125 < \Delta p \leq -0.02$
2	In-the.money call Out-of-the-money put	$0.625 < \Delta c \leq 0.875$ $-0.375 < \Delta p \leq -0.125$
3	At-the.money call At-the-money put	$0.375 < \Delta c \leq 0.625$ $-0.625 < \Delta p \leq -0.375$
4	Out-of-the.money call In-the-money put	$0.125 < \Delta c \leq 0.375$ $-0.875 < \Delta p \leq -0.625$
5	Deep out-of-the.money call Deep in-the-money put	$0.02 < \Delta c \leq 0.125$ $-0.98 < \Delta p \leq -0.875$

Table 2. Summary of Number of Contracts and Implied Volatilities.

Daily option data are from OptionMetrics and cover the period January 2000 to December 2004. The first column shows the corresponding delta moneyness category defined in Table 1. Column two and four show the number of SPX contracts traded during that period for calls and puts, respectively. Columns three and five show the corresponding proportions. I exclude deep in-the money (DITM) and in-the-money (ITM) calls and puts from my sample (denoted by -). The bid-ask midpoint of option prices and the dividend-adjust underlying S&P 500 are taken to estimate implied volatilities using the analytical Black-Scholes-Merton formula. The last column shows the average implied volatility of each moneyness category.

	Calls		Puts		Average Implied Volatility
Delta Category	No. of contracts	% Total	No. of contracts	% Total	
1	-	-	19,355,307	0.226	0.284
2	-	-	25,982,293	0.303	0.229
3	6,694,369	0.078	10,980,298	0.128	0.196
4	15,170,413	0.177	-	-	0.174
5	7,636,768	0.089	-	-	0.166
Total	29,501,550	0.344	56,317,898	0.656	

Table 3 –Short-term (1 month) Risk-Neutral Skewness

The Table reports results of a regression of daily changes in risk-neutral skewness on selected contemporaneous variables. The sample includes daily observations from January 3, 2000 to December 2004. MF is my proxy for the aggregate mutual fund trading activity. Ret is the S&P500 index futures return for a futures contract with a 1 month maturity, which is calculated form the term structure of index futures prices. Ret*MF is the daily interaction between Ret and MF. UnexpMF (ExpMF) is the residual (predicted value) from a regression of MF on five lags of MF and Ret. Ret*UnexpMF (Ret*ExpMF) is the daily interaction between Ret and UnexpMF (ExpMF). “Controls” controls for: the daily change in the average relative bid-ask spread [(Ask-Bid)/Midpoint] of out-of-the-money puts (category 1+2); the daily change in the relative bid-ask spread [(Ask-Bid)/Midpoint] of out-of-the-money calls (category 4+5); daily log-changes of out-of-the-money put volumes (traded contracts, category 1+2); the daily log-changes of out-of-the-money call volumes (traded contracts, category 4+5); daily log-change of index futures volumes; and the daily change in the average ratio between the futures’s daily high-and-low price difference and the daily high price [(High-Low)/High]. t-statistics below the coefficients are adjusted for serial correlation using the Newey-West (1987) correction and ***, ** and * indicate significance at the 1%, 5% and 10% level, respectively.

	Dependent Variable: Short-Term Risk-Neutral Skewness						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
MF	-0.035**	-0.035**					
	(-2.29)	(-2.28)					
Ret	-0.026***	-0.027***	-0.026***	-0.026***	-0.030***	-0.033***	-0.027***
	(-3.70)	(-3.71)	(-3.65)	(-2.76)	(-4.28)	(-4.42)	(3.71)
*Ret*MF*		-0.003					-0.003
		(-0.43)					(-0.43)
UnexpMF			-0.049***	-0.049***			-0.049***
			(-2.89)	(-2.88)			(-2.87)
*Ret*UnexpMF*				0.001			
				(0.05)			
ExpMF					0.030	0.032	0.028
					(0.81)	(0.87)	(0.77)
*Ret*ExpMF*						-0.015	
						(-1.12)	
Lagged	-0.471***	-0.471***	-0.471***	-0.471***	-0.473***	-0.473***	-0.472***
Dependent	(-18.94)	(-18.94)	(-18.97)	(-18.96)	(-19.00)	(-18.99)	(-18.98)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adj.RSQ	23.0%	23.0%	23.5%	23.0%	19.7%	19.7%	23.5%
N	1249	1249	1249	1249	1249	1249	1249

Table 4 –Short-term (1 month) Risk-Neutral Skewness, Inflows vs. Outflows

The Table reports results of a regression of daily changes in risk-neutral skewness on selected contemporaneous variables. The sample includes daily observations from January 3, 2000 to December 2004. MF is my proxy for the aggregate mutual fund trading activity. "Inflows" refers to days when funds are net byers and "outflows" refers to days when funds are net sellers. Ret is the S&P500 index futures return for a futures contract with a 1 month maturity. Ret*MF is the daily interaction between Ret and MF. UnexpMF (ExpMF) is the residual (predicted value) from a regression of MF on five lags of MF and Ret. Ret*UnexpMF (Ret*ExpMF) is the daily interaction between Ret and UnexpMF (ExpMF). "Controls" controls for: the daily change in the average relative bid-ask spread [(Ask-Bid)/Midpoint] of out-of-the-money puts (category 1+2); the daily change in the relative bid-ask spread [(Ask-Bid)/Midpoint] of out-of-the-money calls (category 4+5); daily log-changes of out-of-the-money put volumes (traded contracts, category 1+2); the daily log-changes of out-of-the-money call volumes (traded contracts, category 4+5); daily log-change of index futures volumes; and the daily change in the average ratio between the futures's daily high-and-low price difference and the daily high price [(High-Low)/High]. t-statistics below the coefficients are adjusted for serial correlation using the Newey-West (1987) correction and ***, ** and * indicate significance at the 1%, 5% and 10% level, respectively.

	Dependent Variable: Short-Term Risk-Neutral Skewness						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$MF_{outflows}$	-0.021	-0.022					
	(-0.36)	(-0.86)					
$MF_{inflows}$	-0.049**	-0.045**					
	(-2.04)	(-1.98)					
Ret	-0.027***	-0.027***	-0.026***	-0.026***	-0.030***	-0.033***	-0.027***
	(-3.75)	(-3.74)	(-3.65)	(-3.63)	(-4.29)	(-4.40)	(3.71)
*Ret*MF*		-0.002					-0.002
		(-0.32)					(-0.36)
$UnexpMF_{outflows}$			-0.027	-0.027			-0.023
			(-1.08)	(-1.07)			(-0.87)
$UnexpMF_{inflows}$			-0.076***	-0.076***			-0.082***
			(-2.65)	(-2.65)			(-2.73)
*Ret*UnexpMF*				0.001			
				(0.15)			
$ExpMF_{outflows}$					0.052	0.042	0.020
					(0.76)	(0.61)	(0.29)
$ExpMF_{inflows}$					0.013	0.024	0.053
					(0.23)	(0.42)	(0.89)
*Ret*ExpMF*						-0.014	
						(-1.06)	
Lagged	-0.471***	-0.471***	-0.470***	-0.470***	-0.474***	-0.474***	-0.471***
Dependent	(-18.92)	(-18.91)	(-18.93)	(-18.91)	(-18.99)	(-18.97)	(-18.89)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adj.RSQ	24.0%	23.9%	24.2%	24.2%	19.7%	19.7%	24.1%
N	1249	1249	1249	1249	1249	1249	1249

Table 5 –Long-term (6 months) Risk-Neutral Skewness

The Table reports results of a regression of daily changes in risk-neutral skewness on selected contemporaneous variables. The sample includes daily observations from January 3, 2000 to December 2004. MF is my proxy for the aggregate mutual fund trading activity. Ret is the S&P500 index futures return for a futures contract with a 6 month maturity. Ret*MF is the daily interaction between Ret and MF. UnexpMF (ExpMF) is the residual (predicted value) from a regression of MF on five lags of MF and Ret. Ret*UnexpMF (Ret*ExpMF) is the daily interaction between Ret and UnexpMF (ExpMF). "Controls" controls for: the daily change in the average relative bid-ask spread [(Ask-Bid)/Midpoint] of out-of-the-money puts (category 1+2); the daily change in the relative bid-ask spread [(Ask-Bid)/Midpoint] of out-of-the-money calls (category 4+5); daily log-changes of out-of-the-money put volumes (traded contracts, category 1+2); the daily log-changes of out-of-the-money call volumes (traded contracts, category 4+5); daily log-change of index futures volumes; and the daily change in the average ratio between the futures's daily high-and-low price difference and the daily high price [(High-Low)/High]. t-statistics below the coefficients are adjusted for serial correlation using the Newey-West (1987) correction and ***, ** and * indicate significance at the 1%, 5% and 10% level, respectively.

	Dependent Variable: Long-Term Risk-Neutral Skewness						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
MF	-0.004	-0.004					
	(-0.27)	(-0.27)					
Ret	-0.017**	-0.016**	-0.016**	-0.016**	-0.017**	-0.018**	-0.016**
	(-2.27)	(-2.15)	(-2.26)	(-2.21)	(-2.39)	(-2.43)	(-2.15)
*Ret*MF*		0.002					0.002
		(0.413)					(0.41)
UnexpMF			-0.007	-0.007			-0.007
			(-0.42)	(-0.42)			(-0.41)
*Ret*UnexpMF*				0.005			
				(0.75)			
ExpMF					0.010	0.011	0.010
					(0.27)	(0.30)	(0.27)
*Ret*ExpMF*						-0.007	
						(-0.52)	
Lagged	-0.488***	-0.486***	-0.488***	-0.485***	-0.489***	-0.488***	-0.489***
Dependent	(-19.76)	(-19.76)	(-19.78)	(-19.77)	(-19.77)	(-19.75)	(-19.76)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adj.RSQ	20.1%	20.1%	20.0%	20.0%	18.1%	18.1%	20.0%
N	1249	1249	1249	1249	1249	1249	1249

Table 6 – Short-term (1 month) Risk-Neutral Volatility, Inflows vs. Outflows

The Table reports results of a regression of daily changes in risk-neutral volatility on selected contemporaneous variables. The sample includes daily observations from January 3, 2000 to December 2004. MF is my proxy for the aggregate mutual fund trading activity. “Inflows” refers to days when funds are net byers and “outflows” refers to days when funds are net sellers. Ret is the S&P500 index futures return for a futures contract with a 1 month maturity. Ret*MF is the daily interaction between Ret and MF. UnexpMF (ExpMF) is the residual (predicted value) from a regression of MF on five lags of MF and Ret. Ret*UnexpMF (Ret*ExpMF) is the daily interaction between Ret and UnexpMF (ExpMF). “Controls” controls for: the daily change in the average relative bid-ask spread [(Ask-Bid)/Midpoint] of out-of-the-money puts (category 1+2); the daily change in the relative bid-ask spread [(Ask-Bid)/Midpoint] of out-of-the-money calls (category 4+5); daily log-changes of out-of-the-money put volumes (traded contracts, category 1+2); the daily log-changes of out-of-the-money call volumes (traded contracts, category 4+5); daily log-change of index futures volumes; and the daily change in the average ratio between the futures’s daily high-and-low price difference and the daily high price [(High-Low)/High]. t-statistics below the coefficients are adjusted for serial correlation using the Newey-West (1987) correction and ***, ** and * indicate significance at the 1%, 5% and 10% level, respectively.

	Dependent Variable: Short-Term Risk-Neutral Volatility						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$MF_{outflows}$	-0.044***	-0.037***					
	(-4.33)	(-3.70)					
$MF_{inflows}$	-0.045***	-0.051***					
	(-4.76)	(-5.37)					
Ret	-0.025***	-0.023***	-0.026***	-0.024***	-0.031***	-0.030***	-0.024****
	(-8.55)	(-7.72)	(-8.76)	(-8.52)	(-10.49)	(-9.74)	(-8.07)
*Ret*MF*		0.011***					0.011***
		(4.67)					(4.84)
$UnexpMF_{outflows}$			-0.043***	-0.040***			-0.034***
			(-4.33)	(-4.06)			(-3.45)
$UnexpMF_{inflows}$			-0.079***	-0.083***			-0.089***
			(-7.06)	(-7.49)			(-7.69)
*Ret*UnexpMF*				0.016***			
				(5.18)			
$ExpMF_{outflows}$					0.045	0.021	0.031
					(1.59)	(1.59)	(1.11)
$ExpMF_{inflows}$					0.021	0.010	0.046**
					(0.90)	(0.91)	(1.97)
*Ret*ExpMF*						0.004	
						(0.89)	
Lagged	-0.112***	-0.118***	-0.127***	-0.133***	-0.155***	-0.156***	-0.146***
Dependent	(-4.01)	(-4.24)	(-4.62)	(-4.88)	(-5.32)	(-5.34)	(-5.19)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adj.RSQ	11.7%	13.1%	13.9%	15.6%	8.4%	8.4%	15.8%
N	1249	1249	1249	1249	1249	1249	1249

Table 7 – Long-term (6 months) Risk-Neutral Volatility, Inflows vs. Outflows

The Table reports results of a regression of daily changes in risk-neutral volatility on selected contemporaneous variables. The sample includes daily observations from January 3, 2000 to December 2004. MF is my proxy for the aggregate mutual fund trading activity. “Inflows” refers to days when funds are net byers and “outflows” refers to days when funds are net sellers. Ret is the S&P500 index futures return for a futures contract with a 6 month maturity. Ret*MF is the daily interaction between Ret and MF. UnexpMF (ExpMF) is the residual (predicted value) from a regression of MF on five lags of MF and Ret. Ret*UnexpMF (Ret*ExpMF) is the daily interaction between Ret and UnexpMF (ExpMF). “Controls” controls for: the daily change in the average relative bid-ask spread [(Ask-Bid)/Midpoint] of out-of-the-money puts (category 1+2); the daily change in the relative bid-ask spread [(Ask-Bid)/Midpoint] of out-of-the-money calls (category 4+5); daily log-changes of out-of-the-money put volumes (traded contracts, category 1+2); the daily log-changes of out-of-the-money call volumes (traded contracts, category 4+5); daily log-change of index futures volumes; and the daily change in the average ratio between the futures’s daily high-and-low price difference and the daily high price [(High-Low)/High]. t-statistics below the coefficients are adjusted for serial correlation using the Newey-West (1987) correction and ***, ** and * indicate significance at the 1%, 5% and 10% level, respectively.

	Dependent Variable: Long-Term Risk-Neutral Volatility						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$MF_{outflows}$	-0.025***	-0.023***					
	(-3.45)	(-3.16)					
$MF_{inflows}$	-0.021***	-0.022***					
	(-3.04)	(-3.29)					
Ret	-0.024***	-0.023***	-0.024***	-0.024***	-0.031***	-0.026***	-0.024***
	(-10.97)	(-10.51)	(-11.17)	(-11.05)	(-10.49)	(-11.77)	(-10.92)
*Ret*MF*		0.003**					0.004**
		(1.99)					(2.29)
$UnexpMF_{outflows}$			-0.027***	-0.026***			-0.026***
			(-3.76)	(-3.65)			(-3.11)
$UnexpMF_{inflows}$			-0.040***	-0.041***			-0.044***
			(-4.91)	(-5.04)			(-5.20)
*Ret*UnexpMF*				0.004*			
				(1.89)			
$ExpMF_{outflows}$					0.045**	0.049**	0.036*
					(2.24)	(2.41)	(1.78)
$ExpMF_{inflows}$					0.014	0.010	0.025
					(0.86)	(0.59)	(1.48)
*Ret*ExpMF*						0.005	
						(1.29)	
Lagged	-0.122***	-0.125***	-0.133***	-0.133***	-0.155***	-0.158***	-0.152***
Dependent	(-4.36)	(-4.45)	(-4.62)	(-4.83)	(-5.36)	(-5.44)	(-5.19)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adj.RSQ	13.2%	13.4%	14.6%	14.7%	11.8%	11.9%	15.2%
N	1249	1249	1249	1249	1249	1249	1249

Table 8 – Short-term (1 month) Risk-Neutral Kurtosis, Inflows vs. Outflows

The Table reports results of a regression of daily changes in risk-neutral kurtosis on selected contemporaneous variables. The sample includes daily observations from January 3, 2000 to December 2004. MF is my proxy for the aggregate mutual fund trading activity. "Inflows" refers to days when funds are net byers and "outflows" refers to days when funds are net sellers. Ret is the S&P500 index futures return for a futures contract with a 1 month maturity. Ret*MF is the daily interaction between Ret and MF. UnexpMF (ExpMF) is the residual (predicted value) from a regression of MF on five lags of MF and Ret. Ret*UnexpMF (Ret*ExpMF) is the daily interaction between Ret and UnexpMF (ExpMF). "Controls" controls for: the daily change in the average relative bid-ask spread [(Ask-Bid)/Midpoint] of out-of-the-money puts (category 1+2); the daily change in the relative bid-ask spread [(Ask-Bid)/Midpoint] of out-of-the-money calls (category 4+5); daily log-changes of out-of-the-money put volumes (traded contracts, category 1+2); the daily log-changes of out-of-the-money call volumes (traded contracts, category 4+5); daily log-change of index futures volumes; and the daily change in the average ratio between the futures's daily high-and-low price difference and the daily high price [(High-Low)/High]. t-statistics below the coefficients are adjusted for serial correlation using the Newey-West (1987) correction and ***, ** and * indicate significance at the 1%, 5% and 10% level, respectively.

	Dependent Variable: Short-Term Risk-Neutral Kurtosis						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$MF_{outflows}$	0.014	0.015					
	(0.81)	(0.83)					
$MF_{inflows}$	0.038**	0.038**					
	(2.33)	(2.28)					
Ret	0.020***	0.020***	0.019***	0.019***	0.023***	0.024***	0.020***
	(4.00)	(3.99)	(3.81)	(3.80)	(4.67)	(4.65)	(3.95)
*Ret*MF*		0.001					0.002
		(0.25)					(0.38)
$UnexpMF_{outflows}$			0.019	0.020			0.011
			(1.12)	(1.12)			(0.61)
$UnexpMF_{inflows}$			0.071***	0.071***			0.084***
			(3.64)	(3.62)			(4.07)
*Ret*UnexpMF*				0.001			
				(0.03)			
$ExpMF_{outflows}$					-0.048	-0.044	-0.017
					(-1.03)	(-0.92)	(-0.36)
$ExpMF_{inflows}$					-0.049	-0.054	-0.093**
					(-1.27)	(-1.38)	(-2.27)
*Ret*ExpMF*						0.006	
						(0.70)	
Lagged	-0.396***	-0.396***	-0.396***	-0.396***	-0.404***	-0.404***	-0.400***
Dependent	(-15.22)	(-15.21)	(-15.31)	(-15.29)	(-15.48)	(-15.48)	(-15.39)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adj.RSQ	16.9%	16.8%	17.5%	17.4%	16.6%	16.6%	17.7%
N	1249	1249	1249	1249	1249	1249	1249

Table 9 – Long-term (6 months) Risk-Neutral Kurtosis, Inflows vs. Outflows

The Table reports results of a regression of daily changes in risk-neutral kurtosis on selected contemporaneous variables. The sample includes daily observations from January 3, 2000 to December 2004. MF is my proxy for the aggregate mutual fund trading activity. “Inflows” refers to days when funds are net byers and “outflows” refers to days when funds are net sellers. Ret is the S&P500 index futures return for a futures contract with a 6 month maturity. Ret*MF is the daily interaction between Ret and MF. UnexpMF (ExpMF) is the residual (predicted value) from a regression of MF on five lags of MF and Ret. Ret*UnexpMF (Ret*ExpMF) is the daily interaction between Ret and UnexpMF (ExpMF). “Controls” controls for: the daily change in the average relative bid-ask spread [(Ask-Bid)/Midpoint] of out-of-the-money puts (category 1+2); the daily change in the relative bid-ask spread [(Ask-Bid)/Midpoint] of out-of-the-money calls (category 4+5); daily log-changes of out-of-the-money put volumes (traded contracts, category 1+2); the daily log-changes of out-of-the-money call volumes (traded contracts, category 4+5); daily log-change of index futures volumes; and the daily change in the average ratio between the futures’s daily high-and-low price difference and the daily high price [(High-Low)/High]. t-statistics below the coefficients are adjusted for serial correlation using the Newey-West (1987) correction and ***, ** and * indicate significance at the 1%, 5% and 10% level, respectively.

	Dependent Variable: Long-Term Risk-Neutral Kurtosis						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$MF_{outflows}$	0.030	0.033					
	(0.92)	(1.01)					
$MF_{inflows}$	-0.005	-0.008					
	(-0.16)	(-0.26)					
Ret	-0.006	-0.004	-0.006	-0.005	-0.004	-0.005	-0.004
	(-0.64)	(-0.49)	(-0.63)	(-0.56)	(-0.41)	(-0.47)	(-0.44)
*Ret*MF*		0.006					0.005
		(0.77)					(0.66)
$UnexpMF_{outflows}$			0.031	0.033			0.030
			(0.96)	(1.01)			(0.91)
$UnexpMF_{inflows}$			0.006	0.004			0.006
			(0.17)	(0.10)			(0.17)
*Ret*UnexpMF*				0.008			
				(0.93)			
$ExpMF_{outflows}$					-0.041	-0.045	-0.027
					(-0.47)	(-0.50)	(-0.31)
$ExpMF_{inflows}$					-0.018	-0.014	-0.020
					(-0.24)	(-0.19)	(-0.25)
*Ret*ExpMF*						-0.004	
						(-0.26)	
Lagged	-0.480***	-0.480***	-0.480***	-0.481***	-0.480***	-0.480***	-0.481***
Dependent	(-19.28)	(-19.29)	(-19.30)	(-19.31)	(-19.29)	(-19.27)	(-19.29)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adj.RSQ	22.9%	22.9%	22.9%	22.9%	22.9%	22.8%	22.8%
N	1249	1249	1249	1249	1249	1249	1249

Figure 1 – Implied Volatility Smirk before and after an inflow shock

The figure depicts the fitted implied volatility smirks on two subsequent days during my sample period, before and after an inflow shock. The magnitude of the shock is 1.5 standard deviations. A smirk that is more skewed can be associated with a negative shift in risk-neutral skewness. I plot the option implied volatility vis à vis the call deltas.