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The Price Pressure of Aggregate Mutual Fund Flows

Azi Ben-Rephael, Shmuel Kandel, and Avi Wohl*

Abstract

Using a unique database of aggregate daily flows to equity mutual funds in Israel, we find strong support for the "temporary price pressure hypothesis" regarding mutual fund flows: Mutual fund flows create temporary price pressure that is subsequently corrected. We find that flows are positively autocorrelated, and are correlated with market returns (R^2 of 20%). Our main finding is that approximately one-half of the price change is reversed within 10 trading days. This support for the "temporary price pressure hypothesis" complements microstructure research concerning price impact and price noise in stocks by indicating price noise at the aggregate market level.

I. Introduction

We use a unique database comprising a complete record of aggregate *daily* flows to equity mutual funds in Israel. Using this database we find new evidence regarding the relationship between aggregate equity mutual fund flows and stock market returns. We show a high positive correlation (R^2 of 20%) between aggregate flows and market returns. Our main finding is that approximately ½ of the price changes related to flows are reversed within 10 trading days. These findings are clear evidence for the "temporary price pressure hypothesis" regarding mutual fund flows: Mutual fund flows create temporary price pressure that is subsequently corrected. By using a trading strategy based on this pattern, we show that this reversal is economically significant.

Warther (1995), Edwards and Zhang (1998), and Fant (1999) document a significant positive contemporaneous relationship between aggregate net monthly

*Ben-Rephael, azibenr@post.tau.ac.il, Wohl, aviwohl@post.tau.ac.il, Faculty of Management, Tel Aviv University, POB 39010, Tel Aviv 69978, Israel; Shmuel Kandel, Faculty of Management, Tel Aviv University, Wharton School, University of Pennsylvania, and CEPR, died on January 16, 2007, after a sudden illness. We thank the Tel Aviv Stock Exchange for providing us the mutual funds flows data. We thank Simon Benninga, Hendrik Bessembinder (the editor), Roger Edelen (the referee), Eugene Kandel, Saggi Katz, Sapir Forum participants, and seminar participants at the Bank of Israel for helpful comments and suggestions. This research was supported by the Israel Science Foundation (Grant No. 1314/08) and by the Sapir Forum. Ben-Rephael thanks the David Orgler and Family Research Fund for Banking and Finance for financial support. Wohl thanks the Henry Crown Institute of Business Research in Israel at Tel Aviv University for partial financial support. Ben-Rephael and Wohl dedicate this paper to the memory of Shmuel Kandel, a mentor and a friend.

fund flows and equity market returns. Three hypotheses have been proposed to explain the contemporaneous relationship between flows and returns. The first hypothesis is the information hypothesis: Good (bad) news regarding the equity market leads to positive (negative) returns and to flows into (out of) equity funds. The second hypothesis is the return chasing or feedback trading hypothesis: Investors react to lag returns, with positive (negative) returns leading to positive (negative) flows. Both hypotheses imply no relation between lagged flows and future returns. Since the empirical predictions of these hypotheses are very similar, we subsequently refer to both hypotheses as the information/return chasing hypothesis. The third hypothesis is the temporary price pressure hypothesis: If demand for equity is not fully elastic, a large flow into (out of) equity funds will push security prices up (down), and this will be reversed in subsequent periods. Consequently, lagged positive flows should predict negative returns, and vice versa. Finding no empirical evidence of a negative relation between lagged flows and future returns, Warther and Fant reject the price pressure hypothesis.

Edelen and Warner (EW) (2001) use the data of TrimTabs Company. The data contain aggregate daily flows to equity mutual funds and are based on voluntary reporting of a sample of 424 U.S. equity funds. EW find a high positive correlation (R^2 of 48%) between market return and subsequent flows, and a contemporaneous relationship between flows and market return, with R^2 of 3%. As EW report, the price impact relation is similar in magnitude to the price impact of institutional trading in individual stocks.[1] EW find a weak relation between flows and subsequent daily returns.[2] Overall their findings may be interpreted as strong support for the information/return chasing hypothesis and weak support for the price pressure hypothesis. EW's results are consistent with findings by Goetzmann and Massa (GM) (2003), who investigate daily flows to 3 Standard & Poor's (S&P) 500 index funds. Similar to EW, GM find R^2 of about 3%, between aggregate flows and concurrent market returns. GM do not find a relation between flows to subsequent returns. Contrary to EW, who find that aggregate flows are negatively serially autocorrelated, GM find that aggregate flows are positively serially autocorrelated.

As discussed by EW ((2001), Sec. 2.2 and Appendix), several issues involving the timeliness of their data may have affected their analysis. The main issue is that fund managers have imprecise information about the flows on the day they are created, which is 1 day before funds receive official information on money flows. Therefore it is not clear which day the flows affect fund transactions and indirectly affect stock prices. In Israel, all fund flows (sales and redemptions) are transferred electronically and immediately from investor brokers (typically banks) to the Tel Aviv Stock Exchange (TASE). The TASE transfers this information to the relevant funds at intervals of 10–15 minutes. We received

[1]See Chan and Lakonishok (1993), (1995), Keim and Madhavan (1997), and Jones and Lipson (1999).

[2]Tables 3 and 8 in EW (2001) present weak and insignificant evidence for a negative relation between flows and subsequent returns. Looking at a 1-day lag of flows and subsequent intradaily returns (Table 7), EW find a positive and significant relation with the overnight/morning returns and a negative and significant relation with afternoon returns.

information about the aggregate daily flows into equity fund categories from the TASE.

We investigate the relationship between net daily flows (sales minus redemptions) and the returns of the Tel Aviv 25 (TA-25) index (the index of the 25 largest stocks in Israel). We find that the flows are positively autocorrelated and are positively correlated with lagged returns and contemporaneous returns. The dynamic relationship between flows and returns is addressed by the bivariate vector autoregression (VAR) of flows and returns. We find that a shock of 1 standard deviation (SD) to fund flows is related to a positive contemporaneous price impact of 0.62%, followed by a reversal of 0.30% in the following 10-day period (accumulated reversal after 5 days is 0.21%). The accumulated reversal is statistically significant. The reversal starts 3 days after the shock to aggregate fund flows. For demonstrating the economic magnitude of these relations, we build a simple strategy that invests in the market and the risk-free rate based on lag flows. In the days of stock investing, the average daily stock market return is 0.179% (SD = 1.26%), while on riskless investing days the average daily stock market return is –0.019% (SD = 1.30%). The difference between the means is statistically significant.

Our findings offer additional support for the information/return chasing hypothesis.[3] Our main contribution is that our findings provide clear support for the "price pressure" hypothesis. It seems that mutual fund investors not only follow returns but also affect stock prices. Their buying (selling) pushes prices up (down), and this effect is reversed with 10 trading days. The findings of this paper are related to microstructure research investigating the price impact of uninformed traders and transaction costs (see surveys by Madhavan (2000) and Biais, Glosten, and Spatt (2005)). The general message of this line of research is that uninformed investors affect prices and "push" them from the fundamentals. Empirically, this impact is reflected in the reversal of a price effect (as opposed to a permanent price effect that reflects information). The horizon used to detect a reversal is typically between 30 minutes and 1 day because empirical measurement of such effects in longer horizons becomes difficult.[4] Measuring these effects is done typically at the stock level (separately for each stock). However, it is not clear whether price noises at the individual stock level vanish at the aggregate stock level. If there is a systematic component in these noises, the effect should also appear at the aggregate level. Answering this question is difficult econometrically when observing only transactions and orders in the stock market. Data on mutual funds flows, however, can provide indirect evidence concerning this issue. Mutual funds investors are retail investors, and by investing through mutual funds, they indicate that they perceive themselves as uninformed. Their consequent investment flows are transmitted to transactions in the stock market because the funds are required to hold mainly stocks. Therefore, it is possible to observe the effect of uninformed

[3]Motivation for return chasing can be found in Chalmers, Edelen, and Kadlec (2001) and Greene and Hodges (2002), where return chasing is profitable due to stale prices used for net asset value (NAV) calculation. This is not the case in our market—see Section II for a detailed description of the Israeli market.

[4]Hendershott and Seasholes (2007) find evidence for price reversal in individual stocks at a period up to 12 days. Other papers that investigate price impacts in longer than daily horizons are Obizhaeva (2007), Andrade, Chang, and Seasholes (2008), and Subrahmanyam (2008).

investors on the market as a whole. The partial reversal pattern that we find indicates that some of the "noise" induced by uninformed traders holds at the aggregate level of the stock market. This noise is not corrected immediately, but within 10 days.

Our findings are also related to research on the transaction costs of institutional investors.[5] Since investor flows induce price pressure on the market level, funds should buy "high" and sell "low." That is, mutual funds may appear to be "bad timers" because they are forced to respond to their investors' flows. This is consistent with Edelen's (1999) findings that negative market timing of mutual funds is attributed to their flows.

Ben-Rephael, Kandel, and Wohl (BKW) (2011) find that aggregate monthly net exchanges to equity funds in the U.S., as a proxy for shifts between bond funds and equity funds, are positively contemporaneously correlated with aggregate stock market returns. Approximately 85% of the contemporaneous relationship is reversed within 4 months. They view their findings as support for the price pressure hypothesis, which has been rejected in the past by Warther (1995) and Fant (1999) using monthly data. Our paper provides complementary evidence for the price pressure hypothesis. BKW use monthly data and therefore cannot detect short-term reversal patterns as are detected in this paper. This paper, on the other hand, uses daily data but for a short sample period of 26 months and therefore cannot detect long-term reversal patterns. The combination of the results reported in both papers suggests that the reversal pattern is underestimated in both papers due to data limitations.

The remainder of the paper is organized as follows. Section II describes the environment and data. Section III presents the summary statistics. Section IV presents the empirical results, and Section V concludes.

II. Environment and Data

In Israel, there are about 35 fund families and more than 1,000 funds. Almost all mutual fund investors are retail investors. Mutual funds are NOT used for tax-benefited retirement investments.

The mutual fund flows time line is as follows:

i) An investor transmits an order (to buy or sell mutual fund units) to her bank by phone, by fax, electronically, or in person.

ii) Orders for the same day can be transmitted from 8:00 to 15:30–16:00 (depending on the fund), as the TASE trading day ends at 17:30. This allows funds sufficient time to adjust their positions according to the daily flows, and prevents costs imposed by last-minute orders as discussed in Gastineau (2004). This limitation reduces the profitability of strategies based on non-synchronous trading as described in Chalmers et al. (2001). In funds that focus on the most active stocks of the TA-25 index, such opportunities do not effectively exist.

iii) The bank transfers the orders immediately and electronically to the TASE.

[5]See Keim and Madhavan (1997) for evidence and a literature survey.

iv) The TASE transmits its flows to each fund family every 10–15 minutes. It should be emphasized that flow transmissions are not related to the trading at the TASE. Flows are transmitted through the TASE for cost saving reasons.

v) At the end of the trading day (17:30), each fund calculates and transmits its NAV to the TASE for clearing. The clearing is performed by the TASE but again, clearing is not related to TASE trading.

vi) The information on each fund's monthly flows becomes publicly available 60 days after the end of each month.

The sample period extends from August 2002 to September 2004, covering a total of 529 trading days. In 2004, approximately 800 stocks, warrants, and convertible bonds of approximately 600 firms were traded on the TASE, with a total (end of year) market value of 397 billion NIS (new Israeli shekel).[6] Most of the market value and the trading activity are concentrated in the TA-25 stocks. TA-25 is a value-weighted index of the largest 25 stocks (with a 9.5% cap for any single stock). Its market value at the end of 2004 was 242 billion NIS, or an average market value of 9.7 billion NIS per stock. The average market value of the 75 next largest stocks (the TA-75 index) is only 1.1 billion NIS. In 2004, the average daily trading volume of TA-25 stocks was 369 million NIS (14.76 million NIS per stock). The daily average number of transactions in TA-25 stocks was 24,951 (approximately 1,000 transactions per stock). The respective volume figures for TA-75 stocks are much smaller: The average daily number of transactions per TA-75 stock was 94, and the average trading volume was 1.825 million NIS. In Israel, no options are written on individual stocks, although there is an active market for index options on the TA-25. Since most of the trading activity in the TASE is concentrated in the TA-25, and in order to avoid analysis problems arising from nonsynchronous trading, we focus on the TA-25 index.[7] We present its returns in percentage terms, denoted as RET.

We received daily flows data aggregated by fund categories from the TASE. That is, we have no information on the flows of any specific fund. TASE categories include 12 different types of domestic equity funds. For example, one category is TA-25 funds that invest mainly in TA-25 stocks. Redemptions are defined as negative flows. If money is transferred from one fund to another, it is recorded as 2 distinct transactions. The TASE data do not include 1st-day inflows of new funds (initial seeding of funds). While we lack formal statistics, it seems that these inflows are negligible relative to total flows, as launching funds is relatively rare and 1st-day flows are relatively small. Since we use TA-25 as a proxy for market returns, we focus on the net daily flows in the TA-25 fund category and denote it by FLOWS. Return and volume data were obtained from the TASE. Bank of Israel short-term interest rate data were obtained from its site.

[6]In the sample period, 1 NIS was equal, on average, to 0.22 USD.

[7]There are indications of potential nonsynchronous trading in TA-75 stocks (see Campbell, Lo, and MacKinlay (1997), chap. 3.1). The correlation between the daily return of TA-75 and its lag is 0.20 with *p*-value of 0.001, while correlation between the daily return and lag of return in the TA-25 index is not significantly different from 0. Also, the correlation between the TA-75 daily return and the lag of the TA-25 daily return is 0.137 with *p*-value of 0.002, while the correlation between the TA-25 daily return and the lag of the TA-75 daily return is not significantly different from 0.

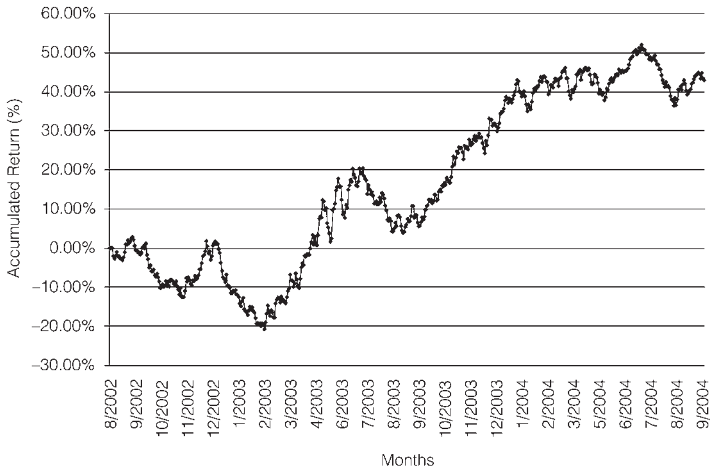
III. Summary Statistics

Our paper focuses on the TA-25 (25 largest stocks). The average RET (the daily return of the TA-25 index) is 0.076%, which cumulates to 44.4% over the sample period. The SD of RET is 1.28%, approximately 20.3% on an annual basis. The accumulated return over the sample period is presented in Figure 1. Stocks in the TA-25 index account for a major portion in broader indices (as TA-100) or industry indices (as Banks index). Therefore, flows that affect the TA-25 index are not limited to flows to TA-25 funds. Consequently, the summary statistics reported in Table 1 include information on all equity fund flows. The daily net aggregate flows into and out of the TA-25 funds (denoted hereafter as FLOWS) are positive on approximately ½ (266 out of 529) of the days. The average of daily net aggregate flows to TA-25 funds (all equity funds) is positive: 0.57 (4.91) million NIS. The SD of daily net aggregate flows to TA-25 funds (all equity funds) is 7.5 (34.1) million NIS. We normalize the net flows by funds' NAV. We denote the normalization of TA-25 flows by TA-25_FUNDS_FLOWS_TO_NAV and denote the normalization of all equity funds by EQUITY_FUNDS_FLOWS_TO_NAV. The SD of these daily ratios is 0.60% and 0.62% for all equity funds and TA-25 funds, respectively.[8] FUNDS_VOL is the sum of the daily inflows and outflows in millions of NIS. The average value of TA-25 FUNDS_VOL (all equity FUNDS_VOL) is 14.7 (53.2) million NIS. The average of absolute daily net aggregate flows of TA-25 funds (all equity funds) is 4.65 (19.91) million NIS with an SD of 5.96 (28.38) million NIS. The daily net aggregate flows over the sample period are shown in Figure 2. MARKET_VOL is the daily volume of the equity stocks in million NIS. The average daily market volume over the sample period of TA-25

FIGURE 1

Accumulated Return of the TA-25 Index

Figure 1 depicts the accumulated return of the TA-25 (the Tel Aviv Stock Exchange's 25 largest stocks index) from August 2002 to September 2004.



[8]We have monthly data on the funds' NAV; for the normalization we use the NAV at the beginning of the month.

TABLE 1

Summary Statistics

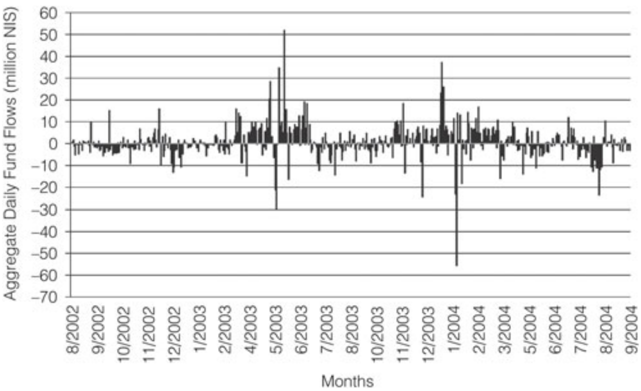
Table 1 reports the summary statistics of the sample. The data span the period from August 2002 to September 2004, a total of 529 days. RET is the percentage return of TA-25 (the index of the largest 25 stocks in the TASE). TA-25_FUNDS_FLOWS is the net aggregate flows to the TA-25 equity funds (in millions of NIS (new Israeli shekel)). TA-25_ABS_FUNDS_FLOWS is the absolute value of TA-25_FUNDS_FLOWS. TA-25_FUNDS_VOL is the sum of the inflows and outflows to/from TA-25 equity funds (in millions of NIS). TA-25_MARKET_VOL is the daily volume of TA-25 stocks (in millions of NIS). EQUITY_FUNDS_FLOWS is the net aggregate flows to all equity funds (in millions of NIS). EQUITY_ABS_FUNDS_FLOWS is the absolute value of EQUITY_FUNDS_FLOWS. EQUITY_FUNDS_VOL is the sum of the inflows and outflows to/from all equity funds (in millions of NIS). EQUITY_MARKET_VOL is the daily volume of the equity market (in millions of NIS). TA-25_FUNDS_FLOWS_TO_NAV is TA-25_FUNDS_FLOWS divided by the total net assets (NAV) of TA-25 funds at the beginning of the month. EQUITY_FUNDS_FLOWS_TO_NAV is EQUITY_FUNDS_FLOWS divided by the total net assets (NAV) of equity funds at the beginning of month. In the sample period, 1 NIS was equal on average to 0.22 USD.

Variables	Mean	Median	SD	Min	Max
RET (%)	0.076	0.004	1.28	–3.49	7.19
TA-25_FUNDS_FLOWS (mil NIS)	0.57	0.02	7.50	–55.62	52.13
TA-25_ABS_FUND_FLOW (mil NIS)	4.65	2.84	5.96	0.00	55.62
TA-25_FUNDS_VOL (mil NIS)	14.73	12.52	10.58	1.45	76.05
TA-25_MARKET_VOL (mil NIS)	257.38	230.63	178.55	51.03	1,419.54
EQUITY_FUNDS_FLOWS (mil NIS)	4.91	–0.03	34.13	–294.86	185.02
EQUITY_ABS_FUND_FLOW (mil NIS)	19.91	9.48	28.38	0.01	294.86
EQUITY_FUNDS_VOL (mil NIS)	53.20	41.67	49.31	3.74	435.11
EQUITY_MARKET_VOL (mil NIS)	381.58	346.11	239.58	75.60	1,587.23
TA-25_FUNDS_FLOWS_TO_NAV (%)	0.05	0.01	0.62	–3.38	4.41
EQUITY_FUNDS_FLOWS_TO_NAV (%)	0.09	0.00	0.60	–4.56	2.86

FIGURE 2

Daily Funds Flows during the Sample Period

Figure 2 depicts the daily net aggregate flows into and out of the TA-25 equity funds from August 2002 to September 2004 (in millions of NIS).



(all equity) stocks is 257.4 (381.6) million NIS. On average, TA-25 (all equity) FUNDS_VOL (the sum of inflows and outflows) is 6.1% (12.9%) from TA-25 (all equity) market volume. The correlation between market volume and equity FUNDS_VOL is 66.8%. The correlation between market volume and the absolute daily net aggregate flows of the equity funds is 49.0%. The average NAV of TA-25 funds (all equity funds) is 1,349 million NIS (5,527 million NIS), while the average market value of the TA-25 index (all equity markets) is 174,190 million NIS (265,194 million NIS). This ratio is much smaller than in the U.S., but it should be noted that the average "floating quantity" in the stock population is

33% according to TASE data (February 2008). The remaining stocks are held by large block holders (such as funding families) that rarely trade stocks.

The daily correlation between flows and returns is presented in Table 2. The contemporaneous correlation between the FLOWS and RET is 0.451, which indicates a strong positive relation.[9] The correlation between FLOWS and its lag (LFLOWS) is 0.304, which indicates a strong autocorrelation in FLOWS. The correlation between FLOWS and the 1-day lag of RET (LRET) is significant and quite large: 0.219.

TABLE 2

Correlation Matrix

Pearson's correlations with *p*-values in square brackets are reported. The data span from August 2002 to September 2004, a total of 529 days. RET is the percentage return of TA-25 (the index of the largest 25 stocks in the TASE). LRET is the 1-day lag of RET. FLOWS is the net aggregate flows to the TA-25 equity funds (in millions of NIS). LFLOWS is the 1-day lag of FLOWS.

Variables	LFLOWS	RET	LRET
FLOWS	0.304 [< 0.0001]	0.451 [< 0.0001]	0.219 [<0.0001]
LFLOWS		–0.015 [0.72]	0.451 [<0.0001]
RET			0.057 [0.19]

IV. Empirical Results

In this section we analyze the relationship between FLOWS and RET. We estimate the dynamic effect of a shock to FLOWS on returns using VAR analysis based on these relations.

A. The Relationship between FLOWS, Lagged FLOWS, and Lagged Returns

We start from an estimation of the relations between FLOWS and lagged variables. The coefficients from the time-series regressions of FLOWS as a dependent variable on the respective lag variables are presented in Table 3. The basic number of lags in the regression specifications is set as 4.[10] The regression of FLOWS on its own lags (specification (1)) presents positive and significant autocorrelation. The adjusted-R^2 is 0.103 and the *p*-value of the lags' significance is less than 0.001. The regression of FLOWS on RET lags (specification (2)) also presents positive correlation. The adjusted-R^2 is 0.079 and the *p*-value of lags'

[9]Consistent with previous papers (e.g., Warther (1995)), we find that the contemporaneous relation between flows and returns is mainly due to the unexpected component of the flows. The adjusted-R^2 is 0.236.

[10]Our main focus in this paper is the estimation of the dynamic relation between flows and returns based on the impulse response function of a 4-lag VAR. The number of lags was set by the next likelihood ratio test: $(T-k)(\ln \mathrm{DET}_R - \ln \mathrm{DET}_{ur}) \sim \chi^2(q)$. DET is the determinant of the covariance matrix of the residuals of the VAR equations.

significance is less than 0.0001. Specification (3) includes both lags of FLOWS and RET. The adjusted-R^2 is 0.115. The p-value of the F-test for RET lags after controlling for FLOWS' lags is 0.025, which indicates that the lag of the return has an effect on the FLOWS beyond the lag of the FLOWS. The F-test for lags 2–4 of RET indicates that it may be possible to use the 1st lag of RET only. Specification (4) includes only 1 lag of RET, and the p-value of RET is 0.006. In all the specifications we find positive correlations and autocorrelations. Based on the results of these regressions, it is evident that both lags of FLOWS and RET Granger-cause FLOWS positively.[11]

TABLE 3

Regressions of Flows on Lag Variables

Table 3 presents the coefficients from the time-series regression of FLOWS on the respective variables. The data span the period from August 2002 to September 2004, a total of 529 days. FLOWS is the net aggregate flows to the TA-25 equity funds (in millions of NIS). FLOWS($t-1$) to FLOWS($t-4$) are the lags of FLOWS from day $t-1$ to day $t-4$, respectively. RET($t-1$) to RET($t-4$) are the returns of TA-25 (the index of the largest 25 stocks in the TASE) from day $t-1$ to day $t-4$ (in percentage points), respectively. The t-statistics of the regression coefficients are in square brackets. The table also presents the p-values of the F-tests for regression significance and for variable significance. For example, FLOWS lags' p-value is the p-value of the F-test for FLOWS lags as a group.

Variables	(1)	(2)	(3)	(4)
INTERCEPT	0.344	0.330	0.267	0.298
	[1.10]	[1.04]	[0.85]	[0.96]
FLOWS($t-1$)	0.264		0.187	0.196
	[6.02]		[3.71]	[3.92]
FLOWS($t-2$)	0.107		0.094	0.125
	[2.36]		[1.84]	[2.75]
FLOWS($t-3$)	0.068		0.043	0.070
	[1.51]		[0.85]	[1.55]
FLOWS($t-4$)	–0.042		–0.015	–0.022
	[0.95]		[0.30]	[0.50]
RET($t-1$)		1.207	0.756	0.769
		[4.90]	[2.71]	[2.76]
RET($t-2$)		0.719	0.289	
		[2.91]	[1.04]	
RET($t-3$)		0.753	0.418	
		[3.05]	[1.51]	
RET($t-4$)		0.326	0.117	
		[1.32]	[0.43]	
Adjusted-R^2	0.103	0.079	0.115	0.114
p-values of F-test for:				
Regression	< 0.0001	< 0.0001	< 0.0001	< 0.0001
FLOWS lags	< 0.0001		< 0.0001	< 0.0001
RET lags		< 0.0001	0.025	0.006
RET lags 2–4			0.305	

B. The Relation between Returns, Lagged Flows, and Lagged Returns

Table 4 presents coefficients from the time-series regressions of RET as a dependent variable on lagged variables. The first specification is the regression of RET on the lags of the FLOWS. The first 2 lags of FLOWS are positive but not significant, while lags 3 and 4 are negative and significant. The p-value of the F-test for lags 1 and 2 is 0.5846, while the F-test for lags 3 and 4 is 0.0149.

[11] See Granger (1963) and Geweke, Meese, and Dent (1983).

We find a significant (negative) relation for only the 3rd lag. Specification (2) regresses RET on RET lags. The coefficients of the regression are not significant, and the lags of return do not predict future returns. Specifications (3) and (4) estimate different relations between RET and lags of FLOWS and RET. Specification (3) uses 4 lags of FLOWS and 4 lags of return, while specification (4) uses only the 1st lag of return, similar to Table 3. In both specifications the lags of the FLOWS are significant, and the lags of RET are not significant. To summarize, lagged flows seem to predict future returns, while lagged returns do not.

TABLE 4

Regressions of RET on Lag Variables

Table 4 presents the coefficients from the time-series regression of RET on the respective variables. The sample period spans the period from August 2002 to September 2004, a total of 529 days. FLOWS is the net aggregate flows to the TA-25 equity funds (in millions of NIS). FLOWS($t-1$) to FLOWS($t-4$) are the lags of FLOWS from day $t-1$ to day $t-4$, respectively. RET($t-1$) to RET($t-4$) are the returns of TA-25 (the index of the largest 25 stocks in the TASE) from day $t-1$ to day $t-4$ (in percentage points), respectively. The t-statistics of the regression coefficients are in square brackets. The table also presents the p-values of the F-tests for regression significance and for variable significance. For example, FLOWS lags' p-value is the p-value of the F-test for FLOWS lags significance as a group.

Variables	(1)	(2)	(3)	(4)
INTERCEPT	0.0900	0.0697	0.0808	0.0859
	[1.60]	[1.24]	[1.44]	[1.53]
FLOWS($t-1$)	–0.0002		–0.0077	–0.0062
	[0.02]		[0.84]	[0.68]
FLOWS($t-2$)	0.0082		0.0054	0.0098
	[1.01]		[0.59]	[1.20]
FLOWS($t-3$)	–0.0180		–0.0233	–0.0179
	[2.23]		[2.54]	[2.21]
FLOWS($t-4$)	–0.0099		–0.0079	–0.0081
	[1.25]		[0.89]	[1.02]
RET($t-1$)		0.0520	0.0650	0.0677
		[1.19]	[1.29]	[1.35]
RET($t-2$)		0.0491	0.0363	
		[1.12]	[0.73]	
RET($t-3$)		0.0174	0.0753	
		[0.40]	[1.51]	
RET($t-4$)		–0.0159	0.0339	
		[0.36]	[0.69]	
Adjusted-R^2	0.009	0.000	0.011	0.010
p-values of F-test for:				
Regression	0.072	0.535	0.088	0.064
FLOWS lags	0.072		0.031	0.066
RET lags		0.535	0.269	0.178
RET lags 2–4			0.338	

C. VAR Analysis of FLOWS and RET

In Sections IV.A and IV.B we estimate the relations between flows and returns by ordinary least squares (OLS) regressions. The following analysis uses the impulse response function simulation to estimate the dynamic relations between FLOWS and RET. The VAR system based on the optimal lag test includes 4 lags of FLOWS and RET:[12]

[12]In the impulse response analysis we assume that the causality runs from FLOWS to RET, meaning that, at time t, a shock to FLOWS affects RET but a shock to RET does not affect FLOWS. For robustness, we also check a VAR system where a shock to RET affect FLOWS contemporaneously.

$$(1)\qquad \begin{aligned} \text{FLOWS}_t &= \alpha_{1,t} + \sum_{i=1}^{4} \beta_i \text{FLOWS}_{t-i} + \sum_{i=1}^{4} \gamma_i \text{RET}_{t-i} + \varepsilon_t, \\ \text{RET}_t &= \alpha_{2,t} + \sum_{i=1}^{4} \lambda_i \text{FLOWS}_{t-i} + \sum_{i=1}^{4} \delta_i \text{RET}_{t-i} + \eta_t. \end{aligned}$$

The periodic and accumulated impulse response of RET to a 1-SD shock to FLOWS is presented in Table 5. The effect of a shock of 1 SD to FLOWS (7.08 million NIS) on RET is 0.62%. This response is followed by 2 days of insignificant returns that are probably a result of 2 confounding effects: the persistence of price pressure and price reversal.[13] The accumulated effect from day 1 to day 10 is –0.306%, and is significant with a t-statistic of 2.06.[14] After 2 days the reversal effect dominates, and if we exclude the first 2 insignificant days, the t-statistic of the accumulated effect for days 3–10 is 2.76. Since the reversal is partial, the permanent price effect of a shock of 1 SD to FLOWS is 0.314% and significant (the t-statistic for the accumulated effect from day 0 to day 10 is 2.02) and is approximately ½ of the immediate effect of 0.62%. VAR relations are plotted in Graphs A–D of Figure 3. Graph A plots the results of Table 5. We can see a reversal of RET within 10 days after the shock to FLOWS. The accumulated response of RET to shock in RET, or the continuation effect of market return, is presented in Graph B. On day 0, the graph shows the 1 SD of the unexpected component of RET (see equations (1) – η_t), which is 1.12%. On the following 10 days, the continuation effect is 0.17%, creating a total effect of 1.29%. This continuation effect is marginally significant. The t-statistic for the accumulated return from day 1 to day 10 is 1.54. The response of FLOWS to shock in the FLOWS, or the continuation effect of FLOWS, is presented in Graph C. We can see a positive strong continuation after the shock. On day 0, the graph shows 1 SD of the unexpected component of FLOWS (see equations (1) – ε_t), which is 7.08 million NIS. On the next 10 days the continuation effect is 3.94 million NIS. This continuation effect is highly significant. The t-statistic for the accumulated FLOWS from day 1 to day 10 is 3.20. The response of the FLOWS to shock in returns is presented in Graph D. It can be seen that a shock of 1 SD of return (RET) is related to an accumulated response of the flows (FLOWS) of 3.00 million NIS, which is spread over 7 trading days (t-statistic = 2.87).

We performed some robustness tests (for the sake of brevity, we do not report these results in detail):

i) We estimated a restricted VAR system based on specification (4) of Tables 3 and 4. The results are qualitatively similar to the complete VAR results.

ii) Kalay, Sade, and Wohl (2004) study the opening call auctions in the TASE and find that the price impact of buys is larger than that of sells and its

In this specification we find that a shock of 1 SD to FLOWS is followed by a return of –0.35% over the next 10 trading days. The t-statistic for the accumulated return over days 1–10 is 2.53.

[13]This is consistent with the weak relation, found in EW (2001), between flows and next day returns.

[14]The t-statistics of the accumulated periods were estimated using a Monte Carlo simulation (see Hamilton (1994)).

TABLE 5

Impulse Response Simulation

Table 5 presents the impulse response function results of the bivariate VAR analysis with 4 lags of FLOWS (the net aggregate flows to the TA-25 equity funds) and RET (the returns of the TA-25 index). The presented results are the response of RET to a 1-SD shock to the flows. The sample period spans a period from August 2002 to September 2004, a total of 529 days. Day 0 is the contemporaneous period of the shock. The Response column is the periodic effect, and the *t*-statistic relates to that period effect. The Accumulated column is the accumulated periodic response.

	Impulse Response in %		
Day	Response	*t*-Statistic	Accumulated
0	0.620	11.86	0.620
1	–0.014	0.25	0.607
2	0.046	0.82	0.653
3	–0.115	2.07	0.537
4	–0.085	1.59	0.453
5	–0.045	2.01	0.408
6	–0.044	2.49	0.364
7	–0.028	1.75	0.336
8	–0.013	1.39	0.323
9	–0.006	1.01	0.316
10	–0.002	0.35	0.314
11	0.000	0.11	0.315
12	0.001	0.45	0.316
13	0.001	0.68	0.318
14	0.001	0.80	0.319
15	0.001	0.85	0.320

reversal is smaller. Following these results, we analyze a VAR system with different effects for negative and positive FLOWS. We do not find significant differences between positive FLOWS and negative FLOWS.

iii) To avoid estimation issues related to nonsynchronous trading, we focus on TA-25 stocks, which account for 66% of total market capitalization in the sample period. As a robustness test we estimate VAR using flows to all equity funds and returns of the TA-100 index (the largest 100 stocks in Israel, which account for 88% of market capitalization in the sample period). The results are qualitatively similar to our main analysis (the *t*-statistic of the reversal from day 3 to day 10 is 2.44).

iv) We also look at normalized FLOWS (FLOWS divided by the TA-25 market value) instead of FLOWS. The results are also qualitatively similar to our main analysis (the *t*-statistic of the reversal from day 3 to day 10 is 2.87).

D. Magnitude of the Contemporaneous Price Impact

The correlation between flows and returns may seem large given the low proportion of flows volume relative to market volume: 6.1% (12.9%) for TA-25 (all equity) funds. However, it should be emphasized that fund flows are probably correlated with other individual investor flows, and it is plausible to assume that price changes are related to larger demand shocks than the mutual funds flows. Support for this assumption can be found in the high correlation between fund flows and market volume. The correlation between TA-25 (all equity) funds volume and TA-25 (all equity) market volume is 51.2% (66.8).

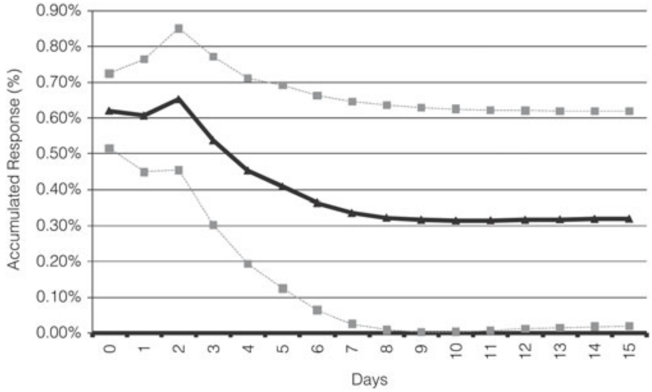
Our estimates refer to the aggregate level. It is interesting to compare them to estimates of price impacts for individual stocks. We calculate Amihud's illiquidity measure (see Amihud (2002)), which is based on daily data (division of the absolute price change by 1 million NIS volume) for TA-25 stocks. The measure indicates that 1 million NIS volume is related to a 0.22% stock price change on average (the average is value weighted, similar to the TA-25 index). Our VAR analysis (see Table 5) indicates that 1 SD of FLOWS shock is associated with a 0.62% price change. As the SD of the unexpected FLOWS in the VAR model is 7.08 million NIS, then 1 million net flow of funds is related to a price change of 0.09% (0.62%/7.08). A plausible reason for the difference between the measures (0.22% and 0.09%) is that the Amihud measure is an upward bias of the relation between volume and price. It explicitly assumes that the entire price change is

FIGURE 3

Accumulated Impulse Response Functions

Graph A. Response of RET to a 1-SD Shock in FLOWS

Graph A of Figure 3 depicts the accumulated impulse response of RET (in %) to a 1-SD shock in FLOWS. The bivariate VAR includes 4 lags of flows and returns. The contemporaneous relation between flows and returns is such that shock to flows affects the returns. Day 0 is the contemporaneous response to the shock. Confidence intervals of 95% are plotted with dashed gray lines.



Graph B. Response of RET to a 1-SD Shock in RET

Graph B depicts the accumulated impulse response of RET (in %) to a 1-SD shock in RET. The bivariate VAR includes 4 lags of flows and returns. The contemporaneous relation between flows and returns is such that shock to flows affects the returns. Day 0 is the shock itself. Confidence intervals of 95% are plotted as dashed gray lines.

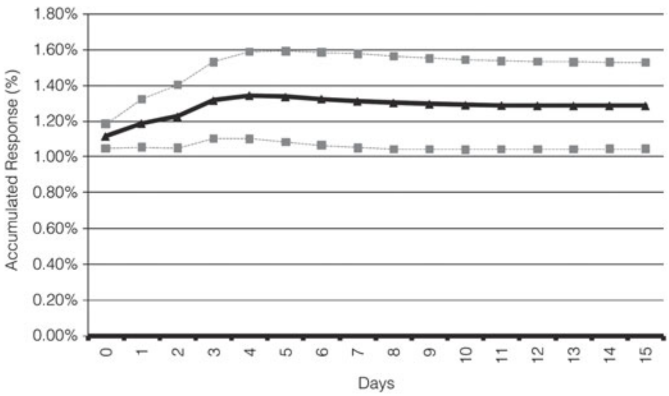


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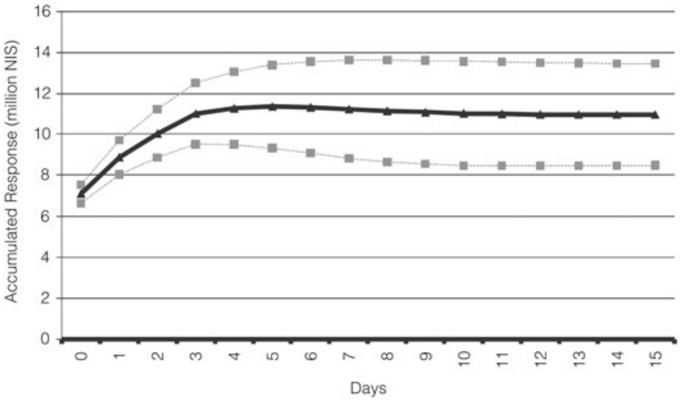
FIGURE 3 (continued)

Accumulated Impulse Response Functions

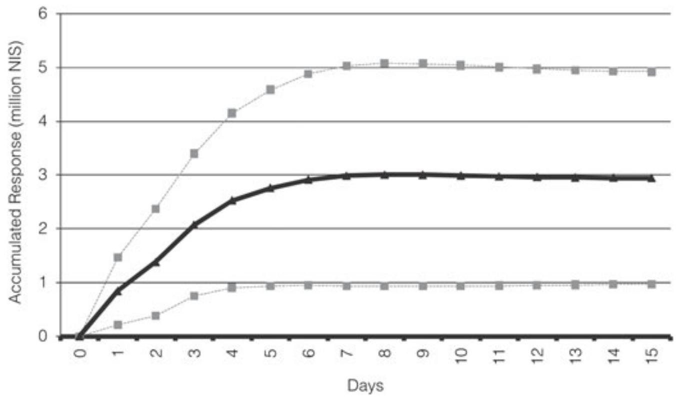
Graph C. Response of FLOWS to a 1-SD Shock in FLOWS

Graph C depicts the accumulated impulse response of FLOWS (in millions of NIS) to a 1-SD shock in FLOWS. The bivariate VAR includes 4 lags of flows and returns. The contemporaneous relation between flows and returns is such that a shock to flows affects the returns. Day 0 is the contemporaneous response to the shock. Confidence intervals of 95% are plotted with dashed gray lines.



Graph D. Response of FLOWS to a 1-SD Shock in RET

Graph D depicts the accumulated impulse response of FLOWS (in millions of NIS) to a 1-SD shock in RET. The bivariate VAR includes 4 lags of flows and returns. The contemporaneous relation between flows and returns is such that a shock to flows affects the returns. Day 0 is the contemporaneous response to the shock. Confidence intervals of 95% are plotted as dashed gray lines.



related to volume.[15] Therefore it seems that our VAR estimates are on the order of magnitude price impact of individual stocks. This is consistent with the EW (2001) finding of an impact relation similar in magnitude to the price impact of institutional trading in individual stocks.

[15]It should be noted that the purpose of the Amihud (2002) measure is to provide a simple measure of price impact for a cross-sectional analysis based on daily data; it was not designed to provide an accurate measure of price impact.

E. Unexpected Daily Flows and Intraday Returns

To shed more light on the relation between flows and returns, we follow EW (2001) and split the daily return into 2 parts: from the previous day's close to 10 AM and from 10 AM to the closing price of the same day.[16] We look at the relation between these returns and the daily flows. The cutoff point of 10 AM was chosen such that the SDs of market returns are approximately equal in both parts of the day: 0.932% and 0.978% for morning and noon/afternoon return, respectively. The correlation of morning returns with unexpected daily flows is 0.462. This correlation is roughly double the correlation of noon/afternoon returns with the unexpected daily flows: 0.228. One interpretation of this finding is support for the return chasing hypothesis: Noon/afternoon flows are affected by opening returns, and therefore morning returns have a greater correlation with daily flows than do noon/afternoon returns. One may argue that causality from flows to returns should result in a stronger correlation of flows with afternoon returns. Conversations with fund managers suggest another interpretation. Managers of fund families receive their flows almost immediately. According to fund managers, morning flows are a good predictor for all-day aggregate flows; therefore, they act almost immediately upon the information they derive from these flows. Therefore, the correlation of daily flows with morning returns is stronger than the correlation of daily flows with later returns. Examination of these explanations obviously requires intraday flows data.

F. Simple Strategy Based on Lagged Flows

To demonstrate the economic significance of the relation between flows and returns, we examine a simple trading strategy based on the flow-return relationship. Based on the results shown in Table 4, we construct an indicator for investment that is the sum of lag flows 3 and 4 ($\text{SUM\_FLOWS}_{\_34}$). Based on the negative relation between lags 3 and 4 of flows and returns, we create the following decision rule for investment in the stock market: For each day t, we look at $\text{SUM\_FLOWS}_{\_34}$ (these flows are known at period $t-1$). If the indicator is smaller than 0 (which is a natural reference point), the decision is to invest 100% in the stock market. If the indicator is higher than 0, the decision is to invest 100% at the risk-free rate (the Bank of Israel risk-free rate). Because flows information is released after 2 months and only at a monthly resolution, this strategy is notably not a trading rule.[17] Moreover the results presented below are based on in-sample analysis. Therefore they should be interpreted as a calibration of the economic magnitude of the observed in-sample correlations and not as a possible trading rule.

[16]Since we do not have intraday data of the TA-25 index, we approximate the TA-25 intraday returns by equal-weighting stock returns. The correlation between this approximated index and the TA-25 index in a daily resolution is 0.989.

[17]Fund managers know that their fund family's flows are probably positively correlated with aggregate flows. They may use this information, but their declared investment policy limits their ability to modify their positions.

The strategy results are presented in Table 6 and in Figures 4 and 5. As can be seen from Panel A of Table 6, on 257 days (48.95%) the strategy recommends investing in the market. The average stock market return (RET) for these days is 0.179% and the SD is 1.26%. On 268 days (51.05%) the strategy recommends to invest in the riskless asset. The average stock market return (RET) for these days is –0.019% and the SD is 1.30%. Thus, the average return is higher and the SD is mildly lower on days when the strategy recommends stock investing, compared to other days. The difference between the 2 series' average returns is marginally significant (p-value = 0.07).

TABLE 6

Strategy Results

Table 6 presents the results of a simple strategy based on lags 3 and 4 of the flows. If the sum of lags 3 and 4 of FLOWS (the net aggregate flows to the TA-25 equity funds) is negative, the investment decision is to invest in the stock market and obtain its return, RET (the return of the TA-25 index). If the sum is positive, the investment decision is to invest in the risk-free asset, R_f (Bank of Israel interest rate). Average and SD of RET conditional on the decision to invest in the stock market ("IN" or "OUT") are presented in Panel A. The average returns and Sharpe (1966) ratios of 4 different strategies are presented in Panel B.

Panel A. Market Return Based on Strategy Decision

Daily Market Return	IN	OUT
Number of days	257	268
Average market return	0.179%	–0.019%
SD	1.26%	1.30%

Panel B. Comparison of Different Strategies

Strategies	Mean	SD	Sharpe
(1) Constant weights of 49% in RET and 51% in R_f	0.052%	0.63%	0.040
(2) Investment of 0% or 100% in RET based on SUM_FLOWS$_{-34}$	0.101%	0.89%	0.084
(3) RET investment	0.078%	1.28%	0.040
(4) Investment of –47.5% or 147.5% in RET based on SUM_FLOWS$_{-34}$	0.135%	1.28%	0.084

FIGURE 4

Trading Strategy over Time

Figure 4 depicts the dynamics of the investment based on lags 3 and 4 of the flows. If the sum of lags 3 and 4 of FLOWS (the net aggregate flows to the TA-25 equity funds) is negative, the investment decision is to invest in the stock market and obtain its return, RET (which is the return of the TA-25 index). If the sum is positive the investment decision is to invest in the risk-free asset, R_f (Bank of Israel interest rate). Stock investing is presented with the score 1, and investment in the risk-free asset is presented by the score 0.

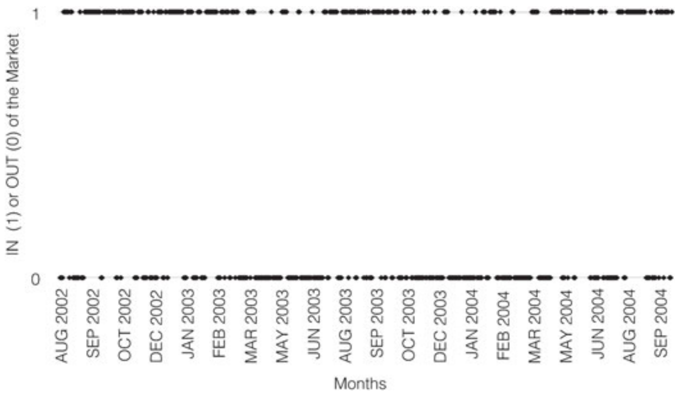


FIGURE 5

The Accumulated Return of a Trading Strategy

Figure 5 depicts the accumulated return of 2 trading strategies. Strategy (3), the thick gray line, is a simple investment in the TA-25 index (and getting its return, RET). Strategy (4) is depicted by the black line. It invests −47.5% or 147.5% in the TA-25 index (the complementary investment is the risk-free rate (the Bank of Israel rate)) based on lags 3 and 4 of the flows. If the sum of lags 3 and 4 of FLOWS (the net aggregate flows to the TA-25 equity funds) is negative, the investment decision is to invest in the stock market (and obtain its return, RET, which is the return of TA-25). If the sum is positive, the investment decision is to invest in the risk-free asset.

Figure 4 plots the strategy decisions over time. There are 129 switches in the strategy over the 525-day investment period. The average return, SD, and Sharpe (1966) ratios of 4 strategies are presented in Panel B of Table 6. Strategy (1) invests in RET and R_f at a constant ratio of 48.95% in the stock market and 51.05% in the riskless interest rate. The average return of strategy (1) is 0.052%, with a Sharpe ratio of 0.04. Strategy (2) invests according to the forecast indicator. The average return is 0.101%, with a Sharpe ratio of 0.084. We employ the Treynor-Mazuy (1966) and Henriksson-Merton (1981) timing tests for the excess return series of strategy (2). The *t*-statistics are 3.31 and 2.65, respectively. Strategy (3) invests in the stock market for the entire period: The average market return for that period is 0.078%, with a Sharpe ratio of 0.04.[18] Strategy (4) is the market risk equivalent of forecast strategy (2). In order to maintain the same risk (measured by the SD), the strategy invests 147.5% in the stock market (and borrows 47.5% at the risk-free rate) when the decision is to invest in the market. The average return is 0.135% and the Sharpe ratio is 0.084. Figure 5 depicts the accumulated return over time for market investment strategy (3) and its risk-equivalent strategy (4). The accumulated return of the market investment is 44.4%, while the risk-equivalent forecast strategy accumulated return amounts to 94.1%.

G. Interpretation of the Observed Relations between Flows and Returns

Our findings can be summarized as follows:

i) Equity fund flows are positively autocorrelated.

ii) There is a positive relation between market returns and subsequent fund flows.

[18]The difference from Table 1 is due to dropping off the first 4 days that are used for the first decision.

iii) Flows are positively correlated contemporaneously with market returns.

iv) Approximately ½ of the contemporaneous relation is reversed within 10 trading days.

The first 3 findings are additional support for the information/return chasing hypothesis. Our main contribution is clear evidence for the reversal pattern that supports the "price pressure" hypothesis. It seems that mutual fund investors not only follow returns (or positive information) but also affect stock prices. Their buying (selling) pushes prices up (down), and this effect is reversed with 10 trading days.

V. Conclusion

We use a unique database of aggregate daily flows to equity mutual funds in Israel. We find that aggregate daily flows are positively autocorrelated and positively correlated with lag returns. We find a high positive contemporaneous correlation (R^2 of 20%) between flows to market returns and demonstrate that approximately ½ of the price change is reversed within 10 trading days. Our results are consistent with the information/return chasing hypothesis that posits that flows follow information or returns. Our main finding is the clear reversal pattern that supports the temporary price pressure hypothesis, that investor flows temporarily shift prices from their fundamentals.

Ben-Rephael, Kandel, and Wohl (BKW) (2011) find that aggregate net exchanges to equity funds in the U.S., as a proxy for shifts between bond funds and equity funds, are positively contemporaneously correlated with aggregate stock market returns. Approximately 85% of the contemporaneous relation is reversed within 4 months. BKW use monthly data and therefore cannot detect short-term reversal patterns as are reported in this paper. This paper, on the other hand, uses daily data but for a short sample period of 26 months and therefore cannot detect long-term reversal patterns. Therefore this paper and BKW are complimentary. Together, these papers offer direct support for the temporary price pressure hypothesis. Moreover, the combination of the results in both papers suggests that the reversal pattern is underestimated in both papers as a result of data limitations.

The findings of this paper are related to microstructure research dealing with price impact of uniformed traders and transaction costs. Our findings suggest that a part of the price noise induced by uninformed trading does not vanish at the aggregate level, but is difficult to detect because the reversal occurs within several days and is not immediate.

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