Herding, Heterogeneity, and Momentum Trading of Institutional Investors Across Asset Classes

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Abstract: This paper examines herding, heterogeneity, and momentum trading of institutional investors in Israel across a broad variety of financial assets. While previous studies typically focus on stocks only, we examine herding patterns, heterogeneity, and momentum trading of institutional investors in five asset classes. We find that during the sample period (1/2002 – 12/2011) large investors tended to herd more than medium and small-size investors. In contrast, small investors used momentum trading patterns more than medium and large-size investors. Homogeneity was found among large investors, especially pension funds, and during the first half of the 2000s, when investors purchased corporate bonds at the expense of government bonds. This phenomenon ended upon the beginning of the subprime crisis and against the backdrop of the financial difficulties of the bond issuers. In those years, panicked investors withdrew funds from the most liquid institutions (study funds), while infusing funds to pension and provident funds due to legally binding arrangements. We attribute some of the heterogeneous trading of the institutional investors, to those factors.

Keywords: Herding, momentum trading, feedback trading, institutional investors.

1. INTRODUCTION

The Israeli stock and bond markets are characterized by an emphasized presence of institutional investors and large segments of the markets are relatively narrow and non-liquid. The extent of trading of the institutional investors is higher than that of other investors; accordingly, their influence on security prices is dominant (see Yan and Zhang, 2009; Dasgupta *et al*., 2011). If institutional investors tend to trade specific types of assets as a herd, it could impact the liquidity and/or increase the volatility of those same assets as well as the correlation of return rates with the market portfolio. The combination of these two might affect the value of securities and thus raise the cost of equity and debt capital due to an increase in risk premiums. Among the negative symptoms of herding we may enumerate: a reduced variety of investment strategies available to the private investor; reduced ability of private investors to distinguish between the performances of different investment managers; increased volatility of returns; increased correlation between returns; and the formation of trends to the point of bubbles in asset prices. The question of herding behavior and the use of momentum trading strategies among institutional investors has been studied throughout the world especially with regard to stocks and found to be significant in a number of countries and during specific periods. In contrast, little is known about the manner in which institutional investors are trading in various asset markets. This study is the first to examine the existence of herding and momentum trading among institutional investor portfolios in Israel and the characteristics of their buys and sells in the majority of asset types; this through the use of a unique and comprehensive data base. More particularly, our study examines the phenomenon of herding and momentum trading among institutional investors in the Israeli market across a broad diversity of financial assets and investment types. Our contribution to the empirical literature dealing with institutional investors' herding is therefore, twofold:

1. We analyze trading data of all institutional investors in the economy (with the exception of insurance companies) rather than merely a sample of investors. This is an important advantage that is made possible through the use of a unique data base at our disposal. This unique dataset is founded on actual buying and selling flows at the investor level. This is in contrast to numerous other studies in this area in which trading flows are derived from balance differences net of price effects.

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2. The majority of studies on institutional investors' herding have focused on investment in particular stocks. In contrast, we examine the trading of institutional investors in various asset types: bank deposits, short-term and long-term government bonds, corporate bonds, and stocks. Moreover, we examine all assets held by an institutional investor within an asset type using a heterogeneity (feedback) measures. These measures are based on the degree to which a group of investors (in our case, a given type of institutional investor), are on the same side of the market: the buy side or the sell side. One of the measures is based on the amount of money traded. Such an examination is of greater importance to regulators and policy makers as it recognizes herding from one asset type into another.

The rest of the paper is organized as follows: Section 2 surveys the literature on herding, heterogeneity, and momentum trading; Section 3 presents the tests for herding, heterogeneity, and momentum trading used in our study; Section 4 describes the data; Section 5 analyzes the data and presents the results and Section 6 concludes.

2. LITERATURE SURVEY

When herding exists in the market, it usually occurs among a group of investors with a degree of homogeneity between them (e.g., knowledge and specialization profile), and who possess access to information concerning the activity of the remainder of the group's members. Since the group's members generally have no access to information concerning the specific investments of other members, herding usually exists within the context of investment in a type, or group of financial assets. Indeed, most of the research explores institutional investors' herding in the stock market, or sectors within the stock market, like stocks of a specific industry or stocks of a particular technology.[1]

When investors make investment decisions in the trail of decisions of other investors and contrary to actions they would take based on their own information signals, it is liable to cause an 'information cascade'. This is a process in which an investment decision maker, in the early stage of the process, greatly influences the direction of the information cascade (increase or decrease in the price of the financial asset). The information that causes herding in a cascade is likely to be wrong. At a certain stage, usually following new information that arrives to investors they tend to make a reverse investment decision (buying instead of selling, or vice versa), thus generating an information cascade in the opposite direction. Such processes increase volatility of financial asset prices.[2] In addition to herding, it is interesting to learn about the trading style institutional investors follow. One of the popular investment patterns is momentum trading. Investors who use such a style are positively influenced by previous market returns and are also called 'trend chasers' as they follow the popular phrase: 'make the trend your friend'. However, from the viewpoint of policymakers and regulators, momentum trading and homogenous behavior of institutional investors may destabilize the market.

A pioneering study of Lakonishok, Shleifer, and Vishny (1992) (hereafter LSV) introduced one of the popular measures for herding which is based on the transactions of a homogenous group of investors over a defined time period. LSV examined the behavior of 769 tax-exempt, stock-based funds (the majority of which were pension funds) managed by 341 different investment managers over the period 1985-1989. The measure was based on purchases and sales of specific stocks. After analyzing the panel data, LSV concluded that no data was found that significantly indicated herding. Still, a certain amount of herding behavior was found in the stocks of smaller companies. LSV explained this by suggesting that information on the stocks of small companies was relatively sparse; therefore investment managers rely, to a large extent, more on the decisions of other investment managers when purchasing or selling those stocks. Grinblatt, Titman, and Wermers (1995) (hereinafter GTW) employed the LSV measure and analyzed the investments of 274 mutual funds from 1974 to 1984. This study also based itself on the purchase and sale of specific stocks, and it did not find significant herding

[1]Few studies examine herding in other markets such as the FX market (see McAleer and Radalj, 2013) or bank loans (Uchida and Nakagawa, 2007). However, to the best of our knowledge this study is the first to explore herding and momentum trading among institutional investors across various asset types.

[2]We should clarify that the analyses we performed in this study are not intended to investigate whether herding behavior is rational or not (see a discussion in McAleer and Radalj, 2013). Rather, we focus on identifying herding behavior itself either rational or irrational. Additionally, this study is not meant to look into the question of the influence of herding behavior on different asset prices.

patterns. The average value of the herding index in the GTW study was 2.5, meaning that on average, there were 2.5 percent more investment managers who 'sided' with the market (buying side or selling side) as compared to a situation in which investment managers rely on nothing but their own decisions. This finding is similar to that found by LSV, i.e., 2.7 percent. However, GTW found a larger degree of herding in the purchase of stocks whose price rose in the past as compared with herding in the selling of stocks whose price fell in the past. The LSV measure also served Wermers (1999) in his study of quarterly data on mutual funds from 1975 to 1994. He arrived at the conclusion that there was a certain degree of herding in the behavior of the funds, with the LSV's herding measure at average of 3.4 percent. This average was to a certain extent higher and more significant than the average from the LSV and GTW samples, perhaps as a result of there being more herding among mutual funds as compared with pension funds, which were the subject of the LSV study. Uchida and Nakagawa (2007) (hereafter UN) inspected herding behavior in the bank loan market in Japan. The study attempted to examine whether herding behavior of banks can also be explained based on rational behavior with the use of the LSV measure. They found significant herding towards the end of the 1970s and the 1980s. In contrast, they did not find herding in the first half of the 1980s and at the end of the 1990s. UN found mean LSV measures ranging from almost zero to 14.3 percent across the sample years. Recently, Venezia, Nashikkar, and Shapira (2011) (hereafter VNS) examined the micro and macro aspects of herding among private investors and professional investors (portfolio managers) in Israel during the period 1994 to 1997. Using LSV measure on a database of almost 10,000 investors of which one fourth are professionals, they found an average LSV measure of 3.4 percent for professional investors versus 6.4 percent among small naïve investors.

The popular LSV measure has two conspicuous disadvantages (see Bikhchandani and Sharma, 2000): Firstly, it relies only on the number of investors who buy and the number of investors who sell a specific stock, irrespective of the scale of the transactions. Secondly, although it makes it possible to examine whether herding in the previous period influences herding in the current period, it does not make it possible to check whether it is the same investors who are continuing the herding behavior. The index is also sensitive to the choice of category and the length of the period. If investment managers are not exposed to information concerning the make-up of the competition's investment portfolios at the single stock level, herding at the single stock level will certainly not exist since the investment manager cannot copy actions that he or she are not exposed to. As to the length of the period, it needs to match the average interval between transactions in the financial asset. If the average time interval is, say, a month, quarterly data might not identify herding behavior due to a mismatch between the frequency of transactions and the length of the period. Since the trading in the stock of large companies is apparently more frequent than that of small companies, it is reasonable to assume that the desirable period for checking herding on large-company stock is shorter than the desired period for checking herding on small-company stock. Despite its disadvantages, the LSV measure is quite popular and fits our focus in this study since we can compare our results calculated on various asset types with those obtained in previous studies on a particular asset type e.g., stocks.

Another issue discussed in the literature is whether institutional investors are momentum or contrarians traders? GTW examined whether a mutual fund tends to act with the trend or against it. They found that the performance of a mutual fund positively correlates to the fund's tendency towards herding, however this springs from the fund's tendency to increase its investment in stocks with good past performance ("winners"), i.e., following a momentum trading policy. Yet, the correlation between herding and performance disappeared after subtracting the tendency to purchase stocks whose past performance was good. Yan and Zhang (2009) found that short-term institutional investors (active traders) are better informed and tend to be more momentum traders than long-term institutional investors. The latter is in contrast with Gompers and Metrick (2001) whose conclusion was that institutional investors are not momentum traders. Badrinath and Wahal (2002) (hereafter BW) found that institutional investors act as momentum traders when they enter stocks but act as contrarian traders when they exit or make adjustments to ongoing holdings. Finally, Choi *et al*. (2012) found that the behavior of institutional investors vary depending on whether the market is in uptrend or downtrend.

In summary, herding activity among institutional investors is common during specific periods, among specific assets, and among a portion of investors characterized by relative homogeneity. Such an activity which is characterized by herding, homogeneity and

momentum trading, may increase the price volatility of assets affected by herding activity and is liable to increase the volatility of other assets due to contagion. Accordingly, identifying and monitoring institutional investors who may act as a herd is of importance for regulators, policy makers, and savers. In the following section we describe the measures employed to examine the existence of herding, heterogeneity, and momentum trading.

3. HERDING, HETEROGENEITY, AND MOMENTUM TRADING MEASURES

We employ two measures based on LSV to examine the existence of herding and heterogeneity (called feedback strategy by LSV) and another measure for momentum trading by BW.

The LSV measure for herding is based on the number of investment managers who were net buyers in asset *i* during period *t*. This is a proper measure of herding since it counts the number of managers trading at the same time. It is defined as follows:

$$LSV_{it} = |P_{it} - P_t| - E|P_{it} - P_t| \quad (1)$$

where, $P_{it} = X_{it}/N_{it}$ is the proportion of investors who (net) purchased asset *i* in period *t*, X_{it} is the number of Net buyers of asset *i* in period *t* and N_{it} is the number of active investors in period *t*. P_t is the expected proportion of net buyers of asset *i* in period *t* and is calculated as the mean of all P_{it}s. The subtraction of the expected value of $|P_{it} - P_t|$ is meant to standardize LSV_{it} to 0 under the null hypothesis of lack of herding. When the number of all investors is large, $E|P_{it} - P_t|$ is close to zero; however, in periods where the number of investors is small, $E|P_{it} - P_t|$ is not necessarily close to zero, but is generally positive. Values of LSV_{it} that are significantly larger than zero are indicative of herding. Since the empirical distribution of this expression is not known *ex ante*, we calculate the expression based on VNS. Significance testing is done under the assumption of binomial distribution of X_{it} with the "success" parameter, P_t.

In contrast to the measure of herding, the measure of heterogeneity is based on the monetary value of purchase and sale quantities in asset type *i*, in period *t*. This measure accounts for the potential price impact of the coordinated trades.

$$HET_{it} = \frac{buy_{it} - sell_{it}}{buy_{it} + sell_{it}} \quad (2)$$

Where buy_{it} indicates the total buying amounts of asset *i* during period *t* by the investors in the tested group and $sell_{it}$ indicates the total selling amounts. When the HET_{it} index is close to 0, it reflects heterogeneous behavior (lack of feedback), while HET_{it} index close to +1 or -1 reflects homogenous behavior: positive feedback if +1, or negative feedback if -1.[3] Notice that HET_{it} is different from the herding measure of equation (1) in three aspects: it is a cross sectional measure; it is influenced by quantities rather than number of buy/sell investors; and it does not take into consideration active investors whose net buy/sell activity is zero.

We follow BW and calculate a similar momentum trading measure as follow:

$$MTM(k,l)_{jt} = \sum_{i=1}^{n} W_{ijt} dF_{ijt} dI_{it-k} \quad (3)$$

Where, W_{ijt} is the weight of asset *i* in time *t* in the investor *j*'s total portfolio consisting of the n = 5 asset categories (deposits, Makam (Israeli T-bills), government bonds, corporate bonds, and stocks), dF_{ijt} is the change rate of the flows invested in asset *i* in time *t* (flows divided by total portfolio), and dI_{it-k} is the index's rate of return of asset type *i* in period *t-k*. We use deposit rates (up to a year) as the index for deposits, one year Makam yield as an index for Makam, 5 to 10 years government bond yield as the index for government bonds, general corporate bond index as an index for corporate bonds, and TA100 stock index for stocks. The duration of the momentum (the trend) is determined by *k* {*k* = 0,1,2,3,6 month} and following BW we let *l*=1, where *l* indicates the time frame over which the portfolio weight changes are measured. Positive significant *MTM(k, l)* reflects momentum trading while negative significant *MTM(k, l)* reflects a contrarian behavior.

4. DATA DESCRIPTION: KEY TRENDS IN INSTITUTIONAL FUND MANAGEMENT

This section describes the Israeli institutional market during the sample period of 1/2002 – 12/2011. As of the end of 2011, institutional investors (with the exception of insurance companies, for which the data was incomplete) managed approximately $207 billion[4]

[3]Like LSV we also calculated another heterogeneity measure, using the number of investors who buy and sell asset *i* rather than the quantities. As the results were similar to those accepted in this study, we do not present them.

[4]The average exchange rate during the period of the local currency, Israeli Shekel, to the US Dollar was about 3.5.

of which some $124 billion were managed by pension funds and approximately $84 billion managed by provident funds and study funds[5]. At the beginning of the sample period, the total amount managed by these institutions was approximately $80 billion; so during the sample period, the managed portfolio of these institutions increased by a factor of 2.6, an average annual increase of about 10%. The increase among the institutions was highly diverse; while the sum managed by pension funds grew almost fourfold, the portfolio of provident funds and study funds grew by a factor of only 1.7. Consequently, there were different average annual growth rates in comparing between the types of institutional investors: While the average annual growth rate of assets in the pension funds was approximately 15%, the growth rate for provident funds and study funds was only 6%. Possible reasons for the difference in the rate of asset increases are the result of continuing legislation throughout the sample period and the subprime crisis that caused provident and study funds to be less attractive.

After excluding from the sample the institutions that did not have a complete dataset,[6] the sample of institutional investors comprised of 227 investors that were active throughout the period. All of the investors, regardless of their institutional attribution, were divided into three sized-based groups: (1) large institutional institutions – whose average total of managed assets during the sampled period was higher than NIS 1 billion; (2) medium-sized institutions – whose average total of managed assets during the sampled period was above NIS 200 million and up to NIS 1 billion; and (3) small institutional institutions – whose average total of managed assets during the sampled period was NIS 200 million or less. These were divided into eight categories, according to their attribution to the following groups: (1) provident funds – large; (2) provident funds – medium; (3) provident funds – small; (4) study funds – large; (5) study funds – medium; (6) study funds – small; (7) pension funds – large; (8) pension funds – small. [7] Israeli provident funds are saving institutions with substantial tax benefits if savings are not withdrawn before the age of 60. Study funds are similar but withdrawals are allowed for certain purposes, mainly educational, during the saving period. Pension funds are savings institution for retirement income. Their liabilities are life annuities that start at the plan participant's retirement.

4.1. Descriptive Statistics

Table **1** details the average monthly percentage change (net buying/selling for the current month divided by the closing balance/position of the previous month) in fund's holdings in the main asset types, and the standard deviation of these percentage changes. The table is sorted by institutional investor type, with a secondary sort by size, and across asset classes. The number of investors of each type is presented in the rightmost column of the table.

The data demonstrate that investor size is inversely related to the percentage change in flows.

The percentage change in flows of the small investors is higher than that of the medium sized investors, which in turn is higher than that of the large investors. Additionally, the variability of percentage changes is also negatively related to size, something that seemingly reveals flexibility on the part of small investors in changing their asset allocation (relatively frequent buys and sells) as compared to medium sized and large investors. The latter two do not make frequent changes in their holdings, among other things probably due to adverse price impact. Supporting evidence for differences in investment flexibility between large and small investors is obtained from the serial correlation coefficient found to be significant among the large investors and close to zero and non-significant among the small investors. However, it should be remembered that intensive trading activity is expressed by relatively high management costs, both in direct trading costs and costs due to intensive decision-making. Across asset types, the proportional change in holdings of corporate bonds is highest in relation to the other asset types, apparently in light of the increased popularity of this investment channel in the beginning of the new century. The sharp decline in the attractiveness of corporate bonds following the real-estate crisis and the subsequent subprime crisis during 2007-2009 further increased turnover in this asset type. Panel 5 of Table **1** shows that, in an aggregate calculation, the large investors reduced their holdings during the sample period in deposits and government

[5]Provident funds and study funds provide tax incentives to the individual saver, provided they are locked-in for a mandatory number of years. Both types are generally similar but Study funds savings are allowed to be liquidated more frequently than provident funds savings, thus they are somewhat more short-term oriented.

[6]We excluded from the sample the insurance companies due to incomplete transaction data; a subset of 'old', defined-benefit pension funds, whose asset holdings substantially differ from the remainder of the institutions; and lastly, we excluded those institutions that did not survive throughout the entire sample period, or whose reporting was incomplete.

[7]Provident funds include also compensation components. Pension funds have only two defined sizes: large funds – more than NIS 5 billion, and small funds – NIS 5 billion or less.

Table 1: Summary Statistics of the Flow Rates (%) Among Institutional Investors

Investor/Asset type	Total	Makam (T-bill)	Deposits	Gvmt. bonds	Corp. bonds	Stocks	Auto Correl.	# of investors
(1) All investors								
Mean	0.73	0.05	0.09	0.09	0.24	0.04	0.26**	227
St. Dev.	12.35	2.54	9.78	4.60	2.69	1.51		
(2) Provident funds								
All								
Mean	0.68	0.05	0.09	0.11	0.21	0.02	0.24**	143
St. Dev.	14.41	2.69	11.32	5.26	3.10	1.62		
Large								
Mean	-0.06	0.01	-0.15	-0.19	0.08	-0.03	0.44**	26
St. Dev.	3.21	0.89	1.80	2.31	1.40	1.12		
Medium								
Mean	0.26	0.03	-0.09	-0.03	0.14	-0.01	0.45**	53
St. Dev.	3.80	2.31	3.14	2.93	1.52	1.05		
Small								
Mean	1.33	0.09	0.32	0.35	0.31	0.07	0.06	64
St. Dev.	21.15	3.39	16.65	7.24	4.33	2.11		
(3) Study funds								
All								
Mean	0.96	0.05	0.08	0.17	0.31	0.08	0.16	61
St. Dev.	8.54	2.56	6.89	3.63	2.01	1.34		
Large								
Mean	0.37	0.02	-0.11	-0.08	0.20	0.03	0.43**	20
St. Dev.	2.31	0.91	2.05	1.76	1.37	0.91		
Medium								
Mean	0.69	0.03	0.04	0.08	0.22	0.08	0.39**	20
St. Dev.	6.66	1.31	5.01	3.04	1.92	1.56		
Small								
Mean	1.77	0.11	0.29	0.51	0.51	0.12	-0.01	21
St. Dev.	12.79	4.08	10.48	5.14	2.53	1.46		
(4) Pension funds								
All								
Mean	0.41	0.02	0.14	-0.24	0.25	0.07	-0.15	23
St. Dev.	4.38	0.97	4.47	1.48	0.85	1.14		
Large								
Mean	0.32	0.03	0.03	-0.26	0.19	0.08	-0.27**	8
St. Dev.	2.46	1.35	2.12	1.35	0.52	0.51		
Small								
Mean	0.45	0.01	0.19	-0.22	0.29	0.06	-0.02	15
St. Dev.	5.12	0.69	5.33	1.54	0.98	1.36		
(5) All investors by size								
Large								
Mean	0.16	0.02	-0.11	-0.16	0.14	0.01	0.46**	54
St. Dev.	2.80	0.98	1.95	2.00	1.30	0.97		
Medium								
Mean	0.38	0.03	-0.05	0.00	0.16	0.02	0.48**	73
St. Dev.	4.76	2.09	3.74	2.96	1.64	1.21		
Small								
Mean	1.29	0.08	0.30	0.30	0.35	0.08	0.04	100
St. Dev.	18.03	3.30	14.31	6.29	3.67	1.89		

Total portfolios include also cash and holding in both ETFs and mutual funds (not presented here). The sample period is 1/2002 - 12/2011 and percentage changes in flows were calculated as monthly net flows over the position in previous month. Institutional investors are classified by type (provident funds, study funds and pension funds) and by size (large, medium, and small). Auto correlation coefficients were calculated using one-month lag. ** denotes a significance level of 0.99 or more.

bonds, while the small investors, across all types of institutions, increased their holdings in these assets. Note however, that during a considerable portion of the period, between 2003 and 2006, the supply of

Table 2: Investment Portfolio Composition (% of Total Portfolio), by Type of Investor and Size Categories

Investor/Asset type	Cash	Makam (T-bill)	Deposits	Gvmt. bonds	Corp. bonds	Stocks	Other	# of investors
(1) All investors								
Mean	2.2	2.7	11.8	38.5	26.8	13.4	4.6	227
St. Dev.	4.28	7.43	11.00	22.10	14.75	10.54		
(2) Provident funds								
All								
Mean	2.4	3.1	11.7	38.5	26.8	13.1	4.5	143
St. Dev.	4.31	8.77	11.05	22.50	14.63	10.87		
Large								
Mean	2.9	4.6	11.6	35.3	25.6	15.3	4.8	26
St. Dev.	4.75	14.12	12.99	22.99	15.16	14.74		
Medium								
Mean	1.8	1.9	13.1	40.7	25.4	12.6	4.4	53
St. Dev.	3.81	3.21	10.05	21.41	13.16	9.31		
Small								
Mean	2.7	3.5	10.5	37.9	28.3	12.7	4.5	64
St. Dev.	4.45	8.95	10.84	22.98	15.40	10.09		
(3) Study funds								
All								
Mean	1.7	1.9	12.4	40.1	25.8	13.3	4.8	61
St. Dev.	4.45	4.33	11.42	22.31	15.34	10.58		
Large								
Mean	1.5	2.1	11.8	41.9	25.6	12.6	4.6	20
St. Dev.	2.84	6.02	11.58	23.07	14.79	7.13		
Medium								
Mean	1.6	1.5	13.0	45.7	22.4	11.9	4.0	20
St. Dev.	2.70	2.59	10.73	24.19	13.38	7.94		
Small								
Mean	2.1	2.0	12.5	33.2	29.3	15.3	5.7	21
St. Dev.	6.54	3.66	11.88	17.37	16.79	14.51		
(4) Pension funds								
All								
Mean	2.2	2.5	11.2	34.7	29.4	14.9	4.9	23
St. Dev.	3.46	3.74	9.36	18.25	13.46	7.92		
Large								
Mean	2.4	2.9	9.5	33.5	33.1	14.4	4.3	8
St. Dev.	3.09	4.18	9.18	15.89	13.29	9.13		
Small								
Mean	2.1	2.3	12.2	35.4	27.5	15.2	5.2	15
St. Dev.	3.64	3.47	9.33	19.37	13.15	7.17		
(5) All investors by size								
Large								
Mean	2.3	3.4	11.3	37.4	26.7	14.2	4.7	54
St. Dev.	3.96	10.65	12.00	22.37	15.00	11.72		
Medium								
Mean	1.7	1.8	13.1	42.1	24.6	12.4	4.3	73
St. Dev.	3.54	3.06	10.24	22.32	13.29	8.96		
Small								
Mean	2.5	3.0	11.2	36.5	28.4	13.6	4.9	100
St. Dev.	4.87	7.51	10.90	21.47	15.40	10.89		

This table presents a decomposition of total portfolio balances (positions). The institutional investors were classified by type (provident funds, study funds and pension funds) and by size (large, medium, and small). The sample period is 1/2002 - 12/2011. 'Other' contains holdings in both ETFs and mutual funds.

government bonds remained relatively fixed while supply of corporate bonds increased rapidly. In addition, one may see that small investors purchased corporate bonds at a rate more than double than the rate among the medium sized and large investors. These findings seemingly reveal the tendency of the

small investors to be exposed to higher risk, whether in order to produce higher returns, thus attracting investors and thereby growing, or as an expression of the greater flexibility of the small institutional investors when rebalancing their portfolios.

Table **2** presents asset allocation by investor types. One may see that the main weight of the holding of government bonds was 38.5%, followed by corporate bonds at 26.8%, stocks at 13.4%, and deposits at 11.8%. It is interesting to note that the medium sized provident funds and the study funds held a higher proportion of their assets in government bonds as compared with the small and large sized funds. The small pension funds held 27.5% of their assets in corporate bonds while the rate of holdings among the large pension funds was 33.1%. This might attest to a preference for high risk premium while relying on reduced risk based on diversification, although an additional relevant factor is the lack of liquidity in this market. Additionally, it is worth pointing out that while the large provident funds have the highest holding rate of stocks from among the provident funds, among the study funds, it is actually the small ones that were more exposed to stocks as compared with the medium and large sized study funds.

5. INVESTMENT PATTERNS AMONG INSTITUTIONAL INVESTORS

Figures **1A-1C** below are based on heterogeneity measures depicted in equation (2). These heterogeneity measures are cross sectional but they are quite volatile across the sample period. The measures for each asset type range between +1 and -1. A zero value is obtained under full heterogeneity. A value approaching +1 indicates homogeneity in buying, while a value near -1 indicates homogeneity in selling. The figures indeed indicate significant homogeneity in specific periods among a number of types of institutional investors. In general, no significant homogeneity was discerned for deposits and Makam (not shown in the figures). In contrast, government bonds reflect to some extent a mirror image to that of corporate bonds during the first part of the sample period. This mirror image reflects the transition that occurred during the first half of the 2000s, from safe assets (particularly government bonds, but also deposits) to risky assets (particularly corporate bonds, but also stocks). With the outbreak of the subprime crisis, the trend for homogeneity turned to heterogeneity for all asset types except for corporate bonds, which were sold by the majority of institutional investors; this, against the backdrop of the difficult financial situations of a portion of bond issuers. In this context, we should mention the large pension funds, which acted especially homogeneously in 2011 and in an opposite direction to the other institutional investor types, and purchased corporate bonds. One explanation for this unique behavior is that pension funds accumulate funds periodically through depositors' automatic deductions from monthly salary.

This generates a highly significant autocorrelation, and persistence in funds' investment patterns, which the heterogeneity indicator depicts. Interestingly, study-funds exhibited highly positive heterogeneity measures before the crisis and highly negative measures after the crisis, until 2011. This pattern can be explained by the higher liquidity of these saving channels, since by local regulations, much of these funds can be withdrawn tax free, while provident and pension funds are far-less liquid. Because of the crisis, individuals preferred cash, and the most accessible vehicle was indeed study funds. Finally, throughout the entire period pension funds homogeneously purchased stocks, often regardless of market conditions, while large provident funds sold stocks during the second half of the sample period.

The herding index (Figure **2**) is based on LSV and equation (1). An index value significantly different from zero indicates herding among the different investors that are included in a specific group category for all asset types. In comparison to the original LSV index, we refer, similarly to UN, to five asset types – short-term bonds, deposits, government bonds, corporate bonds, and stocks - as those researchers referred to different loan categories.

The figure presents a different development in this index, both among the groups and over the years. The herding average is different from group to group: on one hand, the average LSV index for the large pension funds throughout the period stood at 11.1% (the average number of net purchasers among the large pension funds was higher than the number of sellers by 11.1%), while on the other hand, the index for small study funds was 3.04%. We should mention that all of the indexes were found to be significant according the t-test, which assumes independence among the observations (month – asset type) at a significance level of 0.99. Generally, there is no significant change in the herding hierarchy for the different groups over time. Thus, for example, the pension funds were the most herd-like through the entire period while the small

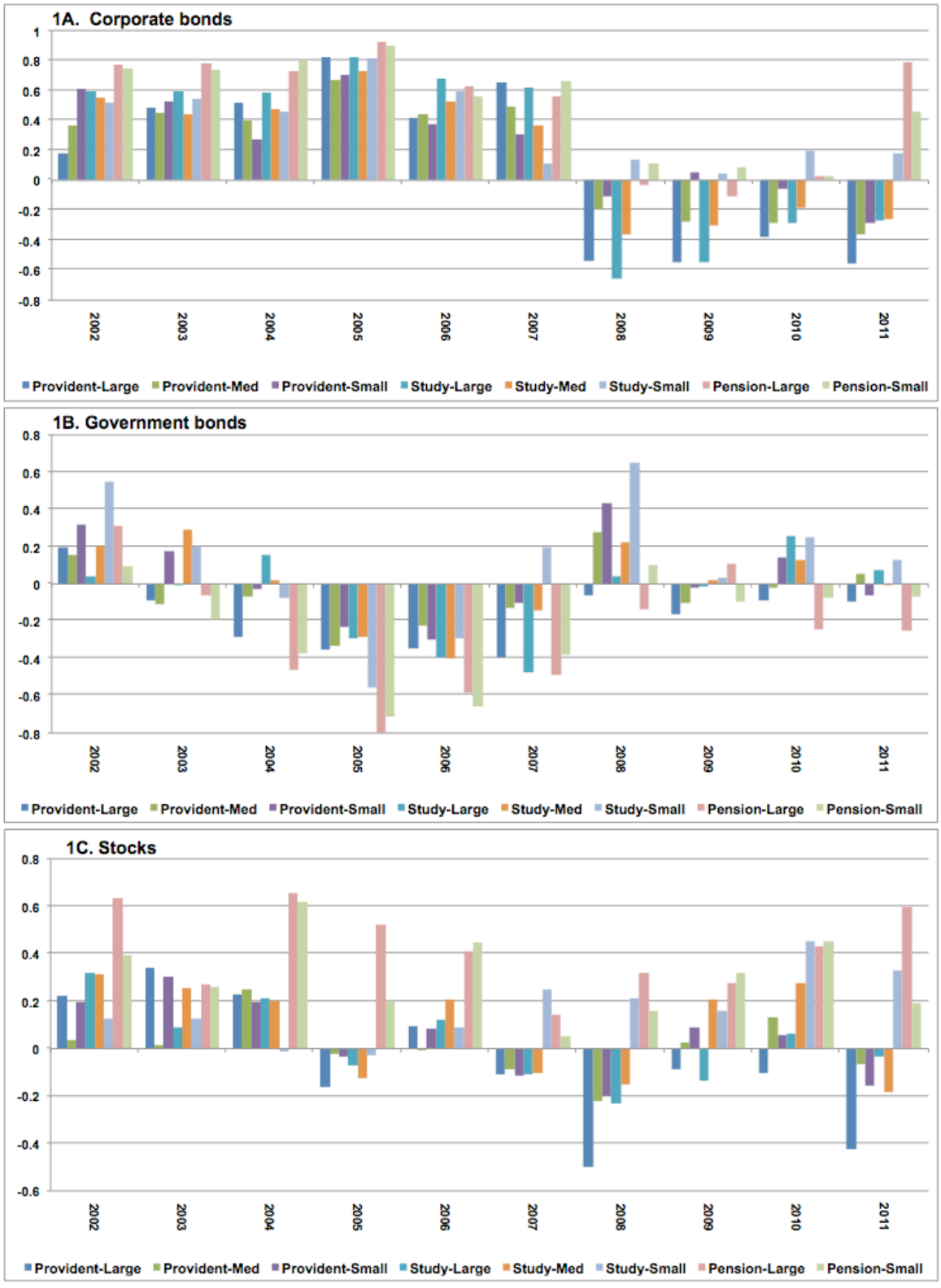

Figure 1: Heterogeneity measure of eight institutional investor groups and three asset classes, 2002 to 2011.

The figure presents the cross-sectional heterogeneity measures for the period 2002 to 2011 as depicted by equation (2): $HET_{it} = (buy_{it} - sell_{it}) / (buy_{it} + sell_{it})$. The measure ranges from +1 to -1. A zero value indicates full heterogeneity; +1 indicates extreme homogeneity in buying; -1 indicates extreme homogeneity in selling. The measure is presented for eight institutional investor groups as detailed in the legend and three asset classes (one in each panel): corporate bonds, government bonds and stocks.

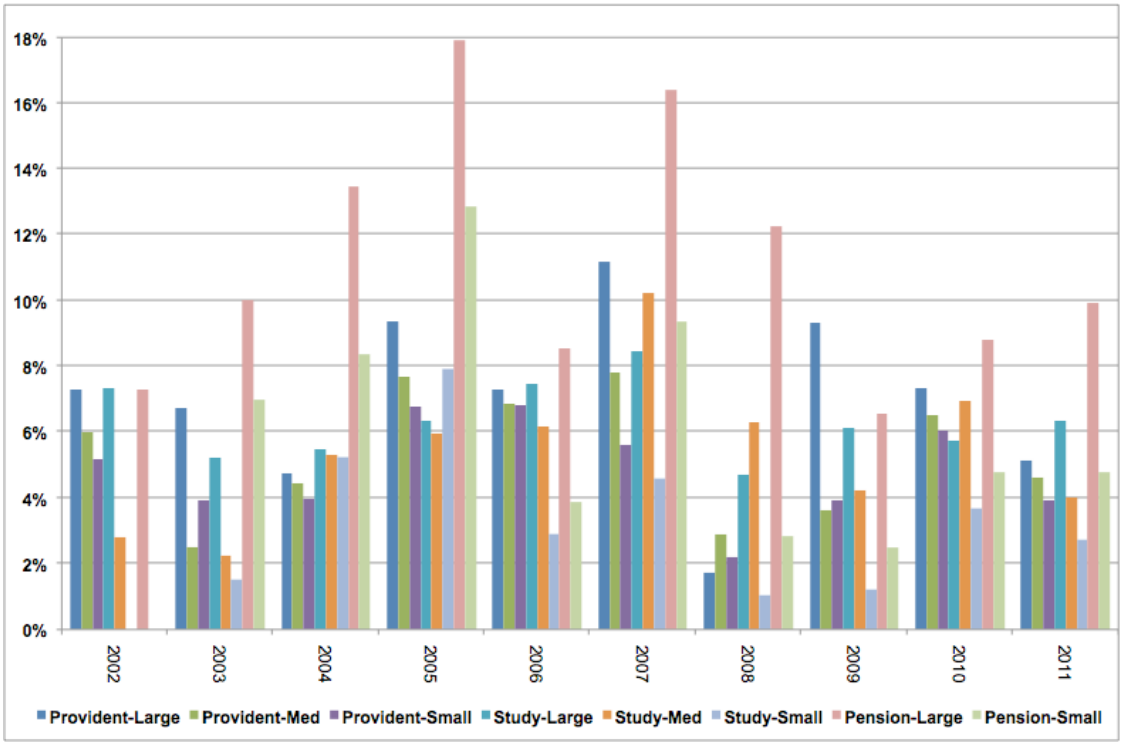

Figure 2: Herding index of eight institutional investors for the period 2002 to 2011.

The herding index is based on LSV and equation (1): $LSV_{it} = |P_{it} - P_t| - E|P_{it} - P_t|$. An index value significantly different from zero indicates herding among investors that are included in a specific group category for all asset types.

study funds were the least herd-like. As explained above, this result is probably due to the persistency of inflows to pension funds on one hand, and to the liquidity of study-funds on the other hand. Moreover, herding diminishes with size in each group. For example, the LSV index for the large, medium sized and small provident funds for the entire period stood at 7.01, 5.28, and 4.82 percent, respectively. Other studies that examined herding found an LSV index ranging between an average of 2.7 percent (Lakonishok *et al.,* 1992) and 3.4 (Wermers, 1999) percent, while in Israel, among professional investors, the average stood at 5.8 percent, and among more naïve investors at 6.4 percent (Venezia *et al.,* 2011). Additionally, Uchida and Nakagawa (2007) found much higher herding levels among the loan portfolios of Japanese banks in specific periods, similarly to this study.

The average herding of the groups is conspicuous in 2005 and 2007 (the index average stood at 9.35 and 9.20 percent, respectively) while in 2002 and 2008, the herding level dropped to a minimum (4.28 and 4.24 percent, respectively). In 2005 and 2007, the large pension funds stood out in their herding levels (index of 18 and 16 percent, respectively), and indeed, after neutralizing the large pension funds, LSV indexes over the years are more similar to each other.

The last measure we use in this study is momentum trading measures (MTM) (equation 3). Table **3** presents the *MTM(k, l)* for each investor category, $k = \{0,1,2,3,6\}$ and $l = 1$.

It can be seen from the table that both size and the duration of the trend (k) matter. For instance, the means MTM of small investors (panel 5) are the largest regardless of k while the means MTM of large investors are the smallest. Additionally, the former are significant in all cases of k while the latter are significant for $k > 0$ only. Usually, the MTM of all size and $k > 0$ are significant and skewed as the means are greater than the medians. In contrast, $k = 1$ or $k = 2$ pertain the largest MTM. Thus, institutional investors in order to maximize profits should examine trends that have a duration of one to two month lags before they chase the trend (buy or sell assets in their portfolios). Finally, the results confirm the view that institutional investors in Israel behave like trend chasers thus, destabilize asset prices.

6. SUMMARY

Herding, heterogeneity, and momentum trading of institutional investors have substantial consequences on capital markets and asset prices. This study examines the behavior of Israeli institutional investors

Table 3: Momentum Trading Measures of the Institutional Investors (Basis Points)

	MTM(0,1)	MTM(1,1)	MTM(2,1)	MTM(3,1)	MTM(6,1)
(1) All investors					
Mean	0.21**	0.23**	0.21**	0.19**	0.15**
Median	0.12++	0.11++	0.12++	0.09++	0.10++
(2) Provident funds					
All					
Mean	0.22**	0.24**	0.23**	0.21**	0.15**
Median	0.12++	0.10++	0.12++	0.09++	0.09++
Large					
Mean	0.060	0.19**	0.16**	0.15**	0.10**
Median	0.023	0.05++	0.04+	0.04+	0.06++
Medium					
Mean	0.14**	0.15**	0.14**	0.14**	0.11**
Median	0.05++	0.06++	0.08++	0.06++	0.05++
Small					
Mean	0.36**	0.35**	0.34**	0.30**	0.21**
Median	0.16++	0.16++	0.16++	0.14++	0.12++
(3) Study funds					
All					
Mean	0.23**	0.23**	0.21**	0.20**	0.17**
Median	0.12++	0.13++	0.13++	0.11++	0.12++
Large					
Mean	0.059	0.095	0.092	0.10**	0.09**
Median	0.011	0.07++	0.03+	0.05++	0.07++
Medium					
Mean	0.22**	0.21**	0.19**	0.15**	0.11**
Median	0.11++	0.09++	0.10++	0.08++	0.07++
Small					
Mean	0.36**	0.35**	0.32**	0.29**	0.28**
Median	0.18++	0.18++	0.17++	0.15++	0.13++
(4) Pension funds					
All					
Mean	0.039	0.10**	0.10**	0.09**	0.08**
Median	0.04++	0.06++	0.07++	0.05++	0.06++
Large					
Mean	0.035	0.08**	0.08**	0.07**	0.06**
Median	0.05++	0.06++	0.06++	0.05++	0.03++
Small					
Mean	0.040	0.12**	0.12**	0.10**	0.09**
Median	0.02+	0.08++	0.07++	0.07++	0.05++
(5) All investors by size					
Large					
Mean	0.007	0.21**	0.08**	0.06**	0.04**
Median	0.013	0.20++	0.05++	0.03+	0.03++
Medium					
Mean	0.16**	0.17**	0.16**	0.14**	0.11**
Median	0.08++	0.09++	0.10++	0.08++	0.07++
Small					
Mean	0.32**	0.31**	0.30**	0.27**	0.21**
Median	0.15++	0.15++	0.15++	0.13++	0.12++

This table presents momentum trading measures (*MTM*) of the institutional investors. The measures are based on Badrinath and Wahal (2002) as follows: $MTM(k,l)_{jt} = \sum_{t=1}^{n} W_{ijt} dF_{ijt} dI_{it-k}$ where, W_{ijt} is the weight of asset *i* by investor *j* in time *t* in the investor's total portfolio, *n* = 5 asset categories, dF_{ijt} is the change rate of the flows invested in asset *i* in time *t*, and dI_{it-k} is the asset type index's rate of return. We report *p*-values based on *t*-statistics nearby the means (assuming independent observations).

*represent a significance level of 0.95 and ** represent a significance levels of 0.99. Since the independency assumption is questionable, we report binomial tests *p*-values based on the proportion of positive median figures. The null is a probability of 0.5 to get a positive figure. + represent a significance level of 0.95 and ++ represent a significance levels of 0.99.

across a broad variety of financial assets during the period (1/2002 – 12/2011). Unlike many other studies that focus on stocks only; we examine herding patterns, heterogeneity, and momentum trading of institutional investors also in bank deposits, short-term and long-term government bonds, corporate bonds, and stocks. Using the popular LSV herding index, which we apply to each of the asset types that trade in the local market, we found a positive relation between the size of the investor and the herding level in each investor group. Additionally, in the years 2005 and 2007, the average herding of all groups was higher in comparison with 2002 and 2008, when it was lower. Large investors, especially pension funds were more homogenous in their activity than medium and small-sized investors. Moreover, large pension funds acted sometimes in the opposite direction of other investors. We explain these patterns by the stable flow of funds into pension funds on one hand, and the higher liquidity of study funds, on the other hand. Homogenous behavior among the majority of investor groups was also observed in both government and corporate bonds.

Regarding those groups, one can divide the period into two: from the beginning of the period until 2006, homogeneity was observed in purchases of corporate bonds at the expense of selling of government bonds (risk taking). This is explained by the proliferation of available corporate bonds, particularly issued by real-estate and holdings companies, as part of the real-estate bubble. From 2007, the beginning of the subprime crisis, until the end of the sample period, the picture is reversed, with the onset of homogeneity in the selling of corporate bonds due to the difficult financial situation of a portion of the bond issuers. Usually, small investors used momentum trading patterns more than medium and large-sized investors. The results point at the tendency of various institutional investors to herd homogeneously and to chase the trend in specific assets and during particular periods.

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