Do sell-side participants in the financial industry produce profitable stock selections when compensation is linked to performance?

- An evaluation of a performance based trading system in Sweden

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Abstract

Nordinvest is the first buy-side agent on the Swedish financial market that has changed the business model to the sell-side by the implementation of a trading system that bases compensation on performance. This thesis describes Nordinvest's performance based trading system and evaluates whether the system is fulfilling its objectives and if it constitutes a profitable investment alternative. To analyze the profitability of the system that is built on pairs-trading, we use three different measures of return. Regardless of how we calculate the returns, we find that the performance based trading system generates excess returns. The return measure that we choose to focus on produces an excess return of 46.63% during 2008 and 2009. Moreover, we find that the system outperforms several of our chosen benchmarks in terms of risk-adjusted returns. For the sell-side participants that are involved in the system, we find positive performance persistency for half of them. This suggests that these participants are able to constantly produce positive risk-adjusted returns. Finally, we find that the returns generated from the system are uncorrelated to the return of the stock market.

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1 Introduction

The financial securities market is commonly segmented into a sell-side and a buy-side. As the name suggests, investment banks and brokerage houses on the sell-side are selling investment services to asset,- and money management firms, positioned on the buy-side. Professionals on the sell-side include analysts, traders and stockbrokers and their main responsibility is to provide the investors on the buy-side with information that can increase the return of their investments. In order to detect valuable investment opportunities, the buy-side is in close contact with the sell-side. For instance, they get stock recommendations and trading ideas through morning telephone calls from sales representatives. Furthermore, the buy-side receives reports and analyses on specific companies and attends organized meetings with the management of listed firms, arranged by the sell-side. From the sell-side's perspective, the aim of these events is to receive orders to purchase or sell securities from clients on the buy-side. Investment banks and brokerage houses charge commission on these trades, which is how the sell-side representatives' job with gathering and analyzing information is converted into revenue.

According to the semi-strong form of Eugene Fama's famous Efficient Market Hypothesis (EMH) first presented in 1970, prices on traded assets reflect all publicly available information about its fundamental value and adjust instantly to new information. This suggests that financial markets are efficient and that it is impossible for market participants to consistently outperform the market by using publicly available information. Extensive academic research about sell-side analysts' abilities to generate excess returns through their stock recommendations often confirms the EMH – there seems to be no strong consensus concerning analysts' ability to outperform relevant benchmarks once taking transaction costs into account[1].

In contrast to the evidence in this body of research, agents on the buy-side still value the input from sell-side representatives and continue to spend money on the trades that this information leads to. This gap between theory and what the reality looks like was first illustrated in the now classical article "The Impossibility of Informationally Efficient Markets" by Grossman and Stiglitz (1980). According to the authors, once all relevant information is reflected in

[1] See, for instance: Desai and Jain (1995)., Stickel (1995)., and Womack (1996)

market prices, market agents have no longer incentives to acquire the information on which prices are based. However, a critical level of information is needed before this equilibrium is obtained and this is why the exchange of information between the sell-side and the buy-side in the financial market place is of importance.

There exists however elements in the relationship between the sell-side and the buy-side that often are questioned. Normally, investment banks have three main sources of income: (1) corporate financing, issuance of securities and merger advisory services; (2) brokerage services; and (3) proprietary trading. These three income sources can create conflicts of interest within the bank and with its clients (Michely and Womack 1999). For example, the proprietary trading activities can create conflicts with the bank's fiduciary responsibility to obtain "best execution" for clients and there may be pressure on the sell-side analyst not to issue reports detrimental to the positions that the firm has taken (Jacob, Rock and Weber 1993). Moreover, the compensation structure within the bank may bias the analysts' and the stockbrokers' stock recommendations to clients on the buy-side. As explained before, the bank generates revenue through commission when clients buy and sell securities. Typically, the analysts' and stockbrokers' individual compensation is also related to trading commission, which implies incentives for both to increase trading volume. The buy-side receives numerous investment ideas from the sell-side every day, and although both internal and external[2] ranking systems are trying to evaluate and rank analysts' and brokers' individual qualities, the compensation to the sell-side is not directly related to the value of the recommendations given.

In hedge and mutual funds, the compensation to fund managers is often related to the performance of the funds. Several studies about incentive contracts' impact on fund managers' and advisors performance show that such contracts are often efficient in aligning interest between the investor and the fund manager/advisor[3]. Although very few agents on the buy-side in the financial industry take advantage of this in their relation to the sell-side, there are agents that advocate a change. In 2005 Nordinvest, a subsidy to the holding company Industrivarden, initiated a unique trading system in Sweden where sell-side participants are

[2] Internal refers to the ranking systems performed by the sell-side and external ranking systems to the rankings performed by agents such as Prospera and Morningstar

[3] See for instance: Ackermann, McEnally and Ravenscraft (1999)., and Golec (1993)

compensated according to the performance of their suggested and implemented trades. The rationale behind the system is that there exists valuable investment opportunities in the information received from the sell-side (in line with Grossman and Stiglitz 1980), but that this information is hard to detect in the volumes of recommendations received from the sell-side every day. By basing compensation according to performance, Nordinvest is trying to reduce the amount of information received from the sell-side in order to capture trades that generate excess return. Nordinvest does not solely use information from the sell-side as input when making investment decisions, instead Nordinvest allows selected representatives on the sell-side to directly initiate trades according to their ideas and analyses. The traditional brokerage fee is replaced by a certain percentage of the profit generated from the executed trades. For risk management purposes and in order to reach the investment goals that Nordinvest is aiming at, there are restrictions and rules that the sell-side participants have to comply with. Nordinvest is seeking excess return and pairs-trading, a commonly applied strategy by arbitrageurs, is the trading strategy that the participants on the sell-side are forced to follow. Originated on Wall Street in the early 1980's, pairs-trading is a speculation strategy that takes advantage of potential short-term price deviations that distort a long-term pricing relationship between two stocks that historically move together. If a price diversion is detected, the stock with an expected price increase is bought, financed by the short-sell of the stock with an expected price declination. Hence, pairs-trading is self-financing and the only capital outlay that Nordinvest has to put in is the marginal capacity required to cover the short-position. Since pairs-trading is designed to exploit market inefficiencies, a profitable pairs-trade implies that the initiator had both good stock selection skills and market timing.

When compensation to the sell-side is incorporated in fixed brokerage fees as in the traditional relationship between the buy-side and the sell-side, little connection between the value of the recommendations and the price of the service exists. By basing compensation to the sell-side on performance, Nordinvest is challenging the existing business model. Nordinvest's Performance Based Trading is one of a kind in Sweden and there exists only a few world-wide examples of similar systems[4]. The purpose with our thesis is to describe and evaluate Nordinvest's Performance Based Trading in order to investigate whether the system is fulfilling its objectives and if it constitutes a profitable investment alternative for Nordinvest.

[4] For instance, TOPS (Trade Optimization Portfolio System) by UK headquartered hedge fund Marshall & Wace

Nordinvest and the participants from the sell-side are well aware of how Performance Based Trading works, but there exist no documentation of how the system is operated. Our first contribution to the existing literature will therefore be a detailed description of a trading system where compensation is linked to the performance of the trades. Previous studies on incentives' impact on performance have mainly focused on the relationship between buy-side agents and their investors. For instance, Ackermann, McEnally and Ravenscraft (1999) studied incentive structures in hedge funds and found that an increase in the incentive fee led to higher Sharpe ratios for the funds. To our knowledge, no previous studies have taken our approach where incentives' impact on sell-side agents' performances is being evaluated.

Our second contribution to the existing literature is our evaluation methodology of Performance Based Trading. Previous studies related to pairs-trading performance have analyzed the profitability of identifying historical trading patterns of stocks, forming pairs, and then computing the return of these pairs. Gatev, Goetzmann and Rouwenhorst (2006) are pioneers' on the topic. With daily data over 1962-2002, Gatev et al. matched stocks into pairs by looking at the minimum distance between normalized historical prices. Most studies on pairs-trading follow Gatev et. al's approach and surprisingly few studies have investigated pairs-trading in markets other than that of the USA. Performance Based Trading consists of stocks on the Nordic stock exchanges and in contrast to Gatev et al., we deal with a live trading system with real investors. In other words, our study focuses on pairs-trades that are initiated without knowledge about the future pricing relationship of the pairs. To our knowledge, no study has taken this approach when evaluating the profitability of pairs-trades before.

By this being said, our thesis is unique both in terms of the topic as well as the applied approach to evaluate and analyze it. We have found inspiration from the studies made on pairs-trading as well as from research focusing on incentive structures in hedge funds that share many resemblances with Performance Based Trading. With the insights gained from these studies as well as inputs from several practitioners in the financial industry, we have formed our own approach for how to describe and evaluate Nordinvest's Performance Based Trading.

1.1 Thesis outline

The thesis is organized as follows. After this introduction follows a presentation of our research objective. This chapter also contains our research questions. The next sections, Chapter 3 and 4, give a thorough description of Nordinvest's Performance Trading System. Chapter 5 covers the methodology employed to evaluate the system and Chapter 6 discusses the data and variables used for the empirical tests. In Chapter 7, our empirical results are presented and analyzed. Finally, in chapter 8, the research questions are answered and the findings of the thesis concluded.

1.2 Additional references

Information described in Chapter 3 and 4 was obtained through a number of interviews with different representatives from Nordinvest and the sell-side. We met with the initiator of the system at Nordinvest during several occasions. Questions and discussions during these meetings provided us with a detailed understanding of how the Performance Based Trading is build and gave us the necessary knowledge needed to structure the description of the system with the most relevant parameters. To gain knowledge from the representatives on the sell-side's point of view and to assure that this thesis is projected objectively, we also conducted individual interviews with a couple of the participants from the sell-side. The sell-side and representatives from Nordinvest also provided us with insight concerning the traditional way the sell-side interacts with the buy-side. For formality reasons, the participants in the system as well as their employers will remain anonymous throughout this thesis.

2 Research Questions

As stated in the introduction, the purpose with our thesis is to describe and evaluate Nordinvest's Performance Based Trading in order to investigate whether the system is fulfilling its objectives and if it constitutes a profitable investment alternative for Nordinvest.

One of the aims with Performance Based Trading is to reduce noise from the sell-side in order to capture trades that generate excess returns. Hence, in order to analyze if this objective is achieved we will look at the profitability of the system. Our first research question is therefore:

1. *Does Nordinvest's Performance Based Trading produce excess return during 2008 and 2009?*

The sell-side participants are only compensated if profits from their trades are generated. This compensation structure gives incentives for the participants to implement trading ideas that they have strong beliefs in. From Nordinvest's point of view, their aim is to constantly receive trading ideas that generate excess return. To investigate whether this objective has been fulfilled, we will study the persistency in the participants' performances. Thus, our second research question is:

2. *Is there persistence in the sell-side participants' performances?*

Nordinvest is seeking to generate excess returns independently on how the stock market in general is performing. In other words, Performance Based Trading should be a market neutral system. In order to investigate how well Performance Based Trading fulfills that criteria, we want to examine the following question:

3. *Does Nordinvest's Performance Based Trading produce returns that are uncorrelated to the market?*

3 Introduction to Industrivarden and Nordinvest

Since Nordinvest is less well known in comparison to its parent company Industrivarden, we devote this chapter to a short description of both Industrivarden and Nordinvest and the purposes of their respective activities. Since only Nordinvest, and not Industrivarden, is using Performance Based Trading (hereafter PBT) in their businesses with the sell-side, this chapter also serves as an illustration of how PBT differs from the traditional way of how the sell-side and the buy-side interact.

Industrivarden is a Swedish holding company and one of the leading players in the Nordic region. By taking the role of an active investor in listed Nordic firms, Industrivarden's main goal is to provide its shareholders with superior returns that in the long run exceed the average of the Swedish Stock Exchange, NASDAQ OMX Stockholm. Hence, the importance of making investments with good potential for value appreciation is at the core of Industrivarden's business. Nordinvest is a subsidiary of Industrivarden that is supporting these investment activities and conducts various market operations. Apart from providing Industrivarden with market information and the execution of investment decisions, Nordinvest actively engages in short-term trading in equities and equity-related instruments in an effort to generate excess returns. Value is primarily created through derivatives transactions in the shares of Industrivarden's existing portfolio companies and through trading activities in other Nordic securities.

Industrivarden and Nordinvest are both relying on inputs from the sell-side as a complement to the information gathered internally. However, the fundamentals of the information received differ. Industrivarden's interest lies in the long-term and hence, the focus is to obtain information about the true value of their existing and future potential holdings. Nordinvest, on the other hand, has a short-term focus and is more interested in finding mispricing among stocks. What further distinguishes Nordinvest's relation to the sell-side from Industrivarden's, is PBT. While Industrivarden has maintained the traditional way of working towards the sell-side, Nordinvest has created a system that attempts to identify the sell-side representatives whose trade inputs deliver positive excess returns.

4 Nordinvest's Performance Based Trading

The following section will describe Nordinvest's PBT in detail. In the first section of the chapter, we introduce the main reasons underlying Nordinvest's decision to change the relationship with the sell-side in the first place. In the second section we focus on providing the reader with a throughout understanding of how the system is operating. More precisely, the points deliberated on are: the trading strategy, the directives, the sell-side participants, compliance control, commission allocation, risk management & distribution and the opportunity cost.

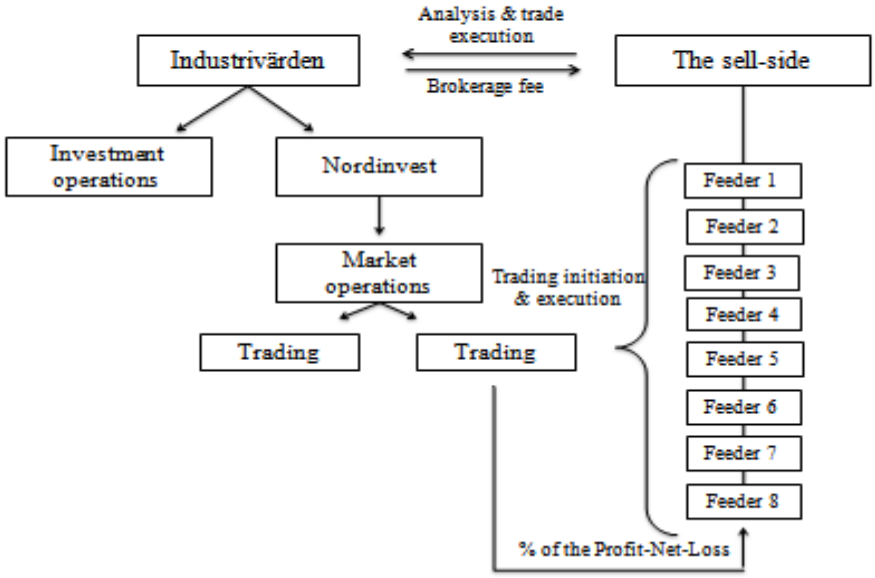
4.1 Background

In the years leading up to the implementation of PBT in 2005, Nordinvest had noticed inconsistency in the investment ideas received from the sell-side. Although no major changes had occurred in the marketplace, a stock that was a buy candidate one day could be a sell aspirant the following day. Nordinvest still believed that in the expertise and analytical edge of the sell-side, there exists value-added information but that this information disappears in the jungle of recommendations received from the sell-side every day. In order to filter away noise to more easily extract and monetize the input from the sell-side, Nordinvest decided to depart from the traditional liaison with these agents. Instead of simply providing recommendations, Nordinvest started to allow the sell-side representatives to execute trades on Nordinvest's account. This means that the sell-side participants are allowed to independently trade on identified investment cases as long as they follow the predetermined rules stated by Nordinvest. Second and more importantly, Nordinvest decided to base the compensation to the sell-side on an incentive structure. Instead of the pre-determined brokerage fee, the sell-side providers receive a certain percentage of the profit generated from the initiated trades. Consequently, no compensation is paid if a loss is generated. By the construction of PBT, Nordinvest aims to receive excess return, which is defined as the return above the risk-free interest rate.

Over the years, Nordinvest has carefully selected stockbrokers and analysts (from now on named feeders) from the sell-side to contribute their highest conviction trading ideas into PBT. As shown in Figure 1, there are presently eight agents from the sell-side that are

constantly active in Nordinvest's PBT[5]. Figure 1 below illustrates Industrivarden's and Nordinvest's structure and how the companies' relationship with the sell-side differs.

Figure 1: The structure of Industrivarden & Nordinvest's investment activities



As shown in the figure, Industrivarden receives information and analyses from the sell-side, and compensation to these agents are based on trading commission. Nordinvest is cooperating with eight feeders from the sales-side. Instead of recommendations, Nordinvest allows the feeders to trade independently on their own ideas. The traditional brokerage fee is replaced by a certain percentage of the profit-net-loss generated. Hence, no compensation accrue to the feeder if the trade generates a zero or negative return, and no money has to be paid out the other way around.

4.2 The Trading Strategy

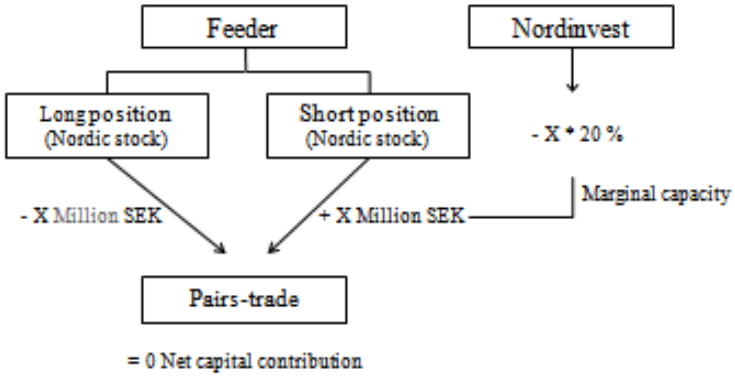
From 2005-2007, the feeders were not restricted in their choice to go long or short in the five stock positions that they were allowed to maximally keep open simultaneously. As time passed, Nordinvest noticed a tendency in the feeders' behavior to only take long positions.

[5] There are however more feeders involved in the system, but these feeders do not participate actively in the PBT.

Since this increased Nordinvest's sensitivity in a bear market, it was decided to force the feeders to invest in pairs-trading, also known as a market neutral- or a statistical arbitrage strategy. A pairs-trade is based on a classical hedge i.e. to go long in a stock believed to have a lower price than its true value and simultaneously short-sell a stock that is considered overpriced. Pairs-trades are formed by identifying a pair of stocks, often competitors within the same sector, that historically are correlated in their day-to-day price movements. If the correlation breaks down, i.e. one stock trades up while the other trades down; it is possible to bet that a "spread" between the two stocks will eventually converge. Since the bet is on the direction of the securities in *relation to each other* and not in the securities price movements relative the market, a pairs-trade should generate profits under all circumstances. If the market as a whole crashes and each leg in the pairs-trade plunge along with it, the negative loss on the long position should be offset by the gain generated from the short position, leaving the trader with a profit close to zero. Approaching this, a feeder in Nordinvest's system goes long in a stock believed to outperform and simultaneously short-sell a security that the feeder expects will underperform during the same time period. If no undervalued/overvalued security can be identified, the feeder goes short/long in an index to offset the market risk. In each "trading leg" the feeder invests a certain amount[6] depending on the security's liquidity and the feeder's past performance in the system. As the feeder both purchases and sells securities for the same amount of money, the initial net capital contribution is zero. However, collateral is required since the feeder short-sells securities. Consequently, Nordinvest keep a marginal capacity of 20 %[7] of the value of the sold security throughout the holding period of the pairs-trade. An overview of an initiated pairs-trades and the attributed capital contribution is shown in Figure 2.

[6] This information is confidential

Figure 2: Pairs-trading and the capital contribution



4.3 Directives

As described in the previous section, the feeders are forced to follow the pairs-trading strategy imposed by Nordinvest. Although Nordinvest rarely questions the idea underlying the selection and timing of a pairs-trade, there are pre-trade restrictions and ongoing trading rules that the feeders must comply with.

4.3.1 Pre-trade restrictions

- The feeder is only allowed to invest in Nordic securities
- The feeder is not allowed to have more than five pairs-trades open at the same time
- The feeder is not allowed to buy/short-sell a security in a company in Industrivarden's portfolio which quarterly report will be published within 30 days or other similar corporate events
- The feeder is not allowed to take a position in a company where he/she or Nordinvest has inside information
- The feeder is not allowed to execute a pairs-trade that is considered too risky, very illiquid or contributing to system overexposure in a certain sector or industry

4.3.2 Ongoing trading rules

- Time-stop order

With regards to Nordinvest's short-term trading horizon and its investment strategy, all pairs-trades should be closed no later than one month after their initiation.

- Stop-loss order

A stop-loss order is forced on the pairs-trade if the pairs-trade loses 3-5 % of its initial value calculated on one side of the pair. Setting a stop-loss order of 5 % means that the loss of the pairs-trade will be limited to 5%. The order to buy back the short position and sell the long position is independent of the direction of each leg and it is the value of the pairs-trade as a whole that triggers the stop-loss order.

- Virtual closing/opening

If the feeder has a future belief in a pairs-trade but the time-stop or the stop-loss order has come into effect, it is possible for the feeder to implement a so called virtual closing. This means that the feeder closes the short and long position in Nordinvest's portfolio tool and simultaneously opens a new pairs-trade that is consisting of the same underlying securities. The closing of the pairs-trade takes place in the portfolio tool where the Profit-Net-Loss is recorded, which means that the pairs-trade is never closed in reality. This is a way for the feeders to lock in profits. It can for instance be the case that a stop-loss has closed a pairs-trade when one of the trading legs has lost 3-5% of its value, but the feeder still believes in the original idea behind the trade and wants to continue with the same pairs-trade. Another example would be a pairs-trade where a large positive return is generated just in the beginning of the trading time horizon and the feeder believes that the pairs-trade will generate positive returns in the future. By virtually closing the pairs-trade, the feeder can secure the initial positive cash-flow but continue to trade on the pairs in the belief that more profits can be generated over time.

4.4 The Sell-side participants

Eight feeders from seven Swedish sell-side agents are actively participating in PBT. The premier incentive for the feeders to participate in the system seems to be the opportunity to independently trade on their own ideas. It can be viewed as an opportunity to be closer to the market and get better feedback on the performance of their trading ideas.

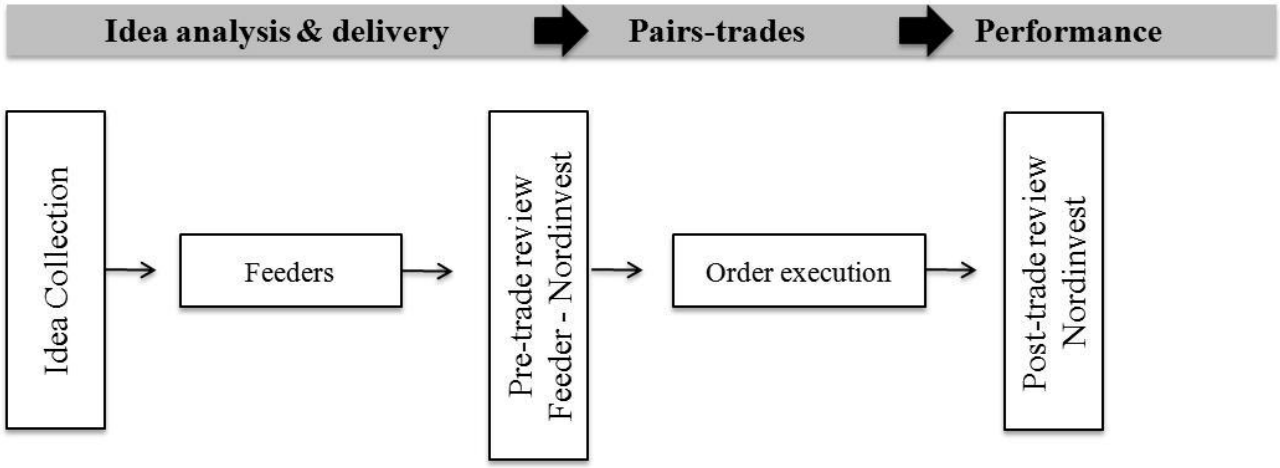
4.4.1 Investment ideas

The feeders in the systems base the pairs-trades on information received from fellow analysts and stockbrokers, but mostly on their own ideas and knowledge about the market.

Considering the short time horizon of Nordinvest's trading strategy, the feeder relies on short-term movements in stock prices rather than on long-term fundamental particulars of companies. The feeder either uses a fundamental strategy or a technical strategy in order to identify each leg in the pair. The fundamental strategy involves research on stocks that are expected to move together. The technical strategy involves the use of statistical techniques in order to identify pairs. Deviations within the pairs are then recognized with convergence-divergence frameworks using historical means.

According to the feeders, there are no large differences between participating in Nordinvest's system and suggesting trade ideas to other clients. If a feeder detects a valuable investment case, the feeder will initiate a pairs-trade in Nordinvest's system and may also forward the idea to other clients with similar preferences as Nordinvest's. Each feeder is allowed to liberally start a pairs-trade according to his preferences regarding timing and insights. Nordinvest has no "overlay" i.e. the firm rarely questions the underlying idea of the feeder's trading choice and most of the pairs-trades suggested are implemented. However, the directives discussed in section 4.3.1 restrict the feeder's independency and each pairs-trade is discussed with Nordinvest before the feeder executes the trade. The feeder inserts the ongoing pairs-trades in an interactive portfolio tool that is linked to the market in order to keep track of the value of the positions. The investment process is summarized in Figure 3. Since everything is manually controlled and no pairs-trade is automatically closed, involvement in PBT is demanding attention from the feeders. Some feeders consider participation to be time-consuming, while others equalize the process with other daily tasks.

Figure 3: The investment process



4.4.2 Reasons for inactivity in PBT

According to the feeders, inactivation in the system can be explained from three different perspectives:

1. Time

Since the system is managed manually, the process to monitor the pairs-trades is time-consuming. Hence, if the feeders are occupied with other clients and/or if it is a busy period of the year (quarterly reporting period etc.) the activity towards Nordinvest can be less intense.

2. Ideas

In addition to the compensation that only is related to profits, PBT is built on the value of the ideas of individuals and consequently; each idea can be trailed to the initiator. Taking this into account, the feeders are careful when presenting cases to Nordinvest and do not participate if no solid ideas can be found.

3. Market conditions

PBT is short-term orientated and performance is closely linked to the daily movements of the market. Hence, the feeders initiate ideas more cautiously when the volatility of the market is high.

4.5 Performance Measurement

Nordinvest keeps track on the executed pairs-trades in a portfolio tool, where the profit-net-loss of each pairs-trade is inserted after the pairs-trade has been closed. Furthermore, each feeder keeps a record of the trades in its own accounts. Nordinvest and the feeder always compare the profit-net-loss received on every pairs-trade before the compensation is distributed. Depending on past performance, the feeders are allowed to invest for a certain amount in every leg of the pairs-trade. There is no explicit rule that specifies what level of performance that grants a feeder the access to more funds. Instead, Nordinvest rewards the feeders with the option to invest more if Nordinvest believes that a feeder deserves it. Nordinvest has the right to remove a feeder from the system if he has performed poorly over time or if the feeder does not follow the trading rules. During the five years that the system has been operating, a handful of feeders' have been forced to quit trading in the system[8]. Two

[8] In total, 20 feeders have been involved in PBT.

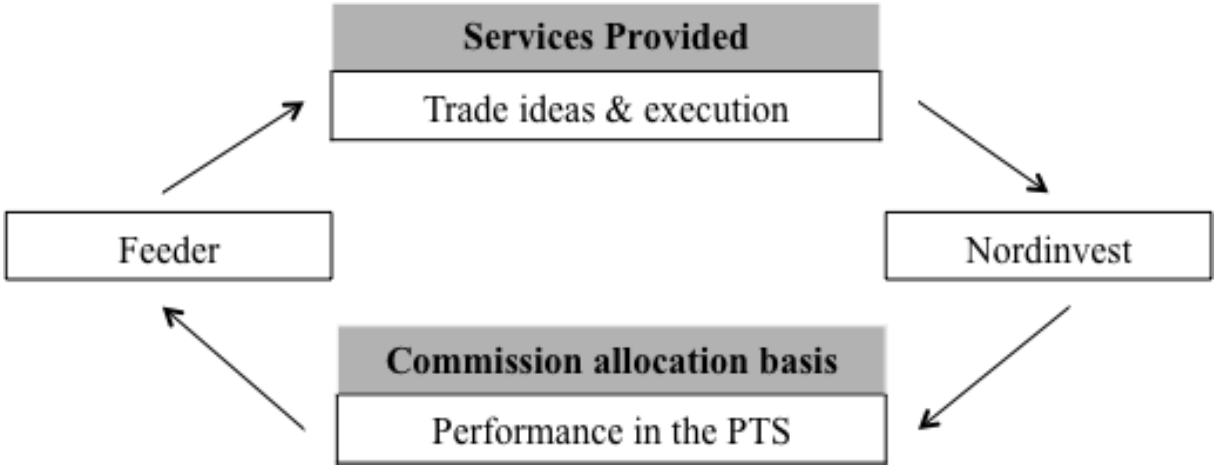
of those abused the system by neglecting the stop-loss- and time-stop rules, whereas the rest consistently generated negative returns.

4.6 Commission Allocation

As described before, the purpose of the system is to generate trades that can produce excess returns. It is not an initiative to reduce brokerage fees, rather to ascertain that commission is paid when excess return is generated. There is no track record that describes the volume of commission paid to the sell-side prior the initiation of the system and as a consequence it is difficult to calculate a break-even point, both from Nordinvest's and the feeder's perspectives. A feeder in the higher range of allowed capital per pairs-trade, do however express that the commission earned from Nordinvest is comparable to the brokerage fee received from other clients. Although Nordinvest keeps track of the cash flow generated by each feeder, actual returns of the pairs-trades are not calculated. Nordinvest do not have a certain base of capital committed to the system, capital is instead borrowed to finance the positions.

The compensation to the feeders has two components that both are depending on performance. First, as described in Section 4.1, compensation is directly correlated to the profit generated. Secondly, the feeder's compensation is related to the value of each leg in the pairs-trade. Since Nordinvest reward performance by increasing the value of each leg in the pairs-trade, this component is also related to performance. The feeder provides Nordinvest with trade ideas and execution of those, while Nordinvest records the performance of the feeders and allocate the commission accordingly. The commission allocation process is illustrated in Figure 4. Worth mentioning is that although the compensation from Nordinvest is based on hard values i.e. the profit-net-loss of the pairs-trades, it is the feeder's employer that determines the individual compensation to the feeders. Hence, the compensation to a feeder is based on soft values as in the traditional system and not directly related to their individual performance in Nordinvest's system.

Figure 4: The Commission Allocation Process



4.7 Risk Management & Distribution

When a pairs-trade is closed it is put in a batch, attributed to the feeder in question, together with four other pairs-trades. Each feeder receives a certain percentage of the profit of a batch. This means that the feeders can never lose money on their pairs-trades in PBT; however, feeders are missing out on traditional commission income if the profit-net-loss of a batch is negative. Each batch consists of five pairs-trades that have been carried out in chronological order, thus the feeders cannot influence the return of a batch by selecting which pairs-trades to be included in a particular batch.

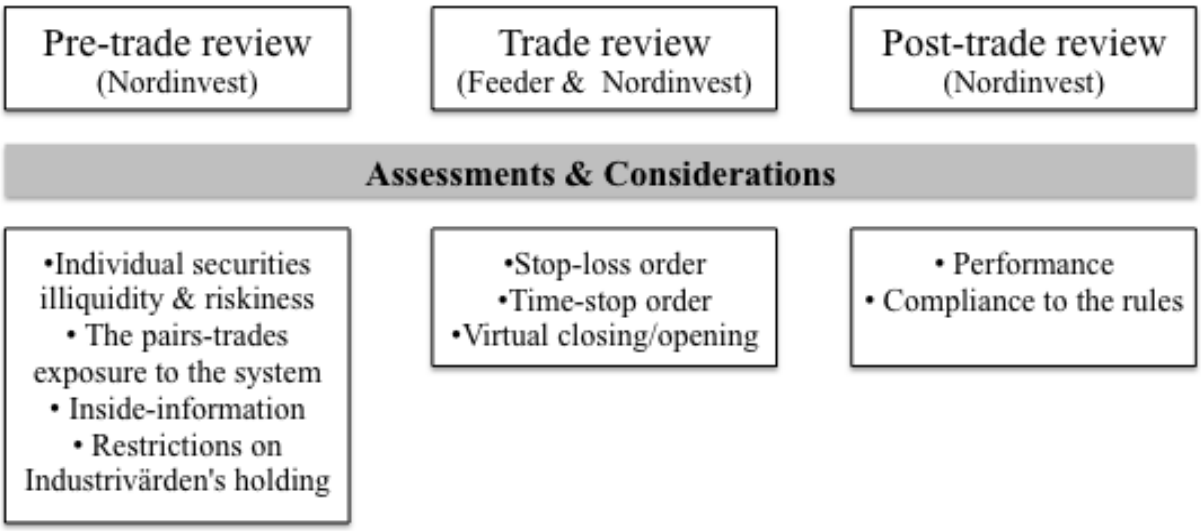
Nordinvest is manually monitoring the system in a portfolio tool in which every pairs-trade is inserted. In a pre-trade review, typically a telephone call between Nordinvest and the feeder, the investment case is considered in several aspects. This is when Nordinvest goes over the pre-trade restrictions and considers the risk and the liquidity of the pairs-trade suggested. Although the feeders are supposed to keep track of their positions and follow the rules regarding time-stop and stop-loss, Nordinvest takes on the losses. Consequently, Nordinvest is always conscious of the on-going pairs-trades and monitors cautiously the open positions. Since the system is managed manually and neither Nordinvest nor the feeder can constantly watch the trades, the human factor is an inherent risk attributed to the system. Restricting the number of on-going pairs-trades is presently the only way Nordinvest limits this particular risk. Even though the feeders are monitoring the system, it is Nordinvest that in the end finances the losses. However, the incentive structure of the system partly reduces this risk because of the positive correlation between money earned and compensation to feeders. Pride

is another important component that can be viewed as an additional incentive for the feeders to perform well. Considering Nordinvest's and Industrivarden's status in the Nordic region as well as the recognition of the participating feeder in his respective department, it is embarrassing for the feeder to be removed from the system.

The main risk faced by the feeders when participating in the system, can be attributed to the loss of commission if a negative return is generated. Apart from the time invested in monitoring the system, participation do not differ from the feeder's daily work towards other clients. This means that the feeder can limit the risk of missing income by only participating in the system when a solid investment case is found. This is also the purpose of the system. Another indirect risk with participation in the system is the fact that if Nordinvest's PBT gains recognition and more agents on the buy-side start to base commission according to performance, participants on the sell-side will miss out on brokerage fees and thereby be more dependent on providing the sell-side with valuable investment cases in order to receive compensation.

Figure 5 summarizes the risk management system of the PBT. As is explained in the figure, there are different risks in different phases of a pairs-trade idea presented by the feeders. When a feeder suggests a pairs-trade to the system, Nordinvest do not ask for detailed analysis or reports underlying the selection of the pair. Instead, Nordinvest trusts the feeder's instinct and looks at other parameters such as the securities liquidity and riskiness. Since the feeders are unaware of the other feeder's activities, Nordinvest always make sure that the securities in a pairs-trade do not contribute to overexposure of a paper or an industry in the system. There are also the overall rules concerning Industrivarden's holdings, described in Section 4.3.1, that4.3.1, which Nordinvest has to consider before agreeing a trade. It is in the post-trade review that Nordinvest overlooks the performance and distributes the compensation to the feeder. The profit-net-loss is recorded in the portfolio tool where Nordinvest keeps track of the feeder's performance. The feeder's performance is measured by using the profit-net-loss of the pairs-trades, the absolute return of the pairs-trades arereturns of the pairs-trades are not calculated. While Nordinvest is responsible in all three phases, the feeders are expected to stick to the trading rules explained in Section 4.3.2 once a pairs-trade is trading.

Figure 5: The Management of Risk



4.8 The Opportunity Cost

Prior to the initiation of PBT in 2005, Nordinvest utilized some investment services from the sell-side in addition to the trades executed internally. Hence, since PBT still uses selective inputs from the sell-side, an opportunity cost from Nordinvest point of view is that less capital is allocated to Nordinvest's internal trading leg. Moreover, PBT shares many characteristics with hedge funds, in particular the market neutral strategy and the focus on generating excess returns. Hence, investments in relevant hedge funds can be viewed as an opportunity cost to implement PBT.

The opportunity cost from the feeders' point of view is the time allocated to the system that can lead to missing income.

5 Methodology

In chapter 4, we explained and described the foundation of PBT. In this chapter, we present the methodology applied to test our research questions. Namely: "Does Nordinvest's Performance Based Trading produce excess return during 2008 and 2009?", "Is there persistency in the sell-side participants' performances?" and "Does Nordinvest's Performance Based Trading produce returns that are uncorrelated to the stock market?" As a reference point to the first two questions, we will test PBT's performance against viable benchmarks. Our benchmarks and the performance evaluation measures will thus also be presented in this chapter. Since Nordinvest's PBT is unique in Sweden and as no study has evaluated a similar system before, we have searched for inspiration from several different types of literature studies in order to structure and test our data in an appropriate manner.

This methodology chapter begins with an explanation of how we structured the pairs-trades in portfolios and how we calculate the return of these portfolios. Then, we present and discuss the different capital bases that we will use when calculating the return of a zero-net capital contribution strategy. For these sections, we focused on the research studies made on pairs-trades. In the following section, we discuss how we will define the excess return. Next, we present our choice of benchmarks and define, with the help from the traditional literature on risk-adjusted performance, the applied performance evaluation measures for evaluating comparative performance. Thereafter, we present how we aim to test the performance persistence of the individual feeders. Inspiration to the performance persistency test was obtained from literature made on hedge fund performance. In the last section of this methodology chapter, we present the classical linear regression used to test if PBT is market neutral.

5.1 Portfolio Construction

We have constructed a portfolio for PBT as a whole, including every pairs-trade that was initiated and closed during 2008 and 2009, as well as portfolios for every feeder's individual pairs-trades. For these portfolios the monthly returns were calculated since the pairs-trades have a trading horizon of maximum one month.

We include the return of the pairs that are open over month-ends to the return of the month when the trade is closed. This is when the return is accrued by Nordinvest. The return of the

portfolio for a given month is the total profit-net-loss generated by all the pairs-trades that have been closed during that month, divided by the sum of all pairs-trades capital bases.

We will use three different capital bases, hence three different returns for each portfolio will be computed. These capital bases will be presented and explained in the following section. Equation (1) below illustrates the monthly return of a portfolio.

$$\text{Portfolio Return} = \frac{PNL_i}{CB_i} \quad , \qquad (1)$$

where PNL_i is the total profit-net-loss from all pairs-trades in month (i) and CB_i is the sum of the time-weighted capital base of month (i). We time-weight each capital base by multiplying the amount of capital with the average number of trading days that the pairs-trades have been open divided by 21, which is the average number of trading days in a month[9]. By time-weighting the capital, we take into account the fact that the capital is not committed to a pairs-trade position during the complete month. Most pairs-trades are open only for a couple of days.

Equation (1) was also applied when computing the yearly returns and the total return generated by PBT and the feeders' portfolios. However, the capital base in these calculations is based on the average capital base for that period.

5.2 The return computation of a pairs-trade

Calculating the return of a pairs-trade is not a trivial task. Since the strategy by nature is self-financing, the definition of the capital base to base the return on is not as straightforward as in a long-only strategy. Gatev et al. (Hereafter GGR) identify two alternative ways of dealing with this, namely to calculate the return on the committed capital (1) and the return on employed capital (2). Later studies made on pairs-trading apply the same strategy[10]. The return on committed capital is calculated as the profit-net-loss obtained from the pairs-trades divided by the total amount of capital that is dedicated to the trading system. The fully invested return on employed capital is computed by dividing the total profit-net-loss from the

[9] The average number of trading days for the PBT is 6.2. Hence the factor that we multiply the capital base with is 6.2/21 when computing the return for the PBT.

[10] See for instance Doo and Faff, (2009)

open pairs-trades by the sum of the capital base attributed to those trades. According to GGR the advantage with the first approach is that it is more conservative and takes into account the opportunity cost of having to commit capital to a strategy even if the strategy does not trade. The downside is that the approach is not very realistic when funds using a pairs-trading strategy are flexible in their sources and use of funds. In this study, we will combine the two methods for computing the capital allocated to the system. We take a conservative approach by calculating the return on committed capital to PBT a specific month. However, this capital is time-weighted as the maximum trading horizon is one month but very few pairs-trades trade for the complete period. On average, the pairs-trades in our sample have been open for 6.2 trading days.

There are different ways to deal with the self-financing nature of pairs-trades. GGR define the capital base as the value of the long position whereas in a study by Mitchell, Pulvino and Stafford (2002), the return is calculated from the amount of marginal capacity needed to cover the short position. The latter approach reflects the true cost for each pairs-trade, as the only capital outlay that a pairs-trade investor has is the marginal capacity needed to cover the short position. However, these two methods fail to take into account the total risk attributable to both the short- and the long position. The only way to reflect the total risk is to define the capital base as the combined value of the long and the short position. Practitioners in the hedge fund industry that invest in short/long strategies commonly use this approach. The numerical examples below help to illustrate the three approaches, assuming that 4 million is invested in each leg of the pairs-trade and that a profit-net-loss of 400 000 is generated after the positions are closed.

1. The gross capital exposure as the capital base

The gross capital exposure is the sum of the long and the short position together.

$$\frac{1}{(4M+4M)} \times 400\,000 = 5\,\% \qquad (2)$$

From now on, the returns calculated with this approach will be called r.1.

2. The value of the long position as the capital base

The return is calculated per SEK long in every pairs-trade

$$\frac{1}{4\,M} \times 400\,000 = 10\,\% \qquad (3)$$

From now on, the returns calculated with this approach will be called r.2.

3. The marginal capacity as the capital base

A short position requires 20 % in marginal capacity[11]

$$\frac{1}{(0.20x4M)} \times 400\,000 = 50\,\% \quad (4)$$

From now on, the returns calculated with this approach will be called r.3.

As the examples illustrates, the three different capital bases generate considerable different levels of the return. If the pairs are weighted equally, i.e. if the value of the long position is exactly equal to the value of the short position, r.1 will always be half the size of r.2. Furthermore, since the marginal capacity is 20 % of the value of the short position, r.3 will yield a return that is 10 times that of r.1.

As previously discussed, there is no strong consensus in the literature concerning the most appropriate capital base to use when calculating the return of a pairs-trade. Since no previous study, to our knowledge, has evaluated a similar trading system like PBT, we cannot exclude any method and will therefore utilize all three approaches. However, we argue that as many market practitioners use the r.1 approach, we should focus on that measure in order to make relevant comparisons. Moreover, the r.1 approach is the most conservative approach, meaning that if we found PBT to be profitable with r.1 we will come up with the same conclusions for r.2 and r.3 as well. Consequently, we will focus on r.1 when presenting and analyzing our results.

5.3 Computing the Excess Return

The excess return is defined as the return above and beyond the risk-free interest rate. However, due to the self-financing nature of pairs-trades, several studies made on pairs-trading have chosen to define the excess return as all return above zero. GGR use the r.2 approach when computing the returns of their pairs-trades and they do not deduct the risk-free rate when computing the excess return. We have also chosen to use this definition of the

[11] 20% in marginal capacity is Nordinvest's estimation of what they need to put aside in order to cover the short position. However, Nordinvest argues that it might be a conservative estimation in the sense that the marginal capacity can be even smaller, sometimes only 5-10%.

excess return for the r.2 approach. Moreover, we argue that it is not completely fair to also benchmark r.1 against the risk-free rate. The gross capital exposure is the sum of the long and the short position, but this money could not have been invested in the risk-free rate since the long position is financing the short position. Thereby, it is impossible to invest the sum of both the long and short leg in the risk-free rate. Thus, also in the case of r.1 we will not deduct the risk-free interest rate in the excess return computation.

Mitchell et al., that use the r.3 approach when computing the returns on their pairs-trades, do deduct the risk-free rate in the excess return computation. This is because the marginal capacity is the pairs-trade investor's actual cash outlay that can be invested in the risk-free rate. In the case of Nordinvest, they receive the risk-free rate on the money that they have to put aside to cover the short leg in the pairs-trade. The risk-free rate that is earned offsets the risk-free rate deducted in the excess return computation, hence the excess return for r.3 is thereby the return of the pairs-trade.

5.4 Benchmark Selection

Hedge funds display many features that are similar to the foundations of Nordinvest's PBT. Hedge fund managers exploit mispricing of securities by using a variety of financial instruments. They seek to generate alpha during all market conditions and are not judged by their ability to track a passive benchmark. As a result, the compensation structure for hedge funds is to a large extent based on performance (Brown, Goetzmann and Ibbotson 1999). Furthermore, hedge funds are often structured to be unrelated to movements in the market, just as Nordinvest's PBT is intended to be. Taking into account the incentive structure of hedge funds and the market neutrality focus, hedge funds can be viewed as suitable benchmarks to PBT.

Hedge funds are not very transparent and it is hard to receive information concerning the applied trading strategies and what parameters that are used as inputs in the performance measurements that are presented in monthly/yearly reports etc. Therefore, we will not benchmark PBT against hedge funds with explicit pairs-trading strategies in isolation but instead against hedge fund indices. The most relevant hedge fund indices that we have identified are two Swedish hedge fund indices; SIX value-weighted (SIX vw) and SIX equally-weighted (SIX ew), and the Nordic Hedge Fund Index (NHX), an equally-weighted

hedge fund index derived from the performance of hedge fund managers and advisors within the universe of Nordic hedge funds. As an additional point of reference, we will also benchmark Nordinvest's PBT against the SIX Return Index (OMXS) that tracks the performance of all the stocks listed on the Swedish stock exchange, adjusted for dividends.

5.5 Risk-Adjusted Performance Measures

In order to better appraise the performance of PBT, we must also consider the risk-adjusted return, as oppose to only the gross return. In the world of finance, risk can be defined as market risk, firm-specific risk, total risk and downside risk. The firm-specific risk is defined as Jensen's alpha, after its creator Michael C. Jensen (1967), and measures an investment's over-or underperformance in relation to its expected return. Other risk-adjusted measures are usually obtained by dividing the excess return of an asset, a security or a portfolio, with one of the different risk factors. The Treynor ratio, developed in 1965 by Jack L. Treynor, measures returns earned in excess of what could have been earned on a riskless investment per each unit of market risk[12]. Nordinvest system is built to capture returns that are unrelated to the market return. Hence, Treynor's measure of the return adjusted for market risk is not relevant and will not contribute to a better understanding of the performance of PBT. The firm-specific risk would be a preferable way of evaluating the performance of Nordinvest's system in comparison to benchmarks but to derive this risk from the return generated by PBT and our benchmarks is not easy and falls beyond the scope of this thesis. Therefore, we will be focusing on the total risk and the downside risk when calculating our risk-adjusted performance measures.

When it comes to total risk, a commonly used performance evaluation measure in the industry is the Sharpe ratio, developed by William Forsyth Sharpe in 1966. Sharpe makes no distinction of market or firm-specific risk and uses the concept of total risk. The Sharpe ratio (Equation (6)) measures the reward to total volatility trade-off and is commonly asserted to imply high management skills.

$$S = \frac{ER_i}{\sigma_i} \qquad (6)$$

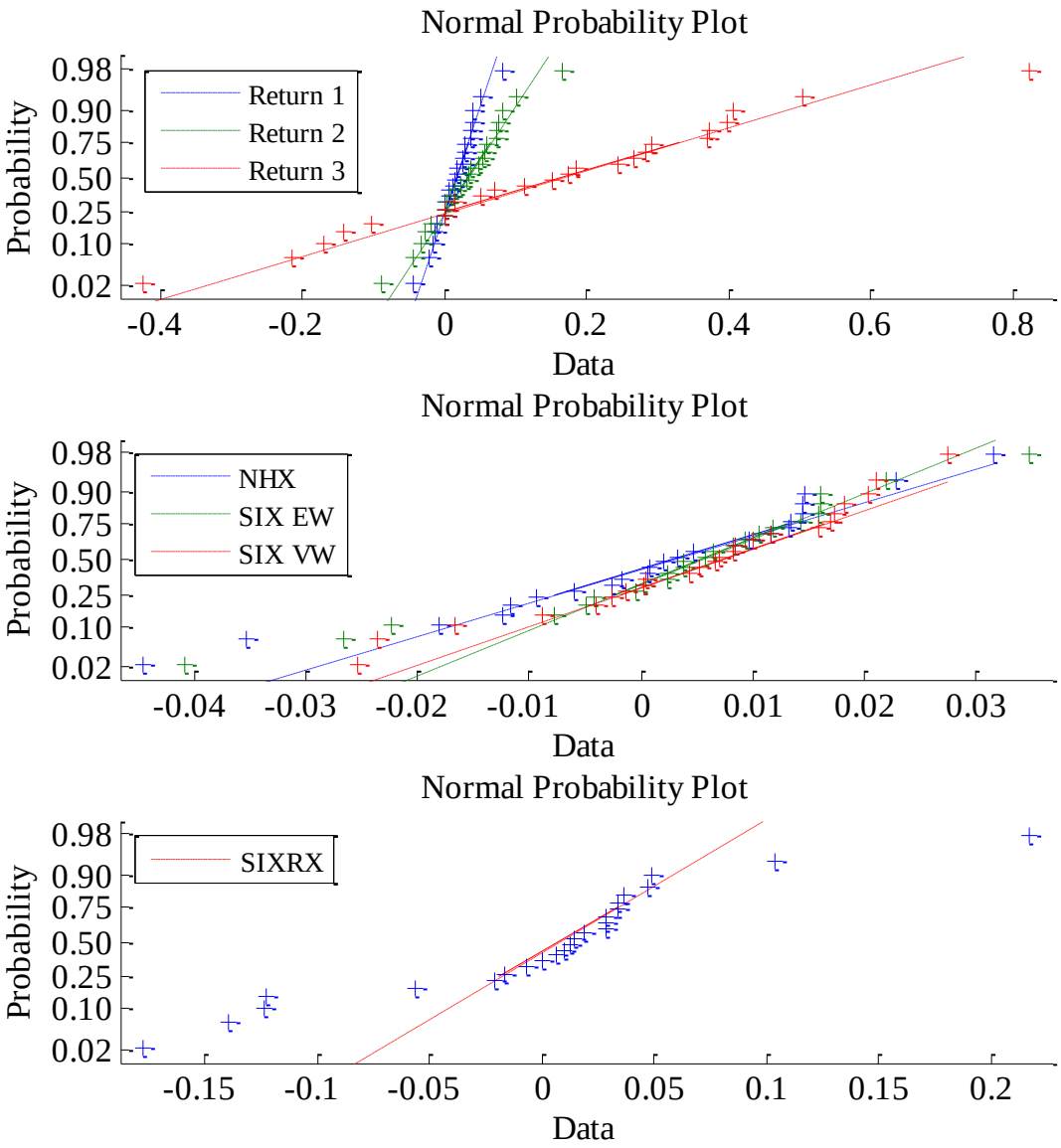
[12] Treynor ratio $= \frac{r_i - r_f}{\beta_i}$, where r_i is the return of asset (i), r_f the risk-free rate and β_i the market risk of asset(i).

Where ER_i is the monthly excess return of asset (i), and σ_i is the monthly standard deviation of asset (i).

One shortcoming with the Sharpe ratio is the equally weighting of positive and negative deviations from the benchmark return. A vast amount of literature has documented on the asymmetry in stock index distribution and that returns cannot be assumed to be normally distributed. For sound criticism of this assumption, see the analyses of Ekholm and Pasternack (2005) and Leland (1999). Using a graphical technique introduced by Chambers in 1983, we present Nordinvest's three return measures and the benchmarks' returns over the period evaluated in order to determine if the returns are approximately normally distributed or not. The data is plotted against a theoretical normal distribution in such a way that the points should form an approximate straight line. Departures from this line indicate deviations from normality. From graph 1, it is clear that Nordinvest's three return measureesmeasures (r.1-r.3) and the returns of the hedge fund indices can be assumed to be normally distributed. OMXS, however, shows a negative skewness in the return and a diversion from the straight line. This indicates that the returns of the OMXS were not normally distributed during the analyzed time period, and consequently, that the Sharpe ratio is not reflecting the risk-adjusted performance of OMXS properly.[13]

[13] From the construction of the Sharpe ratio, it is clear that a negative excess return combined with a high risk has a lower (less negative) Sharpe ratio than the same excess return combined with a lower risk. This suggests that an asset with a negative excess return and a high risk is a better investment alternative than the same excess return with a lower risk.

Graph 1: Normal probability plots



There are a number of ratios with modified risk measures that capture downside risk. In 1986, Brian M. Rom presented the Sortino ratio that allows the calculation of a risk-adjusted measure of a risky assets performance without penalizing it for upward price changes as in the case of the Sharpe's measurement. Instead of the total risk of the portfolio, the downside risk is used when assessing the risk-adjusted return. A higher Sortino ratio indicates a lower risk of large losses. The Sortino ratio is computed as:

$$Sr = \frac{ER_i}{DR_i} \quad (7)$$

where ER_i is the monthly excess return of asset (i), and DR_i is the downside risk of asset (i) defined as the monthly standard deviation below a certain Minimum Accepted Return (MAR) set according to the investor's objectives. In this thesis, MAR is set equal to the risk-free interest rate, r_f.

Since the Sharpe ratio is an accepted and commonly used risk-adjusted return measure in the financial industry, we have decided not to exclude it but we will however focus on the Sortino ratio when we compare PBT's risk-adjusted performance in comparison to our benchmarks.

5.6 Test of the feeders' performance persistency

In the literature made on performance persistence in hedge funds, we have identified two different tests: parametric- and non-parametric tests. Non-parametric tests are based on contingency tables of fund winners and losers. The funds are termed winners or losers depending on their relative performance to the median performance of all funds in that period[14]. The idea behind the non-parametric tests is to analyze the rankings in two consecutive periods in order to investigate if performance persistence exists. Performance persistence exists if a sufficient number of funds are termed winner in both periods or ranked as loser in the two consecutive periods. In this framework, Cross-Product Ratio and Chi-square statistic are commonly used to detect persistence. Parametric tests on the other hand, are usually based on regressions of a return in period *t* on the return in period *t-1*.

In this thesis we have chosen to use the parametric tests in order to detect performance persistence of the feeders. This is because the feeders have been active to different extents during 2008 and 2009, meaning that there are few months where all feeders have been active at the same time. Hence, the non-parametric tests are not an appropriate methodology for this system.

Using every pairs-trade initiated by the feeders individually, we run parametric tests by regressing the daily risk-adjusted return of the current pairs-trade on the preceding pairs-trade's risk-adjusted return. The linear regression model used is expressed as:

[14] See for instance Agarwal and Naik (2000) and Brorsen and Harri (2004)

$$ar_{t+1} = X_1 + X_2 * ar_t + \varepsilon \quad , \qquad (8)$$

where ar_{t+1} is the following pairs-trade's daily return divided by that pairs-trade's standard deviation, ar_t is the past pairs-trade's daily return divided by its standard deviation, X_1 is the intercept of the regression, X_2 is the slope coefficient, and ε is the error term obtained from the regression. A positive (negative) and significant slope coefficient X_2 indicates that positive (negative) performance persistence exists.

5.7 Test of market neutrality

To test if Nordinvest's system is market neutral, we run linear regressions with the monthly excess returns of PBT as the dependent variable and the excess return of OMXS as the explanatory variable.

$$y_i = a + \beta * x_i + \varepsilon \quad , \qquad (9)$$

where y_i is the excess return of PBT in month i, a the intercept and β the slope coefficient. X_i is the excess return of OMXS in month i, and ε the error term obtained from the regression. A significant slope coefficient β indicates that the returns of PBT are correlated to the returns of the stock market. In other words, a significant slope coefficient is an indication of that PBT is not market neutral.

6 Data

Our data consists of all the pairs-trades that have been part of PBT in 2008 and 2009. This data is confidential and have been obtained from Nordinvest's portfolio tool. In total, we have 255 pairs-trades over the years of 2008 and 2009. During this time period, seven agents and eight feeders participated and no feeder was excluded from the system.

We chose to neglect the use of more observations by not including the first three years (2005-2007) after the initiation of the Nordinvest's PBT for two reasons. First, 2008 was the first year when pairs-trading was applied as the overall strategy and it makes more sense to compare the feeders' and the overall system's performances when the trading strategy is consistent. Secondly, 2008 and 2009 were years with significantly different market conditions. While 2008 was characterized by the world financial crisis and falling stock prices, the stock market in 2009 had many reversal trends. For a system that is constructed to be market neutral, the years 2008-2009 represent a valid and interesting time period.

Other data inputs:

- Thomson Datastream Advance 4.0 provided the data necessary for calculating the daily value of the monthly portfolios, both on system- and feeder basis. Daily stock values of the relevant shares were collected and adjusted for dividends and other corporate actions. Furthermore, the values of the stocks traded on non-Swedish exchanges were converted to Swedish kronor by using daily foreign exchange rates.
- Data concerning the value of the OMXS and the SIX vw and ew indices were obtained from the database SIX Edge 3.3.
- The hedge fund association, Hedge Nordic, provided us with the monthly values of the NHX.
- The overnight STIBOR rate, obtained from the Swedish Riksbank, is used as a proxy for the risk-free interest rate.
- We have performed our tests in Stata (Intercooled Stata 9).

7 Empirical Results and Analysis

In this chapter we present and analyze the results from our tests. We will answer the research questions of this thesis and compare our findings to results of previous studies conducted on similar areas. In the first two sections, we discuss the profitability of PBT and, as a reference point, we make comparisons of PBT with the benchmarks. Section 3 covers the performances of the feeders and the results from the parametric tests on performance persistence. In section 4 we present the results from the market neutrality regressions. Finally, in section 5 we summarize and discuss our main findings.

As we explained in the methodology chapter, r.1 is the most conservative way of calculating the return of a pairs-trade and it is the method that many market practitioners use. Furthermore, we argued that the Sortino ratio is a more valid performance measure than the Sharpe ratio for the investments that we evaluate. Hence, in order to present our empirical results and analyze those in a clear and interesting manner, we will focus on all results produced by r.1, and leave out the results of r.2 and r.3[15]. When looking at risk-adjusted returns we will focus on the Sortino ratio, instead of on the Sharpe ratio. If we come up with different conclusions from the excluded return measures (i.e r.2 and r.3) or from the omitted risk-adjusted returns measures (the Sharpe ratios), we will present and analyze the differences in results. All our empirical results, even if not discussed or reported in this chapter, can be found in the Appendix.

7.1 The profitability of PBT

In this section we present and discuss the returns and the excess returns produced by PBT and compare them to the performance of our benchmarks. In Table 1 below, we have summarized the yearly returns and excess returns generated by PBT and the benchmarks.

[15] If nothing else is stated, PBT refers to r.1

Table 1: Yearly returns and excess returns

Return:	PBT	OMXS	NHX	SIX ew	SIX vw	STIBOR
Total(2008-2009)	46,63%	-7,05%	2,14%	7,66%	12,14%	5,24%
2008	31,55%	-39,05%	-11,14%	-6,40%	-3,68%	4,49%
2009	20,95%	52,50%	14,95%	15,03%	16,43%	0,72%
Excess return:						
Total(2008-2009)	46,63%	-12,29%	-3,10%	2,42%	6,90%	
2008	31,55%	-43,54%	-15,63%	-10,89%	-8,17%	
2009	20,95%	51,78%	14,22%	14,31%	15,71%	

As shown in the table, PBT produced an excess return of 31,55% in 2008, which was the highest excess return generated in comparison to the benchmarks during that year. As we all know, 2008 was the year when the financial crisis hit and prices of many stocks declined drastically. This is well reflected in the large and negative return of -43,54% for OMXS during that year. The fact that PBT managed to produce positive returns during 2008 when OMXS fell drastically, indicates that PBT is independent of the movements of the market. A further sign of low correlation in returns between PBT and OMXS can be found when analyzing the monthly returns (see Table 2.1 and Table 2.2 in Appendix). An interesting notation is that PBT generated its highest return in January 2008 (8.23 %), a month where the OMXS declined by -12.27%.

While OMXS can be viewed as a buy-and-hold strategy, our other benchmarks are made up by hedge funds. The primary aim for many of these funds is to deliver positive returns under all market conditions. It is therefore noticeable that PBT is producing positive returns during 2008 while all the hedge fund indices generated negative returns. In the introduction of this thesis we explained that the success of a pairs-trade is depending both on the timing and the stock-selection skills of the feeder. Hence, the fact that the feeders collectively outperform the benchmarks is an indication that the feeders in PBT are very skillful in their selection of stocks in comparison to hedge funds on average. However, we must keep in mind that in order to make proper comparisons between investments, we need to take the risk associated with each investment into account. This is what is done when comparing the risk-adjusted performances in section 7.2.

In 2009, PBT and all our benchmarks are delivering positive excess returns. The OMXS was the best performing index with an excess return of 51,78%, which can be compared to the excess return of PBT of 20,95%. As can be seen from the table, the excess return of the hedge fund indices were also positive during this year. This gives an indication of the fact that the hedge funds have been more correlated to the stock market than PBT has been[16].

Analyzing the total period, 2008-2009, PBT generated a total return of 46,63%. By that, PBT is exceeding the total return of all the benchmarks. We consider this result as a strong achievement for Nordinvest considering the fact that 2008 and 2009 were two years with extreme market conditions. The correlation between stocks was high during this period and stock prices declined drastically in 2008, but PBT still manages to produce positive returns in both years.

Another valid point to make is that we have chosen to focus on r.1 when presenting our result. This is the most conservative way of calculating the return of a portfolio of pairs-trades. Thus, the returns generated with r.2 and r.3 are even higher. In Table 2.1 in the Appendix, the returns calculated with these measures are presented. As can be seen from the table, PBT generated a total return of 466,56% using the r.3 measure. At a first glance, this might not seem to be a valid result. However, we argue that r.3 is the only return measure that takes into account the true cost of each pairs-trade. The only capital outlay that a pairs-trade investor has is the marginal capacity needed to cover the short position, and not the total size of the pairs-trade. Thus, even though many market practitioners use the r.1 approach, the r.3 measure might be more appropriate to use. In that case, the profitability of PBT is huge. However, for the time period that we have evaluated PBT, the choice between the different return measures does not affect our conclusion about whether PBT has been profitable or not. As we concluded before, PBT managed to produce excess returns in both 2008 and 2009. Hence, the answer is "Yes" to our first research question: "*Does Nordinvest's Performance Based Trading produce excess returns during 2008 and 2009?"*

[16] Credit Suisse (2009) writes in their publication about equity market neutral hedge funds that: "Many investors were unpleasantly surprised to find that a large number of hedge funds ended 2008 in negative territory, particularly since hedge funds posted overall positive returns for the previous ten years." The fact that many market neutral hedge funds are correlated to the stock market is reported in several other papers as well. See for instance, Patton (2009).

This finding is in line with the results in GGR where it is shown that the most profitable portfolio of the identified pairs-trades yield an average annualized excess return of 11 %. Also in a study by Perlin (2009), which identified pairs-trades on the Brazilian stock exchange and compared the return of these trades to a naive approach with an out-of-skill investor, the excess returns are positive. However, in Mitchell et al. (2001) the pairs-trading strategy is not able to generate excess returns. As previously explained, this study uses the r.3 approach when computing the returns, but the marginal capacity is 50 % of the short position which is more than twice the size of the fraction that Nordinvest is required to pay. Mitchell et al. reflect on the high marginal capacity in their conclusion where it is discussed that a relaxation of the capital requirements would have generated an excess return considerably higher than zero, and thus, also this study's result would be in line with our findings.

We should keep in mind that these studies are evaluating pairs-trading from an ex-post perspective. Our study is, to our knowledge, the first study that evaluates a pairs-trading system that is "live" with real investors and where the pairs-trades are formed ex-ante. Although our study and previous studies on pairs-trading are not identical, the findings from the studies indicate that pairs-trading as an investment strategy is profitable.

7.2 The risk-adjusted return of PBT

As discussed before, in order to better relate the performance of PBT to the benchmarks, we have to consider the risk associated with each investment. We explained in section 5.2 that the three different return measures that we use should follow a pattern where r.1 is half the size of r.2 and 1/10 the size of r.3. This relation is also reflected in the downside risk of the three return computations. Hence, in theory the Sortino ratios of the three return measures should be equal[17]. However, this is not the case when studying the average Sortino ratios for r.1-r.3, presented in Table 2.9 in Appendix. The differences in the results can be explained by the fact that the short and long positions of PBT's pairs-trades are not exactly equal in size from the start. Moreover, the values of the positions are not daily weighted. This means that price

[17] This relation holds for the Sharpe ratios as well

fluctuations during the course of the trade change the values of the two legs, which will contribute to differences in the Sortino ratios for r.1-r.3.

Table 2 presents statistics for the Sortino ratios of PBT and the benchmarks (Statistics for the Sharpe ratios can be found in Appendix 2, Table 3.2 and Table 3.3). PBT produced an average monthly Sortino ratio of 1.91 in 2008 and 1.07 in 2009. Over the complete time-period (2008 and 2009), PBT's average monthly Sortino ratio is 1.49. With these three averages, PBT outperforms the corresponding average Sortino ratios of all benchmarks except from the SIW vw index that managed to generate a Sortino ratio of 1.37 in 2009.

Table 2: Average monthly Sortino ratios

	PBT	OMXS	NHX	SIX ew	SIX vw
Total	1,49	0,01	-0,04	0,09	0,31
2008	1,91	-0,75	-0,44	-0,77	-0,75
2009	1,07	0,77	0,37	0,96	1,37

In order to draw conclusions that can be backed up by statistical proof regarding PBT's performance in relation to the benchmarks, we have performed two-tailed t-tests. The null hypothesis is that the difference between the monthly Sortino ratio of the benchmark and the monthly Sortino ratio of PBT is zero, and the alternative hypothesis is that the difference does not equal zero[18]. Only when the null hypothesis is rejected, we can conclude that PBT has performed better or worse than the benchmark. These tests have been performed with two different assumptions regarding the variances of the population, assuming both equal and unequal variances. The results from the tests are presented in Tables 3-6 below[19].

Table 3: t-tests on the difference between the Sortino ratio of NHX and PBT

Sortino	Mean	Std. Err	Stdev	t-stat	Sign. level
NHX	-0,03655	0,123579	0,605412		
PBT	1,487642	0,53857	2,638444		
Combined	0,725544	0,295069	2,044297		
Diff.	-1,5242	0,552566		-2,7584	***

[18] H0: Sortino ratio Benchmarki – Sortino ratio PBT = 0, H1: Sortino ratio Benchmarki – Sortino ratio PBT $\neq 0$

[19] The results of the t-test were identical for the two assumptions regarding the variances of the populations, thus we have chosen to only present the results of the t-tests that assume equal variances.

*** Statistically different from zero at 1% level

Table 4: t-tests on the difference between the Sortino ratio of SIX ew and PBT

Sortino	Mean	Std. Err	Stdev	t-stat	Sign. level
SIX ew	0,091793	0,298209	1,460918		
PBT	1,487642	0,53857	2,638444		
Combined	0,789718	0,321083	2,22453		
Diff.	-1,39585	0,615619		-2,2674	**

** Statistically different from zero at 5% level

Table 5: t-tests on the difference between the Sortino ratio of SIX vw and PBT

Sortino	Mean	Std. Err	Stdev	t-stat	Sign. level
SIX vw	0,308705	0,338633	1,658958		
PBT	1,487642	0,53857	2,638444		
Combined	0,898173	0,326225	2,260153		
Diff.	-1,17894	0,636184		-1,8531	**

** Statistically different from zero at 5% level

Table 6: t-tests on the difference between the Sortino ratio of OMXS and PBT

Sortino	Mean	Std. Err	Stdev	t-stat	Sign. level
OMXS	0,008412	0,308307	1,510392		
PBT	1,487642	0,53857	2,638444		
Combined	0,748027	0,325374	2,254258		
Diff.	-1,47923	0,620573		-2,3837	**

** Statistically different from zero at 5% level

A very interesting observation from the results presented in the tables is the fact that we found negative and statistically significant differences for all comparisons between the Sortino ratio of PBT and the corresponding risk-adjusted measures for the benchmarks. Since the differences are negative, we find that PBT outperforms all benchmarks in terms of monthly Sortino ratios over the estimated time-period. The null hypothesis is rejected on a 5% significance level for the comparison with OMXS, SIX ew and SIX vw, and on a 1% significance level for NHX. This is a strong achievement for PBT as it implies that Nordinvest earned more excess return per each unit of downside risk when investing in PBT than what they would have earned if they invested in the benchmarks. Thus, both in terms of excess returns and risk-adjusted returns, PBT has performed better than our chosen

benchmarks during the evaluated time period. This finding is, once again, confirming the profitability of PBT.

Tables 5.5-5.8 in Appendix present the results from the t-test on Sharpe ratio. As can be observed from these tables, the null hypothesis is not rejected for the comparison between the two SIX indices' Sharpe ratios and the Sharpe ratio of the PBT. In other words, we cannot conclude that PBT has out-, or underperformed these benchmarks in terms of Sharpe ratio. These results are in contradiction to the findings from the t-tests made on the Sortino ratio from which we found that PBT outperformed all the benchmarks, including the two SIX indices. One explanation for the differences in the results can be due the shortcoming with the Sharpe ratio, namely that the ratio is not reflecting the risk-adjusted performance appropriately when the excess return is negative. This is because negative Sharpe ratios favor higher risk and thereby contributing to a less negative ratio. Thus, when performing the mean difference tests between the indices' Sharpe ratios and the Sharpe ratio of PBT, the differences will decrease the less negative the Sharpe ratios of the indices are. The Sortino ratio is partly created to avoid this bias.

7.3 The performance of the feeders in PBT

We previously concluded that PBT has performed well, both in terms of excess returns and risk-adjusted returns, and in comparison to our chosen benchmarks. Pairs-trading is a profitable trading strategy, which is an important component of PBT. However, profitable pairs are not formed by coincident; it is the knowledge and the expertise of the feeders involved in the system that help to explain the profitability of PBT.

Table 7 summarizes the total returns and the risk-adjusted returns generated from each of the feeders in PBT. As can be seen from the table, only one feeder has had a negative total return. The fact that seven out of eight feeders achieved positive total returns gives an indication of the high skills and the good knowledge that the feeders in PBT possess. It also reflects that the feeders have been careful when selecting their pairs and that Nordinvest fulfills its aim of reducing noise from the sell-side in order to capture profitable investment ideas. Another observation from the results is that feeder D has been the most successful feeder with a total

return of 255.30%. However, looking at the risk-adjusted total return, feeder E is most successful.

Table 7: Total returns and risk-adjusted total returns of the feeders

Feeder:	A	A2	B	C	D	E	F	G
Total return	-48,75%	9,50%	54,31%	26,35%	255,30%	208,09%	92,08%	122,39%
Risk-adjusted return	-0.02	0.27	2.21	0.94	9.55	11.66	2.99	9.87

As shown in Table 7, the returns produced by all the feeders are large in absolute terms. We explained in section 5.1 that when calculating the returns, we take into account the fact that the pairs-trades seldom trade for the complete month. Hence, we chose to time-weight the capital contributed to the system. If we do not time-weight the trades, and thus, assume that the capital devoted to the PBT is committed for the complete month, the returns will be smaller. Table 8 below, shows the total returns for the feeders when this assumption is made.

Table 8: Total returns when capital is committed for one month

Feeder:	A	A2	B	C	D	E	F	G
Total return	-11,61%	3,17%	12,10%	6,54%	50,23%	16,25%	11,52%	62,70%

As can be observed from the results in the table, feeder G is now the most successful feeder. The difference in result can be explained by the fact that feeder G trades, on average, for 10,76 days, which is more than what the other feeders, on average, trade for.[20] Hence, feeder G commits the capital of each pairs-trade for a longer period and this has an effect on the return when the capital base is time-weighted.

In order to see if the feeders are persistent in their performances, we ran linear regressions of the form stated in Equation (8) in chapter 5.5. These regressions are based on the daily risk-adjusted returns of the pairs-trades, as explained in that section. The results from the regressions are summarized in Table 9. Recall that a positive (negative) and statistically significant slope coefficient is an indication of positive (negative) performance persistence for the feeder's pairs-trades.

[20] See Table 3.3 in Appendix

Table 9: Parametric tests on performance persistency

Feeder	Coefficient	Z	Significance level	N
A	0.1022383	1.11		11
	(0.0918377)			
A2	0.0547167	0.89		11
	(0.0615563)			
B	0.0903192	2.21	**	30
	(0.0408075)			
C	-0.0430599	-0.45		14
	(0.0966474)			
D	0.1012843	3.16	***	38
	(0.0320975)			
E	0.1081514	0.48		43
	(0.2250732)			
F	0.0575675	1.91	*	51
	0.0301365			
G	0.1318678	5.17	***	57
	(0.0255216)			

*** Statistically different from zero at 1% level

** Statistically different from zero at 5% level

* Statistically different from zero at 10% level

From the results of the parametric tests of performance persistency, we find that feeders B, D, F and G have positive and statistically significant slope coefficients. In other words, these feeders are positive persistent in their performances. Another interesting observation is the fact that none of the feeders are reversed in their performances, meaning that they, time after time, generate negative risk-adjusted returns for their pairs-trades. Thus, the answer to our research question: "*Is there persistence in the sell-side participants' performances?*" is "Yes. Four out of eight feeders in PBT show signs of positive performance persistence."

Although we have not found any previous studies on performance persistency for participants in a system like PBT, we have found studies on performance persistency in hedge funds. Brown, Goetzmann and Ibbotson (1999) study year-by-year performance persistence in the off-shore hedge fund industry but found no evidence of performance persistence, in contrast to our results. Agarwal and Naik (2000) investigate the extent of pre- and post-fee performance persistence exhibited by hedge funds during January 1982 to December 1998. Compared to the study conducted by Brown et al. which., which only took yearly returns into account, Agarwal and Naik investigate whether performance persistence exists at quarterly,

half-yearly and yearly intervals. They find that there exists considerable amount of performance persistence at quarterly horizons. However, persistence decreases as the return measurement interval increases suggesting that hedge fund managers are primarily short-term in nature. This finding is in line with our result, namely that performance persistency exists at monthly trading horizons for some of the feeders in PBT. Brorsen and Harri (2004) also found evidence of hedge fund performance persistence and that different hedge fund styles are more persistent than others. The styles that show the greatest persistence are Market Neutral and Funds-of-Funds styles. The findings from this study are in line with the result of our study, as we found positive performance persistency for several of the feeders in PBT, which is constructed to be market neutral.

Since the purpose of PBT is to reduce overall noise in the information received from the sell-side in order to detect the value-added information time after time, the persistence in the feeders' behaviors to produce positive risk-adjusted returns indicates that the construction of PBT is functioning in a satisfactory way. Moreover, no feeder is persistently producing negative risk-adjusted returns, a result that is in line with the fact that no feeder has been eliminated from the system during the evaluated time period. It also implies that Nordinvests manages the performance measurement function, described in section 4.4, in a satisfactory wayis well functioning. However, we are questioning whether the feeders that were positive persistent in their performances during 2008 and 2009 will continue to be so even in the future. If these participants, time after time, generate positive risk-adjusted return on their trades, they would be better off by trading on their own account. Hence, Nordinvest needs to find ways to encourage these feeders to continue their participation. Looking at the compensation structure explained in the section 4.6, it seems like Nordinvest is aware of this fact, as Nordinvest determines the limits for the capital allowances for each feeder's trades. If this is satisfactory enough to keep the most successful feeders in PBT, remains to be answered in the future.

7.4 The market neutrality of PBT

One of the aims with Nordinvest's PBT is that the system should be able to produce returns that are uncorrelated to movements in the stock market. In order to test whether this aim has been fulfilled during 2008 and 2009, we have performed linear regressions of the form stated

in Equation (9) in section 5.6. As a proxy for the stock market we have used OMXS. The results from the regressions are presented in Table 10 below.

Table 10: Linear regression result on market neutrality

Excess return	Coefficient	t	R-squared	N
PBT	-0.0316101	-0.40	0.0093	24
	(0.0795719)			

As can be seen from the table, we find a statistically insignificant slope coefficient and low explanatory power of the regression. This result indicates that the returns of PBT have not been correlated with the returns of the stock market during 2008 and 2009 and, hence, that the construction of PBT is satisfactory when it comes to fulfilling the criteria of being market neutral. Thus, the answer to our last research question: "*Does Nordinvest's Performance Based Trading produce returns that are uncorrelated to the market?*" is "Yes. The returns produced by PBT during 2008 and 2009 show low correlation to the market. It is thus an indication of that PBT is a market neutral trading system."

This finding confirms our previous belief of market neutrality when we analyzed the return of PBT in comparison to OMXS in section 7.1 and is a strong achievement for PBT considering that 2008 and 2009 were years characterized by large market movements and high uncertainty on the financial markets. Moreover, the result indicates the power of pairs-trading as a trading strategy. Pairs-trades are often considered by practitioners to be market neutral in nature. GGR confirm this belief by showing that the return of their portfolios of pairs-trades is uncorrelated to the market return. Other studies do not test if the return of the pairs-trading portfolio can be explained by the market return or vice versa. For instance, Bolgün, Kurun and Güven (2009) show that the return of the pairs-trades portfolio is higher and less volatile than the market portfolio, but nothing is said about the correlation with the market return.

7.5 Summary and discussion of our main findings

In this study we have found that Nordinvest's PBT generates large and positive excess returns in both 2008 and 2009 and that PBT's risk-adjusted returns outperform all the benchmarks.

We have concluded that pairs-trading is a profitable investment strategy and that its success is explained by the knowledge of the feeders involved in the system. Seven out of eight feeders are delivering positive total returns and four of these participants are positive persistent in their ability to generate risk-adjusted returns. Finally, we have found that PBT is a market neutral system, meaning that its returns have low correlation to the return of the stock market.

From Nordinvest's perspective, they are fulfilling its objectives with PBT. Even though we have not investigated if it is the incentive structure that can explain the success of PBT, our results are an indication that the construction of PBT is working in a satisfactory way: Through the system, Nordinvest is able to constantly detect valuable investment ideas from the sell-side that are not dependent on the movements of the stock market. It is possible that the profitability of PBT will give more incentives for Nordinvest to further develop and increase the importance of the system. This can be achieved, for instance, by extending the trading universe to include securities listed on stock exchanges outside the Nordic region or by allowing non-Swedish sell-side institutions to participate in the system. However, when looking at all the different components that drive and monitor PBT, it is easy to see that the complexity of PBT will increase with the size of the investments and the number of participants. This will put more pressure on Nordinvest to develop new tools for how they supervise the system and monitor the risks. We have previously reflected on the high returns that PBT is generating but also that this is explained by the good performance of the feeders. However, we have only evaluated two years of data and less successful years can turn the excess return generated in 2008 and 2009 into negative numbers of the same great sizes. Hence, the risk management function that today mainly is managed manually must probably be developed into a more rigorous risk system.

In the introduction of this thesis, we explained that agents on the buy-side are advocating a change of the traditional business model between the buy-side and the sell-side. Nordinvest was the first buy-side agent in Sweden that changed its relation to the sell-side through the implementation of PBT. It is possible that the success of PBT will pave the way for other institutions on the buy-side. Similar systems that aim to relate the compensation to the sell-side on performance may evolve and it is possible that the traditional business model between the sell-side and the buy-side will change in the future. From the sell-side's perspective, this change will create pressure and more uncertaintyuncertainty, as their compensation will be

more linked to their performances. On the other hand, recent years' declining volumes on stock exchanges in combination with lower commission rates, have decreased the profitability of the traditional business model and it might therefore also be in the sell-side's interest to explore new business models. In systems similar to Nordinvest's PBT, the sell-side will have the opportunity to work closer to the market and receive more direct feedback on their trading ideas: A dimension of Nordinvest's PBT that the sell-side participants today motivate as a main reason for their participation. It can also be argued that through these new business models, the sell-side will be able to maintain "proprietary" trading activities within the bank but to share both the profits and the risks of these trades with the buy-side[21].

[21] After the recent financial crisis, the U.S rule makers have decided to implement the so-called Volcker rule that restricts bank entities to engage in proprietary trading in the future. Proprietary trading is defined as "engaging as a principal for the trading account" of a covered banking entity in buying or selling any covered instrument.

8 Conclusion

The aim of this study was to describe and evaluate Nordinvest's Performance Based Trading system in order to investigate whether the system is fulfilling its objectives and if it constitutes a profitable investment alternative for Nordinvest. Our first research question was related to the profitability of the system and if the aim of creating excess return was fulfilled. We identified three different measures of return and found that Performance Based Trading generated excess returns in both 2008 and 2009, regardless of which return measure that was being used. The return that we chose to focus on generated a total excess return of 46.63% during 2008 and 2009. Moreover, we found that the system's risk-adjusted returns were able to outperform all our benchmarks. These results indicate that Performance Based Trading is fulfilling the objectives of creating excess return for Nordinvest and that the system constitutes a profitable investment alternative.

Our second research question was related to the performance of the participants involved in Performance Based Trading and whether the system fulfills its aim of constantly detecting profitable investment ideas from the sell-side. We found that all participants, except one, generated positive total returns for the time period investigated. Moreover, positive performance persistency was found for half of the participants, meaning that these participants were able to constantly produce positive risk-adjusted returns for Nordinvest. We did not find negative performance persistency for any of the participants, which is in line with the fact that none of the participants have been removed from Performance Based Trading during the evaluated time period. These results indicate that the participants in Performance Based Trading possess valuable information and that Nordinvest is able to capture the investment value of this information through the Performance Based Trading.

Our last research question was related to the market neutrality of Performance Based Trading. We found that the returns of the system showed low correlation to the stock market suggesting that the returns produced by Performance Based Trading are independent of market movements. Thus, our result indicates that the system fulfills its objective of being market neutral.

8.1 Limitations

Since Nordinvest's Performance Based Trading has only been active since 2005 and as we have chosen to evaluate the system from the start of 2008, our thesis is necessarily limited by the low availability of data. The result of our study gives thus only an indication of whether a trading system based on performance is profitable or not. In order to make the results more reliable, one has to include more years of data.

8.2 Suggestions for Future Research

To our knowledge, there are no previous studies that have evaluated a similar pairs-trading system. Hence, we had to consult many different literature sources in order to make the evaluation of the Performance Based Trading as precise as possible. One problem with our evaluation was how to calculate the returns of the pairs-tradestrades, as the initial capital contribution is zero. We identified three different capital bases and used all of them when calculating the returns of the pairs-trades. Consequently, we came up with three different results of the profitability of Performance Based Trading. All three return measures have their own pros and cons. Moreover, we had to take into account the fact that the capital committed to the system was not used during the complete month. It is possible that there are other, better ways to evaluate the pairs-trades. Hence, a suggestion for future research is to analyze, and possibly develop, a return measure that takes into account both the total risk of a pairs-trade and the fact that capital is committed to different extents during a trading horizon.

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Appendix

1. Summary Statistics of PBT, the Feeders and the Benchmarks

Table 1.1. Total and yearly returns for PBT's r.1, r.2, r.2, the Benchmarks and the Stibor rate
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Table 5.7 Test of mean difference for the Sortino ratios of PBT r.1, r.2, r.3 and SIX ew
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6. Results from the parametric tests of the Feeders performance persistency

Table 6.1. Parametric tests on performance persistency using r.1
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7. Results from the linear regressions on market neutrality

Table 7.1. The linear regression result on market neutrality for PBT's r.1, r.2 and r.3

1. Summary Statistics of PBT and the Benchmarks

Table 1.1 Total and yearly returns for PBT's r.1, r.2, r.2, the Benchmarks and the Stibor rate

This table displays the total return for 2008-2009 as well as the yearly returns for PBT's three risk-measures, OMXS, NHX, SIX ew, SIX vw and the Stibor rate. The total return for PBT was obtained by dividing the total profit-net-loss of all pairs-trades by the sum of the average monthly time-weighted capital base (1,2 and 3). The yearly returns were calculated by dividing the years total profit-net-loss by the average monthly time-weighted capital base. Recall that PBT r.1 is the return calculated on the gross capital exposure, PBT r.2 is the return calculated on the value of the long leg and PBT r.3 the return calculated on the marginal capacity. OMXS is the Swedish All Share Market Index adjusted for dividends, NHX the Nordic Hedge Fund Index, SIX ew the equally weighted Swedish Hedge Fund Index and SIX vw the value weighted Swedish Hedge Fund Index. The Stibor rate is the Stockholm Interbank Offered Rate.

Table 1.1

RETURN	PBT r.1	PBT r.2	PBT r.3	OMXS	NHX	SIXew	SIXvw	Stibor
Total(2008-2009)	46.63%	93.20%	466.56%	-7.05%	2.14%	7.66%	12.14%	5.24%
2008	31.55%	62.96%	316.15%	-39.05%	-11.14%	-6.40%	-3.68%	4.49%
2009	20.95%	41.90%	209.55%	52.50%	14.95%	15.03%	16.43%	0.72%

Table 1.2 Total and yearly excess returns for PBT's r.1, r.2, r.2 and the Benchmarks

This table displays the total return for 2008-2009 as well as the yearly returns for PBT's three risk-measures, OMXS, NHX, SIX ew and SIX vw.. PBT's excess return is equal to the return since no risk-free rate is deducted. Recall that PBT r.1 is the return calculated on the gross capital exposure, PBT r.2 is the return calculated on the value of the long leg and PBT r.3 the return calculated on the marginal capacity. OMXS is the Swedish All Share Market Index adjusted for dividends, NHX the Nordic Hedge Fund Index, SIX ew the equally weighted Swedish Hedge Fund Index and SIX vw the value weighted Swedish Hedge Fund Index.

Table 1.2

EXCESS RETURN	PBT r.1	PBT r.2	PBT r.3	OMXS	NHX	SIX ew	SIX vw
Total(2008-2009)	46.63%	93.20%	466.56%	-12.29%	-3.10%	2.42%	6.90%
2008	31.55%	62.96%	316.15%	-43.54%	-15.63%	-10.89%	-8.17%
2009	20.95%	41.90%	209.55%	51.78%	14.22%	14.31%	15.71%

Table 1.3 Trade statistics of the PBT

This table displayThis table displays the average trading days and the number of total trades for PBT.

Table 1.3

TRADE STATISTICS, PBT	
Average trading days	6.2
Total trades	255

2. Monthly Statistics of PBT and the Benchmarks

Table 2.1. Monthly Excess returns (returns*) of PBT

Panel A displays the monthly excess returns for PBT's three return measures during 2008. Panel B displays the corresponding values for 2009. A monthly return is obtained by dividing the total profit-net-loss of all pairs-trades that have been closed that month by the sum of the time-weighted capital base (1,2 and 3) attributed to those trades. Recall that PBT r.1 is the return calculated on the gross capital exposure, PBT r.2 is the return calculated on the value of the long leg and PBT r.3 the return calculated on the marginal capacity.
* PBT's monthly excess returns are equal to the monthly returns.

Table 2.1

PANEL A	PTS r.1	PTS r.2	PTS r.3	PANEL B	PTS r.1	PTS r.2	PTS r.3
Excess return jan-08	8.23%	16.45%	82.45%	**Excess return jan-09**	-4.35%	-8.90%	-42.59%
Excess return feb-08	5.06%	10.16%	50.47%	**Excess return feb-09**	1.76%	3.53%	17.53%
Excess return mar-08	-2.16%	-4.32%	-21.64%	**Excess return mar-09**	3.71%	7.40%	37.14%
Excess return apr-08	2.82%	5.63%	28.33%	**Excess return apr-09**	3.71%	7.38%	37.29%
Excess return may-08	1.85%	3.71%	18.45%	**Excess return may-09**	2.44%	4.88%	24.42%
Excess return jun-08	3.86%	7.47%	39.93%	**Excess return jun-09**	-1.43%	-2.88%	-14.30%
Excess return jul-08	4.06%	8.13%	40.54%	**Excess return jul-09**	1.53%	3.06%	15.26%
Excess return aug-08	-1.01%	-2.01%	-10.24%	**Excess return aug-09**	0.72%	1.44%	7.18%
Excess return sep-08	0.51%	1.03%	5.09%	**Excess return sep-09**	2.67%	5.34%	26.76%
Excess return oct-08	0.13%	0.27%	1.33%	**Excess return oct-09**	2.90%	5.80%	29.04%
Excess return nov-08	0.00%	0.00%	0.00%	**Excess return nov-09**	1.13%	2.27%	11.36%
Excess return dec-08	0.00%	0.00%	0.00%	**Excess return dec-09**	-1.69%	-3.38%	-16.91%

Table 2.2. Monthly returns of the Benchmarks

Panel A displays the monthly returns for each respective Benchmarks. Panel B displays the corresponding values for 2009. OMXS is the Swedish All Share Market Index adjusted for dividends, NHX the Nordic Hedge Fund Index, SIX ew the equally weighted Swedish Hedge Fund Index and SIX vw the value weighted Swedish Hedge Fund Index.

Table 2.2

Panel A	NHX	OMXS	SIXew	SIXvw	Panel B	NHX	OMXS	SIXew	SIXvw
Return jan-08	-1.24%	-12.27%	-0.05%	0.66%	**Return jan-09**	0.85%	-5.66%	0.64%	0.84%
Return feb-08	1.34%	3.43%	1.59%	1.82%	**Return feb-09**	0.08%	2.82%	0.25%	0.82%
Return mar-08	-0.94%	-1.65%	0.02%	-0.41%	**Return mar-09**	1.47%	1.45%	0.93%	2.04%
Return apr-08	0.06%	4.91%	-0.78%	-0.89%	**Return apr-09**	3.16%	21.72%	3.48%	2.74%
Return may-08	1.17%	2.86%	0.82%	0.70%	**Return may-09**	2.29%	2.85%	2.20%	1.73%
Return jun-08	-1.81%	-13.98%	-2.66%	-1.66%	**Return jun-09**	0.32%	0.99%	0.24%	-0.13%
Return jul-08	-1.16%	-0.69%	-0.42%	0.02%	**Return jul-09**	1.44%	10.36%	1.44%	1.69%
Return aug-08	-0.17%	1.25%	0.37%	0.44%	**Return aug-09**	1.32%	3.40%	1.61%	1.59%
Return sep-08	-4.46%	-12.33%	-4.08%	-2.54%	**Return sep-09**	1.46%	0.62%	1.61%	2.12%
Return oct-08	-3.53%	-17.77%	-2.23%	-2.36%	**Return oct-09**	0.21%	4.76%	-0.49%	-0.25%
Return nov-08	-0.59%	-2.12%	0.39%	0.52%	**Return nov-09**	0.47%	-0.01%	1.05%	1.00%
Return dec-08	-0.26%	3.69%	0.57%	0.05%	**Return dec-09**	0.97%	1.91%	1.18%	1.16%

Table 2.3. Monthly Stibor rates

This table displays the monthly Stibor rates over 2008 and 2009. The Stibor rate is the Stockholm Interbank Offered Rate, the rate that we define as the risk-free rate and used in the calculation of the excess return for the Benchmarks, presented in table 1.4

Table 2.3

STIBOR RATE	jan	feb	mar	apr	may	jun	jul	aug	sep	oct	nov	dec
2008	0.36%	0.38%	0.39%	0.39%	0.38%	0.38%	0.38%	0.40%	0.43%	0.38%	0.35%	0.18%
2009	0.17%	0.10%	0.09%	0.06%	0.06%	0.06%	0.03%	0.03%	0.03%	0.03%	0.03%	0.03%

Table 2.4. Monthly excess returns of the Benchmarks

Panel A displays the monthly excess returns for each respective Benchmark in 2008. Panel B displays the corresponding values for 2009. OMXS is the Swedish All Share Market Index adjusted for dividends, NHX the Nordic Hedge Fund Index, SIX ew the equally weighted Swedish Hedge Fund Index and SIX vw the value weighted Swedish Hedge Fund Index.

Table 2.4

PANEL A	NHX	OMXS	SIXew	SIXvw	PANEL B	NHX	OMXS	SIXew	SIXvw
Excess return jan-08	-1.60%	-12.63%	-0.41%	0.30%	**Excess return jan-09**	0.68%	2.65%	0.48%	0.68%
Excess return feb-08	0.97%	3.06%	1.21%	1.44%	**Excess return feb-09**	-0.01%	1.35%	0.15%	0.72%
Excess return mar-08	-1.33%	-2.04%	-0.37%	-0.80%	**Excess return mar-09**	1.38%	21.63%	0.84%	1.95%
Excess return apr-08	-0.33%	4.52%	-1.17%	-1.27%	**Excess return apr-09**	3.10%	2.79%	3.42%	2.68%
Excess return maj-08	0.79%	2.48%	0.44%	0.31%	**Excess return maj-09**	2.23%	0.92%	2.14%	1.67%
Excess return jun-08	-2.19%	-14.36%	-3.04%	-2.05%	**Excess return jun-09**	0.26%	10.30%	0.17%	-0.19%
Excess return jul-08	-1.55%	-1.08%	-0.81%	-0.36%	**Excess return jul-09**	1.41%	3.36%	1.40%	1.66%
Excess return aug-08	-0.56%	0.86%	-0.02%	0.04%	**Excess return aug-09**	1.29%	0.58%	1.57%	1.55%
Excess return sep-08	-4.89%	-12.76%	-4.51%	-2.98%	**Excess return sep-09**	1.43%	4.73%	1.58%	2.09%
Excess return okt-08	-3.91%	-18.15%	-2.61%	-2.73%	**Excess return okt-09**	0.18%	-0.04%	-0.52%	-0.28%
Excess return nov-08	-0.94%	-2.47%	0.04%	0.17%	**Excess return nov-09**	0.44%	1.88%	1.02%	0.97%
Excess return dec-08	-0.44%	3.51%	0.39%	-0.13%	**Excess return dec-09**	0.94%	-0.03%	1.16%	1.13%

Table 2.5. Measures of risk for PBT and the Benchmarks

Table 3.1 displays the risk-measures used as inputs in the calculation of the monthly Sharpe-, and Sortino ratios. The monthly standard deviations (Stdev) were calculated on monthly returns over the complete time period 2008-2009. The downside risk (DR risk) measures were calculated by taking the standard deviation of the values below the MAR (the Stibor rate) of the monthly returns in 2008 and 2009.

Table 2.5

RISK-MEASURES	PTS r.1	PTS r.2	PTS r.3	NHX	OMXS	SIXew	SIXvw
Stdev 08-09	2.69%	5.40%	26.92%	1.72%	8.21%	1.65%	1.33%
DR risk 08-09	1.04%	2.11%	10.24%	3.03%	5.43%	1.17%	0.89%

Table 2.6. Monthly Sharpe ratios of PBT

Panel A displays the monthly Sharpe ratios for PBT's three return measures during 2008. Panel B displays the corresponding values for 2009. Recall that PBT r.1 is the return calculated on the gross capital exposure, PBT r.2 is the return calculated on the value of the long leg and PBT r.3 the return calculated on the marginal capacity. The Sharpe ratio (S) was calculated through the following formula: $S = \frac{ER_i}{\sigma_i}$, where ERi is the monthly excess return of return measure (i), and σi is the monthly standard deviation of return measure (i).

Table 2.6

PANEL A	PTS r.1	PTS r.2	PTS r.3	PANEL B	PTS r.1	PTS r.2	PTS r.3
Sharpe jan-08	3.06	3.05	3.06	**Sharpe jan-09**	-1.62	-1.65	-1.58
Sharpe feb-08	1.88	1.88	1.87	**Sharpe feb-09**	0.65	0.65	0.65
Sharpe mar-08	-0.80	-0.80	-0.80	**Sharpe mar-09**	1.38	1.37	1.38
Sharpe apr-08	1.05	1.04	1.05	**Sharpe apr-09**	1.38	1.37	1.39
Sharpe may-08	0.69	0.69	0.69	**Sharpe may-09**	0.91	0.91	0.91
Sharpe jun-08	1.43	1.39	1.48	**Sharpe jun-09**	-0.53	-0.53	-0.53
Sharpe jul-08	1.51	1.51	1.51	**Sharpe jul-09**	0.57	0.57	0.57
Sharpe aug-08	-0.38	-0.37	-0.38	**Sharpe aug-09**	0.27	0.27	0.27
Sharpe sep-08	0.19	0.19	0.19	**Sharpe sep-09**	0.99	0.99	0.99
Sharpe oct-08	0.05	0.05	0.05	**Sharpe oct-09**	1.08	1.08	1.08
Sharpe nov-08	0.00	0.00	0.00	**Sharpe nov-09**	0.42	0.42	0.42
Sharpe dec-08	0.00	0.00	0.00	**Sharpe dec-09**	-0.63	-0.63	-0.63

Table 2.7. Monthly Sharpe ratios of the Benchmarks

Panel A displays the monthly Sharpe ratios for each respective Benchmark in 2008. Panel B displays the corresponding values for 2009. OMXS is the Swedish All Share Market Index adjusted for dividends, NHX the Nordic hedge fund index, SIX ew the equally weighted Swedish hedge fund index and SIX vw the value weighted Swedish hedge fund index. The Sharpe ratio (S) was calculated through the following formula: $S = \frac{ER_i}{\sigma_i}$, where ERi is the monthly excess return of benchmark (i), and σi is the monthly standard deviation of benchmark (i).

Table 2.7

PANEL A	NHX	OMXS	SIXew	SIXvw	PANEL B	NHX	OMXS	SIXew	SIXvw
Sharpe jan-08	-0.93	-1.54	-0.25	0.23	**Sharpe jan-09**	0.40	0.32	0.29	0.76
Sharpe feb-08	0.56	0.37	0.73	1.09	**Sharpe feb-09**	-0.01	0.16	0.09	0.81
Sharpe mar-08	-0.77	-0.25	-0.22	-0.60	**Sharpe mar-09**	0.80	2.64	0.51	2.19
Sharpe apr-08	-0.19	0.55	-0.71	-0.96	**Sharpe apr-09**	1.80	0.34	2.08	3.01
Sharpe may-08	0.46	0.30	0.27	0.24	**Sharpe may-09**	1.30	0.11	1.30	1.88
Sharpe jun-08	-1.27	-1.75	-1.85	-1.54	**Sharpe jun-09**	0.15	1.26	0.11	-0.22
Sharpe jul-08	-0.90	-0.13	-0.49	-0.27	**Sharpe jul-09**	0.82	0.41	0.85	1.86
Sharpe aug-08	-0.33	0.10	-0.01	0.03	**Sharpe aug-09**	0.75	0.07	0.96	1.75
Sharpe sep-08	-2.84	-1.55	-2.74	-2.24	**Sharpe sep-09**	0.83	0.58	0.96	2.35
Sharpe oct-08	-2.27	-2.21	-1.58	-2.06	**Sharpe oct-09**	0.11	0.00	-0.31	-0.31
Sharpe nov-08	-0.55	-0.30	0.03	0.13	**Sharpe nov-09**	0.26	0.23	0.62	1.09
Sharpe dec-08	-0.26	0.43	0.24	-0.10	**Sharpe dec-09**	0.55	0.00	0.70	1.27

Table 2.8. Monthly Sortino ratios of PBT

Panel A displays the monthly Sortino ratios for PBT's three return measures during 2008. Panel B displays the corresponding values for 2009. Recall that PBT r.1 is the return calculated on the gross capital exposure, PBT r.2 is the return calculated on the value of the long leg and PBT r.3 the return calculated on the marginal capacity. The Sortino ratio (Sr) was calculated through the following formula:
$Sr = \frac{ER_i}{DR_i}$, where ERi is the monthly return of return measure (i), and DRi is the downside risk of return measure (i) defined as the monthly standard deviation below the Stibor rate.

Table 2.8

PANEL A	PBT r.1	PBT r.2	PBT r.3	PANEL B	PBT r.1	PBT r.2	PBT r.3
Sortino jan-08	7.92	7.79	8.05	**Sortino jan-09**	-4.19	-4.22	-4.16
Sortino feb-08	4.87	4.82	4.93	**Sortino feb-09**	1.69	1.67	1.71
Sortino mar-08	-2.08	-2.05	-2.11	**Sortino mar-09**	3.57	3.51	3.63
Sortino apr-08	2.72	2.67	2.77	**Sortino apr-09**	3.57	3.50	3.64
Sortino may-08	1.78	1.76	1.80	**Sortino may-09**	2.35	2.31	2.38
Sortino jun-08	3.72	3.54	3.90	**Sortino jun-09**	-1.38	-1.36	-1.40
Sortino jul-08	3.91	3.85	3.96	**Sortino jul-09**	1.47	1.45	1.49
Sortino aug-08	-0.98	-0.95	-1.00	**Sortino aug-09**	0.69	0.68	0.70
Sortino sep-08	0.49	0.49	0.50	**Sortino sep-09**	2.57	2.53	2.61
Sortino oct-08	0.13	0.13	0.13	**Sortino oct-09**	2.79	2.75	2.84
Sortino nov-08	0.00	0.00	0.00	**Sortino nov-09**	1.09	1.07	1.11
Sortino dec-08	0.00	0.00	0.00	**Sortino dec-09**	-1.63	-1.60	-1.65

Table 2.9. Average monthly Sortino ratios of PBT

This table displays the average monthly Sortino ratios of the PBT for 2008, 2009 and over the complete time period (2008-2009).

Table 2.9

Average Monthly Sortino	PBT r.1	PBT r.2	PBT r.3
2008	1.87	1.84	1.91
2009	1.05	1.02	1.08
2008 and 2009	1.46	1.43	1.49

Table 2.10. Monthly Sortino ratios of the Benchmarks

Panel A displays the monthly sortinoSortino ratios for each respective Benchmark in 2008. Panel B displays the corresponding values for 2009. OMXS is the Swedish All Share Market Index adjusted for dividends, NHX the Nordic hedge fund index, SIX ew the equally weighted Swedish hedge fund index and SIX vw the value weighted Swedish hedge fund index. The Sortino ratio (Sr) was calculated through the following formula $Sr = \frac{ER_i}{DR_i}$, where ERi is the monthly return of return benchmark (i), and DRi is the downside risk of return benchmark (i) defined as the monthly standard deviation below the Stibor rate.

Table 2.9

PANEL A	NHX	OMXS	SIXew	SIXvw	PANEL B	NHX	OMXS	SIXew	SIXvw
Sortino jan-08	-0,53	-2,33	-0,35	0,34	**Sortino jan-09**	0,23	0,49	0,41	0,76
Sortino feb-08	0,32	0,56	1,03	1,62	**Sortino feb-09**	0,00	0,25	0,13	0,81
Sortino mar-08	-0,44	-0,38	-0,31	-0,90	**Sortino mar-09**	0,46	3,98	0,72	2,19
Sortino apr-08	-0,11	0,83	-1,00	-1,43	**Sortino apr-09**	1,02	0,51	2,93	3,02
Sortino may-08	0,26	0,46	0,38	0,35	**Sortino may-09**	0,74	0,17	1,83	1,88

Sortino jun-08	-0,72	-2,64	-2,60	-2,30	**Sortino jun-09**	0,09	1,90	0,15	-0,22
Sortino jul-08	-0,51	-0,20	-0,69	-0,41	**Sortino jul-09**	0,47	0,62	1,20	1,86
Sortino aug-08	-0,19	0,16	-0,02	0,05	**Sortino aug-09**	0,43	0,11	1,35	1,75
Sortino sep-08	-1,62	-2,35	-3,86	-3,35	**Sortino sep-09**	0,47	0,87	1,35	2,35
Sortino oct-08	-1,29	-3,34	-2,23	-3,07	**Sortino oct-09**	0,06	-0,01	-0,44	-0,31
Sortino nov-08	-0,31	-0,45	0,04	0,19	**Sortino nov-09**	0,15	0,35	0,87	1,09
Sortino dec-08	-0,15	0,65	0,33	-0,15	**Sortino dec-09**	0,31	-0,01	0,99	1,28

3. Summary Statistics of the Feeders

3.1 The total excess returns of the Feeders

The total return for each Feeder was obtained by dividing the total profit-net-loss of all pairs-trades initiated by Feeder (i) by the sum of the average monthly time-weighted capital base (1,2 and 3) of Feeder (i). Recall that PBT r.1 is the return calculated on the gross capital exposure, PBT r.2 is the return calculated on the value of the long leg and PBT r.3 the return calculated on the marginal capacity.

Table 3.1

TOTAL EXCESS RETURN, FEEDER	A	A2	B	C	D	E	F	G
r.1	-48.75%	9.50%	54.31%	26.35%	255.30%	208.09%	92.08%	122.39%
r.2	-98.08%	18.97%	108.74%	52.42%	509.23%	416.12%	184.13%	244.88%
r.3	-484.63%	95.23%	542.45%	265.01%	2559.87%	2081.23%	920.93%	1223.38%

3.2 The risk-adjusted returns of the Feeders

This table displays the risk-adjusted returns of the Feeders over the complete time period. The risk-adjusted returns were calculated by dividing the total return by the standard deviation of the monthly returns. Recall that PBT r.1 is the return calculated on the gross capital exposure, PBT r.2 is the return calculated on the value of the long leg and PBT r.3 the return calculated on the marginal capacity.

Table 3.2

RISK-ADJUSTED RETURN	A	A2	B	C	D	E	F	G
r.1	-0.02	0.27	2.21	0.94	9.55	11.66	2.99	9.87
r.2	-2.51	0.27	2.21	0.92	9.58	11.91	3.00	9.90
r.3	-2.50	0.27	2.21	0.94	9.48	11.42	2.99	9.84

3.3 The trade statistics of the Feeders

This table displays the average trading days and the number of total trades for every Feeder.

Table 3.3

TRADE STATISTICS, FEEDER	A	A2	B	C	D	E	F	G
Average trading days	7.00	5.00	4.68	5.21	4.13	7.51	2.63	10.76
Total trades	12.00	11.00	28.00	14.00	38.00	43.00	51.00	58.00

4. Monthly Statistics of the Feeders

Table 4.1. The monthly excess returns, the monthly standard deviations and the monthly Sharpe ratios of Feeder A

This table displays the monthly excess returns, the monthly standard deviations and the sharpeSharpe ratio for each of the three return measurements of Feeder A. Recall that r.1 is the return calculated on the gross capital exposure, r.2 is the return calculated on the value of the long leg and r.3 the return calculated on the marginal capacity. The Sharpe ratio (S) was calculated through the following formula: $S = \frac{ER_i}{\sigma_i}$, where ERi is the monthly excess return of return measure (i), and σi is the monthly standard deviation of return measure (i).

Table 4.1

FEEDER A	Excess Return r.1	Excess Return r.2	Excess Return r.3	Stdev r.1	Stdev r.2	Stdev r.3	Sharpe r.1	Sharpe r.2	Sharpe r.3
feb-09	2.96%	5.94%	29.43%	5.67%	11.28%	55.96%	0.52	0.53	0.53
mar-09	-9.19%	-18.03%	-89.28%	5.67%	11.28%	55.96%	-1.62	-1.60	-1.60
apr-09	7.01%	14.02%	70.10%	5.67%	11.28%	55.96%	1.24	1.24	1.25
may-09	-4.19%	-8.38%	-41.85%	5.67%	11.28%	55.96%	-0.74	-0.74	-0.75
jun-09	-7.07%	-14.28%	-69.97%	5.67%	11.28%	55.96%	-1.25	-1.27	-1.25
jul-09	-0.59%	-1.21%	-5.66%	5.67%	11.28%	55.96%	-0.10	-0.11	-0.10
oct-09	0.01%	0.02%	0.11%	5.67%	11.28%	55.96%	0.00	0.00	0.00

Table 4.2. The monthly excess returns, the monthly standard deviations and the monthly Sharpe ratios of Feeder A2

This table displays the monthly excess returns, the monthly standard deviations and the Sharpe ratios for each of the three return measurements of Feeder A. Recall that r.1 is the return calculated on the gross capital exposure, r.2 is the return calculated on the value of the long leg and r.3 the return calculated on the marginal capacity. The Sharpe ratio (S) was calculated through the following formula: $S = \frac{ER_i}{\sigma_i}$, where ERi is the monthly excess return of return measure (i), and σi is the monthly standard deviation of return measure (i).

Table 4.2

FEEDER A2	Excess Return r.1	Excess Return r.2	Excess Return r.3	Stdev r.1	Stdev r.2	Stdev r.3	Sharpe r.1	Sharpe r.2	Sharpe r.3
oct-09	5.4%	10.7%	53.8%	10.3%	20.6%	103.5%	0.52	0.52	0.52
nov-09	6.8%	13.6%	68.0%	10.3%	20.6%	103.5%	0.66	0.66	0.66
dec-10	-11.8%	-23.4%	-117.9%	10.3%	20.6%	103.5%	-1.14	-1.14	-1.14

Table 4.3. The monthly excess returns, the monthly standard deviations and the monthly Sharpe ratios of Feeder B

This table displays the monthly excess returns, the monthly standard deviations and the Sharpe ratios for each of the three return measurements of Feeder B. Recall that r.1 is the return calculated on the gross capital exposure, r.2 is the return calculated on the value of the long leg and r.3 the return calculated on the marginal capacity. The Sharpe ratio (S) was calculated through the following formula: $S = \frac{ER_i}{\sigma_i}$, where ERi is the monthly excess return of return measure (i), and σi is the monthly standard deviation of return measure (i).

Table 4.3

FEEDER B	Excess Return r.1	Excess Return r.2	Excess Return r.3	Stdev r.1	Stdev r.2	Stdev r.3	Sharpe r.1	Sharpe r.2	Sharpe r.3
jan-08	4.98%	9.97%	49.75%	7.09%	14.19%	70.91%	0.70	0.70	0.70
feb-08	4.35%	8.70%	43.51%	7.09%	14.19%	70.91%	0.61	0.61	0.61
mar-08	-6.87%	-14.02%	-68.67%	7.09%	14.19%	70.91%	-0.97	-0.99	-0.97
apr-08	4.80%	9.61%	47.92%	7.09%	14.19%	70.91%	0.68	0.68	0.68
may-08	-1.00%	-2.01%	-9.87%	7.09%	14.19%	70.91%	-0.14	-0.14	-0.14
aug-08	1.49%	2.79%	13.95%	7.09%	14.19%	70.91%	0.21	0.20	0.20
sep-08	6.79%	13.58%	67.88%	7.09%	14.19%	70.91%	0.96	0.96	0.96
okt-08	0.18%	0.35%	1.76%	7.09%	14.19%	70.91%	0.02	0.02	0.02
jan-09	-13.51%	-27.02%	-135.07%	7.09%	14.19%	70.91%	-1.91	-1.90	-1.90
feb-09	6.42%	12.77%	64.56%	7.09%	14.19%	70.91%	0.91	0.90	0.91
maj-09	14.31%	28.60%	143.15%	7.09%	14.19%	70.91%	2.02	2.02	2.02
jun-09	4.23%	8.48%	42.28%	7.09%	14.19%	70.91%	0.60	0.60	0.60
aug-09	1.89%	3.77%	18.86%	7.09%	14.19%	70.91%	0.27	0.27	0.27
sep-09	-9.54%	-19.07%	-95.36%	7.09%	14.19%	70.91%	-1.35	-1.34	-1.34
oct-09	-7.57%	-15.12%	-75.78%	7.09%	14.19%	70.91%	-1.07	-1.07	-1.07

Table 4.4. The monthly excess returns, the monthly standard deviations and the monthly Sharpe ratios of Feeder C

This table displays the monthly excess returns, the monthly standard deviations and the Sharpe ratios for each of the three return measurements of Feeder C. Recall that r.1 is the return calculated on the gross capital exposure, r.2 is the return calculated on the value of the long leg and r.3 the return calculated on the marginal capacity. The Sharpe ratio (S) was calculated through the following formula: $S = \frac{ER_i}{\sigma_i}$, where ERi is the monthly excess return of return measure (i), and σi is the monthly standard deviation of return measure (i).

Table 4.4

FEEDER C	Excess Return r.1	Excess Return r.2	Excess Return r.3	Stdev r.1	Stdev r.2	Stdev r.3	Sharpe r.1	Sharpe r.2	Sharpe r.3
apr-09	2.59%	5.05%	26.52%	8.09%	16.37%	81.24%	0.32	0.31	0.33
may-09	8.84%	17.61%	88.81%	8.09%	16.37%	81.24%	1.09	1.08	1.09
jun-09	-4.83%	-10.68%	-48.34%	8.09%	16.37%	81.24%	-0.60	-0.65	-0.59
sep-09	7.30%	14.58%	73.14%	8.09%	16.37%	81.24%	0.90	0.89	0.90
oct-09	-12.15%	-24.71%	-122.31%	8.09%	16.37%	81.24%	-1.50	-1.51	-1.51
dec-09	-4.33%	-8.67%	-43.33%	8.09%	16.37%	81.24%	-0.54	-0.53	-0.53

Table 4.5. The monthly excess returns, the monthly standard deviations and the monthly Sharpe ratios of Feeder D

This table displays the monthly excess returns, the monthly standard deviations and the Sharpe ratios for each of the three return measurements of Feeder D. Recall that r.1 is the return calculated on the gross capital exposure, r.2 is the return calculated on the value of the long leg and r.3 the return calculated on the marginal capacity. The Sharpe ratio (S) was calculated through the following formula: $S = \frac{ER_i}{\sigma_i}$, where ERi is the monthly excess return of return measure (i), and σi is the monthly standard deviation of return measure (i).

Table 4.5

FEEDER D	Excess Return r.1	Excess Return r.2	Excess Return r.3	Stdev r.1	Stdev r.2	Stdev r.3	Sharpe r.1	Sharpe r.2	Sharpe r.3
feb-08	9.85%	19.67%	98.69%	7.72%	15.35%	77.92%	1.28	1.28	1.27
mar-08	-13.55%	-27.29%	-134.58%	7.72%	15.35%	77.92%	-1.75	-1.78	-1.73
apr-08	4.60%	9.28%	45.66%	7.72%	15.35%	77.92%	0.60	0.60	0.59
may-08	-13.72%	-27.57%	-136.55%	7.72%	15.35%	77.92%	-1.78	-1.80	-1.75
jun-08	-11.96%	-22.50%	-127.62%	7.72%	15.35%	77.92%	-1.55	-1.47	-1.64
sep-08	5.14%	10.55%	50.05%	7.72%	15.35%	77.92%	0.66	0.69	0.64
jan-09	-2.50%	-5.16%	-24.20%	7.72%	15.35%	77.92%	-0.32	-0.34	-0.31
feb-09	-7.57%	-15.55%	-73.71%	7.72%	15.35%	77.92%	-0.98	-1.01	-0.95
mar-09	11.03%	21.89%	111.17%	7.72%	15.35%	77.92%	1.43	1.43	1.43
may-09	1.17%	2.32%	11.78%	7.72%	15.35%	77.92%	0.15	0.15	0.15
jun-09	3.64%	7.33%	36.11%	7.72%	15.35%	77.92%	0.47	0.48	0.46
jul-09	-5.87%	-11.10%	-62.22%	7.72%	15.35%	77.92%	-0.76	-0.72	-0.80
sep-09	-1.27%	-2.51%	-12.85%	7.72%	15.35%	77.92%	-0.16	-0.16	-0.16
oct-09	4.74%	9.48%	47.41%	7.72%	15.35%	77.92%	0.61	0.62	0.61
nov-09	3.75%	7.46%	37.61%	7.72%	15.35%	77.92%	0.48	0.49	0.48
dec-09	5.11%	10.16%	51.51%	7.72%	15.35%	77.92%	0.66	0.66	0.66

Table 4.6. The monthly excess returns, the monthly standard deviations and the monthly Sharpe ratios of Feeder E

This table displays the monthly excess returns, the monthly standard deviations and the Sharpe ratios for each of the three return measurements of Feeder E. Recall that r.1 is the return calculated on the gross capital exposure, r.2 is the return calculated on the value of the long leg and r.3 the return calculated on the marginal capacity. The Sharpe ratio (S) was calculated through the following formula: $S = \frac{ER_i}{\sigma_i}$, where ERi is the monthly excess return of return measure (i), and σi is the monthly standard deviation of return measure (i).

Table 4.6

FEEDER E	Excess Return r.1	Excess Return r.2	Excess Return r.3	Stdev r.1	Stdev r.2	Stdev r.3	Sharpe r.1	Sharpe r.2	Sharpe r.3
apr-08	-0.91%	-1.80%	-9.33%	5.15%	10.09%	52.61%	-0.18	-0.18	-0.18
may-08	0.78%	1.54%	7.82%	5.15%	10.09%	52.61%	0.15	0.15	0.15
jun-08	17.14%	33.32%	176.45%	5.15%	10.09%	52.61%	3.32	3.30	3.35
sep-08	-1.65%	-3.31%	-16.49%	5.15%	10.09%	52.61%	-0.32	-0.33	-0.31
feb-09	2.47%	4.95%	24.67%	5.15%	10.09%	52.61%	0.48	0.49	0.47
mar-09	1.29%	2.58%	12.93%	5.15%	10.09%	52.61%	0.25	0.26	0.25
apr-09	-6.74%	-13.23%	-67.43%	5.15%	10.09%	52.61%	-1.31	-1.31	-1.28
may-09	-0.72%	-1.45%	-7.21%	5.15%	10.09%	52.61%	-0.14	-0.14	-0.14
jun-09	1.17%	2.33%	11.66%	5.15%	10.09%	52.61%	0.23	0.23	0.22
jul-09	5.98%	11.92%	59.95%	5.15%	10.09%	52.61%	1.16	1.18	1.14
aug-09	2.23%	4.49%	22.13%	5.15%	10.09%	52.61%	0.43	0.45	0.42
sep-09	-0.36%	-0.72%	-3.56%	5.15%	10.09%	52.61%	-0.07	-0.07	-0.07
oct-09	3.50%	7.01%	35.06%	5.15%	10.09%	52.61%	0.68	0.69	0.67
nov-09	-3.22%	-6.43%	-32.22%	5.15%	10.09%	52.61%	-0.62	-0.64	-0.61
dec-09	-2.09%	-4.20%	-20.76%	5.15%	10.09%	52.61%	-0.40	-0.42	-0.39

Table 4.7. The monthly excess returns, the monthly standard deviations and the monthly Sharpe ratios of Feeder F

This table displays the monthly excess returns, the monthly standard deviations and the Sharpe ratios for each of the three return measurements of Feeder F. Recall that r.1 is the return calculated on the gross capital exposure, r.2 is the return calculated on the value of the long leg and r.3 the return calculated on the marginal capacity. The Sharpe ratio (S) was calculated through the following formula: $S = \frac{ER_i}{\sigma_i}$, where ERi is the monthly excess return of return measure (i), and σi is the monthly standard deviation of return measure (i).

Table 4.7

FEEDER F	Excess Return r.1	Excess Return r.2	Excess Return r.3	Stdev r.1	Stdev r.2	Stdev r.3	Sharpe r.1	Sharpe r.2	Sharpe r.3
mar-09	4.61%	9.22%	46.08%	8.88%	17.73%	89.00%	0.52	0.52	0.52
apr-09	4.74%	9.48%	47.51%	8.88%	17.73%	89.00%	0.53	0.53	0.53
may-09	0.88%	1.77%	8.82%	8.88%	17.73%	89.00%	0.10	0.10	0.10
jun-09	-11.72%	-23.38%	-117.46%	8.88%	17.73%	89.00%	-1.32	-1.32	-1.32
jul-09	0.65%	1.29%	6.47%	8.88%	17.73%	89.00%	0.07	0.07	0.07
aug-09	4.95%	9.92%	49.34%	8.88%	17.73%	89.00%	0.56	0.56	0.55
sep-09	-2.05%	-4.10%	-20.60%	8.88%	17.73%	89.00%	-0.23	-0.23	-0.23
oct-09	3.42%	6.84%	34.26%	8.88%	17.73%	89.00%	0.39	0.39	0.38
nov-09	0.43%	0.86%	4.32%	8.88%	17.73%	89.00%	0.05	0.05	0.05
dec-09	-22.71%	-45.31%	-227.60%	8.88%	17.73%	89.00%	-2.56	-2.55	-2.56

Table 4.8. The monthly excess returns, the monthly standard deviations and the monthly Sharpe ratios of Feeder G

This table displays the monthly excess returns, the monthly standard deviations and the Sharpe ratios for each of the three return measurements of Feeder G. Recall that r.1 is the return calculated on the gross capital exposure, r.2 is the return calculated on the value of the long leg and r.3 the return calculated on the marginal capacity. The Sharpe ratio (S) was calculated through the following formula: $S = \frac{ER_i}{\sigma_i}$, where ERi is the monthly excess return of return measure (i), and σi is the monthly standard deviation of return measure (i).

Table 4.8

FEEDER G	Excess Return r.1	Excess Return r.2	Excess Return r.3	Stdev r.1	Stdev r.2	Stdev r.3	Sharpe r.1	Sharpe r.2	Sharpe r.3
jan-08	5.59%	11.16%	56.05%	3.58%	7.14%	35.89%	1.56	1.56	1.56
feb-08	2.15%	4.37%	21.21%	3.58%	7.14%	35.89%	0.60	0.61	0.59
mar-08	5.07%	9.72%	51.37%	3.58%	7.14%	35.89%	1.42	1.36	1.43
apr-08	5.13%	10.20%	51.56%	3.58%	7.14%	35.89%	1.43	1.43	1.44
may-08	6.16%	12.41%	6.16%	3.58%	7.14%	35.89%	1.72	1.74	0.17
jun-08	7.20%	14.39%	72.07%	3.58%	7.14%	35.89%	2.01	2.02	2.01
jul-08	2.34%	7.10%	23.36%	3.58%	7.14%	35.89%	0.65	0.99	0.65
sep-08	-5.91%	-11.82%	-59.17%	3.58%	7.14%	35.89%	-1.65	-1.66	-1.65
feb-09	-0.11%	-0.21%	-1.07%	3.58%	7.14%	35.89%	-0.03	-0.03	-0.03
mar-09	4.72%	9.46%	47.16%	3.58%	7.14%	35.89%	1.32	1.33	1.31
apr-09	7.94%	15.93%	79.21%	3.58%	7.14%	35.89%	2.22	2.23	2.21
may-09	8.05%	16.06%	80.77%	3.58%	7.14%	35.89%	2.25	2.25	2.25
jun-09	0.16%	0.32%	1.59%	3.58%	7.14%	35.89%	0.04	0.04	0.04

jul-09	1.59%	3.18%	15.93%	3.58%	7.14%	35.89%	0.44	0.45	0.44
aug-09	-0.26%	-0.52%	-5.03%	3.58%	7.14%	35.89%	-0.07	-0.07	-0.14
sep-09	8.27%	16.55%	82.59%	3.58%	7.14%	35.89%	2.31	2.32	2.30
oct-09	4.46%	8.92%	44.62%	3.58%	7.14%	35.89%	1.24	1.25	1.24
nov-09	2.01%	4.01%	20.20%	3.58%	7.14%	35.89%	0.56	0.56	0.56
dec-09	3.48%	6.96%	34.78%	3.58%	7.14%	35.89%	0.97	0.98	0.97

5. Results from the two-tailed mean difference test

Table 5.1 Test of mean difference for the Sortino ratios of PBT r.1, r.2, r.3 and NHX

This table displays the results from the two-tailed t-test performed on the mean difference between the Sortino ratio of the benchmark and PBT's Sortino ratio r.1 under the following hypothesis:
H0: Sortino ratio NHX – Sortino ratio PBT = 0, H1: Sortino ratio NHX– Sortino ratio PBT ≠ 0
As shown in the picture, the results from both the test on equal- and unequal variances are presented.

Table 5.1

Equal variances

Sortino	Mean	Std. Err	Stdev	t-stat	Sign. level
NHX	-0.0365544	0.1235791	0.6054116		
PBT r.1	1.487642	0.5385701	2.638444		
Combined	0.7255437	0.2950688	2.044297		
Diff.	-1.524196	0.5525663		-2.7584	***

Unequal variances

Sortino	Mean	Std. Err	Stdev	t-stat	Sign. level
NHX	-0.0365544	0.1235791	0.6054116		
PBT r.1	1.487642	0.5385701	2.638444		
Combined	0.7255437	0.2950688	2.044297		
Diff.	-1.524196	0.5525663		-2.7584	***

Equal variances

Sortino	Mean	Std. Err	Stdev	t-stat	Sign. level
NHX	-0.0365544	0.1235791	0.6054116		
PBT r.2	1.456264	0.5311374	2.602031		
Combined	0.709855	0.2908894	2.015341		
Diff.	-1.492819	0.5453244		-2.7375	***

Unequal variances

Sortino	Mean	Std. Err	Stdev	t-stat	Sign. level
NHX	-0.0365544	0.1235791	0.6054116		
PBT r.2	1.456264	0.5311374	2.602031		
Combined	0.709855	0.2908894	2.015341		
Diff.	-1.492819	0.5453244		-2.7375	***

Equal variances

Sortino	Mean	Std. Err	Stdev	t-stat	Sign. level
NHX	-0.0365544	0.1235791	0.6054116		
PBT r.3	1.518912	0.5460109	2.674896		
Combined	0.7411787	0.2992532	2.073287		
Diff.	-1.555466	0.5598212		-2.7785	***

Unequal variances

Sortino	Mean	Std. Err	Stdev	t-stat	Sign. level
NHX	-0.0365544	0.1235791	0.6054116		
PBT r.3	1.518912	0.5460109	2.674896		
Combined	0.7411787	0.2992532	2.073287		
Diff.	-1.555466	0.5598212		-2.7785	***

***** Statistically different from zero at 1% level**

**** Statistically different from zero at 5% level**

*** Statistically different from zero at 10% level**

Table 5.2 Test of mean difference for the Sortino ratios of PBT r.1, r.2, r.3 and OMXS

This table displays the results from the two-tailed t-test performed on the mean difference between the Sortino ratio of the benchmark and PBT's Sortino ratio r.1 under the following hypothesis:
H0: Sortino ratio OMXS – Sortino ratio PBT = 0, H1: Sortino ratio OMXS – Sortino ratio PBT ≠ 0
As shown in the picture, the results from both the test on equal- and unequal variances are presented.

Table 5.2

Equal variances						Unequal variances					
Sortino	**Mean**	**Std. Err**	**Stdev**	**t-stat**	**Sign. level**	**Sortino**	**Mean**	**Std. Err**	**Stdev**	**t-stat**	**Sign. level**
OMXS	0.0084115	0.3083074	1.510392			**OMXS**	0.0084115	0.3083074	1.510392		
PBT r.1	1.487642	0.5385701	2.638444			**PBT r.1**	1.487642	0.5385701	2.638444		
Combined	0.7480267	0.3253741	2.254258			**Combined**	0.7480267	0.3253741	2.254258		
Diff.	-1.47923	0.6205732		-2.3837	**	**Diff.**	-1.47923	0.6205732		-2.3837	**

Sortino	**Mean**	**Std. Err**	**Stdev**	**t-stat**	**Sign. level**	**Sortino**	**Mean**	**Std. Err**	**Stdev**	**t-stat**	**Sign. level**
OMXS	0.0084115	0.3083074	1.510392			**OMXS**	0.0084115	0.3083074	1.510392		
PBT r.2	1.456264	0.5311374	2.602031			**PBT r.2**	1.456264	0.5311374	2.602031		
Combined	0.732338	0.3216121	2.228194			**Combined**	0.732338	0.3216121	2.228194		
Diff.	-1.447853	0.6141338		-2.3576	**	**Diff.**	-1.447853	0.6141338		-2.3576	**

Sortino	**Mean**	**Std. Err**	**Stdev**	**t-stat**	**Sign. level**	**Sortino**	**Mean**	**Std. Err**	**Stdev**	**t-stat**	**Sign. level**
OMXS	0.0084115	0.3083074	1.510392			**OMXS**	0.0084115	0.3083074	1.510392		
PBT r.3	1.518912	0.5460109	2.674896			**PBT r.3**	1.518912	0.5460109	2.674896		
Combined	0.7636617	0.3291507	2.280423			**Combined**	0.7636617	0.3291507	2.280423		
Diff.	-1.5105	0.6270418		-2.4089	***	**Diff.**	-1.5105	0.6270418		-2.4089	**

***** Statistically different from zero at 1% level**

**** Statistically different from zero at 5% level**

*** Statistically different from zero at 10% level**

Table 5.3 Test of mean difference for the Sortino ratios of PBT r.1, r.2, r.3 and SIX ew

This table displays the results from the two-tailed t-test performed on the mean difference between the Sortino ratio of the benchmark and PBT's Sortino ratio r.1 under the following hypothesis:
H0: Sortino ratio SIX ew – Sortino ratio PBT = 0, H1: Sortino ratio SIX ew – Sortino ratio PBT ≠ 0
As shown in the picture, the results from both the test on equal- and unequal variances are presented.

Table 5.3

Equal variances						Unequal variances					
Sortino	**Mean**	**Std. Err**	**Stdev**	**t-stat**	**Sign. level**	**Sortino**	**Mean**	**Std. Err**	**Stdev**	**t-stat**	**Sign. level**
SIXew	0.0917931	0.2982087	1.460918			**SIXew**	0.0917931	0.2982087	1.460918		
PBT r.1	1.487642	0.5385701	2.638444			**PBT r.1**	1.487642	0.5385701	2.638444		
Combined	0.7897175	0.3210832	2.22453			**Combined**	0.7897175	0.3210832	2.22453		
Diff.	-1.395849	0.6156185		-2.2674	**	**Diff.**	-1.395849	0.6156185		-2.2674	**

Sortino	**Mean**	**Std. Err**	**Stdev**	**t-stat**	**Sign. level**	**Sortino**	**Mean**	**Std. Err**	**Stdev**	**t-stat**	**Sign. level**
SIXew	0.0917931	0.2982087	1.460918			**SIXew**	0.0917931	0.2982087	1.460918		
PBT r.2	1.456264	0.5311374	2.602031			**PBT r.2**	1.456264	0.5311374	2.602031		
Combined	0.7740288	0.3173142	2.198418			**Combined**	0.7740288	0.3173142	2.198418		
Diff.	-1.364471	0.6091267		-2.2400	**	**Diff.**	-1.364471	0.6091267		-2.2400	**

Sortino	**Mean**	**Std. Err**	**Stdev**	**t-stat**	**Sign. level**	**Sortino**	**Mean**	**Std. Err**	**Stdev**	**t-stat**	**Sign. level**

SIXew	0.0917931	0.2982087	1.460918			**SIXew**	0.0917931	0.2982087	1.460918		
PBT r.3	1.518912	0.5460109	2.674896			**PBT r.3**	1.518912	0.5460109	2.674896		
Combined	0.8053525	0.3248671	2.250745			**Combined**	0.8053525	0.3248671	2.250745		
Diff.	-1.427119	0.6221385		-2.2939	**	**Diff.**	-1.427119	0.6221385		-2.2939	**

***** Statistically different from zero at 1% level**

**** Statistically different from zero at 5% level**

*** Statistically different from zero at 10% level**

Table 5.4 Test of mean difference for the Sortino ratios of PBT r.1, r.2, r.3 and SIX vw

This table displays the results from the two-tailed t-test performed on the mean difference between the Sortino ratio of the benchmark and PBT's Sortino ratio r.1 under the following hypothesis:
H0: Sortino ratio SIX vw – Sortino ratio PBT = 0, H1: Sortino ratio SIX vw – Sortino ratio PBT ≠ 0
As shown in the picture, the results from both the test on equal- and unequal variances are presented.

Table 5.4

Equal variances

Sortino	Mean	Std. Err	Stdev	t-stat	Sign. level
SIXvw	0.3087049	0.3386333	1.658958		
PBT r.1	1.487642	0.5385701	2.638444		
Combined	0.8981734	0.326225	2.260153		
Diff.	-1.178937	0.6361841		-1.8531	**

Sortino	Mean	Std. Err	Stdev	t-stat	Sign. level
SIXvw	0.3087049	0.3386333	1.658958		
PBT r.2	1.456264	0.5311374	2.602031		
Combined	0.8824847	0.3226284	2.235235		
Diff.	-1.14756	0.6299043		-1.8218	**

Sortino	Mean	Std. Err	Stdev	t-stat	Sign. level
SIXvw	0.3087049	0.3386333	1.658958		
PBT r.3	1.518912	0.5460109	2.674896		
Combined	0.9138084	0.3298406	2.285202		
Diff.	-1.210207	0.6424955		1.8836	**

Unequal variances

Sortino	Mean	Std. Err	Stdev	t-stat	Sign. level
SIXvw	0.3087049	0.3386333	1.658958		
PBT r.1	1.487642	0.5385701	2.638444		
Combined	0.8981734	0.326225	2.260153		
Diff.	-1.178937	0.6361841		-1.8531	**

Sortino	Mean	Std. Err	Stdev	t-stat	Sign. level
SIXvw	0.3087049	0.3386333	1.658958		
PBT r.2	1.456264	0.5311374	2.602031		
Combined	0.8824847	0.3226284	2.235235		
Diff.	-1.14756	0.6299043		-1.8218	**

Sortino	Mean	Std. Err	Stdev	t-stat	Sign. level
SIXvw	0.3087049	0.3386333	1.658958		
PBT r.3	1.518912	0.5460109	2.674896		
Combined	0.9138084	0.3298406	2.285202		
Diff.	-1.210207	0.6424955		-1.8836	**

***** Statistically different from zero at 1% level**

**** Statistically different from zero at 5% level**

*** Statistically different from zero at 10% level**

Table 5.5 Test of mean difference for the Sharpe ratios of PBT r.1, r.2, r.3 and NHX

This table displays the results from the two-tailed t-test performed on the mean difference between the Sharpe ratio of the benchmark and PBT's Sortino ratio r.1 under the following hypothesis:
H0: Sharpe ratio NHX – Sharpe ratio PBT = 0, H1: Sharpe ratio NHX – Sharpe ratio PBT ≠ 0
As shown in the picture, the results from both the test on equal- and unequal variances are presented.

Table 5.5

Equal variances

Sharpe	Mean	Std. Err	Stdev	t-stat	Sign. level

Unequal variances

Sharpe	Mean	Std. Err	Stdev	t-stat	Sign. level

NHX	-0.0642899	0.2173443	1.064765			**NHX**	-0.0642899	0.2173443	1.064765		
PBT r.1	0.5638331	0.2041241	1			**PBT r.1**	0.5638331	0.2041241	1		
Combined	0.2497716	0.154441	1.069998			**Combined**	0.2497716	0.154441	1.069998		
Diff.	-0.6281231	0.2981698		-2.1066	**	**Diff.**	-0.6281231	0.2981698		-2.1066	**

Sharpe	**Mean**	**Std. Err**	**Stdev**	**t-stat**	**Sign. level**	**Sharpe**	**Mean**	**Std. Err**	**Stdev**	**t-stat**	**Sign. level**
NHX	-0.0642899	0.2173443	1.064765			**NHX**	-0.0642899	0.2173443	1.064765		
PBT r.2	0.5596645	0.2041241	1			**PBT r.2**	0.5596645	0.2041241	1		
Combined	0.2476873	0.1543511	1.069376			**Combined**	0.2476873	0.1543511	1.069376		
Diff.	-0.6239545	0.2981698		-2.0926	**	**Diff.**	-0.6239545	0.2981698		-2.0926	**

Sharpe	**Mean**	**Std. Err**	**Stdev**	**t-stat**	**Sign. level**	**Sharpe**	**Mean**	**Std. Err**	**Stdev**	**t-stat**	**Sign. level**
NHX	-0.0642899	0.2173443	1.064765			**NHX**	-0.0642899	0.2173443	1.064765		
PBT r.3	0.5596645	0.2041241	1			**PBT r.3**	0.5678395	0.2041241	1		
Combined	0.2476873	0.1543511	1.069376			**Combined**	0.2517748	0.1545279	1.070601		
Diff.	-0.6239545	0.2981698		-2.12	**	**Diff.**	-0.6321295	0.2981698		-2.1200	**

***** Statistically different from zero at 1% level**

**** Statistically different from zero at 5% level**

*** Statistically different from zero at 10% level**

Table 5.6 Test of mean difference for the Sharpe ratios of PBT r.1, r.2, r.3 and OMXS

This table displays the results from the two-tailed t-test performed on the mean difference between the Sharpe ratio of the benchmark and PBT's Sharpe ratio r.1 under the following hypothesis:
H0: Sharpe ratio OMXS – Sharpe ratio PBT = 0, H1: Sharpe ratio OMXS – Sharpe ratio PBT ≠ 0
As shown in the picture, the results from both the test on equal- and unequal variances are presented.

Table 5.6

Equal variances

Sharpe	**Mean**	**Std. Err**	**Stdev**	**t-stat**	**Sign. level**
OMXS	0.0055653	0.2039871	0.9993286		
PBT r.1	0.5638331	0.2041241	1		
Combined	0.2846992	0.1484391	1.028416		
Diff.	-0.5582678	0.2885782		-1.9345	**

Sharpe	**Mean**	**Std. Err**	**Stdev**	**t-stat**	**Sign. level**
OMXS	0.0055653	0.2039871	0.9993286		
PBT r.2	0.5596645	0.2041241	1		
Combined	0.2826149	0.148356	1.02784		
Diff.	-0.5540992	0.2885782		-1.9201	**

Sharpe	**Mean**	**Std. Err**	**Stdev**	**t-stat**	**Sign. level**
OMXS	0.0055653	0.2039871	0.9993286		
PBT r.3	0.5678395	0.2041241	1		
Combined	0.2867024	0.1485195	1.028973		
Diff.	-0.5622742	0.2885782		-1.9484	**

Unequal variances

Sharpe	**Mean**	**Std. Err**	**Stdev**	**t-stat**	**Sign. level**
OMXS	0.0055653	0.2039871	0.9993286		
PBT r.1	0.5638331	0.2041241	1		
Combined	0.2846992	0.1484391	1.028416		
Diff.	-0.5582678	0.2885782		-1.9345	**

Sharpe	**Mean**	**Std. Err**	**Stdev**	**t-stat**	**Sign. level**
OMXS	0.0055653	0.2039871	0.9993286		
PBT r.2	0.5596645	0.2041241	1		
Combined	0.2826149	0.148356	1.02784		
Diff.	-0.5540992	0.2885782		-1.9201	**

Sharpe	**Mean**	**Std. Err**	**Stdev**	**t-stat**	**Sign. level**
OMXS	0.0055653	0.2039871	0.9993286		
PBT r.3	0.5678395	0.2041241	1		
Combined	0.2867024	0.1485195	1.028973		
Diff.	-0.5622742	0.2885782		-1.9484	**

***** Statistically different from zero at 1% level**

**** Statistically different from zero at 5% level**

*** Statistically different from zero at 10% level**

Table 5.7 Test of mean difference for the Sharpe ratios of PBT r.1, r.2, r.3 and SIX ew

This table displays the results from the two-tailed t-test performed on the mean difference between the Sharpe ratio of the benchmark and PBT's Sharpe ratio r.1 under the following hypothesis:
H0: Sharpe ratio SIX vw – Sharpe ratio PBT = 0, H1: Sharpe ratio OMXS SIX ew – Sharpe ratio PBT ≠ 0
As shown in the picture, the results from both the test on equal- and unequal variances are presented.

Table 5.7

Equal variances					Unequal variances				
Sharpe	**Mean**	**Std. Err**	**Stdev**	**t-stat**	**Sharpe**	**Mean**	**Std. Err**	**Stdev**	**t-stat**
Sixew	0.2679864	0.2640732	1.293689		**SIXew**	0.0055653	0.2039871	0.9993286	
PBT r.1	0.5638331	0.2041241	1		**PBT r.1**	0.5678395	0.2041241	1	
Combined	0.4159098	0.1665033	1.153568		**Combined**	0.2867024	0.1485195	1.028973	
Diff.	-0.2958467	0.3337684		-0.8864	**Diff.**	-0.5622742	0.2885782		-0.8864

Sharpe	**Mean**	**Std. Err**	**Stdev**	**t-stat**	**Sharpe**	**Mean**	**Std. Err**	**Stdev**	**t-stat**
Sixew	0.2679864	0.2640732	1.293689		**SIXew**	0.2679864	0.2640732	1.293689	
PBT r.2	0.5596645	0.2041241	1		**PBT r.2**	0.5596645	0.2041241	1	
Combined	0.4138255	0.1664641	1.153297		**Combined**	0.4138255	0.1664641	1.153297	
Diff.	-0.2916781	0.3337684		-0.8739	**Diff.**	-0.2916781	0.3337684		-0.8739

Sharpe	**Mean**	**Std. Err**	**Stdev**	**t-stat**	**Sharpe**	**Mean**	**Std. Err**	**Stdev**	**t-stat**
Sixew	0.2679864	0.2640732	1.293689		**SIXew**	0.2679864	0.2640732	1.293689	
PBT r.3	0.5596645	0.2041241	1		**PBT r.3**	0.5678395	0.2041241	1	
Combined	0.4138255	0.1664641	1.153297		**Combined**	0.417913	0.1665414	1.153832	
Diff.	-0.2916781	0.3337684		-0.8984	**Diff.**	-0.2998531	0.3337684		-0.8984

Table 5.8 Test of mean difference for the Sharpe ratios of PBT r.1, r.2, r.3 and SIX vw

This table displays the results from the two-tailed t-test performed on the mean difference between the Sharpe ratio of the benchmark and PBT's Sharpe ratio r.1 under the following hypothesis:
H0: Sharpe ratio SIX vw – Sharpe ratio PBT = 0, H1: Sharpe ratio OMXS SIXvw– Sharpe ratio PBT ≠ 0
As shown in the picture, the results from both the test on equal- and unequal variances are presented.

Table 5.8

Equal variances					Unequal variances				
Sharpe	**Mean**	**Std. Err**	**Stdev**	**t-stat**	**Sharpe**	**Mean**	**Std. Err**	**Stdev**	**t-stat**
Sixvw	0.4325081	0.2807026	1.375156		**SIXvw**	0.4325081	0.2807026	1.375156	
PBT r.1	0.5638331	0.2041241	1		**PBT r.1**	0.5638331	0.2041241	1	
Combined	0.4981706	0.1719481	1.191291		**Combined**	0.4981706	0.1719481	1.191291	
Diff.	-0.131325	0.3470743		-0.3784	**Diff.**	-0.131325	0.3470743		-0.3784

Sharpe	Mean	Std. Err	Stdev	t-stat	Sharpe2	Mean3	Std. Err4	Stdev5	t-stat6
Sixvw	0.4325081	0.2807026	1.375156		**SIXvw**	0.4325081	0.2807026	1.375156	
PBT r.2	0.5596645	0.2041241	1		**PBT r.2**	0.5596645	0.2041241	1	
Combined	0.4960863	0.1719314	1.191176		**Combined**	0.4960863	0.1719314	1.191176	
Diff.	-0.1271564	0.3470743		-0.3664	**Diff.**	-0.1271564	0.3470743		-0.3664

Sharpe	Mean	Std. Err	Stdev	t-stat	Sharpe	Mean	Std. Err	Stdev	t-stat
Sixvw	0.4325081	0.2807026	1.375156		**SIXvw**	0.4325081	0.2807026	1.375156	
PBT r.3	0.5596645	0.2041241	1		**PBT r.3**	0.5678395	0.2041241	1	
Combined	0.4960863	0.1719314	1.191176		**Combined**	0.5001738	0.1719646	1.191406	
Diff.	-0.1271564	0.3470743		-0.3899	**Diff.**	-0.1353314	0.3470743		-0.3899

6. Results from the parametric test of the Feeders performance persistency

Table 6.1. Parametric tests on performance persistency using r.1

This table displays the results of the linear regression model applied to test if the feeder'sfeeders are persistent. The regression model is expressed as: $ar_{t+1} = X_1 + X_2 * ar_t + \varepsilon$, where ar_{t+1} is the following pairs-trade's daily excess return of r.1 divided by that pairs-trade's standard deviation, ar_t is the past pairs-trade's daily excess return of r.1 divided by its standard deviation, X_1 is the intercept of the regression, X_2 is the slope coefficient, and ε is the error term obtained from the regression. A positive (negative) and significant slope coefficient X_2 indicates that positive (negative) performance persistence exists.

Table 6.1

FEEDER	Coefficient	Z	Significance level	N
A	0.1022383	1.11		11
	(0.0918377)			
A2	0.0547167	0.89		11
	(0.0615563)			
B	0.0903192	2.21	**	30
	(0.0408075)			
C	-0.0430599	-0.45		14
	(0.0966474)			
D	0.1012843	3.16	***	38
	(0.0320975)			
E	0.1081514	0.48		43
	(0.2250732)			
F	0.0575675	1.91	*	51
	0.0301365			
G	0.1318678	5.17	***	57
	(0.0255216)			

*** Statistically different from zero at 1% level

** Statistically different from zero at 5% level

* Statistically different from zero at 10% level

Table 6.2. Parametric tests on performance persistency using r.2

This table displays the results of the linear regression model applied to test if the feeder'sfeeders are persistent. The regression model is expressed as: $ar_{t+1} = X_1 + X_2 * ar_t + \varepsilon$, where ar_{t+1} is the following pairs-trade's daily excess return of r.2 divided by that pairs-trade's standard deviation, ar_t is the past pairs-trade's daily excess return of r.2 divided by its standard deviation, X_1 is the intercept of the regression, X_2 is the slope coefficient, and ε is the error term obtained from the regression. A positive (negative) and significant slope coefficient X_2 indicates that positive (negative) performance persistence exists.

Table 6.2

FEEDER	Coefficient	Z	Significance level	N
A	0.1004821	1.09		11
	(0.0919904)			
A2	0.0547907	0.89		11
	(0.061498)			
B	0.0908199	2.23	**	30
	(0.0407754)			
C	-0.0493611	-0.49		14
	(0.101697)			
D	0.0923339	2.91	***	38
	(0.0317062)			
E	0.1151669	0.5		43
	(0.2286125)			
F	0.0577881	1.92	*	51
	(0.0301041)			
G	0.1356017	5.24	***	57
	(0.0258954)			

*** Statistically different from zero at 1% level

** Statistically different from zero at 5% level

* Statistically different from zero at 10% level

Table 6.3. The results from the parametric tests on performance persistency using r.3

This table displays the results of the linear regression model applied to test if the feeder'sfeeders are persistent. The regression model is expressed as: $ar_{t+1} = X_1 + X_2 * ar_t + \varepsilon$, where ar_{t+1} is the following pairs-trade's daily excess return of r.3 divided by that pairs-trade's standard deviation, ar_t is the past pairs-trade's daily excess return of r.3 divided by its standard deviation, X_1 is the intercept of the regression, X_2 is the slope coefficient, and ε is the error term obtained from the regression. A positive (negative) and significant slope coefficient X_2 indicates that positive (negative) performance persistence exists.

Table 6.3

FEEDER	Coefficient	Z	Significance level	N
A	0.103509	1.14		11
A2	0.0546725	0.89		11
B	0.0898146	2.20	**	30
C	-0.0372606	-0.4		14

D	0.0908955	2.88	***	38
E	0.1235149	0.53		43
F	0.0568377	1.89	*	51
G	0.1333972	5.11	***	57

*** Statistically different from zero at 1% level

** Statistically different from zero at 5% level

* Statistically different from zero at 10% level

7. Results from the linear regressions on market neutrality

Table 7.1. The linear regression result on market neutrality for PBT's r.1, r.2 and r.3

This table displays the results from the linear regressions with the monthly excess returns of PBT's three return measures as the dependent variable and the excess return of OMXS, the Swedish All Share Market Index adjusted for dividends, as the explanatory variable. The linear regression is expressed as follows:
$y_i = a + \beta * x_i + \varepsilon$, where y_i is the excess return of PBT in month i, a the intercept and β the slope coefficient. X_i is the excess return of OMXS in month i, and ε the error term obtained from the regression. A significant slope coefficient β indicates that the excess returns of PBT are correlated to the excess returns of the stock market.

Table 7.1

EXCESS RETURN	Coefficient	t	R-squared	N
r.1	-0.0093325	-0.4	0.0093	24
	(0.0234927)			
r.2	-0.0181202	-0.39	0.0087	24
	(0.0467577)			
r.3	-0.0963019	-0.41	0.0099	24
	(0.2361938)			