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The Ultimate 'Black box'

*A review of human behaviour and
the implications on the financial markets*

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Purpose: Account for scientific research on human behaviour and study the stock market behaviour throughout a complete market cycle.

Empirical foundation: The Swedish Stock exchange index; OMXS30, has during 2000-2008 been empirically studied to obtain the data needed.

Theoretical perspective The Dow Theory, supported by research results from the neurological, the psychological, and the behavioural finance science fields.

Methodology: A quantitative approach has been used.

Conclusions: Stock seems to evolve over time in a structure similar to what is proposed by the Dow Theory. The investigation of intra-day investor behaviour suggests that the return characteristics are different from previous research around market close. It is most likely due to Sweden being a small and open economy affected by the global financial markets. The findings correspond to what is expected in terms of investors behavior from previous research and the reviewed sciences.

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Abstract

Scientific discoveries and research results from behavioral finance, biology, economics, finance, neuroscience, psychology, and technical analysis has to various degrees been accounted for in this study of intra-day stock market and investor behavior. Insights on how our brain behaves in an economic context are reviewed with implications on asset price evolution and investor facing behavioral dilemmas. The general finding in regards of intra-day stock price returns is in consistency with Prospect Theory. It is further observed that the novice investors do best staying out of stocks; both for his/her own sake and the stability in the financial markets around the globe. However, the used theory, not being perfect, can provide a structure to analyze investor and stock market behavior. Finally, human evolutionary factors and policymakers' lack of potential for development suggest that the observed findings are expected to remain in effect until proved otherwise.

“A master chess player does not see the same board as the novice.”

(Kahneman, 2003)

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1 Introduction

In this introductory chapter choice and motives behind the research topic are presented and this leads up to the purpose of the thesis. The chapter is ended by delimitations and a disposition of the thesis.

1.1 Background

“A specialist is a man who knows more and more about less and less.”
(William J. Mayo)

In the process of finding a good asset to invest in, it has long been two main focuses of investment analysis. Some investors use the fundamental analysis philosophy others use the technical analysis philosophy as their guidance in finding good investment opportunities. The fundamental analysis is argued to answer the question “What to invest in?” While the technical analysis is argued to answer the question “When should I invest?” The combination ought to be the optimal choice. Both philosophies have many practitioners with good and solid track-records.¹ Although, the two methods of investment analysis are advised by investors, layman as professionals, it is only the fundamental analysis that has been widely accepted in the academics. It has long been argued that the market is efficient (EMH-theory). The EMH supporters argue that a practitioner of technical analysis is doing nothing more than reading tea leaves, when s/he is looking at a stocks historic performance.² Evident today is that technical analysis has been more accepted ever since the emergence of behavioural finance in the 1970s.

All investors would surely agree that there is more to investing than figuring out “what” and “when”. The market as well as the individual behaviour is important factors to consider both analyzing the financial markets as well as being successful and long lasting. No matter how good analysis one has to assist one in the forecasting of asset prices over the next minute, day or year it is *the next* minute, day or year. Risk, uncertainty and emotions among other factors affect investors' continuously

¹ Schwager (2006)

² Talbott (2009)

affecting their performance. Research in how people and animals deal with uncertainty in decision-makings have for a long time been studied by Economist and Psychologist, (Glimcher and Rustichini, 2004). However, the cellular mechanisms and the neural basis for the broad range of economic and psychological theories, underlying risky choices, are yet to be understood. (Lee, 2005)

From technological advances it has become possible today to perform sophisticated brain scans. From this the development of a new science has emerged, with a very rapid growth in the past decade. Its ambition is to combine the science of psychology, economics and neuroscience and study how people form their decisions. Scientists dig deep into our brains and evaluate how it works and the role it has when we evaluate decisions, categorize risks and rewards and when we interact with each other³⁴. Just as the critics were many and persisted regarding technical analysis this holds true for this new science as well. The emerged science is known as neuroeconomics. From their research results and how we humans work they argue that the economic models and theories aren't in accordance with how humans act and behave. Economists confront and argue that they have misunderstood and underestimated the economic models⁵. No matter what, it seems as the economists are either poor at explaining their models, or is today's economic models continuously making inaccurate forecasts of how an economy functions and peoples financial decision makings are accomplished.

Not only have technological advances opened up several new science fields it has also changed the great world of finance. Sophisticated models and advanced computer science technology are trying to find the ultimate investment strategy. Has this changed how financial markets evolve over time? With a quick look in the history we're reminded by the collapse of Lehman Brothers⁶ and Long Term Capital

3 Kenning and Plassmann (2005)

4 Dickhaut and Rustichini (2008)

5 Gul and Pesendorfer (2008)

6 Lehman folds with record \$613 billion debt, Market Watch, The Wall Street Journal, September 15th 2008

Management⁷ among others. The failure of both firms caused enormous consequences around the world. In regards of the current crisis Barack Obama, (President of United States, 2008 -) stressed: "*the credit dried up*".

Can we expect bust and booms to occur in the future? What is causing them? Are different bust and booms showing similarities under the evolvement of each period? Can we find any guidance in the history books of what seems to be reoccurring cycles? A lot remains undetermined.

⁷ Greenspan (2007)

1.2 Problem discussion

“It is a very sad thing that nowadays there is so little useless information.”
(Oscar Wilde)

The society we live in today is very different from the one that existed for 50 or even 400 to a thousand years ago. That said, we humans still seem in general to behave and function as we always have done. Tomorrow's individual is expected to continue and make more or less the same mistakes as yesterday's individuals. We are just repeating ourselves in a different and new environment. This is certainly evident from our present situation having experienced two severe crashes already in the first decade of the 21st century. Evident is that financial bubbles and crashes still remain part of society just as they did in the 17th century with the Tulip mania in Holland. The consequences are just the same, prices go up and eventually come back down. Suggestively at a higher level than before, since technological advances and demographic changes among other factors take us further. The result, of our dynamic and continuously changing society is that after the crash a new economic era starts off. In other words illustrated by our past it seems incongruous to think that the underlying human behaviour has changed.

In the past decade technological advances have had a great impact on our society. Not only has it opened up a new world of investment opportunities for everyone with an interest and an Internet connection. It has also had a great impact on how investing is perceived and performed today. With the use of technology professional investors and financial institutions use highly advanced and sophisticated trading strategies and trades are automatically executed. One can ask then if the many suggested anomalies and behavioural biases argued for in previous research and experienced by market practitioners have disappeared. Has the “human factor” that characterized the market behaviour and investing been addressed and perhaps even been “built” away? Perhaps some have been reduced or addressed. On the other hand, not to forget, the sophisticated trading models are built by humans to predict the economics and business in large where human first and foremost act. Just as well as many of the trading strategies are built upon previous research and the developer's own experience

one could suspect that the behavioural biases are systematically “built in” in the financial markets. They are just executed by computers instead of humans. Judging from our past decade, with the availability of advanced technology, financial market behaviour and underlying human behaviour of decision-makings seem not to be particularly different from our previous history. If this is true in the long-term, is unclear.

Being still, in the turmoil of the greatest financial crash in about a century it is impossible to know what the consequences on our future will be. An increased regulation is evident according to an ongoing debate⁸. Although, with the overall information overflow and conflicting interest characterizing our modern world it is hard to find consensus.

“I believe in equality for everyone, except reporters and photographers.”
(Mahatma Gandhi)

Economist have been criticised for assuming that humans act “rationally” in economic decision making. The psychologists argue that we humans are “irrational” beings in that sense. The economists argue that humans act rationally when they have complete information. This led me to the following question: Will humans be rational in the future as s/he becomes more educated and enlightened? Suggestively not, as we become more educated we become more specialized and we might lose the “The Big Picture”. Whether this will be true or not I find the economist assumption of rationality confusing. Psychology is a science that tries figuring out how people feel, think and act, whilst economics is a science that tries to solve problems of how to allocate and economize scarce resources. The consequence being the psychologist must be trustworthy when it comes to the behaviour of an individual. Hence, isn't it rather inconsistent that the economists have rejected other sciences suggested research and knowledge when s/he *examine, describe and explain* the reality?

⁸ SEC chief says legislation needed to govern newer investment products, Financial Times, October 28th 2008

As mentioned previously economists have criticised the technical analysis framework and proposed that psychologists haven't understood the core of economics. Moreover some economist argue that neuroeconomics is an unnecessary field. (Camerer et al., (2004) Stressing that what they try to explain and incorporate is already taken into account by the economists. It seems odd since all sciences would meet a consistent conclusion if they where right and explained the reality. Since this seems not to be the case it is an improper use of resources and available information not to account for suggestions and evidence from above mentioned sciences.

The unfortunate in many cases is that the scientists from each profession not always share or perceive a specific problem due to the differences in their expertise. The economists have an overall knowledge of how an economy works but certainly not as much about the individual behavior making it up. The suggested situation is unfavorable for the economist as his decisions and suggestions consistently must suit all of us over time.

Finance and economics isn't easy, and it gets tougher. It is argued by psychologist that we humans have a tendency to simplify and make a problem as easy and intuitive for our understanding as possible. In general this is good, it makes life easier and when cognitive resources are economized, we can focus on and address the next problem. In the process of narrowing down the problem, we are unfortunately prone to make errors. (Kahneman, 2003) This obviously holds true for investors in the financial markets as well. In a theoretical framework trying to build an accurate model to predict decision-making and behaviour among humans is problematic and debated. Without going further into fact that the science of decision-making is rather confusing right now where philosophy, psychology and economics, among others, all have different and sometimes conflicting views about the nature of decision making and the conditions that make it rational (Hardy-Vallée, 2007).

Further, it is hard to know the overall implications on financial market and investor behaviour emerging from imposed regulations, technological shifts, scientific discoveries and a stressed environment, which seems evident in the future.

“My responsibility as president isn't just to help our economy to rebound from this recession but to make sure the economic crisis like the one that help trigger this recession never happens again”

(Barack Obama)

Could any future event have such an influence on humans and investors that the overall decision-making process and market behaviour should change?

1.2.1 Research questions

Based on the previous introduction and problem discussion three research questions are formulated.

- What does the criticised neuroeconomics, psychology, and behavioural finance sciences suggest in regards of human behaviour and how she engage in the modern world?
- What does these sciences suggest with regards to the stock market and investor behaviour as evident from our history? Is bust and booms expected to continue to occur in our future?
- How do investors behave throughout a complete stock market cycle?

1.3 Purpose

My purpose is to account for the research within the science of economics, finance, psychology, and neuroscience in a study of the stock market and the investors behaviour. The infradian⁹, circadian¹⁰ and ultradian¹¹ rhythms of the stock market behaviours will be analyzed throughout its complete market cycle (a bull and a bear period) using high frequency intra-day price and volume data.

1.4 Delimitations

This study does not try to prove the accuracy of the used theory. Furthermore, studying market behaviour and suggesting some variables and not others, not thought off, is not desirable. Challenging this would increase the risk of a model misspecification and wrong conclusions. Therefore, no data other than time, price and volume will be considered. These three variables incorporate all available information and emotions in the financial markets. This is concluded to be more than enough to investigate financial behaviour and reach consensus.

The study is limited to stocks on the Swedish stock exchange, more specifically the OMXS30 listed stocks, throughout the sample period 2000-2008.

1.5 Thesis outline

The rest of the thesis is organized as follows. Chapter 2 gives an overview of the, for the thesis, relevant theoretical framework with focus on investor and stock market behaviour. Chapter 3 discusses the methodology, data collection and methodological problems. In Chapter 4 the empirical findings from the study is described in text, tables and graphs. Chapter 5 contains an analysis of the empirical findings and discussion of the literature review. Chapter 6 concludes the thesis accompanied by suggestions for future research.

⁹ A biological rhythm with a frequency greater than 28 hours

¹⁰ A biological rhythm with a frequency of about 24 hours

¹¹ A biological rhythm with a frequency less than 20 hours

2 Theoretical Framework

In this chapter I present the theoretical context, which is three-fold. First, each science section (neuroscience and –economics, psychology and behavioural finance) contains three main subsections. Each science section starts with a brief definition followed by a literature review that is finished off with a few concluding remarks and implications. Second, a discussion of the reviewed sciences is presented leading up to motives and choice of theory. At last, the sample of stocks and previous research on intra-day behaviour is presented. Please note that each consecutive science research results discussed, overall, provide the explanation why the next reviewed science has observed the results it has.¹²

Neuroscience is the scientific study of the nervous system¹³. With the help of brain imaging technologies, single neuron measurement, psychopathology and brain damage studies, and psychophysical measurement efforts into revealing the molecular, cellular, behavioral, and cognitive mechanism among beings can be revealed. (Désposito, 2000, Camerer et al., 2004) As previously indicated it is criticized for providing nothing more than just a picture of the brain, “*Where things happen in the brain*” or as others like to express it, “*showing that behavior is caused by action in the nervous system (which was never in doubt)*”. The long run goal is to gain an understanding of how different parts interact and how it solves different types of problems. (Camerer et al., 2004) In regards of Neuroeconomics it is the study of neural mechanisms involved in decision-making and their economic significance. It is the product of brain processes involved in the representation, anticipation, valuation and selection of choice opportunities. (Hardy-Vallée, 2007)

“Life is a whole series of circumstances beyond your control.”
(Van Roy's Truism)

¹² Neuroscience => Psychology => Behavioral Finance => Theory => Previous research
¹³ Nationalencyklopedin

2.1 Neuroscience and -economics

2.1.1 Two-dimensional theoretical framework of neural functioning

The first dimension refers to Automatic and Controlled Processes. They evolved to solve problems of evolutionary importance. We have little or no introspective access to these processes, or volitional control over them. The behaviour these processes generated need not follow normative axioms of inference and choice. The second dimensions are Affective and Cognitive processes and they are strongly influenced by finely tuned effective systems¹⁴. These systems are essential for daily functioning, and when they are damaged or perturbed, by brain injury, stress, imbalances in neurotransmitters, or at the 'heat of the moment', the logical-deliberative system – even if completely intact - cannot regulate behaviour appropriately. (Camerer et al., 2004)

It is required for human behaviour that there is a fluid interaction between the controlled and automatic processes, and between the cognitive and affective systems. The distinction between processes in the 1970s has led different scientists to develop “new” two-system models, with different labels, from the original framework which will now follow. (Camerer et al., 2004)

2.1.2 Intuition and reasoning

Kahneman (2003) discusses two generic modes of cognitive functions. The treatment distinguishes two modes of humans thinking and deciding, which corresponds, roughly, to the everyday concepts of reasoning and intuition. System 1 is responsible for the intuitive thinking and System 2 is responsible for reasoning (Stanovich and West, 2000). Operations of system 1 are fast, automatic, effortless, associative and often emotionally charged, they are also governed by habit, and are therefore difficult to control or modify. The operations of system 2 are slower, serial, effortful, and deliberately controlled; they are also relatively flexible and potentially rule-governed. Further the capacity of our mental efforts is limited and consequently effortful processes tend to disrupt each other. Effortless processes neither cause nor suffer

¹⁴ The basic design is common to humans and many animals.

much interference when combined with other tasks.¹⁵ Further, Kahneman (2003) expresses that the judgement people express, the actions they take and the mistakes they commit depend on the monitoring and corrective functions of System 2, just as well as on the impressions and tendencies generated by System 1. Klein (1998) states that judgement and choices are normally intuitive, skilled, unproblematic and reasonably successful. Kahneman (2003) add and point out that people mostly do not think very hard and that system 2 monitor's judgement quite lightly. Sometimes the monitoring of system 2 detects an error, doubt, and efforts will be made to correct it. Researchers have brought up several factors trying to explain when doubt to one's intuitive judgment comes to mind. Research by Finucane et al., (2000) argues that the ability to avoid errors on intuitive judgment is impaired by time pressure, and Gilbert (1991, 2002) by concurrent involvement in a different cognitive task. Bodenhausen (1990) establish that the ability to avoid errors on intuitive judgment is impaired by performing the task in the evening for "morning people" and in the morning by "evening people". According to Isen et al. (1988) and Bless et al. (1996) it was also impaired by the mood. The facility for System 2 is according to Stanovich and West (2002) positively correlated with intelligence, positively correlated with people thinking, thinking is fun (Shafir and LeBoeuf, 2002), and lastly it is positively correlated to statistical thinking (Nisbett et al, 1983; Agnoli 1991). Kahneman (2003) stress that intuition and reasoning are alternative ways to solve problems, that intuition resembles perception, and that people sometimes answer a difficult question by answering an easier one instead, that the process of information is often superficial, and that categories are represented by prototypes.

15 Klein (1998) presents that experienced decision makers (e.g. fire fighting company captains) rarely need to choose between options because in most cases only one single option comes to mind spontaneously, intuitively. The ease in which mental contents come to mind is also refereed to as accessibility (Higgins, 1996). Kahneman (2003) argues that accessibility is a continuum, not a dichotomy, and some effortful operations demand more efforts than others. Some is argued to be genetically and other are argued to be developed through experience. *"The acquisition of skill gradually increase the accessibility of useful responses and of productive ways to organize information, until skilled performance becomes almost effortless"* (Kahneman 2003)

2.1.3 Economic implications of interest

2.1.3.1 *Impatience and utility among individuals*

Takahashi (2005), backed by research evidence from the field of biology, psychopharmacology, behavioural neuroscience, and neuroeconomics, argues that people do not discount future reward value exponentially which is hypothesized in classic economic theory. Rather it is observed a hyperbolic discounting¹⁶ among humans (as well as non-humans). Further, Geoffard and Luchini (2009) research time and emotions¹⁷¹⁸ effect on impatience. They assume that emotions are induced by imagining some situation that is different from the actual one¹⁹. Their research is based upon their review of time perception and emotions from two sciences: The first one is psychophysiology, which suggests that “*there is a correlation between affective valence, physiological arousal and perceived time and the correlation between valence and perceived time is more likely to be positive for waiting periods*”. The second one is neurobiology, which suggests that “*time is not exogenously to the individual, it is elastic, and this will be influenced by the emotion the person experiences*”.²⁰ Their theory can explain that people tend to prefer to perform painful actions earlier than pleasurable ones. This revealed suggestion was also noticed by Loewenstein and Prelec (1991) and is completely contrary to the predictions yielded by the standard exponential discounting utility framework. (Geoffard and Luchini, 2009)

16 A preference for one that arrives sooner rather than later.

17 According to philosopher Pierre Livet (Livet, 2002) an emotion is an affective resonance (physiological and behavioural) induced by a differential between the actual situation and a given (perceived or imagined) situation or event, evaluated accordingly to our actual preferences and affective dispositions.

“*The larger the differential, the stronger is the emotion...*

...*When emotions are represented as differential, ‘surprise’ is not a necessary condition for emotions to arise. Hence, we do not rely on any form of ‘uncertainty’ about the future events in the present exercise.*” (Geoffard and Luchini, 2009)

¹⁸ Humans’ interaction with computers have revealed that social emotions are reduced. Further, the human and computer partners do not elicit the same neural affective reactions. (Rilling et al., 2002; and Hardy-Vallée, 2007)

19 Imagining an oily greasy meal is enough to induce the emotional experience of disgust – whether or not we may have to eat such a meal in the future. (Geoffard and Luchini, 2009)

20 When a person anticipates an event that generates a positive emotion, say spending the next holiday on a sunny beach in the Maldives, she may experience impatience and may feel that these longingly awaited holidays will never arrive – that is, the anticipated duration expands. On the other hand, if this same person faces a negative event some time in the future, such as a difficult exam, she may feel anxiety and time seems to fly until this event, it feels to her as if the exam will arrive too quickly. Hence, the sensation is one of time contracting. (Geoffard and Luchini, 2009)

2.1.3.2 Risk, return and volatility in a economic context

In a study by Sapienza et al., (2009) >500 MBA students were tested in regards of their financial risk aversion which was accounted for by salivary concentrations of testosterone. They find that higher levels of circulating testosterone were associated with lower risk aversion among women, but not among men. However the gender difference disappeared at comparably low levels of salivary testosterone. According to the authors this suggests that testosterone has nonlinear effects on risk aversion regardless of gender. They continued and argued that the combination of testosterone and risk aversion could have both organizational and activation effects on risk-sensitive financial decisions²¹.

Coates and Herbert (2007) studied, under real working conditions, a group of male traders in the City of London. They found that a trader's morning testosterone level predicted his day's profitability. As their focus was to investigate the impact of endogenous steroids they could also conclude that a trader's cortisol rises with both the variance of his trading results and the volatility of the market.²² Another possibility as consequence from these steroids was also presented. If they were to persist or increase as volatility rises they may shift risk preferences and even affect trader's ability to engage in rational choice. Coates et al., (2010) points out little is known about the role of the endocrine system in financial decision-making. They examine potential links to traders' performance in the financial market in regards to previously mentioned hormones, among others, and their cognitive effects. They justify previous findings by stressing that a traders interpretation of information may not be stable. The same trader could see only opportunities in a set of facts with high levels of testosterone and in retrospect only risk with chronically elevated cortisol. Consequently, if traders are subject to the winner effect²³, steroid hormones may shift risk preferences systematically across the business cycle. Hence, rising levels of testosterone increase appetite for risk during a bull market versus rising levels of cortisol decrease their appetite for risk during a bear market. (Coates et al., 2010)

²¹ Just as well as long-term career choices.

²² Testosterone and cortisol are known to have cognitive and behavioral effects

²³ See behavioural finance section for further discussion.

Camerer and Fehr (2006) argue that this could destabilize the financial markets, even if it is only confined to a small number of people.²⁴

Furthermore, Emanuele et al., (2009) performed an ultimate game study²⁵, investigating implications of omega-3 fatty acids in a bargain decision between subjects.²⁶ Their results suggested that a depletion of serum omega-3 fatty acids were associated with a rejection of unfair ultimatum offers.

2.1.3.3 Reward and time preferences

Research by Hariri et al., (2006) study people and the immediate and delayed rewards in response to gaining or losing money. They found that people with a greater activation of the mesolimbic dopamine system place greater weight on choices between immediate rewards relative to delayed rewards. When humans are offered the choice between rewards available at different points in time, the relative values of the opinions are discounted according to their expected delays until delivery (McClure et al., 2004). McClure et al., (2004) examine valuation and decision-making of inter-temporal choice of immediate rewards and delayed rewards up to weeks. They concluded that the activity of previous mentioned reward system is associated with choices involving immediate rewards. They also found that the prefrontal and parietal regions are active in all intertemporal choices. These mentioned areas, the prefrontal and parietal regions, are commonly associated with deliberative cognitive processes such as numerical processing (Dehaene et al., 1998) and future planning (McClure et al., 2007).

Takahashi (2004) examined the relationship between cortisol levels and preferences to a small immediate reward. It was investigated using an economic decision-making

²⁴ The hypothesis that market moves are exaggerated by steroids has been long known, John Maynard Keynes called it 'animal spirits'. (Coates et al., 2010)

²⁵ Two players were involved to bargain over a division of a given sum of money. The proposer makes an ultimatum offer of a fraction of money, while the responder can either accept or reject the proposer's decision. If the responder doesn't come to an agreement with the proposer neither player would get anything.

²⁶ There study was based on a lot of previous well documented research on the relation between negative affect and low levels of omega-3 and a reduced omega-3/omega-6 ratio

task. The conclusion was that high cortisol levels were associated with the reduction in the degree of time-discounting of monetary gain in inter-temporal choice. Hence, subjects' with low cortisol levels were shown to be more impulsive in inter-temporal choice of monetary gain. He continues and explained that neurobiological, high baseline cortisol levels might reduce the degree of time-discounting via—the enhancement of amygdale activation and – the change in dopaminergic neuronal functions which mediate time-discounting. (Takahashi, 2004)

2.1.3.4 Rational or Irrational

Several studies in neuroeconomics have shown that emotional aspects may significantly contribute to economic decision-making. (Sanfey et al., 2006) Rotenberg (2008) and Emanuele et al., (2009) have suggested that negative affect and impulsiveness, affected by hormones, may play a relevant role in the rejection of unfair offers²⁷. The philosopher Hardy-Vallée discusses neuroeconomics from a philosophical point of view. He emphasises the fact that what externally seems to be an irrational choice can according to neuroscience and economics be internally rational. He continues to stress that it has been seen among many studies²⁸ from which loss-and ambiguity adverse subjects are rational in the internal sense, because they try to minimize negative feeling.

²⁷ They studied subjects in an ultimatum game setup.

²⁸ Studies have been performed using a game theoretical or ultimatum game setup.

2.1.4 Concluding remarks and implications

From the initial discussion it is evident that successfully performing a cognitive task is problematic for individuals where knowledge, experience and habit among other factors are of importance. Depending on which investors (professional or non-professional) are acting in a certain market it has implications on the evolution of financial asset prices. Variables' affecting the endocrine system implies a severely different behaviour in a bull and bear market period respectively. Further, emotions and rewards in different context are of importance as individuals try to reduce negative feeling quick and painful, expressed differently between investor groups.

“Under the most rigorously controlled conditions of pressure, temperature, volume, humidity, and other variables, the organism will do as it damn well pleases.”

(Harvard Law I)

2.2 Psychology

Psychology is the scientific study which tries to describe and explain how and why humans feel, think and act. It tries to answer how individuals develop in these considerations and what role nurture and nature have on the process of development. This is studied in the context that an individual is both a biological and a social creature.²⁹

“All human situations have their inconveniences. We feel those of the present but neither see nor feel those of the future; and hence we often make troublesome changes without amendment, and frequently for the worse.”

(Benjamin Franklin)

2.2.1 Heuristics and Biases

Kahneman and Tversky (1974) describe how judgement heuristics³⁰ such as representativeness³¹, availability and anchoring lead to systematic and predictable errors when people make up their judgement under uncertainty. These and other heuristics are employed by people when they are faced with a complex problem. They continue and explain that it occurs as a consequence of people trying to simplify the representation and the evaluation of prospects. According to the availability heuristic people tend to assess the frequency of a class, or the probability of an event, by the ease with which instances of that class or event can be brought to mind. De Bondt's and Thaler's (1985) winner-loser effect, refers to peoples reliance on similarity or

29 Nationalencyklopedin

30 Kahneman and Frederick (2002) revised the judgement heuristics and proposed a formulation in which the reduction of complex tasks to simpler operations is achieved by an operation of attribute substitution earlier proposed by Kahneman and Tversky (1973). Kahneman (2003) clarifies: a description based on unreliable information must be given little weight, and predictions made in the absence of valid evidence must revert to base-rates.

31 The representativeness heuristic is revised by Kahneman (2003). He proposes it should be embedded into a broader class, prototype heuristics. The prototype heuristics share the common psychological mechanism – the representation of categories by their prototypes – and a remarkably consistent pattern of biases. He argues that the prototype heuristic is associated with two major biases, which generalize the biases of representativeness. First, the violations of monotonicity – “*adding elements to a set may lower the average and cause the judgement of the target variable to decrease, contrary to the logic of extensional variables.*” Second, the extension neglect – “*other things equal, an increase in the extension of a category will increase the value of its extensional attributes, but leave unchanged the values of its prototype attributes.*” see Kahneman (2003) for a comprehensive summary.

representativeness when judging the likelihood that an event or object A belongs to class or process B. (Faulkner, 2002) The many studies that has studied the day-to-day stock price movements is examined by Shiller (2000)³². He notes that prices tend to be stable over long periods but liable to sudden shift and explain this with two types of anchors: a quantitative anchor, corresponding to the 'appropriate level' of the market and a moral anchor that determines the strength of reason for buying stocks. (Shiller, 2000)

An additional and well documented bias facing individuals is overconfident. Lichtenstein et al., (1978) document that it may in part stem from two other biases, self-attribution bias and hindsight bias (Barberis and Thaler, 2002), arguing that people are poor when estimating probabilities.

Another psychological bias that faces individuals is the framing effect. Different versions of the same underlying problem bring to mind different associations and evaluations. (Kahneman and Tversky 1981) Barberis et al (2003) suggest that investor's decisions appear to be considered in isolation from the remainder of the investor's portfolio. Benartzi and Thaler (1995) conclude that investors evaluating their investments appear to adopt an unreasonably short time horizon.³³

Moreover it is argued that our perception is reference-dependent. The perceived attributes of a focal stimulus reflect the contrast between that stimulus and a context of prior and current stimuli. The perceptual system is designed to enhance the accessibility of changes and differences. (Kahneman, 2003)

³² A more extensive discussion will follow in the behavioural finance section.

³³ From these findings Kahneman (2003) concluded that the gain/loss framing of outcomes suggested by Kahneman and Tversky (1979) Prospect Theory (see figure 1) could be seen as an instance of narrow framing.

2.2.2 Prospect Theory

In the 1970s Daniel Kahneman and Amos Tversky presented their Prospect theory. The distinctive prediction of prospect theory is illustrated in Figure 1. Three features characterize gains and losses: (1) it is concave in the domain of gains, favouring risk aversion; (2) it is convex in the domain of losses, favouring risk seeking and (3) the function is sharply kinked at the reference point, and loss-averse, steeper for losses than for gains by a factor of 2-2.5. (Kahneman et al, 1991; Kahneman and Tversky, 1992) Faulkner (2002) clarifies Kahneman's and Tversky's suggested decision making process according to the Prospect theory. First there is an initial editing phase in which a number of cognitive operations that transform the outcome and probabilities associated with an action into a representation. Next, this is then entered into the second phase, the evaluation phase. Examples of the editing operations are:

- the coding of outcomes into gains and losses,
- the simplification of prospects, - the detection of dominance,
- the cancellation of common components. (Faulkner, 2002)

2.2.3 Mental accounting

Mental accounting is an important behaviour in decision-making among people. As Thaler (1999) stated, it is the set of cognitive operations used by individuals and households to organize evaluate and keep track of financial activities. Faulkner (2002) continues and stresses that these operations matter because the rules that people adopt are not neutral with respect to decision making. He clarifies: "*the assignment of a purchase to one account rather than another, or the decision to combine a number of outcomes within one category, or how often to balance the books, affect the decisions that people make*".

2.2.4 Psychological traits and the mind

Sunstein (2003) reminds us that Kahneman and Tversky did not argue that it is irrational for people to use the relevant heuristics, rather are they quite valuable. The problem though is that they tend to lead to severe and non random systematic errors, which can be predicted. Research by Faulkner (2002) studied the three psychological traits: prospect theory, heuristics and mental accounting from a Serlean perspective. The philosophy of the mind this perspective takes is that mental input into rational behaviour consists of more than our conscience, reflected upon, reasons for acting. Further, there is Background states (a set of non-intentional, non-mental, brain states), predispositions, skills and capacities that function causally but non-consciously. According to Runde (2002) it is an ignorance of the importance of the Background states in the dominant conception of rational agency, such as the expected utility theory, that is criticised in economic theory. Faulkner (2002) concludes and stress that rationality should not be confused with expected utility maximization. Further he argues, backed by Searle's analysis, that rational behaviour necessarily involves both conscious reasoning and unconscious dispositions. He withheld, that, a conception of rational choice which excludes the non-intentional is therefore an incomplete one.

Philosopher Hardy-Vallée (2007) further point out, as many psychological studies have showed, that we are not as selfish and greedy as the common interpretation of rational-choice theory suggests. He exemplifies this with studies in experimental game theory by Ledyard, (1995) and Sally, (1995), which indicates that subjects cooperate massively in a prisoner's dilemma. This has also been evident in experimental studies in an ultimatum game scenario (Emanuele et al., (2009). According to Shiller (2000) the traits of the behavioural finance agent affecting human behaviour are not the result of extreme human ignorance but rather of the character of human intelligence. He continues and argues that investors are striving to do the right thing, but they have limited abilities and certain natural modes of behaviour.

2.2.5 Concluding remarks and implications

Our judgement is not trustworthy under uncertainty. Individuals are overconfident giving rise to a possible momentum and price reversal effects. It is important to stress that our perception is reference dependent and has multiple implications in finance and investment. Charting suggested by technical analysis could consequently be of relevance forecasting asset prices. The previous neuroscience discussion and research findings bring support to Prospect Theory where factors such as impatience, the endocrines system, reward and emotions appears to be consistent with what this theory concludes.

2.3 Behavioral Finance

In the 1970s the work by Psychologist Daniel Kahneman and Amon Tversky laid much of the ground work for the development of Behavioural Finance. It is an approach to study economics and finance and how psychological traits affect individuals and group behaviour. The economist Richard Thaler is according Daniel Kahneman the “guru” of Behavioural Finance.³⁴

“To predict the behavior of ordinary people in advance, you only have to assume that they will always try to escape a disagreeable situation with the smallest possible expenditure of intelligence.”

(Friedrich Nietzsche)

2.3.1 The Cross-Section of Average Returns

An extensive body of research on cross-section of stock returns have investigated past return and provided evidence of strategies achieving abnormal returns. (Chan et al., 1996) A number of possible explanations for the repeating pattern has been suggested. Some are concluded to be a consequence and consistent with proposed behavioural biases previously discussed.

Levy, already in 1967, claimed evidence of achieving abnormal return by buying stock with current prices which were substantially higher than their average prices over the past 27 weeks. (Levy, 1967) De Bondt and Thaler, (1985, 1987) performed a study, motivated from the research on cognitive psychology on intuitive prediction and the notion that many investors are poor Bayesian³⁵ decision makers. They investigated overreactions and accordingly suggested that stocks are mean reverting. They found that long-term past losers outperform long-term past winners over the subsequent three to five years. Some of the mean reversion was argued to be due to time-varying equilibrium expected returns. They also found evidence of a month effect suggesting that the tax code could be linked to unusual returns in January.

34 Interview with Daniel Kahneman, (2004)

35 A theory of statistical inferences, in which probabilities are associated with individual events or statements rather than with sequences of events.

Several studies have consistently provided evidence of month effects. (Jegadeesh, 1990; Lehman, 1990; Jagadeesh and Titman, 1993; Jagadeesh and Titman 2001; and Asgharian et al 2010) Jagadeesh and Titman (1993) momentum study also investigated quarterly earnings announcements effects. They concluded that the returns from stocks in their winners' portfolio outperformed the stocks in the losers' portfolio in the first few months following the earnings announcement. They found a reversed pattern in the 8-20 month in which the stocks in the losers' portfolio outperform the stocks in the winners' portfolio. The overall conclusion has been that cross-section stock returns is predictable and that abnormal returns can be achieved. These studies have been debated and criticised. It is suggested that the accuracy is poor and the abnormal return was a consequence of changes in debt-equity ratio and risk premia. (Chan, 1986; Chan, 1987; and Keim and Stambaugh, 1986). If transaction costs would be incorporated the ability to achieve abnormal return would drop significantly (Vermaelen and Verstringe, 1986; and Chan and Lakonishok, 1995). Other critique was that the momentum strategy was a result of data snooping.

Jegadeesh and Titman (2001) extended Jagadeesh and Titman (1993) study using a larger sample. The authors further tried to seek alternative explanations for the evidence of the successful momentum strategy and address critics. Several authors in the 90s had presented papers within the growing field of behavioural finance, suggesting a psychological explanation for the proposed momentum strategies. Barberis et al (1998) argued that representative heuristic may lead investors to mistakenly conclude that firms realizing extraordinary earnings growth will continue to experience similar extraordinary growth in the future. Daniel et al (1998) suggest that informed traders suffered from a "self-attribution" bias. He argued that the informed trader might attribute the performance of ex post winners to their selection skill while ex post losers were bad luck giving rise to an overconfidence bias pushing prices up.

Chan et al., (1996) study whether the predictability of returns were due to the markets under reaction to information. Their results suggested that a market responded only gradually to new information. Jagadeesh and Titman (2001) addressed

some other critic as well. More specifically Conrad and Kaul (1998) suggested that momentum strategies would yield positive returns on average even if the expected returns on stocks were constant over time. They address and rejected his hypothesis, by examining the post holding period ranging from month 13 to 60, following the portfolio formation month for their complete sample. In retrospect their evidence of negative performance in the 13 to 60 month post portfolio formation was consistent with the hypothesis emerged from the behavioural models³⁶ suggested by Barberis et al (1998) and Daniel et al (1998).

Moreover, Fama and French (1992) revealed a size premium effect in their study of all NYSE, Amex, and Nasdaq traded stocks between 1963 and 1990. Their conclusion was that small stocks average return was higher than large stocks. Further they concluded that the difference in risk was not enough to explain revealed differences. Nofsinger (2001) among others found that institutional investors traded to a greater extent large firm stock in respect to individual investors that mostly trade in small firm stocks.

2.3.2 Investor behaviour

Keim and Stambaugh (1986) argue that a stock return varies over time in a manner that can be predicted by variables that reflect levels of asset prices. Mizrach and Weerts (2009) investigate behavioural biases emerging from n -day highs and n -day lows. Their study, in which they study the price and volume movements from a multi-period time framework, is an extension from the work of Huddart et al. (2009). Huddart et al. (2009) study looked upon the 52 week highs and lows in price. Both authors conclude a sharp rise in turnover when a stock crossed an n -day high or low. They suggest that extreme prices in stocks past price path affect investors trading decisions in equity markets, further demonstrating that turnover was increasing with n . Their results were robust to common factors such as earnings news, dividends and analyst recommendations. (Mizrach and Weerts, 2009) Statman et al (2006) suggested

³⁶ Barberies, Shleifer, and Vishny (1998), Daniel, Hirshleifer and Subramanyam (1998), and Hong and Stein (1999) have proposed models which account for some of the previously mentioned biases that affect investors.

that high trading volume in stocks with high returns is persistent and a consequence of overconfidence. According to Barber and Odean (2008), this behaviour among investors can be explained from their findings that investors are most likely to trade attention grabbing stocks, and stocks breaking outside prior trading ranges appear to earn positive excess returns after the event. Huddart et al., (2009) stress that the magnitude of this effect is striking considering that no new information of firm consensus has been released. Their results present statistically significant evidence that the magnitude of the effect are economically as large as or larger than the effects of prominent information events, including earnings announcements and tax based trading strategies, such as dividend capture.

An observation found in the financial markets is the disposition effect. Investors in financial markets tend to sell profitable assets too soon and hold losing assets too long. (Shefrin and Statman, 1985) There is further evidence suggesting a difference between professional investors being less affected by the disposition effect than private investors. (Shapira and Venezia, 2000; and Dhar and Zhu, 2000) Lock and Mann (2000) further observed that professional investors with lower performance were more affected by the disposition effect. Two explanations for this effect was provided, one is based on Prospect Theory (Kahneman and Tversky, 1979) and the other one on mean reversion (Andreassen, 1988).

Shafran et al., (2009) perform an experimental trading study where subjects were tested under three different conditions: no restrictions on trading, trading requirement³⁷ and additional information³⁸. With no restrictions there were no effects; under trading requirement the effect was consistent with a momentum effect and finally with additional information results was consistent with relative disposition effect. Consequently, disposition effect or momentum behaviour can be a product of trading conditions and information.

37 Hold only three assets, and each asset a minimum of 10% of the subject's budget

38 Information of market return, which was the average of the six assets, and no restriction.

Heaney et al., (2007) perform an experimental study where naïve investors took part in a share market game. According to previous research naïve investors tend to trade too often and their performance is fairly poor. (Odean, 1999; and Barber and Odean, 2000) Heaney et al., (2007) find that trading profit volatility is positively correlated with the level of understanding of the market, the level of self-efficacy or self-confidence, and the level of trading.

Fehle and Zdorovtsov (2003) examine the effects of the overreaction hypothesis, liquidity pressure and public information flow measures.³⁹ The results revealed an economically significant positive return, which were consistent with the overreaction hypothesis. They also found reversals to be larger for events unaccompanied by public news release which was consistent with behavioural models proposed by Daniel et al., (1998) and Hong and Stein (1999).

³⁹ In regards of the information flow it is argued to be different over months. In November and December the information flow is lightest and in May and July it is the heaviest. It has also been found that January, April, July, and October have more information because of quarterly reports. (Berry and Howe, 1994; and Mitchell and Mulherin, 1994) Certain days have also been proposed to differ, where especially Tuesdays and Thursdays are light on information. The degree of firm specific news releases was an increasing function of the firm size. (Nofsinger, 2001)

2.3.3 Concluding remarks and implications

Prices were concluded to demonstrate momentum and price reversal effect under different time frames. Further it was suggested that different investors trade different assets. Which according to Fehle and Zdorovtsov (2003) might have effect on the time it takes for investors to incorporate new information in asset prices. As well as an observation that different investors are to different degrees exposed to psychological traits accompanied by implications of reinforced by requirements (regulation). Consequently, the return and volatility distribution should differ among stocks over time.

In addition, the degree of behavioural biases affecting investors is expected to differ over consecutive time as a consequence of differences in the information flow.

Factors such as a lack of transaction costs, data snooping effect, changed debt-equity ratio have been brought up in the criticism of achieving an abnormal return. Further, finding the proper risk premia has also been discussed in other literature bringing up the survivorship bias that could severely impact the reliability of many suggested performance strategies and their ability to achieve an abnormal return. (Goetzmann and Ibbotsson, 2006). Furthermore, absurd behaviour related to the neurological system, attention grabbing events, regulation and information is unlikely to be fully accounted for in the risk premia. Consequently, if all risks facing investors and the investment were complete, accurate and properly accounted for, there would be no possibility to achieve a risk adjusted “abnormal” return.

2.4 Discussion of theoretical framework and motives

According to psychologist Daniel Kahneman, 2002's Nobel Prize winner of economic science, psychologists are often criticized by economists for their lack of suggesting a coherent alternative to the rational-agent model. Psychologists cannot offer a formal normative model of belief and choice. These models simply do not exist; it is not that simple when it comes to explaining the behaviour and decision making of human beings. (Kahneman, 2003)

It is unclear of what the regulation will look like which is under discussion at the moment. Certain regulation, trading restrictions, has been suggested by Shafran et al., (2009) to be a contributing factor of behavioural biases. In addition, the affect of technology is just as unclear in regards of behaviour. Fewer emotions are involved and consequently hard blow market behaviour is demonstrated. It is further absurd to think that all factors causing a price move can be explained by a quantitative study when science suggest that so many "immeasurable"⁴⁰ factors influence the behavior and the outcome it takes. It is impossible to accurately suggest a strategy or cause of a behavior associated to a specific event in time. After all, it might be the effect of something completely irrelevant for the situation.

Furthermore, the human behavior is brutally inconsistent, even when it is exposed to the exact same information s/he could treat it differently caused by factors such as what time of the day it is, the nutritional intake, exercise, and previous experience suggesting a specific reason for a bias is questionable. It is rather improper to suggest behavioral biases when one isn't completely sure of the underlying reason of an anomaly, and finding it out seems rather difficult. Finally, it is unfavorable for the investor to suggest that a trading strategy can achieve a long term abnormal risk adjusted return when it isn't even a trustworthy risk premia at hand. An investor's realized return reflects his/her performance in the market and the amount of risk s/he takes. S/He can only perform equal to or less than the asset's return in questions given the risk accepted. Comparing a portfolio of apples to a portfolio of fruits disobeys a

40 This is further aggravated due to investors these days, with the use of advanced technology, engage in trading and financial investments from all over the world.

consistent comparison. Accompanied by the lack of accounting for risk facing the investors, any conclusion from such a comparison is inaccurate since all risk isn't incorporated.

It is clear that investors have access to different sources of information, level of information credibility, different resources to perform investment analysis and execute investments, as well as different knowledge and understanding of a particular stock and market. From this analogy the market is suspected to move in different, repeating cycles over time as information, news, business conditions and consensus is revealed to participants. The degree of participation from the professional, layman and naïve investor should consequently differ over a business cycle as well as within a particular day.

Further it is reasonable to expect that our anatomy and nervous systems overall structure and functionality will remain and be just what it was centuries, millenniums,... ago. This suggests that history is indeed repeating itself. No matter which market you talk about it is a human market affected by human emotions. Consequently, no matter the economic era we are in, in time, a consistent structure of asset prices evolution is appropriate and not unthinkable to expect. Furthermore, it should be possible to expect such an overall structure on any underlying asset that humans are engaged in investing and governing.

Human behavior is affected by anchors, a reference-dependent perception, hormones among other factors suggesting that everything moves in relation to history and the given stimuli. It is therefore appropriate to believe that the size of the firm should not have any severe implications on the overall asset price evolution. Consequently it is beneficial with a structure that treats all assets equally, no matter the economic climate or firm.

“Study the past if you would define the future.”

(Confucius)

2.5 Technical Analysis

The science of Technical Analysis⁴¹ uses a pool of methods, main thing short term, analyzing historical price- and volume movement for stocks trying to predict the future development.⁴² The implications from previous discussions suggest that the propositions offered by technical analysis theorems offered by the Dow Theory are of relevance in analysing the stock market⁴³.

“Everything has its beauty but not everyone sees it.”

(Confucius)

(See Figure 2, for “tea leaves”)

2.5.1 The work of Charles Henry Dow

In the year 1851 Charles Henry Dow was born in USA. He came to work as business journalist. In the year 1889 he and a few of his colleagues founded The Wall street Journal. After his death over hundred years ago, based on his articles, the Dow Theory⁴⁴ was formed. It is argued that this theory (theorems) laid much of the ground work of technical analysis.⁴⁵

41 Technical Analysis is suggested to suit well within the framework of behavioural finance. (Aronson, 2006)

42 Nationalencyklopedin

43 Dow Theory will not be tested since this has been done previously in history. In regards of how to forecast the underlying trend the original theory is argued not to be valid anymore due to the different society we live in today. It should have no implications of the study. Bear in mind that it is not a perfect theory, neither is this anywhere suggested.

44 There is little academic support for the profitability of his theory. (Cowels, A., 1934) Goetzmann et al (1998) later revised this proving that the theory produced excess risk adjusted returns.

45 Dow Theory, investopedia.com

2.5.2 The foundation of the Dow Theory⁴⁶

The theory's underlying assumptions will be supported and discussed using the implications and suggestions from the literature review and the standpoint of brought up research findings.

Dow Theory is accompanied by three assumptions:

1. The manipulation of the primary trend is not possible.
2. The market reflects all available information.
3. The theory is not perfect.

A stock markets primary trend is either bullish or bearish. The Dow Theory expands on this, suggesting that each primary trend should be separated into three different market movements (see Figure 3 and 4 to accompany text below):

- Two infradian rhythms, a primary and a secondary.
- One circadian rhythm (daily), with an ultradian intraday rhythm.
- *Primary* movements last from a few months to many years, considered the broad underlying trend of the market.
- *Secondary* movements last from a few weeks to a few months and move counter to the primary trend.
- *Daily* fluctuations move with or against the primary trend lasting for a few hours to a few days.

When the primary trend has been identified it will remain in effect until proved otherwise. The secondary move is reactionary in nature. In a bull market it is considered a correction and in a bear market it is considered a reaction rally.⁴⁷ Due to suggested randomness of day-to-day movements there is limited forecasting ability of those movements. The daily fluctuations are argued to be based on emotions, and studying daily price action must be taken in context of the larger picture.

⁴⁶ Dow Theory, stockcharts.com/

⁴⁷ Through observations suggestions on characteristics were made on the amplitude of the correction. Just as well as the observation of a sharper decline.

2.5.2.1 *Bull market*

- *Stage 1* – is argued to be indistinguishable from the last reaction rally of a bear market. The public is out of stock and news is bad and valuations usually at historical lows. This is the time for the “smart money” to get in. Eventually a “disbelief” of a market turnaround leads to a first correction.
- *Stage 2* – is usually the longest with the largest return accompanied by improving business conditions (the layman investor enters gradually, accompanied by the improved consensus). An overreaction causes the second correction.
- *Stage 3* – is where the excessive speculation and appearance of inflationary pressures rises.

2.5.2.2 *Bear market*

- *Stage a* – is where the “smart money” realize it is time to exit. There is little indication in the news indicating overvaluation and the changing business conditions. After a while and a moderate decline a reaction rally starts (the third correction). A lower high is reached in the reaction rally and an end of increasing prices is a fact.
- *Stage b* –is where the largest price move occurs. Everyone wants to get out of the financial asset.
- *Stage c* –is where it is as bad as it gets. Once the stock fully reflects the worst possible outcome, at that point the cycle starts over again.

2.5.2.3 *Summation*

A common denominator between all these suggestive stages is that impatience, reward, the endocrine system and psychological traits accompanied by economic consensus, behavioural finance findings, and availability of information among investors is reasonable explanations giving rise to the suggested characteristic and underlying stock market structure.

- Primary and secondary movements with different price amplitude, time length and volume in the bull and bear market is supported by momentum, price

reversal, impatience, the endocrine system, the suggested amount of investor in the market (free float, supply and demand), availability of information, the category of investors that are engaged in stock market.

- A secondary movement shorter in time and amplitude is further supported by the reference-dependent perception and anchoring governing investors.
- The primary and secondary market movement evolve, over time, in respect to the stock itself and the available firm specific information and associated investor emotions.
- The proportions between the three investors; professional, layman, and naïve, in each market movement will determine the definite characteristic of previous mentioned parameters and the stocks definitive asset price structure.

2.5.3 Concluding remarks and implications

- Stocks should be analyzed by themselves revealing investor behaviour and stock performance characteristics.
- A stocks performance over a stock price cycle should be sorted into different market movements for an accurate investigation of investor behaviour.
- A stocks performance is reference-dependent and a cross-section analysis is only available after separating stocks into different performance groups trying to explain cross-sectional investor behaviour and predict asset prices.
- A stock's up and down movement is different in time length and price amplitude.

2.6 Motives and choices for my study

A separation of stock price cycle will be performed in accordance with the Dow Theory. Since scientific research suggests a number of factors, impossible to account for explaining intraday investor behaviour, none will be suggested. Price, time and volume is the parameters considered investigating the stock market behaviour. As the market is in all times the supreme referee these parameters will be sufficient and will assure that the results will be valid throughout history and stock markets.

The trading day will be separated into four different trading sessions (TS), each in general with a time length of 150 minutes⁴⁸.

<i>CLOSE-OPEN (COS)</i>	<i>Close-Open behaviour: Capture overnight implications</i>
OPEN – 11:30 (OTS)	Morning opening behaviour: release of European macroeconomic figures, general news.
11:31 – 14:00 (LTS)	Lunch behaviour: Low presence of new information.
14:01 – 16:30 (ATS)	Afternoon behaviour: US market opening, release of US, important, macroeconomic figures. ⁴⁹
16:31 – CLOSE (CTS)	Evening closing behaviour: Close the book.

This time frame will make it possible to account for a response to stimuli in a consistent manner over the whole time period analysed, in retrospect of stock exchange structural changes (opening/closing hour). Moreover it should be enough time pre⁵⁰ and post an expected event reducing the risk of missing out of behaviour effects in the market caused by information asymmetry.

“However beautiful the strategy, you should occasionally look at the results.”

(Winston Churchill)

⁴⁸ The use of this timeframe will assure that the release of information is treated equally throughout the year, as countries adjust to daylight savings time which would hinder a higher frequent timeframe without any further, time-consuming, adjustments.

⁴⁹ Economic calendar, fidweek.econoday.com

⁵⁰ Investors positioning themselves for a expected upcoming event perhaps accompanied by inside information trading.

2.7 Formulation of hypotheses

From the previous discussion of the Dow Theory and human behavior the following three hypotheses are developed:

Hypothesis 1: The circadian return, volatility, turnover, and volume characteristic will differ between a bull and a bear market.

Hypothesis 2: The circadian return, volatility and turnover, and volume characteristic will differ between a primary and a secondary market movement within the bull and the bear market.

Hypothesis 3: The return, volatility and turnover, and volume characteristic will systematic differ between the ultradian rhythms within the different market movements.

“History will be kind to me for I intend to write it.”

(Winston Churchill)

2.8 OMX Stockholm Stock Exchange

In an international comparison Sweden is a small country and open economy. That said, Sweden do have many firms with a high degree of international presence. A list of the firms' considered in this study is found in table 5, accompanied by an indicative illustration of each firms sales share associated to four geographical regions around the globe. Figures for 2000 are presented illustrating the market presence around the end of the Internet market boom, see figure 5. They are accompanied by the corresponding figures for 2007 around the end of the most recent market boom, pre “subprime” financial crisis⁵¹, see figure 6. For OMXS30 index performance throughout the sample period see figure 4.

⁵¹ Beware of the lag in sales figures, which corresponds to sales from the previous year.

2.9 Previous Research: Intra-day behavior

Research on intraday price movements has been conducted from stock markets around the world, from America in West to Japan in East. They have shown that markets are more active in the beginning and ending trading sessions with an intraday U-shaped pattern in the volatility. (Chan et al., 1995; Andersen et al., 2000)

Further, Block et al., (2000) argues that high returns around open and close is due to institutional investors, which lay orders more frequently 30 minutes post opening and 30 minutes pre closing session.

Harris (1986) show that a predominant portion of stock price moves takes place in the first 45 minutes of trading. A similar result is suggested by Kramer (2001) which finds that the average realized return for the first trading hour is ranging from 26 to 78 times larger than the afternoon hour return.

Hamelink (2003) study predominantly positive and negative price changes between 2.5 % and 10.0%. In his study, using French data, the duration of large price changes is between 2.5 and 5.75 hours. He found that pre-event spread was a positive function of the magnitude of the large price change to come, and spreads increase strongly when a large price drop occurs. One suggested explanation to the pre-event move was the possibility of inside information trading. Further he observes a sharp drop in trading volumes associated to an event, which drop is much stronger in the case of a price decrease.

Ammann and Kessler (2008) conducted an intra-day study of returns and liquidity around idiosyncratic stock price crashes on the US market⁵². They found that liquidity was in general increasing during the crash resulting in higher turnover. After a crash returns were further found to exhibit a negative price drift lasting for more than 6.5 hours. The crash itself was concluded to range between a few minutes to over two

⁵² In a different study of a volatile period, October 1997, Goldstein and Kavajecz (2004) found that investors even withdraw liquidity from their electronic limit order book and chose the flexibility and discretion of floor trading instead.

hours (which corresponded to be within 1.96 standard deviations from the mean, 61.55 minutes).

Asgharian et al., (2010) analyzed price movements around a jump in price using high frequency intra-day data. The authors studied psychological biases of price movements among stocks in the S&P 100 index, ranging from April 1997 to March 2007, under the Bull and Bear market during this period. They conclude that there was an overreaction to positive news, which was corrected for in the subsequent trading days in the Internet bull market. In the following Bear market they found evidence of a strong overreaction to negative news and an under reaction to positive news. Their conclusion is that investors in the different market conditions tend to respond asymmetrically to positive and negative unexpected news. They also find that investors' behavioural bias significantly corresponds to firm size.

3 Method

This third chapter I give a description of the methodology used in order to perform my proposed research. I describe how data for the study was collected and which problems I had to resolve for the study to be reliable and valid.

3.1 Research design

Research design is a framework for gathering and analysis of data. The choice of research design reflects the stands the researcher has taken regarding what priority be given to the number of dimensions and aspects in the research process (Bryman and Bell, 2003)

“The more time you spend in reporting on what you are doing, the less time you have to do anything. Stability is achieved when you spend all your time doing nothing but reporting on the nothing you are doing.”

(Cohn's Law)

3.1.1 Research philosophy

The research philosophy is associated with the view that was taken on the research process. The philosophy captures the way the researchers view the world and subsequently affects the research design, the data collection and the analysis of the study (Saunders, et al., 2003). In this study I will focus on objective and quantifiable observations that can be analysed and result in consistent and regular generalizations.

3.1.2 Research approach

Research approach can be described as the theoretical design of the research. Of the two main approaches, the one that is best suited for my study is the deductive one. The deductive approach has a structured design in which existing theories are examined through hypothesis testing (Saunders et al., 2003), which fit best with how I want to carry out my study. The study has not been relied upon any particular prior

work found, it is rather a combination of research from the reviewed field which has lead up to a study of existing theories and research observations.

3.1.3 Research motivation

First, I want to find out the characteristics of stock market behaviour among a few of the largest companies in Sweden, suggestively being a good representation of the world as such and stock market behaviour. This is done by performing a quantitative study on the assets time, price and volume performance during the years ranging from the start of 2000 to the end of 2008. Secondly, I want to discuss internal and external aspects of human behaviour in fields outside the mainstream literature of economics and finance. The motivation for this is that it might add new insights on why asset prices evolve and fluctuate as they show. The implications could be of severe importance for corporate leaders, politics and society and the future prospects of a healthy economy and a successful financial market.

3.1.4 Reliability

It is of importance that the research results are trustworthy and reliable. Reliability is often of concern in quantitative research since the researcher is interested in whether the measurement technique is stable or not. A high degree of reliability is assured if it were to generate the same results if performed again. (Bryman and Bell, 2003)

The used literature is to a large extent assumed reliable. Data in this study has been collected from the database TradeTicker given accessed to by the economic professor Hossein Asgharian at Lund University. The data is originally provided by NASDAQ OMX, and judged to be very reliable. However, inconsistencies have been found in the used data suggestively due to other parties' involvement in processing it.

All processing of data, calculations and graphical objects are performed using Microsoft Excel 2007. The procedure of processing millions cells of data, calculating return, volatility, turnover and volume down to determining line colour of graphs is

completed using Visual Basic for Application Macro (VBA). (Jackson and Staunton, 2001; and Walkenbach, J., 2004)

3.1.5 Validity

For a study to have validity it should measure what it sets out to measure i.e. does the data really measure what the authors intended and can the conclusions drawn from the study actually be made based on it? (Bryman and Bell, 2003; and Saunders et al, 2003)

Before this thesis began I had no prior knowledge of programming and VBA. Extensive time, effort, and evaluation has been conducted to minimize potential biases and errors from the calculation process. To further assess the validity of this paper, the method has comprehensively been justified and supported by my argumentation. The argumentation is based on a thorough investigation of different sciences of importance and relevance for financial market behaviour. I rely on previous research to the extent possible. I hold not more than four months of university studies and curiosity in the field of neuroscience and psychology. But once again, considerable effort to gain as much accurate and interesting information for the implications of financial investment and investor behaviour has been taken. I complement it with my own life experience and expertise gained from my studies received from the professionalism that imbues the professors at Lund University, and more specifically at the Department of Economics and Department of Business Administration and Management.

3.1.6 Generalisation

Since the European markets are characterized by rather long opening hours these markets and to a greater extent than other markets, are subject to stock market consensus from the Asian markets in the morning session and the American markets in the afternoon session. This could hinder the generalisations of my results to these markets in regards of the intra-day behaviour at a certain time of the day. Further it is also commonly suggested by psychologist that the American culture is individualistic. The Asian culture is characterized as being collectivistic. In retrospect the European culture is somewhere in between. This could have possible altruistic, social and behaviour implications of importance for my suggested finding of stock market behaviour and to what extent they can be generalized.

However, although the scope of this study is limited to stocks listed on the Swedish market I would like to argue that it still is possible to generalize it to many other markets if not all. Cultural differences might differ but technology has opened up access for any (more or less) investor around the world to trade Swedish stocks which they suggestively do. This suggests that the “Swedish” investors aren’t perhaps so Swedish after all. Further, the combined group of investors in the world engaged in trading and investment activities might share rather common behaviour and attitudes towards investment and risk taking. Proposing that they might share a similar behaviour in regards of how they act and respond to the financial markets. Proposed implications from this research would consequently hold true for any financial asset, in any market, at any time all over the world.

“All generalizations are bad”

(R H Grenier)

3.2 Data collection

The research accounted for is searched and found up to 70% using the Electronic Library Information Navigator (ELIN), 25 % contributed to the Social Science Research Network (SSRN) and the remaining 5% to the PubMed research database. The data this thesis is built upon is secondary data accessed at Lund University. The data is processed and filtered by employers at Lund University into one minute intervals. The data is high-frequency enough revealing intra-day market behaviour during a day in a general stock market.

3.2.1 Sample selection

The sample contains of stocks listed on the Swedish stock exchange. More specifically of large cap stock listed on the OMX Stockholm 30 Index. Some stocks were excluded from the sample due to insufficient data over the chosen sample period.

3.2.2 Potential biases

The price at each trading session break might be manipulated giving rise to bias. Research further suggests high volatility around the close of the day. This might have implications on the determination of the primary and the secondary market movement, which in effect could give rise to a misspecification of the market movement and a misinterpretation of investor behaviour and the observed. A separation into primary and secondary market movement is moreover only possible given that the stock price history demonstrate the proposed market movement structure. Consequently, the found results might be self-fulfilling in that sense and perhaps not that unexpected. The separation into primary and secondary market movements is partly based on my subjective opinion as alternative market movements might be evident from strict quantitative suggestions. Although this will reduce the potential of a misspecification it might give rise to biased results.

Some firms report quarterly and annual reports outside regular trading hours. Since this study does not consider trading activity outside general trading hours. Hence, if

such an activity is offered investor behaviour is not examined in this study other than included in the COS. It is also possible that a firm has changed reporting time over the 9 year sample period.

The opening and closing time has several times been changed, and extended, on the Swedish stock exchange. This has obvious TS sample size implications on with no session are really equally large throughout the sample period. Furthermore, note that the CTS is considerable shorter than the other TS as the close do occur no later than 17:30 in this study.

The intra-day data used is filtered and processed by other parties and inconsistencies have been found in the data set, with obvious consequences.

3.3 Calculations

Return in TS:
$$R = \ln\left(\frac{P_{TS\ End}}{P_{TS\ Start}}\right),$$

where P is the price.

Index t is each minute within TS.

Volatility⁵³ in TS:
$$\hat{\sigma}^2 = \frac{1}{T} \sum_{t=1}^T (r_t - \hat{\mu}_{TS})^2,$$

where $\hat{\mu}$ is the average return in TS and r is the return at time t within TS.

Turnover in TS:
$$TO = \sum_{t=0}^T (to_t)$$

where to is the volume at time t .

Volume in TS:
$$VOL = \sum_{t=0}^T (vol_t),$$

where vol is the volume at time t .

The close price is used in the separation of market movements. The bull and bear market period and underlying submarket movement is filtered out using two different minimum percentages; one for the primary movement and one for the secondary market movement. Different performing stocks, in regards of their cumulative return from bottom to top, will act as criteria for a separation into a high and a low performing group of stocks.

⁵³ Campbell et al., (1997)

Hypotheses testing of the average return and volatility between trading sessions, the bear and bull markets and their corresponding underlying market movements.

Return:
$$Z = \frac{\bar{x} - \mu_0}{s/\sqrt{n}}$$

Volatility:
$$F = \frac{s_1^2}{s_2^2}$$

where \bar{x} is the average value, μ_0 is the hypothesised value, s is the standard deviation and n is the sample size.

Hypothesis testing of the average return and volatility between trading sessions and market movements within a performance group:

Return:
$$Z = \frac{(\bar{x}_1 - \bar{x}_2)}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}}$$

Volatility:
$$F = \frac{s_1^2}{s_2^2}$$

where \bar{x}_i is the average value, s_i is the standard deviation and n is the sample size.

Hypothesis testing of the turnover ratio.⁵⁴

Turnover ratio:
$$Z = \frac{(P_1 - P_2)}{\sqrt{P(1-P) \left(\frac{1}{n_1} + \frac{1}{n_2} \right)}}$$

where P_i is the proportion and n is the sample size

Statistical analysis of each variables frequency distribution:

$$\chi^2 = \sum \frac{(O-E)^2}{E}$$

where O is the observed frequency and E is the expected frequency.

⁵⁴ With a suspected rapid increase of automatic execution of trading activities using advanced technology statistical inferences from an investigation of the volume over sample period is questionable. Moreover a cross-sectional comparison of average volume and turnover is less meaningful.

3.4 Methodological problems

“I'm sure you've heard the expression, ‘If something sounds too good to be true, it probably is.’ Well, in the investment world, I say, ‘If something sounds too good to be true, it definitely is.’”

(1997 Washington Times 3 June B7)

The incorporation of my method on the available nine year data sample was not sufficient to determine a bull and bear market trend for each and every stock. Consequently, further separation was not meaningful. Furthermore it was in the case of some stock troublesome to determine the secondary market movement. This combined with minor inconsistencies in the raw data set hindered a thorough investigation of the complete sample of constituents in OMXS30. This obviously has severe implications on the study. The suggested cross-sectional analysis of different performance groups is consequently hindered. These mentioned problems lead me to exclusively investigate the stock price and the investors' behaviour relating to Investor AB. As this is a Nordic holding company holding shares in several of the constituents of OMXS30 index⁵⁵ I should still be able to discuss overall stock market and the investors behaviour. Investor should make sure, to the extent possible, that the reliability of the study is still assured although the intended cross-sectional investigation of the investors' behaviour not being performed. Consequently, the observed findings might only represent a portfolio of stocks, or suggestively a stock market index. In Figure 7 - 13 the listed stocks held by Investor over the complete sample period is presented, as an illustration of a single stock price performance over time. However, no focused discussion on these stocks will be given. An additional analysis of all these stocks would be very time-consuming.

⁵⁵ Investor AB, Annual Report 2007

“What” one should invest in and “When” one should invest has been addressed by previous research and is frequently discussed in media and scientific research. Need not to forget that the previous theoretical discussion of problem and critique towards the previous behavioural finance research results is well justified, which holds true for this research as well. Further accompanied by “How” the investors should act, respond and handle him- or herself and a given stimuli associated to investment activities moral and ethical problems arise for me. The “How” appears to be the factor of highest importance as the investor governs the other two activities, “What” and “When”. Consequently, presenting statistical significant or insignificant results for my hypotheses and observed findings emerged from the investigation of just one stock will do more harm than good for the reader. This as s/he might experience doubt or be misled in the decision making process for other stocks which demonstrate a price structure consistent with the Dow Theory. The layman or naïve investors, which are those most likely to read this paper, might jump to faulty conclusions missing out on the “Big Picture” from such an inclusion⁵⁶. A larger study, with a longer time horizon using more than one stock, must take place for a presentation and discussion of statistical inferences. The analysis and discussion of the observed results will consequently rely upon descriptive statistics and graphical illustration of how Investor performed and evolved over the chosen sample period. It is obvious that this limits my ability to draw extensive conclusions from the hypotheses and the observed results.

⁵⁶ If you are a reader with a high level of understanding of yourself, the financial markets and statistics realizing the limitations of this study, you will find sufficient figures to perform some statistical calculations on your own in the Appendix.

4 Empirical Results

In this fourth chapter I present the empirical findings from the conducted study. All results are revealed in graphs and tables for each market and each studied parameter, accompanied by a brief discussion of what is found.

4.1 Results

Each section is introduced with descriptive statistics, focusing on the average return and variance for each particular market, which is about to be presented. The next sections present, in brought up order, the realized return going from one trading session to the next. Each trading session's volatility then follows. At last the cumulative turnover is presented for each trading session, accompanied by brief comments on the volume⁵⁷. For more detailed results please see appendix where you will find descriptive statistics in full detail, probability and cumulative distributions for each analyzed market movement over the sample period.

4.1.1 Comments on how to read and interpret presented graphs

The graphs are presented with five different lines representing the percentile of the observed findings. It is set in accordance with the first and second standard deviation of a normal distribution. In the case of the volatility the 1st and 2nd standard deviation is calculated and included as a benchmark simplifying comparison between market movements. In the case with returns the percentiles were corresponding to the respective standard deviation figures. In the return and turnover graphs results are presented in the 09:00 column. In the case of the return graphs this exhibits the realized return for the opening trade compared to the previous day's close. The corresponding column of the turnover graph is illustrating the associated turnover.

⁵⁷ The corresponding graphs on volume are not included as the turnover graphs will to a great extent cover the volume characteristic as well. (Be aware of the stock price difference between trends)

4.2 The complete period, the bear market and the bull market

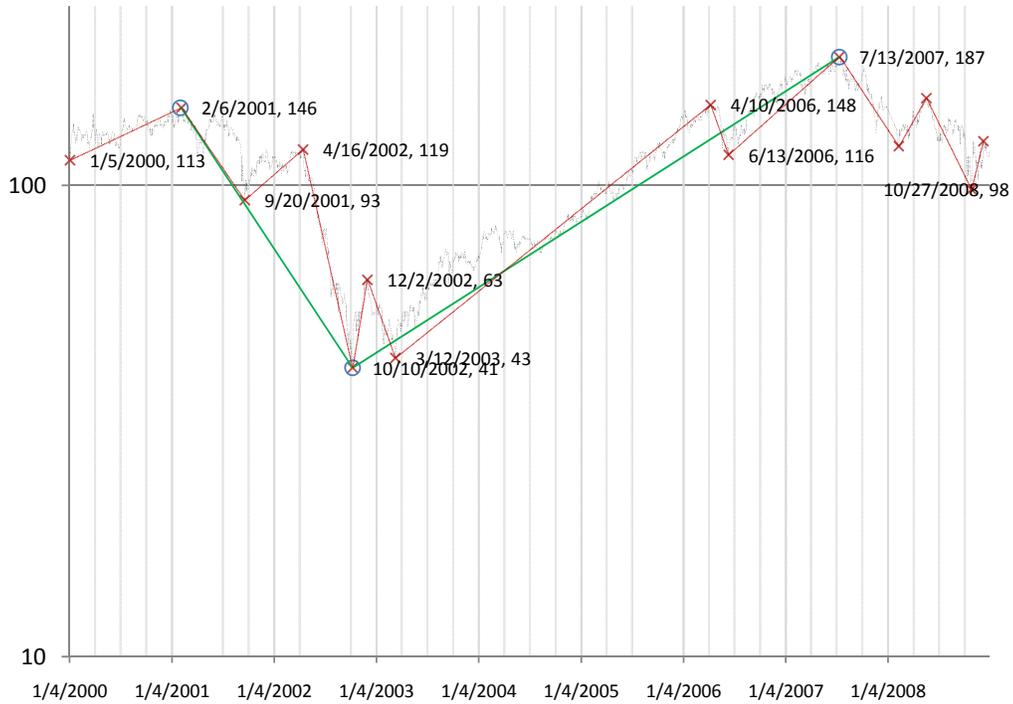
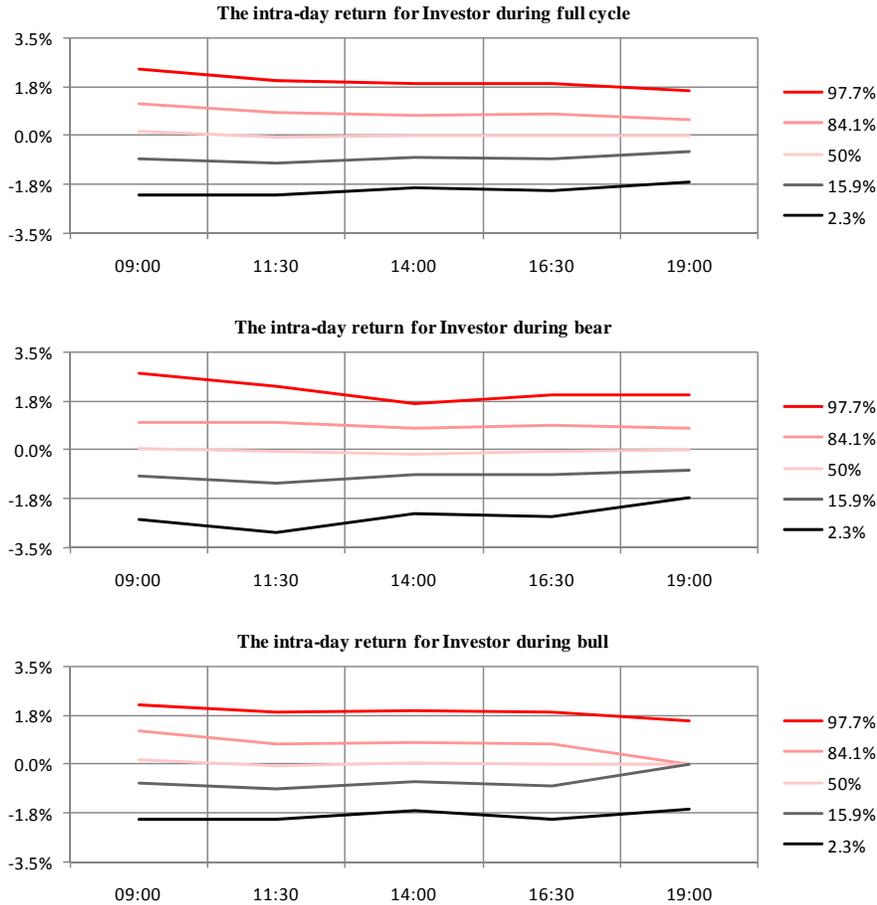


Table 1, The complete period, the bear market and the bull market

Market condition:	Start date	End date	# of trading days	Return	μ return	σ	σ^2	% days positive return	Kurt	Skew
Complete Cycle	6/2-01	13/7-07	1613	25%	-0.119%	1.621%	0.0020%	37.8%	7.6	-0.8
Bear Market	6/2-01	10/10-02	421	-127%	-0.333%	2.057%	0.0019%	34.9%	2.7	-0.4
Bull market	10/10-02	13/7-07	1193	157%	-0.043%	1.428%	0.0021%	38.7%	12	-1.0

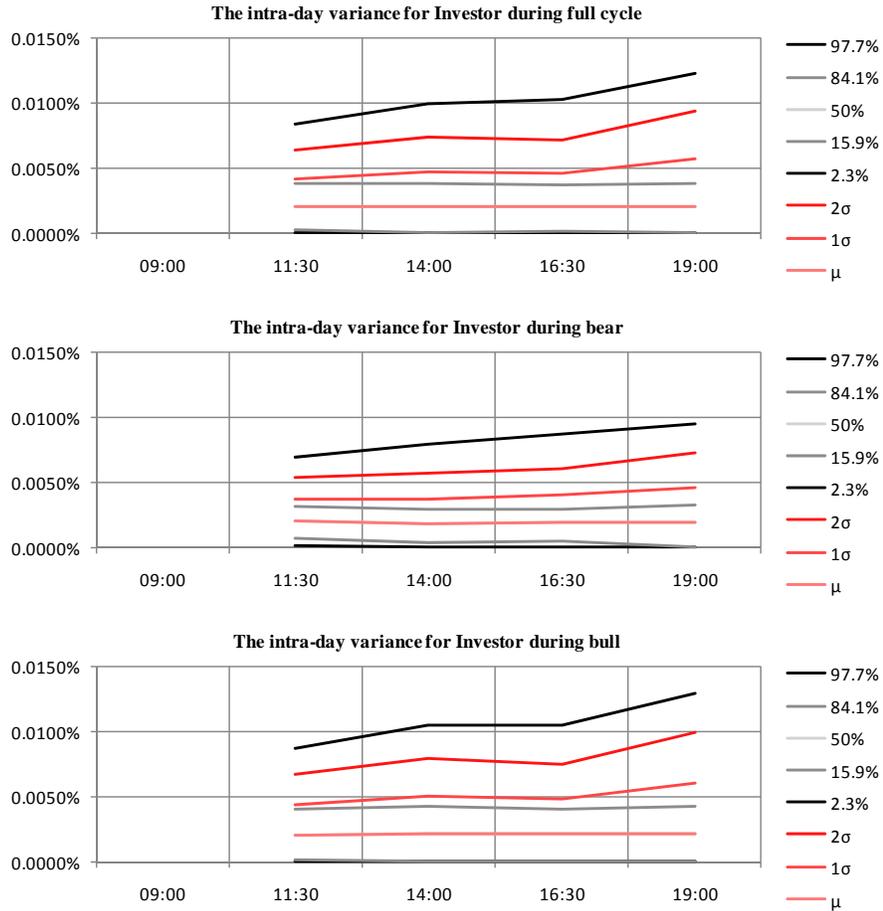
(See appendix I.a for more detailed information)

4.2.1 Return



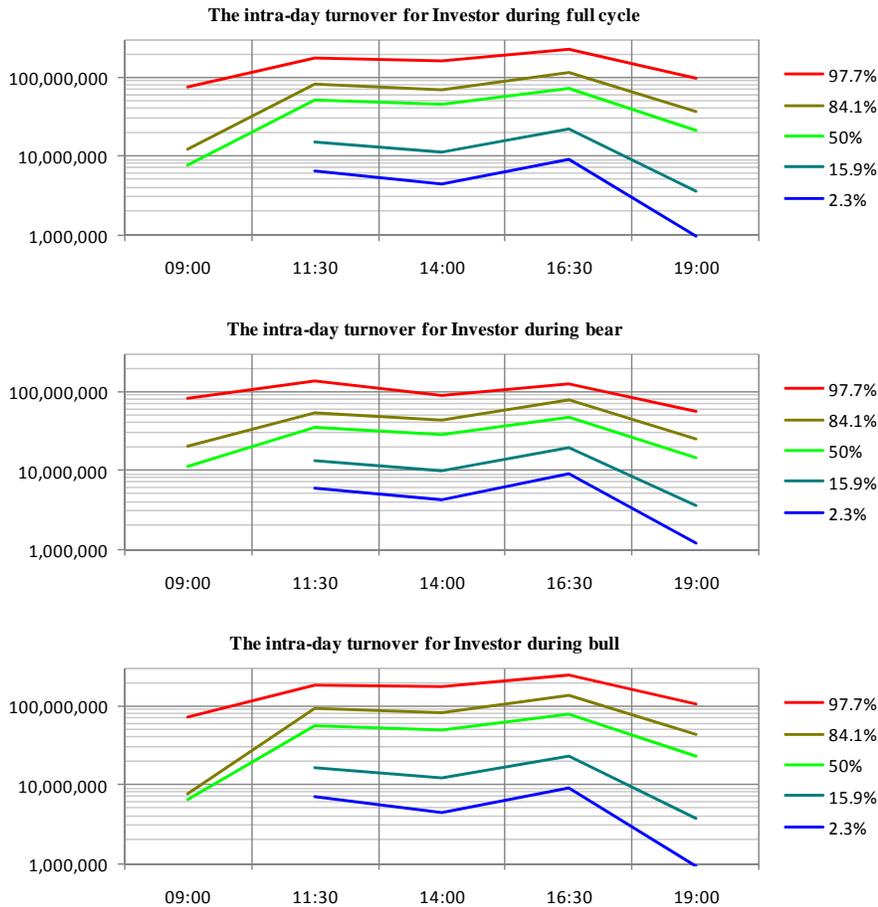
The complete cycle indicates that the return spread is higher around COS and OTS contracting towards CTS. The bear market period is exhibiting a large spread of positive and negative extreme returns. From the COS to the OTS the return spread is shifted down. From the OTS and onwards the returns slowly contract while extreme returns are trending upwards. The bull market period is exhibiting a slight downwards trend in the OTS compared to the more positive return occurred from COS. At CTS 68 % of the return is at 0 %. (see appendix I.a-c for more detailed information)

4.2.2 Volatility



From above graphs it is evident that 84 % of the volatility spread is well below the 1st standard deviation in all the periods, being less than 0.005 %. The occurrence of extreme volatility is conclusively increasing from the OTS and peaks at the CTS, as well as being more present in the bull market period. (See appendix I.d-f for more detailed information)

4.2.3 Turnover



With the exception of the COS and the CTS turnover (not comparable due to their shorter trading session), the turnover is exhibiting a V-shape. The overall observation is that the highest activity is present around the ATS. Similar graphs for the volume indicate a more evident upward shift in the bull market period for the five percentiles compared to the bear market period. The turnover activity from each trading session is further revealed in appendix illustrating a significant upwards shift in the ATS demonstrating the highest turnover share in general between the four trading sessions. (See appendix I.g-j for more detailed information)

4.3 The bear market's underlying market movements

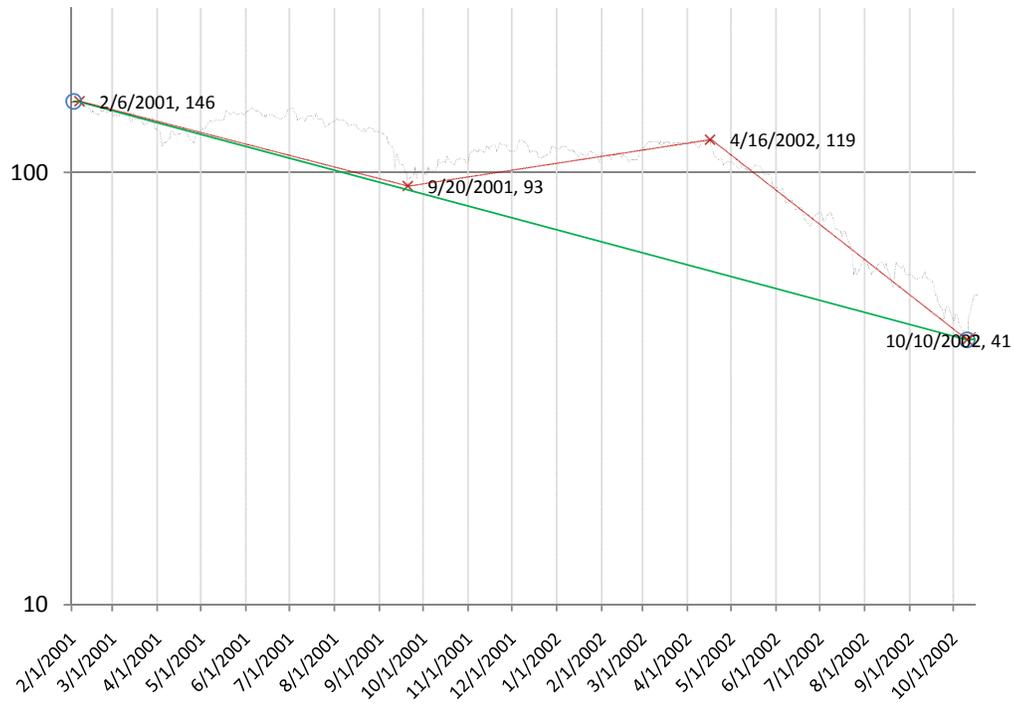
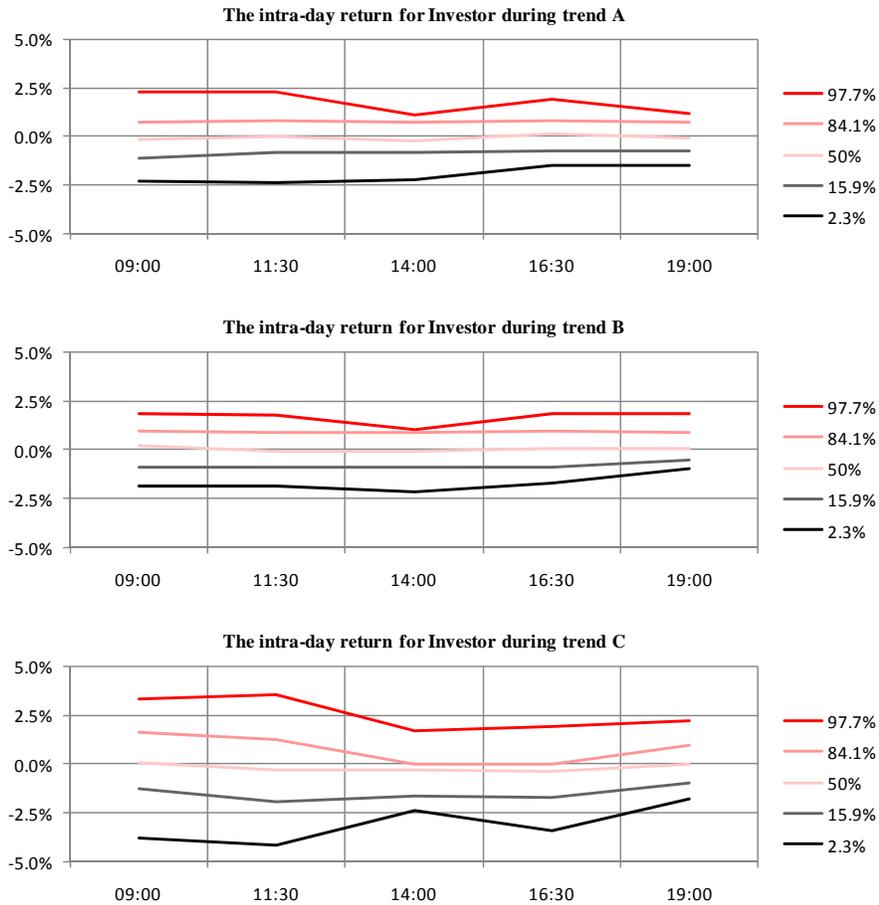


Table 2, The bear market

Market condition:	Start date	End date	# of trading days	Return	μ return	σ	σ^2	% days positive return	Kurt	Skew
Trend A	6/2-01	20/9-01	157	-45%	-0.166%	1.883%	0.0013%	36.9%	7.4	-1.3
Trend B	20/9-01	16/4-02	142	-25%	-0.055%	1.732%	0.0015%	40.1%	0.8	0.8
Trend C	16/4-02	10/10-02	124	-107%	-0.909%	2.518%	0.0031%	25.8%	1	0.2

(See appendix II.a for more detailed information)

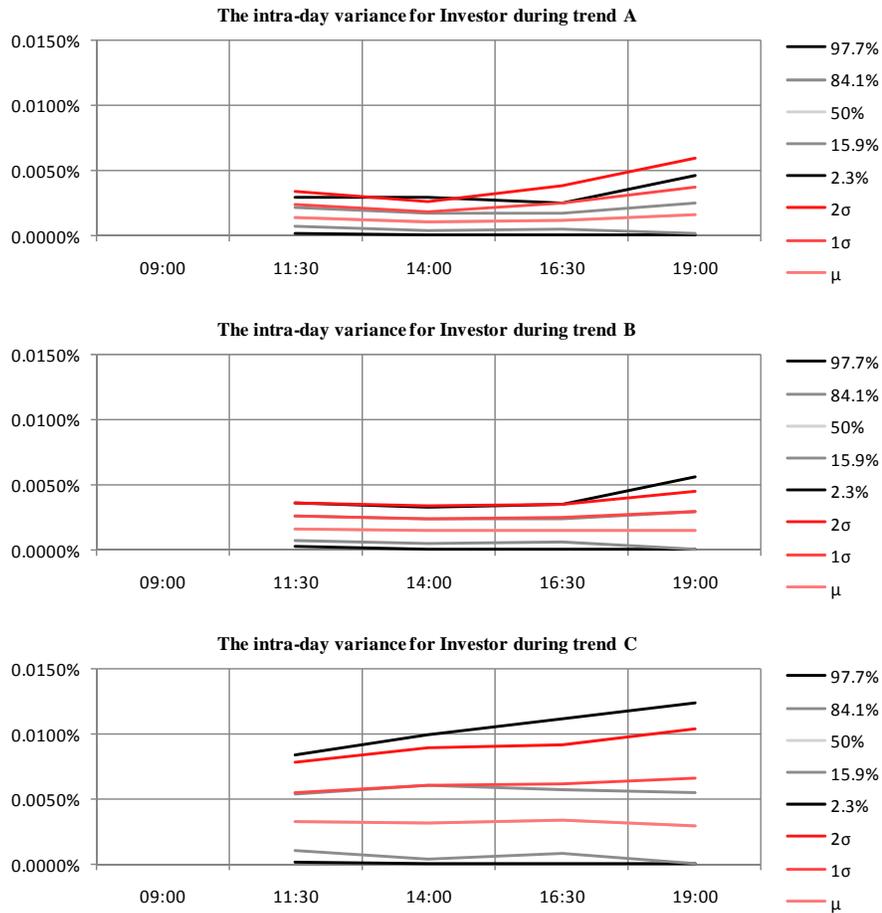
4.3.1 Return



In trend A the occurrence of extreme return is contracting as trading activity evolves throughout the day. The tightening of the return spread occurs predominately during the LTS where the probability of extreme positive returns is significantly reduced. The trend is further exhibiting a slight upwards shift towards the end of the day. A similar pattern is found for the trend B period, with an even tighter spread over the whole day. In trend C on the other hand a significant wide spread is evident in COS which remains, and increases, while shifts down in the OTS. Further there is a considerable tightening in the LTS which is followed by an increased spread in the ATS and upwards shift at CTS. Note that 84 % of the returns are negative in LTS and ATS. An overall finding is the gradually reducing spread throughout all trends when heading towards the end of the day. Further, positive extreme returns are less likely to

occur in the CTS in trend A whilst in trend C negative extreme returns are less likely to occur. (See appendix II.a-c for more detailed information)

4.3.2 Volatility



The volatility in trend A and B is showing, with less amplitude the same observed findings as in the complete bear and bull market period. In trend A 97 % of observed volatility is at or well below the 2nd standard deviation, and less than 0.005%. The volatility gradually increases heading into trend B. In the third and final down trend a remarkable shift up occurs. Note that 84% still remains rather stable throughout the day, with an indication of a slight increase in the OTS and ATS in trend C. Further the volatility is considerably above the corresponding 2nd standard deviation. (See appendix II.d-f for more detailed information)

4.3.3 Turnover



No particular differences are found between the three trends in the turnover. Bare in mind though, that the price is considerable higher in trend A and B. Suggesting a radical increase in volume, which is also expressed by the graphs of the volume. There is a reduction of volume in LTS throughout all trends. (See appendix II.g-j for more detailed information)

4.4 The bull market's underlying market movements

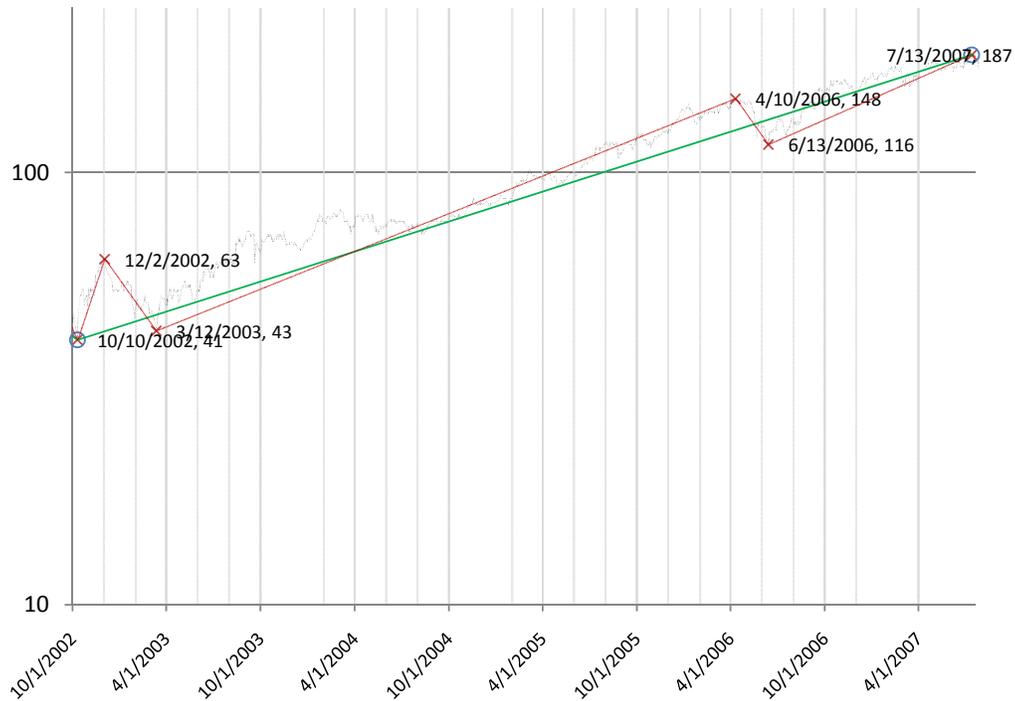
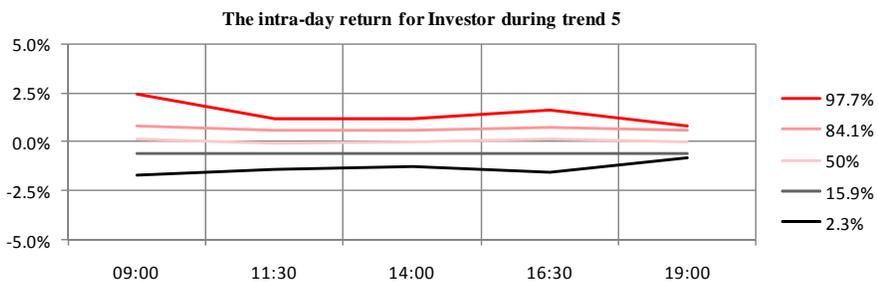
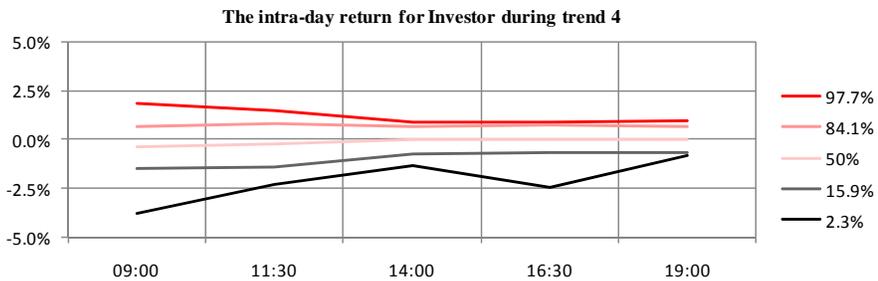
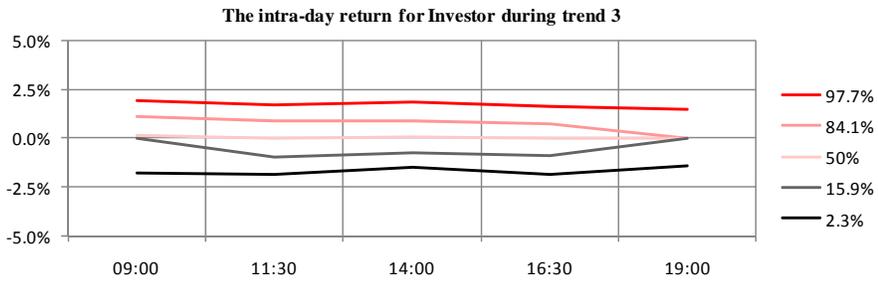
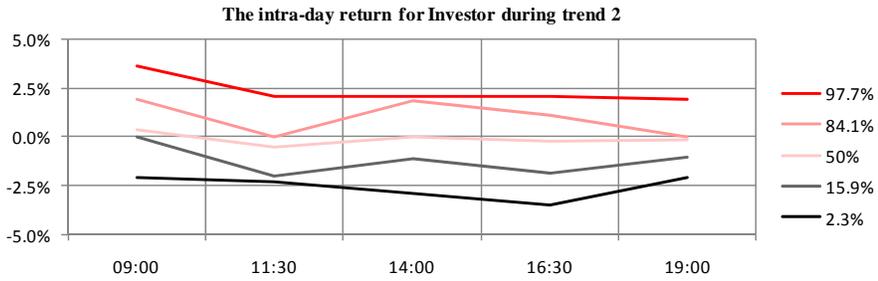
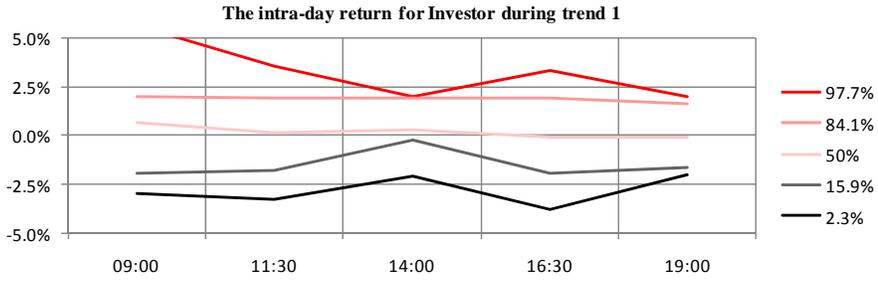


Table 3, The bull market

Market condition:	Start date	End date	# of trading days	Return	μ return	σ	σ^2	% days positive return	Kurt	Skew
Trend 1	10/10-02	2/12-02	38	43%	0.413%	2.611%	0.0051%	36.9%	1.1	-0.1
Trend 2	2/12-02	12/3-03	66	-38%	-0.920%	2.130%	0.0038%	42.1%	0.8	-0.1
Trend 3	12/3-03	10/4-06	777	124%	-0.004%	1.330%	0.0023%	36.8%	21.1	-1.6
Trend 4	10/4-06	13/6-06	42	-24%	-0.270%	1.605%	0.0011%	33.3%	3.4	-0.8
Trend 5	13/6-06	13/7-07	134	47%	0.019%	1.129%	0.0008%	48.9%	0.5	-0.1

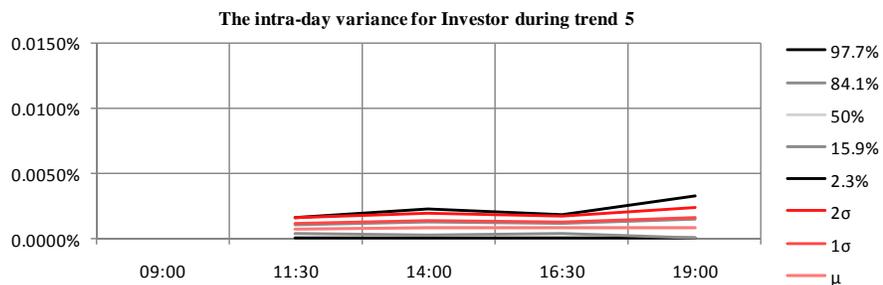
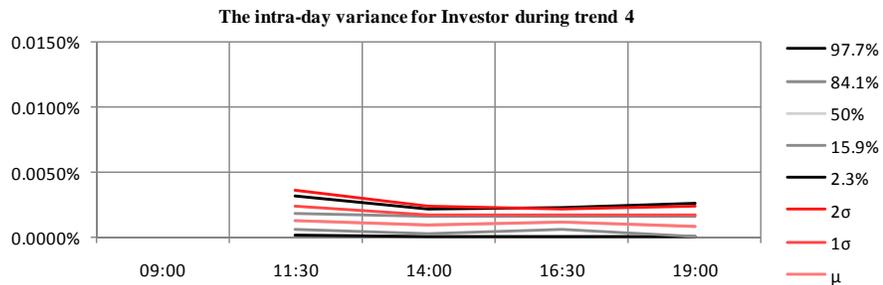
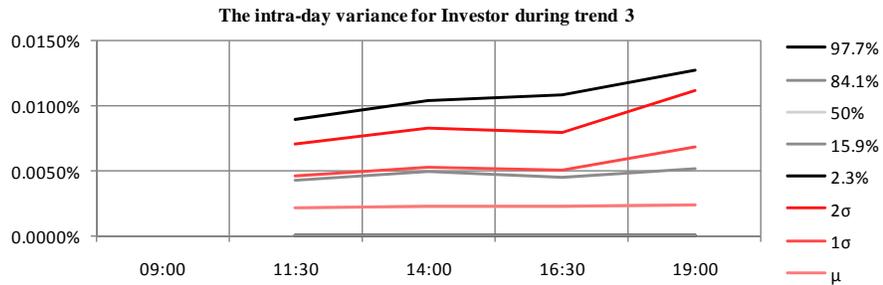
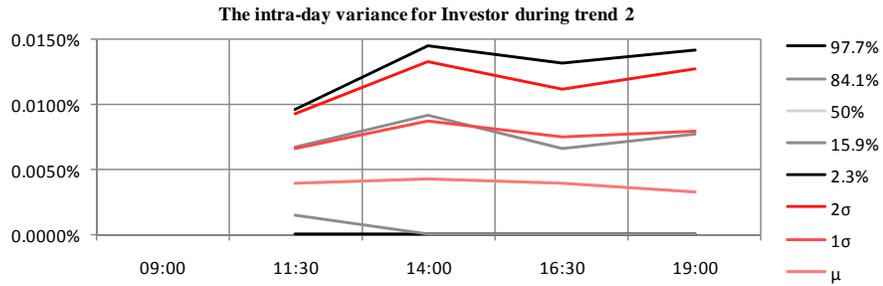
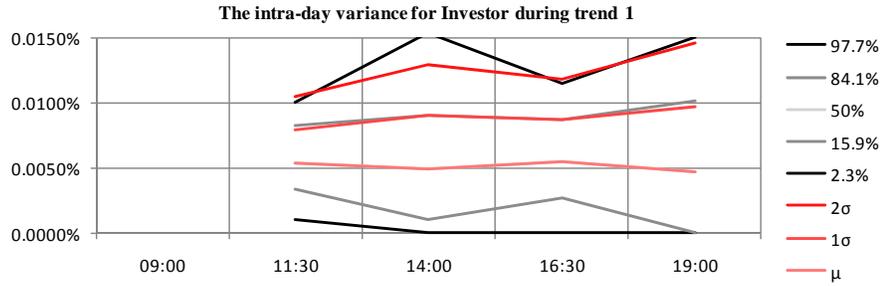
(See appendix III.a for more detailed information)

4.4.1 Return



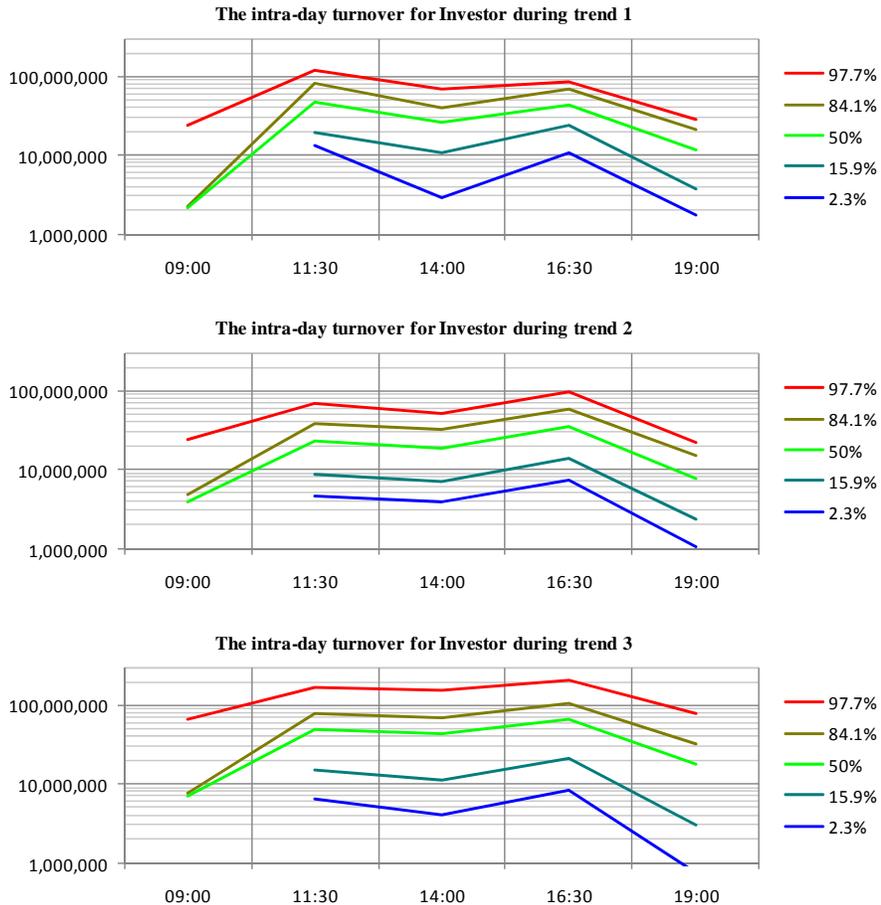
Entering the bull market period the spread is considerably high around COS which remains in the OTS. As previously noted the return spread tightens around LTS, where, in trend 1, ~84 % of the returns are positive. Trend 1 is exhibiting, what was also noted throughout the bear market movements, an increasing spread at ATS which holds true for more or less all five bull market movements. Interesting is that both in trend 1 and 2 there is an increased fluctuation of the three inner percentiles (84.1%, 50%, and 15.9 %) between trading sessions not demonstrated before among all other market movements. In trend 2 to 5 the extreme return is gradually coming back down again. Overall the return spread is high at open and gradually contracts evolving towards the CTS. Noteworthy is that of the return occurring at COS in trend 2 and 3 about 84 % is exhibiting a zero or positive increase in prices. For trend 3-5 ~84 % of the return in CTS is close to 0 % if not at 0%. (See appendix III.a-c for more detailed information)

4.4.2 Volatility

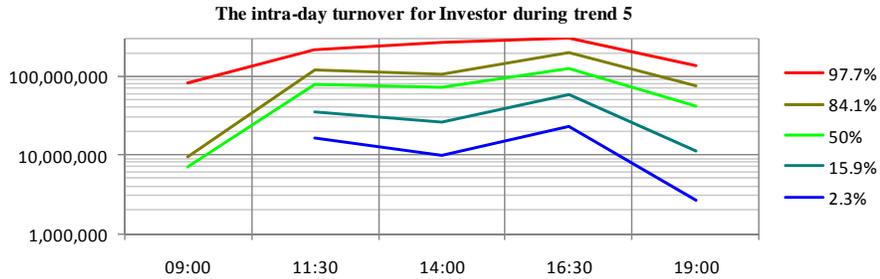
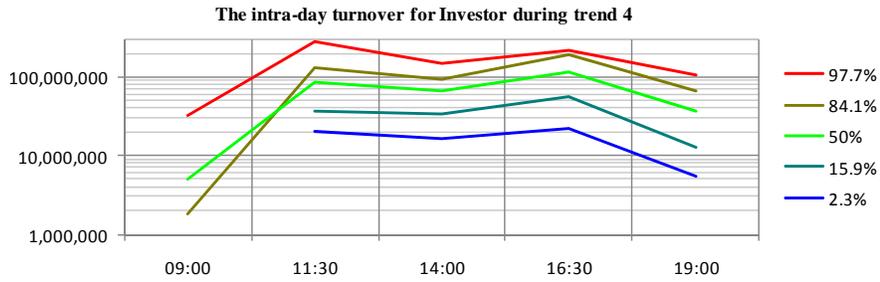


In trend 1 and 2 the characteristic of the volatility is, to a large degree, completely different from previously noted. It illustrates a considerable shift upwards, which has increased with about 80% and 40 % respectively compared to trend C. It is especially in the LTS that extreme volatility occur in trend 1, still accompanied by a high volatility in CTS as previously noted. The volatility starts to come back down in trend 3, which further continues in the next two trends where volatility is considerably lower than previously noted. (Note that trend 4 is the only market movement with a tendency to exhibit a higher volatility in the OTS rather than in the CTS). (See appendix III.d-f for more detailed information)

4.4.3 Turnover



~The Ultimate 'Black Box' ~



The overall activity from trend 1 and 2 is similar to what was observed in the bear market movements, still showing a V-pattern as previously noted. From trend 3 to 5 there is a significant upwards-shift in turnover. It is of course obvious that part of this is due to a higher price for the stock in question. But bare in mind that the price range is around what was observed in trend A and B. The investigation of the volume reveals that the activity in trend 1 and 2 demonstrate little difference from trend 3-5. However, the volume in trend 1 is overall well above what is found for trend 3. The corresponding graphs of volume are demonstrating an equivalent and a more obvious separation between trading among the trends. As previously noted from the bear market period, the largest turnover share of the day is indeed occurring in the ATS. (See appendix III.g-j for more detailed information)

4.5 Summary of Appendix

4.5.1 The Complete period, the bear market and the bull market

It is hard to determine any structural differences between the return probability and cumulative distribution of the bear and bull market, just as well between each trading session within them. Noteworthy is that all returns throughout the day is above 67 % negative in both periods, even higher for the bull period. The largest positive returns occur in the close-open session. In regards of the volatility it is clear that the bull market indeed exhibits a higher probability of large volatility. Moreover the afternoon trading session does as suggested exhibit the highest turnover throughout these periods.

4.5.2 The Bear and the Bull market's underlying market movements

In the first two trends of the bear market, trend A and B, the distributions are rather identical but they do exhibit a clear difference between trading sessions. The open trading session is similar to a normal distribution which changes throughout the day transforming into a distribution corresponding to Prospect Theory. In trend C an overall transformation occurs. It continues in the first two trends of the bull market, in which the probability curve demonstrate a positive skewness which is close to symmetric around zero, with. The cumulative return continues to be largely negative ranging from 65 % to 85 % throughout the day among the three trends, trend C-2. The volatility remains, as previously noted, low until trend C begins and remains high into trend 3. There are no particular differences in the turnover between the trends. In trend 3 the return exhibits a distribution consistent with the complete stock market cycle. Reaching the end of the bull market, in trend 4 and 5, the return distributions are identical to those exhibited in trend A and trend B. Overall 65 % to 90 % of the returns are negative throughout the trading sessions and trends. The volatility and turnover graphs demonstrate a clearer illustration of what has already been noted from previously presented graphs. The afternoon trading session is indeed demonstrating the highest activity as revealed.

4.6 Concluding remarks from the observations

Table 4, Summary of intra-day characteristics

	COS	OTS	LTS	ATS	CTS
Return:	High-Spread	High-Spread	Tightening of spread	Increased-spread	Lowest-spread
Volatility:	A gradual increase in extreme volatility throughout the day				
Turnover: (Volume)	Low	High	Low	Highest	Low

Negative returns are exhibiting a leptokurtic distribution and the positive returns a skewed positive distribution. The full day activity is similar to a normal distribution with the exception of a downward spike near 0 % in return, due to the skewed positive distribution. This is corresponding to the suggested gains and losses proposed by the Prospect Theory. The return spread is greater in the first two trading sessions. The cumulative return for each trading session is above 67 % expressing a negative return in both bear and bull market. In the bull market it is even as high as above 75 %. The overall finding in regards of volatility is that volatility clustering demonstrated among financial assets corresponds well to what has been found. It is in trend C to 3 that high volatility is demonstrated and in trend 4 to B that low volatility is demonstrated. Throughout the day volatility is low around open and steadily increasing towards market close. The turnover demonstrates the largest activity in the afternoon trading session. Further, it is a significant difference between the volume demonstrated in trend A and B compared to trend 4 to 5. The more recent demonstrate an average of 2.5 times higher daily volume compared to the former periods. Overall, the results demonstrate that there are differences between trends, demonstrating different return, volatility, turnover and volume characteristics.

5 Analysis and discussion

This chapter begins with a discussion of the results. Calculated figures and statistical findings is analyzed and discussed in regards of the developed hypotheses.

Implications from the literature review, economics, and previous studies on behavioural finance are accounted for, trying to reveal and express what lies behind the observed stock market and investors behaviour. Next, an overall discussion and implication of results and findings is presented. The section is finished with a discussion of the future market behaviour, with focus on the current debate on financial crashes, regulations of the financial market, and stock market volatility.

At the end of the 19th century the Dow Theory began to take its form. Since then the western countries society and economy has changed going from an industrial economy to a service economy. Technological advances have provided investors with new resources assisting them in the investment process. This has further been accompanied by important research discoveries such as CAPM and Black-Scholes Option Pricing Model etc. Yet the stock market structure suggested by the Dow Theory can still be found among stocks. Whether this price evolvement over time is random or not or demonstrated due to investors use of the Dow Theory is impossible to know. Either case the separation of market movements is indeed exhibited among many stocks (see figure 7-13), demonstrating different characteristic and investor behavior throughout the market movements. Keim and Stambaugh (1986) suggestion that stock returns can be predicted seem to be possible using the observations found with the Dow Theory as a framework. Momentum and price reversal effects are demonstrated and consistent with previous research findings. (De Bondt and Thaler, 1985 and 1987; Jagadeesh, 1990; Lehman, 1990; Jagadeesh and Titman, 1993; Jagadeesh and Titman 2001) These findings were demonstrated both over long and short time-periods, which made the subdivision into primary and secondary market movements possible.

A knowledge of this suggested market movement structure is consequently of value for investors, corporate leaders and policymakers as it can provide guidance of where

an stock or economy is in its price cycle and what could be expected in the near future.

Consistent with previous research, by Mizrach and Weerts (2009); Huddart et al., (2009) and Barber and Odean (2008) the increase in turnover around n -day highs and lows is indeed demonstrated by the results.

5.1 Hypotheses discussion

5.1.1 Hypothesis 1:

The circadian return, volatility, and turnover, and volume characteristic will differ between a bull and a bear market.

In the bear market, suggested by neurological and psychological research, a change in the endocrine system and overall homeostasis would induce a different time-discounting compared to a bull market. (Geoffard and Luchini, 2009; Coates et al., 2010) This suggestion is indeed demonstrated by the result, in which the bear market is one third the time of the subsequent bull market.

The return distribution is overall consistent with the suggestions offered by the Prospect Theory. It is further demonstrated that the bear market exhibit a wider return spread, suggesting that investors indeed tend to overreact to stimuli in this economic and emotional negative period. (Fehle and Zdorovtsov, 2003; Asgharian et al., 2010) The explanation for this relates to, as science suggest, the endocrine system eliciting different emotions and time preferences giving rise to the observed findings(Coates and Herbert, 2007; Coates et al., 2010; Emanuele et al., 2009; Geoffard and Luchini, 2009; Hariri et al., 2006; Lichtenstein et al., 1978; Loewenstein and Prelec, 1991; Kahneman and Tversky, 1979; McClure et al., 2004; Rotenberg, 2008; Sapienza et al., 2009; Takahashi, 2004 and Takahashi, 2005) These results should consequently hold true for a general financial marketplace.

Ammann and Kessler (2008) and Hamelink (2003) observation of increased liquidity around stock price crashes were also observed. In the case off the Investor stock the average daily turnover were found to be twice that observed in the following bull market. It is of severe importance to note some aspects concerning this observation. First, as sciences have documented that human's exhibit impatience this could provide one explanation. (Takahashi, 2005; Geoffard and Luchini, 2009; Loewenstein and Prelec, 1991) Since the same stock supply, suggestively, will be turned around in less time, due to observed impatience, along with an assumed increased public

participation, the turnover on an average day will naturally be higher. An accompanying and additional explanation for this is, other than impatience, that humans have been documented to behave differently and use different cognitive resources under certain market conditions. Different cortical regions of our brain are used on average in the different markets respectively. Overall we are striving to reduce negative feelings. (Coates and Herbert, 2007; Coates et al, 2010; Dehaene et al., 1998; Hardy-Vallée, 2007; Hariri et al., 2006; McClure et al., 2004; McClure et al., 2007) A consequence of this will result in a more rapid decline in asset prices as the investor tries to reduce the time of his/her experiencing negative emotions. Consequently, if one relaxed the time dimension analysing the investors behaviour there would suggestively be less differences between the behaviour in an increasing and decreasing stock market.

Moreover, technology, (automatic stop-loss orders and computer trading) and psychological traits (disposition effect, anchoring etc.) could further provide explanations. These are of secondary importance as prices do seem to exhibit the same characteristic today as when technology didn't assist investors at the same magnitude. Further the psychological traits are a consequence of neurological aspects.

Do remind yourself that the faster decline in asset prices should be considered overall positive. It reduces, the time of negative emotions for the investors and the overall society, as a shortened recession will be the evident result.

The hypothesis was supported.

5.1.2 Hypothesis 2

The circadian return, volatility and turnover, and volume characteristic will differ between a primary and a secondary market movement within the bull and the bear market.

Around the peak in prices the following observations were made. Trend 4 and A with a decline in prices did demonstrate close to an identical return and volatility distributions. Further, trend 5 and B with an increase in prices illustrated close to an identical return distribution and a very similar volatility distribution. What is interesting is that the turnover and volume is significantly and radically higher in trend 4 and 5 compared to trend A and B. This although prices being around the same level. There are some potential explanations for these observed findings.

First, in periods where a stock is considered an attention grabbing stock, (Mizrach and Weerts, 2009; Huddart et al., 2009; and Barber and Odean, 2008) suggestively of overall greater importance around the peak in asset prices,⁵⁸ more investors, institutional as well as public is expected to monitor stocks. Accompanied by steroid hormones affecting the novice and the professional investor, although differently, the risk appetite is higher in these times. (Coates et al., 2010). Moreover accompanied by the two anchors; a quantitative and a moral, (Shiller, 2000) the first subject to the professional investor facing the appropriate level; and the second to the novice facing the strength of reason for buying stocks. Accompanied by the brains anatomy and neurological factors this separation is intuitive and not unreasonable. (Agnoli 1991; Camerer et al., 2004; Finucane et al., 2000; Gilbert, 1991 and 2002; Kahneman, 2003; Nisbett et al., 1983; Shafir and LeBoeuf, 2002; Stanovich and West, 2000; and Stanovich and West, 2002) This could suggestively provide an explanation why the return, volatility, turnover and volume observations differ both between trend 4-5 and trend A-B as well as between these trends and those corresponding to the bear market turnaround, trend C-3.

⁵⁸ A period when media reporting is extensive reporting on the positive outlook on the economy, attracting investors to the financial markets, unprecedented about what is about to follow.

The increased monitoring suggests that more investors are around to seize the supply of stocks in circulation. The intuitive explanation for an increased interest in the financial market is extensive media coverage and reporting, affecting the public opinion. Accompanied by overconfidence facing humans s/he engages in investment activities in the financial market although his/her lack of expertise. (Lichtenstein et al., 1978; and Barberis and Thaler, 2002) This may give the professional and institutional investors time to reduce their exposure to risk. Moreover as a prolonged period of increasing asset price is expected, due to inverse impatience the professional capital is, possibly, allowed to leave the market under high volume. This without any severe effects on the return spread and volatility as observed. This would make sure that the overall positive opinion and market consensus maintain around these price levels.

This suggestion is not unprecedented. Heaney et al., (2007) suggest investors' performance on the financial market is correlated with factors such as the understanding of financial markets, self-confidence and level of trading in favour of the professional with experience and good understanding of financial markets. This has suggestively positive implications for the professional investor's cortisol levels, which is able to maintain a higher risk appetite in times of uncertainty while maintaining an objective mind. Furthermore research suggests that the professional isn't affected as much by the disposition effect as the layman or naïve investor. (Dhar and Zhu, 2000; Locke and Mann 2000; Shefrin and Statman, 1985 and Shapira and Venezia, 2000) This suggests that the volume and turnover observations are rational and not unexpected. Moreover as the majority of investors gradually start to lose money, and realize losses (in trend A and B), their risk attitude increases. This is moreover in consistency with Prospect Theory, and the suggestions related to mental accounting. The consequence being: some investors experiencing losses might add more risk to their portfolio as a "new" strategy rather than to "cut losses short". (Faulkner, 2002; Kahneman and Tversky, 1979; Thaler, 1999) Consequently, it is not unexpected to think that the combination of an increased engagement of more investors, layman and naïve, together with a suggested reduced engagement from

professionals' could result in the observed stock market behaviour around those times.

The reversed situation, explaining investor behaviour around the bear market turnaround would also relate to supply and demand. Further accompanied by research findings from the neurological and psychological sciences reaching reasonable explanations for the observed behaviour at times around nadir.

The hypothesis was supported.

It is important to note that the observed average daily turnover of the combined trend 4 and 5 period is 2.5 times as large as expressed in the combined trend A and B, being adjusted for the different cumulative time. Suggesting that this radical increase is due to the increased activity of public engagement is implausible. Four other explanations are in its place: Demographic changes along with the wide spread use of computer technology could provide additional explanations. As more investors in the later period could in an easy manner trade financial assets, the overall activity might explain the observation. Second, another explanation could be foreign direct investment. As Sweden is an open economy and a market with a large share of high technological companies and a country rich on natural resources foreign investors might have addressed Swedish stocks a higher interest throughout the analyzed sample period. The third explanation is credit. With access to cheap credit, well documented momentum and price reversal effects, inversed impatience, and advanced technology, assisting the average professional investors they are certainly generating arbitrage profits. The expected return from stock investments is expected to be higher than the cost of capital. This is of course due to the additional risk. But the risk is only risk for those investors with a lack of understanding of the financial markets. For those with a thorough understanding of the financial markets the observed risk is not close to being as high as what is expected at the first glance. As those investors, with great understanding, grow big over time they could most certainly destabilize the financial markets if they choose to. The fourth explanation could be due to an increased use of derivatives. Hence, there is an increased incentive for the large players to trade

the underlying as well as moving prices. The third and fourth are the two explanations of potentially highest explanatory power. When the price starts to turnaround it is indeed the start of the inevitable. Not unexpected from this analogy it would explain why the financial meltdown following the peak in prices 2007 had such drastic and enormous consequences, which of course were already obvious. Still, credit is suggestively the solely determining factor among all severe price declines throughout stock market history.

5.1.3 Hypothesis 3

The return, volatility and turnover and volume characteristic will systematic differ between the ultradian rhythms within the different market movements.

In the bear market none of the market movements did show a positive return in the two first trading sessions. In the even more uncertain times in trend C, a rapid price decline occurs on average around market open which maintains throughout the day till close. The close does demonstrate a modest positive return. This might reveal that a correction takes place around close due to an overreaction from previously during the day. In the following trend, trend 1, still characterized by severe uncertainty of the overall market consensus the opposite holds true; a large price increase around open and a modest downward correction towards the close, however under low volume. This observation seems to be in line with what is argued among several behavioral studies. (Asgharian et al., 2010) Investors tend to overreact to information, expressing subsequent corrections towards the stock market close in this study. At the end of the bull market, where all consensus is suggestively bullish, market opens down on average and reach positive returns towards the end of the day. This could reveal an indication of a present overvaluation among investors and in general disbelief of continuing stock price increases.

The OTS did in general demonstrate the lowest volatility and highest return spread. In regards of the return this was expected as this is a period, just as ATS, where most economic figures are released. Together with the time it takes for all information to reach investors proposed by Fehle and Zdorovtsov (2003) incorporating what has happened overnight large return spread isn't unexpected. In regards of volatility it could reveal that most investors, accompanied by their asset pricing models might have a similar overall opinion of how the market will respond to available consensus and the first trading hours. In the morning when the liquidity is high, high-frequency trading might also be involved, seizing even the slightest miss pricing in the stock, resulting in lower volatility.

Furthermore in the morning investors demonstrate homeostasis which is not as certain to hold true later in the day caused by several neurological factors. (Coates and Herbert, 2007; and Coates et al., 2010; Emanuele et al., 2009). Factors such as time pressure, increased cortisol levels, and the 'heat of the moment' could have affected the investors' cognitive abilities. (Bless et al., 1996 Finucane et al., 2000; Gilbert, 1989 and 2002; Isen et al., 1988 and Sapienza et al, 2009) This in turn can provide additional explanation to the gradual increase in volatility throughout the day. However, the reduced turnover in LTS is expected to increase the market power for those investors still in the market. Further the contraction of extreme returns around LTS, and a reduction in overall trading activity in this session throughout trends are most likely the cause of most investors having incorporated all available information and little new information is released as media, trade and industry in general is on "lunch break".

In the ATS a severe shift in activity starts again with an increase in turnover and the return spread. Since the Swedish economy and stock exchange is small in an international comparison, however with large internationally traded firms, the activity around this time-period account for the US stock exchange open. Which according to Chan et al., (1996) demonstrate a U-shaped volatility pattern during the trading day. As is observed from the results ATS do indeed reveal such a spill over effect. This provides additional evidence, already known, that Sweden is largely affected by the global financial markets. However, the finding contradicts Block et al., (2000) suggestion of large returns occurring around market close. Although, the volatility around close remains very high. This is suggestively due to the decline in overall trading activity. It appears as most investors have already closed their books more than 30 minutes pre close. Resulting in an increased market power for those investors left in the market.

The hypothesis was supported, indicating systematic and distinct differences between the four trading sessions among trends.

5.1.4 Concluding remarks and implications

Volatility and returns were highest around the first hours of trading, and later on in the afternoon around US stock market opening. Noteworthy however is that neither bull or bear market period exhibit a positive return, on average, in these time periods.

The results did confirm the research findings by Harris, (1986) and Kramer, (2001) of tremendous return differences between open and close trading sessions on average. Although this study uses a different intra-day time-period, the open trading session return is still 20-25 times larger than close trading session in the bull and bear market period. Although the different market movements do exhibit differences.

On the whole stocks do seem to evolve in a structure consistent with the observations made 100 years ago, suggesting that little in regards of human behaviour in the financial markets has changed. Perhaps it might be that stock prices move faster but that should be considered as overall positive as in all occasions this means a reduction of negative feeling among investors and the economy. The subdivision of a stock's price cycle reveals extensive amount of information which has been far from fully touched upon. There has been several interesting observations and results accompanied by a number of possible and interesting explanations for the observations. Furthermore, there is little consensus suggesting that what has been observed and revealed should not be demonstrated among other financial markets and assets demonstrating similar stock price structure as Investor AB does.

5.2 Financial behavior and the future

It has been concluded from scientific research that we humans are complex beings, and we are just about to be fully understood. (Hardy-Vallée, 2007) Even the simplest and perhaps most unthinkable factor has been proven to be of importance explaining financial behaviour. Factors such as the nutritional intake, exercise and attitude has demonstrated significant effect on investors behaviour. If homeostasis is not in effect it could destabilize the financial markets if confined among the “right” group of investors. (Camerer and Fehr, 2006) Moreover, risk taking individuals are attracted by the financial industry which could provide additional explanation of overall financial markets stability. (Coates and Herbert, 2007; Emanuele et al., 2009; Sapienza et al., 2009)

Cognitive resources such as our unconscious mind and intuition are concluded to be necessary and very important factors in the process of guiding an investor towards the right action in his/her day-to-day activities. (Faulkner, 2002; Runde, 2002; Stanovich and West, 2000) Moreover, suggested behavioural finance biases found investors' use of heuristics, giving rise to “abnormal” returns, are not an irrational behaviour as suspected. It is a rational behaviour, as a result of our intelligence and mind economizing cognitive resources. On the whole it desires minimized negative emotions. (Shiller, 2000 and Sunstein, 2003) Moreover, the increased use of advanced technology in the modern world today and extensive use in the financial sector has lead to a reduction in overall emotions. (Hardy-Vallée, 2007 and Rilling et al., 2002) This has, accompanied by the use of computerized trading strategies and new and sophisticated financial products, increased the speed in which the financial markets moves these days'. However, this should not be considered as bad for the overall economy. Human “over-reaction” and financial market booms and busts periods are a consequence of our Stone Age brain acting in a “modern” world society. All together, technology, speed and emotion is the perfect combination with positive effect on the overall society. It abbreviates the time of investors as well as common people, experiencing negative feelings reaching market consensus and price equilibrium.

According to Geoffard and Luchini, 2009 and Loewenstein and Prelec, 1991 people prefer to perform painful actions earlier than pleasurable ones not following the standard exponential discounting utility framework. This might hold true for the average human. But not for the corporate leaders and policy makers that to a large degree decide on the outcome which our world takes. To mention two factors they are suggestively older as well as more monitored by media than the average individual. As they have more at stake the above mentioned assumption does not necessarily hold true for them. The negative emotions from a difficult decision are suggestively far worse from an attack by media or the public versus them not being involved. Consequently it is not unexpected to think that corporate leaders and policy makers keep on postponing difficult decisions to buy themselves time or leave it to their successors rather than to handle it by themselves.

Moreover it has been demonstrated that restrictions and trading requirements give rise to behavioural biases and inefficient markets. (Shafran et al., 2009) It was brought up in Chapter 1 that an increased regulation was on the verge. As the work of this thesis has come along policymakers have begun imposing regulations on financial institutions, investment and trading industries.^{59 60} It will prevent or solve nothing in regards of future crisis or market movements. We humans want to be free of choice and when we are constrained to practice this we use our cognitive resources to get around this lock up. Regulations will result in nothing more than an intensification of future financial problems. Furthermore it will prolong the period of a recession and negative emotions among all citizens in a world of globalization as free market mechanisms are restricted to work properly.

“You cannot conceive the many without the one.”

(Plato)

59 SEC plans ‘circuit breakers’ to prevent crashes, Financial Times, May 18th 2010

60 Berlin set for partial naked short selling ban, Financial Times, May 19th 2010

“My responsibility as president isn't just to help our economy to rebound from this recession but to make sure the economic crisis like the one that help trigger this recession never happens again”

(Barack Obama)

Barack Obama further stressed that “*the credit dried up*”, previously mentioned in the introduction. It is crucial to understand that human behaviour is the result of millions of years of evolution. It isn't changed overnight. During this evolution an excessive use of credit and media reporting has not been accounted for. These two factors are the crucial consequences resulting in financial meltdowns and social problems.

6 Conclusion

In this final chapter I present my conclusions from the performed study. I also shed light on why my findings are important, how they can be incorporated, and implications on our society and the future of asset prices and the financial markets. I reflect on my research and finally I give suggestions to further research around some of the fields this study has touched upon.

“I am not bound to please thee with my answers.”

(William Shakespeare)

The research question that was formulated has throughout the thesis been answered. The first one was covered in the theory section. Human behaviour and decision making is determined by a number of factors, internal as well as external. These factors are moreover not always something the individual can fully control or might even be conscious of. Our brain, the Ultimate 'Black Box'⁶¹, is the supreme referee determining the behaviour among us. Its survival instincts, intelligence and response to the supply and demand of an asset has in this study demonstrated that asset prices do follow a price order know for over 100 years. Using the Dow Theory the separation of a stock's price cycle into sub-movements managed to reveal additional insights on intra-day and day-to-day stock market behavior. Then just as well as today stock price structure do exhibit what is commonly argued for as behavioral biases. I would like to stress that these “behavioral biases” are normal behavior. It is a lack of self-awareness and self-control that give rise to inefficiencies and predictable price movements. The “behavioural biases” are not, in a foreseeable future, expected to disappear nor change. Overall the implication from the reviewed sciences and the anatomy of the human brain and body causing behaviour seem to be consistent with how stock prices evolve over time. The shorter bear than bull market period and higher volatility around turnaround going into a bull than going in to a bear market period is in consistence with what can be expected according to emotions, reward, impatience and our hormones. However, what comes first and what causes what, in

⁶¹ Cramerer et al., (2004)

regards of neurological responses versus pure economic events, cannot be determined in this study nor how large the impact might be on the financial markets.

The overall evolvement of stock prices do not seem to have changed over history no matter new technological advances, regulation, the economic era or the human population. Different economic eras still solely demonstrate bull and bear market periods. Technological advance may have resulted in a shift in how trading activities among the financial markets are performed today. The result, an increased speed, is overall positive for humans. This as negative emotion is reduced as market equilibrium will be reached faster. When this speeded market becomes accepted, expected and understood, among the public, corporate leaders and policymakers, the overall implication on a country's and the world economy will be reduced. However as incapable policymakers imposed regulations, restricting the free market mechanisms to work as well as maintaining an artificial economic system with credit, documented behavioural biases from previous research will remain. The implications are a prolonged suffering among all world citizens, when an economic downturn occurs. Moreover as policymakers' competence seems not to differ from previous in history the findings and observations in this work will remain in effect until proved otherwise.

On the whole it was confirmed that the investors engaging in stock investment on the Swedish market do indeed demonstrate behavioral biases. Moreover, structural intra-day differences throughout a stock's price cycle were further revealed. The investigation of a small and open economy discovered that the intra-day behavior is partly dependent on the financial markets in America. This finding implied that the return around stock exchange close did not exhibit as an extreme spread as for the previous trading session. This contradicts previous behavioral finance research.

“Truth is what stands the test of experience.”

(Albert Einstein)

6.1 Criticism of research

“There's never time to do it right, but there's always time to do it over.”

(Meskimen's Law)

It is important that you as reader realize that I as the writer of this paper am subject to many of the brought up neurological and psychological factors in this paper. According to Kahneman, as I have investigate Investor AB a stock exhibiting portfolio features, the conclusion from the retrieved results is not necessary accurate. This due to the prototype heuristic and the suggested biases, which can be found in footnote 32, (page 19). Substantial and important information is filtered out by investigating a stock exhibiting portfolio features. The reached conclusion that the Dow Theory could be of good use analysing stock prices and accompany the investor, might consequently be inaccurate. However as investors behaviour in the stock markets has been the main focus in this thesis a holding company was argued better than a single industrial stock or similar as a smaller group of investors would otherwise be investigated. Moreover as difficulties emerged determining sub-market movements for several stocks the possibility to complete this separation for Investor might suggestively be due to the many stocks and investors accounted for in the price data. A comparison of the Investor stock performance and other stocks are found in figure 7-13.

Moreover, the discussion and analysis of the results associated to the study of Investor AB is partly based upon a comparison between the bear market and next following bull market. This is not consistent with the Dow Theory as the bull market track the bear market. The bear market and the price movements in this period ought to reflect the investors behaviour from the bull market and what was moving the market in this period not the opposite as is the case in this study. Consequently comparing the Internet boom bear market period with the pre subprime-crisis bull market is neither desirable nor good. Unfortunately this was nothing that could have been accounted for as the data needed for such a study was not accessible. Moreover as inconsistencies with the data set was found it was determined best to do what was done to reduce the effect of biased results under the time horizon given. However this meant that the

study resulted in an investigation of just one stock being analyzed. Consequently there are obvious weaknesses with the proposed investment strategy: “Invest overnight”, and should be addressed in accordance. Furthermore, it is of course no guarantee for what seemed to have been a good strategy in the past is a good one in the future. This certainly not, as the world will go through radical shifts and transformation throughout the next years and decades to come.

It is important to stress that no statistical analysis for the observed results has been conducted. Presenting statistical “evidence” for some results and not others in this limited study was determined not satisfactory. No matter if a rejection or acceptance of the developed hypothesis and the observed findings would take place only one stock has been investigated. Hence, presenting a statistical conclusion in this case will do more harm than good for you as a reader and the Dow Theory. The use and credibility of this research in regards of the results from the markets movements separation is perhaps low as consequence. Need not to forget, the Dow Theory was developed through observations of the financial markets over 100 years ago, and the same structure has been revealed in today’s financial markets for a number of stocks. Of greater importance is that we humans are still first and foremost the decision maker in trade and industry and the investment process no matter changes in our society and environment. Our anatomy determines our behaviour, which more or less has remained constant throughout centuries. This has been demonstrated giving rise to systematic behaviour which could be a contributing factor giving rise to the observed stock price structure.

6.2 Further studies

The observed results, as suggested, might not reflect what would be found if a single stock were to be investigated. Moreover, the study has provided no insights or explanation of what makes a stock turnaround, giving rise to the observed market structure, other than what is suggested by the classic Dow Theory explanations. Which are in general rather vague considering the complexity around the financial markets these days. Therefore no guidance is provided of how one can determine the market movement before it has already finished.

One should suggestively investigate:

- A larger sample and the proposed presence of the Dow Theory market movements among stocks and other financial assets. Investigating variables such as sector, firm size, ownership structure, free float, information release among others could provide additional insights why some and not other demonstrate the suggested price movements.
- What makes a stock turnaround? In this used sample 6 out of 8 turnarounds occurred between the 10th and 16th day of the month. Was this a coincidence or can economic consensus and information flow provide insights why the investors decided to change their opinion around these dates?
- Since humans' endocrine systems has been concluded to affect his/her investor performance it is of interest to investigate stock prices intra-day weekday effects. Return, variance and volume might suggestively, systematic differ throughout the week as investors are allowed to "recharge" and reach homeostasis. A higher probability of negative returns on Mondays' and a higher probability of positive returns on Fridays' might be the effect. This as investors' positive emotions reaching the weekend might be reflected as an asset price increase versus the Monday when cognitive resources are re-set they might conclude that a given situation is intolerable, causing price declines, even though no new information has necessarily been released. See footnote 40, page 28 for information on seasonality effects.

~The Ultimate 'Black Box' ~

*“We are what we repeatedly do.
Excellence then, is not an act, but a habit.”*

(Aristotle)

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Appendix

I. Complete period, bear market and bull market for Investor 2000-2008

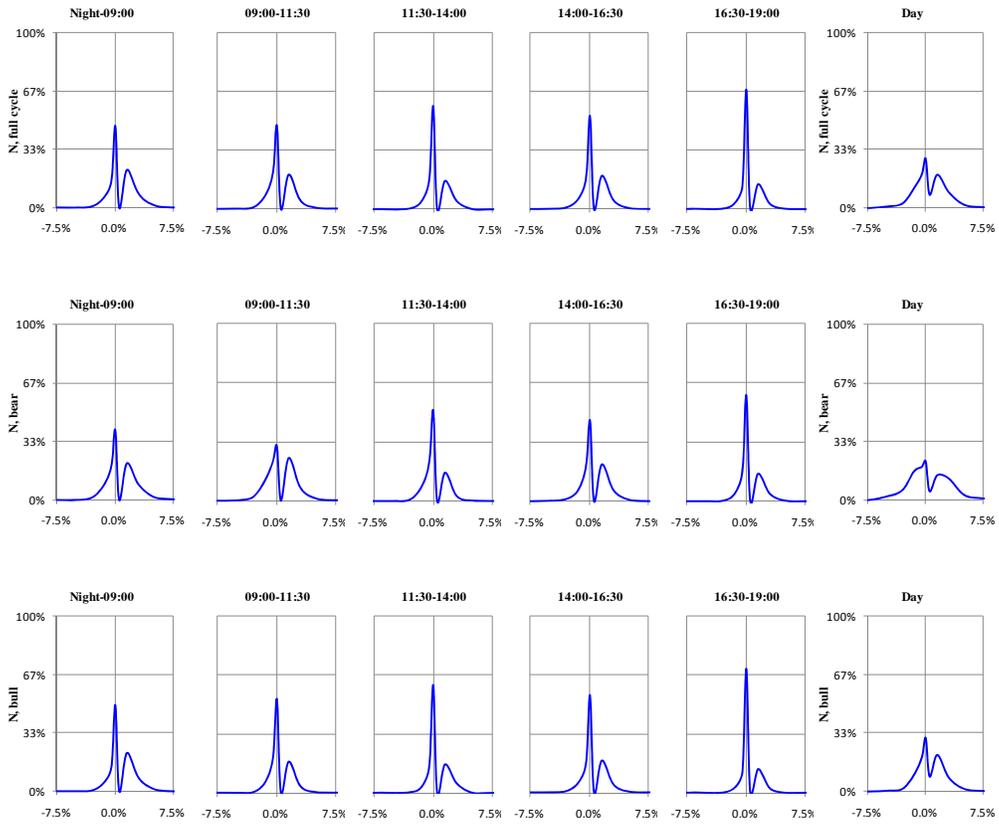
a. Descriptive statistics of return

SE0000107419 Investor		Date				Price	Return
Return		Start:	2/6/2001		146	24.75%	
full cycle		End:	7/13/2007		187		
Time:	09:00	11:30	14:00	16:30	19:00	DAY	
Average	0.132%	-0.075%	-0.011%	-0.029%	-0.003%	-0.119%	
StDev	1.192%	1.043%	0.834%	0.951%	0.774%	1.621%	
Max	12.1%	5.6%	3.3%	4.4%	4.2%	7.1%	
Min	-7.7%	-5.9%	-4.7%	-7.2%	-15.0%	-15.0%	
N	1,613	1,613	1,613	1,602	1,588	1,613	
Kurtosis	12.6	3.1	2.2	3.9	89.1	7.6	
Skewness	0.9	-0.1	-0.3	-0.5	-4.5	-0.8	
Count Pos	505	394	332	382	266	609	
Count Neg	353	461	344	380	254	723	

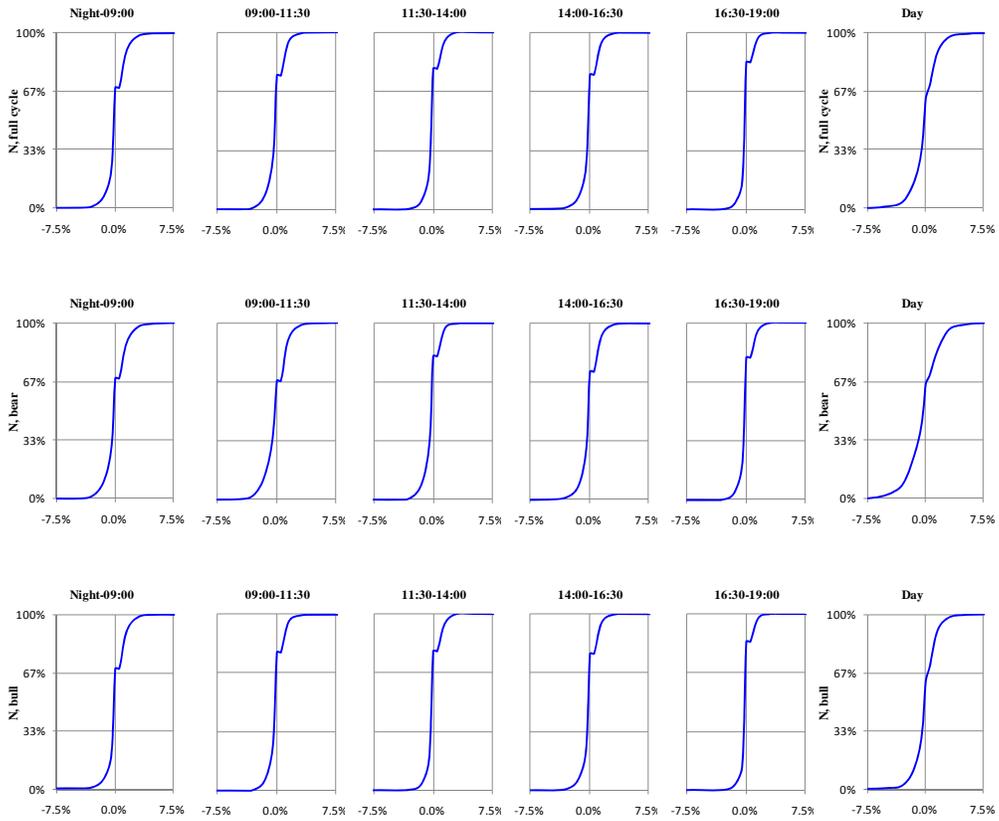
SE0000107419 Investor		Date				Price	Return
Return		Start:	2/6/2001		146	-127.00%	
bear		End:	10/10/2002		41		
Time:	09:00	11:30	14:00	16:30	19:00	DAY	
Average	0.032%	-0.103%	-0.184%	-0.050%	0.004%	-0.333%	
StDev	1.290%	1.338%	0.912%	1.078%	0.802%	2.057%	
Max	6.5%	5.4%	3.3%	3.3%	4.2%	7.1%	
Min	-4.9%	-5.9%	-4.7%	-7.2%	-4.8%	-11.1%	
N	421	421	421	421	420	421	
Kurtosis	3.3	2.2	2.3	5.5	5.4	2.7	
Skewness	0.2	-0.2	-0.6	-0.9	0.1	-0.4	
Count Pos	133	138	79	115	83	147	
Count Neg	122	153	128	115	87	225	

SE0000107419 Investor		Date				Price	Return
Return		Start:	10/10/2002		41	151.75%	
bull		End:	7/13/2007		187		
Time:	09:00	11:30	14:00	16:30	19:00	DAY	
Average	0.165%	-0.065%	0.048%	-0.022%	-0.003%	-0.043%	
StDev	1.156%	0.917%	0.799%	0.901%	0.768%	1.428%	
Max	12.1%	5.6%	2.9%	4.4%	2.5%	6.7%	
Min	-7.7%	-4.2%	-3.8%	-3.9%	-15.0%	-15.0%	
N	1,193	1,193	1,193	1,182	1,169	1,193	
Kurtosis	17.3	2.5	1.9	2.5	123.3	12.0	
Skewness	1.2	0.1	0.0	-0.2	-6.3	-1.0	
Count Pos	372	256	253	267	184	462	
Count Neg	232	308	217	265	167	499	

b. Probability distribution of return



c. Cumulative distribution of return



~The Ultimate 'Black Box' ~

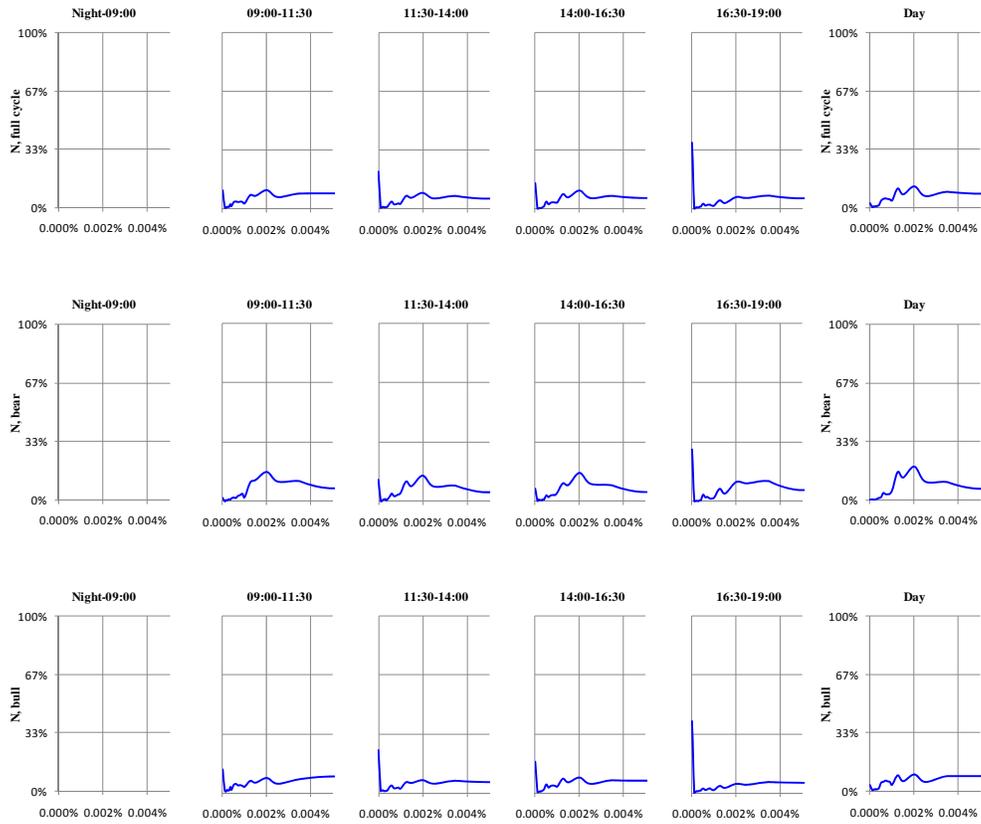
d. Descriptive statistics of volatility

SE0000107419 Investor		Date				Price	Return
Variance		Start:	2/6/2001		146	24.75%	
full cycle		End:	7/13/2007		187		
Time:	09:00	11:30	14:00	16:30	19:00	DAY	
Average	0.0020%	0.0020%	0.0020%	0.0020%	0.0020%	0.0020%	
StDev	0.0022%	0.0027%	0.0026%	0.0026%	0.0036%	0.0021%	
Max	0.016%	0.018%	0.019%	0.019%	0.071%	0.021%	
Min	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	
N	1,613	1,613	1,602	1,599	1,613		
Kurtosis	5.2	6.5	7.6	85.8	8.6		
Skewness	2.0	2.3	2.5	6.2	2.4		

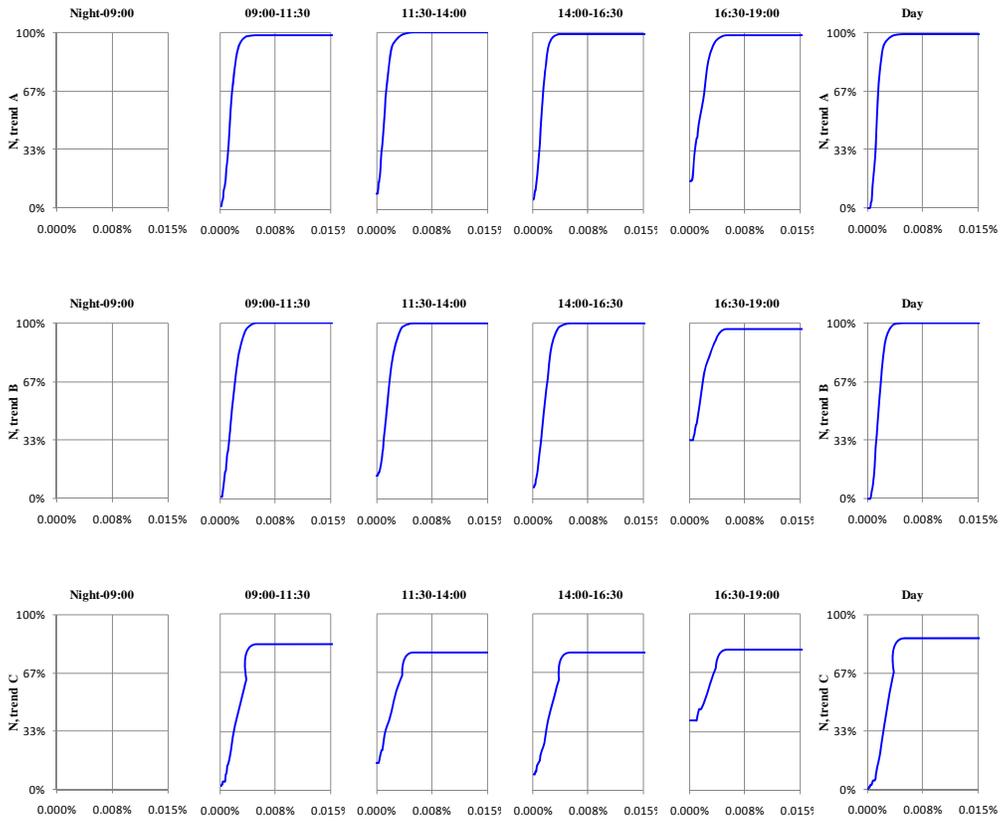
SE0000107419 Investor		Date				Price	Return
Variance		Start:	2/6/2001		146	-127.00%	
bear		End:	10/10/2002		41		
Time:	09:00	11:30	14:00	16:30	19:00	DAY	
Average	0.0020%	0.0018%	0.0019%	0.0019%	0.0019%	0.0019%	
StDev	0.0017%	0.0019%	0.0021%	0.0027%	0.0027%	0.0015%	
Max	0.014%	0.014%	0.015%	0.024%	0.010%		
Min	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	
N	421	421	421	420	421		
Kurtosis	8.8	8.1	11.2	21.4	9.7		
Skewness	2.4	2.5	2.9	3.7	2.7		

SE0000107419 Investor		Date				Price	Return
Variance		Start:	10/10/2002		41	151.75%	
bull		End:	7/13/2007		187		
Time:	09:00	11:30	14:00	16:30	19:00	DAY	
Average	0.0020%	0.0021%	0.0021%	0.0021%	0.0021%	0.0021%	
StDev	0.0024%	0.0029%	0.0027%	0.0039%	0.0022%		
Max	0.016%	0.018%	0.019%	0.071%	0.021%		
Min	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	
N	1,193	1,193	1,182	1,180	1,193		
Kurtosis	4.4	5.4	6.7	83.6	7.6		
Skewness	1.9	2.2	2.4	6.2	2.3		

e. Probability distribution of volatility



f. Cumulative distribution of volatility



~The Ultimate 'Black Box' ~

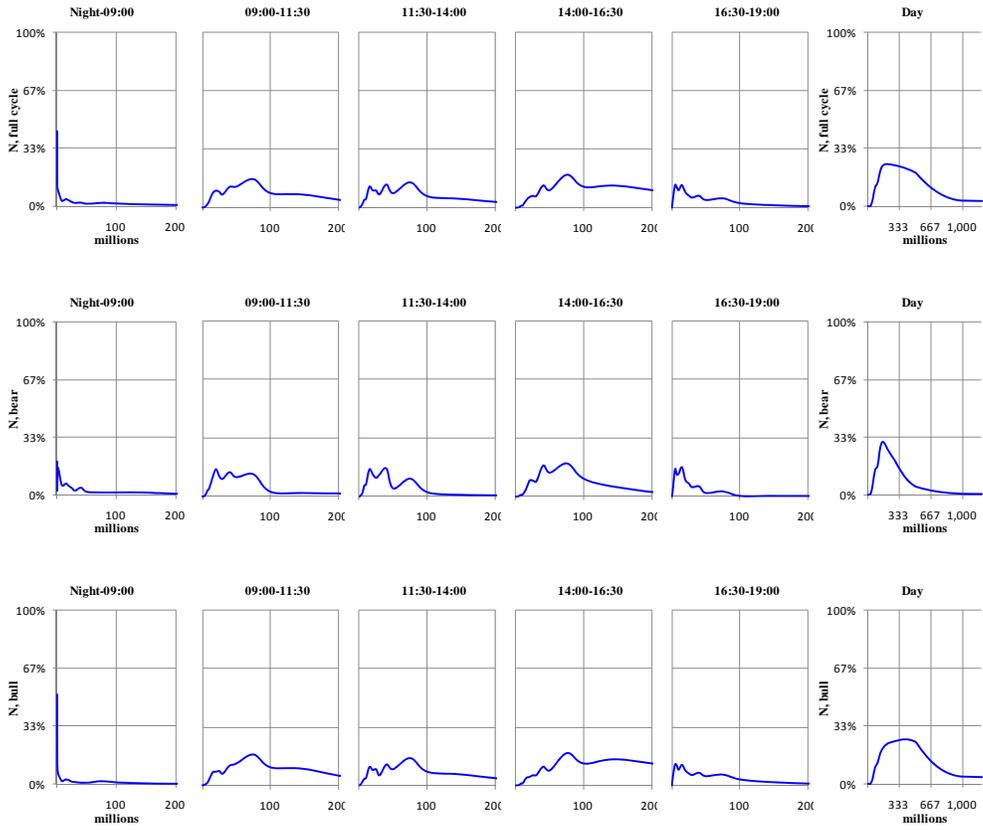
g. Descriptive statistics of turnover

SE0000107419 Investor		Date				Price	Return
Turnover	(million SEK)	Start:	2/6/2001		146	24.75%	
full cycle		End:	7/13/2007		187		
Time:	09:00	11:30	14:00	16:30	19:00	DAY	
Average	7.9	50.9	44.3	71.6	21.0	187.1	
StDev	24.4	54.3	72.0	80.2	26.4	163.3	
Max	355.5	1,244.9	1,750.3	2,112.8	286.5	2,408.8	
Min	0.0	1.5	0.9	1.4	0.2	14.7	
N	1,613	1,613	1,613	1,602	1,599	1,613	
Kurtosis	76.8	150.4	343.5	264.9	19.0	41.5	
Skewness	7.4	8.2	15.6	11.5	3.4	4.5	

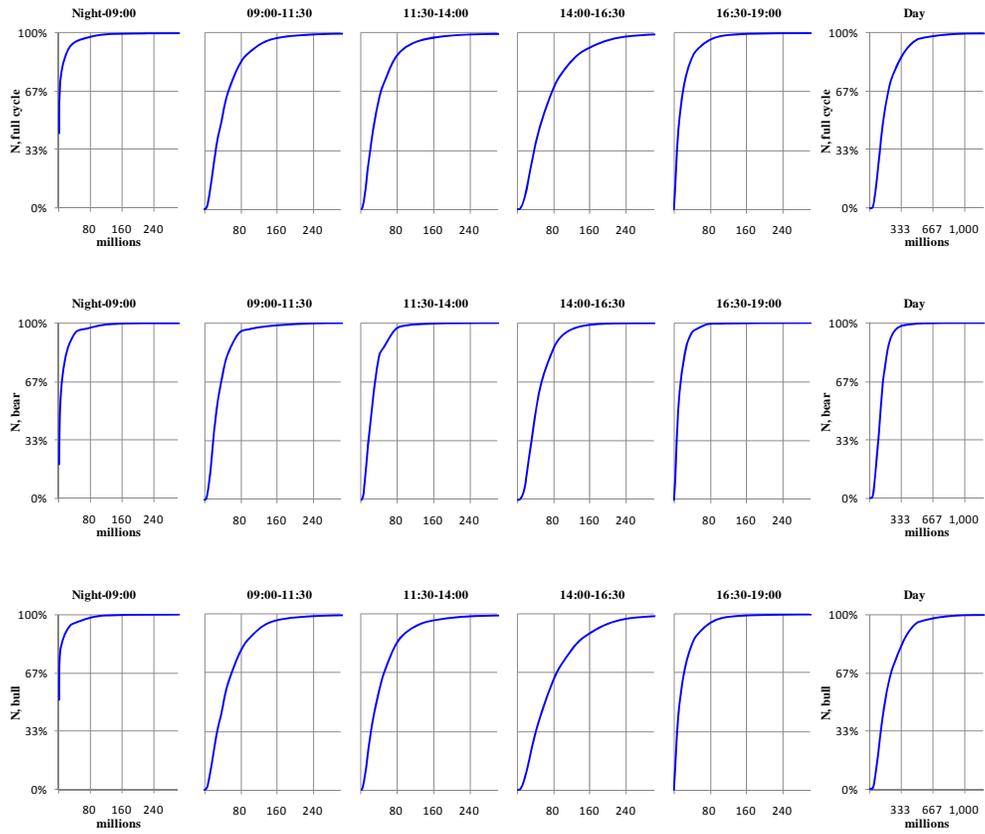
SE0000107419 Investor		Date				Price	Return
Turnover	(million SEK)	Start:	2/6/2001		146	-127.00%	
bear		End:	10/10/2002		41		
Time:	09:00	11:30	14:00	16:30	19:00	DAY	
Average	11.3	35.2	28.6	48.0	14.8	126.6	
StDev	26.4	31.7	24.4	37.8	16.2	76.3	
Max	320.2	279.1	224.6	500.6	181.6	653.1	
Min	0.0	3.3	1.6	3.1	0.2	19.8	
N	421	421	421	421	420	421	
Kurtosis	60.7	16.5	16.8	50.4	31.1	11.1	
Skewness	6.6	3.4	3.1	5.0	4.1	2.4	

SE0000107419 Investor		Date				Price	Return
Turnover	(million SEK)	Start:	10/10/2002		41	151.75%	
bull		End:	7/13/2007		187		
Time:	09:00	11:30	14:00	16:30	19:00	DAY	
Average	6.6	56.4	49.8	80.0	23.2	208.4	
StDev	23.6	59.3	81.8	89.2	28.8	179.7	
Max	355.5	1,244.9	1,750.3	2,112.8	286.5	2,408.8	
Min	0.0	1.5	0.9	1.4	0.2	14.7	
N	1,193	1,193	1,193	1,182	1,180	1,193	
Kurtosis	86.3	139.6	275.3	230.7	15.9	36.0	
Skewness	7.8	8.1	14.2	11.0	3.2	4.2	

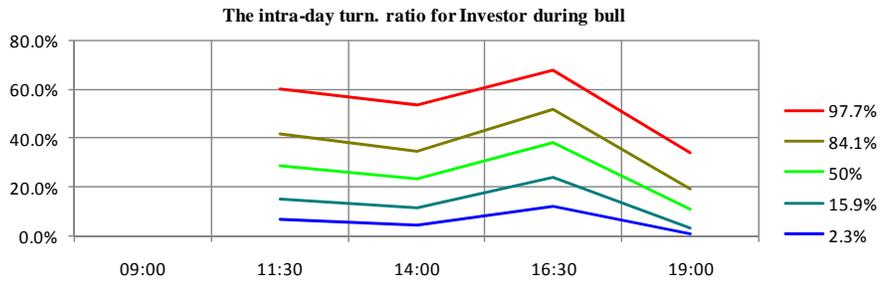
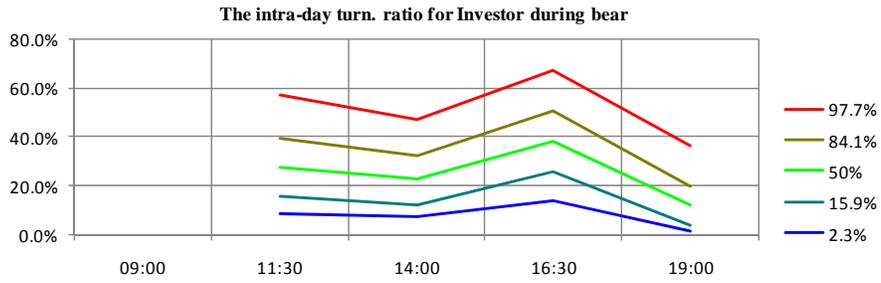
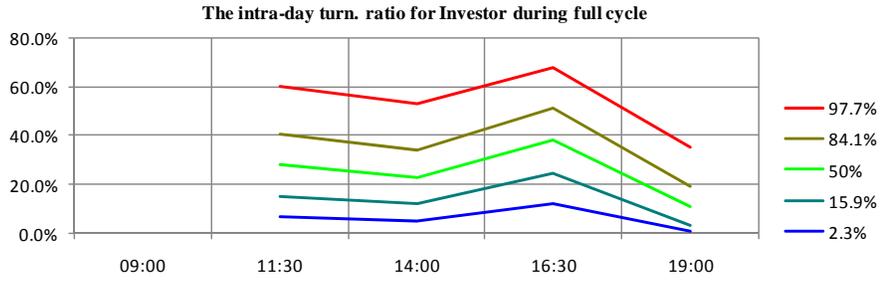
h. Probability distribution of turnover



i. Cumulative distribution of turnover



j. Turnover ratio



II. Bear market's underlying market movements

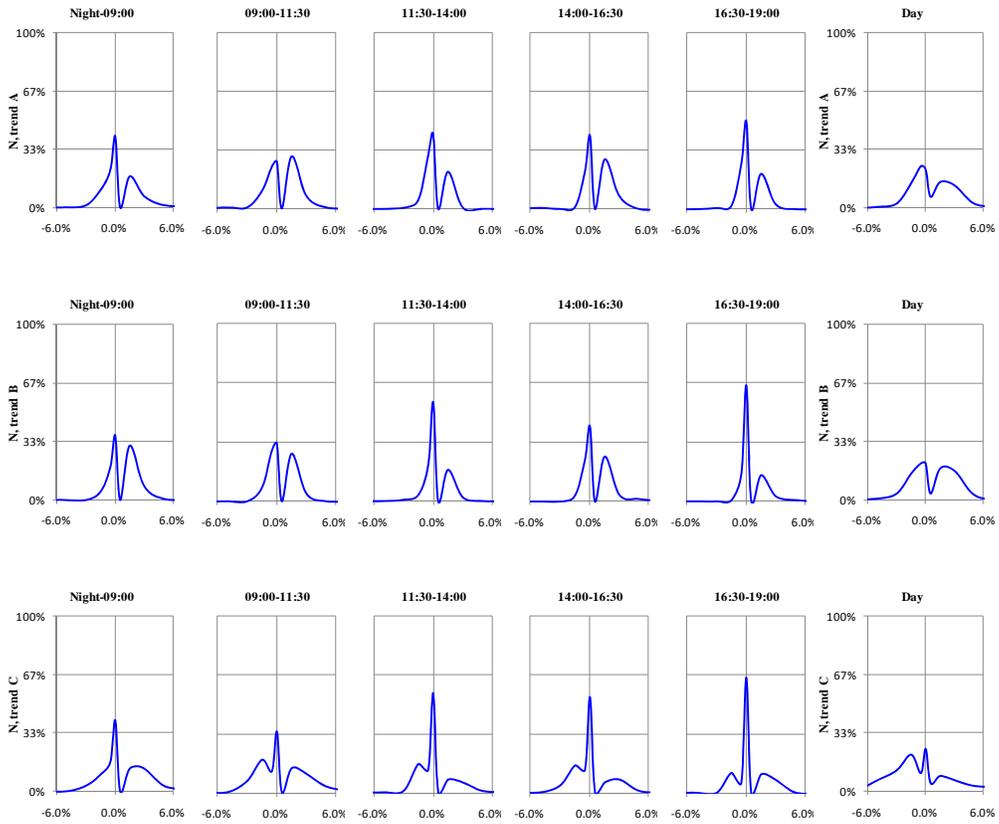
a. Descriptive statistics of return

SE0000107419 Investor		Date				Price	Return
Return		Start:	2/6/2001		146	-45.10%	
trend A		End:	9/20/2001		93		
Time:	09:00	11:30	14:00	16:30	19:00	DAY	
Average	-0.121%	-0.006%	-0.201%	0.106%	-0.065%	-0.166%	
StDev	1.220%	1.229%	0.846%	1.006%	0.772%	1.883%	
Max	5.3%	4.3%	1.7%	3.0%	2.8%	5.2%	
Min	-4.9%	-5.9%	-4.7%	-7.2%	-4.8%	-11.1%	
N	157	157	157	157	156	157	
Kurtosis	4.1	3.5	4.4	17.3	9.2	7.4	
Skewness	0.2	-0.5	-1.2	-2.2	-1.1	-1.3	
Count Pos	41	59	34	55	35	58	
Count Neg	52	56	57	37	44	86	

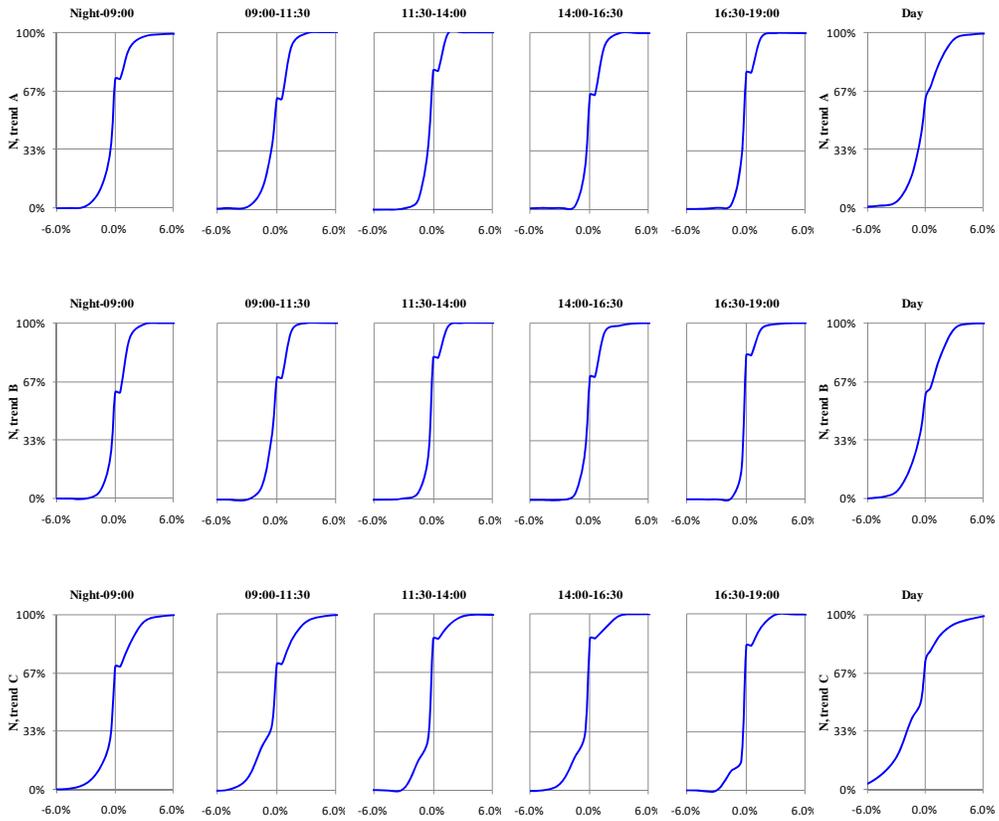
SE0000107419 Investor		Date				Price	Return
Return		Start:	9/20/2001		93	24.65%	
trend B		End:	4/16/2002		119		
Time:	09:00	11:30	14:00	16:30	19:00	DAY	
Average	0.177%	-0.077%	-0.091%	0.053%	0.061%	-0.055%	
StDev	0.970%	0.947%	0.811%	0.900%	0.714%	1.732%	
Max	3.0%	2.9%	2.0%	3.3%	4.2%	4.8%	
Min	-2.8%	-2.2%	-3.0%	-2.7%	-2.1%	-6.3%	
N	142	142	142	142	142	142	
Kurtosis	0.5	-0.2	2.7	1.4	8.3	0.8	
Skewness	-0.1	0.1	-0.9	0.3	1.6	-0.2	
Count Pos	56	44	28	43	26	57	
Count Neg	34	52	35	39	23	65	

SE0000107419 Investor		Date				Price	Return
Return		Start:	4/16/2002		119	-106.56%	
trend C		End:	10/10/2002		41		
Time:	09:00	11:30	14:00	16:30	19:00	DAY	
Average	0.057%	-0.271%	-0.276%	-0.372%	0.009%	-0.909%	
StDev	1.634%	1.777%	1.078%	1.272%	0.939%	2.518%	
Max	6.5%	5.4%	3.3%	3.3%	2.5%	7.1%	
Min	-4.8%	-4.5%	-3.4%	-3.8%	-2.3%	-6.9%	
N	124	124	124	124	124	124	
Kurtosis	2.2	0.6	0.8	0.8	0.9	1.0	
Skewness	0.2	0.1	-0.1	-0.3	0.1	0.2	
Count Pos	37	35	17	17	22	32	
Count Neg	37	46	37	40	21	75	

b. Probability distribution of return



c. Cumulative distribution of return



~The Ultimate 'Black Box' ~

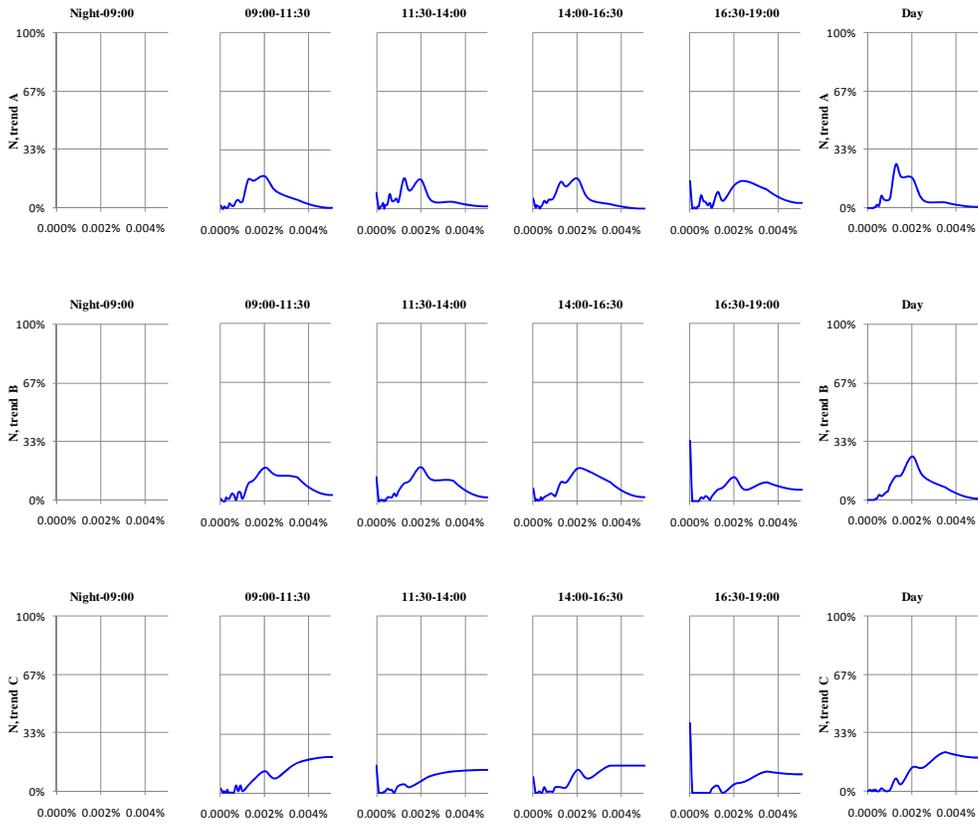
d. Descriptive statistics of volatility

SE0000107419 Investor						Date	Price	Return
Variance				Start:	2/6/2001	146	-45.10%	
trend A				End:	9/20/2001	93		
Time:	09:00	11:30	14:00	16:30	19:00		DAY	
Average	0.0014%	0.0011%	0.0012%	0.0016%	0.0013%			
StDev	0.0010%	0.0007%	0.0013%	0.0022%	0.0009%			
Max	0.009%	0.004%	0.015%	0.024%	0.010%			
Min	0.000%	0.000%	0.000%	0.000%	0.000%			
N	157	157	157	156	157			
Kurtosis	23.3	1.1	88.9	75.4	59.7			
Skewness	3.6	0.8	8.2	7.5	6.4			

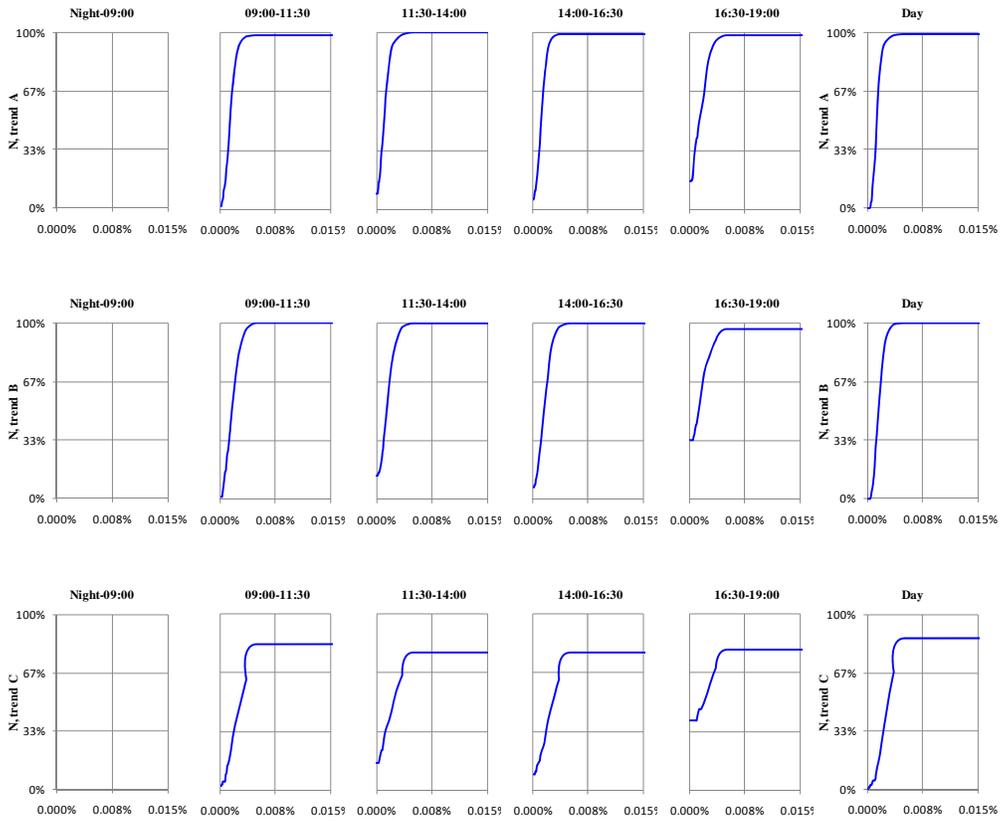
SE0000107419 Investor						Date	Price	Return
Variance				Start:	9/20/2001	93	24.65%	
trend B				End:	4/16/2002	119		
Time:	09:00	11:30	14:00	16:30	19:00		DAY	
Average	0.0016%	0.0014%	0.0015%	0.0014%	0.0015%			
StDev	0.0009%	0.0010%	0.0010%	0.0015%	0.0007%			
Max	0.005%	0.005%	0.005%	0.007%	0.004%			
Min	0.000%	0.000%	0.000%	0.000%	0.000%			
N	142	142	142	142	142			
Kurtosis	0.2	0.0	0.7	1.4	0.1			
Skewness	0.6	0.4	0.6	1.3	0.6			

SE0000107419 Investor						Date	Price	Return
Variance				Start:	4/16/2002	119	-106.56%	
trend C				End:	10/10/2002	41		
Time:	09:00	11:30	14:00	16:30	19:00		DAY	
Average	0.0032%	0.0031%	0.0033%	0.0029%	0.0031%			
StDev	0.0023%	0.0029%	0.0029%	0.0037%	0.0020%			
Max	0.014%	0.014%	0.013%	0.021%	0.010%			
Min	0.000%	0.000%	0.000%	0.000%	0.000%			
N	124	124	124	124	124			
Kurtosis	3.0	1.0	1.6	5.1	2.4			
Skewness	1.4	1.1	1.3	2.0	1.4			

e. Probability distribution of volatility



f. Cumulative distribution of volatility



~The Ultimate 'Black Box' ~

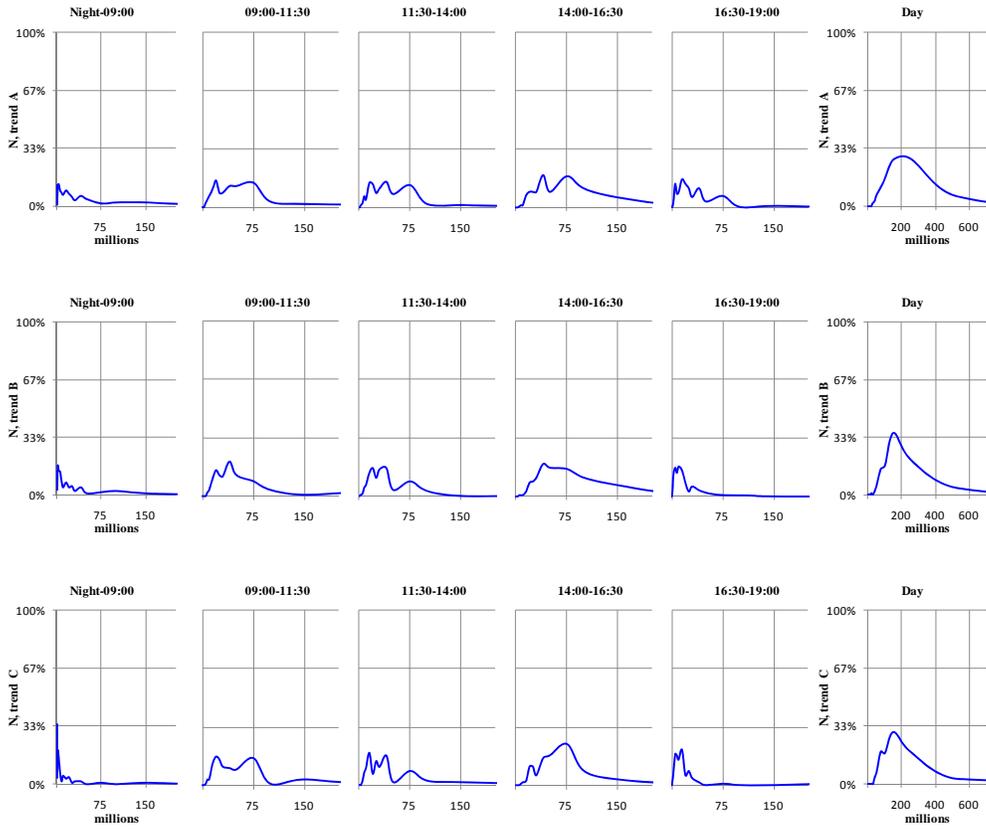
g. Descriptive statistics of turnover

SE0000107419 Investor		Date				Price	Return
Turnover	(million SEK)	Start:	2/6/2001		146	-45.10%	
trend A		End:	9/20/2001		93		
Time:	09:00	11:30	14:00	16:30	19:00	DAY	
Average	17.6	34.5	30.5	46.4	20.0	131.3	
StDev	36.9	30.2	26.2	33.0	16.9	70.3	
Max	320.2	217.5	224.6	237.9	112.7	361.1	
Min	0.0	3.3	2.4	4.2	1.3	21.8	
N	157	157	157	157	156	157	
Kurtosis	37.6	11.7	19.1	6.8	5.7	0.1	
Skewness	5.5	2.8	3.3	2.0	1.9	0.7	

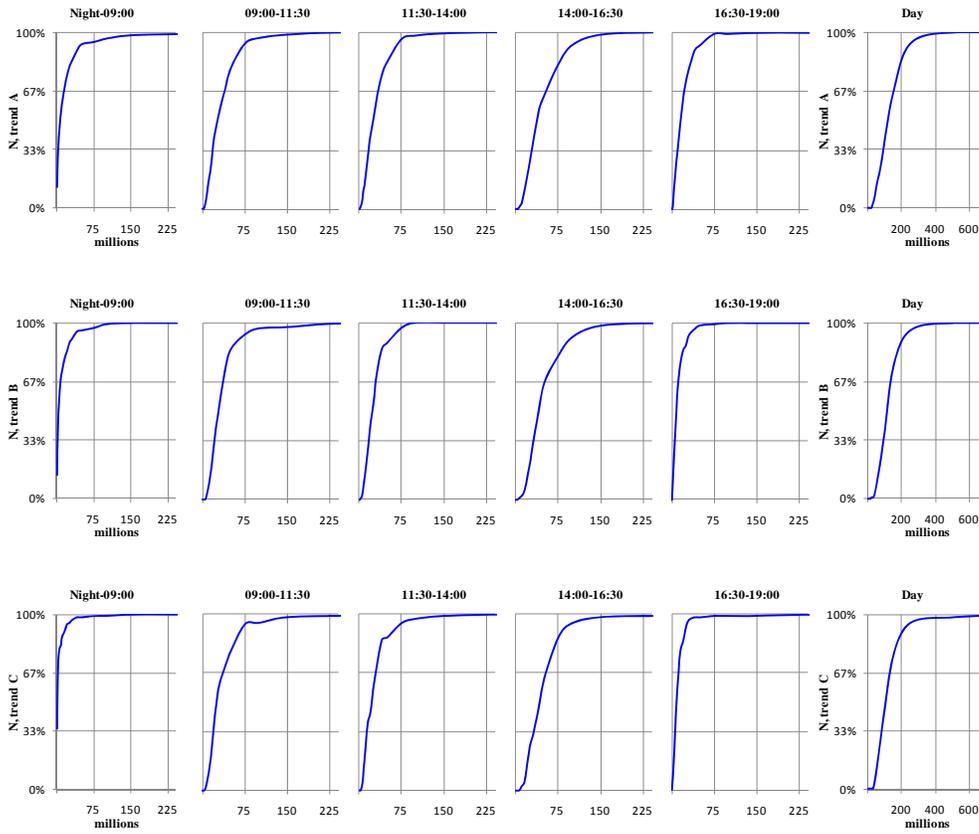
SE0000107419 Investor		Date				Price	Return
Turnover	(million SEK)	Start:	9/20/2001		93	24.65%	
trend B		End:	4/16/2002		119		
Time:	09:00	11:30	14:00	16:30	19:00	DAY	
Average	10.0	35.0	26.9	48.6	11.6	122.1	
StDev	17.9	29.3	18.4	31.7	12.2	64.3	
Max	106.5	207.0	91.9	202.0	89.1	486.7	
Min	0.0	5.6	1.6	3.1	0.2	19.8	
N	142	142	142	142	142	142	
Kurtosis	12.4	16.2	1.9	4.1	12.2	7.2	
Skewness	3.3	3.4	1.4	1.7	2.8	2.0	

SE0000107419 Investor		Date				Price	Return
Turnover	(million SEK)	Start:	4/16/2002		119	-106.56%	
trend C		End:	10/10/2002		41		
Time:	09:00	11:30	14:00	16:30	19:00	DAY	
Average	4.9	36.3	28.2	49.0	11.9	125.3	
StDev	13.8	35.9	27.6	48.4	17.4	93.9	
Max	123.9	279.1	204.3	500.6	181.6	653.1	
Min	0.0	3.6	2.8	5.6	0.6	30.4	
N	124	124	124	124	124	124	
Kurtosis	47.9	19.3	14.6	62.0	73.8	15.0	
Skewness	6.2	3.7	3.2	6.9	7.8	3.3	

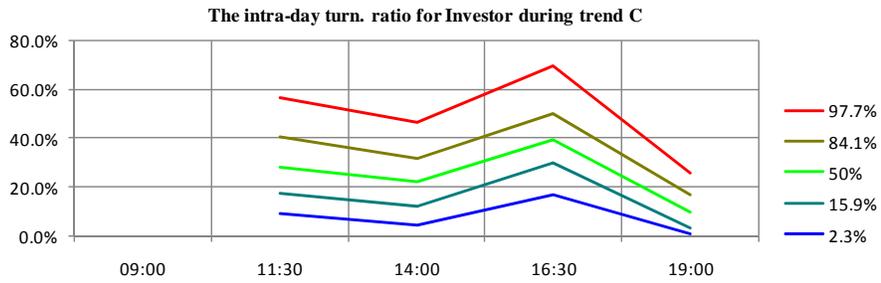
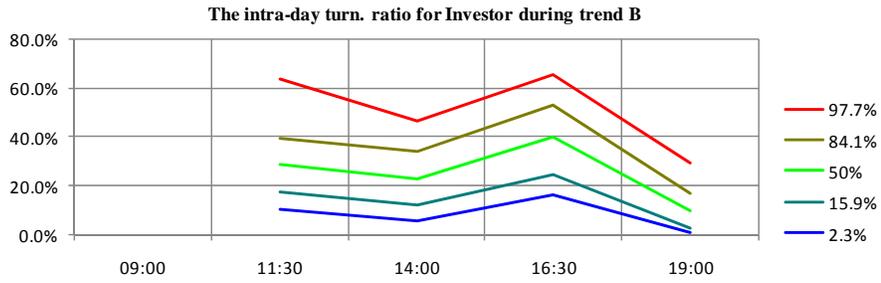
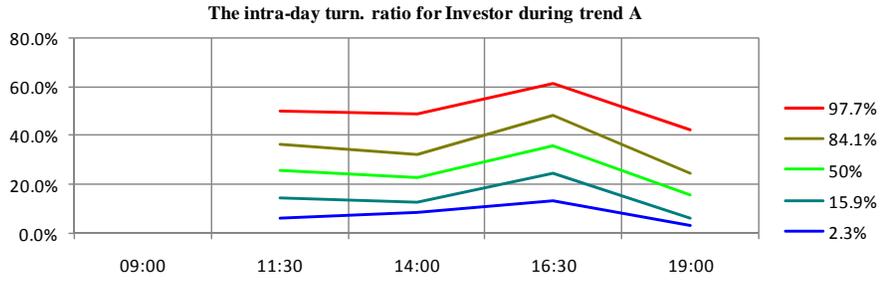
h. Probability distribution of turnover



i. Cumulative distribution of turnover



j. *Turnover ratio*



III. Bull market's underlying market movements

a. Descriptive statistics of return

SE0000107419 Investor		Date				Price	Return
Return		Start:	10/10/2002		41	42.96%	
trend 1		End:	12/2/2002		63		
Time:	09:00	11:30	14:00	16:30	19:00	DAY	
Average	0.654%	0.175%	0.336%	-0.052%	-0.046%	0.413%	
StDev	2.570%	1.808%	1.324%	1.838%	1.186%	2.611%	
Max	10.3%	3.8%	2.2%	4.0%	2.5%	6.7%	
Min	-5.7%	-3.8%	-2.5%	-3.8%	-2.0%	-5.9%	
N	38	38	38	38	38	38	
Kurtosis	4.9	-0.3	-0.6	-0.4	-0.2	1.1	
Skewness	1.1	0.0	-0.3	0.0	0.1	-0.1	
Count Pos	17	12	13	12	7	16	
Count Neg	9	10	6	13	8	17	

SE0000107419 Investor		Date				Price	Return
Return		Start:	12/2/2002		63	-38.19%	
trend 2		End:	3/12/2003		43		
Time:	09:00	11:30	14:00	16:30	19:00	DAY	
Average	0.341%	-0.512%	0.013%	-0.246%	-0.174%	-0.920%	
StDev	1.419%	1.336%	1.287%	1.419%	0.912%	2.130%	
Max	3.7%	2.1%	2.2%	2.2%	2.0%	4.2%	
Min	-4.0%	-4.2%	-3.8%	-3.9%	-2.2%	-7.1%	
N	66	66	66	66	66	66	
Kurtosis	1.0	-0.2	1.0	0.3	1.3	0.8	
Skewness	0.0	0.0	-0.5	-0.5	-0.3	-0.1	
Count Pos	18	8	13	11	5	13	
Count Neg	8	24	11	16	11	40	

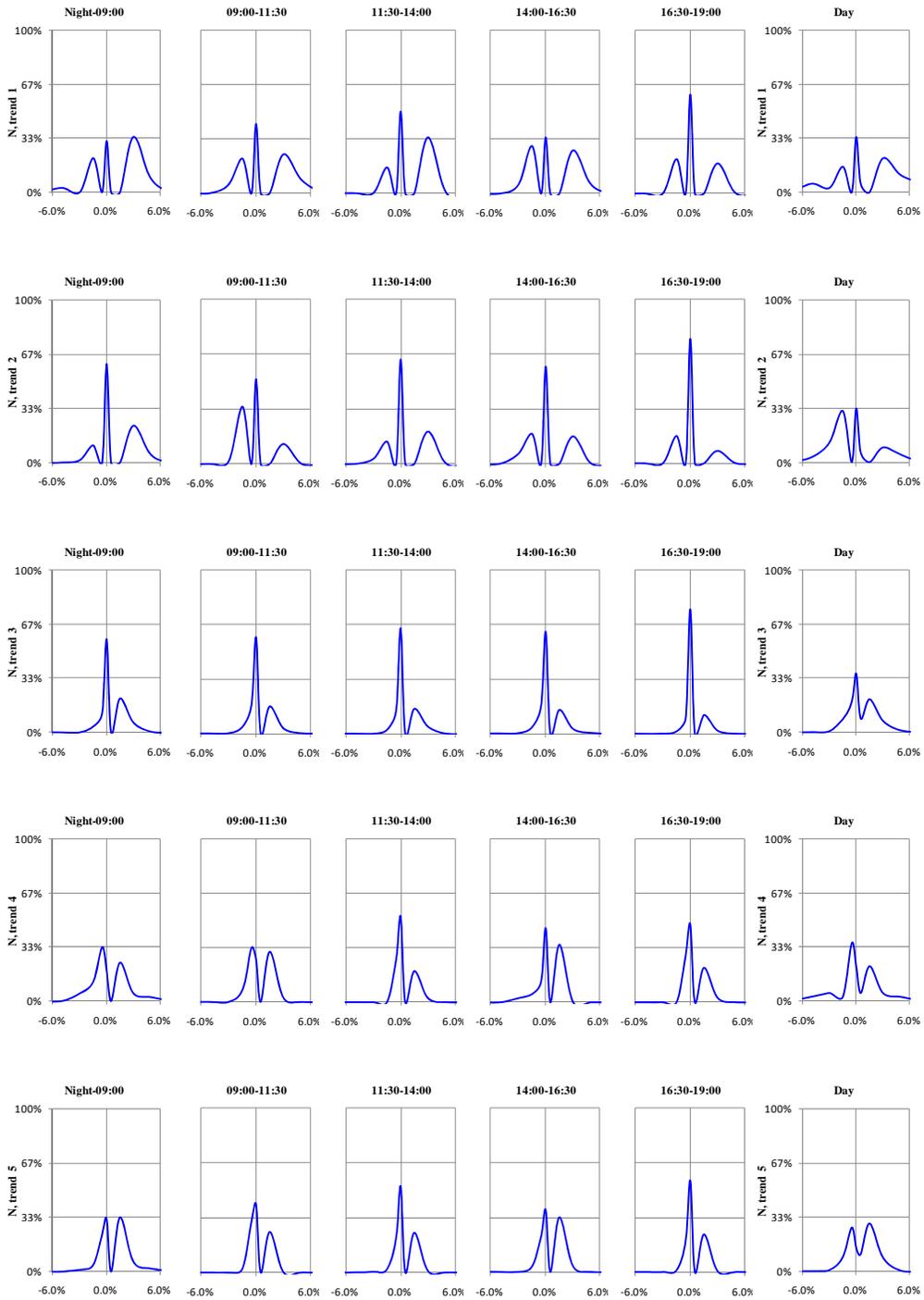
SE0000107419 Investor		Date				Price	Return
Return		Start:	3/12/2003		43	123.60%	
trend 3		End:	4/10/2006		148		
Time:	09:00	11:30	14:00	16:30	19:00	DAY	
Average	0.158%	-0.029%	0.061%	-0.043%	0.007%	-0.004%	
StDev	1.037%	0.883%	0.772%	0.819%	0.813%	1.330%	
Max	12.1%	5.6%	2.9%	4.4%	2.1%	5.9%	
Min	-7.7%	-3.7%	-2.4%	-3.1%	-15.0%	-15.0%	
N	777	777	777	773	767	777	
Kurtosis	27.0	2.7	0.9	2.3	149.8	21.1	
Skewness	1.5	0.2	0.2	0.1	-8.1	-1.6	
Count Pos	213	154	151	134	101	286	
Count Neg	119	168	126	160	86	294	

~The Ultimate 'Black Box' ~

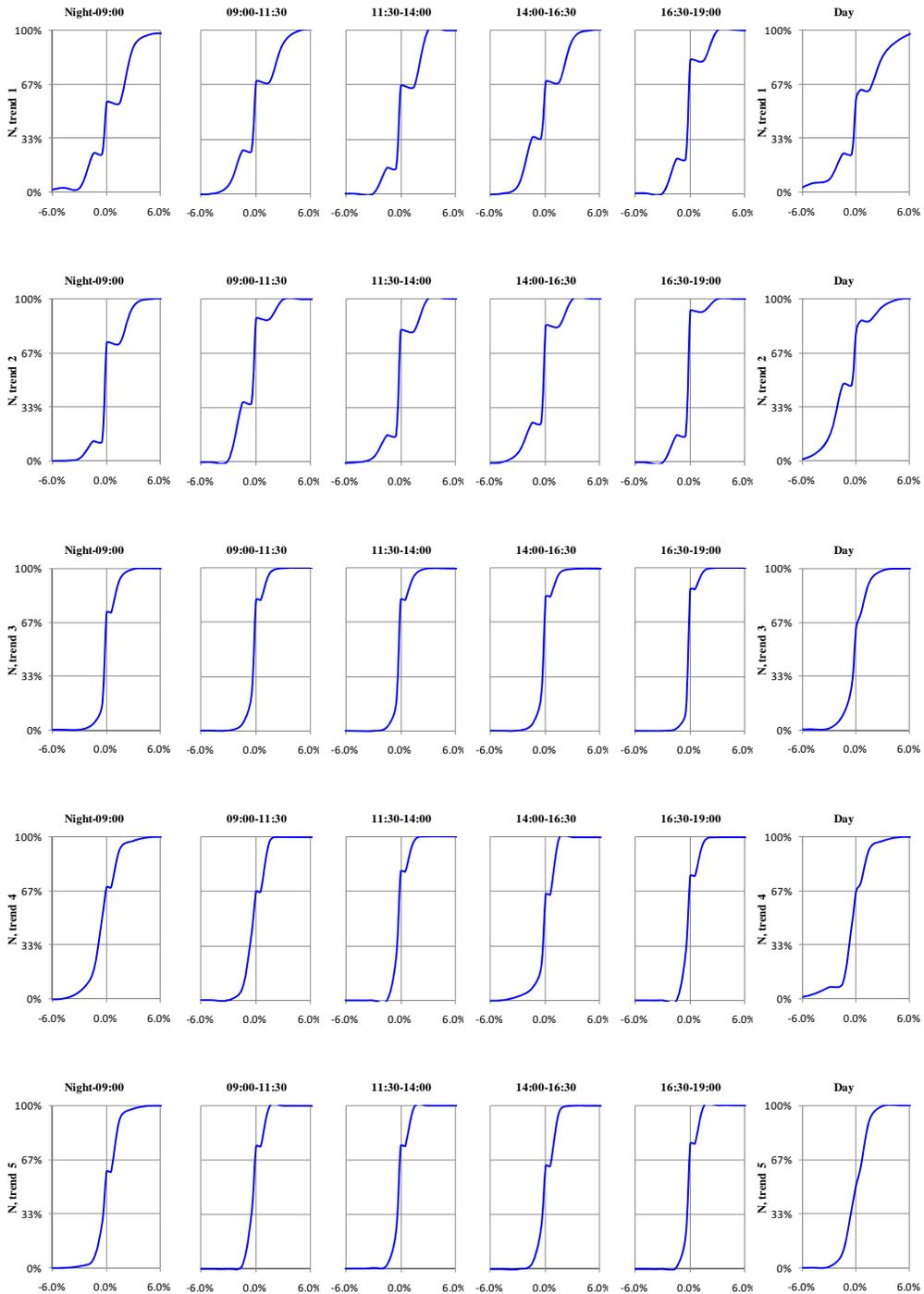
SE0000107419 Investor				Date	Price	Return
Return			Start:	4/10/2006	148	-24.36%
trend 4			End:	6/13/2006	116	
Time:	09:00	11:30	14:00	16:30	19:00	DAY
Average	-0.346%	-0.211%	-0.038%	-0.013%	-0.010%	-0.270%
StDev	1.448%	1.004%	0.675%	0.904%	0.599%	1.605%
Max	4.1%	1.5%	2.4%	1.4%	1.6%	3.9%
Min	-4.1%	-2.4%	-1.4%	-3.3%	-0.9%	-5.7%
N	42	42	42	40	38	42
Kurtosis	2.1	-0.7	2.9	4.2	-0.1	3.4
Skewness	0.0	-0.3	0.8	-1.8	0.5	-0.8
Count Pos	13	14	9	14	9	14
Count Neg	21	17	11	8	11	25

SE0000107419 Investor				Date	Price	Return
Return			Start:	6/13/2006	116	47.75%
trend 5			End:	7/13/2007	187	
Time:	09:00	11:30	14:00	16:30	19:00	DAY
Average	0.144%	-0.087%	-0.008%	0.109%	0.006%	0.019%
StDev	1.013%	0.629%	0.616%	0.747%	0.497%	1.129%
Max	4.0%	1.3%	1.8%	2.8%	1.6%	3.5%
Min	-3.8%	-2.1%	-3.7%	-2.0%	-2.4%	-4.0%
N	274	274	274	269	264	274
Kurtosis	2.9	0.2	5.2	0.8	2.6	0.5
Skewness	-0.1	-0.3	-1.0	0.1	-0.6	-0.1
Count Pos	111	68	68	99	62	134
Count Neg	76	92	63	68	54	126

b. Probability distribution of return



c. Cumulative distribution of return



~The Ultimate 'Black Box' ~

d. Descriptive statistics of volatility

SE0000107419 Investor		Date				Price	Return
Variance		Start:	10/10/2002		41	42.96%	
trend 1		End:	12/2/2002		63		
Time:	09:00	11:30	14:00	16:30	19:00	DAY	
Average	0.0053%	0.0050%	0.0055%	0.0047%	0.0051%		
StDev	0.0026%	0.0040%	0.0032%	0.0050%	0.0019%		
Max	0.012%	0.017%	0.012%	0.015%	0.009%		
Min	0.001%	0.000%	0.000%	0.000%	0.001%		
N	38	38	38	38	38		
Kurtosis	0.1	1.2	-0.6	-0.8	0.1		
Skewness	0.4	1.0	0.2	0.7	0.2		

SE0000107419 Investor		Date				Price	Return
Variance		Start:	12/2/2002		63	-38.19%	
trend 2		End:	3/12/2003		43		
Time:	09:00	11:30	14:00	16:30	19:00	DAY	
Average	0.0040%	0.0042%	0.0039%	0.0032%	0.0038%		
StDev	0.0027%	0.0045%	0.0036%	0.0047%	0.0025%		
Max	0.011%	0.015%	0.015%	0.017%	0.011%		
Min	0.000%	0.000%	0.000%	0.000%	0.000%		
N	66	66	66	66	66		
Kurtosis	-0.2	-0.4	1.2	0.9	0.1		
Skewness	0.5	0.8	1.2	1.4	0.7		

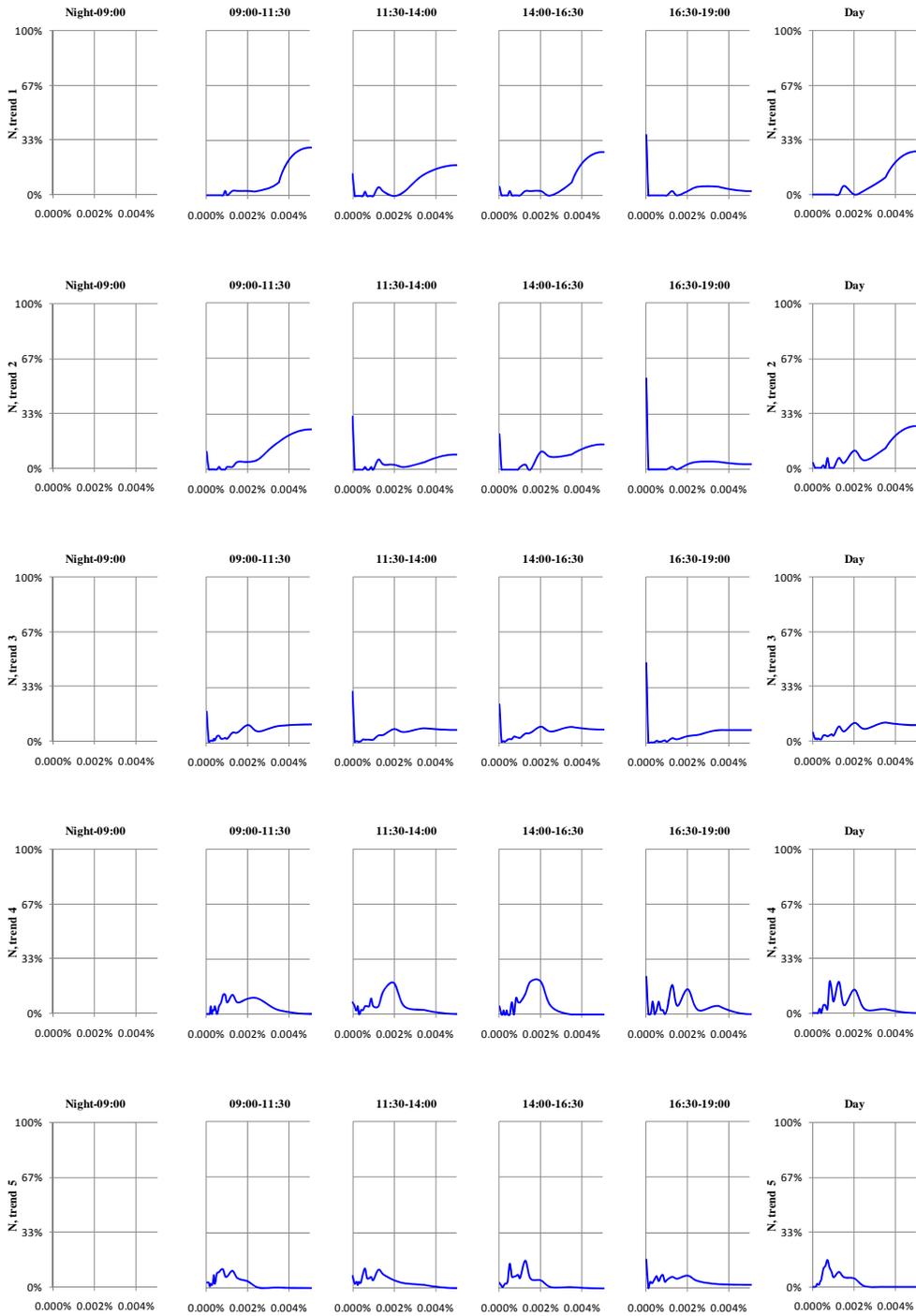
SE0000107419 Investor		Date				Price	Return
Variance		Start:	3/12/2003		43	123.60%	
trend 3		End:	4/10/2006		148		
Time:	09:00	11:30	14:00	16:30	19:00	DAY	
Average	0.0022%	0.0023%	0.0023%	0.0024%	0.0023%		
StDev	0.0024%	0.0030%	0.0028%	0.0044%	0.0023%		
Max	0.016%	0.018%	0.019%	0.071%	0.021%		
Min	0.000%	0.000%	0.000%	0.000%	0.000%		
N	777	777	773	771	777		
Kurtosis	4.3	4.3	6.1	80.6	8.1		
Skewness	1.8	1.9	2.2	6.3	2.3		

~The Ultimate 'Black Box' ~

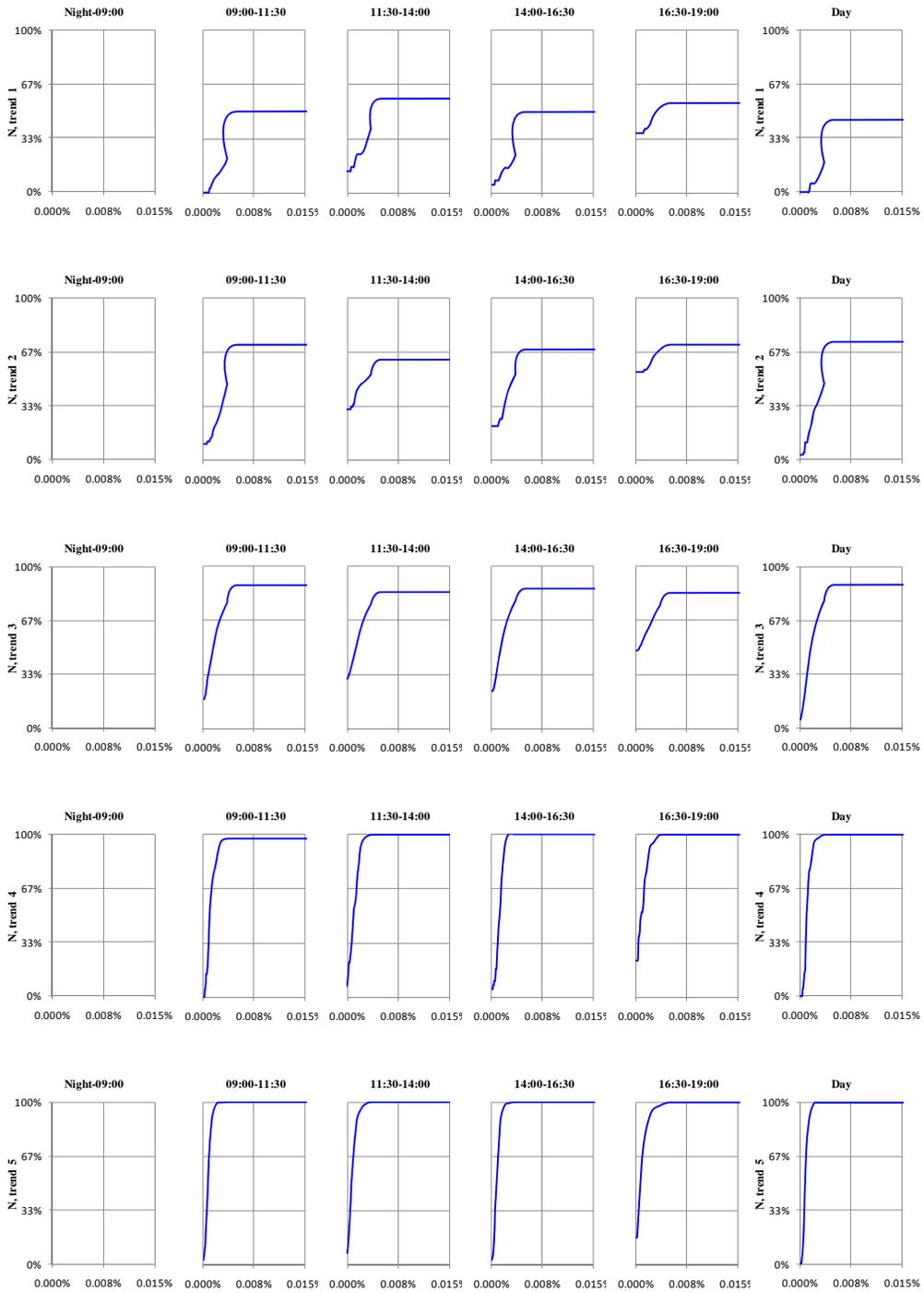
SE0000107419 Investor				Date	Price	Return
Variance			Start:	4/10/2006	148	-24.36%
trend 4			End:	6/13/2006	116	
Time:	09:00	11:30	14:00	16:30	19:00	DAY
Average	0.0012%	0.0010%		0.0011%	0.0009%	0.0011%
StDev	0.0012%	0.0007%		0.0005%	0.0008%	0.0006%
Max	0.008%	0.003%		0.002%	0.003%	0.003%
Min	0.000%	0.000%		0.000%	0.000%	0.000%
N	42	42		40	40	42
Kurtosis	20.3	0.0		-0.3	0.0	5.4
Skewness	4.0	0.4		-0.2	0.8	1.8

SE0000107419 Investor				Date	Price	Return
Variance			Start:	6/13/2006	116	47.75%
trend 5			End:	7/13/2007	187	
Time:	09:00	11:30	14:00	16:30	19:00	DAY
Average	0.0007%	0.0008%		0.0008%	0.0008%	0.0008%
StDev	0.0004%	0.0006%		0.0005%	0.0008%	0.0004%
Max	0.003%	0.003%		0.003%	0.004%	0.002%
Min	0.000%	0.000%		0.000%	0.000%	0.000%
N	274	274		269	269	274
Kurtosis	3.4	1.2		1.5	3.5	1.5
Skewness	1.1	1.1		0.9	1.7	1.1

e. Probability distribution of volatility



f. Cumulative distribution of volatility



g. Descriptive statistics of turnover

SE0000107419 Investor		Date				Price	Return
Turnover	(million SEK)	Start:	10/10/2002		41	42.96%	
trend 1		End:	12/2/2002		63		
Time:	09:00	11:30	14:00	16:30	19:00	DAY	
Average	2.2	47.1	26.0	44.0	11.5	128.7	
StDev	5.7	36.7	18.4	22.8	8.3	69.9	
Max	26.0	196.4	90.6	103.9	34.5	300.9	
Min	0.0	6.1	1.8	9.0	1.7	34.0	
N	38	38	38	38	38	38	
Kurtosis	13.2	6.2	3.2	-0.2	0.0	0.5	
Skewness	3.7	2.1	1.5	0.6	0.9	1.0	

SE0000107419 Investor		Date				Price	Return
Turnover	(million SEK)	Start:	12/2/2002		63	-38.19%	
trend 2		End:	3/12/2003		43		
Time:	09:00	11:30	14:00	16:30	19:00	DAY	
Average	3.9	23.4	18.3	35.1	7.8	84.6	
StDev	12.3	16.9	12.9	23.7	6.0	45.2	
Max	92.7	87.1	53.9	112.0	27.5	240.5	
Min	0.0	4.1	1.2	3.8	1.0	18.2	
N	66	66	66	66	66	66	
Kurtosis	43.0	2.8	0.7	1.3	1.1	1.4	
Skewness	6.1	1.6	1.2	1.3	1.3	1.1	

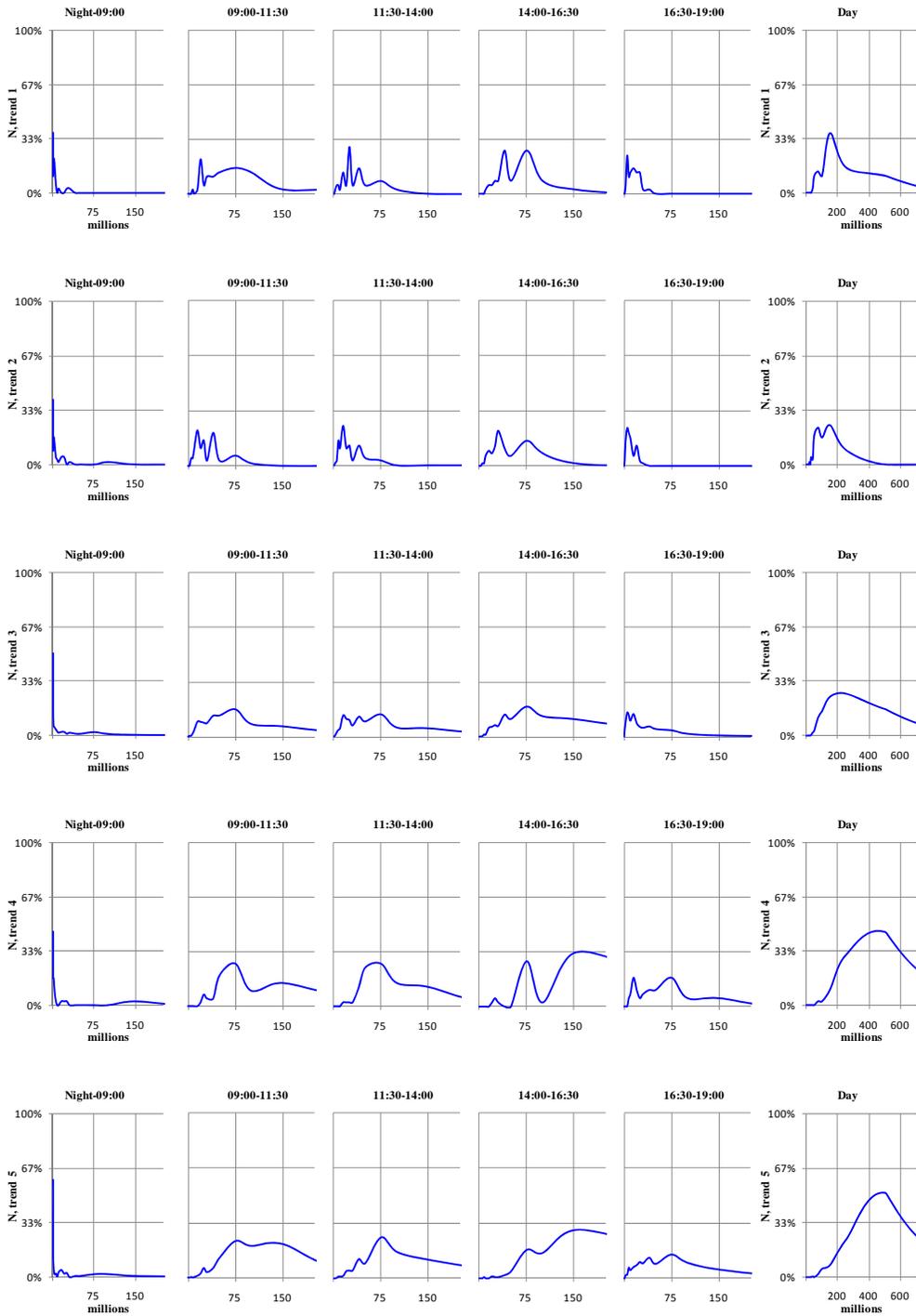
SE0000107419 Investor		Date				Price	Return
Turnover	(million SEK)	Start:	3/12/2003		43	123.60%	
trend 3		End:	4/10/2006		148		
Time:	09:00	11:30	14:00	16:30	19:00	DAY	
Average	7.0	49.6	44.6	67.3	17.7	178.6	
StDev	24.8	60.5	93.3	93.5	23.1	176.5	
Max	355.5	1,244.9	1,750.3	2,112.8	286.5	2,408.8	
Min	0.0	1.5	0.9	1.4	0.2	14.7	
N	777	777	777	773	771	777	
Kurtosis	93.1	198.9	252.5	299.7	31.9	62.5	
Skewness	8.2	10.9	14.6	14.4	4.3	6.3	

~The Ultimate 'Black Box' ~

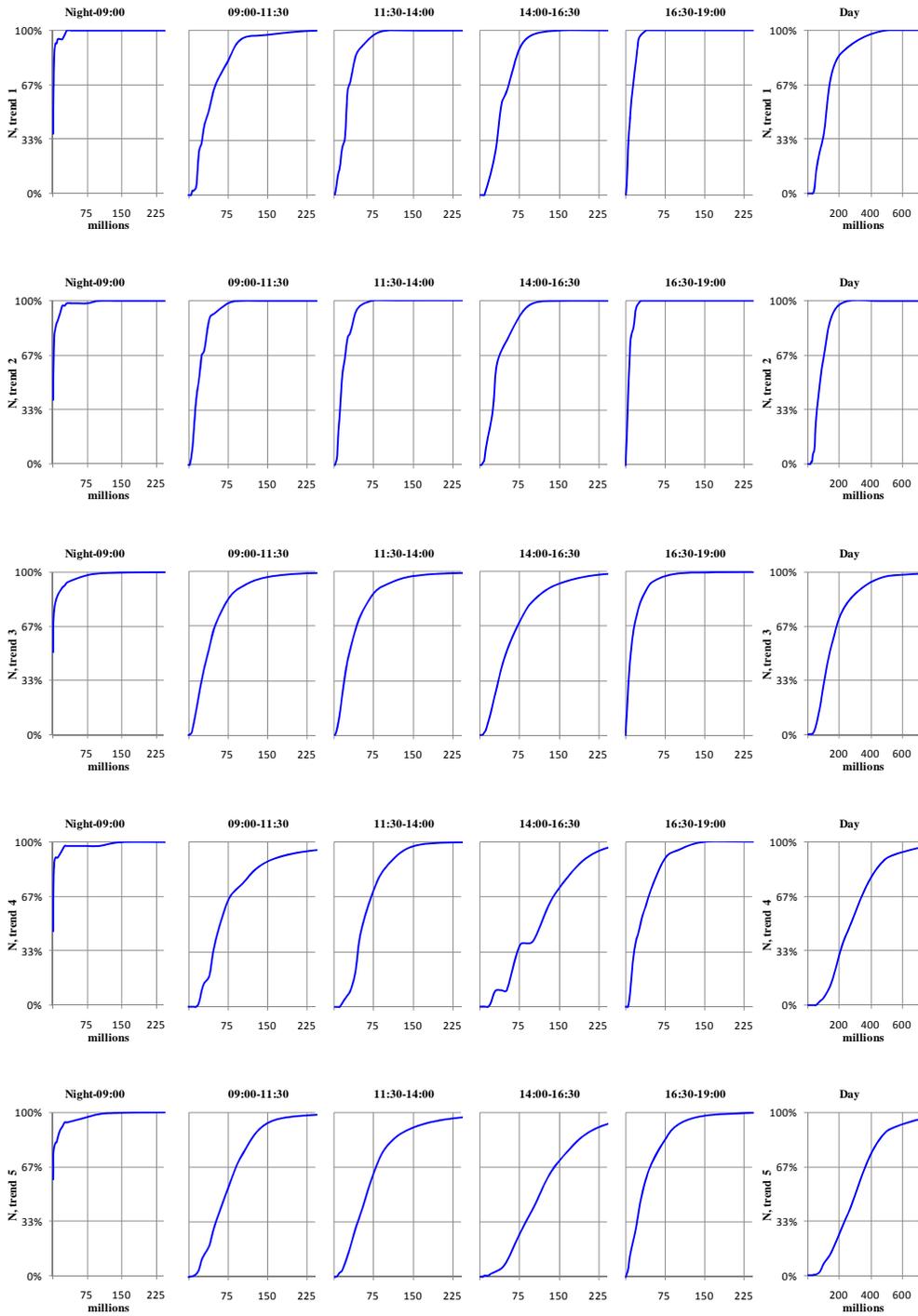
SE0000107419 Investor				Date	Price	Return
Turnover	(million SEK)			Start: 4/10/2006	148	-24.36%
trend 4				End: 6/13/2006	116	
Time:	09:00	11:30	14:00	16:30	19:00	DAY
Average	5.0	85.8	65.4	114.3	36.9	295.3
StDev	21.6	70.6	35.9	61.6	28.4	158.6
Max	137.5	313.2	156.5	253.9	108.1	715.8
Min	0.0	19.8	10.0	16.4	5.5	55.7
N	42	42	42	40	40	42
Kurtosis	36.9	3.1	0.4	-0.7	0.4	0.8
Skewness	5.9	1.9	1.0	0.4	1.1	1.0

SE0000107419 Investor				Date	Price	Return
Turnover	(million SEK)			Start: 6/13/2006	116	47.75%
trend 5				End: 7/13/2007	187	
Time:	09:00	11:30	14:00	16:30	19:00	DAY
Average	7.0	80.0	73.0	127.7	42.4	320.1
StDev	23.6	53.4	56.7	75.0	37.9	164.7
Max	246.2	429.3	388.4	515.3	274.7	1,013.1
Min	0.0	4.7	2.8	5.9	1.1	38.6
N	274	274	274	269	269	274
Kurtosis	45.4	10.4	6.8	3.7	6.7	1.9
Skewness	5.9	2.4	2.2	1.4	2.1	1.0

h. Probability distribution of turnover



i. Cumulative distribution of turnover



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j. Turnover ratio

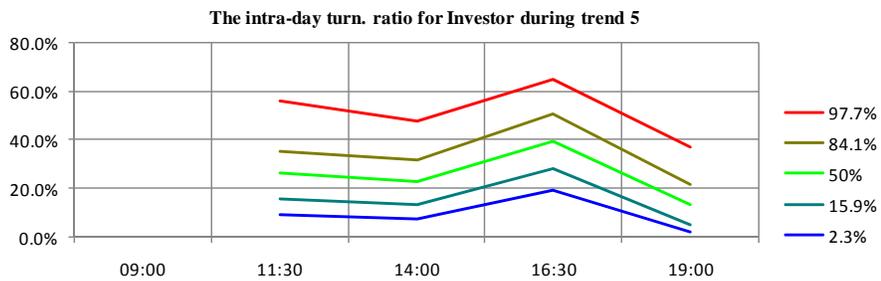
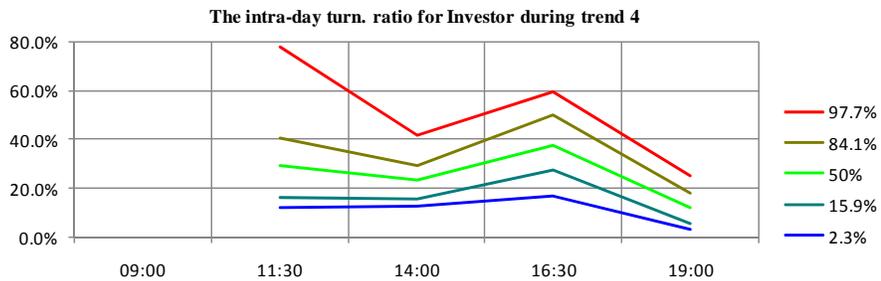
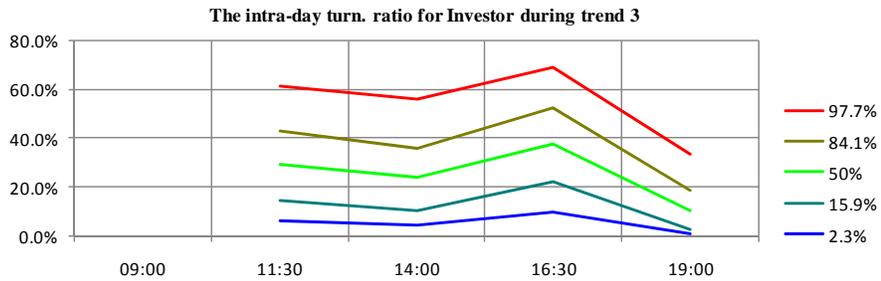
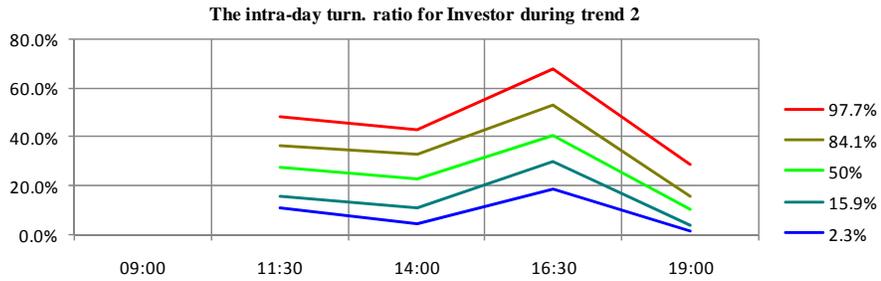
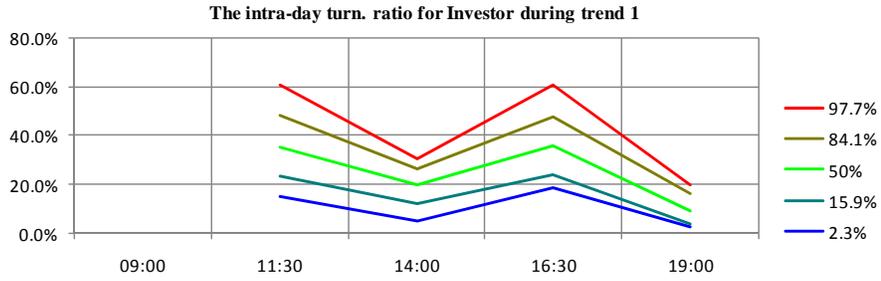


Figure 1, Prospect Theory gains/losses

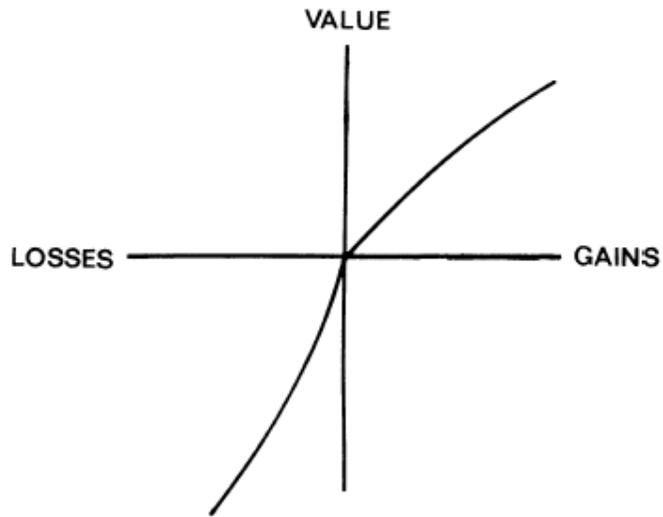


Figure 2, What is this?



Figure 3, Dow Theory

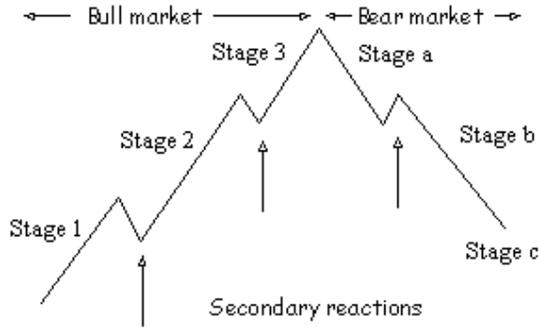
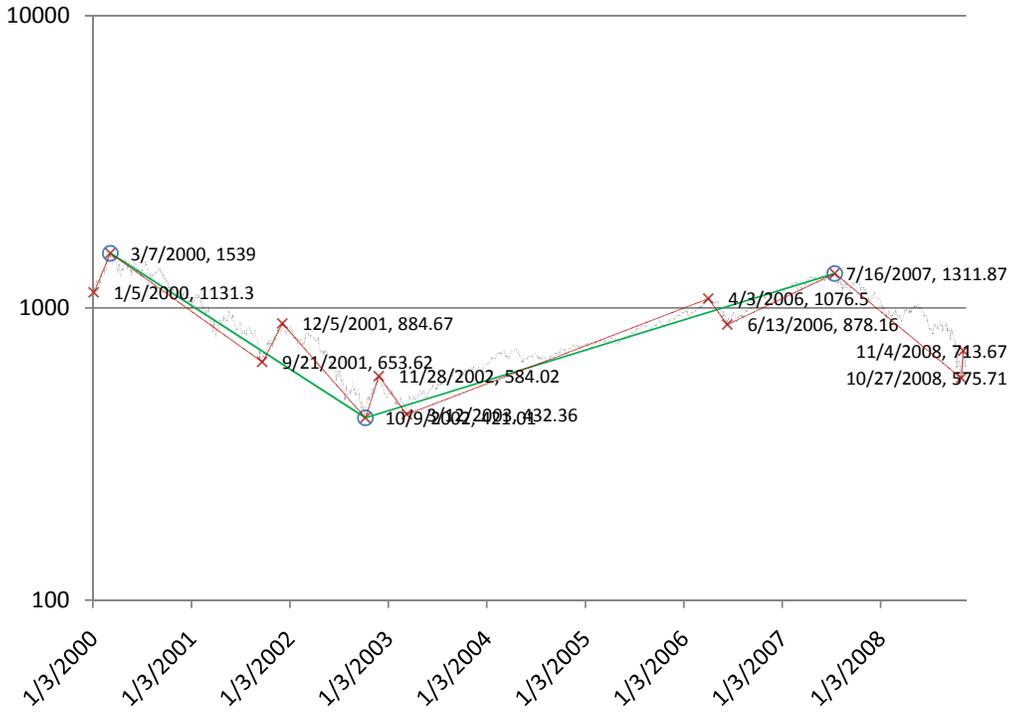


Figure 4, OMXS30



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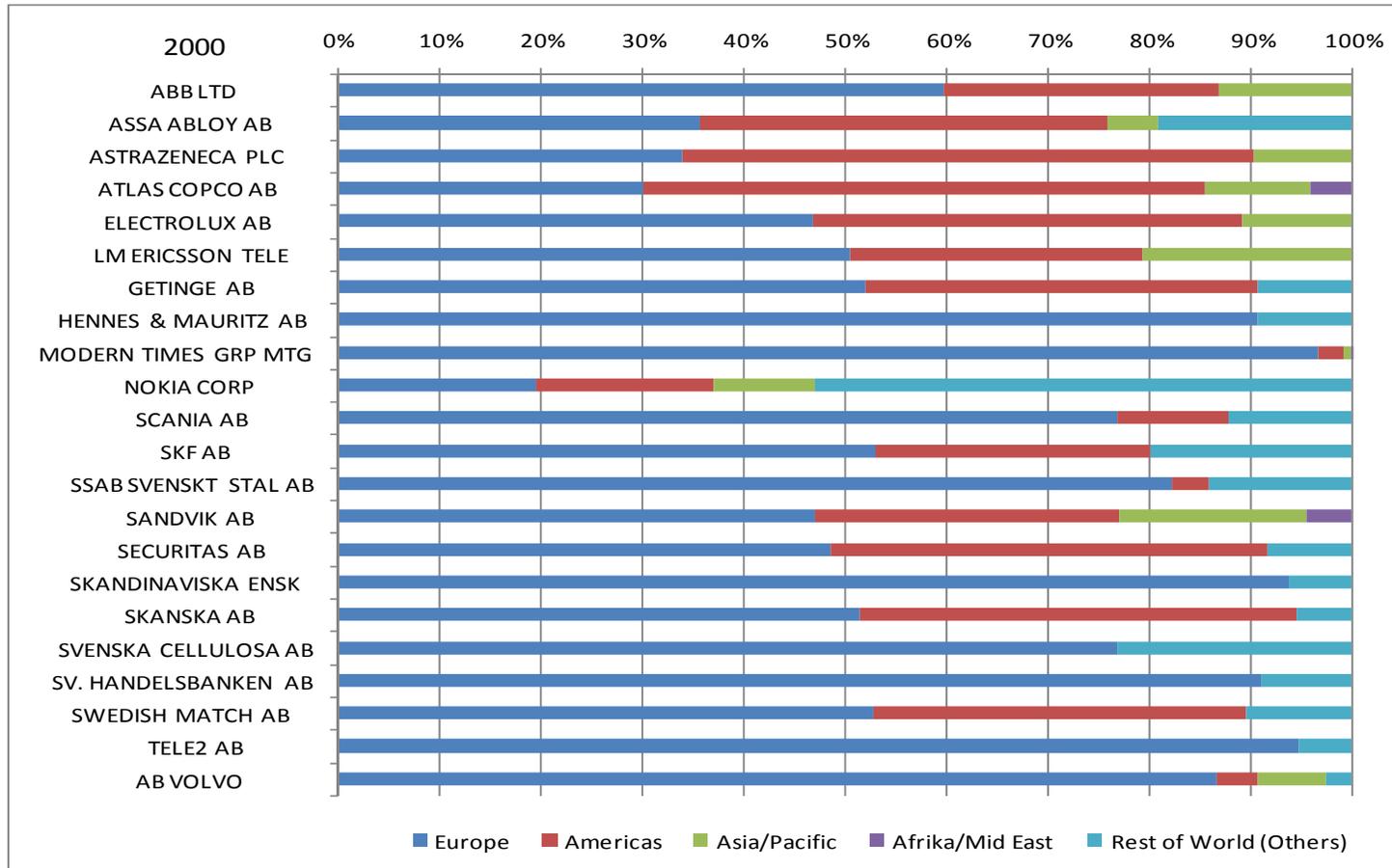
Table 5 OMXS30 constituents

COMPANY	ICB SECTOR NAME	COMPANY	ICB SECTOR NAME
ABB (OME)	Industrial Engineering	NORDEA BANK	Banks
ATLAS COPCO	Industrial Engineering	SEB	Banks
SCANIA	Industrial Engineering	SVENSKA HANDBANK.	Banks
SKF	Industrial Engineering	SWEDBANK	Banks
SANDVIK	Industrial Engineering	INVESTOR	Financial Services (Sector)
VOLVO	Industrial Engineering		
ELECTROLUX	Household Goods & Home Construction	ASSA ABLOY	Construction & Materials
HENNES & MAURITZ	General Retailers	SKANSKA	Construction & Materials
MODERN TIMES GROUP	Media	LUNDIN PETROLEUM	Oil & Gas Producers
SCA	Personal Goods	SSAB	Industrial Metals & Mining
SECURITAS	Support Services		
TELE2	Fixed Line Telecommunications	ASTRAZENECA (OME)	Pharmaceuticals & Biotechnology
ERICSSON	Technology Hardware & Equipment	GETINGE	Health Care Equipment & Services
NOKIA (OME)	Technology Hardware & Equipment	SWEDISH MATCH	Tobacco
EXCLUDED:		ICB - INDUSTRY CLASSIFICATION BENCHMARK ⁶²	
ALFA LAVAL	Industrial Engineering	(INDUSTRY)	(SECTOR)
BOLIDEN	Mining	(SUPERSECTOR)	(SUBSECTOR)
TELIASONERA	Mobile Telecommunications		

Firms in **bold** are assets held by Investor AB in 2007 among the above listed firms included in total sample.

⁶² ICB Benchmark, icbenchmark.com

Figure 5, Firm sales geographical distribution 2000

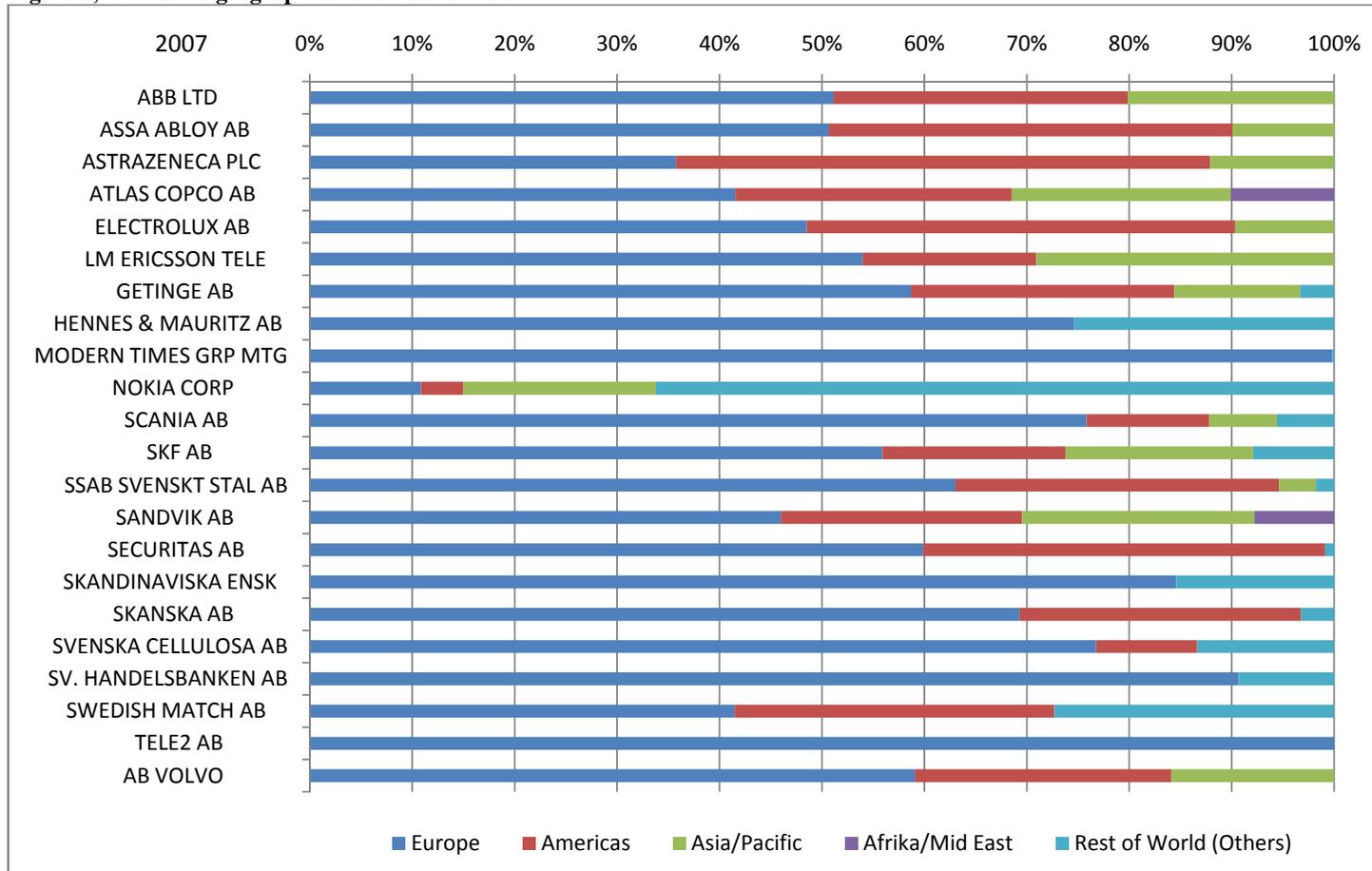


Note that "Rest of World (Others)" might include sales figures that correspond to another brought up region.

Investor, Nordea and Swedbank are excluded due to lack of available data.

~The Ultimate 'Black Box' ~

Figure 6, Firm sales geographical distribution 2007



Note that "Rest of the world (Others)" might include sales figures that correspond to another brought up region.

Investor, Nordea and Swedbank are excluded due to lack of available data.

Figure 7, ABB LTD

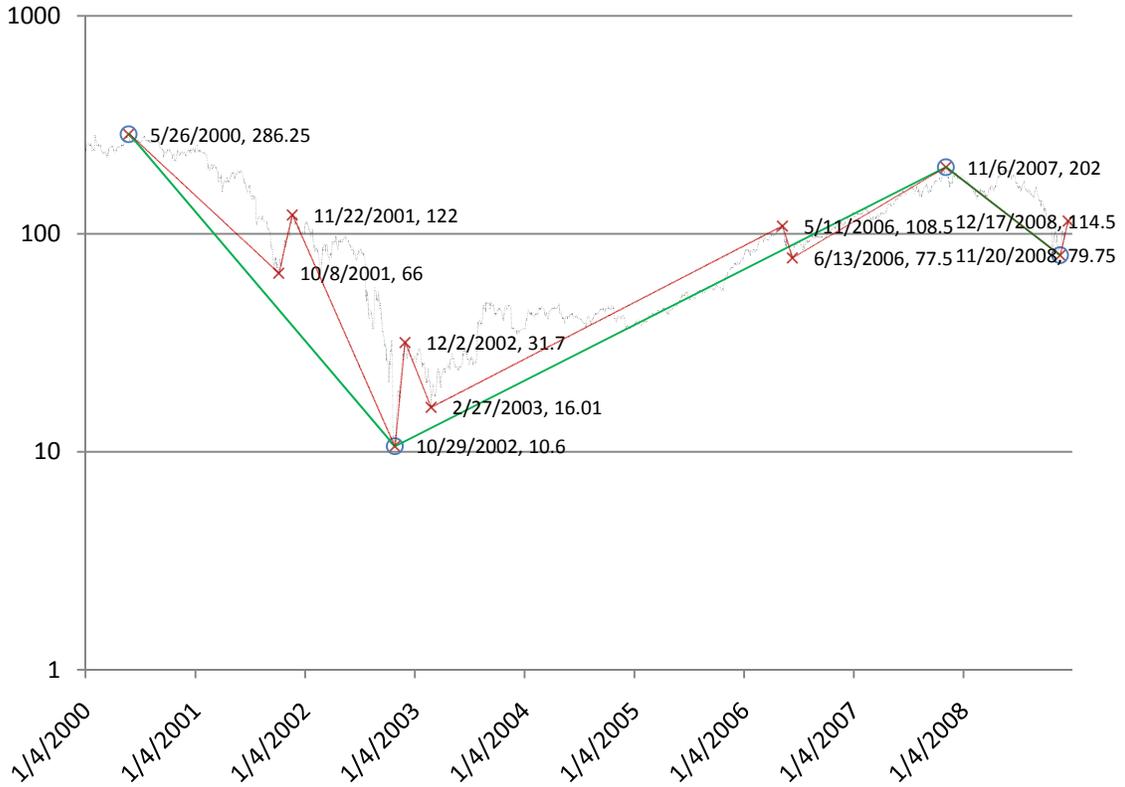


Figure 8, Astra Zeneca PLC

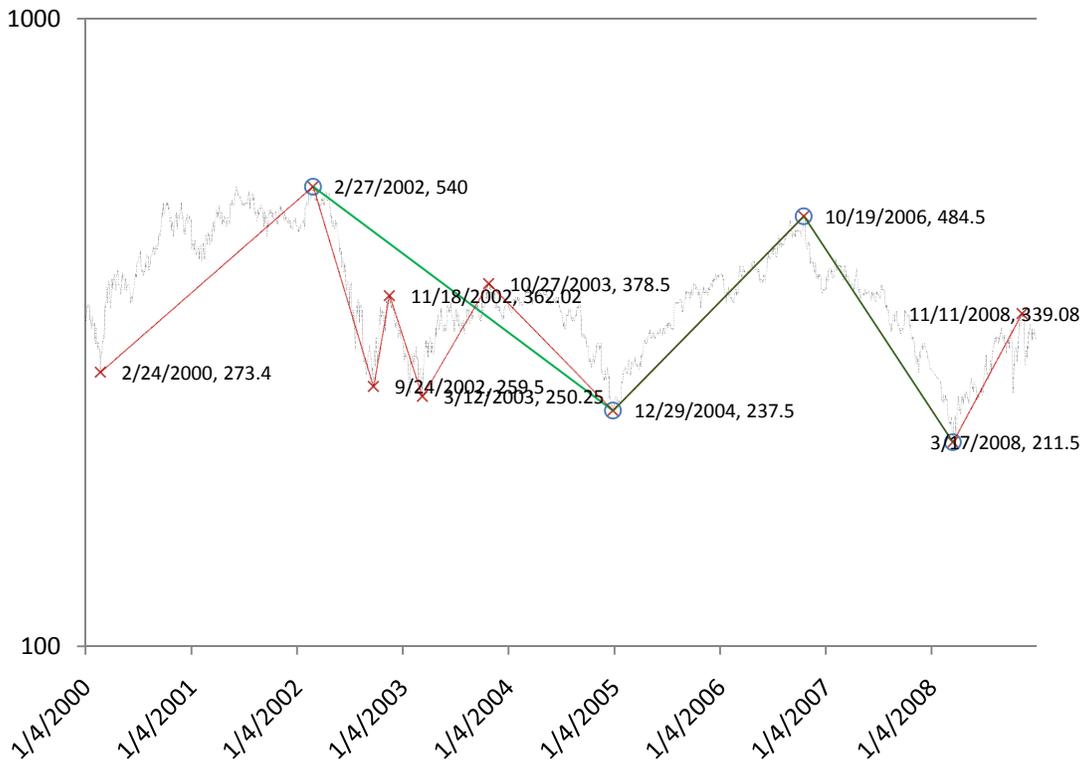


Figure 9, Atlas Copco AB

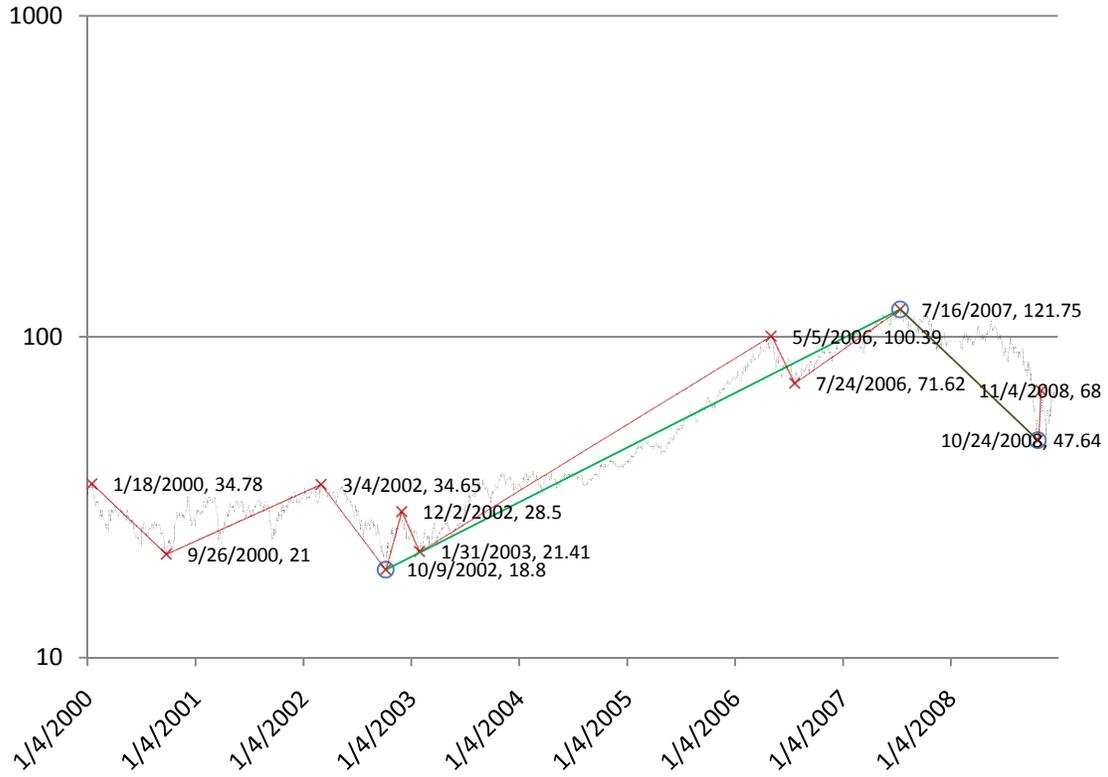


Figure 10, Electrolux AB

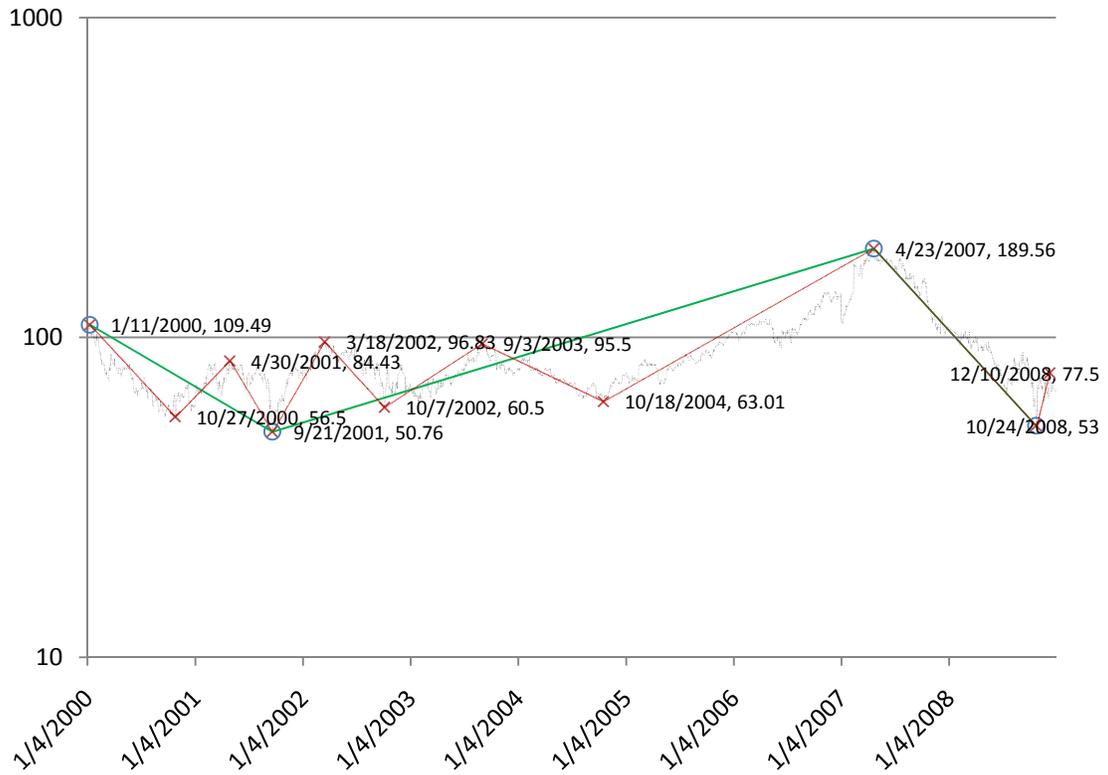


Figure 11, LM Ericsson AB

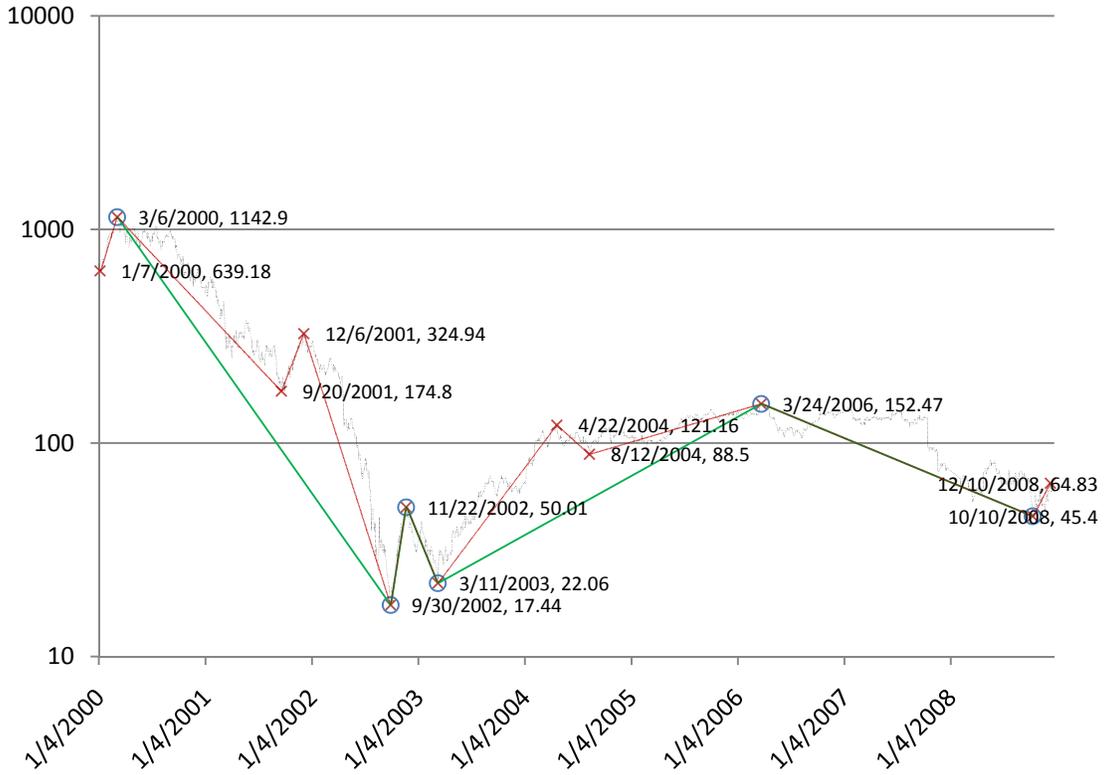


Figure 12, Scania AB

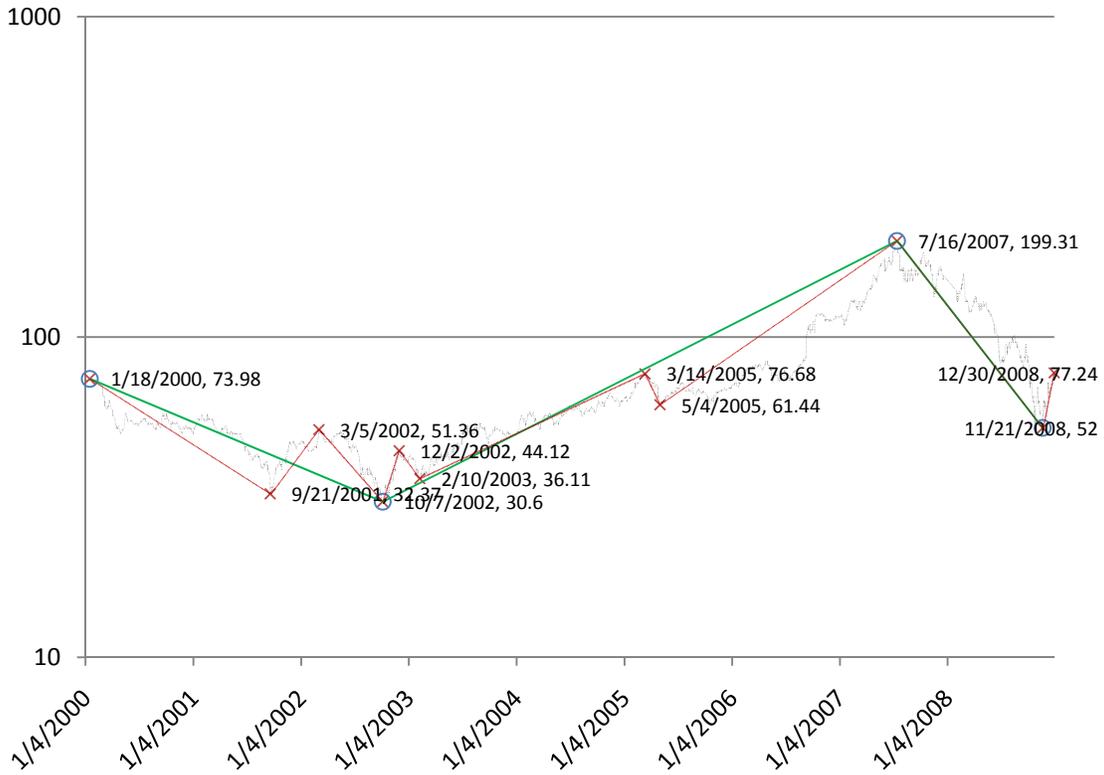


Figure 13, SEB

