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**SEASONAL AFFECTIVE DISORDER (SAD)**  
**EFFECT ON STOCK MARKET**  
**EVIDENCE FROM SWEDISH STOCK MARKET**

**Master's Thesis in**  
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**ABSTRACT**

In general the theory of finance assumes that the markets are efficient, but behavioral finance concept shows that markets are not efficient due to deviations known as anomalies. This study focuses on a seasonal anomaly called the Seasonal Affective Disorder (SAD). The anomaly refers to significantly lower stock returns before winter solstice and abnormally higher after winter solstice.

This paper investigates the role of SAD phenomenon on the Swedish stock market. It also examines the possible influence of weather factors such as air pressure, precipitation and cloud cover on the Swedish stock returns as well as the SAD impact on shares in a matter of risk. The research examines two stock market indices-Nordic Small Cap index and Stockholm OMX30 index. The studied time period for the Nordic Small Cap index is 2006-2012 and for the Stockholm OMX30 index is from 2003 to 2012. The market data comprises of daily log returns. Main testing method is regression analysis with seasonal dummy variables. In addition to Ordinary Least Squares (OLS), the GARCH model is also used in order to measure the shares volatility.

The results indicate that the SAD effect can be observed during autumn on the Nordic Small Cap index returns. The returns during the period from the autumnal equinox until the winter solstice are lower than usual. Besides that, Monday and tax dummies for the same index appear to be statistically significant. The returns on the first day of the week are lower than during the other days of the week. At the end of the year, during tax time, the returns for the same index appear to be higher than the average returns. The weather factors do not affect the stock returns. The GARCH model results show that the tax arrangements at the end of the year cause a change in the index volatility that leads to an increase in the returns whereas the Monday effect on the risk returns is expressed in a decrease.

This study considers a possible connection between SAD anomaly and January effect. However, the regression results do not confirm the existence of the January effect on the Swedish stock market.

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**KEYWORDS:** Behavioral finance, Market efficiency, SAD anomaly, seasonal anomalies



## 1. INTRODUCTION

Why should investors consider winter depression as a factor influencing economics? Winter depression or more known as Seasonal Affective Disorder (SAD) is a seasonal form of depression that is caused by the shortness of the day in fall and winter and the limited daylight during that period (Kamstra, Kramer & Levi (2003), Avery et. al. (2001)). Indeed the SAD anomaly is amongst the calendar anomalies that have influence on investors' stock portfolio. This conclusion is based on the concept of efficient markets by Fama (1965) and the theory of behavioral finance. The theory of behavioral finance gives explanation about the behavior of the stock on the basis of investors' psychological anomalies (Shiller, 2003). According to the Efficient Market Theory (EMT) the price of securities reflects all available information at all time and it is always right. Later during periods of time the efficient market theory began to be questioned because of the appearance of anomalies in securities' returns. Thus, it cannot be said that investors are rational and hence neither the markets are efficient.

It is possible to achieve efficiency by using arbitrage. Investors can create a stock portfolio that is based on anomalies, but according to the concept of efficient markets by Fama (1970) this is not quite suitable. The reason for that is the existence of the weak form of efficiency. According to this is not possible to predict future course of price development in past, it reflects only past prices.

SAD impact depends on the relative latitude, sunlight hours actually experienced, and person or possibly population (Kihn, 2012). Evidence suggests that the markets with higher latitude tend to have more distinct SAD effects. Experimental research in psychology and economics has documented that this type of depression causes risk-aversion (Kamstra, Kramer & Levi 2003).

Often anomalies don't appear alone, but they can be connected with each other. SAD can be connected with the January effect anomaly. The essential about this anomaly is the fact that shareholders prices are higher than normal in January. The January effect is primarily a low-share price effect and less so a market value effect (Ravinder K. Bhardwaj & Leroy D. Brooks 1992). This increase in share price can be explained by SAD with the sunlight after the winter solstice. Another explanation is due to firm size- small firms tend to have large, positive returns (Seyhun, 1988). SAD anomaly can be explained also by the company size.

### 1.1 Purpose of the study

The purpose of this study is to find out whether there is a Seasonal Affective Disorder anomaly on the Swedish Stock Exchange.

The hypotheses are formulated as follows:

H0: Seasonal Affective Disorder anomaly does not affect stock returns.

H1: Seasonal Affective Disorder anomaly affects stocks returns.

The null hypothesis is based on the efficient market hypothesis or more specifically on the theory of random walk which states that the share prices take random and unpredictable path. According to this theory stock price changes are independent of each other and have the same distribution, thus the past movement of a stock price can't be used to predict its future movement.

### 1.2 Contribution

As far as it is known there are a few studies that examine the Swedish Stock market (i.e. Frennberg & Hansson (1993); Metghalchi, Chang & Marcucci (2008)), but there are no detailed researches concerning the topic and the anomalies that occurred in it. This paper examines whether there is a SAD anomaly observed on Swedish stock market.

The impact of Seasonal Affective Disorder has been previously studied and observed in stock markets in U.S, Australia and also there were little observations in Finland, Europe as well as in Sweden. The purpose of this thesis is to make a detailed research on the topic and compare it with the previous literature results.

### 1.3 Course of the study

In the following chapter is provided a theoretical background that includes important concepts representing the theory of market efficiency. Since the efficient financial market is a foundation of seasonality in stock prices, it is essential for the current research to be examined before moving further. The subchapter also includes risk and share evaluation as well as important financial equilibrium models such as Markowitz modern portfolio, CAPM and APT.

The following chapter is about literature review and more specifically the theory of behavioral finance and different anomalies that exist on the stock market.

Chapter four is entirely focused on the Seasonal Affective Disorder (SAD), its characteristics and previous literature in order to give a complete idea to the reader about the anomaly. The chapter also includes a subchapter that describes the possible investing strategies for the shareholders.

The empirical part of the current research starts with chapter five, which gives an explanation about the type of data used for the testing the study hypothesis. Following this, chapter six provides the used methods. The results are represented in chapter seven and chapter eight summarizes the whole research.

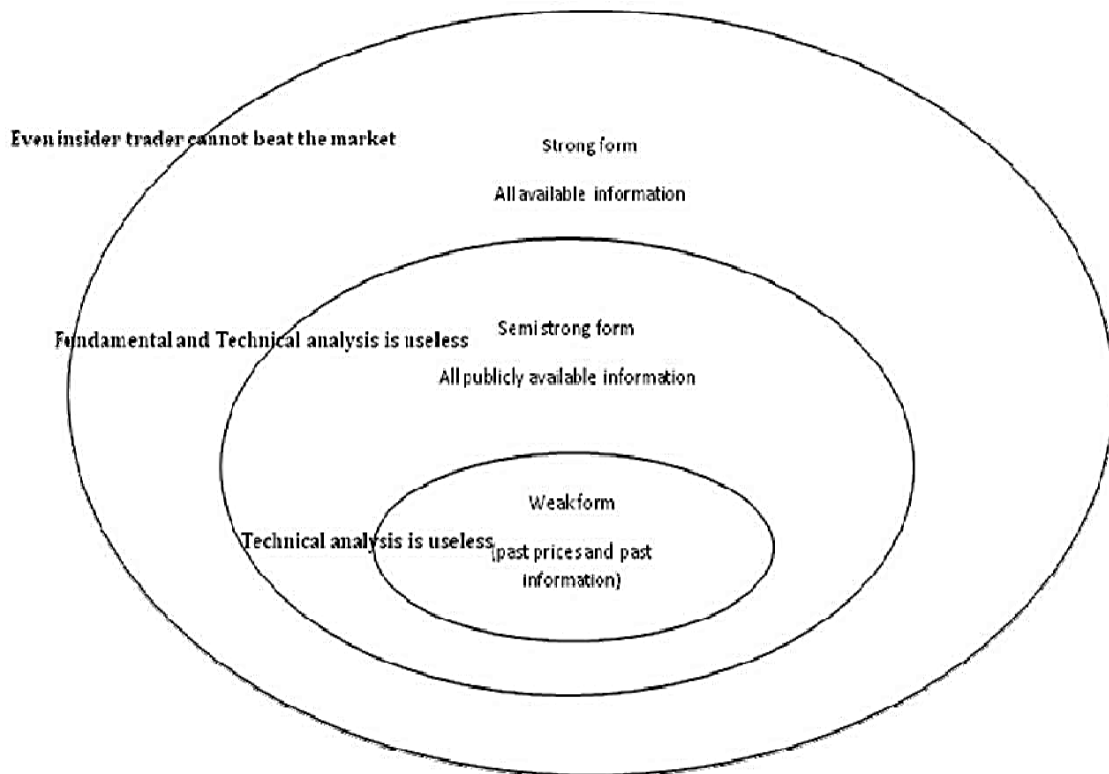
## 2. THEORETICAL BACKGROUND

The following chapter reviews the previous studies concerning the efficient financial markets and the financial market equilibrium models in order to introduce the literature background of the study.

### 2.1 Efficient Financial Markets

Eugene Fama first set the foundation of the efficient market hypothesis in 1965 in his paper “Efficient Capital Markets: A View of Theory and Empirical Work”. According to the efficient market theory stock returns follow a random walk.

According to Fama (1970) one financial market is efficient when the prices on it always fully reflect all available information. The efficient markets model covers three forms of efficiency. The first one is weak form tests where all past prices and information are discussed. When the market appears to be efficient in the weak form, excess returns cannot be made simply by studying past returns.



**Figure 1** Forms of efficiency (Latif, Arshad, Fatima & Farooq, 2011:2)

The next form of efficiency is semi-strong form where prices reflect all publically available information. The market prices tend to react to new information, such as annual earn-

ings announcement, lay-off announcements or any other security announcements (Brealey et al. 2011:345-346). The last form is represented by strong form tests where all public and private information is incorporated into prices (Kihn, 2011). Concerning private information this form of efficiency appears to be quite risky, mainly because trading of inside information is illegal (Bodie et al. 2002: 343).

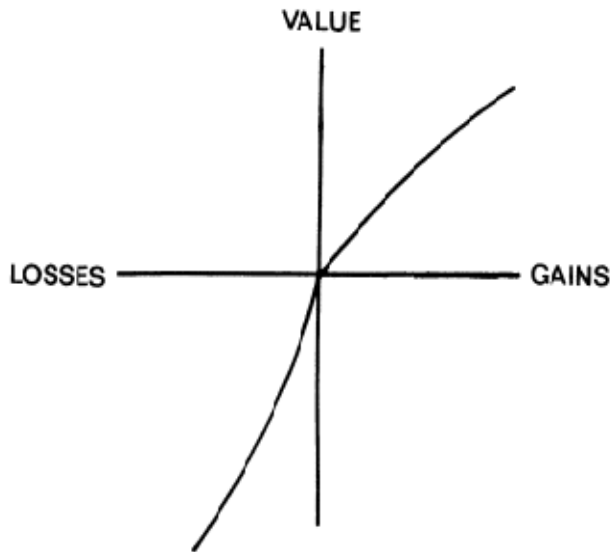
Fama (1970) defined in his paper the sufficient conditions for capital market efficiency. In the ideal market : (1) there are no transaction costs in trading securities, (2) all available information is costless for the market participants, (3) all have a common understanding of the effect of public information about the securities prices.

According to Shleifer (2000) to be efficient the market has to meet some requirements. For example, the investors should be rational and value securities rationally. Rational behavior means that investors take advantage of all possible information and make the right decisions, when prices will remain on the right-level. As a result, the prices include all relevant information to the market. But “to the extent that some investors are not rational, their trades are random and therefore cancel each other out without affecting prices” i.e. cancelation (Kihn, 2011). Often the irrational investors are met by rational arbitrageurs and that is one of the Efficient Market Hypothesis (EMH) assumptions that seem to hold. Rational arbitrageurs are assumed to always and anywhere correct mispricing, but after couple of researches on the topic it turns out that rational arbitrageurs seem to have limited impact and sometimes even encourage mispricing and irrational traders don't cancel each other out (Kihn, 2011).

### 2.1.1 Risk and Share Evaluation

The paper by Kahneman and Tversky (1979) questions the effectiveness of expected utility theory as a model of decision making under risk. People tend to make decisions based on potential losses and profits of the share rather than taking into account the final outcome. Thus, the greater profit probability the greater impact on decision making can be observed. Therefore, the figure of value function below is asymmetrical.





**Figure 2** Value function (Kahneman & Tversky, 1979)

According to Shefrin and Statman (1985) people tend to sell their shares too early, on one hand, but on the other hand waiting too much may result in price decrease of the share. If investors wait a bit longer before selling their shares it is quite possible the share price to increase, so they can sell the share for a higher price. Shefrin and Statman call this the disposition effect where investors sell winners too early and ride losers too long.

Practical studies in psychology have shown that there is a relationship between heightened risk aversion and depression (Schmidt, 2003). The change in risk aversion in a costless and competitive market can influence the equilibrium price (Bierwag & Grove, 1965).

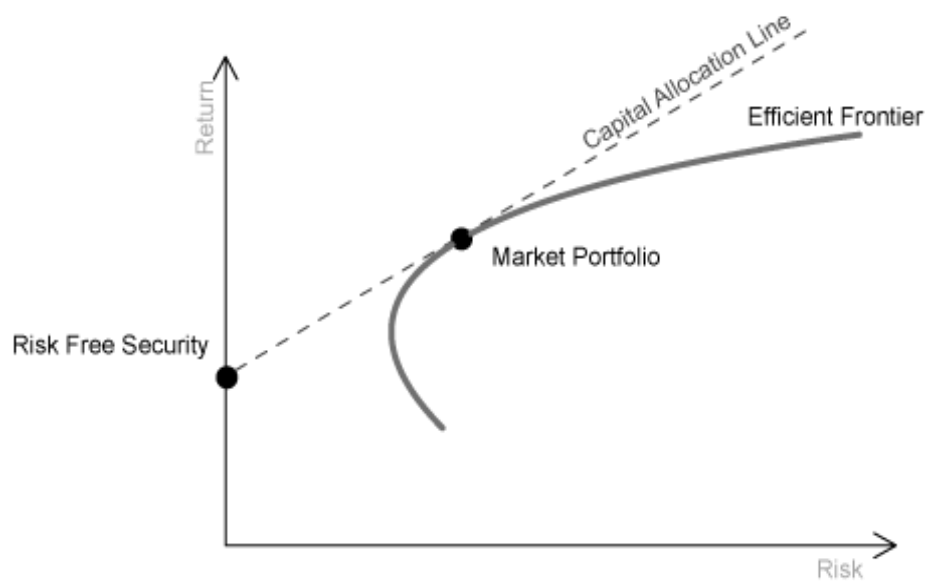
Concerning possible implications of heightened risk aversion on trading volume, Campbell et al (1993) examined the relationship between aggregate stock market trading volume and the serial correlation of daily stock returns. The model used in the study consists of risk-averse “market makers” that accommodate buying or selling pressure from “liquidity” or “non-informational” traders. It suggests that increased risk aversion will increase trading volume as return decreases. Wang (1994) studied the link between trading volume and stock returns. According to Wang (1994) trading volume and stock price changes are positively correlated. The positive relation escalates as the information asymmetry increases.

## 2.2 Financial market equilibrium models

This part of the study focuses on the financial equilibrium models - Markowitz modern portfolio, Capital Asset Pricing Model (CAPM) and Arbitrage Pricing Theory (APT) as determinants of expected returns.

### 2.2.1 Markowitz Modern Portfolio

H. Markowitz (1952) first developed the concept of modern portfolio theory. The idea behind his model is to identify the efficient portfolio by taking into consideration level of risk and return on the maximum ratio. There are two possible options regarding efficient frontier. It can rather show the smallest possible risk of the return level or the maximum return at any level of risk. The aim of investors is to achieve the highest possible returns with minimum standard deviation of risk.



**Figure 3** Markowitz Modern Portfolio

The process of security selection goes first through finding the available risk-return opportunities. If the portfolio is lying on minimum-variance portfolio above the global minimum-variance portfolio then we can say that it is efficient.

The role of the Capital Allocation Line (CAL) when determine the efficient frontier is that CAL is the tangent point, resulting from portfolio weights. In order to find the optimal portfolio we need to search for CAL with the highest reward-to-variability ratio.

Everyone invests in the Market Portfolio (look at Figure 1) regardless of their risk aversion. The investors who are risk-lovers will put more in the risk-free assets while the less risk oriented investors will put in the Market Portfolio (Bodie et al , 2011).

### 2.2.2 Capital Asset Pricing Model (CAPM)

Capital Asset Pricing Model (CAPM) is an important model in the modern economy and it is invented by William Sharpe (1964), John Lintner (1965), Mossin (1966). Its foundation is laid by Markowitz's modern portfolio. The model gives a precise prediction concerning the relationship between the risk of an asset and its expected return. It also can be used as a tool of measuring risk.

The CAPM can be expressed by the following equation:

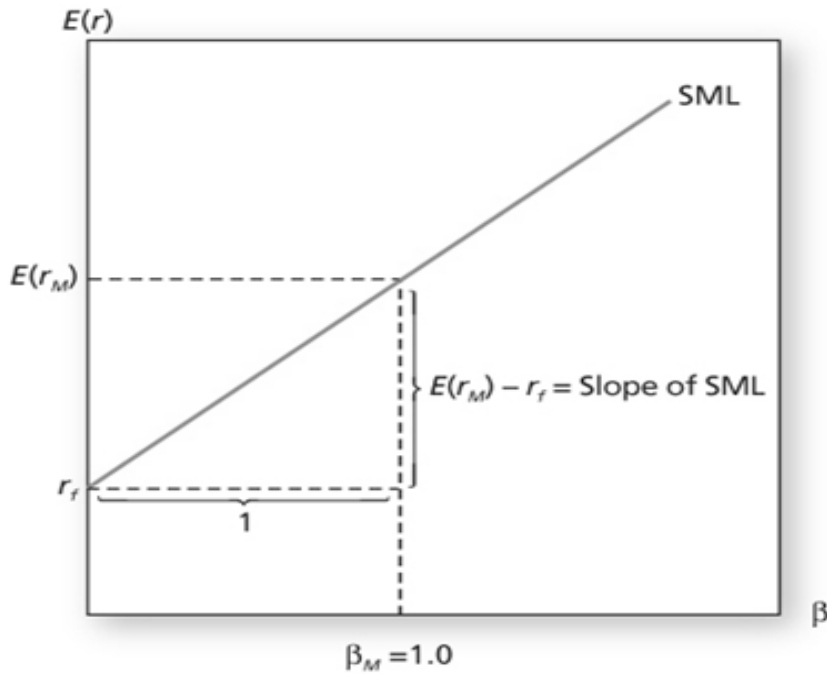
$$(1) E(R_i) = R_f + \beta_i (E(R_m) - R_f),$$

where  $E(R_i)$  is the expected return on the capital asset,  $R_m$  is the expected return on the market portfolio,  $R_f$  is the risk-free rate of interest and  $\beta_i$  is the market beta of asset. The beta factor describes the covariance of an asset return with the market return divided by the market return. It can be calculated using the following formula:

$$(2) \beta_i = \frac{COV(R_i, R_m)}{VAR(R_m)}$$

where  $R_i$  is the return of the stock and  $R_m$  is the return of the market for the same time period.

The beta coefficient also represents the slope in the regression on its return on the market return, thus from this point of view we can interpret the role of beta as a measurement tool of sensitivity of the asset's return to variation in the market return.



**Figure 4** CAPM graph represented by Security Market Line (SML)

There are couples of assumptions behind the CAPM model. According to it investors are price-takers which mean that they act in such a way that security prices are not affected by their own trades. Moreover, investors' planning is characterized by single-period horizon. This behavior is also called myopic or short-sighted. Investments are limited to traded financial assets, such as stocks and bonds for example. The model also assumes that there are no taxes and no transaction costs on security trades and information is costless and available for all traders. The CAPM suggests that all investors are rational mean-variance optimizers and have homogeneous expectations. It means that they use the same expected returns and covariance matrix of security returns in order to generate the optimal risky portfolio.

In reality the above mentioned assumptions do not really hold. For example, in real world it does not seem quite logical for all investors to have the same market expectations because that would make it impossible for the market to generate any volume. All investors will hold the same asset portfolio as in the market portfolio, including in that all traded assets. Another implication that appears, if we assume CAPM theory to be entire true, is connected to the fact that market portfolio contains all securities. The proportion of each security is its market value as a percentage of total market value. Furthermore, risk premi-

um on the markets should depend on the average degree of risk aversion and risk premium on individual assets is proportional to the risk premium on the market portfolio (Kihn, 2011).

Despite the above mentioned implications financial practice shows that CAPM model is easy to use and it provides an exact prediction of the relationship between the risk of a security and its expected return. This is the reason why CAPM is a preferred tool for determining expected returns in financial research (Bodie, Kane & Marcus 2008: 192–197).

### 2.2.3 Arbitrage Pricing Theory (APT)

The arbitrage pricing theory is developed by Stephen Ross in 1976. The theory represents an alternative model to CAPM, but it has different approach towards predicting security market line (SML). According to the theory security returns can results from two sources: firm specific events and common macroeconomic factors, such as for example interest rate and Gross Domestic Product (GDP).

The assumptions behind APT are the following:

- Investors can lend or borrow money at the risk-free rate
- They are risk-averse and their goal is to enlarge their wealth
- There are no taxes and no transaction costs and no restrictions towards short-selling (Harrington 1978:193).

We can spot an arbitrage opportunity in the cases when no investment is required and hence investors can obtain sure large profits. Investors will insist to have an infinite position in a risk-free arbitrage portfolio no matter the wealth and risk aversion (Bodie et al. 2011). That can be a problem because profitable arbitrage opportunities don't last long in the efficient markets and also the possible increase in wealth can lead to an increase in risk-aversion (Ross, S. 1976).

While CAPM implies the holding of mean-variance portfolio, APT uses well-diversified portfolio. Such a portfolio is defined as the one which includes large number of securities, each with small enough weight to neglect the nonsystematic variance (Bodie et al. 2011). The well-diversified portfolio can be described with the following equation:

$$(3) \quad r_p = E(r_p) + \beta_p F + e_p,$$

where:  $r_p$  – the rate of return on the portfolio

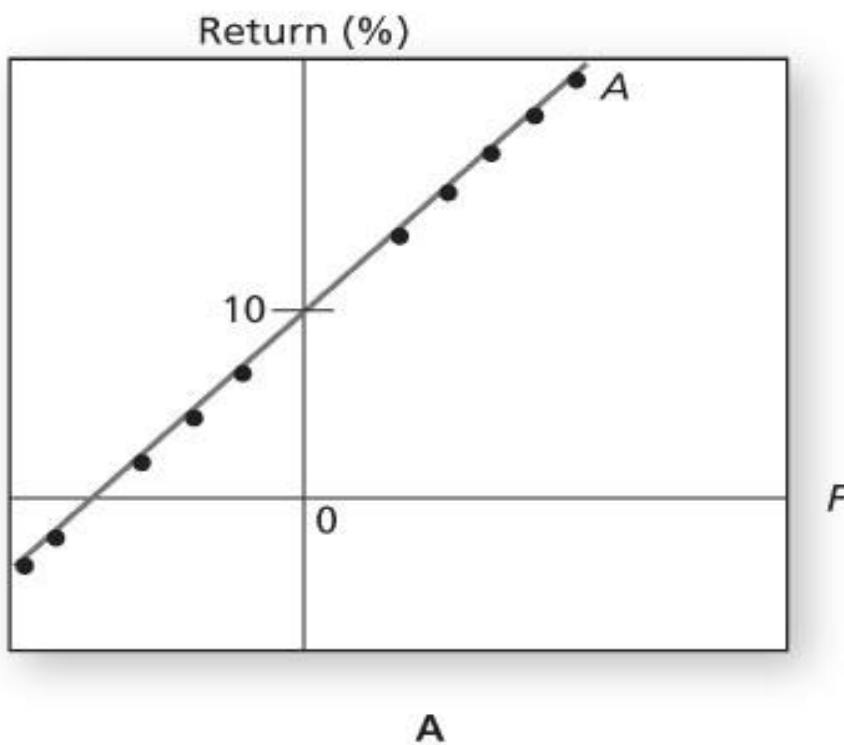
$E(r_p)$  – expected returns on n securities

$\beta_p$  – weighted averages of the  $\beta_i$  (the sensitivity of firm i)

F – deviation of the common factor

$e_p$  - Non-systematic component

In comparison with a normal n-stock portfolio, in the well-diversified portfolio  $e_p$  approaches zero as the number of securities in the portfolio increases.



**Figure 5** Returns in well-diversified portfolio (Bodie et al. 2011)

The APT model can be applied also to individual stocks. In that case it is possible for some single stocks to be mispriced.

The model can be extended to multifactor models, by using more than one systematic factor.

### 3. LITERATURE REVIEW

This chapter focuses on the term behavioral finance and further it gives explanation about some anomalies like January effect anomaly, the other January effect, Halloween anomaly, day-of-the week anomaly, P/E anomaly.

#### 3.1 Behavioral finance

Behavioral finance can simply be explained as the application of psychology to financial behavior. The extended definition of the term can be formulated as follows: “Behavioral finance argues that some financial phenomena can plausibly be understood using models in which some agents are not fully rational.” (Barberis and Thaler, 2002). According to Shiller (2003) behavioral economics examines the financial markets and the economy in a broader social science perspective, including psychology and sociology.

The two main foundation of the term behavioral finance are: (1) limits to arbitrage and (2) psychology. The limits to arbitrage argue that there could be some difficulties for rational traders to misprice the dislocations caused by rational traders. And psychology explains the possible kinds of deviations from full rationality (Kihn , 2011 :10).

Behavioral finance assumes that there is no fully efficient market. Hence, this makes good conditions for arbitrage profits. In theory arbitrage profits can be gained including no capital and risk. For example, different markets can sell the same security at different prices, so that it is possible to make a profit by buying the security at a cheaper price from one market and then sell it at a higher price at another market (Shleifer & Vishny, 1997). It is often expected from arbitrage to make markets efficient. Referring to EMH, where agents are assumed to be rational, price of securities should be equal to their fundamental value. By “fundamental value” is understood the discounted sum of future cash flows at specified discount rate. According to the hypothesis, in an efficient market, prices are right and there is “no free lunch”. That means “no investment strategy can earn excess risk-adjusted average returns, or average returns greater than are warranted for its risk.” (Barberis and Thaler, 2002). Limits to arbitrage make sure that even though some institutional investors act quite rationally they simply can’t compensate for the number or irrational traders that cause mispricing.



The most common limits of arbitrage can be listed as follows:

- transaction costs
- noise or various behavioral limits to arbitrage
- capital constrains
- liquidity constrains (Kihn, 2011:65)

Cognitive psychology is also an important part of behavioral finance. It explains what kind of disorders can be found in rational human thinking, referring to people's beliefs and preferences.

Several biases connected to the market can be found in psychology. The first bias is overconfidence. People tend to overestimate or exaggerate probabilities and provide too narrow ranges. It is considered to be one of the most important psychological biases, because it may have significant influence on both pricing and trading. Accordingly, Grinblatt and Keloharju (2008) found that overconfidence has an impact on investors' trading skills in Finland. Another bias is related to people's tendency to be overly optimistic about positive outcomes and under optimistic about negative outcomes (Kihn, 2011:94). People who are in an optimistic mood are more likely to make better decisions than the individuals in a bad mood (Baker and Nofsinger, 2002). Baker et al. support the statement that sunshine influences mood and optimism and hence it affects financial decisions.

Representativeness is a bias that causes people to over-weight recent information and deemphasize base rates or priors (Tversky & Kahneman, 1982). The bias known as conservatism implies that investors underweight sample information which contributes to investor under-reaction to new information (Edwards, 1968). Belief perseverance can be related to people's tendency to ignore logic and/or evidence that possibly can be at variance with their beliefs. Along with the belief perseverance Kihn (2011) puts the confirmation bias. Under confirmation bias decision makers tend to seek out and support more the evidence that confirms their statements and hypothesis or in another words "people will reinterpret evidence against as evidence in favor" (Kihn, 2011:95). Sometimes people tend to make decisions relying too heavily on the first source of information they receive. This kind of bias is called anchoring and once it is set cannot affect any other decisions made after that. Another bias can be found in people's tendency to search and work from actual

experience (Kahn, 2011:96). The bias is known as availability bias and causes investors to overreact to the market.

Many economic studies conclude that investors tend to irrationally make decisions when proceeding financial information. Except for the above mentioned behavioral biases, there are other behavioral biases that influence the way that investors make decisions of, for example, risk versus return (Body et al. 2011).

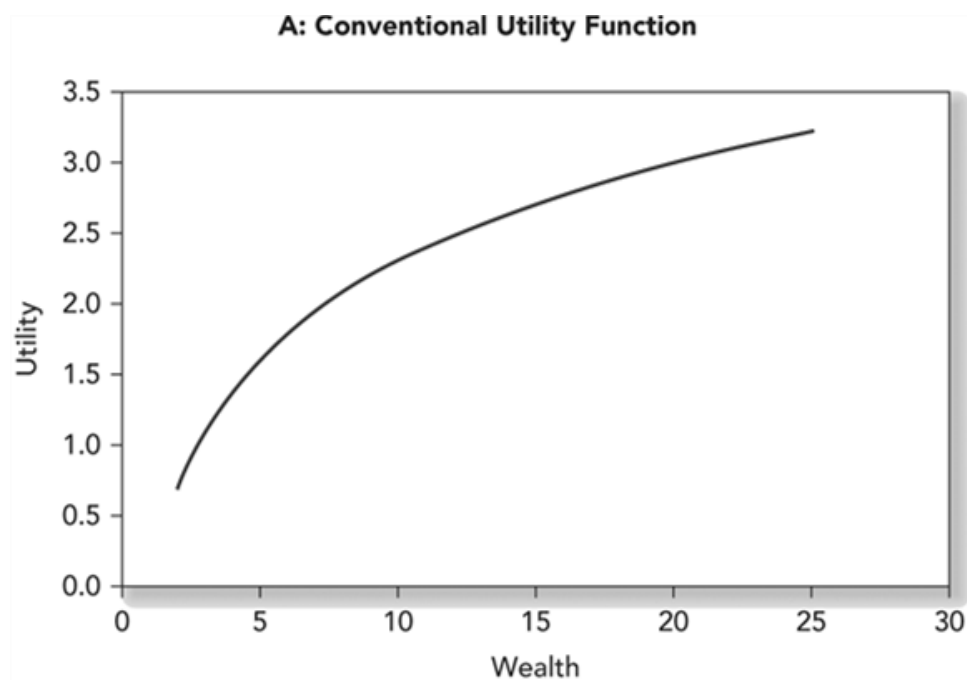
On first place decisions appeared to be influenced by the way choices are outlined or framed which draws the attention to the behavioral bias of framing. Framing a decision is done by considering all the possibilities, effective acts and outcomes of the decision (Tversky & Kahneman, 1986). Whether the outcomes are described as gains or losses, it has been discovered to have effect on people's choices. In general individuals tend to act risk averse in terms of gains, but pursuing for risk when it comes to losses. For better understanding we can use the so-called Asian disease problem. Assume that there is a strange Asian disease outbreak in the United States, which is expected to kill 600 people. Two options for action have been proposed to treat the disease. The first one suggests that 200 people will be saved while the second one offers a chance of one-third that 600 will be saved and a two-thirds probability that no people will be saved. Studies show that most people choose the first option. If we propose two more programs: program A where 400 will die and program B where there is a one-third probability that nobody will die and a two-thirds probability that 600 will die. In this case the majority chose program B. In fact, if we compare the two sets of options of the experiment, we can conclude that they are identical. The first programs (options) in both cases are identical, but framed in different ways. In the first case, the first option is framed in gain demands-200 people will be saved while in the second case program A is framed in loss domain- 400 people will die. This experiment shows that decision making is very much dependent on the framing options (Kahneman & Tversky, 1981).

A specific form of framing is mental accounting (MA). It represents a group of cognitive procedures used by individuals in order to control their financial activities (Thaler, 1999). According to Statman (1997) mental accounting appears to be coherent with individuals' tendency to ride losing stock positions for too long and favoritism of high cash dividends. Indeed, investors prefer to sell 'winner' stocks than selling those that have losing position (Shefrin & Statman, 1985). Mental accounting is useful for explaining momentum in

stock prices. MA investors tend to be risk indifferent over gambles for some stocks and embracing risk over gambles for others (Grinblatt and Han, 2005).

Modern psychology has found that people tend to blame themselves more if the decisions they had made turn out badly, especially if the decision was more unusual for the person. This bias is known as regret avoidance where people are most likely not to learn from their mistakes and not to correct their bad decisions. According to De Bondt and Thaler (1987) regret avoidance is coherent with firm size effect and book-to market effect. Firms with high book-to-market ratio effect tend to have low stock prices which make them not so favorable for investments. The same applies for small-sized firms.

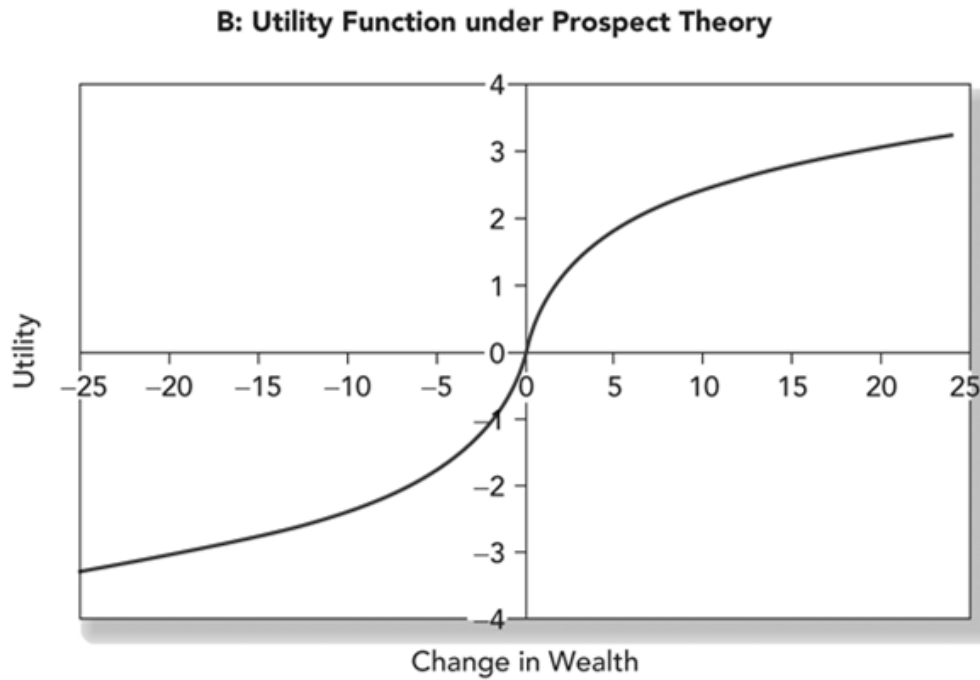
Prospect theory by Kahneman and Tversky (1979) provides another explanation of individuals' irrational decision making. The theory represents an alternative way of decision making under risk.



**Figure 6** Prospect theory. **Panel A:** Conventional Utility Function. (Source: Bodie, Z., Kane A., Marcus, A., J. (2011). *Investments and Portfolio Management*. 9. Edition.).

Figure 6, panel A describes the investors' risk-aversion. On one hand, the higher the wealth, the greater the utility, or profit, has an investor. On the other hand, the curve tends

to flatten as the wealth grows which means that gaining profit is at lowering rate and investors may become less risk-averse as wealth increases.



**Figure 6** Prospect theory. **Panel B:** Utility Function under Prospect Theory (Source: Bodie, Z., Kane A., Marcus,A., J. (2011). *Investments and Portfolio Management*. 9. Edition.).

Figure 6, panel B, shows utility function under Prospect theory. In this case, it is considered the explanation of a loss-averse investor. Utility depends on the changes in wealth from current positions. The utility function is out curved to the left of zero which makes investors rather risk oriented than risk averse with regard to losses.

### 3.2 Anomalies

According to Kuhn (1970) an anomaly can be described as a violation of the expectations, which are caused by archetypes. Anomalies are identified through empirical analyses and have formed the ground for most discoveries in the natural sciences. Anomalies are empirical difficulties that reflect differences between the observed and theoretically expected

data. In financial context, an anomaly is any deviation from the market efficiency. By studying different anomalies, many researchers have found a connection between stock prices and abnormal returns.

This subchapter outlines some of the well-known in the financial literature anomalies, as well as their main characteristics and categories.

Stracca (2004) divides anomalies according to psychological factors into five groups. The first group is represented by decision heuristics and implies decision making by using shortcuts and the rule of thumb which use mainly reflects deliberation and optimization costs. The second group includes emotions and visceral factors which hinder decision making. According to Loewenstein (2000) visceral factors include huge range of negative emotions, drive states and states of feelings that influence people's behavior. The next psychological factor is choice bracketing. Read, Loewenstein and Rabin (1996) explain choice bracketing as a concept denoting a set of individual choices where decision problems are narrowly framed. Stochastic and context-dependent preferences are included in the fourth group. In Stracca's opinion behavioral finance literature suppose that the predetermined and well-defined agent's decisions are doubtful and even false. Stochastic and context-dependent preferences are preferred. Last is the group of reference dependence. Reference dependence is related to prospect theory by Kahneman and Tversky (1979). The reference dependent model suggests that agent's preferences for consumption and other variables depend on so called "reference points". Thus, in another words, the utility function is rather defined on  $ct - zt$ , where  $z$  a reference point for the representative agent.

Lakonishok and Smidt (1988) tested whether anomalies exist and have impact on stock returns. The data used for the study was for 90-year period. What they found was that around the turn of the week, the turn of the month, the turn of the year and around holidays anomalies in returns are rising and moreover they affect share returns. It is also shown that the anomalies are reduced when they come to investors. If investors believe that they will have benefit by a certain anomaly-based portfolio, they reduce the impact of the anomaly.

### 3.2.1 January Effect anomaly

January effect is also known as turn-of-the-year effect and it is the most famous calendar anomaly. There are numerous studies examining the January effect anomaly. The first re-

search about the phenomena is the one by Watchtel (1942) who suggests that stock prices tend to rise in January due to investors' decision to buy after the year-end tax-induced sell-off. Later, in 1976 Rozeff & Kinney investigate monthly returns of the New York Stock Exchange (NYSE) for the time period 1904-1974. They discover that there is a statistically significant difference between months due to higher returns in January. The average return for January was 3,5 % which was much higher comparing to around 0,5% for the other months.

According to Bhardwaj, K. R., Brooks, D., L. (1992) the January effect is a firm size phenomenon while the paper of Seyhun (1988) examines two potential explanation of the January effect. One of the explanations states that for the small firms the positive returns in January are compensation for increased risk of trading against the informed traders. Another explanation is that the positive returns are due to "price pressure from predictable seasonal changes in demand for different securities" (Seyhun, 1988). Referring to the January effect as a firm size phenomena, Bhardwaj et al. (1992) are not the only authors supporting this characteristic of the anomaly. Most of the researches come to the conclusion that the January effect mainly originates from small firms. Lakonishok & Smidt (1988) find no statistical difference between January returns and other monthly returns of the Dow Jones Industrial Average index (DJIA), which consists of large firms. Rozeff & Kinney (1976) used equally-weighted stock index, which is simply the average of the prices of all the NYSE firms. According to Thaler (1987) this method gives higher weight to small firms' shares. Hence, January anomaly can be associated mainly to small firms.

### 3.2.2 The Other January Effect

The Other January Effect has been introduced for the first time in the 1970s in Stock Traders' Almanac publication by Yale Hirsch. Since then couple of papers focus on the Other January anomaly as an adequate tool for predicting US equity index returns. For example, Cooper, McConnell and Ovtchinnikov (2006) distinguish the Other January Effect (OJE) from the well-known January Effect anomaly by claiming that stock market returns in January can predict the returns over the following 11 months. They proof it by examining the NYSE data for the years 1940- 2003. The study by Brown and Luo (2006) has the same results over a similar data set for the time period 1941-2003.

Bohl M. and Salm Ch. (2007) examine the OJE efficiency in international markets obtaining data from 14 countries' markets covering, for most of them, the time period from Jan-

uary 1970 to December 2006. The countries subject to the research were Austria, Australia, Belgium, Canada, Denmark, France, Germany, Italy, Japan, the Netherlands, Norway, Sweden, the U. K. and the U.S. The results from the study concerning the U.S. are in favor of the OJE, similarly to the findings of Cooper et. al (2006). By observing positive and negative January market returns Cooper et. al (2006) discovered that positive January market returns are followed by rest-of-the-year returns and negative January market returns are followed by negative rest-of-the-year returns. Another research by Marshall and Visaltanachoti (2010) investigate whether the OJE can be actually used to obtain risk-adjusted risk returns, assuming the OJE to be indicator against the EMT. Consistently with previous works, their findings show that 11-month returns are higher following positive returns in January than the negative January returns. Hence, the OJE do not lead to profit of risk-adjusted excess returns.

### 3.2.3 Halloween anomaly

The Halloween or the so called “Sell-in-May or go away” effect indicates that winter returns are significantly higher than the ones in summer. “What makes the Halloween or Sell in May effect particularly interesting is that it challenges traditional economic theory, as it suggests predictably negative excess returns during summer”(Jacobsen & Zhang, 2012). Stock returns should be lower during May until September comparing to the rest of the year. The trend is to sell your stocks in May, because markets tend to go down in summer (Bouman & Jacobsen 2002). Bouman & Jacobsen (2002) formed two portfolios in their study. One of them is the so-called Halloween-strategy-based portfolio. According to it you should buy the shares at the end of October and sell them in May. Further in their research the authors compared that strategy with another strategy with the same portfolio, but it is considered to be around the whole year. The results showed that the Halloween strategy is worth more.

Maberly & Pierce (2004) extended the study of Bouman & Jacobsen (2002) by using S&P 500 stock index futures. The methodology part is developed by adding regulation for the deviations which in this case were the stock market crashes in October 1987 and August 1998 as well as the January effect. The results show that the Halloween effect decreases which prove that the January effect and the outliers in the data do not have any contribution to the “appearance” of the “Sell-in-May or go away” effect.

### 3.2.4 Day-of-the-week anomaly

Researches have shown that stocks tend to move more on Fridays than on Mondays and also that there is a bias towards positive markets performance on Fridays. Average Monday returns showed up to be positive when following positive Friday returns and highly negative after negative Friday returns. Some potential causes of this type of anomaly are settlement effects, timing of earnings announcements, measurement errors. Still they haven't been able to explain the anomaly satisfactory. (Sias & Stark, 1995). Other researchers found that the day-of-the-week anomaly means that stock returns are negative or positive regularly to days of the week compared to the average daily returns. For example it was discovered that between Fridays and Mondays returns are negative and they tend to be positive between the other days of the week. (Keim & Stambaugh, 1984). According to Keim & Stambaugh (1984) there is a relation between returns on weekend days and firm size. They found that the average returns on Friday are getting higher when the firm size is smaller. Following the "calendar time hypothesis" by French (1980) stock prices should rise more on Mondays comparing to the other days of the week. The reason for that is due to three-days-time between trading on Mondays and trading on Fridays which logically leads to the conclusion that Monday returns should be three times higher than the other days' returns because normally there is only one day interval of time between the other trading days.

### 3.2.5 Price earnings (P/E) anomaly

The predictability of abnormal returns due to the earnings announcement is one of the most significant anomalies lately in the financial markets. Price earnings (P/E) ratio describes the company's market value and the net result of the relationship. There are two possible explanations about price earnings anomalies. The first option assumes that the market is inefficient and hence the systematic mispricing allows abnormal returns to be obtained at zero costs using the earnings information. The other possible explanation about price earnings anomaly is under the assumption that the market is efficient and the abnormal returns are biased estimates of pure economic profit (Ball, 1992).

Cook & Rozeff (1984) study the P/E anomaly effect by examining data for the period 1964- 1981 for NYSE stocks. The purpose of the study is to test whether the findings, concerning price earnings ratio, of Reinganum (1981) and Basu (1983) work. According to Reinganum (1981) size and E/P effects are present separately in equity rates of return.



On the other hand, Basu (1983) had opposite to Reinganum's results i.e. "the E/P effect was significant even after controlling for size". The findings by Cook & Rozeff (1984) suggest that the both effects work.

## 4. SEASONAL AFFECTIVE DISORDER (SAD) ANOMALY

This chapter of the study presents the background of the SAD anomaly including some of its psychological and physiological aspects of the phenomenon. There are a lot of previous studies about the Seasonal Affective Disorder phenomena. Some examine the individual impact of weather conditions as whole on share prices and also the SAD effect in humans. The effect of SAD on humans is being observed mainly on people who are living far away from the equator (Rosenthal et al. 1984).

### 4.1 Introduction to SAD

“From darkness; take me unto Light.

O, God! Help me today, make my maiden flight.

From sorrow; give me the strength to break. And help me to love and to care.

From darkness take me unto Light.

O, God! Hear my prayers and let in the sunlight.”

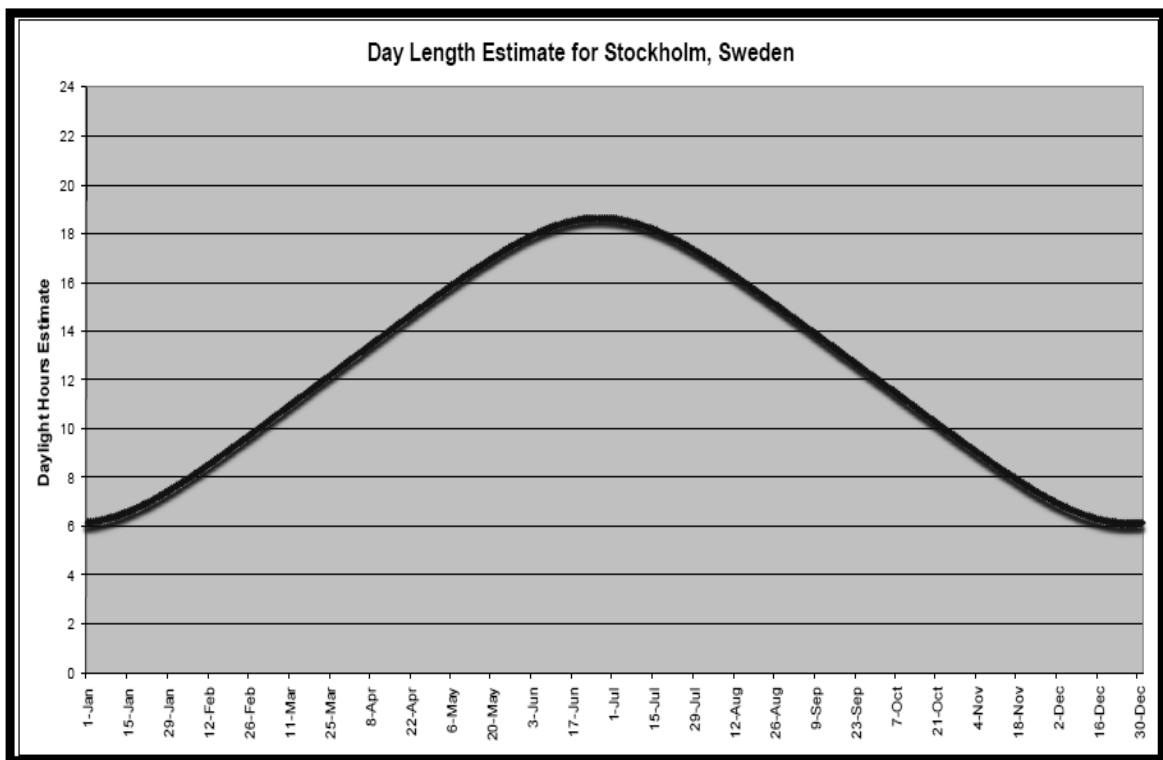
— Madhavi Sood ('From the Silence Within').

Seasonal Affective Disorder is a clinically documented condition that influenced a large number of the people around the world. According to Kamstra, Kramer & Levi (2003) SAD is a clinical defined form of depression, where “affective” means emotional. It is known also as a “winter depression” since the symptoms are more likely to occur during the winter months. Usually SAD goes along with prolonged sadness and chronic fatigue and the most common symptoms are difficulty in concentrating, loss of interest in sex, loss of energy, social withdrawal, anxiety, sleep disturbance and so on. Bagby et al. (1996) discover in SAD patients a tendency of emotional sensitivity, imagination and consideration of idiosyncratic ideas.

After positron emission topography scans (PET) some abnormalities in the prefrontal and parietal cortex areas appeared. The reason for this is the limited amount of daylight. ”For those, affected the annual onset of SAD symptoms can occur as early as September, around the time of autumn equinox.”, or also put in another words in Northern Hemisphere (Kamstra, Kramer and Levi, 2003). For countries in the Northern Hemisphere, the longest night appears on winter solstice, December 21<sup>st</sup> and the shortest night appears on

summer solstice, June 21<sup>st</sup>. The greater is the latitude north or south from the equator, the greater is the length of the night. By studying latitude, Young et al. (1997) and Molin et al. (1996) find that SAD is linked to the number of daylight, where levels of depression tend to increase with the declining of the daylight hours. The graph below roughly represents the daylight hours over a year in Stockholm, Sweden:

**Figure 7** Day Length Estimate for Stockholm, Sweden ( Source: Kihn, J. (2011). *Behavioral finance 101: cognitive financial economics*. Lexington , KY)



The average amount of daylight is close to 12.4 per day and the greater amount of sunshine is around 18.6 and it can be encountered during the summer solstice in the middle of June.

Dowling and Lucey (2008) find strong evidence that SAD influence increase with latitude. Sweden is amongst the countries which are situated farthest from the equator with extreme latitude of near 59 ° N. Kamstra et al. (2003) found that, unlike the countries situated closer to the equator, Sweden tends to have higher and more significant returns due to SAD.

On the other hand, Sweden seems to be situated a bit lower from the pole, comparing to its neighbor country Finland which has latitude of 60 ° N. Taskinen (2012) examines the SAD impact on the Finnish stock market by comparing OMX Helsinki Cap index and OMX Small Cap index. The data for the OMX Helsinki Cap index covers the time period of 1991-2010 and for the OMX Helsinki Small Cap index covers the years 2003-2010. The results from the study of Taskinen (2012) show that SAD occurrence on the Finnish stock market is weak. This finding opens a possibility, for the current research, of SAD impact comparison between Swedish and Finnish stock markets. The comparison will be reviewed in the Empirical Results chapter of the study.

Another important assumption about SAD anomaly is the psychological link between it and depression on one hand and on the other hand the link between depression and heightened risk aversion (Kihn, 2012). Further in their research Kamstra, Kramer & Levi (2003) used returns from several large stock exchanges around the world at varying latitudes and on both northern and southern hemispheres. What they found is a seasonal pattern in returns that occurs under the SAD influence. Investors tend to avoid risky assets in the fall and resume their risky holdings in the winter, which leads to returns in the fall that are lower than average and returns following the longest night of the year which are higher than average. "Although Kamstra et al. interpret their results as being due to changes in risk preferences through the year, the seasonal pattern in returns is also consistent with changes in cash flow expectations. In other words, negative abnormal returns in the fall could be due to an increase in the discount rate (often called a "denominator effect") or a decrease in expected future cash flows ("numerator effect)." Lo & Wu, (2010). Kramer & Weber (2012) study the people who suffer from SAD and their attitude towards financial risk by conducting a survey amongst randomly selected people from a large American university. The data collection used in the research was separated into three waves where the participants in the survey have to deal with a real financial risk. The results indicate that individuals who suffer from SAD tend to be more risk averse in the winter than the non-SAD-sufferers. The difference between the people affected by SAD and those who are not appear to diminish in the summer. The SAD influence on risk aversion during the winter was determined by depression.

Garret (2005) confirms that there is a significant SAD effect on stock market. Using both daily and monthly data he proved that there is a SAD impact on returns in the US, Sweden, New Zealand, the UK, Australia and Japan.

Hirsheifer (2003) examines sunshine and how it affects people's mood. During the study he found out that people are more optimistic when the weather is sunny and hence they tend to buy more stocks. However, news about sunny weather do not cause increase in the share purchasing. Only the sunshine itself makes stock prices move.

Goetzmann & Zhu (2003) investigated the effect of a cloudy day on stock prices. They found that a cloudy day does not affect the investor's willingness to buy or sell and does not cause changes in share prices. The study found that, when taking into account the exchange rate difference of mere changes of meteorological observations, meteorological observations impact on profit declined. Another study that examines the cloud cover impact on stock returns is the one by Saunders (1993). He discovered that there is a negative correlation between cloudy weather and NYSE (New York Stock Exchange) returns. Further studies on the topic about weather effect on stock returns found no positive relation between weather and stock returns. For example, Sogner and Fruhwirth (2012) found no weather impact on stock returns.

Kaplanski and Levy (2003) made a research about the seasonality in volatility risk premium sentiment (VRPS). Their findings indicate that the SAD phenomenon is positively related with the seasonality of VRPS. Another literature connects SAD with IPO. For example, Kliger (2010) examines the effect of the daylight duration on investors' mood and how it affects the IPO pricing. The finding state that during depressing photophase conditions, lower excess returns are observed.

The study of Klinger and Levy (2008) is also in support of SAD influence on markets. SAD provokes investors to deceive their probability weighting functions (PWFs).

#### 4.2 SAD anomaly based on investment strategy

Apart from behavioral finance, there are other sciences that can give more information about the economic theories and help explaining them. Neuroeconomics attempts to combine economics, psychology, biology and neuroscience in order to give further clarity about how the brain makes decisions. After all decisions are nothing more but the activity of the brain. Therefore, decision-making can be explained first by examining the brain activity by using neuroscience as a guidance tool. Neuroscience studies the nervous system. The nervous system, itself consists mainly of neurons. They are cells that are responsible for emotional and psychological response as well as for the ability of the brain to make choice. Assuming this it can be used to provide additional information about economic

theory (Camerer et al., 2005). The awareness of the SAD anomaly can be possibly helpful when forming an investment strategy that in theory can make a profit. Low returns can be observed before winter solstice while abnormally high returns can be seen following the winter solstice (Kamstra et al, 2003). According to the findings of Carton (1995) depression decreases risk seeking in such a way that individuals are more unwilling to make decisions with high level of risk. With the beginning of autumn people influenced by SAD tend to avoid risk and change their portfolios in order to support their relatively safe assets. Kamstra et al (2003) suggest that this event should be followed by abnormally high returns when the days start to be longer.

Kamstra et al (2003) study the daily percentage returns in the United States, Sweden, Britain, Germany, Canada, New Zealand, Japan, Australia and South Africa. Sweden and Australia are used to employ and compare two investment strategies based on the SAD effect. The strategy from the Swedish market is during the Northern Hemisphere's fall and winter while the Australian one is during the Southern Hemisphere's fall and winter. These investment strategies were compared with a neutral portfolio during the spring and autumn equinox. The results, after relocating the investments from fall and spring equinox to fall and winter, show 21.1 % profit which is 7.9% higher than the neutral strategy. Further, after moving the investments into the Swedish and Australian markets during the spring and summer, it was found that the annual average returns are 5.2% which is 8% less compared to the returns from the neutral strategy.

## 5. DATA

The data used in the empirical research is weather data gathered from Swedish Meteorological and Hydrological Institute and a historical data from Nordic Small Cap Index for the years 2006-2012 and Stockholm OMX 30 index for the period 2003-2012. The OMX30 Stockholm Index is a stock market weighted index for the Stockholm Stock Exchange. It consists of 30 components which represent the most traded stocks. The structure of the index is edited two times in a year. The index was established on September 30, 1986 with a base level of 125 and later on April 27, 1998 it was split in a 4-1 ([www.bloomberg.com](http://www.bloomberg.com)). In addition OMXS30 is also used for structured products, for example warrants, index bonds, exchange traded funds and other non-standardized derivatives products. The sectors within the index are based on the GICS (Global Industry Classification Standard). The most recent industry breakdown of the index is the following, starting with the industry with the highest percent share:

- Financials
- Industrials
- Consumer Services
- Technology
- Telecommunications
- Consumer Goods
- Health Care
- Basic Materials
- Oil and Gas ([www.indexes.nasdaqomx.com](http://www.indexes.nasdaqomx.com)).

### 5.1 Weather data

Previous literature studies the influence of environmental factors on market returns. Saunders (1993) and Shumway and Hirshleifer (2002) investigates the possibility that the number of sunlight hours influences human's mood and therefore also affects market returns. Moreover, Saunders (1993) uses the cloud cover measurements as the cloud cover has an influence on the amount of the hours of sunshine. Saunders (1993) finds a relation between sunshine and market returns by using a measure of cloudiness in New York City determined by organizing the degree of cloudiness into three categories: 0-30 percent; 40-70 percent; 80-100 percent. Kamstra et al. (2003) also used his method in their paper. Cloudiness measurement approach is also suitable for the current research.

Hence, the weather data includes the cloud cover, air pressure and rainfall in Stockholm for each day for the period 2003-2011 obtained from the website of the Swedish Meteorological and Hydrological Institute ([www.smhi.se](http://www.smhi.se)).

The table below represents the way of measurement of the weather events also used in the paper of Taskinen (2012). Cloud cover is measured using the scale of 0-9 where 0 stands for completely clear sky and 8-9 indicates that clouds have been observed, for example during a fog. The days of rainfall are expressed in millimeters. The air pressure is reported every day in daily average hPa (1Hpa=100Pa).

**Table 1** Measurements of weather events

| <b>Weather event</b> | <b>Scale</b> |
|----------------------|--------------|
| Cloud cover          | 0-9          |
| Air pressure         | hPa          |
| Rainfall             | mm           |

## 5.2 Stock Market Data

The stock data used in this study covers the years 2006-2012 from the Nordic Small Cap index and the years 2003-2012 from the Stockholm OMX30 Index. OMX Nordic Small Cap Index is established in 2003, so prior data is not available.

The following equation is used in order to transform the continuously compounded returns into logarithmic returns:

$$(4) \quad r_t = \log(p_t/p_{(t-1)}) \times 100$$

$R_t$  represents the daily return on the stock indices for period  $t$  and it is defined as the natural logarithm of price relative. The variables  $p_t$  and  $p_{(t-1)}$  represent price quotes of the indices at time  $t$  and  $t-1$  i.e. the price of the index of the current day and the price of the index of the preceding days. Moreover, the output of the equation is further multiplied by



one hundred thereby presenting returns in percentages. Measuring log returns instead of raw price provides the assumption that the prices are normally distributed.

**Table 2** Descriptive statistics of log returns for Nordic Small Cap Index and Stockholm OMX30 Index

|                     | <b>Stockholm OMX30</b>         | <b>Nordic Small Cap</b>       |
|---------------------|--------------------------------|-------------------------------|
|                     | <b>Index log returns</b>       | <b>Index log returns</b>      |
|                     | <b>(1.1.2003 – 31.12.2012)</b> | <b>(2.1.2006– 31.12.2012)</b> |
| <b>Mean</b>         | 0.013                          | -0.008                        |
| <b>Median</b>       | 0.012                          | 0.022                         |
| <b>Maximum</b>      | 4.284                          | 2.365                         |
| <b>Minimum</b>      | -3.263                         | -2.474                        |
| <b>Std. Dev.</b>    | 0.639                          | 0.375                         |
| <b>Skewness</b>     | 0.049                          | -0.899                        |
| <b>Kurtosis</b>     | 7.306                          | 9.789                         |
| <b>Observations</b> | 2608                           | 1825                          |

From *Table 2* it can be seen that the highest returns are found to be on Stockholm OMX30 Small Cap Index with the maximum value of 4.28 while the maximum return in Nordic Small Cap Index is almost half less 2.36. The standard deviation indicates how much the returns differentiate from the average value. The values in this case are high. Skewness describes how symmetric is the distribution. Positive skewness illustrates that the distribution is more above the mean values of the graph is inclined to the right. Negative skewness shows that the distribution is below the mean values and the graph is inclined on the left. Nordic Small Cap Index returns are negatively skewed while Stockholm OMX30 Small Cap Index returns are positively skewed. Positive kurtosis indicates that the distri-

bution of the peak is higher than the normal peak. The height of the normal peak is 0. Negative kurtosis indicates that the distribution of the peak is lower than the normal peak. Both indices have positive kurtosis.

## 6. METHODOLOGY

The methods used for examining the SAD phenomena are regression analysis and GARCH model. The aim of the regression analysis is to determine impact of SAD on the stock returns. Regression analysis is a statistical method which enables dependency on explanatory variables. And with testing the GARCH model it can be shown whether SAD anomaly is causing changes in the volatility of shares or at risk.

In this study the following regression equation by Kamstra et al. (2003) is used to determine the SAD impact on stock returns:

$$(5) \quad R_t = \mu + p_1 r_{t-1} + p_2 r_{t-2} + \mu_{SAD} SAD_t + \mu_{Autumn} D_t^{autumn} + \mu_{monday} D_t^{monday} + \mu_{tax} D_t^{tax} + \mu_{cloudcover} Cloudcover_t + \mu_{precipitation} Air\ pressure_t + \mu_{rainfall} Rainfall_t + \varepsilon_t$$

Where:

$R_t$  – Stock Index of the logarithmic return date

$p_1 r_{t-1} + p_2 r_{t-2}$  - lagged returns (from the last two days of stock returns)

$SAD_t$  - SAD variable

$D_t^{autumn}$  -autumn dummy

$D_t^{monday}$  -Monday dummy

$\mu_{tax} D_t^{tax}$  -tax dummy

$Cloudcover_t$  -cloud cover situation

$Air\ pressure_t$  - Air pressure

$Rainfall_t$  - Rainfall situation

$\varepsilon_t$  – error term

The significance of the regression results is based on t-test. The explanatory variables in the regression model are described in the following sections:

### Weather variables

Weather observations include the cloud cover situation, barometric pressure and rainfall every day. Air pressure may have positive effect, because weather is better when the air pressure is higher. Cloud cover is proved to be positively correlated with daily stock returns (Joshi & Bhattarai, 2007).

### Lagged returns

This study uses two lagged returns to describe logarithmic daily returns from the previous and next to last day of observation. The purpose of using lagged returns is to reduce the impact of large individual variations in shareholder's value which can distort the results.

### SAD-variable

Concerning the SAD-phenomenon, previous studies have proved that equity returns during the shortest days in winter solstice or the autumnal equinox cause the stock to lower income levels below the annual average. Following the winter solstice the income level tends to rise higher than the annual average thus we can observe abnormally high returns for investors who hold the same portfolio of autumnal equinox during that period, including the ones affected by SAD (Kamstra et. 2003).

SAD variable is defined as follows, using the model of Kamstra, M., L. Kramer & M. Levi (2003):

$$(6) \quad SAD_t = \begin{cases} H_t - 12 & \text{for trading days in the fall and winter} \\ 0 & \text{otherwise.} \end{cases}$$

$H_t$  describes the time from sunset to sunrise hours. The SAD measure equals zero at fall equinox (September 21) and spring equinox (March 20) and it can take only positive or negative values during winter and summer. Autumnal equinox at the time of the SAD variable has the value zero, since the day and night are then of equal length. On the winter solstice (December 12) the SAD variable in Sweden reaches its peak of +6 and equals to 0 during the spring and summer (Kamstra et al., 2003).  $H_t$ , the number of hours of night, is calculated by estimating on the first place the sun's declination angle  $\lambda t$ , using the formula given in the paper of Kasmtra (2003):

$$(7) \quad \lambda_t = 0.4102 \times \sin \left[ \left( \frac{2\pi}{365} \right) (julian_t - 80.25) \right],$$

where  $julian_t$  is a variable that represents the number of the day in the year and ranges from 1 to 365 or 366 in a leap year. For example  $julian_t$  equals to 1 for January 1, 2 for January 2, 3 for January 3 and so on. After that  $H_t$  can be simply estimated as using the equation for the countries situated in the Northern Hemisphere (as Sweden is situated in the Northern Hemisphere):

$$(8) \quad H_t = 24 - 7.72 \times \arccos[-\tan(2\pi\delta|360) \times \tan(\lambda_t)],$$

where  $\delta$  is the latitude which in this case for Sweden is equal to 59 and arcs is the trigonometry function arc cosine.

### Dummy variables

Following the paper of Taskinen (2012), the dummy variables used in the regression model as well as the time duration taken for each of them are shown in the table below:

**Table 3** Dummy variables duration

| Dummy variables | Duration  |
|-----------------|---|
| Autumn-dummy    | Autumnal equinox-winter solstice<br>(22.09-21.12) |
| Monday-dummy    | First day of the week                             |
| Tax-dummy       | 26.12-7.1 annually                                |

The autumn-dummy is included in the regression model in order to differentiate the impact of SAD in the autumn from the SAD in the winter. For that purpose the autumn dummy is equal to one for trading days in the fall and zero otherwise Kamstra et al. (2003):

$$(9) \quad D_t^{autumn} = \begin{cases} 1 & \text{for trading days in the fall} \\ 0 & \text{for the rest of the days} \end{cases}$$

Usually tax-loss effect can be observed in January in Northern Hemisphere and in July in Southern hemisphere along with the SAD effect. While studying the possible SAD effect

on the stock market in several countries, Kamstra et al (2003) found statistically significant tax-loss selling effect. Since the current study is focused on the Swedish stock market, the possible tax-loss effect can be eventually expected to be in January.

It is important for the study to note the duration of the fall and winter period for the Northern Hemisphere. According to the assumptions of Kamstra (2003) the fall and winter last from September 21 to March 20.

The opinions about Monday effect as part of the day-of-the-week effect are quite controversial. According to theory abnormal returns on Mondays are associated with high abnormal returns. However, empirical researches show that the returns on Monday are negatively related to the Monday volume changes (Lakonishok and Maberly, 1990).

### 6.1 GARCH Model

The GARCH model is used in this study in order to show whether SAD anomaly has an impact on shares volatility or on the level of risk. If SAD raises the shares volatility that means the return volatility increases too and hence the shares will be riskier.

The model was introduced by Engle (1982) and Bollerslev (1986) and it is a form of Autoregressive Conditional Heteroskedasticity (ARCH) model which is designed for capturing volatility clustering and modeling the behavior of financial data (Alexander, C., 2008; Pagan, 1996).

The GARCH model has the following form:

$$(10) \quad h_t = \alpha_0 + \alpha_1 u_{t-1}^2 + \beta h_{t-1},$$

where :

$\alpha_0$  is assumed to be positive ( $\alpha_0 > 0$ )

$\beta$  is the persistence of the volatility and  $0 < \alpha + \beta < 1$

$\alpha_1$  is the coefficient of the lagged square residual  $u_{t-1}^2$

$h_{t-1}$  represents the historical volatility

The model is quite helpful in dealing with the autocorrelation and heteroskedasticity matters (Connolly, 1989). The autocorrelation can lead to systematic errors in parameters es-

timates and in order to avoid this is good to make sure that there is no autocorrelations present in the data.

According to Engle (2001) GARCH model considers heteroskedasticity as a variance to be formed, not as a problem. When variance is unknown in advance, ARCH and GARCH models are justified.

## 6.2 Hypotheses and levels of significance

Based on the previous literature the main research problem in the current study is whether SAD effect exists in the Swedish stock market. Hence, the hypotheses will be the following:

H0: Seasonal Affective Disorder anomaly does not affect stock returns.

H1: Seasonal Affective Disorder anomaly affects stocks returns.

The null hypothesis is based on the Efficient Market Theory (EMT). Accepting the null hypothesis would mean that market did not react to anomalies and market prices react fast to new information.

The level of significance, or significance level, describes the probability of rejecting the null hypothesis if the value stated in null hypothesis were true.

The study uses the following levels of significance:

5% of the results are statistically significant if P-value  $< 0.05$ .

1% of the results are statistically significant if P-value  $< 0.01$ .

10% of the results are statistically significant if P-value  $< 0.001$ .

If the p-value is less than the selected probability (level of significance) then the null hypothesis will be rejected in favor of the alternative hypothesis.

## 7. EMPIRICAL RESULTS

This chapter examines the results of the thesis. The results are separated into three sub-chapters. The first one considers the results concerning the possible SAD effect on the Swedish stock market and also looks at whether the weather variables, such as cloud situation, air pressure and rainfall on equity returns have impact on the results. In the second subchapter displays the results conducted with the GARCH model. The third subchapter compares the results of the current study with the results from previous literature.

### 7.1 Market index results

Following the methodology developed by Kamstra & Kramer (2003) are obtained results for the Stockholm OMX30 index that can be summarized in the following table:

**Table 4** Regression analysis results of the Stockholm OMX30 index

| Variable           | Coefficient | Std. Error            | t-Statistic | Prob. |
|--------------------|-------------|-----------------------|-------------|-------|
| C                  | 0.112       | 0.313                 | 0.357       | 0.721 |
| LAG1RT_SOMX        | -0.031      | 0.021                 | -1.493      | 0.136 |
| LAG2RT_SOMX        | -0.054      | 0.021                 | -2.602      | 0.009 |
| MONDAY             | -0.015      | 0.034                 | -0.450      | 0.653 |
| AUTUMN             | 0.009       | 0.038                 | 0.229       | 0.819 |
| SAD                | -0.003      | 0.008                 | -0.390      | 0.697 |
| TAX                | 0.038       | 0.084                 | 0.448       | 0.655 |
| AIR PRESSURE       | -9.13E      | 0.000                 | -0.294      | 0.769 |
| PRECIPITATION      | 0.0001      | 0.000                 | 0.171       | 0.864 |
| TOTAL CLOUD AMOUNT | -0.0004     | 0.000                 | -0.729      | 0.466 |
| R-squared          | 0.004       | Mean dependent var    |             | 0.012 |
| Adjusted R-squared | 0.000       | S.D. dependent var    |             | 0.647 |
| S.E. of regression | 0.646       | Akaike info criterion |             | 1.969 |
| Sum squared resid  | 951.01      | Schwarz criterion     |             | 1.995 |
| Log likelihood     | -2241.24    | Hannan-Quinn criter.  |             | 1.979 |
| F-statistic        | 1.092       | Durbin-Watson stat    |             | 2.001 |
| Prob.(F-statistic) | 0.365       |                       |             |       |



The displayed results indicate no statistical significance for any of the variables including the SAD variable. A positive and statistically significant coefficient of the SAD dummy would be evidence that the SAD anomaly exists on the Stockholm OMX30 stock market. Unfortunately, the results show that SAD coefficient is negative and statistically insignificant. Hence, SAD phenomenon does not affect the income of the stock returns on the Swedish stock market. Weather factors such as air pressure, precipitation and cloud cover appear not to have an impact on the Stockholm OMX30 market returns neither. Taking into consideration the results above, the null hypothesis ( $H_0$ ) is accepted i.e. Seasonal Affective Disorder (SAD) does not affect equity returns on Stockholm OMX30 Index.

For each index in the current study is introduced a data which consists of the average annual returns due to a SAD measure. For computing the SAD measure it is used the method developed by Kamstra & Kramer (2003). According to the method the first thing that has to be calculated is the value of the SAD variable for each trading day. This calculation is possible by using the explained in the previous chapter formula for the SAD variable  $SAD_t = H_t - 12$  (see p.44). After that the derived values are multiplied by index's SAD variable estimate that can be found in the Table 4 and Table 6 respectively for Stockholm OMX30 Index and Nordic Small Cap Index.

**Table 5** Average Annual Percentage Return Due to SAD

| <b>Index</b>     | <b>Annual Return due to SAD</b> | <b>Unconditional Return</b> |
|------------------|---------------------------------|-----------------------------|
| Stockholm OMX30  | -0.54                           | 3.59                        |
| Nordic Small Cap | 0.53                            | -2.21                       |

Table 5 comes upon interesting results. The annualized return due to SAD for Stockholm OMX30 is negative with a higher unconditional return, whereas the returns for the Nordic Small Cap index differs significantly- a positive annual return and a negative unconditional return. Overall combined, it seems that the average annual return due to SAD in Sweden is negative.

Table 6 provides the results from the regression equation for the Nordic Small Cap index returns. OMX Nordic Small Cap index returns from the period of autumn equinox- winter solstice are 4.9 % lower than the average returns. SAD estimate is again statistically insignificant. Monday dummy and tax dummy appear to be statistically significant at 5 % level of significance. The Monday- dummy estimate is significantly negative which means that the first-day-of-the-week returns are with 6.3% lower than the average returns. Tax – dummy is positively significant which shows that at the end of the year, during tax time, the returns are with 13.4% higher than normal. The weather factors i.e. air pressure, precipitation and cloud cover are statistically insignificant, and hence they have no impact on the index returns.

**Table 6** Regression analysis results of the Nordic Small Cap Index

| Variable           | Coefficient | Std. Error            | t-Statistic | Prob.   |
|--------------------|-------------|-----------------------|-------------|---------|
| C                  | 0.037       | 0.191                 | 0.193       | 0.847   |
| LAG1RT_NOMX        | 0.138       | 0.026                 | 5.329       | 0.000   |
| LAG2RT_NOMX        | 0.071       | 0.026                 | 2.733       | 0.006   |
| SAD                | 0.003       | 0.006                 | 0.530       | 0.596   |
| AUTUMN             | -0.049      | 0.029                 | -1.748      | 0.081*  |
| MONDAY             | -0.063      | 0.025                 | -2.528      | 0.012** |
| TAX                | 0.134       | 0.064                 | 2.116       | 0.035** |
| AIR PRESSURE       | -2.90E      | 0.000                 | -0.153      | 0.878   |
| PRECIPITATION      | -0.004      | 0.004                 | -1.144      | 0.253   |
| TOTAL CLOUD AMOUNT | -0.000      | 0.000                 | -0.793      | 0.428   |
| R-squared          | 0.043       | Mean dependent var    |             | -0.011  |
| Adjusted R-squared | 0.038       | S.D. dependent var    |             | 0.396   |
| S.E. of regression | 0.389       | Akaike info criterion |             | 0.954   |
| Sum squared resid  | 225.46      | Schwarz criterion     |             | 0.989   |
| Log likelihood     | -707.03     | Hannan-Quinn criter.  |             | 0.967   |
| F-statistic        | 7.525       | Durbin-Watson stat    |             | 2.004   |
| Prob(F-statistic)  | 0.000       |                       |             |         |

\*, \*\* and \*\*\* stand for statistical significance at 10%, 5% and 1% levels.

F-statistics tells about joint hypothesis of independent variables. In another words explained, the F-test describes whether the independent variables collectively can influence

the dependent variable. As a rule if prob. (F-statistic) is less than 5%, then it is significant. In Table 6 F test-statistics appear to be highly significant, because the p-value is 0 which is less than 5%. Thus, all together the independent variables have an impact on the Nordic Small Cap index returns. This will mean that SAD phenomenon has a small impact on the market returns of Nordic Small Cap index. It means that the null hypothesis is rejected which automatically make it to accept the alternative hypothesis ( $H_1$ ), i.e. Seasonal Affective Disorder anomaly affects stocks returns.

R-squared explains how much the independent variables can mutually affect the dependent variables. In this case R-squared indicates 4.3% variation in the Nordic Small Cap index returns which means that the influence of the independent variables all together is small (only 4.3%).

## 7.2 Testing for January effect

January effect anomaly is characterized by higher stock returns during the first month of the year. Since the winter blues is characterized by higher returns during winter and fall, it can be also concluded that the SAD anomaly captures different impacts over the months including the effect on returns in January. Furthermore, Kamstra & Kramer (2003) found evidence for the SAD responsibility for the January effect. This subchapter extends the current research by adding to the regression equation a January dummy variable. The new regression equation has the following form:

$$(11) R_t = \mu + p_1 r_{t-1} + p_2 r_{t-2} + \mu_{SAD} SAD_t + \mu_{January} January_t + \mu_{Autumn} D_t^{autumn} \\ + \mu_{monday} D_t^{monday} + \mu_{tax} D_t^{tax} + \mu_{cloudcover} Cloudcover_t \\ + \mu_{precipitation} Air\ pressure_t + \mu_{rainfall} Rainfall_t + \varepsilon_t$$

The January variable is set to be equal to 1 whenever month t is January and 0 otherwise. Therefore, the inclusion of the January criterion should detect a possible January effect.

Table 6 provides the results for the January effect testing on the Stockholm OMX30 index. The January dummy variable probability is statistically insignificant which indicates the absence of the anomaly on the index stock market. That is completely normal, taking into the account the fact that SAD has not have an impact on the stock market either.

**Table 7** Testing for January effect on the Stockholm OMX30 index.

| Variable           | Coefficient | Std. Error            | t-Statistic | Prob. |
|--------------------|-------------|-----------------------|-------------|-------|
| C                  | 0.118       | 0.313                 | 0.376       | 0.707 |
| LAG1RT_SOMX        | -0.032      | 0.021                 | -1.549      | 0.122 |
| LAG2RT_SOMX        | -0.056      | 0.021                 | -2.657      | 0.008 |
| SAD                | 0.005       | 0.009                 | 0.543       | 0.587 |
| JANUARY            | -0.094      | 0.063                 | -1.505      | 0.132 |
| MONDAY             | -0.015      | 0.034                 | -0.444      | 0.657 |
| AUTUMN             | -0.021      | 0.043                 | -0.497      | 0.619 |
| AIR PRESSURE       | -9.62E      | 0.000                 | -0.309      | 0.757 |
| TAX                | 0.041       | 0.084                 | 0.492       | 0.623 |
| PRECIPITATION      | 0.000       | 0.001                 | 0.229       | 0.819 |
| TOTAL CLOUD AMOUNT | -0.000      | 0.001                 | -0.717      | 0.473 |
| R-squared          | 0.005       | Mean dependent var    |             | 0.012 |
| Adjusted R-squared | 0.001       | S.D. dependent var    |             | 0.647 |
| S.E. of regression | 0.646       | Akaike info criterion |             | 1.969 |
| Sum squared resid  | 950.06      | Schwarz criterion     |             | 1.997 |
| Log likelihood     | -2240.11    | Hannan-Quinn criter.  |             | 1.979 |
| F-statistic        | 1.210       | Durbin-Watson stat    |             | 2.001 |
| Prob.(F-statistic) | 0.279       |                       |             |       |

The results represented in table 8 suggest that the January effect is not present either on the Nordic Small Cap stock market.

**Table 8** Testing for January effect on the Nordic Small Cap index.

| Variable           | Coefficient | Std. Error            | t-Statistic | Prob.  |
|--------------------|-------------|-----------------------|-------------|--------|
| C                  | 0.037       | 0.191                 | 0.191       | 0.848  |
| LAG1RT_NOMX        | 0.137       | 0.026                 | 5.326       | 0.000  |
| LAG2RT_NOMX        | 0.071       | 0.026                 | 2.729       | 0.006  |
| SAD                | 0.002       | 0.007                 | 0.309       | 0.757  |
| JANUARY            | 0.009       | 0.047                 | 0.211       | 0.833  |
| MONDAY             | -0.063      | 0.025                 | -2.528      | 0.012  |
| AUTUMN             | -0.047      | 0.032                 | -1.451      | 0.147  |
| AIR PRESSURE       | -2.88E      | 0.000                 | -0.152      | 0.879  |
| TAX                | 0.134       | 0.064                 | 2.106       | 0.035  |
| PRECIPITATION      | -0.004      | 0.004                 | -1.150      | 0.250  |
| TOTAL CLOUD AMOUNT | -0.000      | 0.000                 | -0.795      | 0.427  |
| R-squared          | 0.043       | Mean dependent var    |             | -0.011 |
| Adjusted R-squared | 0.037       | S.D. dependent var    |             | 0.396  |
| S.E. of regression | 0.389       | Akaike info criterion |             | 0.955  |
| Sum squared resid  | 225.46      | Schwarz criterion     |             | 0.994  |
| Log likelihood     | -707.01     | Hannan-Quinn criter.  |             | 0.969  |
| F-statistic        | 6.773       | Durbin-Watson stat    |             | 2.002  |
| Prob(F-statistic)  | 0.000       |                       |             |        |

### 7.3 GARCH model results

The following subchapter provides the results from the volatility testing with GARCH model. Before examining the results from the GARCH model test, the autocorrelation between the time series residuals have been tested. The results are displayed below in tables.

**Table 9** Autocorrelation test between the residuals for Stockholm OMX30 index

| Autocorrelation | Partial Correlation | AC       | PAC    | Q-Stat | Prob. |
|-----------------|---------------------|----------|--------|--------|-------|
|                 |                     | 1 -0.002 | -0.002 | 0.0074 | 0.932 |
|                 |                     | 2 -0.001 | -0.001 | 0.0108 | 0.995 |
|                 |                     | 3 -0.048 | -0.048 | 5.3213 | 0.150 |
|                 |                     | 4 0.014  | 0.014  | 5.7586 | 0.218 |
|                 |                     | 5 -0.056 | -0.057 | 13.027 | 0.023 |
|                 |                     | 6 -0.018 | -0.020 | 13.739 | 0.033 |
|                 |                     | 7 -0.020 | -0.019 | 14.657 | 0.041 |
|                 |                     | 8 -0.005 | -0.011 | 14.714 | 0.065 |

Table 9 represents whether there is a serial correlation (autocorrelation) between residuals for Stockholm OMX30 index. The table takes into account eight delays. It shows that three delays of autocorrelation are detected to be significant - 2.3%, 3.3% and 4.1%, all less than 5%. However, this not causes significant deviations from the results. The results indicate that there is no autocorrelation between the error terms i.e. residuals. The Breusch-Godfrey Serial Correlation LM test in Table 9 below confirms it. The probability is 15.2% which is more than 5%.

**Table 10** Breusch-Godfrey Serial Correlation LM Test for Stockholm OMX30 Index

|                |       |                     |       |
|----------------|-------|---------------------|-------|
| F-statistic    | 2.043 | Prob. F(1,2275)     | 0.153 |
| Obs.*R-squared | 2.051 | Prob. Chi-Square(1) | 0.152 |

One condition to find out if GARCH model is appropriate to be used is to check whether there is an ARCH effect observed. Table 10 represents the results from the conducted testing for serial correlation between squared residuals of errors for the Stockholm OMX30 index. If the errors happen to be significant, that will be an evidence for heteroskedasticity i.e. the variance of the squared residuals is not constant.

**Table 11** ARCH effect results on Stockholm OMX30 index returns.

| Autocorrelation | Partial Correlation | AC      | PAC    | Q-Stat | Prob. |
|-----------------|---------------------|---------|--------|--------|-------|
| *               | *                   | 1 0.191 | 0.191  | 83.464 | 0.000 |
| *               | *                   | 2 0.207 | 0.177  | 181.47 | 0.000 |
| **              | **                  | 3 0.276 | 0.225  | 355.97 | 0.000 |
| *               | *                   | 4 0.191 | 0.097  | 439.35 | 0.000 |
| **              | *                   | 5 0.281 | 0.188  | 620.76 | 0.000 |
| *               | *                   | 6 0.211 | 0.080  | 723.04 | 0.000 |
| *               |                     | 7 0.161 | 0.023  | 782.64 | 0.000 |
| *               |                     | 8 0.152 | -0.007 | 835.45 | 0.000 |

The results provide a significant p-value of 0 for all of the lags which means that there is an auto correlation between the squared residuals. Since the values are statistically significant it means that there is heteroskedasticity. Thus, the conclusion that can be made is that ARCH effect is present on the Stockholm OMX30 index and GARCH model is suitable to be performed.

Table 12 shows the GARCH test results for Stockholm OMX30 index returns. As it can be seen from the table, none of the variables affect the share volatility of the index. The results from the variance equation show that SAD and Autumn dummies do not affect the volatility of the index. Therefore, SAD does not have impact on the level of risk on Stockholm OMX30 index returns.

Table 13 provides results concerning the serial correlation test between the residuals for the Nordic Small Cap index. The results indicate that there is no autocorrelation between the residuals for the above mentioned market index since there is no statistical significance. None of the eight delays shows values less than 5% in order to be classified as statistically significant.

**Table 12** GARCH model results for the Stockholm OMX30 index returns.

| Variable           | Coefficient | Std. Error         | z-Statistic | Prob. |
|--------------------|-------------|--------------------|-------------|-------|
| C                  | 0.253       | 0.529              | 0.477       | 0.634 |
| SAD                | -0.003      | 0.005              | -0.612      | 0.541 |
| AUTUMN             | 0.026       | 0.026              | 1.003       | 0.316 |
| MONDAY             | -0.039      | 0.024              | -1.600      | 0.109 |
| TAX                | 0.056       | 0.052              | 1.081       | 0.279 |
| PRECIPITATION      | 0.000       | 0.002              | 0.127       | 0.899 |
| AIR PRESSURE       | -0.000      | 0.001              | -0.398      | 0.691 |
| TOTAL CLOUD AMOUNT | -0.001      | 0.002              | -0.384      | 0.701 |
| Variance Equation  |             |                    |             |       |
| RESID(-1)^2        | 0.083       | 0.008              | 9.888       | 0.000 |
| GARCH(-1)          | 0.906       | 0.009              | 102.3       | 0.000 |
| SAD                | -0.000      | 0.000              | -0.960      | 0.337 |
| AUTUMN             | -0.002      | 0.001              | -1.411      | 0.158 |
| R-squared          | -0.001      | Mean dependent var |             | 0.013 |
| Adjusted R-squared | -0.004      | S.D. dependent var |             | 0.647 |

**Table 13** Autocorrelation test between the residuals for Nordic Small Cap Index

| Autocorrelation | Partial Correlation | AC | PAC    | Q-Stat | Prob.  |       |
|-----------------|---------------------|----|--------|--------|--------|-------|
|                 |                     | 1  | -0.001 | -0.001 | 0.0023 | 0.962 |
|                 |                     | 2  | -0.007 | -0.007 | 0.0764 | 0.962 |
|                 |                     | 3  | 0.021  | 0.021  | 0.7231 | 0.868 |
|                 |                     | 4  | 0.041  | 0.041  | 3.2163 | 0.522 |
|                 |                     | 5  | -0.019 | -0.019 | 3.7787 | 0.582 |
|                 |                     | 6  | 0.005  | 0.005  | 3.8146 | 0.702 |
|                 |                     | 7  | 0.024  | 0.023  | 4.7201 | 0.694 |
|                 |                     | 8  | 0.040  | 0.040  | 7.1811 | 0.517 |



The further serial correlation test, or Breusch-Godfrey Serial Correlation LM Test (see Table 14), shows that the probability is 64.38% which is much more than the 5% level of significance. That only proves the fact that there is no autocorrelation between the residuals for the examined index.

**Table 14** Breusch-Godfrey Serial Correlation LM Test for Nordic Small Cap Index

|                |       |                     |       |
|----------------|-------|---------------------|-------|
| F-statistic    | 0.212 | Prob. F(1,1492)     | 0.645 |
| Obs.*R-squared | 0.214 | Prob. Chi-Square(1) | 0.644 |

Table 15 below displays the results from the serial correlations testing between squared residuals on the Nordic Small Cap index returns. The probability values are all significant and Q-statistics values are large. In this case there is a strong autocorrelation between the residuals and ARCH effect is present. Therefore, GARCH model will be appropriate to be used.

**Table 15** ARCH effect results on the Nordic Small Cap index returns.

| Autocorrelation | Partial Correlation | AC      | PAC    | Q-Stat | Prob. |
|-----------------|---------------------|---------|--------|--------|-------|
| ***             | ***                 | 1 0.307 | 0.307  | 142.22 | 0.000 |
| ***             | ***                 | 2 0.291 | 0.217  | 269.92 | 0.000 |
| ***             | *                   | 3 0.278 | 0.163  | 386.22 | 0.000 |
| *               |                     | 4 0.134 | -0.030 | 413.12 | 0.000 |
| *               | *                   | 5 0.213 | 0.112  | 481.65 | 0.000 |
| *               |                     | 6 0.094 | -0.040 | 495.03 | 0.000 |
| *               |                     | 7 0.144 | 0.071  | 526.25 | 0.000 |
| *               |                     | 8 0.137 | 0.035  | 554.60 | 0.000 |

**Table 16** GARCH model results for the Nordic Small Cap index returns.

| Variable           | Coefficient | Std. Error         | z-Statistic | Prob.  |
|--------------------|-------------|--------------------|-------------|--------|
| C                  | 0.044       | 0.404              | 0.109       | 0.913  |
| SAD                | 0.002       | 0.005              | 0.493       | 0.622  |
| AUTUMN             | -0.005      | 0.022              | -0.231      | 0.818  |
| MONDAY             | -0.052      | 0.015              | -3.351      | 0.001  |
| TAX                | 0.179       | 0.043              | 4.144       | 0.000  |
| PRECIPITATION      | -0.001      | 0.004              | -0.279      | 0.779  |
| AIR PRESSURE       | -5.74E      | 0.000              | -0.014      | 0.989  |
| TOTAL CLOUD AMOUNT | -0.000      | 0.002              | -0.212      | 0.832  |
| Variance Equation  |             |                    |             |        |
| RESID(-1)^2        | 0.199       | 0.018              | 10.84       | 0.000  |
| GARCH(-1)          | 0.778       | 0.016              | 47.81       | 0.000  |
| SAD                | 0.000       | 0.000              | 1.923       | 0.054  |
| AUTUMN             | -0.003      | 0.001              | -2.253      | 0.024  |
| R-squared          | 0.001       | Mean dependent var |             | -0.010 |
| Adjusted R-squared | -0.004      | S.D. dependent var |             | 0.396  |

Table 16 provides the results from the GARCH model test for the Nordic Small Cap index returns. The regression equation results show that Monday and Tax variables are statistically significant. It means that both Monday effect and tax effect have influence on the Nordic Small Cap index shares volatility. Tax arrangements in the end of the year causes a change in the volatility, which increases the index returns with 17.9%. First-day- of- the – week effect lead to change in the share volatility, which decreases the index returns with 5.1%. The variance regression results show statistically significant values for both SAD and Autumn dummies. SAD anomaly is statistically significant at 10% level of significance and Autumn dummy has a stronger significance at 5 %. The last mentioned means that SAD phenomenon has an influence on the Nordic Small Cap index share volatility also during the autumn. In the autumn the conditional volatility is 0.2% lower than other times. In this case, the equity risk is slightly lower during the autumn.

#### 7.4 Comparison with previous literature results

The results from the current research are going to be compared mainly with two previous researches on the SAD anomaly impact on the stock market- the one by Kamstra et al. (2003) and the study by Taskinen (2012). As it was mentioned in previous chapters of the current study, Kamstra et al. (2003) investigate the SAD phenomenon influence on different indices returns from nine countries including Sweden. The results for Sweden suggest that the annualized return due to SAD is positive and statistically significant which means that the SAD anomaly has an influence on the Swedish stock market. The findings from the current research indicate that SAD has a small impact on the Swedish stock market.

Taskinen (2012) conducts a research about SAD anomaly effect on the Finnish stock market by studying OMX Helsinki Cap index for the period 1991-2010 and OMX Helsinki Small Cap for the period 2003-2010. Since Finland and Sweden are Nordic countries and have always been competing with each other, it is suitable for the current study to compare the SAD effect results on the stock market for both countries. The findings about SAD anomaly impact on the Finnish stock market suggest that SAD phenomenon slightly affects the stock market in Finland. The evidence indicates that during the period from the autumnal equinox to winter solstice OMX Small Cap index returns are slightly lower than the annual average returns. Moreover, the SAD phenomenon did not appear to have a statistically significant impact on the mentioned indices stock shares for the interval from the autumnal equinox to the spring equinox. However, these outcomes do not differentiate from the ones which the current study obtained. In fact they are the same i.e. during autumnal equinox-winter solstice the Nordic Small Cap index returns have slightly lower values than normal. When it comes to the weather variables such as rain, cloud cover situation and air pressure- they had no influence on OMX Helsinki Cap and OMX Small Cap equity returns either. In comparison with this finding, the outcomes for Stockholm OMX30 Small Cap index and Nordic Small Cap index are the same i.e. there is no impact of air pressure, cloud cover or precipitation on the equity returns. The GARCH model results for the OMX Helsinki Cap index show that volatility is somewhat higher than usual while the shares of OMX Small Cap Index were not affected in a matter of risk. Concerning the GARCH model results from the current study, on one hand, SAD does not have an impact on the level of risk on the Stockholm OMX30 index. On the other hand, tax arrangements in the end of the year lead to higher risk returns on the Nordic Small Cap index. The Monday effect appears to also influence share volatility. Risk returns on the Nor-

dic Small Cap index are lower during each first day of the week. Moreover, the variance regression results indicate that SAD phenomenon has a slight impact also during the autumn where it appears that the level of risk is somewhat lower than usual.

Taking into account both the findings provided by the paper of Taskinen (2012) and the results from the present study it can be concluded that both Finnish and Swedish stock markets are similarly affected by SAD phenomenon.

## 8. SUMMARY AND CONCLUSION

This paper examines whether the Seasonal Affective Disorder (SAD) anomaly has an effect on the Swedish stock market by studying market returns from Nordic Small Cap Index for the period 2006-2012 and Stockholm OMX 30 index for the years 2003-2012. This study investigated also the influence of the following weather factors: air pressure, cloud cover and precipitation on the market returns.

As a whole, the results indicate that the SAD phenomenon has a small impact on the Swedish stock returns. The regression results for the Stockholm OMX30 index display no present SAD effect on the index returns, but the results for the Nordic Small Cap index provide different evidence. In fact, they are a little more encouraging by claiming that SAD has a slight impact on the Nordic Small Cap equity returns. The returns during the period from the autumnal equinox until the winter solstice are 4.9 % lower than usual. Besides that, Monday and tax dummies for the same index appear to be statistically significant. The returns on the first day of the week are 6.3% lower than during the other days of the week. At the end of the year, during tax time, the returns for the same index appear to be 13.4% higher than the average returns. Concerning the weather variables, the findings show that none of the climate factors has an influence on the indices stock returns. The outcomes from the additional investigation concerning the January effect existence suggest that there is no January effect on the Swedish market.

The results related to volatility show that SAD does not have an impact on the level of risk for the Stockholm OMX30 index. However, the GARCH results for the Nordic Small Cap index are different. The findings reveal changes in the risk returns due to Monday effect and tax arrangements at the end of the year. According to the GARCH test results, dealing with the tax causes a change in the index volatility that leads to an increase in the returns of 17.9%, while the Monday effect on the risk returns is expressed in a decrease of 5.1%. During autumn, the conditional share volatility is only 0.2% lower than the average. Related to the conditional equity volatility, SAD is also statistically significant and hence it has a slight impact on the level of risk.

Some previous researches on the subject have similar results i.e. SAD has a small impact on the stock returns in Sweden. Comparing to another Nordic country, indeed in particular with Finland, it turns out that both countries obtain somewhat similar results. Both Finland and Sweden are SAD affected to some degree.

### 8.1 Suggestions for further research

This paper confirms the limited influence of the SAD anomaly on the Swedish stock market. It also investigated the influence of the weather parameters such as air pressure, rainfall and cloud cover and it proved that they do not have any impact on the stock market. The paper also includes the Monday effect and January effect impact, but does not contain a Halloween anomaly variable. The research on the current topic can be extended by investigating the possible Halloween anomaly effect with combination with SAD and January effect on the Swedish stock market and compare it with the eventual impact of the mentioned seasonal anomalies on the Scandinavian countries as a whole.

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