

# Overnight Return on the Norwegian Stock Exchange

A study of 15 stocks with the highest turnover over the period of 2003 to 2014 on Oslo Stock Exchange.

**Henrik Fjeldheim Amundsen**

**Joachim Holm Bryhn**

**Supervisor**

Steen Koekebakker

*This master's thesis is carried out as a part of the education at the University of Agder and is therefore approved as a part of this education. However, this does not imply that the University answers for the methods that are used or the conclusions that are drawn.*

University of Agder, 2015

School of Business and Law

Department of Economics and Finance

## **Preface**

This paper is written as a final assignment of our MSc in Finance at University of Agder. During this work, we have used knowledge and experience, accumulated over our period at the institution. Our personal level of knowledge has increased throughout the experience, through extensive work on the problem at hand.

The motivation for choosing the problem is a personal interest in financial markets and securities. We have also used our network for acquiring sufficient data through the thesis.

We were challenged to combine our personal interests and skills to solve the problem at hand. Our paper has demanded a great amount of data processing. This led to a challenge with choosing the right software. In the end, we ended up using both R and Microsoft Excel for the computations. We had some prior knowledge about R, but this program has proven to be challenging. Fortunately for us, R is widely used and many problems were solved by learning from others online.

We would like to express our gratitude towards our supervisor Steen Koekebakker for insightful inputs and collaboration. We would also like to thank Lars Thorstensen at Nordea Markets and Frode Finsrud at DNB Markets for data, access to financial software and general inquiries.

Henrik Fjeldheim Amundsen & Joachim Holm Bryhn

Kristiansand, 03.06.2015

## Abstract

In this thesis we decompose the close-to-close return into overnight and intraday returns for the 15 most traded stocks on Oslo Stock Exchange over the period of 2003 to 2014. By analyzing the stocks individually and in an equally weighted portfolio we find the return of non-trading hours consistently higher than the trading hours. This holds across all weekdays, monthly and yearly measures as well the sub-periods of 2003 to 2008 and 2009 to 2014. We find the overnight and intraday having a negative relationship, where the returns tend to move in opposite directions. From the first to the second sub-period we discover large difference in the amount of overnight and intraday return. We argue possible causes being: the presence of semiprofessional day traders; illiquidity premium; change in the risk-reward. The true return of the weekend, the overnight on Monday, is found positive while an exceeding amount of intraday is the one contributing to the overall negative weekend return. This adds new view to previous studies on the Weekend Effect (French, 1980).

JEL classification codes: G10, G12, G14

## Table of Contents

Preface .....	II
Abstract .....	III
List of Figures: .....	V
List of Tables:.....	V
1. Introduction .....	1
2. Literature Review .....	5
3. Data .....	10
3.1 Adjusting for Splits and Dividend Payments. ....	13
3.2 Computation of Daily, Overnight and Intraday Returns .....	15
3.3 Descriptive Statistics .....	16
4. Empirical Results of the Night and Day Return .....	18
4.1 Presence of the Night and Day Return in Individual Stocks. ....	24
4.2 Predictive Abilities of the Night and Day Relationship .....	29
4.3 Does the Behaviour of the Night and Day Return Change over Time .....	33
5. Discussion .....	43
6. Conclusion.....	51
7. References .....	54

## List of Figures:

Figure 1: Visual presentations of the decomposition of daily close-to-close return .....	15
Figure 2: Cumulative wealth from 2003 to 2014 .....	20
Figure 3: Fluctuation in return for close-to-close, overnight and intraday from 2003 to 2014.....	22
Figure 4: Squared returns from 2003 to 2014 .....	23
Figure 5: Fluctuation in intraday return for individual stocks from 2003 to 2014.....	24
Figure 6: Fluctuation in overnight return for individual stocks from 2003 to 2014.....	25
Figure 7: Cumulative wealth for ORK and SUBC from 2003 to 2014 .....	28
Figure 8: Cumulative wealth from 2003 to 2008 .....	39
Figure 9: Cumulative wealth from 2009 to 2014 .....	42

## List of Tables:

Table 1: Sampled stocks with respective sector and turnover.....	12
Table 2: Descriptive statistics of the equally weighted portfolio .....	17
Table 3: Return and standard deviation from 2003 to 2014.....	18
Table 4: Amount of days with negative return from 2003 to 2014 .....	19
Table 5: Final value and geometric return from 2003 to 2014.....	21
Table 6: Daily mean and standard deviation for individual stocks from 2003 to 2014.....	26
Table 7: Correlation coefficients for the individual stocks .....	29
Table 8: Regression coefficients for the individual stocks.....	31
Table 9: Weekday returns from 2003 to 2014.....	33
Table 10: Amount of weekdays with negative return from 2003 to 2014.....	34
Table 11: Return by months from 2003 to 2014 .....	35
Table 12: Returns by year from 2003 to 2014.....	36
Table 13: Return and standard deviation from 2003 to 2008.....	37
Table 14: Amount of days with negative return from 2003 to 2008 .....	38
Table 15: Final value and geometric return from 2003 to 2008.....	40
Table 16: Return and standard deviation from 2009 to 2014.....	40

Table 17: Amount of days with negative return from 2009 to 2014 ..... 41

Table 18: Final value and geometric return from 2009 to 2014..... 42

## 1. Introduction

In today's financial markets there is continuous flow of information. Since the development of the Efficient Market Hypothesis (EMH, Fama, 1965a) it was widely accepted that the price of a security should reflect all information. As a result, a change in the price of a security would only be caused by new information. A security would have the ability to efficiently grasp news, and it would be incorporated without delay in its price. According to the EMH, a stock cannot be considered to be over- neither undervalued nor can an investor hope to achieve greater return than that of a portfolio, consisting of individual stocks by doing technical or fundamental analyses.

Over the last decades, there have been numerous documentations of so called "anomalies" that are inconsistent with the EMH. These anomalies are patterns of returns, which seem to contradict that of an efficient market. Take for example the documented anomalies of: The January Effect, finding an abnormal behavior, where stock prices tend to substantial increase, during the month of January; The Weekend Effect, documenting a pattern, where returns tend to be strong on Friday and weak on the following Monday implying a negative, at best zero weekend return; The Day of the Week Effect, finding stock returns to continuously increase as the week progresses; The Holiday Effect, finding stocks to perform better close to holiday dates<sup>1</sup>. These anomalies document irregular returns contradicting the EMH.

Recently, there has been empirical evidence towards an anomaly related to the relationship between a stocks return during trading and non-trading hours. During market closure, price changes are not continuous. As a result, new information is not incorporated in the stock price. The information related to prior day closure is not equivalent to the information at opening hours. This has implications for dynamics of the stock price. Normally, a stocks daily return is estimated using the difference between the current and previous closing price. Improved availability of transaction data makes it possible to decompose the close-to-close return into two sub-periods; night (close-to-open) return and day (open-to-close) return. Empirical studies found stock returns to be higher at night than during day. These findings are important as they document returns only

---

<sup>1</sup> E.g. Thaler, Richard H. (1987) for January Effect, French (1980) for the Weekend Effect, Dubious & Louvet (1986) for the Day of the Week Effect and Cadsby & Ratner (1992) for the Holiday Effect.

being achievable during night, when there is no ongoing trade, rather than day.

The goal of this thesis is to study the returns of night and the day on the Norwegian stock exchange. We investigate the 15 most traded stocks over the period of 2003 to 2014. As far as we know, there has been done no similar research on the Oslo Stock Exchange on the anomaly. In the rest of the thesis we address the night (close-to-open) return as overnight and the day (open-to-close) return as intraday. Returns referred to are daily averages. Returns of individual weekdays, months and years are summarized daily averages, divided by the amount of trading days of the respective weekday, month or year.

We examine stocks both individually and in a constructed equally weighted portfolio. Our results reveal high overnight return and weak intraday return. This holds for any day of the week, as well as for most of months and years of the 12-year period. Among the investigated stocks, we find two extreme opposites. These deliver a remarkable amount of return. One delivers a high amount of overnight return, the other a high amount of intraday return. Strangely, the one with high overnight has negative intraday and the one with high intraday has negative overnight. This phenomenon is not only found for the two individual stocks, but across our sample. It may seem as the overnight return always is the reverse of the intraday return.

The difference between overnight and intraday led us towards performing a correlation and a regression. The correlation is used to investigate whether the overnight and subsequent intraday exhibit a relationship or not. The high overnight return and weak intraday return could indicate that they vary negatively. We also use lagged values of intraday and overnight to see if there is a relationship with preceding returns. Our results reveal that majority of the stocks holds a negative correlation between overnight and intraday, but at a low degree. This has consequences as the Theory of Random Walk (e.g. Fama, 1965b) predicts historical prices, not to hold any form for consistent relationship. Our results prove that overnight and intraday tend to vary in opposite directions. although the relationship is weak. Using lagged values gives a result more consistent with the Theory of Random Walk, as the results are highly mixed. It gives no clear picture. On the other hand, one would not expect the overnight and intraday to exhibit such a behavior.



Since there exists a correlation between the overnight and intraday, we investigate if the overnight return is able to predict the intraday return using a regression analysis. We use the intraday return as the dependent variable. The independent variable consists of the overnight, but also the lagged returns of intraday and overnight. The coefficient for the overnight return for majority of the samples is found to be negative. This implies that a minor increase in the overnight return would lead to an expected decrease in the following intraday return. The movements of the overnight affects the intraday. Our result is found to be contradicting to the Weak-Form of the EMH, as historical prices are not supposed to be beneficial to predict future returns. On the other hand, the explanatory power of our model is moderate. We find the overnight return to explain a small part of the variation of the intraday. Despite this, our results are not supposed to find a relationship between night and day, according to the EMH and the Theory of Random Walk.

We perform robustness tests, by dividing the equally weighted portfolio into two consecutive periods extending from 2003 to 2008 and 2009 to 2014. Between the two periods we find a large difference in the amount of overnight and intraday return. From the first to the second sub-period the return of overnight is found to increase more than two times. Returns of intraday are found to decrease more than three times. We find the positive close-to-close return over the period of 2009 to 2014 to solely be due to the non-trading hours. Trading hours are found to deliver zero, mostly negative returns. An interesting finding is that the standard deviation of the overnight decrease in the latter period, while the standard deviation of the intraday is unchanged. This implies that the increased amount of positive and negative return in the second period is not a result of increased fluctuation. In other words, a decreased standard deviation means the overnight return fluctuates less around its mean. This is contrary to what we would expect seeing the amount of overnight and intraday changing so much. We argue a possible explanation behind the increase of the overnight return in the second period being due to three reasons: the presence of semiprofessional day traders; illiquidity premium; change in the risk-reward. Consequently, we suggest the intraday return correcting the high overnight and thus, being negative.

Our results have implications for the validity of the EMH, but also add new views to the above-mentioned anomalies. The Weekend Effect, Day of the Week Effect and Holiday Effect all have

returns estimated using the close-to-close. When we decompose the close-to-close return we find among others a positive return over the weekend, which is the reversed previously documented on the Weekend Effect. We find the overnight of Friday close to Monday open to be highly positive. Our results indicate that the negative weekend is only due to weak returns during Mondays trading hours. The true weekend return is positive. Similarly, in the case of the Day of the Week Effect, we find the behavior, where returns increase as the week progresses only to be because of the overnight. Intraday returns does not show a similar strong pattern to increase as the week progress. Adding to the Holiday Effect, we find the overnight return to be weak during months consisting of many non-trading days (e.g. May & December). In the same months, the intraday is found to be strong. We argue a possible explanation being a shift in the behavior of investors holding stocks longer and being reluctant to sell.

The rest of the thesis is structured as follows. In chapter 2 we present existing literature related to the problem at hand. We introduce theoretical papers that to some extent led to the study of the overnight and intraday, both those who argue for and against its existence. Following, we present the main studies contributing to the empirical literature on the overnight and intraday return. We also distinguish between the theoretical and empirical hypothesizes on the explanation behind the anomaly. Chapter 3 presents the data, assumptions and techniques used in this paper, as well as the process of extracting raw material, decomposing into returns and adjusting data for dividend and splits. A descriptive statistic is also presented to give an overview over our main results. In chapter 4, we present the results of calculations and robustness tests. In chapter 5, our findings are discussed in the light of existing theoretical and empirical literature, and we add possible explanations to the behavior of night and day. Included is a brief subchapter regarding the challenges of implementing the overnight as an investment strategy. We present a conclusion in chapter 6, summarizing our main findings.

## 2. Literature Review

The origin of financial anomalies is the pattern of return, which shows inconsistency with what is defined as an efficient market. The Efficient Market Hypothesis (EMH) is a concept developed by Eugene Fama (1965a). The theory, both highly controversial and disputed, states that it is impossible to beat the market. Consequently, under the light of the theory, modern financial methods of using fundamental or technical analyses to search for undervalued stocks or predicting trends are rendered useless.

A market could be considered to have three different forms of efficiency (Bodie, Kane & Marcus, 2011, 375-376):

- Weak-form, stating that examining historical prices, trading volume or short interest would not be beneficial to predict future returns.
- Semi-strong-form, all available information to the public is reflected in the stock price. Information also including past prices.
- Strong-form, stock prices reflect all relevant information, even the information only available for inside workers.

Supporting the EMH is the theory of Random Walk (Fama, 1965b), which states stock prices series is independent from each other, and while following a similar distribution, their past movements or trends cannot be used to predict that of future movements.

Among others<sup>2</sup>, a counterpoint to the discussion around the validity of an efficient market is the growing study of the overnight and the intraday return. Empirical results have been found inconsistent with the weak-form of the efficient market. Historical prices have beneficial relations to predict future returns. The returns of overnight and intraday have a behavior indicating a non-random walk. In other words, the returns of night and day are found to be dependent on each other. The study of the anomaly is a result of previous theoretical and empirical work. Papers

---

<sup>2</sup> Take for example the above-mentioned anomalies of the Weekend Effect, the Day of the Week Effect and the Holiday Effect

studying the volatility and return around market closure are relevant. We present the main relevant papers for our study here.

McInish, Ord and Wood (1985) were among the first to investigate patterns around non-trading hours. Using high frequency (intra minute tick) data to analyze the behavior of returns and the characteristics of trades, they report the return and standard deviation to be unusually high during the beginning and the ending of a trading day. Omitting the beginning and the end-of-day movements from the sample revealed a strong reduction in the autocorrelation of the time series. This suggested that there exists a relation in the movement of a stock right after and before non-trading hours. Harris (1989) extended the investigation of the abnormal return occurring at trading end and cites the following: *“A large mean price change is observed on the last daily NYSE transaction. [...] The results indicate that the phenomenon is pervasive over most firms and days.”* (Harris, 1989, p.29) The event of strong movements in a stock’s price around closure and opening is found to be persistent and not just limited to an individual period, firm or industry.

French and Roll (1986) reports stock returns to be more volatile during normal trading hours than the non-trading hours of the weekend. A phenomenon they categorize as strange as they cite: *“Asset returns display a puzzling difference in volatility between exchange trading hours and non-trading hours.”* (French & Roll, 1986, p.23) They report the open-to-close variance of return from an average trading day to be six times higher than the variance of close-to-open return over a weekend. Despite the fact that the weekend lasts eleven times longer. In other words, the volatility of return is much stronger during opening hours, than during non-trading period of a weekend. They argued the reason for higher volatility during the week, being due to the difference in information flow between trading and non-trading hours.

The standard way to measure price volatility is to look at the returns upon close-to-close. Stoll and Whaley (1990) attempted to measure volatility better and created a framework to look at the returns of open-to-open. They found the volatility of open-to-open to be higher than close-to-close. Evidence presented the correlation between daytime and following overnight, exceeding the correlation between the overnight and the following daytime return. For the result of the 24-hour analysis they quote: *“[...] the overnight return tends to be reversed by the following daytime*

*return [...] On the other hand, the daytime return is much less likely to be reversed by the return in the following night.*” (Stoll & Whaley, 1990, p.54) They argued that this would imply a temporary price deviation at the market opening. The closing price was less likely to reflect a temporary deviation.

Hong and Wang (2000) found similarities with previous empirical findings when they studied how market closures affect investor’s trading policies and the resulting return-generating process. Several of these findings are related to the overnight and intraday return. Firstly, there exists a U-shaped pattern for the mean and volatility of returns over trading periods. Secondly, the market activity around closure and opening are higher. Thirdly, the returns over trading periods are more volatile than non-trading periods. Fourthly, open-to-open returns are more volatile than close-to-close returns. Lastly, higher returns over trading periods than over non-trading periods. On the other hand, Longstaff (1995) developed a theoretical model predicting high returns over non-trading hours. He argued the illiquidity investors would face by holding a stock overnight would be rewarded with a premium and therefore, the overnight return would hold a positive return.

There are disputes of the role returns during night has for the overall return. There are especially four empirical studies documenting the impact and importance the return of overnight and intraday has had, which are relevant for our study.

One of the first studies empirically documenting the overnight return continuously outperforming the intraday return is the paper of Cliff, Cooper and Gulen (2008). They find strong documentation on the excess return of the S&P 500 during 1993 to 2006 being solely due to overnight returns. The return of the intraday over the decade is consistently close to zero, sometimes negative. Securities listed on NASDAQ and the NYSE AMEX Inter@ctive Week Internet Index also are documented to have strong returns during market closure. Detailed tick data made it possible to decompose the intraday into various return intervals spread out over the trading day. The main driver behind the negative return was found to be due to the “AM-hour” (8:30 to 9:30), the opening hours. A reason they argue being due to high opening prices, subsequently declining in the first hour of trading. As the day would progress, the various time intervals of returns would gradually improve and daily performance of a stock would be highest

close to trading stop. The overnight exceeding the intraday was found persistent across individual weekdays, as well as most of months and years. Not only limited to returns of indexes, the high overnight return was found to hold for other securities including ETF's and E-Mini Futures.

Clark and Kelly (2011) compared the intraday and overnight returns of various U.S ETF's. Using the returns to estimate Sharpe ratio (SR), they found the overnight SR to constantly exceed the intraday SR. This implies the premium one receives by taking on risk, is higher at night than day. Following, they found the overnight to be positive when the intraday was negative. A possible argument behind the overnight occurrence was due to the influence of day traders. According to Clark and Kelly (2011), a semiprofessional day trader who normally performs more than 25 trades a day would account for a large amount of the trades done on NYSE and NASDAQ. These day traders settling and opening their positions would cause a liquidation effect. Not wanting to hold stocks over a non-trading period, unable to settle their position, would push the day traders to buy at morning and sell at night. Prices increase by the buy and decrease by the sell pattern of the day traders, as a result this would cause positive overnight returns.

The paper of Cai and Qiu (2013) studied the presence of overnight and intraday return across 31 international stock markets. They find the anomaly to exist in 20 countries, both developed and emerging markets. The strongest overnight is documented on exchanges allowing short selling. As they cite: *“Our findings suggest that investors are generally better off buying at close but selling at opening, especially so on those markets that have high level of information asymmetry and short selling is not commonly practiced.”* (Cai & Qiu, 2013, p.1) This implies that an investor would be best entering a long position overnight and a short position during intraday. Then, they find the overnight return to be less volatile than intraday return volatility, as they conclude that the superior overnight is not to be justified by a risk-return trade off. In other words, a low volatility overnight implies that investors are not compensated with a high return by taking on greater risk during non-trading hours.

The paper of Branch and Ma (2012) studied the relationship between the overnight and the subsequent intraday. Over the period of 1994 to 1999 and 2000 to 2005, a negative correlation between the return of overnight and subsequent intraday is found on NYSE, AMEX and

NASDAQ. A negative correlation signifies the return of overnight and subsequent intraday to vary in opposite directions. A further analysis reveals the relation to hold with the previous day (lagged) intraday and overnight returns. The overnight return is found positively correlated with the lagged overnight and negatively correlated with the lagged intraday. By dividing the markets into market size categories, they find the correlation to be strongest among low cap stocks. Hoping to find this discovery usable to predict future returns, it led them towards a regression analysis. The regression was performed by regressing the intraday on the independent variables of overnight and the lagged variables of overnight and intraday. The result from the regression revealed that the overnight could predict the subsequent intraday movement. This also held for the lagged variables. The movement in the overnight and lagged overnight would predict the subsequent intraday to move in the opposite direction. The lagged intraday would predict the subsequent intraday to move in the same direction. This had consequences for the weak-form of the EMH and the Theory of Random Walk. Three potential explanations to the behavior of the overnight and the intraday return are presented in the paper:

- Firstly, the market-makers behavior when opening their assigned stocks. A situation where market-makers would push the price of a stock up during auction hours, resulting in a positive overnight.
- Secondly, the bid-ask bounce. A stock closing at bid following a non-trading period and then, opening at ask would result in a positive overnight, even though the stock had not moved over the non-trading period.
- Thirdly, the specialist behavior. Specialists, who put their own fund at risk, are particularly inclined to allow their assigned stocks to open away from the prior close.

### 3. Data

In this thesis we collect data over the period of 2003 to 2014. A consecutive 12-year period gives us the opportunity to observe the movements of night and day over a long period of time, but also under different market conditions. The last decade has faced rapid declines, serious turmoil and upswings. Following the years of 2003, the Oslo Bors Benchmark Index increased. In 2008, it faced a rapid decline caused by the financial crisis<sup>3</sup>. From 2009 to 2014 the Benchmark Index continuously increased and noted numerous all-time highs, with minor corrections.

We analyze the return of overnight and intraday by two methods. Firstly, we briefly analyze the effect of overnight and intraday on individual stocks. Secondly, we construct an equally weighted portfolio<sup>4</sup>. The purpose behind using an equally weighted portfolio is to study if a common trend in the individual stocks can be found. We also have divided the returns of the equally weighted portfolio into weekly, monthly and yearly values. This is to further analyze which day, month or year contributing to the overall return and to compare our result to other anomalies. The equally weighted portfolio is also divided in to two sub-periods. The first period is from 2003 to 2008 and the second period is from 2009 to 2014. By dividing into sub-periods, we are more closely able to investigate the overnight and the intraday in different market states. We define the first period as a combined bull and bear market. The second period is a pure bull market<sup>5</sup>.

Previous studies on the night and day anomaly include majority of the stocks listed on the represented exchanges in their analysis. We chose to limit the amount of stocks, by having them fulfill two preconditions.

Firstly, we alone want to include stocks listed on the Oslo Stock Exchange for the longest period possible. By doing so, we obtain a dataset excluding stocks potentially including traces of listing effects. It has been documented (e.g. Kadlec & McConnell, June, 1994) an abnormal behavior in the returns of stocks recently listed. Stocks have been found to perform substantially stronger

---

<sup>3</sup> We define the year of 2008 as the main period of the financial crisis

<sup>4</sup> An equally weighted portfolio means a portfolio where each individual stock contribute alike

<sup>5</sup> We define a bull market to be a period with a clear increasing trend in the Oslo Bors stock index, with only minor corrections. We define a bear market to be a period with a clear decreasing trend.



shortly after the listing. We also want to exclude stocks that have been delisted to prevent abnormal behavior in the return due to removal. The benefits with operating with surviving stocks are the opportunity to observe a return pattern over a continuous time. It also reveals where the overnight performs better than the intraday and vice versa. We chose the time period from 2003 to 2014, mainly because this gave us the best tradeoff between length and amount of liquid stocks.

Secondly, we only want to include stocks that are considered highly liquid. To examine the liquidity, we inspect the stocks respective turnover. High turnover typically implies the stock being traded continuously and on a daily basis. The reasoning behind this action is to prevent having the problem with stagnant stocks where there are no trades on the stock over a long period of time. The return of a stagnant stock is usually estimated by using the closing bid and ask or the average of the two. Previous research documents that the return computed on the bid and ask are false, mainly because it does not reflect the true return (e.g. Amihud & Mendelson, 1986). In our case, it is essential to capture the true stock return. A high liquidity is therefore needed. Oslo Stock Exchange is a relatively small financial market and the amount of continuously traded stocks are limited. To determine the stocks to be included, we receive an overview of the 15 most traded stocks, measured by turnover from 2003 to 2014 by DnB Markets<sup>6</sup>. See Table 1. Where the stocks, that fit our requirement are presented with their sectors and turnover. We end up with a total of 15 stocks.

The stock prices are collected from 2 databases. The first period from 2003 to 2008 is collected from Netfonds database<sup>7</sup>. The second period from 2009 to 2014 is received from the database of DnB Markets<sup>8</sup>. We combine the two sets of raw data to create the whole 12-year period. From the raw data we extract two stock prices; the opening and the closing price. From both databases the open value represents the price of the first possible trade after the end of the starting auction and the close represents the price of the last trade<sup>9</sup>.

---

<sup>6</sup> Finsrud F., DNB Markets, personal communication, April 28, 2015

<sup>7</sup> <http://www.netfonds.no/quotes/market.php> - Each individual stock has to be searched for

<sup>8</sup> Finsrud F., DNB Markets, personal communication, February 3, 2015 – Received raw data and the definition of open and close

<sup>9</sup> Ingebritsen L., Netfonds, personal communication, February 20, 2015 – The definition of open and close.

Table 1: Sampled stocks with respective sector and turnover

<b>Company name</b>	<b>Ticker</b>	<b>GICS<sup>10</sup></b>	<b>Turnover</b>
Det Norske Oljeselskap	DNO	Energy	320 486 567
Fred. Olsen Energy	FOE	Energy	123 541 913
Frontline	FRO	Energy	334 772 845
Marine Harvest	MHG	Consumer Staples	380 061 024
Norsk Hydro	NHY	Materials	1 730 478 333
Orkla	ORK	Consumer Staples	556 687 849
Petroleum Geo-Service	PGS	Energy	517 626 247
Prosafe	PRS	Energy	162 884 702
Royal Caribbean Cruises	RCL	Consumer Discretionary	291 025 195
Schibsted	SCH	Consumer Discretionary	139 222 679
Storebrand	STB	Financial	290 383 598
Statoil	STL	Energy	3 671 125 700
Subsea 7	SUBC	Energy	453 958 125
Telenor	TEL	Telecom	1 214 457 292
TGS-NOPEC Geophysical Company	TGS	Energy	236 614 289

Turnover is computed as tick by tick stock price multiplied with volume, given in NOK thousands.

We obtain the amount of active trading days over the 12-year period from Oslo Stock Exchange, a total of 3015 days<sup>11</sup>. For the sub-periods, this equals 1509 active trading days from 2003 to 2008 and 1506 active trading days from 2009 to 2014. Some stocks in our sample have more than 3015 trading days. These additional active trading days have their open and close values equal to the previous day value. As a result, the returns of the respective additional days are zero. These excess observations are deleted and have no impact on the overall return. Other stocks may have shorter observations because of trading pauses. For our analysis we want each stock to have equal amount of active trading days. To achieve this, we manually adjust all trading days from

<sup>10</sup> <https://www.msci.com/gics>

<sup>11</sup> Oslo Bors Information Service, personal communication, January 1 and February 25, 2015.

the sample to fit the number of active trading days received from Oslo Stock Exchange. As a benchmark on which dates of the 3015 active trading days, we use Statoil (STL). STL is the stock with highest turnover on the exchange and also exhibits exactly 3015 trading days. For stocks that have fewer trading days, we set the open and the close of the missing date equal to the previous trading day close value. This nullifies the specific trading day's overnight, intraday and daily return, but still includes the trading day in our analyses. This procedure affects both the means and the standard deviations, but not to an extent we find it significant for our results.

### **3.1 Adjusting for Splits and Dividend Payments.**

To generate data that only consider the return during overnight and intraday, our sample needs to be adjusted for dividend and stock splits. Since our primary data is not pre-adjusted, it has to be done manually. As a stock tends to drop by the same amount it pays in dividend. A stock split would decrease or increase the value of a stock by the split ratio. By doing the adjustments, we remove potential gaps in the return that otherwise could indicate irregular patterns. The result is a smooth return over the 12-year period. We assume the dividend to be distributed as cash dividend and reinvested in the stock. Additionally, when adjusted we assume the dividend to be paid to the investor holding the stock overnight, and not to the investor that is holding the stock intraday.

Information related to the amount of dividend, distribution dates and stock splits are collected from the Newsweb<sup>12</sup> of Oslo Stock Exchange. Issues with dividend amounts being given in a foreign currency is solved by using the Norwegian Central Banks daily exchange rates<sup>13</sup> at the ex-dividend day and then, converting the amount to Norwegian Kroner.

The method for adjusting for dividend and split is the following. For the individual stock, the most recent dividend payment serves as an anchor date. All previous close and open values are adjusted by a dividend multiplier calculated with the values the day before ex. dividend date,

---

<sup>12</sup> <http://www.newsweb.no/newsweb/search.do>

<sup>13</sup> <http://www.norges-bank.no/statistikk/valutakurser/>

adhering to Center for Research in Security Prices standards<sup>14</sup>. The multiplier is calculated as follows:

$$\text{Multiplier} = \frac{P_{t-1} - DD_t}{P_{t-1}} \quad t = 1, 2, \dots \quad (3.1)$$

$$= 1 - \left( \frac{DD_t}{P_{t-1}} \right) \quad t = 1, 2, \dots \quad (3.2)$$

Where: P is price, DD is dividend and t is time.

Where  $P_{t-1}$  equals the close (or open) value at time  $t-1$ ,  $DD_t$  is the amount of dividend distributed at the  $t^{\text{th}}$  date,  $t$  is the ex-dividend date. If the stock has distributed numerous dividends over the time period a set of multipliers are calculated using the same method for each ex-dividend date. Every multiplier will be used to adjust the closing and opening values prior to the respective distribution date, when the multiplier is calculated. An important thing to notice is in case the stock has undergone a split. A split divides the amount of historical dividend distributed, all prior dividend amounts need to be adjusted. This is done by multiplying the dividend by the split ratio.

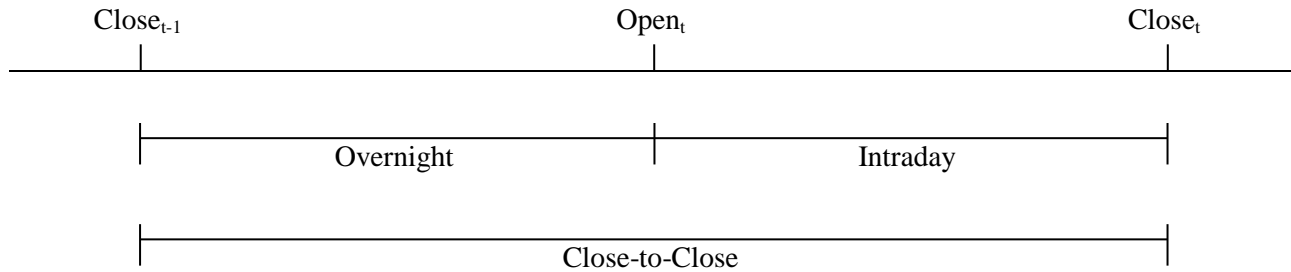
To illustrate the computation, assume a closing price of 210 on January 9<sup>th</sup> and that the ex-date equals January 10<sup>th</sup>. The firm has informed of a 5 NOK cash dividend to be distributed. In this situation we would calculate the dividend multiplier as  $(1 - [5/210]) = 0.9762$ . All prior closing values are modified by multiplying using the multiplier. The investor holding the stock at the overnight period will receive the dividend. The investor holding the stock at the intraday will not. The adjustment makes the price before the dividend distribution aligned with the all previous prices, so that no irregular movements exist as a consequence of dividend payments. If the stock announces another dividend payment a month earlier and the multiplier for that specific date is calculated to be 0.98 then all the prior days closing values are adjusted by multiplying  $0.9762 * 0.98 = 0.9567$ .

---

<sup>14</sup> <http://www.crsp.com/products/documentation/crsp-calculations>

### 3.2 Computation of Daily, Overnight and Intraday Returns

Figure 1: Visual presentations of the decomposition of daily close-to-close return



The goal is to decompose the close-to-close return into a day and a night return as illustrated in Figure 1. Overnight return, defined as the difference between previous close and current open; intraday return, defined as the difference between current open and current close; daily close-to-close return, defined as the difference between current and previous close. Returns are computed as log returns. By using the method of log, we gain the advantage of decomposing daily total return into day and night return and comparing the returns across assets more easily, than that of simple returns. The time-additive (Campbell et al, 1997) property of the log return means that we do not lose any information during the decomposition; it also allows us to write the strings of return as:

$$\sum_{i=1}^n R_i = R_1 + R_2 + R_3 \dots \dots + R_n \quad (3.3)$$

Continuing, the close-to-close return is written as a relationship between the two different continuously compounded returns as:

$$\text{Close - to - close Return}_t = \text{Overnight return}_{t-1} + \text{Intraday return}_t \quad (3.4)$$

In order to do the decomposition, we need to calculate the returns as natural log return. We use the following formula to compute the returns:

$$\text{Overnight Return} = \text{Ln} \left( \frac{\text{Open}_t}{\text{Close}_{t-1}} \right) \quad (3.5)$$

$$\text{Intraday Return} = \text{Ln} \left( \frac{\text{Close}_t}{\text{Open}_t} \right) \quad (3.6)$$

$$\text{Close - to - close Return} = \text{Ln} \left( \frac{\text{Close}_t}{\text{Close}_{t-1}} \right) \quad (3.7)$$

If we were to compare our returns to other papers that use simple return, there will be a difference. The use of log return means that our means will be lower than if we would use simple return, and this amount is equal to the amount related to the variance of the returns. (Hudson, Gregoriou 2010). This means that high variance return will differ even more. Implying that there is no one-to-one relationship between return calculated using log return and simple return. The difference could lead to a variation in the statistical test, as well. T-tests on simple return can produce higher significance level than log returns if means are positive. And may produce lower significance level if mean is negative.

### 3.3 Descriptive Statistics

After following these procedures we end up with a sample consisting of 3015 trading days between 2003 and 2014. All these have adjusted open and close prices. These are used to compute 3014 days with return of close-to-close, which get decomposed using log return into a same amount of overnight and intraday returns per stock. When constructing an equally weighted portfolio we end up same amount of return as for one stock. The portfolio is divided into 2 sub-periods, where the first period holds 1508 days with returns and second holds 1506 days with returns. Each sub-period has its own close-to-close, overnight and intraday return.

In Table 2, we have a descriptive statistic of our main results from the equally weighted portfolio, included is the sub-periods. This data is used frequently in our thesis. We do not present summary on individual stocks.

Table 2: Descriptive statistics of the equally weighted portfolio

	2003 to 2014		
	Overnight	Intraday	Close-to-close
Days with return	3014	3014	3014
Mean	10.3	-5.4	4.9
Standard deviation	1.0	1.5	1.8
Min	-753.6	-1011.4	-1170.5
Max	753.6	988.7	1110.2
Skewness	-0.1	-0.6	-0.4
Kurtosis	9	5	4

	2003 to 2008			2009 to 2014		
	Overnight	Intraday	Close-to-close	Overnight	Intraday	Close-to-close
Days with return	1506	1506	1506	1508	1508	1508
Mean	7.1	-2.3	4.7	13.7	-8.9	4.8
Standard deviation	1.2	1.5	1.9	0.8	1.5	1.7
Min	-753.6	-1011.3	-1170.5	-586.3	-793.4	-780.3
Max	753.6	988.7	1110.2	483.9	727.0	824.1
Skewness	-0.1	-0.8	-0.7	-0.2	-0.4	-0.2
Kurtosis	8	8	6	6	3	3

Key figures from the equally weighted portfolio over the whole period and the two sub-periods. Mean, min and max are given in basis points. Standard deviation is given in per-cent. Skewness and kurtosis is given in real numbers. Returns are given as arithmetic returns.

## 4. Empirical Results of the Night and Day Return

The empirical result is divided into four parts. The first part discloses the main findings from studying the stocks night and day returns, in an equally weighted portfolio. We present the averages and the variance of the returns. The second part covers our analysis of the stocks individually. We also present two unique stocks delivering abnormal returns, relative to the rest of the sample. The third part conveys our result of a correlation and a regression, analyzing the night and day relationship. The fourth part contains the robustness test, where we analyze the night and day return of the equally weighted portfolios by weekdays, months, years and two sub-periods.

The result of analyzing the night and day in an equally weighted portfolio is positive overnight and negative intraday return.

Table 3: Return and standard deviation from 2003 to 2014

	Close-to-close	Overnight	Intraday
Mean	4.9	10.3	-5.4
Standard deviation	1.8	1.0	1.5

Mean is given as basis points and standard deviation is given in per-cent. Returns are given as arithmetic returns.

In Table 3, we present our findings studying the night and day returns over the period of 2003 to 2014. Considering the returns being averages of 3015 trading days, it suggests a strong performance of the overnight and a weak performance of the intraday. The intraday holds a return of negative 5.4 basis points. Entering a position at the opening price and settling the position at the closing price would on average end with a negative return. On the contrary, the overnight holds a return of 10.3 basis points, a remarkably stronger performance than the intraday. The daily spread between the overnight and intraday of 15.7 basis points. The return of non-trading hours is by far exceeding the trading hours. Interestingly, we observe the standard deviation of the overnight to be less than the standard deviation of the intraday. More specifically, the return of intraday tends to vary more around its mean, than the overnight. The intraday faces higher fluctuation than the overnight either in the form of negative or positive return.



Table 4: Amount of days with negative return from 2003 to 2014

Period	Days with negative return	Total	%
Overnight	1224	3014	40.61
Intraday	1488	3014	49.37

Per-cent is given as amount of negative days divided by total days.

In Table 4, we compute the amount of trading days ending with a negative return as a percentage of the total 3014 calculated returns, both for night and day. We question if the large difference we find between the overnight and intraday could be explainable by a persistently negative day result. For the overnight we find 40.6 % of the observations to be negative<sup>15</sup>. A result indicating an average week having 2 out of 5 trading days resulting in a negative overnight return. For the intraday we find 49.4 % of the days ending with a negative performance. Despite majority of the observed intraday holding a positive return at days close, the average return is still negative. This tells us that the sum of all intraday returns of the portfolio is more negative than positive. More specifically, the amount of negative returns exceeds the amount of positive returns, even though the majority of trading days ends with a positive return. However, out of the observed overnight returns 59.4 % days are positive. In this way, we find neither of the returns to be constantly negative. The large difference between night and day cannot be explained by a constant performance. The returns vary between being positive and negative. This leads us to believe we could expect some periods of the 12-years performing differently than others. We are left with an important question: Is it normal with a constant change between positive and negative returns of intraday and overnight. More specifically, do some periods hold a larger amount days ending with negative overnight or intraday return than others.

To illustrate the difference we observe between the overnight and the intraday we graphically plot the growth of \$100 invested in the return one could achieve investing daily in either the night or day period<sup>16</sup>. We add the close-to-close return for comparison. There is one equation for each of the three compared returns. The cumulative wealth for overnight is calculated as follows:

<sup>15</sup> The measure of negative returns does not include days ending with zero return. Positive returns include days ending with zero returns.

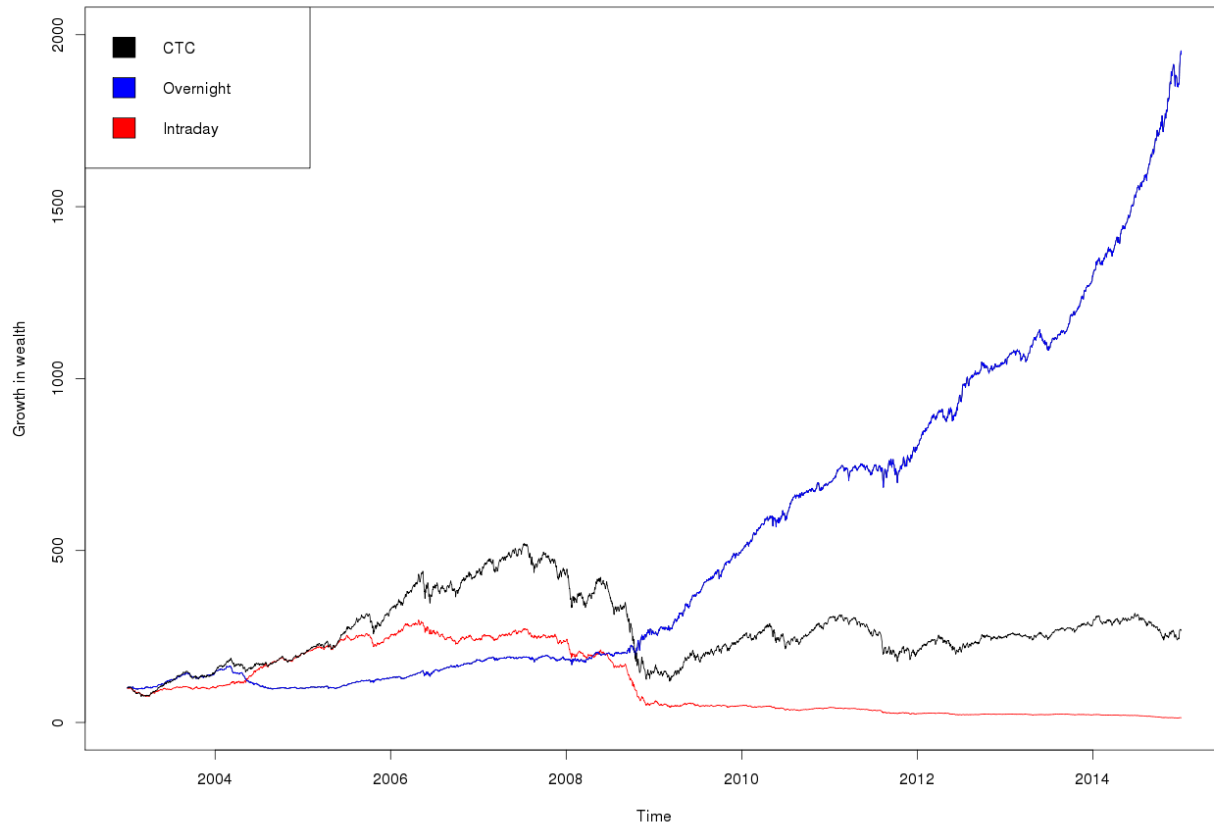
<sup>16</sup> By night period we mean to buy at the previous days close and sell at open. By the day period we mean to buy at the open and sell at the close.

$$Final\ Value_{t \rightarrow n} = P_0 * (1 + Overnight_t) * (1 + Overnight_{t+1}) * \dots * (1 + Overnight_{t+n}) \quad (4.1)$$

Where:  $n = 3014$ ,  $P_0$  = Initial investment and  $Overnight_t$  = First overnight return in our sample.

An important notice is that the graph does not consider transaction costs, but only looks at the growth by the returns.

Figure 2: Cumulative wealth from 2003 to 2014



Initial invest amount \$100. CTC equals the investment in the close-to-close.

The visual perspective of the graph holds three main points. Firstly, the overnight investment has a positive growth over the 12-year period. We observe a limited amount of negative spikes in the overnight curve, as the return is continuously strong. We find no periods, which could indicate a larger amount of negative overnight return. In 2008 the intraday changes from positive returns in the previous years to negative returns and where the investment value falls towards zero. Secondly, the close-to-close investment is only positive because of the strong overnight. The intraday contributes little to the overall return of the investment. Thirdly, we observe a change in the amount of overnight and intraday return in the period from 2008 to 2009. From this period, it

may seem that the overnight is highly positive and the intraday is highly negative. This could be the case, as earlier mentioned, a period where we could expect the intraday and overnight to perform differently from normal.

Table 5: Final value and geometric return from 2003 to 2014

	Close-to-close	Overnight	Intraday
Final Value	\$267	\$1 943	\$14
Daily Geometric Return	-	9.85	-6.57

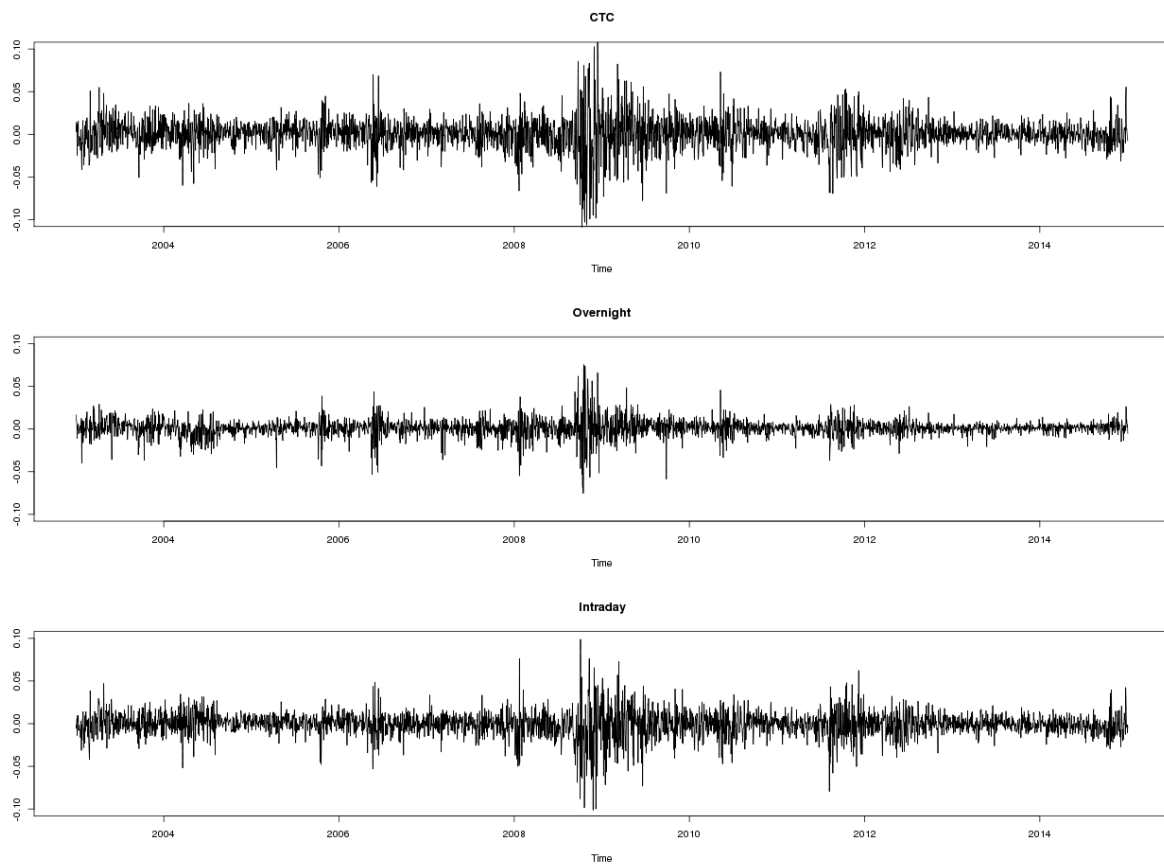
Final value is given in USD and daily geometric return in basis points.

Table 5 presents the final value of the three investments. Over the 12-year period the \$100 investment of overnight grows to \$1 943. In comparison, the intraday investment falls to \$14. This is where the difference between the overnight and intraday becomes clear. From the initial amount, the investment in the overnight grows more than nineteen times while the intraday decreases to less than one fifth. The geometric return of the overnight, representing the daily return needed to achieve the final value, equals to 9.85 basis points. In contrast, the overnight has a geometric return of negative 6.57 basis points. The large difference has impact on the final value of the close-to-close return. As the overnight is the one contributing to the final value of \$267.

In Figure 3, we plot the fluctuations of returns of day, night and close-to-close into separate graphs. The purpose is to give an overview of how the returns fluctuate and further investigate if there are clustered periods of return indicating abnormal changes in returns. In the first years, from 2003 to 2008, there seem to be no particular behavior in the variation of the return between night and day, as there is no apparent amount of high clustering. There is a constant switch between positive and negative returns, as this holds for both night and day. In the period from 2008 to 2009 we find this to change. We observe the fluctuations of intraday to have large clustering, being the highest of all years. There is a noticeable difference between the overnight and intraday in this period. The intraday has a much larger clustering with higher spikes. This would lead us to expect that intraday is most affected by financial turmoil. The rapid variation in the close-to-close is a direct result of movements in the overnight and the intraday. During this

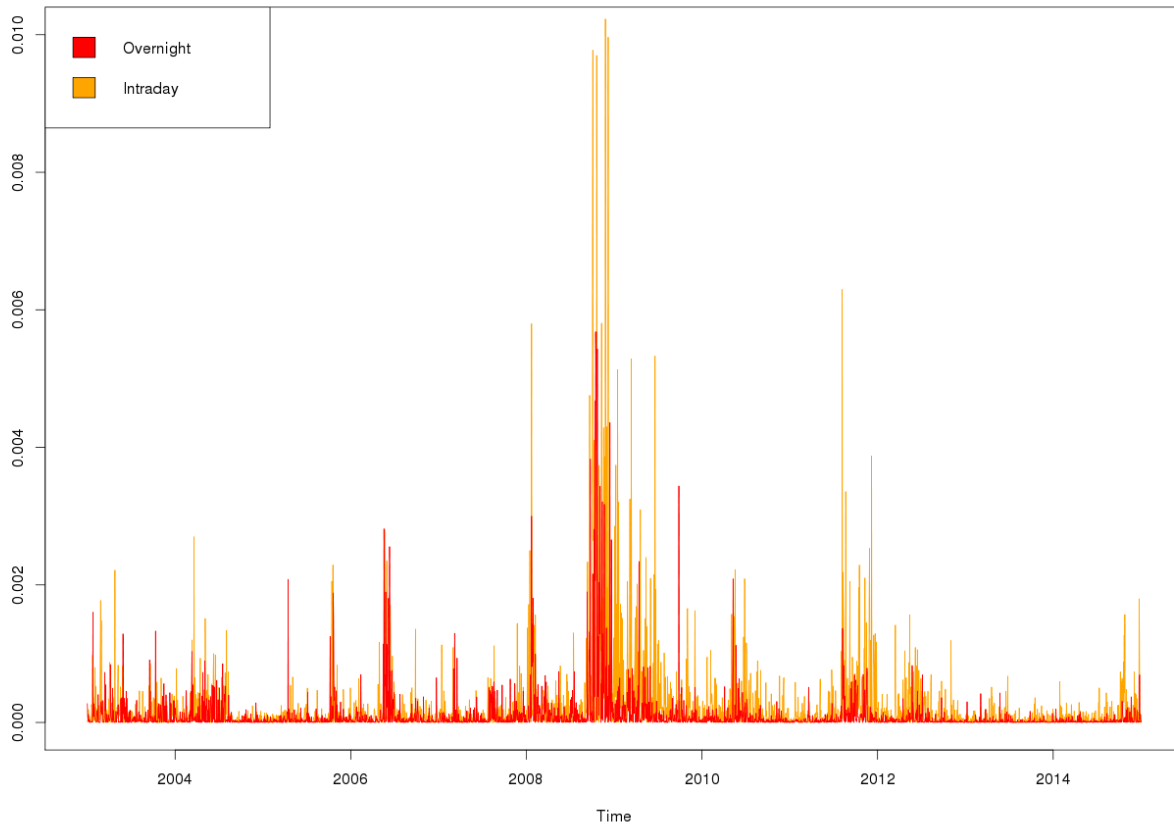
period, the intraday is contributing most to the fluctuations in the close-to-close. What we also observe is intraday, being more clustered and to have more fluctuations in return in the period after 2008 to 2009 than the overnight. This leads us to believe something changed in the behavior of the return in the period after the financial turmoil. We also see this fluctuation in the intraday visible in the overnight. The fluctuations of the overnight on the other hand are less strong. To some extent this leads us to believe the overnight and intraday share a bond, where a movement in intraday affects the overnight. Even though it is hard to observe the overall performance of the night and day, the graphs do illustrate an important picture of how both vary.

Figure 3: Fluctuation in return for close-to-close, overnight and intraday from 2003 to 2014



CTC equals the close-to-close. Returns are given in decimals.

Figure 4: Squared returns from 2003 to 2014



Returns are given in decimals.

In Figure 4, we plot the squared returns of night and day. This helps to further observe if the overnight or intraday has the most variation in return. The orange is the squared return of the intraday and the red is the squared return for overnight. Visual inspection shows clustering, and we find the intraday holding a constantly higher fluctuation in the squared return than the overnight throughout the whole period. Between 2008 and 2009, it is a considerably higher amount of fluctuation in both squared returns. Another aspect is the difference in squared returns of day and night before and after the financial crisis of 2008. After 2008, the squared return for intraday is higher than overnight and is easily visible. This is found to be quite puzzling, as it might indicate that the overnight and intraday have various reactions to different market conditions or that we, to some extent, see a change in the behavior of the returns.

## 4.1 Presence of the Night and Day Return in Individual Stocks.

In the data chapter, we presented an overview over the 15 selected securities over the period of 2003 to 2014, by turnover and the sector they operate in. The analysis on the individual stocks is carried out to investigate, if there are certain securities that perform better at night than day. We present two of the stocks, which have performed best over the whole period that have abnormal returns relatively to the rest.

Figure 5: Fluctuation in intraday return for individual stocks from 2003 to 2014

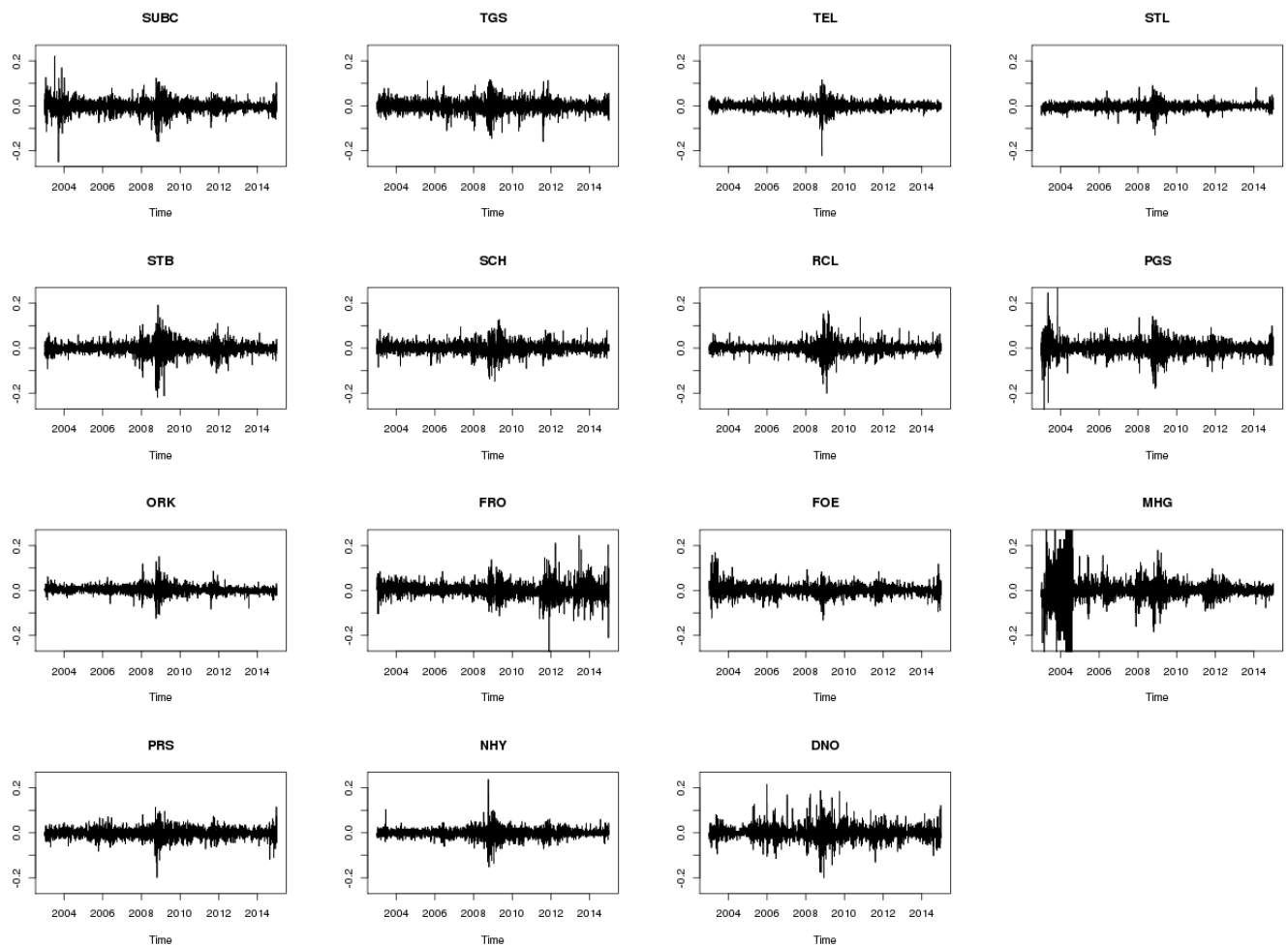
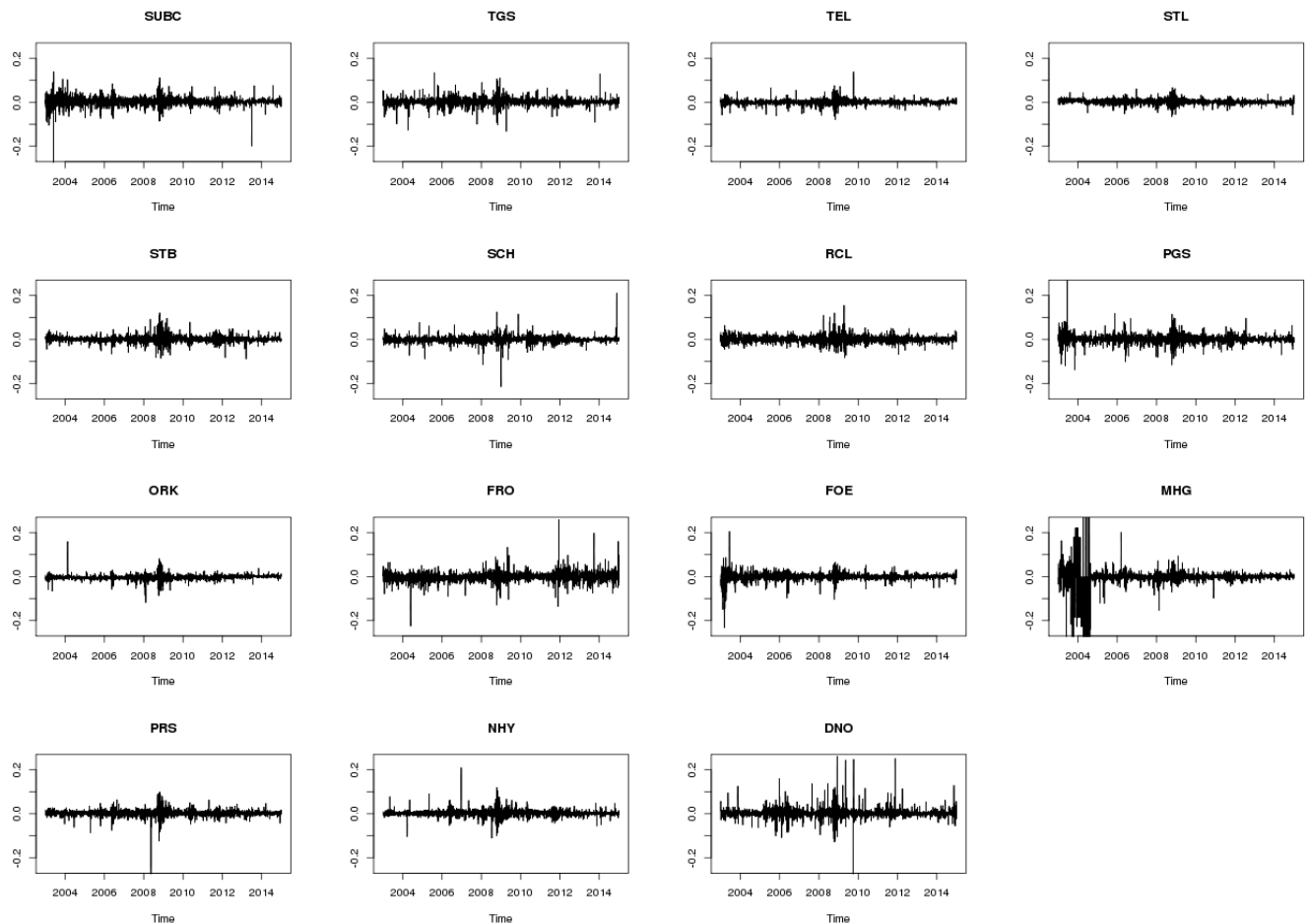


Figure 6: Fluctuation in overnight return for individual stocks from 2003 to 2014



In Figure 5 and Figure 6, we plot the returns of the intraday and the overnight for each individual stock. We observe each stock to have noticeable spikes over the 12-year period. We do not consider this to be a case of abnormal behavior, as a high fall or gain in the stock price is not unusual. What we do see is a combination of both positive and negative returns for night and day. For every stock we find the fluctuation in return to be higher for the intraday than the overnight. This tells us that the variation in the day return is affected by higher fluctuations. We find the behavior of the overnight and the intraday return to some extent being similar. As for the portfolio we observe the fluctuations of the intraday to be visible in the behavior overnight, as this holds for all stocks. If there is a high fluctuation in the intraday, we see a less fluctuation in the overnight. If this co-movement is negatively or positively correlated is hard to observe. The most clustered case period is from 2008 to 2009, as this holds for all stocks. In the period we observe the overnight and the intraday having larger variation in return, both positive and

negative. Despite this, there is no similar pattern observable separating the overnight from the intraday. More specifically, we do not find periods holding only positive or negative returns. In the earlier period, there is especially one stock that stands out. During late 2003 and start of 2004 MHG shows large fluctuations in return<sup>17</sup>. By observing the night and day graphs, we find none of the stock to have a pattern differently than the others. The stocks follow the same behavior as we see in the equally weighted portfolio, which is as expected.

Table 6: Daily mean and standard deviation for individual stocks from 2003 to 2014

		Close-to-close Return														
		SUBC	TGS	TEL	STL	STB	SCH	RCL	PGS	ORK	FRO	FOE	MHG	PRS	NHY	DNO
Mean		7.30	8.77	6.92	4.58	1.90	7.05	5.92	5.56	4.87	0.28	8.23	-4.70	2.75	4.60	10.47
SD		3.3	3.1	2.0	1.9	3.0	2.5	2.8	3.7	1.9	3.9	2.7	6.1	2.5	2.4	3.8

		Overnight Return														
		SUBC	TGS	TEL	STL	STB	SCH	RCL	PGS	ORK	FRO	FOE	MHG	PRS	NHY	DNO
Mean		36.22	25.26	6.38	28.26	16.17	1.48	9.75	16.71	-30.04	-4.70	-2.89	-23.13	26.278	25.35	24.27
SD		2.0	1.6	1.1	1.0	1.4	1.5	1.5	1.9	1.1	2.0	1.6	4.4	1.6	1.4	2.6

		Intraday Return														
		SUBC	TGS	TEL	STL	STB	SCH	RCL	PGS	ORK	FRO	FOE	MHG	PRS	NHY	DNO
Mean		-28.92	-16.49	0.53	-23.70	-14.27	5.57	-3.82	-11.15	34.90	4.57	11.11	18.43	-23.52	-20.75	-13.80
SD		2.7	2.6	1.7	1.6	2.7	2.3	2.3	3.2	1.7	3.2	2.3	5.6	2.2	2.0	3.1

Mean is given as basis points and standard deviation is given as per-cent. Returns are given as arithmetic returns.

In Table 6, we give a more detailed overview of the individual stocks by presenting the return and standard deviation of each. We find the amounts of returns to vary, but 9 out of 15 stocks hold a negative intraday return. The trend in the stocks is a negative intraday; as the intraday differs between negative 28.91 basis points to positive 34.9 basis points. The amount of return of

<sup>17</sup> Between the period of late 2003 and early 2004, MHG is traded between 0.03 and 0.06. Resulting in a high percent change in price.



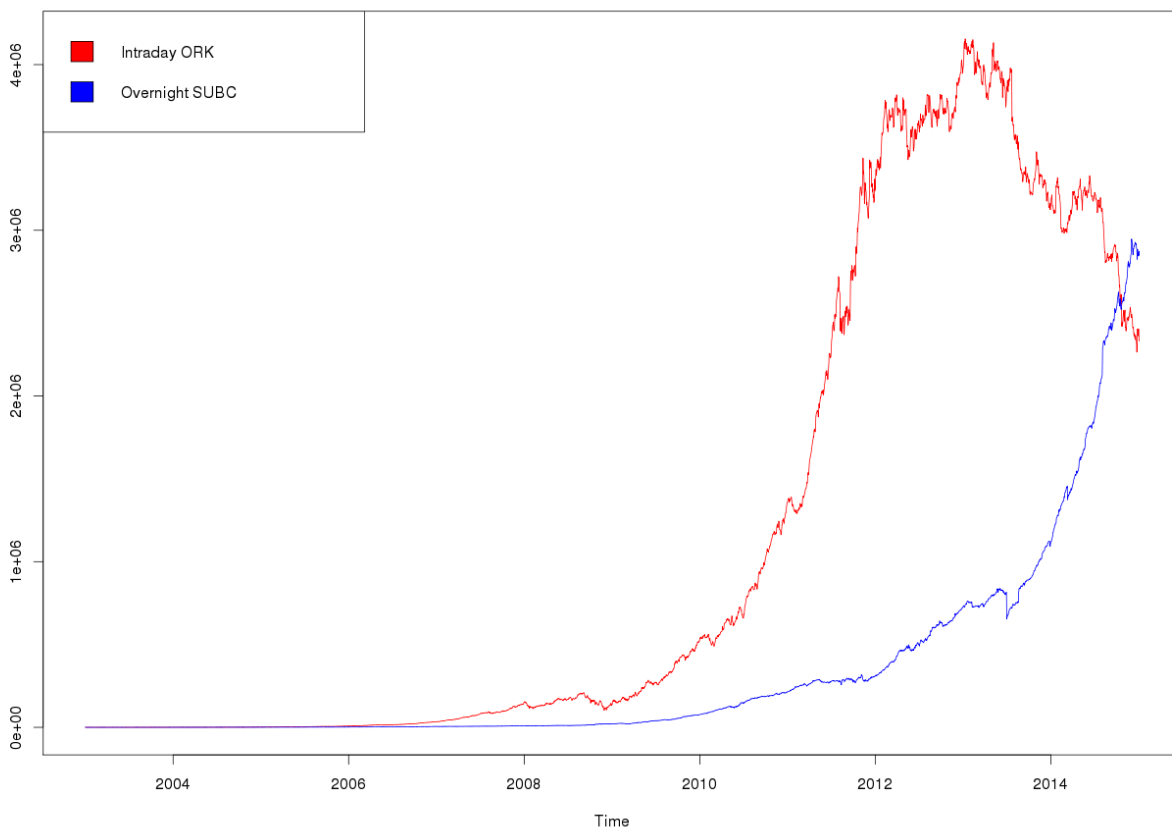
those with a positive intraday is found to be small, except for ORK. The overall intraday return is weak among the stocks. We find only 4 out of 15 stocks having a negative overnight return. The overnight differs from negative 30.03 basis points to positive 36.21 basis points. These results emphasize the fact that the intraday has played a weak role in the total return the past decade. Interestingly enough, the stocks with negative overnight, ORK, FRO, FOE, and MHG all perform with positive intraday returns. When we compare the securities with negative intraday with their respective overnight, we discover that most achieves positive overnights. This is a behavior we find hard being a coincidence. From the return graphs, we observed the intraday spikes to be recognized in the overnight fluctuations. With the case of stocks having reversed intraday from the overnight it may seem as these fluctuations are of negative relationship. For the entire sample the standard deviation of the intraday exceeds the standard deviation of the overnight; implying the variation in return to the close-to-open being less than that of the open-to-close.

From the individual stocks we find SUBC having the highest amount of overnight return with 36.21 basis points. This is a substantially higher amount of night return than the rest of the sample. We find ORK having the highest amount of intraday return with 34.9 basis points. As SUBC and ORK are having a performance exceeding every other stock in terms of intraday and overnight return; we want to treat them as our samples extreme cases. Further, we want to investigate growth one could achieve from investing solely in either the SUBC's overnight return or the ORK's intraday return. We create a plot of the cumulative return, to illustrate the return of night, and day one could achieve in the two cases over the period of 2003 to 2014. Initial investment is set to \$100. The result can be observed in Figure 7. The two stocks are combined for a better graphical comparison.

The cumulative growth in the investment in SUBC's overnight and ORK's intraday are very high. For SUBC the final value of the \$100 invested in the start of 2003 is \$2 846 340. For ORK the final value of the \$100 invested in the start of 2003 is \$2 330 560. Even though these investments do not consider transaction costs, the ending results are remarkably high. Interestingly, we find the returns starting to escalate in 2008. This is evident in the cumulative wealth they could achieve. Interestingly, when we look at them individually in the Figure 5 and Figure 6, both graphs of return for SUBC and ORK do not suggest any remarkable change in the

returns in this period. Neither does the standard deviation of SUBC of 2.0 % or the standard deviation of ORK of 1.7 %. The investment in SUBC multiplies by more than 28 463 times the initial amount. Over the whole period SUBC has a geometric return of 34.08 basis points. ORK achieved a growth of 23 305 times the initial investment. Over the period ORK has a geometric return of 33.42 basis points. There are more high performers in overnight than intraday. The second best stock in terms of overnight return is STL with a return of 28.26 basis points and 1.9% daily standard deviation from mean. The difference in the amount of return between SUBC and STL is moderate. The second best stock in terms of intraday is MHG with a return of 18.42 basis points and a daily standard deviation of 5.6%. The difference in the amount of return between ORK and MHG is large.

Figure 7: Cumulative wealth for ORK and SUBC from 2003 to 2014



Wealth is given in USD.

## 4.2 Predictive Abilities of the Night and Day Relationship

The constant large difference between the return of overnight and intraday led us towards an analysis of the relationship between the returns. We investigate if the night returns tend to move in the opposite direction of the day returns. We also see if the night returns has a relation to the previous day returns of overnight and intraday<sup>18</sup>. This is done by conducting a correlation on the returns of each individual stock. A brief illustration of the process can be examined below.

$$[Overnigh_{t-1}, Intraday_{t-1}] \leftarrow Overnigh_t \rightarrow Intraday_t$$

We correlate the overnight with the subsequent intraday return. This will tell us whether the return of overnight and subsequent intraday tends to move in a similar direction, or not. We also add correlation with the overnight correlated on the previous day value of overnight and intraday return. The reason is to observe whether the overnight return tends to move in the same or opposite direction of the previous day returns.

Table 7: Correlation coefficients for the individual stocks

Ticker	Intraday <sub>t</sub>	Overnigh <sub>t-1</sub>	Intraday <sub>t-1</sub>
STL	-0.0029	0.0047	-0.0438
NHY	-0.0135	-0.0658	0.0273
TEL	0.0134	-0.0771	0.0023
ORK	-0.1415	-0.0206	0.0454
PGS	0.0146	-0.0631	0.0293
MHG	-0.2772	0.0051	-0.0274
FRO	0.0386	0.0187	-0.0644
DNO	-0.1177	-0.0532	-0.0874
SUBC	-0.0611	-0.0537	0.0029
RCL	0.0584	-0.0285	0.0356
STB	-0.0740	-0.0365	0.0168
TGS	0.0094	0.0063	0.0509
PRS	-0.1468	-0.0114	0.0184
FOE	-0.0853	-0.0038	-0.0129
SCH	-0.1350	0.0117	0.0200

<sup>18</sup> Where: intraday<sub>t</sub> is defined as the return of [close<sub>t</sub>-open<sub>t</sub>];  
overnigh<sub>t</sub> is defined as the return of [open<sub>t</sub>-close<sub>t-1</sub>];  
overnigh<sub>t-1</sub> is defined as the return of [open<sub>t-1</sub>-close<sub>t-2</sub>];  
intraday<sub>t-1</sub> is defined as the return of [close<sub>t-1</sub>-open<sub>t-1</sub>].

In Table 7, the result of the correlation analysis can be examined. In the result majority of the stocks holds a negative correlation between the return of overnight and subsequent intraday. More specifically, return of the overnight and subsequent intraday tends to vary in opposite directions. This leads us to believe the difference between the overnight and intraday can to some extent be explained by the negative relationship of the returns. We find the correlations to be of a low degree, implying the relationship between night and day being weak. Even so, we need to take into consideration that we operate with daily returns. A result of low correlation is thus to be expected. What is interesting is the fact that majority of the stocks hold a negative correlation between night and day. The negative correlations of the stocks differ from 0.0029 to negative 0.2772. The positive correlated differ from 0.0094 to 0.0584. Moreover we find the stocks holding a negative correlation between the return of night and subsequent day to be of higher degree. As we compute the correlation between the overnight and the lagged values of night and day, we observe that the degree decreases. The results are highly mixed, and we find no indication towards a clear relationship between current overnight and the previous trading day return. Our result reveals a tendency, where the overnight and subsequent intraday moves in opposite directions. On the other hand, the returns of the overnight and previous day the tendency is mixed between positive and negative correlation, and therefore, does not give a consistent picture.

The results of the correlation led us towards a regression analysis. We question if the negative correlation between night and day have a predictive ability, more specifically, if the overnight can forecast the return of the subsequent intraday. We run a simple ordinary least square regression, where the intraday return is regressed on a set of independent variables, including the overnight return and the previous day return of overnight and intraday. When performing the regression, we assume our data to be normally distributed. We can express the regression line as following:

$$Intraday_t = \beta_0 + \beta_1 * Overnight_t + \beta_2 * Overnight_{t-1} + \beta_3 * Intraday_{t-1} + \varepsilon_t$$

The main reason for limiting the regression to three independent variables is the research done by Branch and Ma (2012), where they also run a similar regression as they quote: “*Apparently adding more regressors does not dilute the explanatory power of the overnight coefficient [...]. Nor does adding more regressors increase the overall explanatory power of our basic model.*” (Branch & Ma, 2012, p.1) Therefore, we do not include more independent variables and we perform the analysis with a basic linear model. By running the regression we expect a low explanatory power taking into consideration that we operate with daily financial data.

Table 8: Regression coefficients for the individual stocks

Ticker	$\beta_0$	$\beta_1$	$\beta_2$	$\beta_3$	$Adj. R^2$
STL	-0.0023 (-7.636)	-0.0020 (-0.073)	-0.0656 (-2.427)	-0.0680 (-3.742)	0.0041
NHY	-0.0024 (-6.292)	-0.0077 (-0.297)	0.0364 (1.401)	-0.1029 (-5.662)	0.0104
TEL	0.0002 (0,487)	-0.1140 (-3,826)	-0.0478 (-1,601)	-0.0694 (-3,816)	0.0088
ORK	0.0032 (9,582)	-0.2206 (-7,775)	0.0507 (1,768)	-0.0735 (-4,046)	0.0262
PGS	-0.0013 (2,244)	0.0356 (1,167)	0.0529 (1,741)	-0.0584 (-3,201)	0.0035
MHG	0.0010 (1,025)	-0.4029 (-17,628)	-0.0856 (-3,742)	-0.1513 (-8,046)	0.0961
FRO	0.0004 (0,711)	0.0575 (1,982)	-0.1065 (-3,580)	0.0462 (2,530)	0.0068
DNO	-0.0009 (-1,574)	-0.1339 (-6,299)	-0.1217 (-5,716)	-0.0853 (-4,692)	0.0288
SUBC	-0.0026 (-5,008)	-0.0830 (-3,340)	0.0121 (0,0663)	0.0006 (0,024)	0.0028
RCL	-0.0005 (-1,232)	0.0870 (3,173)	0.0541 (1,980)	0.0199 (1,090)	0.0042
STB	-0.0013 (-2,531)	-0.1424 (-4,059)	0.0268 (0,763)	-0.0072 (-0,393)	0.0048
TGS	-0.0020 (-4,141)	0.0119 (0,409)	0.0824 (2,830)	-0.0606 (-3,336)	0.0053
PRS	-0.0018 (-4,432)	-0.2015 (-8,095)	0.0293 (1,166)	0.0349 (1,916)	0.0221
FOE	0.0011 (2,518)	-0.1225 (-4,563)	-0.0174 (-0,647)	0.0067 (0,367)	0.0061
SCH	0.0006 (1,431)	-0.2257 (-7,575)	0.0304 (1,015)	-0.0225 (-1,231)	0.0182

Where the coefficient for intercept is  $\beta_0$ , overnight<sub>t</sub> is  $\beta_1$ , overnight<sub>t-1</sub> is  $\beta_2$  and intraday<sub>t-1</sub> is  $\beta_3$ .

In Table 8, the result of the regression analysis can be examined. A quick scan of the estimate values reveals that majority of our overnight coefficients are negative. The interpretation is a minor increase in the overnight return, by 1 %, would decrease the expected value of the intraday return in the opposite direction by the amount of the overnight coefficient. Taking into consideration the coefficients being estimated from daily returns our results are strong. We find 4 stocks, where 2 are insignificant<sup>19</sup> to hold a positive correlation with the intraday and 11 stocks, where 2 are insignificant to hold a negative correlation with the intraday. This is consistent with the result we presented in the previous topic, where the return of night and day for majority of the stocks held a negative correlation. The negative coefficients of the overnight, which are significant, differ from 0.4029 to 0.0830. A possible interpretation of the weak intraday performance could be because of the strong overnight movements. The higher return of the overnight our model states, the weaker we would expect the intraday return to be. Our result could explain some of the large difference between the return of overnight and intraday we observe over the 12-year period.

From the estimated coefficients of the relation between intraday with the lagged overnight we only find 5 to be significant. We also observe the sign of the coefficients to be highly mixed. This means that previous trading day overnight has little or no particular relation with the expected intraday. From the estimated coefficients of the relation between intraday with the lagged intraday we find majority to be significant. As follows, the coefficients are mostly negative. This indicates that the lagged intraday predicts the expected value of the intraday to move in the opposite direction. More specifically, a positive return in the lagged intraday would result in a less positive or negative return in the subsequent intraday.

The explanatory power of our model differs, depending on the stock, between the r-squared values of 0.0028 to 0.0961. Statistically interpreted, our predictive model explains 0.028 % to 9.61 % of the total variation in the intraday movements of the stocks. An explanatory power which is modest, but taking into consideration that we operate with daily financial data, the results are not bad. Even though the explanatory power is modest, we can say our results point towards the existence of a relationship between the overnight and intraday return and that we find

---

<sup>19</sup> A coefficient being insignificant means that we cannot reject the hypothesis of the true coefficient being zero.

the lagged variables to give a weaker prediction compared to the overnight. Our result indicates that there exists a predictive relationship between the returns.

### 4.3 Does the Behaviour of the Night and Day Return Change over Time

We questioned if it was normal with a constant change between positive and negative returns of overnight and intraday, more specifically, if some periods have a larger amount of days ending with a negative return of overnight or intraday than others. To investigate this, we perform a robustness test by analysing the overnight and intraday by returns of individual weekdays, months and years. We also decompose the whole period into two sub-periods from 2003 to 2008 and 2009 to 2014.

When we investigate individual weekdays, we find the same behaviour of strong overnight and weak intraday return.

Table 9: Weekday returns from 2003 to 2014

Day	Close-to-close	Overnight	Intraday	Difference	Days with returns
Monday	-2.04	10.56	-12.59	23.16	591
Tuesday	1.20	7.63	-6.42	14.06	615
Wednesday	2.93	8.24	-5.31	13.57	614
Thursday	2.51	10.95	-8.44	19.39	591
Friday	20.13	14.63	5.49	9.15	603
All	4.96	10.39	-5.42	15.81	3014

Returns are given in basis points. The difference is computed by subtracting the overnight from the intraday. Returns are given as arithmetic returns.

In Table 9, the result of decomposing the equally weighted portfolio into individual weekdays can be examined. We find the strong overnight return to hold for all weekdays. The overnight is purely positive and differs from 7.63 basis points to 14.64 basis points. There are especially two interesting findings for the overnight return: Firstly, the Monday overnight, which here is represented as the difference between Monday open and Friday close, is positive with 10.56 basis points. This tells us, historically speaking, that an investment over the weekend would result in a positive return. Secondly, we observe the overnight return to be increasing following Monday. This leads us to believe that there is a tendency, where the overnight performs better as the week progress. On the contrary, the intraday is negative on all days except on Friday. Compared to the

overnight, the intraday does not show behaviour as to a continuous improvement in the return, as the week progresses. Even so, we find the returns to differ from negative 12.59 basis points to positive 5.49 basis points. We question why the return of Friday intraday is exceeding the rest of the weekdays so much in performance. The positive return we observe for the overnight return on Monday is highly negative in the intraday return. We find the overnight contributing most to the overall positive close-to-close return. In fact, the overnight is persistently higher than that of the intraday for any day of the week.

Table 10: Amount of weekdays with negative return from 2003 to 2014

Weekday	Overnight			Weekday	Intraday		
	Negative days	Total days	%		Negative days	Total days	%
Monday	233	591	39.42	Monday	283	591	47.88
Tuesday	258	615	41.95	Tuesday	326	615	53.01
Wednesday	268	614	43.65	Wednesday	306	614	49.84
Thursday	241	591	40.78	Thursday	301	591	50.93
Friday	224	603	37.15	Friday	272	603	45.11

Per-cent is given as amount of negative days divided by total days

Similar to the whole period we compute the amount of trading days ending with a negative return for each weekday. We found the amount of overnight days ending with a negative return over the whole period to be 40 %. The results for the individual weekdays can be examined in Table 10. A quick inspection reveals the ratio to also hold for each individual weekday. There are none of the weekdays that have a remarkably higher amount of negative days. For the intraday, we found 49 % of the total observed days to end with a negative return. Similar, we do not find a day having a specifically abnormal ratio. What we can add is the Friday and Monday having the least amount of trading days ending with a negative result, as this holds for both the intraday and overnight. Even so it gives little indication on why Fridays return is so much better. This makes us believe that the amount of return on Friday tends to be higher than the rest of the week and that the returns by weekdays do not reveal a day behaving differently than the other ones.

Now, we separate the return of overnight and intraday into their respective months, this can be examined in Table 11.



Table 11: Return by months from 2003 to 2014

Month	Close-to-close	Overnight	Intraday	Difference	Days with return
January	0.63	15.39	-14.76	30.15	257
February	0.02	9.24	-9.25	18.49	242
Mars	6.58	6.31	0.27	6.03	257
April	18.11	11.63	6.48	5.15	230
May	7.24	-0.20	7.44	-7.63	234
June	4.85	15.25	-10.40	25.65	251
July	9.69	13.73	-4.04	17.77	266
August	0.35	8.61	-8.26	16.87	265
September	-9.60	8.76	-18.36	27.12	258
October	-10.48	15.06	-25.54	40.60	266
November	5.66	11.98	-6.32	18.30	256
December	25.74	9.53	16.22	-6.69	232
All	4.96	10.39	-5.42	15.81	3014

Returns are given in basis points. The difference is computed by subtracting the overnight from the intraday. Returns are given as arithmetic returns.

Results of separating the daily return into their respective month emphasize the difference between the overnight and intraday return. We find the result of high overnight and weak intraday to hold for the months as well. All the monthly returns of overnight are positive, with an exception of May. The returns differ from negative 0.20 basis points to positive 15.39 basis points. As of this, we can say that the overnight has a stable performance in almost all months. For the intraday the results are more mixed. The returns of intraday differ from negative 25.54 basis points to positive 16.22 basis points. We find here, as in the individual weekdays, the overnight to contribute the most to the overall close-to-close return. There are especially two remarks of the results. Firstly, we observe a highly negative intraday, often being responded with a similar high positive overnight. This does not hold the other way around, but we observe the negative overnight of May to have a strong positive return for the intraday. The interesting part is

that the gap between the overnight and intraday is consistently high. Even though we find the intraday to be positive in four months, the divergence between night and day is still at a difference of at least +/- 5 basis points. Secondly, we observe the only two months the intraday exceeding the overnight being May and December. Implying that we might expect the behaviour we see rest of the year to be different in these months.

Following this, we separate the return of overnight and intraday into their respective years, this can be examined in Table 12.

Table 12: Returns by year from 2003 to 2014

Year	Close-to-close	Overnight	Intraday	Difference	Days with return
2014	-3.85	15.82	-19.68	35.50	250
2013	8.28	9.40	-1.12	10.52	249
2012	7.62	10.20	-2.58	12.78	251
2011	-12.73	6.36	-19.10	25.46	253
2010	10.07	13.52	-3.45	16.98	252
2009	21.95	27.08	-5.12	32.20	251
2008	-36.51	15.81	-52.33	68.14	252
2007	0.68	0.58	0.09	0.49	250
2006	13.08	14.19	-1.10	15.29	251
2005	20.68	10.78	9.89	0.89	253
2004	14.00	-14.07	28.07	-42.14	253
2003	16.41	15.09	1.32	13.78	249
All	4.96	10.39	-5.42	15.81	3014

Returns are given in basis points. The difference is computed by subtracting the overnight from the intraday. Returns are given as arithmetic returns.

We find the strong overnight and weak intraday to hold across the yearly measures. The overnight, which again performs with strong positive returns, differ from negative 14.07 to 27.08

basis points, where 1 out of 12 years are negative. From the computation we find the overnight contributing substantial to the positive return of the close-to-close. The overnight consistently perform stronger compared to the intraday. The intraday differs from negative 52.33 to 28.07 basis points, where 8 out of 12 years are negative. 2004 is the only year, where overnight has a negative return, but on the other hand, is the year with highest return for intraday. Including 2008 and the last 6-years of our dataset after the financial crisis, all the intraday returns are negative. The overnight is purely positive and is the only one contributing to a positive close-to-close return. This indicates that most of the recovery after the financial crisis can solely be explained by the performance of the night return. Interestingly, we find the overnight to be positive in the financial turmoil of 2008. In the year of 2008 overnight had a mean of 15.81 basis points, while intraday had negative 52.33 basis points. Not only does the overnight hold positive average returns during what would logically be believed to be a highly negative period, but the non-trading hours also performs with an average among 3 of the highest returns of all the years.

As follows, we divide our sample into two sub-periods; this is done for the purpose to further investigate the movements of the overnight and intraday return, since the two periods have different market situation. During the period from 2003 to 2008 the benchmark index is mainly driven by a bull-market until the financial crisis of 2008. The second period of 2009 to 2014 can be characterized as a bull market with no persistent bear-period, only small corrections. This is also a period, where the benchmark index has reached an all-time high. The aim is to study the effects of these market situations. To simplify the presentation of the results of the two periods, we present them separately, while the differences are examined in the discussion.

The result of the analysis of the period from 2003 to 2008 revealed moderate overnight and weak intraday return.

Table 13: Return and standard deviation from 2003 to 2008

	Close-to-close	Overnight	Intraday
Mean	4.7	7.1	-2.3
Standard deviation	1.9	1.2	1.5

Mean is given as basis points and standard deviation is given in per-cent. Returns are given as arithmetic returns.

In Table 13, we present our findings of studying the night and day returns over the period. A quick view reveals that the amounts of returns for both night and day are less compared to the whole period. This implies that there is a higher amount of returns in the second period. When analysing the whole period, we were left with the impression that there is a change in the amount of overnight and intraday return after the period of 2008 to 2009. In the preceding years, we observed mainly positive returns, both for night and day. Even so, we find the average intraday return for the first period to be of negative 2.3 basis points. We find this to be mainly due to the high negative return in 2008, as excluding the last year of the period would make the intraday return positive. On the other hand, we find the overnight to exhibit a positive return of 7.1 basis points, in spite of finding the overnight return to be negative in 2004. We also note that the standard deviation of the intraday of 1.5% is higher than the daily standard deviation of the overnight of 1.2%. This is expected, as we found this to hold for both the whole period and every individual stock.

We compute the amount of days ending with a negative return during closure and opening hours, as can be examined in Table 14.

Table 14: Amount of days with negative return from 2003 to 2008

Period	Days with negative return	Total	%
Overnight	656	1508	43.50
Intraday	723	1508	47.94

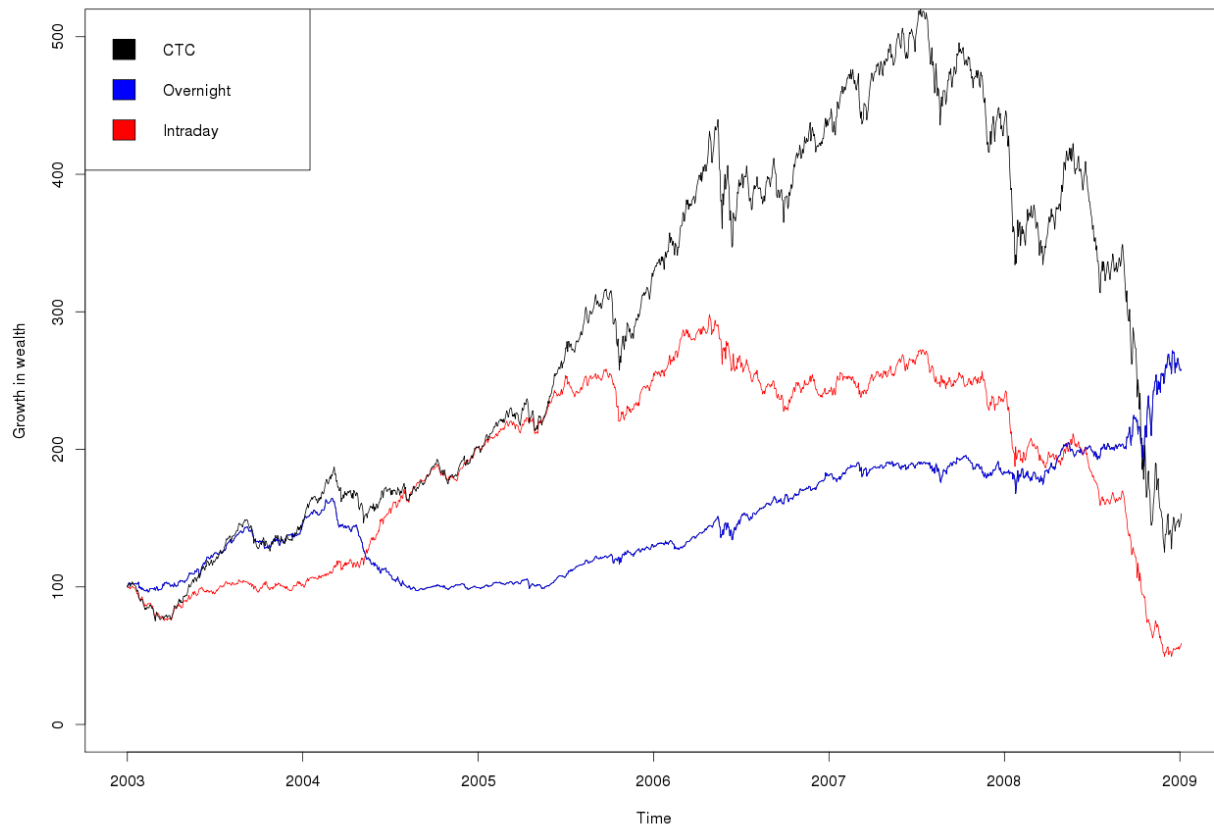
Per-cent is given as amount of negative days divided by total days.

For the whole period we found the ratio for the amount of negative trading days to be 49 % for the intraday and 41 % for the overnight. In the first 6-years, we find the intraday to have 47.94 % of total days with a negative return and the overnight to have 43.50 % of total days with a negative return. As for this, the ratio is similar to the whole period. The observed lower amount of positive overnight and negative intraday returns can thus not be explained by a high number of negative trading days.

To illustrate the difference we observe between the overnight and the intraday of the period, we graphically plot the growth of \$100 invested in the return one could achieve investing daily in

either the night or day period. We add the close-to-close return as well. The mathematical procedure is the same as for the whole period.

Figure 8: Cumulative wealth from 2003 to 2008



Initial invest amount \$100. CTC equals the investment in the close-to-close.

In the first years, the intraday performs strong as it reaches a peak of around \$300. We actually observe the intraday investment to exceed the overnight investment for most of the period. On the other hand, after reaching the peak in 2006 the following years are negative. This negativity is clearly intensified by financial turmoil in 2008. The overnight, on the other hand, have a steady behaviour after the negative return we observed in 2004. Interestingly, we see that even though the intraday is decreasing, the overnight is steadily increasing. Observing the close-to-close reveals the intraday to have a large effect on the negative return in the last years.

Table 15: Final value and geometric return from 2003 to 2008

	Close-to-close	Overnight	Intraday
Final Value	\$153	\$258	\$58
Daily Geometric Return	-	6.29	-3.51

Final value is given in USD and daily geometric return in basis points.

In Table 15, the final values of the investments can be examined. Over 1509 active trading days, the investment in the intraday delivers a geometric return of negative 3.51 basis points. A relatively bad overall performance considering a normal investment by close-to-close would lead to a final value of \$153. The final value of the intraday is \$153. On the other hand, the overnight return, performing consistently strong, has a final value of \$258. This is the same as a geometric return of positive 6.29 basis points.

The result of the analysing the period of 2009 to 2014 revealed high overnight and weak intraday return.

Table 16: Return and standard deviation from 2009 to 2014

	Close-to-close	Overnight	Intraday
Mean	4.8	13.7	-8.9
Standard deviation	1.7	0.8	1.5

Mean is given as basis points and standard deviation is given in per-cent. Returns are given as arithmetic returns.

In Table 16, we present our findings of studying the night and day returns over the period. We questioned if we saw a change in the behaviour of the returns in 2008 to 2009. This seems to be the case. The results reveal the amount of returns for both night and day to be higher than the overall and first sub-period. The return of the intraday is negative 8.9 basis points. This is not as we expected considering the state of the overall market. Even though the market is in what we defined as a bull-state the intraday keeps underperforming. We find the overnight to have a daily average return of 13.7 basis points. Taking into consideration that our returns are of daily values of 1506 active trading days, we find the returns to be high. Even more interesting is the higher amount of return in the second period than the first. The standard deviation of the intraday is 1.5 % and the standard deviation of the overnight is 0.8 %. We observe the standard deviation of the

intraday to be equal to the first period and the standard deviation of the overnight to decrease. Both for the overnight and intraday to decrease and to be equal is strange. We would expect a higher amount of returns to equally be reflected by a higher amount of standard deviation. This is not the case.

We compute the number of days ending with a positive return during closure and opening hours, as can be examined in Table 17.

Table 17: Amount of days with negative return from 2009 to 2014

Period	Days with negative return	Total	%
Overnight	568	1506	37.72%
Intraday	765	1506	50.80%

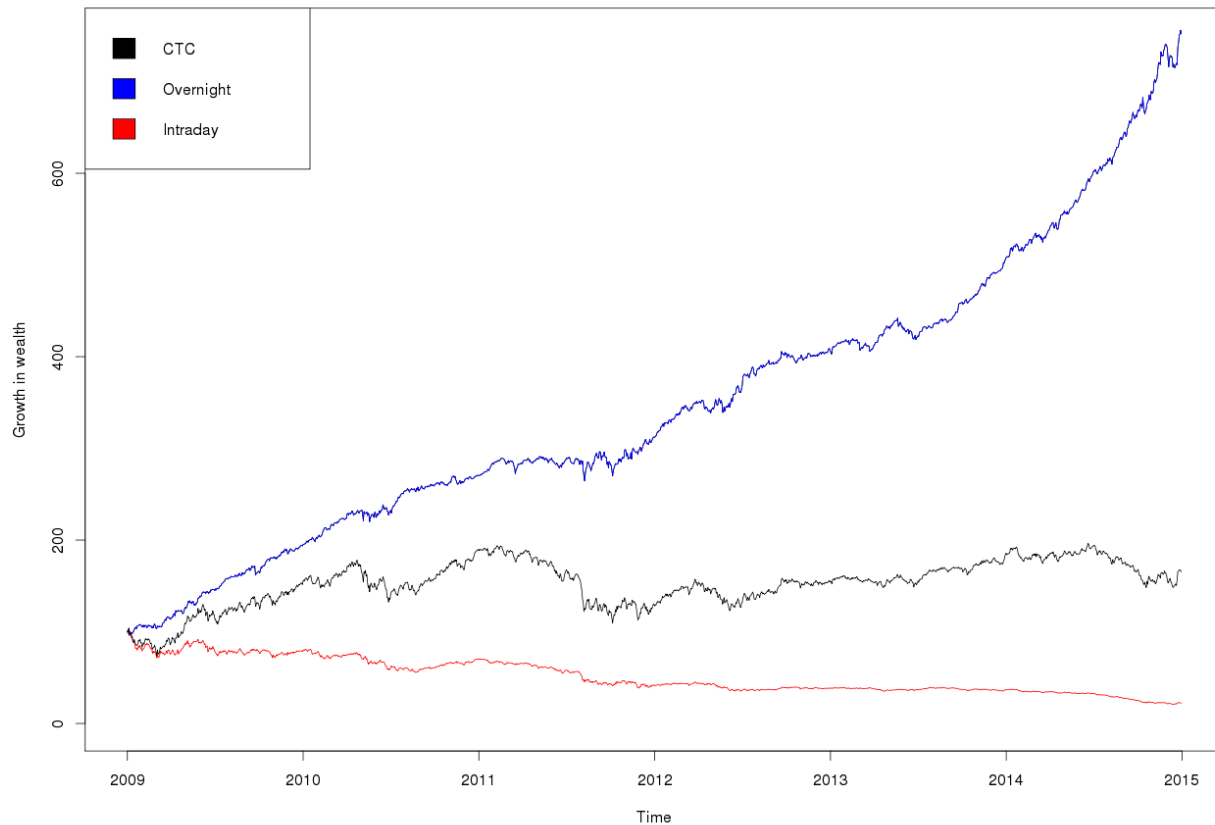
Per-cent is given as amount of negative days divided by total days.

For the whole period, we found the ratio for the amount of negative trading days to be 49 % for the intraday and 41 % for the overnight. In the last 6-years we find the intraday to have 50.80 % of total days with a negative return and the overnight to have 37.72 % of total days with a negative return. As for this, the ratio is similar to the whole period. The higher amount of positive overnight and negative intraday returns can thus not be explained by a high number of negative trading days.

To illustrate the difference we observe between the overnight and the intraday of the period, we graphically plot the growth of \$100 invested in the return one could achieve investing daily in either the night or day period. We add the close-to-close return as well. The mathematical procedure is the same for the whole period.

The 6-year period emphasizes the significant difference between the overnight and the intraday. From the start of 2009 to 2014, the overnight is consistently higher than the intraday. As we see the investment of overnight substantially increase and the intraday falling towards zero.

Figure 9: Cumulative wealth from 2009 to 2014



Initial invest amount \$100. CTC equals the investment in the close-to-close.

In Table 18, the final values of the investments can be examined. The \$100 night investment is consecutively performing better than the day investment. The overnight has a final value of \$751 compared to the intraday of \$22. The overall close-to-close has a final value of \$165. Over the 1506 trading days the intraday delivers a daily geometric return of negative 9.962 basis points, while the overnight 13.272 basis points.

Table 18: Final value and geometric return from 2009 to 2014

	Close-to-close	Overnight	Intraday
Final Value	\$165	\$752	\$2
Daily Geometric Return	-	13.3	-10.0

Final value is given in USD and daily geometric return in basis points.



## 5. Discussion

After inspecting the relationship between the overnight and intraday return it is evident, the important role non-trading hours has had on the overall performance of our sample. Over the 12-year period, we find high overnight and low intraday returns. Our results are similar to the above-mentioned empirical studies introduced in the literature. Even though we investigate the return of night and day on a set of individual stocks rather than a complete market, we still find positive returns of overnight and negative returns of intraday. The overnight is persistently high, and the intraday is constantly weak. There is no surprise that the returns during trading hours vary, but we find it strange that there seem to be no compensation for holding assets through a fluctuating day. Majority of our stocks are found to hold a negative, at best zero, “risk-return trade-off”<sup>20</sup> as holding a risky asset gives no payoff during trading hours. As the intraday is found to fluctuate more in return than the overnight, one would expect the return to reflect the greater risk. This seems not to be the case.

Cliff, Gulen and Cooper (2006) document average overnight returns for each individual weekday to be positive. This holds for our result as well. Despite similar findings, they do not find the behavior where returns overnight increase as the week progress. We on the other hand, find weekday returns to steadily increase and Friday to have the highest average return. Our result is relevant to the anomaly familiarized in the introduction; the Day of the Week Effect, where the daily return of a stock is found to increase with the week’s progression. Studies of the Day of the Week Effect operate with close-to-close returns (e.g. Dubois & Louvet, 1996). Our result adds a new view. When we divide our return into overnight and intraday we find the increasing weekday return solely caused by overnight returns. The average overnight return for the weekdays gradually increases, as this is easily observable<sup>21</sup>. To some extent, we find the intraday to perform better as the Friday return is positive, but the increase is not clearly visible as the overnight. The remaining weekdays of the intraday are negative. Our result leads us to believe that the Day of the Week Effect mainly returns over non-trading hours rather than trading hours.

---

<sup>20</sup> Bodie, Kane & Marcus (2011) p. 37-38.

<sup>21</sup> See Table 9, page 34.

The study by French (1980) found average weekend returns to be negative 16 basis points from 1953 to 1977. As mentioned in introductory part, this occurrence is known as the Weekend Effect. According to the anomaly, the weekend is not supposed to exhibit any form of positive return. Past studies operated with close-to-close returns and likewise when we use close-to-close returns, we find the weekend return to be of negative value. The overnight return of a weekend is represented as the difference between Monday open and previous Fridays close. It is, therefore, the best measurement for studying the true return over a weekend. It does not consider movements in the return after the opening, neither before the close. It should be the best indicators to see if there exists a return over the weekend. Cliff, Gulen and Cooper (2006) found overnight return of the Monday to be positive. Our Monday overnight return is 10.56 basis points. This raises the question on the validity of the Weekend Effect. Our results imply that the weekend itself is not experiencing negative returns. It is the intraday of negative 12.60 basis points that exceeds the overnight, resulting in a negative close-to-close return. We find a possible explanation to why the overnight is positive and the intraday is negative to be the case of a market correction. The high increase in the Friday stock price, as we document, might be corrected by a following low return on the intraday of Monday. This might be the case, where investors hold their stocks over the weekend and then, settle the position during trading hours of Monday. The effect of an aggregated amount of investors wanting to settle their position on Friday would lead to a decrease in the stock price.

Although we find positive overnight returns for the weekend and individual weekdays, the amount of days ending with positive return holds for 60 % of the total observations. A varying performance might indicate that we could expect certain periods of the 12-year analysis to perform differently from the other ones. Separating average daily returns into monthly values, gives mixed results. We find the overnight of January to perform best, but not with an amount we find differently from the rest of the months. On the other hand, we observe May being the only month holding a negative overnight return and we question why. Potentially this could indicate an irregular pattern in the returns as to what we see for the rest of the year. In Norway, the month of May has numerous non-trading days, in this case holidays. The negative overnight could be a reversed process of the Holiday Effect, shown in the introduction. According to Ariel (1990), high return pre-holidays are to be persistent across trading hours. It should thus affect the

intraday. We do in fact find the second highest positive average intraday return in the month of May. Not only is the overnight negative, but the intraday exceeds it by far. We find the same behavior in December, where we observe high positive intraday return exceeding the overnight return. December like May has several non-trading days. A possible explanation is the case, where investors hold their position longer and are reluctantly to sell. This would explain the increase in the intraday return, where a larger demand for a stock and an investor being reluctantly to sell increases the closing value, and thus, the intraday return. On the other hand, this does not explain the negative and weak overnight. Throughout our sample, we see a large difference between the return of night and day. A possibility is the negative correlation between night and day (Branch & Ma, 2012), as we document, being strong during May and December. If this is the case, we would expect the positive intraday return to have the opposite effect on the overnight return.

As we turn to yearly returns we surprisingly find the turmoil of 2008 to 2009 holding good results for the overnight. Not only does the overnight hold positive average returns during what would logically be believed to be a highly negative period, but the non-trading hours also perform with an average among 3 of the highest returns of all the years. In contrast, the intraday underperforms in 2008 with high negative returns. Our result for the intraday is as expected, but we question why the overnight is so strong. The study of Cliff, Gulen and Cooper (2006) for the period of 1993 to 2006 includes the dot-com-bubble crash<sup>22</sup>. They report negative overnights in both 2001 and 2002 following the bubble-burst. This opposite of what we find in 2008 and 2009. Since it is inappropriate to compare two crises, not to mention on different exchanges, it gives us no indication as to why the overnight is so high during turmoil. Even so, it might seem as the overnight is independent from the current market situation. So, the overnight seem averagely strong during a bull period.

When we analyze the two sub periods we observe that our results may indicate a shift in the pattern of return. In the first sub-period we find the intraday to perform well as majority of the measured years hold positive means. For the intraday to hold a positive return, the close has to beat the opening price. This happens frequently as 4 out of 5 years hold a positive average daily

---

<sup>22</sup> <http://www.investopedia.com/features/crashes/crashes8.asp>

return. Following this, we observe the intraday to change by persistently holding a negative daily mean for the subsequent years after 2007. Even though we find the daily average close-to-close to be similar for both sub periods, 4.7 and 4.8 basis points respectively, there is a clear difference in the amount of overnight and intraday return between the two sub periods. In fact, the overall negative intraday return from the first to the second period increases more than three times. The overnight almost doubles. This is interesting, as we would not expect the trading hours to exhibit so much negative return. Even more interestingly, we observe the overnight to perform more steadily. The daily average standard deviation from the first to the second period falls from 0.3% to 1.2%. The standard deviation of the intraday remains unchanged. From this it can be stated that the increased returns of overnight and intraday are not because of an increased fluctuation in the returns. More specifically, the overnight deviates less from its mean of 13.727 basis points. The opening price more frequently outperforms the previous days close and by far. Not only do we observe a weak closing price, than that of the next day opening, but also a higher opening price. This leads us to believe the second period holds fluctuations in the returns more centralized at the after-opening and pre-closing hours. Meaning a high opening price followed by a weak closing price. Cliff, Gulen and Cooper (2006) divided the overnight and intraday into 4 different segments of the trading day<sup>23</sup>. They found the after auction hours of AM (8:30 to 9:30) to exhibit a negative average return over the period of 1993 to 2006. This implies a negative average return following the opening. As the day would progress, the various time intervals of returns would gradually improve and daily performance of a stock would be highest close to trading stop. So, the accumulated intraday would still be negative. This might be what we see in our situation, but at a stronger magnitude.

The paper of Hong and Wang (2000) states the volatility of the trading hours, holding a U-shaped pattern. This suggests high volatility at the opening and the closing hours. This has implications for the return of overnight, as one buys and sells at these points of time. If the price is driven up during opening from the previous close, then the overnight would benefit from a low buy and high sell price. This could be the behavior we see occurring and is a potential explanation to why we observe such high overnight returns in the second period. After the crisis of 2008, we see

---

<sup>23</sup> Cliff, Gulen and Cooper (2006, e.g. p.30) divided the day into 4 segments: Night (4 PM-9:30 AM), AM (9:30-10.30), Mid-day (10:30-3:00), and PM (3:00-4:00).

higher amount of overnight. This could be the result of higher volatility in the market. Schwert (1989) finds volatility to increase after a financial crisis. Due to an increase in volatility, investor can shorten their investment horizon and be more reluctant to sit with stocks during non-trading hours. More specifically, this can result in a high amount of investors settling their position at the end of the day, which would decrease the closing price. If there are no investors willingly to hold a stock overnight, then the positive night return we observe might be in a form of illiquidity premium. This leaves some evidence towards the theory of Longstaff, (1995) stating the non-trading hours are rewarded with a premium, where a non-marketability effect, a period where no stocks are traded, is the cause of positive overnight.

Another reasonable explanation for the change in the amount of overnight and intraday return might be the case of semiprofessional<sup>24</sup> day traders, as according to Clark and Kelly (2011). In a volatile market, there is most likely to be a higher amount of investors betting on the daily movement of the market. The situation, where semiprofessional day traders settle and open their positions would cause a liquidation effect. Reluctantly, to hold stocks over a non-trading period, where they would be unable to sell, would push traders to buy in the early trading hours and sell close to closure. The price of a stock would be affected by the buy and sell behavior of the semiprofessional day traders. The early buy would push the open price up and the late sell would push the closing price down. An aggregated amount of the day trader behavior would have strong effect on the overnight, as it would gain on the low close and high open. The intraday would lose. In fact, it follows from the study of Goldberg and Lupercio (2004) that the semiprofessional day traders had a large impact on the trading volume of NYSE and NASDAQ in 2003. It does not imply if the same holds for OSE, even so it could be a potential explanation to what we see occurring in our second sub-period.

In our results we find 11 out of the 15 stocks to hold positive overnight return. We find especially two stocks having remarkably strong amount of returns. We consider these as the two extreme cases of our sample. The stocks are SUBC and ORK. SUBC delivers high overnight return while ORK delivers high intraday return. Both SUBC and ORK show different qualities regarding the reward for holding the stock. We believe ORKs intraday to be firm specific as the risk and

---

<sup>24</sup> Semiprofessional refers to a trader entering / settling more than 25 positions daily (Clark and Kelly, 2011)

reward during the day is substantially higher than the rest and not representation of the behavior of the other stocks in the sample.

The strong difference between the return of overnight and intraday let us towards a correlation analysis. Branch and Ma (2012) found strong empirical evidence towards the overnight and the intraday holding a relationship, where the two returns tend to move in opposite directions. However, they discover that a higher market capitalization would result in less amount of negative correlation. Based on this, since our stocks have a high market capitalization, we would expect a weak relationship between the overnight and the intraday return. Results reveal the majority of our stocks to have a negative correlation and of a low degree, this is thus, on par with Branch and Ma (2012) findings. On the other hand, it is important to notice that we operate with daily financial data, and that low correlations are to be expected. The result helps us partly explain why the difference between overnight and intraday is so large. The two returns tend to vary in opposite direction, but the correlations are modest. We extended the analysis by adding lagged values of the intraday and the overnight. This was carried out to see whether the relationship holds for preceding returns or not. Branch and Ma (2012), found the correlation to be consistent when using lagged returns. Our results on the other hand, are highly mixed. We find no tendency about whether there exists a correlation with the lagged variables or not.

Since there exists a correlation between the overnight and intraday, it led us to conduct a regression. We investigated if the overnight return held a predicting ability to the intraday return. We used the intraday return as the dependent variable. The independent variable consisted of the overnight, but also the lagged returns of intraday and overnight. Our prediction revealed negative coefficients with overnight and majority statistical significant. This implied that a minor change in the overnight return would change the expected value of the intraday in the opposite direction. This result is similar to Branch and Ma (2012). Our coefficients with lagged variables have a mixed result. We found the lagged intraday to have a negative coefficients with the intraday and the lagged overnight to show no consistent pattern. Branch and Ma (2012) found majority of the coefficients with lagged variables to be negative. As follows, our results using lagged variables are different. Despite this, the correlation and regression have results that are both contracting the EMH and the Theory of Random Walk. There should be no benefits of using historical prices

to predict and find a relationship between overnight and intraday. Even so, we find the existence of a related night and day relationship.

There are some implications connected to overnight and intraday strategies that are not taken into consideration in this thesis. Firstly, we do not consider transaction costs when calculating returns. Secondly, there could be difficulties with buying and selling at both open and closed conditions. We discuss these difficulties and what consequences they might have on the returns when considering intraday and overnight as an investment opportunity. When discussing transactions cost, our primary focus is on trading fees when buying and selling securities.

We have different strategies to obtain returns, by considering close-to-close return, intraday and overnight. Each needs different buy and sell strategies. The close-to-close does not need daily transactions to capture the return, and the holder can simply buy at a close and sell at a close, when the investor wants to cancel the position. The longer the investor holds the stock, the less impact the transaction cost has on the return. On the other hand, an intraday investor needs 2 daily transactions. He needs to buy at opening price and then, sell at the closing price, on the same day. For a positive payoff this implies the investor need a return exceeding the transaction cost. Same holds for the overnight investor. He buys at the closing price and sells at the opening price. This means that both the intraday and the overnight return have large amount of transaction costs over a period. As an example consider Nordea, which offers its private costumers a transaction fee of 5 basis points<sup>25</sup> per trade. The return of an overnight or intraday investment would need to be equal or greater than 10 basis points daily. This happens rarely in our case, and the fee alone would exceed the daily return in most of the stocks both for the night and day period.

To create the equally weighted portfolio strategies, there is substantial amount of transaction costs. In order to create close-to-close portfolio, the investor needs to buy an equal amount in all 15 stocks at close price and sell at the close price, when the investor wants to cancel his position. Typically, the investor needs to pay a fee for each stock and each transaction, totaling to 15 fees to manually create the portfolio also 15 transactions to close his position. Both intraday and

---

<sup>25</sup> <http://www.nordea.no/privat/sparing/aksjer/aksjehandel+p%C3%A5+nett/901762.html>

overnight require 2 daily transactions each. A total of 30 fees per day for the portfolio consisting of 15 stocks are needed. Daily fee would be 1.52 % for the intraday and overnight portfolios. The fees would exceed the return of overnight and intraday. Implementing an overnight and intraday strategy would therefore not be a good investment from a private investor point of view.

Our returns are calculated using the open, which is the first traded price of the day, and the close price, which is the last traded price of the day. For an investor to replicate our results would be challenging. There are large changes in the stock prices from second to second and the probability of buying or selling at the right moment is therefore, slim. This could prove to be even more difficult if the investor has an intraday or overnight portfolio, requiring the investor to trade on open and close simultaneous for all 15 stocks. This could prove to be impossible, and would require the investor to put limit orders before close, engage brokers or use an automated transaction program. If the investor chooses to put a limit order, he must know the end price, and there is a risk that his order does not get filled. If the investor fails to buy and sell at close and open price, this could lead to different returns. If the investor is better off or worse off and if he buys 1, 2 or 3 minutes before close, it becomes impossible to convey, based on the data at hand.



## 6. Conclusion

This thesis investigates the return of overnight and intraday in 15 stocks on the Oslo Stock Exchange over the period of 2003 to 2014. After studying the night and day return of the stocks in an equally weighted portfolio it is evident that the non-trading hours has had the important role on the overall performance of our sample. We find high overnight returns and low intraday returns. This is found to be persistent over the 12-year period, as this holds for yearly, monthly and weekday measures, as well as for sub-periods. We do not find the difference between night and day being caused by a higher ratio of days ending with a negative return. For the whole period, the ratio is centralized around 40 % negative overnight days and 50 % negative intraday days. The difference is thus found to be in the daily amount of overnight and intraday return.

Inspecting the stocks individually reveals majority to hold positive overnight return and negative intraday return. More specifically, 11 out of 15 stocks have positive overnight return and 4 stocks positive intraday return. Interestingly, the amount of overnight and intraday return always seems to be the opposite. We find the stocks with positive overnight to have negative intraday returns and the stocks with positive intraday to have negative overnight return. Among the stocks ORK and SUBC have remarkable returns. These are treated as our samples' extreme points. ORK delivers a high amount of intraday return and SUBC a high amount of overnight return. We believe the reason for SUBCs abnormal return to be the same as for the rest of the sample. While ORK has a return pattern unlike the majority and therefore, the return is thought to be firm specific.

We divide the overall period into sub periods of 2003 to 2008 and 2009 to 2014. From the first to the second period, we see a high increase in the amount of positive overnight and negative intraday return. Interestingly, the increased amount is not a result of increased fluctuations in return as the standard deviation of the overnight decreases and for the intraday it is constant. Neither of those is the cause for a ratio change in the amount of trading days ending with a negative return. We suggest the difference we observe between the overnight and intraday in the sub-periods being caused by three different reasons: a change in the risk-reward; illiquidity

premium for holding stocks over non-trading periods; the presence of a high amount of semiprofessional daytraders in the market.

By performing a correlation and a regression, we investigated the relationship of the overnight and the intraday return. The correlation revealed the night and subsequent day return for majority of our stocks to have a negative relationship. More specifically, a tendency where the returns move in opposite directions was found. We further investigated if this tendency would be persistent with the overnight and the previous day return of night and day. The results were highly mixed and gave no consistent picture. The regression investigated the ability of overnight and preceding returns to predict the intraday return. We only found negative coefficients of overnight to deliver useable predictions. Even so, we found the overnight and intraday to have a negative relation. This partly explains the difference between night and day we observe over the 12-year period.

Our results are found to add new views to the documented anomalies of the Day of the Week Effect, Weekend Effect and Holliday Effect which as far as we know has only been analyzed using close-to-close returns. When decomposing the close-to-close return into overnight and intraday returns, we find the Day of the Weekend Effect, stating the returns of the weekdays to increase as the week progress, solely being caused by the overnight. The Weekend Effect, stating that there are no positive returns over the weekend, is found to be partly consistent. The true return of the weekend, the overnight return on Monday, is positive while an exceeding amount of the Monday intraday return is the one contributing to the overall negative weekend return. We argue the highly positive weekend return being corrected by the following Monday intraday return, originally explaining why we find a negative weekend return in the close-to-close. When investigating monthly returns, we only observe May and December cases where the intraday exceeds the overnight return. Both are suggested to be partly due to a reversed Holiday Effect, documenting strong returns close to holidays, where the overnight performs worse as a compensation for the strong intraday return.

For future additions to the study of overnight and intraday it could be interesting to study the possibility of a long-overnight-short-intraday strategy (e.g. Qiu & Cai, 2013) on OSE. By taking

the difference we observe between the overnight and intraday return and investigate if it is possible to conduct a trading strategy on the negative relationship. Where one use the negative relation to decide whether to sit long or short.

## 7. References

- Ahoniemi, K., & Lanne, M. (2013), Overnight Stock Returns and Realized Volatility, *International Journal of Forecasting*, vol.29, issue 4, 592-604.
- Amihud, Y., & Mendelson H. (1986), Asset Pricing and the Bid-Ask Spread, *Journal of Financial Economics*, vol.17, issue 2, 223-249.
- Andersen, G., T., Bollerslev T., Diebold X., F., & Ebens, H., (2001), The distribution of realized stock return volatility, *Journal of Financial Economics*, vol.61, issue 1, 43-76.
- Ariel, A., R., (1990), High Stock Returns before Holidays: Existence and Evidence on Possible Causes, *The Journal of Finance*, vol.45, issue 5, 1611-1626.
- Banz, R., (1981), The Relationship Between Return and Market Value of Common Stocks, *Journal of Financial Economics*, vol.9, issue 1, 3-18.
- Barcaly, M. & T. Hendershott, (2003), Price Discovery and Trading After Hours, *Review of Financial Studies*, vol.16, issue 4, 1041-1073.
- Barry, B., C., & Brown, J., Stephen, (1984), Differential Information and the small firm effect, *Journal of Financial economics*, vol.13, issue 2, 283-294.
- Basu S, (1977), The Investment Performance of Common stocks in Relation to Their Price-Earnings Ratios: A Test of the Efficient Market Hypothesis, *The Journal of Finance*, vol.32, issue 3, 663-682.
- Bodie, Z., Kane, A., & Marcus, A.J (2011). *Investments and Portfolio Management: Global Edition*, ninth edition, McGraw-Hill/Irwin, New York.
- Branch, S., Ben, & Ma, A., (2006), The Overnight Return, One More Anomaly, *Oklahoma City University – Meinders School of Business, and University of Massachusetts Amherst – Isenberg School of Management*, Working paper.
- Branch, S., Ben, & Ma, A., (2012), Overnight Return the Invisible Hand Behind Intraday Returns?, *Journal of Applied Finance*, vol.22, issue 2.
- Cadsby, Bram, C., & Ratner, M., (1992), Turn-of-month and pre-holiday effects on stock returns: Some international evidence, *Journal of Banking & Finance* vol.16, issue 3, 497-509.
- Campbell, J. Y., A. W. Lo . A. C. Mackinlay. (1997), *The Econometrics of Financial Markets*, New Jersey, Princeton University Press, p 11
- Cliff, M.T., M.J. Cooper, & H. Gulen, (2008), Return Differences Between Trading and Nontrading Hours: Like Night and Day, *Virginia Polytechnic Institute and State University, The University of Utah, and Purdue University*, Working paper.

- Dubois, M., & Louvet, P., (1996), The day-of-the-week effect: The international evidence, *Journal of Banking & Finance*, vol.20, issue 9, 1463-1484.
- Fama, E & French, K.R (1992), The Cross Section of Expected Stock Returns, *The Journal of Finance*, vol.47, issue 2, 427-465.
- Fama, E., (1965a), The Behavior of Stock-Market Prices, *Journal of Business*, vol.38, issue 1, 34-105.
- Fama, E., (1965b), Random Walks in Stock Market Prices, *Financial Analysts Journal*, vol.21, issue 5, 55-59.
- Fama, E., (1970), Efficient Capital Markets: A Review of Theory and Empirical Work, *Journal of Finance* vol.25, issue 2, 383-417.
- Foerster, R., S. & Karolyi, A.G., (1999), The Effect of Market Segmentation and Investor Recognition on Asset Prices: Evidence from Foreign Stocks Listing in the United States, *The Journal of Finance*, vol.54, issue 3, 981-1013.
- French, K.R, (1980), Stock Returns and The Weekend Effect, *Journal of Financial Economics* vol.8, issue 1, 55-69.
- French, K.R, & R. Roll, (1986), Stock Return Variances: The Arrival of Information and the Reaction of Traders, *Journal of Financial Economics* vol.17, issue 1, 5-26.
- Goldberg, D. & Lupercio, A. (2004), Cruising at 30,000: Semi-Pro Numbers Level Off, but Trading Volumes Rise, *Bear Stearns Equity Research*.
- Gregoriou, A & Hudson,R (2010), Calculating and Comparing Security Returns is Harder than you Think: A Comparison between Logarithmic and Simple Returns, *available at SSRN: <http://ssrn.com/abstract=1549328> (February 7, 2010)*
- Harris, L, (1989), A Day-End Transaction Price Anomaly,*The Journal of Financial and Quantitative Analysis* vol.24, issue 1, 29-45.
- Hong, H & Wang, J, (2000), Trading and Returns under Periodic Market Closures, *Journal of Finance*, vol.55, issue 1, 297-354.
- Kadlec, B., G., & McConnell, J., J., (1994), The Effect of Market Segmentations and Illiquidity on Asset Prices: Evidence from Exchange Listings, *The Journal of Finance*, vol.49, issue 2, 611-636.
- Kelly, M. & Clark, S (2011), Returns in Trading Versus Non-Trading Hours: The Difference Is Day and Night, *Journal of Asset Management* vol.12, issue 2, 132-145.

- Longstaff, F., (1995), How Much Can Marketability Affect Security Values?, *Journal of Finance*, vol.50, issue 5, 1767-1774.
- Malkiel, B. G. (2003), The Efficient Market Hypothesis and Its Critics, *The Journal of Economic Perspectives*, vol.17, issue 1, 59-82.
- McInish, H. T, Ord K. J., & Wood, A.R, (1985), An Investigation of Transactions Data for NYSE Stocks, *The Journal of Finance*, vol. 40, issue 3, 723-739.
- McInish, H. T & Wood, A.R, (1990), A Transaction Data Analysis of The Variability of Common Stock Returns During 1980-1984, *Journal of Banking & Finance* vol.14, issue 1, 99-112.
- Qiu, M & Cai, T, (2013), On Overnight Returns Premiums of International Stock Markets, *Department of Economics and Finance (Albany), Massey University*, Working paper.
- Reinganum, R.M., (1981), Misspecification of capital asset pricing, Empirical anomalies based on earning' yields and market values, *Journal of Financial Economics* vol.9, issue 1, 89-104.
- Schwert W., G., (1989), Business cycles, financial crises, and stock volatility, *Carnegie-Rochester Conference Series on Public Policy* vol.31, issue 1, 83-125.
- Slezak, S., (1994), A Theory of the Dynamics of Security Returns around Market Closures, *Journal of Finance*, vol.49, issue 4, 1163-1212
- Stoll, H. & R. Whaley, (1990), Stock Market Structure and Volatility, *Review of Financial Studies* vol.3, issue 1, 37-71.
- Thaler, H.R ,(1987), Seasonal Movements in Security Prices I: The January Effect, *Journal of Economics Perspective*, vol.1, issue 1, 197-201.