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IS THERE A FRIDAY EFFECT IN FINANCIAL MARKETS?

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Abstract

This paper tests for the presence of the Friday effect in various financial markets (stock markets, FOREX, and commodity markets) by using a number of statistical techniques (average analysis, parametric tests such as Student's t-test and ANOVA analysis, non-parametric ones such as the Kruskal-Wallis test, regression analysis with dummy variables). The evidence suggests that stock markets are immune to Friday effects, whilst in the FOREX Fridays exhibit higher volatility, and in the Gold market returns are higher on this day of the week. Using a trading robot approach we show that the latter anomaly can be exploited to make abnormal profits.

Keywords: *Calendar Anomalies; Day-of-the-Week Effect; Stock Market; Efficient Market Hypothesis.*

JEL classification: *G12, C63*

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1. Introduction

Calendar anomalies in financial markets have been extensively analysed in the empirical literature with the aim of establishing whether they generate exploitable profit opportunities that would be inconsistent with market efficiency.

One of the best known calendar anomalies is the “day-of-the-week” or “weekend” effect, namely the common finding that asset prices tend to increase on Fridays and decrease on Mondays (Cross, 1973). Whilst most existing studies analyse the latter phenomenon, the present one will focus on anomalies in price behaviour on Fridays. Two main reasons have been invoked to explain them, i.e. profit realisation (by closing opened positions with a profit) and important news releases (such as non-farm payrolls and GDP in the US) on the last day of the week; these can affect both the mean and the volatility of asset returns. The present paper aims to test for the presence of the Friday effect in various financial markets by using a number of statistical techniques (average analysis, parametric tests such as Student's t-test and ANOVA analysis, non-parametric ones such as the Kruskal-Wallis test, regression analysis with dummy variables). Its findings will be informative for both academics and practitioners aiming to develop more effective trading strategies generating abnormal profits.

The layout of the paper is as follows. Section 2 briefly reviews the literature on calendar anomalies and the possible reasons for the Friday effect. Section 3 describes the data and outlines the empirical methodology. Section 4 discusses the empirical results. Section 5 offers some concluding remarks.

2. Literature Review

According to the Efficient Market Hypothesis (EMH - Fama, 1970) there should be no systematic patterns in price behaviour, specifically mean returns and their volatility should not exhibit significant differences between different days of the week. However, several papers have found evidence of “day-of-the-week” effects. For example, Cross (1973) reported systematic

price increases on Fridays and decreases on Mondays for US stock prices. French (1980) found negative returns on Mondays. Gibbons and Hess (1981), Keim and Stambaugh (1984), Rogalski (1984), Smirlock and Starks (1986), Agrawal and Tandon (1994), Racicot (2011), and Caporale et al. (2016, 2017) also found some evidence of a weekend effect.

Possible explanations for these anomalies are psychological factors (traders and investors look ahead to the weekend optimistically, but are rather pessimistic about Mondays because of the belief that this is a "difficult day); trading patterns of institutional investors; the closing of speculative positions on Fridays and the establishing of new short positions on Mondays by traders; important news releases on Fridays. Another possible reason is that over the weekend market participants have more time to analyse price movements and, as a result, on Mondays a larger number of trades takes place. Alternatively, this might be due to deferred payments during the weekend, which creates an extra incentive for the purchase of securities on Fridays, leading to higher prices on that day.

There is some evidence that the weekend effect has become less important over the years (Fortune, 1999; Schwert, 2003; Olson et al., 2010). As previously mentioned, most studies focus on the Monday effect for mean returns, but anomalies on Fridays, especially concerning the behaviour of price volatility, might be in fact more interesting to investigate. These could be due to profit realisation (by closing opened positions with a profit at the end of the week) and/or important macro news releases. Therefore the following two hypotheses will be tested below:

- Hypothesis 1: Mean returns are different on Fridays from the rest of the week;
- Hypothesis 2: The volatility of prices is different on Fridays from the rest of the week.

3. Data and Methodology

We analyse daily data from different financial markets: stock markets (in both developed and emerging countries), the FOREX and commodity markets. Specifically, the following series are

examined: the Dow Jones Industrial Index, the SP 500 and the NASDAQ for developed stock markets; the MICEX (Russian stock market) and UX (Ukrainian stock market) indices for emerging stock markets; the EUR/USD, GBP/USD, USD/JPY and RUB/USD exchange rates for the FOREX; Gold and Oil (Brent) for the commodity markets. The sample period goes from 2004 to 2016, unless data are available only for a shorter period (for instance, from 2008 to 2016 for the UX Index).

The hypotheses of interest are tested using a variety of statistical techniques including simple average analysis, parametric tests (Student's t-tests, ANOVA), non-parametric ones (Kruskal-Wallis test) and regression analysis with dummy variables.

Returns are computed as follows:

$$\mathrm{R_i} = (\frac{\mathrm{Close_i}}{\mathrm{Open_i}}\text{-1}) \times 100\% \ , \tag{1}$$

where R_i – returns on the *i-th* day in percentage terms;

$Open_i$ – open price on the *i-th* day;

$Close_i$ – close price on the *i-th* day.

Volatility is computed as follows:

$$\mathrm{R_i} = (\frac{\mathrm{High_i}}{\mathrm{Low_i}}\text{-1}) \times 100\% \ , \tag{1}$$

where R_i – returns on the *i-th* day in percentage terms;

$High_i$ – maximum price on the *i-th* day;

Low_i – minimum price on the *i-th* day.

We carry out average analysis to obtain some preliminary evidence, and then implement the statistical tests already mentioned to test whether average returns (volatility) on Fridays differ significantly from those during the rest of the week. The Null Hypothesis (H0) in each case is that the data belong to the same population, a rejection of the null suggesting the presence of an anomaly.

We also run multiple regressions including a dummy variable to identify calendar anomalies:

$$Y_t = a_0 + a_1 D_{1t} + \varepsilon_t \qquad (3)$$

where Y_t – return in period *t;*

a_0– mean return (volatility) during Monday-Thursday;

a_1– mean return (volatility) during Friday;

D_{1t} – a dummy variable equal to 1 for Fridays and 0 for the other days of the week;

ε_t – Random error term for period *t*.

The size, sign and statistical significance of the dummy coefficient (a_1) provide information about possible anomalies.

When significant anomalies are detected, a trading robot approach is then used to establish whether it is possible to make abnormal profits by exploiting them. This approach simulates the actions of a trader using an algorithm (trading strategy). This is a programme in the MetaTrader terminal that has been developed in MetaQuotes Language 4 (MQL4) and used for the automation of analytical and trading processes. Trading robots (called experts in MetaTrader) allow to analyse price data and manage trading activities on the basis of the signals received.

To make sure that trading results are statistically different from the random ones z-tests are carried out. Z-test compares the means from two samples to see whether they come from the same population. In our case the first is the average profit/loss factor of one trade applying the trading strategy, and the second is equal to zero because random trading (without transaction costs) should generate zero profit. The null hypothesis (H0) is that the mean is the same in both samples, and the alternative (H1) that it is not. The computed values of the z-test are compared with the critical one at the 10% significance level. Failure to reject H0 implies that there are no advantages from exploiting the trading strategy being considered, whilst a rejection suggests that the adopted strategy can generate abnormal profits.

4. Empirical Results

First we analyse the US stock market using the Dow Jones (period: 1885-2016) and SP500 (period: 1957-2016) indices to detect the biggest price movements (see Table 1).

Table 1: Biggest price movements in the history of the US stock market in percentage terms (Dow Jones period: 1885-2016 and SP500 period: 1957-2016)

Day of the week	DJI (returns)	DJI (volatility)	SP500 (returns)	SP500 (volatility)
Monday	35%	30%	30%	30%
Tuesday	18%	20%	25%	20%
Wednesday	18%	15%	15%	15%
Thursday	20%	25%	20%	25%
Friday	10%	10%	10%	10%

As can be seen, these tend to occur on Mondays rather than Fridays. Next we focus on the most recent period and analyse the 100 biggest price movements during 2004-2016 in the US stock market (for the Dow Jones Index and the NASDAQ – we use the latter instead of the SP500 whose dynamics are very similar to those of the Dow Jones). The results are presented in Table 2. For this period no clear pattern emerges and Mondays are no longer the most anomalous day of the week.

Table 2: 100 biggest price movements during 2004-2016 in the US stock market (Dow Jones Index and NASDAQ) in percentage terms

Day of the week	DJI (biggest increase)	DJI (biggest decline)	DJI (volatility)	NASDAQ (biggest increase)	NASDAQ (biggest decline)	NASDAQ (volatility)
Monday	17%	21%	20%	11%	16%	16%
Tuesday	24%	16%	21%	30%	18%	23%
Wednesday	21%	21%	21%	20%	20%	18%
Thursday	25%	25%	23%	18%	23%	22%
Friday	13%	17%	15%	21%	23%	21%

We also analyse the 100 biggest price movements during 2004-2016 in the emerging stock markets (Russia and Ukraine) to see whether there are any differences in behaviour between developed and emerging countries (see Table 3). The results are qualitatively the same,

namely there are no specific days of the week when extreme behaviour of the stock market occurs.

Table 3: 100 biggest price movements during 2004-2016 in the emerging stock markets (Russian and Ukrainian stock markets) in percentage terms

Day of the week	MICEX (biggest increase)	MICEX (biggest decline)	MICEX (volatility)	UX (biggest increase)	UX (biggest decline)	UX (volatility)
Monday	22%	20%	21%	27%	24%	23%
Tuesday	22%	22%	24%	23%	23%	22%
Wednesday	17%	25%	23%	11%	22%	14%
Thursday	22%	18%	19%	15%	20%	21%
Friday	15%	15%	12%	23%	11%	19%

The corresponding results for the FOREX (Table 4) and commodity markets (Table 5) lead to the same conclusions.

Table 4: 100 biggest price movements during 2004-2016 in the FOREX in percentage terms

Day of the week	Monday	Tuesday	Wednesday	Thursday	Friday
EURUSD (biggest increase)	18%	23%	16%	21%	22%
EURUSD (biggest decline)	14%	23%	18%	18%	27%
EURUSD (volatility)	21%	17%	18%	23%	21%
GBPUSD (biggest increase)	22%	20%	18%	24%	16%
GBPUSD (biggest decline)	20%	16%	23%	14%	27%
GBPUSD (volatility)	23%	17%	19%	20%	21%
USDJPY (biggest increase)	16%	16%	15%	24%	29%
USDJPY (biggest decline)	14%	17%	26%	19%	24%
USDJPY (volatility)	19%	16%	19%	22%	24%
RUBUSD (biggest increase)	28%	17%	17%	18%	20%
RUBUSD (biggest decline)	18%	23%	24%	22%	13%
RUBUSD (volatility)	27%	18%	15%	19%	21%

Table 5: 100 biggest price movements during 2004-2016 in commodity prices in percentage terms

Day of the week	Gold (biggest increase)	Gold (biggest decline)	Gold (volatility)	Oil (biggest increase)	Oil (biggest decline)	Oil (volatility)
Monday	13%	20%	20%	15%	30%	20%
Tuesday	21%	21%	18%	16%	15%	17%
Wednesday	15%	19%	23%	22%	21%	19%
Thursday	25%	23%	19%	28%	18%	26%
Friday	25%	16%	19%	19%	16%	18%

The next step is to examine the entire dataset rather than extreme points only. Detailed results are presented in the Appendices. The following Tables 6, 7, 8 summarise the main results for the stock markets, FOREX and commodity markets respectively.

Table 6: Overall results for the Stock Markets

Methodology/Instrument	Average analysis	Student's t-test	ANOVA	Kruskal - Wallis test	Regression analysis with dummies
Returns analysis					
DJI index	-	-	-	-	-
NASDAQ	+	-	-	-	-
MICEX	+	-	-	-	-
UX	+	-	-	-	-
Volatility analysis					
DJI index	-	-	-	-	-
NASDAQ	-	-	-	-	-
MICEX	-	+	-	-	-
UX	-	-	-	+	-

As can be seen, all methods used to test the two hypotheses of interest (for the mean and volatility of returns respectively) imply that the null of the data belonging to the same population cannot be rejected in the case of stock markets, whether developed (US) or emerging countries (Russia and Ukraine), and therefore no evidence is found of a Friday effects in such markets.

Table 7: Overall results for the FOREX

Methodology/Instrument	Average analysis	Student's t-test	ANOVA	Kruskal - Wallis test	Regression analysis with dummies
Returns analysis					
EURUSD	+	-	-	-	-
GBPUSD	**+**	**+**	**+**	**+**	**+**
USDJPY	+	-	-	-	-
RUBUSD	+	-	-	-	-
Volatility analysis					
EURUSD	**+**	**+**	**+**	**+**	**+**
GBPUSD	**+**	**-**	**+**	**+**	**+**
USDJPY	**+**	**+**	**+**	**+**	**+**
RUBUSD	-	-	-	-	-

By contrast, it appears that Fridays are rather anomalous days in the FOREX; in particular, volatility is extremely high on this day of the week; mean returns also exhibit an anomalous behaviour on Fridays in the case of the GBP/USD exchange rate.

Table 8: Overall results for commodity prices

Methodology/Instrument	Average analysis	Student's t-test	ANOVA	Kruskal - Wallis test	Regression analysis with dummies
Returns analysis					
Gold	+	+	+	+	+
Oil	+	-	-	-	-
Volatility analysis					
Gold	+	-	-	+	-
Oil	-	-	-	+	-

As for commodity markets, mean returns on Gold on Fridays differ from those in the rest of the week, which can be seen as evidence of market inefficiency. Instead no anomaly is detected for Oil prices.

To establish whether the detected anomaly in Gold prices gives rise to exploitable profit opportunities a trading robot approach is used. The trading strategy in this case is very simple: buy Gold on Friday open and close this position at the end of the day. The results of the trading simulations for Gold for the period 2004-2016 are presented in Appendix E, and confirm that

such a strategy is profitable. The z-tests results at the 10% significance level are presented in Table 9.

Table 9: Z-test for the trading simulation results for the Gold anomaly (testing period 2004-2016)

Parameter	Value
Number of the trades	640
Total profit	36058
Average profit per trade	56,34
Standard deviation	1290,85
z-test	1,71
z critical (0,95)	1,65
Null hypothesis	rejected

As can be seen, H0 is rejected, which implies that the trading simulation results are statistically different from the random ones and therefore this trading strategy is effective and there is exploitable profit opportunity, which is inconsistent with the EMH.

Our findings can be summarised as follows: stock markets do not exhibit Friday effects; in the FOREX these are present in the form of higher volatility on Fridays providing profit opportunities based on volatility trading. Finally, the Gold market is characterized by higher returns on Fridays also generating exploitable profit opportunities.

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5. Conclusions

This paper analyses Friday effects (i.e. whether the mean and volatility of returns on Fridays differ from those on other days of the week) in various financial markets (stock markets, FOREX and commodity markets) in both developed and emerging countries. A number of statistical tests and methods are used for this purpose: average analysis, parametric tests including Student's t-test and ANOVA, non-parametric ones such as the Kruskal-Wallis test and regression analysis with dummy variables. The evidence suggests that stock markets are immune to Friday effects, whilst in the FOREX Fridays exhibit higher volatility, and in the Gold market returns are higher

on this day of the week. Using a trading robot approach we show that a trading strategy based on the anomaly detected in Gold prices is profitable. These results are of interest to both academics and practitioners; the latter can design appropriate trading strategies to exploit the detected anomalies and make abnormal profits.

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Appendix A

Empirical results for the Stock Markets

Average analysis

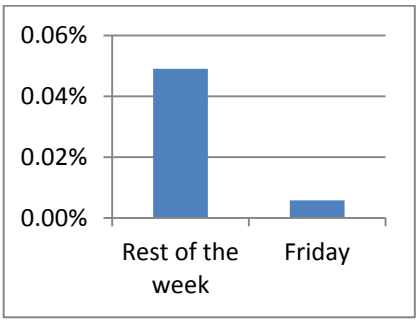

Figure A.1 – Average analysis case of returns (DJI index)

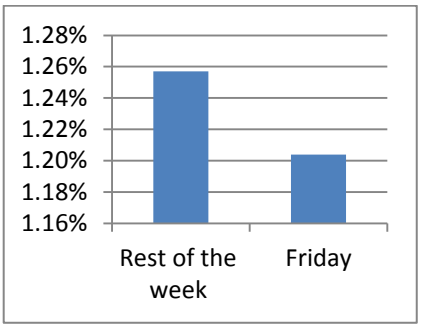

Figure A.2 – Average analysis case of volatility (DJI index)

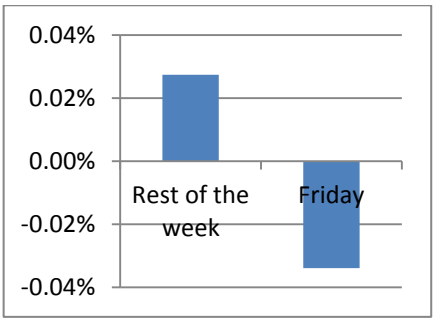

Figure A.3 – Average analysis case of returns (NASDAQ)

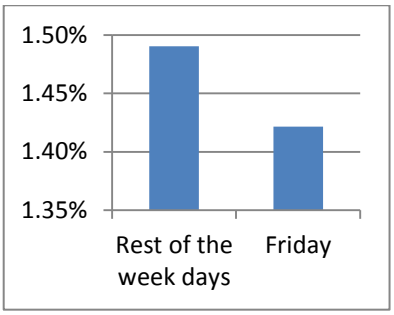

Figure A.4 – Average analysis case of volatility (NASDAQ)

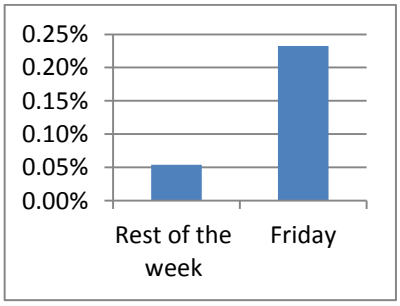

Figure A.5 – Average analysis case of returns (MICEX)

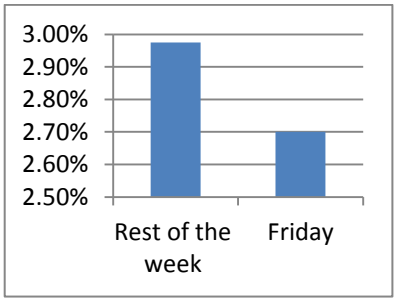

Figure A.6 – Average analysis case of volatility (MICEX)

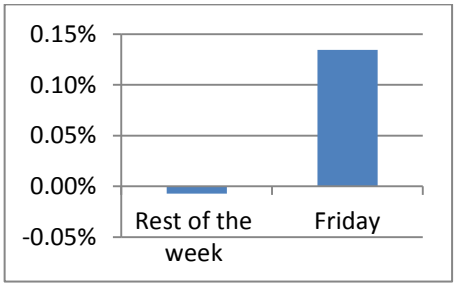

Figure A.7 – Average analysis case of returns (UX)

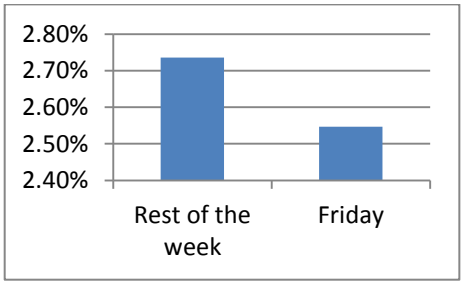

Figure A.8 – Average analysis case of volatility (UX)

Parametric tests: Student's t-test

Table A.1: T-test of the Friday Effect for DJI index

	Returns		Volatility	
Parameter	Rest of the week	Friday	Rest of the week	Friday
Mean,%	0,05%	0,01%	1,26%	1,20%
Standard deviation,%	1,12%	0,96%	1,04%	0,97%
Number of observations	2500	626	2500	626
t-criterion	0,97		1,20	
t-critical (p=0,95)	1,96			
Null hypothesis	Accepted		Accepted	

Table A.2: T-test of the Friday Effect for NASDAQ index

	Returns		Volatility	
Parameter	Rest of the week	Friday	Rest of the week	Friday
Mean,%	0,03%	-0,03%	1,49%	1,42%
Standard deviation,%	1,11%	1,04%	1,07%	1,01%
Number of observations	2253	561	2253	561
t-criterion	1,23		1,42	
t-critical (p=0,95)	1,96			
Null hypothesis	Accepted		Accepted	

Table A.3: T-test of the Friday Effect for MICEX index

	Returns		Volatility	
Parameter	Rest of the week	Friday	Rest of the week	Friday
Mean,%	0,05%	0,23%	2,97%	2,70%
Standard deviation,%	2,51%	2,30%	2,33%	2,20%
Number of observations	1352	338	1352	338
t-criterion	1,25		2,03	
t-critical (p=0,95)	1,96			
Null hypothesis	Accepted		Rejected	

Table A.4: T-test of the Friday Effect for UX index

	Returns		Volatility	
Parameter	Rest of the week	Friday	Rest of the week	Friday
Mean,%	-0,01%	0,13%	2,74%	2,55%
Standard deviation,%	2,02%	1,78%	1,96%	1,86%
Number of observations	1352	338	1352	338
t-criterion	1,27		1,65	
t-critical (p=0,95)	1,96			
Null hypothesis	Accepted		Accepted	

Parametric tests: ANOVA

Table A.5: ANOVA test of the Friday Effect in the Stock Market

Parameter	DJI		NASDAQ		MICEX		UX	
	Returns	Volatility	Returns	Volatility	Returns	Volatility	Returns	Volatility
F	0.78	1.26	1.39	1.79	1.43	3.67	1.39	2.42
p-value	0.37	0.26	0.24	0.18	0.23	0.06	0.24	0.12
F critical	3.84	3.84	3.84	3.84	3.84	3.84	3.84	3.84
Null hypothesis	accepted	accepted	accepted	accepted	accepted	accepted	accepted	accepted

Non-parametric tests: Kruskal -Wallis test

Table A.6: Kruskal -Wallis test of the Friday Effect in the Stock Market

Parameter	DJI		NASDAQ		MICEX		UX	
	Returns	Volatility	Returns	Volatility	Returns	Volatility	Returns	Volatility
Adjusted H	0,91	0,89	3,45	3,11	2,08	5,04	1,15	4,00
d.f.	1	1	1	1	1	1	1	1
P value:	0,34	0,34	0,06	0,08	0,15	0,02	0,28	0,05
Critical value	3.84	3.84	3.84	3.84	3.84	3.84	3.84	3.84
Null hypothesis	accepted	accepted	accepted	accepted	accepted	accepted	accepted	rejected

Regression analysis with dummy variables

Table A.7: Regression analysis with dummy variables in the Stock Market*.

Parameter	DJI		NASDAQ		MICEX		UX	
	Returns	Volatility	Returns	Volatility	Returns	Volatility	Returns	Volatility
Rest of the week (a_0)	0,0005 (0,0250)	0,0126 (0,0000)	0,0003 (0,2369)	0,0149 (0,0000)	0,0005 (0,4223)	0,0298 (0,0000)	-0,0001 (0,8941)	0,02738 (0,0000)
Friday (a_1)	-0,0004 (0,3763)	-0,0005 (0,2603)	-0,0006 (0,2369)	-0,0007 (0,1807)	0,0018 (0,2315)	-0,0027 (0,0550)	0,0014 (0,2380)	-0,00184 (0,1196)
F-test	0,78	1.26	1.4	1.79	1.43	3.68	1.39	2.42
Anomaly	Not confirmed	Not confirmed	Not confirmed	Not confirmed	Not confirmed	Not confirmed	Not confirmed	Not confirmed

* P-values are in parentheses

Appendix B

Empirical results for the FOREX

Average analysis

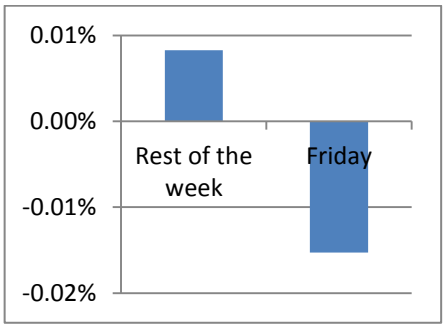

Figure B.1 – Average analysis case of returns (EURUSD)

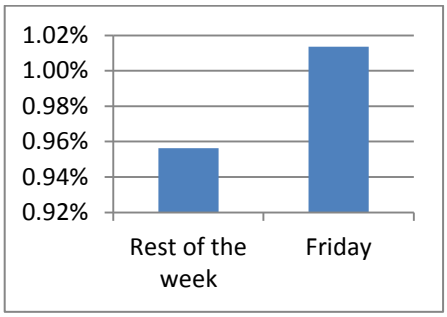

Figure B.2 – Average analysis case of volatility (EURUSD)

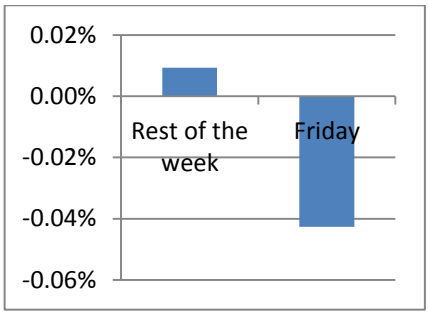

Figure B.3 – Average analysis case of returns (GBPUSD)

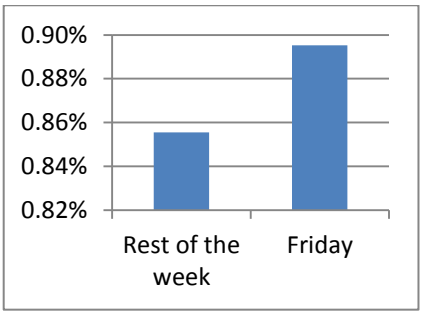

Figure B.4 – Average analysis case of volatility (GBPUSD)

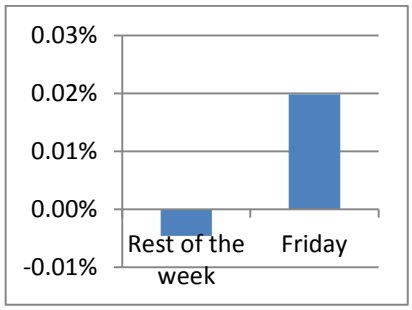

Figure B.5 – Average analysis case of returns (USDJPY)

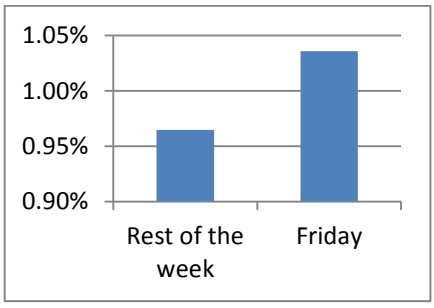

Figure B.6 – Average analysis case of volatility (USDJPY)

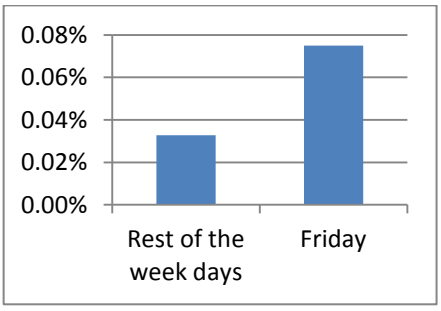

Figure B.7 – Average analysis case of returns (RUBUSD)

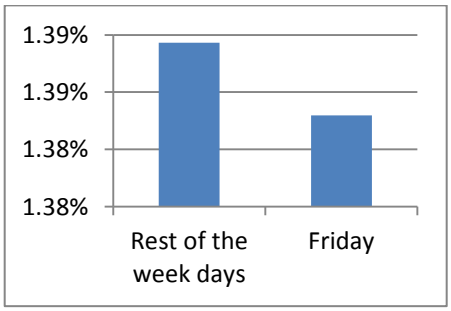

Figure B.8 – Average analysis case of volatility (RUBUSD)

Parametric tests: Student's t-test

Table B.1: T-test of the Friday Effect for EURUSD

	Returns		Volatility	
Parameter	Rest of the week	Friday	Rest of the week	Friday
Mean,%	0,01%	-0,02%	0,96%	1,01%
Standard deviation,%	0,63%	0,67%	0,49%	0,50%
Number of observations	3708	925	3708	925
t-criterion	0,97		3,15	
t-critical (p=0,95)	1,96			
Null hypothesis	Accepted		Rejected	

Table B.2: T-test of the Friday Effect for GBPUSD

	Returns		Volatility	
Parameter	Rest of the week	Friday	Rest of the week	Friday
Mean,%	0,01%	-0,04%	0,86%	0,90%
Standard deviation,%	0,56%	0,62%	0,46%	0,64%
Number of observations	3707	925	3707	925
t-criterion	2,33		1,77	
t-critical (p=0,95)	1,96			
Null hypothesis	Rejected		Accepted	

Table B.3: T-test of the Friday Effect for USDJPY

	Returns		Volatility	
Parameter	Rest of the week	Friday	Rest of the week	Friday
Mean,%	0,00%	0,02%	0,96%	1,04%
Standard deviation,%	0,64%	0,70%	0,54%	0,63%
Number of observations	3707	925	3707	925
t-criterion	0,96		3,15	
t-critical (p=0,95)	1,96			
Null hypothesis	Accepted		Rejected	

Table B.4: T-test of the Friday Effect for RUBUSD

	Returns		Volatility	
Parameter	Rest of the week	Friday	Rest of the week	Friday
Mean,%	0,03%	0,07%	1,39%	1,38%
Standard deviation,%	1,04%	0,93%	1,49%	1,31%
Number of observations	1723	430	1723	430
t-criterion	0,82		0,09	
t-critical (p=0,95)	1,96			
Null hypothesis	Accepted		Accepted	

Parametric tests: ANOVA

Table B.5: ANOVA test of the Friday Effect in the FOREX

Parameter	EURUSD		GBPUSD		USDJPY		RUBUSD	
	Returns	Volatility	Returns	Volatility	Returns	Volatility	Returns	Volatility
F	1.00	10.42	6.08	4.76	1.04	12.05	0.59	0.00
p-value	0.31	0.00	0.01	0.03	0.31	0.00	0.44	0.96
F critical	3.84	3.84	3.84	3.84	3.84	3.84	3.84	3.84
Null hypothesis	accepted	rejected	rejected	rejected	accepted	rejected	accepted	accepted

Non-parametric tests: Kruskal -Wallis test

Table B.6: Kruskal -Wallis test of the Friday Effect in the FOREX

Parameter	EURUSD		GBPUSD		USDJPY		RUBUSD	
	Returns	Volatility	Returns	Volatility	Returns	Volatility	Returns	Volatility
Adjusted H	0,34	17,25	3,92	4,86	0,89	11,18	1,73	0,01
d.f.	1	1	1	1	1	1	1	1
P value:	0,56	0,00	0,05	0,03	0,35	0,00	0,19	0,91
Critical value	3.84	3.84	3.84	3.84	3.84	3.84	3.84	3.84
Null hypothesis	accepted	rejected	rejected	rejected	accepted	rejected	accepted	accepted

Regression analysis with dummy variables

Table B.7: Regression analysis with dummy variables in the FOREX*.

Parameter	EURUSD		GBPUSD		USDJPY		RUBUSD	
	Returns	Volatility	Returns	Volatility	Returns	Volatility	Returns	Volatility
Rest of the week (a_0)	0,0001 (0,4317)	0,0096 (0,0000)	0,0001 (0,3157)	0,0086 (0,0000)	0,0000 (0,6771)	0,0096 (0,0000)	0,0003 (0,1830)	0,0139 (0,0000)
Friday (a_1)	-0,0002 (0,3162)	0,0006 (0,0013)	-0,0005 (0,0135)	0,0004 (0,0286)	0,0002 (0,3095)	0,0007 (0,0005)	0,0004 (0,4414)	0,0000 (0,9597)
F-test	1,00	10,43	6,11	4,79	1,03	12,10	0,59	0,00
Anomaly	Not confirmed	Confirmed	Confirmed	Confirmed	Not confirmed	Confirmed	Not confirmed	Not confirmed

* P-values are in parentheses

Appendix C

Empirical results for the Commodities

Average analysis

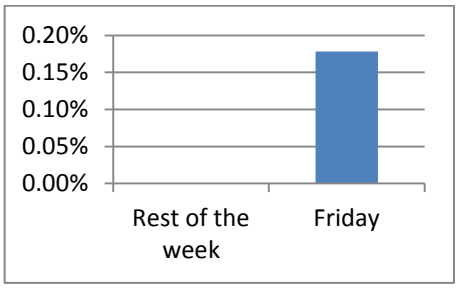

Figure C.1 – Average analysis case of returns (Gold)

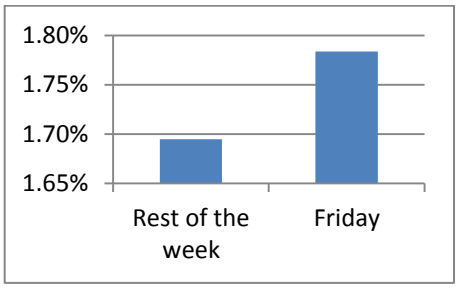

Figure C.2 – Average analysis case of volatility (Gold)

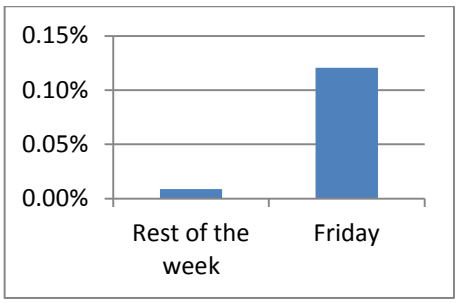

Figure C.3 – Average analysis case of returns (Oil)

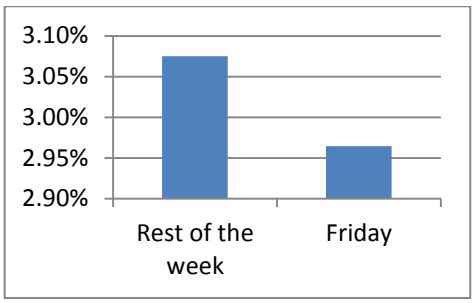

Figure C.4 – Average analysis case of volatility (Oil)

Parametric tests: Student's t-test

Table C.1: T-test of the Friday Effect for the Commodities

	Gold				Oil			
	Returns		Volatility		Returns	Volatility	Returns	Volatility
Parameter	Rest of the week	Friday	Rest of the week	Friday	Rest of the week	Friday	Rest of the week	Friday
Mean,%	0,00%	0,18%	1,69%	1,78%	0,01%	0,12%	3,08%	2,96%
Standard deviation,%	1,19%	1,21%	1,05%	1,15%	2,13%	2,01%	1,77%	1,74%
Number of observations	2551	631	2551	631	3161	776	3161	776
t-criterion	3.31		1.77		1.37		1.58	
t-critical (p=0,95)	1,96							
Null hypothesis	Rejected		Accepted		Accepted		Accepted	

Parametric tests: ANOVA

Table C.2: ANOVA test of the Friday Effect in the Commodities

Parameter	Gold		Oil	
	Returns	Volatility	Returns	Volatility
F	11.27	3.67	1.76	2.32
p-value	0.000	0.055	0.18	0.13
F critical	3.84	3.84	3.84	3.84
Null hypothesis	rejected	accepted	accepted	accepted

Non-parametric tests: Kruskal -Wallis test

Table C.3: Kruskal -Wallis test of the Friday Effect in the Commodities

Parameter	Gold		Oil	
	Returns	Volatility	Returns	Volatility
Adjusted H	12,29	6,54	1,77	4,19
d.f.	1	1	1	1
P value:	0,00	0,01	0,18	0,04
Critical value	3.84	3.84	3.84	3.84
Null hypothesis	rejected	rejected	accepted	rejected

Regression analysis with dummy variables

Table C.4: Regression analysis with dummy variables in the Commodities*.

Parameter	Gold		Oil	
	Returns	Volatility	Returns	Volatility
Rest of the week (a_0)	0,0000 (0,9825)	0,0170 (0,0000)	0,0001 0,8113	0,0308 (0,0000)
Friday (a_1)	0,0018 (0,0008)	0,0009 (0,0554)	0,0011 0,1843	-0,0011 (0,1277)
F-test	11.27	3.67	1.76	2.32
Anomaly	Confirmed	Not confirmed	Not confirmed	Not confirmed

* P-values are in parentheses

Appendix D

Some examples of Fridays in the financial markets

Figure D.1 – Dow Jones abnormal dynamics on Friday (09.09.2016)

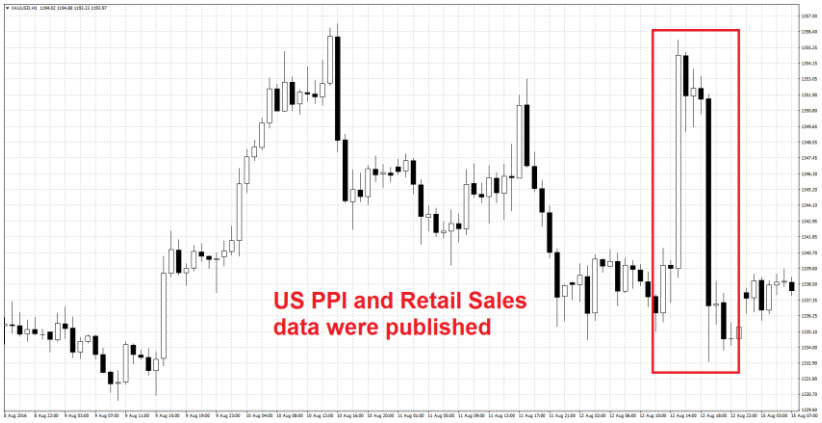

Figure D.2 – Gold abnormal dynamics on Friday (09.08.2016)

Figure D.3 – EURUSD abnormal dynamics on Friday (28.10.2016)

Appendix E

Results of trading imitation: case of Gold (period 2004-2016)

Table E.1: Trading report

Symbol		XAUUSD (Gold (Spot))			
Period		1 Hour (H1) 2004.01.01 00:00 - 2016.12.30 19:00 (2004.01.01 - 2016.12.31)			
Model		Every tick (the most precise method based on all available least timeframes)			
Parameters		Lots=1;			
Bars in test	74530	Ticks modelled	139022254	Modelling quality	n/a
Initial deposit	10000.00			Spread	Current (315)
Total net profit	36058	Gross profit	291454	Gross loss	-255396
Profit factor	1,15	Expected payoff	60.96		
Absolute drawdown	261.50	Maximal drawdown	38411.12 (49.14%)	Relative drawdown	49.14% (38411.12)
Total trades	640	Short positions (won %)	0 (0.00%)	Long positions (won %)	640 (53.28%)
		Profit trades (% of total)	341 (53.28%)	Loss trades (% of total)	299 (46.72%)
	Largest	profit trade	6446.90	loss trade	-8561.50
	Average	profit trade	867.06	loss trade	-858.36
	Maximum	consecutive wins (profit in money)	12 (8962.00)	consecutive losses (loss in money)	7 (-5260.50)
	Maximal	consecutive profit (count of wins)	12011.90 (5)	consecutive loss (count of losses)	-9894.50 (3)
	Average	consecutive wins	2	consecutive losses	2

Figure E.1 – Dynamics of trading account balance