COLEGIO UNIVERSITARIO DE ESTUDIOS FINANCIEROS

BUSINESS ADMINISTRATION DEGREE

"ECONOMETRICS MODELS FOR THE WEEKLY HIGH AND LOW PRICES FORECAST OF EUROPEAN FIRMS"

Oracle Corporation

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1.SUMMARY

This paper studies the possible predictability of Oracle Corporation stock prices based on their past performance. It tries to expand as most as possible, the paper carried out by Caporin et al (2013) on the predictability of high and low prices, with the data from previous weeks (maximum, minimum,). In order to do so, stock market data from Oracle Corporation company is collected and analyzed in order to make forecasts used to elaborate a trading strategy that can outperform the simple "buy and/or sell" strategy.

Key words:

Market

Efficiency

Predictability

Co-integration

VEC model

High, low and closing prices

"Buy and hold" strategy

2.Introduction

The main objective of this paper is to study the behaviour of the stock market in terms of predictability. Wishing to determine how efficient are these markets plus the possibility to find a scope in terms of predictability using econometric models. Afterwards, once we have determined an econometric model to help towards the stocks yield, to determine a strategy whose efficiency can beat against the “buy at the beginning of the year and hold”, in order to seek better potential benefits. Therefore, we expand part of Caporin et al (2013) study.

The aim of the study conducted, is similar to Caporin´s and its co-authors. Theories such as random walk, the stock market being indeed efficient. The market is efficient therefore there is no possible strategy that systematically would estimate precise yields superior to buy and hold through the year. This paper extends such research by adding the closing price as another variable, and preferably weekly data reducing volatility, giving a model with less noise and facilitating the strategy when entering or exiting the market. This data will be from Oracle Corporation stock. A hypothesis will is created and based on two econometric models: Autoregressive models, and VECM (Vector Error Correction model). Following the cointegration between the variables is a must on the data.

To begin the predictability of high and low prices weekly on Oracle Corporation stock yields is to be predicted based on their maximum, minimum and closing price as in needs of other variables to support, so the data from the Dow Jones market is put into consideration to support with less deviation the fluctuations of the stock. This will provide a consistent strategy that can outcast the basic “buy and hold”

The structure follows the subsequent order: to begin a general overview concern of the predictability of the stock price and their efficiency inside the markets; secondly an interpretation of co-integration and VEC models; afterwards building up of the model and the display of the empirical evidence; therefore what trading strategy to pursue; at last a conclusion of the paper.

3. The predictability of stock prices

Throughout the years investors have tried to beat the market by the constant wish of an effortless economic investment, however this has not been accomplished by a large sum of individuals or companies, but the opposite, small number of investors or companies that foresee indicators that not many are aware of, or by finding improbable situations to their advantage. This states the complex idea of foreseeing and estimating the predictability in the markets. Nevertheless, when great “bubbles” have emerged, the factor in common to be found is the excess investment into a certain sector/industry/stock/asset, and when the surplus emerges, the catastrophe can be predicted instead of the stock price.

The tulip crisis
The "tulip crisis" is considered the first massive speculative bubble in world history.

In the 17th century, there was a collective euphoria over the purchase of exotic multicoloured tulips in Holland. The price of the flower bulbs reached such exorbitant levels that people began to sell their houses to get them. A forward sales market was even created from uncollected bulbs. The price escalation came to an end, however, when one day in 1637, no investor wanted to buy.
Whether because the money had dried up, because of the new outbreak of bubonic plague, or simply because of rumours of an eventual collapse, buyers began to sell in desperation and so prices fell sharply.
Financial panic seized the owners of the tulip bulbs and from one second to the next, the Dutch economy went bankrupt.

The crash of 1929
The biggest crash in the history of Wall Street was preceded by a speculative boom that emerged during the 1920s and led thousands of people to invest in the stock market. Many went into debt to buy more shares, creating a bubble that seemed unstoppable. The New York Stock Exchange collapsed. The unstoppable speculative fever came to an end and, with it, the party of those who had managed to make easy money.

The dotcom bubble

The rise of the internet in the late 1990s triggered the so-called dot-com bubble, when the value of some technology firms reached astronomical levels despite the fact that they had no real revenues. Several entrepreneurs became millionaires, and investors rushed to buy more and more stocks that were supposed to keep increasing in value.

As a result, hundreds of dot-com companies were valued at billions of dollars.
The Nasdaq Composite stock index, where most of the tech firms were listed, rose exponentially. And even though the chairman of the Federal Reserve, warned of "irrational exuberance" in prices, the investment frenzy continued, and the bubble

eventually burst when it became clear that many of these companies were unprofitable.

Thus, it was that in October 2002 the index fell sharply and triggered a recession in the US that had global effects.

The toxic mortgage crisis

The global economic crisis at the end of the last decade had its origins in the so-called "subprime" or toxic mortgages, high-interest loans given by US banks to people who did not have the financial solvency to take on such debts.

Banks bundled a number of these bad loans into unclear financial products that were then resold several times on the financial markets. The bubble bursted when the debtors of the loans were unable to pay and house prices collapsed, while millions of people lost their homes.

The phenomenon was accompanied by stock market crashes, rising unemployment and the destabilization of the banking system, which was represented by the symbolic collapse of Lehman Brothers in 2008. The effects of the crisis quickly spread to several countries, generating financial disasters in other economies that had no way to protect themselves.

Like a disease, the mortgage crisis spread to the rest of the world, becoming one of the biggest bubbles of recent years.

The overall conclusion we can take from such crisis is that predictability cannot be easily obtained as seen in the past when great amount of people believe they have found an easy way to make money out of the markets, bubbles seem to arise and when they “explode” they have a great impact on the financial system, ever generating great depressions or worse case scenarios. However, the predictability of trends, and therefore its maximum and minimum prices on a weekly basis seems a better alternative.

The phenomenon of financial predictability has substantial and far-reaching economic consequences. However, the interpretation of predictability, as well as the evidence for its existence, remain contentious. Existing research have focused on forecasting stock market returns primarily in the U.S. market. The predictive capacity of the average correlation, a measure of the co-movement of returns on business portfolios and approximate a variety of regression models with a large number of observations. In most markets, we find that the average correlation is a reliable indicator. The state of the economy has no bearing on this predictive ability. It is also unaffected by subsample cycles, but it is higher in recent years and weaker during financial crises. Therefore, we can positively state that there is an evidence of the predictability of high and low prices.

3.1 Eugene Fama, Lars Hansen and Robert Shiller

Playing up with the studies made by the 2013 Nobel price wines for their empirical work on the calculations of forecasting yields.

Shiller and Fama are two economists whose beliefs in the field go against each other. Hansen being an econometrician, Fama a professor at the university of Chicago, who backs up the theory of “Efficiency Rational Explications”, which settles his beliefs on the contrary on market bubbles, stating on the Ney Yorker in 2010: It’s easy to say prices went down, it must have been a bubble, after the fact. I think most bubbles are twenty-twenty hindsight. Now after the fact you always find people who said before the fact that prices are too high. People are always saying that prices are too high. When they turn out to be right, we anoint them. When they turn out to be wrong, we ignore them. They are typically right and wrong about half the time.” On the other side of the table, Shiller, professor at the University of Chicago positions the idea that markets are driven by “Behavioural Economics”, where bubbles are always looked for. Finally, econometric Hansen, a University of Chicago economist, criticizes and proves the rejection of the simple CCAPM (Consumption-Capital Asset Pricing) model.

Eugene Fama advanced the conviction of being very test the gauge of yield execution temporarily, expressing that costs follow an irregular walk. See Malkiel, B. G. (2007).

While this creator likewise shares that the most exact forecast far the cost of a stock is far the time frame "t+1", adapted to all know until "t (nt)", the cost at "t". The costs estimate infers an outcome of absence of productivity.

The creator alludes to "frail effectiveness" of the data when the blunder (at) isn't auto associated. At the point when the blunder (at) is auto related with the public data at "t" exists "semi-solid productivity". What's more, when the mistake(at) is auto corresponded with private data there is "solid effectiveness". Consequently, when the market yields are unforeseeable and follows an irregular stroll, there is productivity. See Fama (1988)

Then again, Robert Shiller clarifying long haul figure of stock yields has an all-out alternate point of view than Fama. This creator has confidence in "Social Financial matters" where the monetary specialists are not judicious or carry on in an effective manner, all things considered, they not just misinterpret on the most proficient method to gauge hazard or execution of costs, however they follow them sense and sentiments.

Moreover, this creator demonstrated that the differences of the determined costs were higher than the fluctuations of the anticipated profits limited at a steady loan fee. Inferring that profits need more instability to clarify stock exhibitions vacillations.

Shiller gave various exact examination demonstrating the forecast of stock exhibitions. identifying financial proportions has been one of his most renowned commitments. It is significant "profit/value" proportion or "value/mean benefit" proportion as

fundamental far speculative air pocket expectation. An exorbitant cost contrasted with recorded mean benefits might be an admonition signal. The forecast of market rises as 90s emergencies or 2008 land emergencies by Shiller, depend on these proportions.

Despite the fact that Fama and Shiller may appear to follow opposite propensities, both concur on the conjecture of yield exhibitions. They likewise share the possibility of the expansion in the consistency when the prevision skyline increments. Shiller shields that exhibitions might be conjecture on the since a long time ago run, while Fama and EER safeguards try not to deny long haul conjecture. These creators differ concerning why of that gauge. To finish up, consistency is found though it is erroneous. See Flores (2014)

4.Forecasting prices and trends

Accepting the hypothesis on the market not being completely efficient and that stock pricing does not follow a “random walk”, investors sometimes try to find methods that anticipate the market movements, with an approximation to the future changes in the stocks pricing and thus being able to “beat the market”.

Some of the most common methods for these anticipations towards the pricing of future stocks are fundamental analysis and technical analysis which are the most commonly used, quantitative analysis is less common among these methods. Again the wish to forecast with such is not the stock price but more of the future trends over the stocks.

4.1 Fundamental analysis:

Fundamental analysis is another technique used to trade. Fundamental analysis is a technique that is used to determine the value of an asset by focusing on underlying factors that affect the company’s future aspects and its actual business. With this technique, you need to analyze the economic well-being of a financial entity as opposed to its price movements alone. Fundamental analysis is used to identify those assets which are under-valued in the market, which means that they are selling at a lower price than the asset’s intrinsic value. This analysis assumes that buyers would be attracted by the low prices, and this would make them buy the asset in a sufficient enough amount to increase its price.

4.2 Technical analysis:

Technical analysis is a tool, or method, used to predict the probable future price movement of a security – such as a stock or currency pair – based on market data. The theory behind the validity of technical analysis is the notion that the collective actions: buying and selling, of all the participants in the market accurately reflect all relevant information pertaining to a traded security, and therefore, continually assign a fair market value to the security. Technical traders believe that current or past price action in the market is the most reliable indicator of future price action.

4.3 Quantitative analysis:

Quantitative analysis is an approach that emphasizes mathematical and statistical analysis to help determine the value of a financial asset, such as a stock or option. Quantitative trading analysts) use a variety of data, including historical investment and stock market data, to develop trading algorithms and computer models.

5. Co-integration and Vector Error Correction models

Co-integration between two variables, X&Y, means that they have a strong relationship towards the long run. Meaning, that their evolution over the course of time is set in a synchronized pattern. When two variables move in the same direction, they are said to be positively correlated. If they move in opposing directions, the correlation is said to be negative. When this occurs, models can be more reliable to predict and thus developed. In trading terms, cointegration helps identify the degree to which two variables are sensitive to the same average price over a specific period of time. Thus, cointegration does not reflect whether the pairs would move in the same or opposite direction but can tell you whether the distance between them remains the same over time.

The vector autoregressive (VAR) model is a specific model for describing the dynamic interdependence of stationary variables. As a result, the first step in time-series analysis should be to decide if the data levels are stationary. If it doesn't work, go back to the first inconsistencies in the sequence and try again. If the time series' values are not stationary, the first deviations would be.

6.Empirical analysis

To test the weak efficiency and the semi-strong efficiency an empirical analysis is computed on the data of Oracle Corporation

6.1 Data

To begin the model and the study of the possible yield forecasting of the shares, the first thing to take into account are the data. The data gathered so far consists of 1823 observations (10/3/1986 – 01/2/2021). The data consists of the historical public information of the high low and closing prices of the company from NYSE. It corresponds to the weekly period from March 1986 to January 2021. All data has been collected from https://es.finance.yahoo.com/ . This paper also counts with data from the NASDAQ composite, a stock market index and measures the performace of stocks that perform on the New York market.

After all the information is collected, the data is used in the form of logarithm to induce normality. The variables maximum, minimum and the closing price are non-stationary and present co-integration.

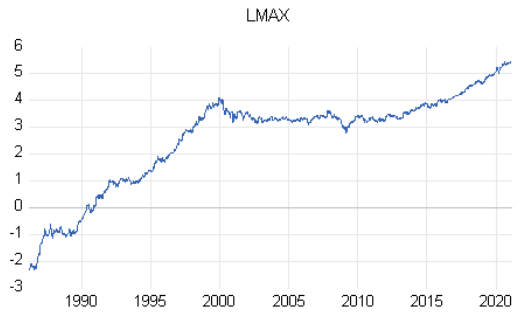

Chart 1: Logarithm of maximum price.

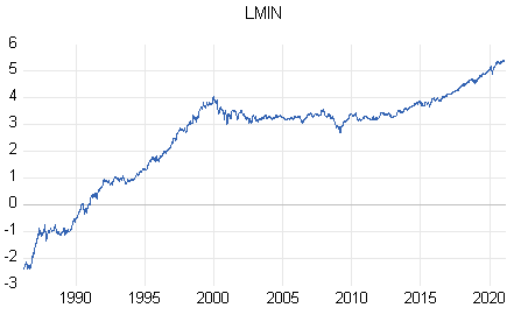

Chart 2: Logarithm of maximum price.

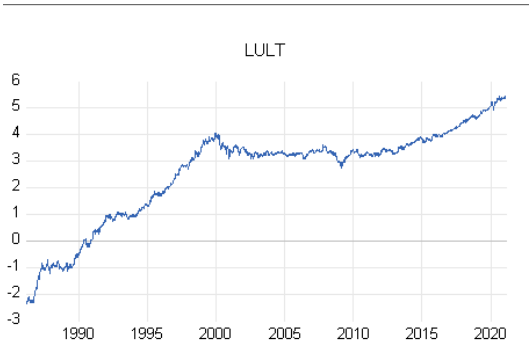

Chart 3: Logarithm of closing price.

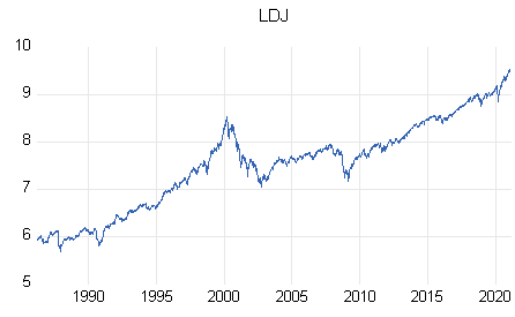

Chart 4: Logarithm of DJ values.

Source: Own elaboration on Eviews program.

When estimating a model it is mandatory to know if all the variables are relevant or not. This stated, the variables are taken into stationary variables implementing first differences:

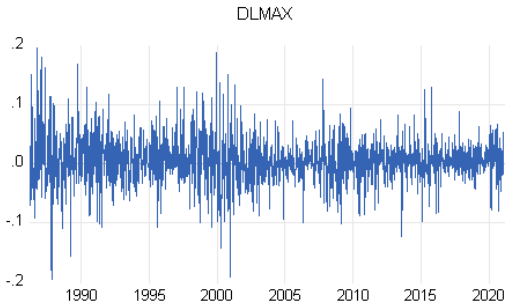

Chart 5: Neperian logarithm of the Maximum prices

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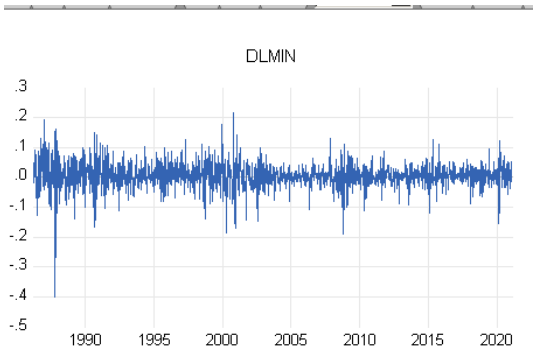


Chart 6: Neperian logarithm of the Minimum prices

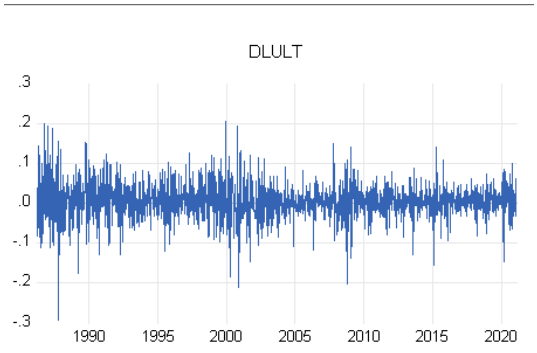


Chart 7: Neperian logarithm of the Closing prices

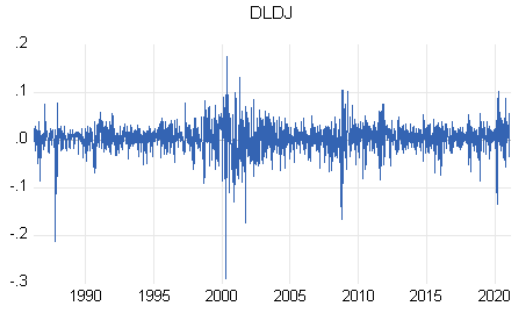
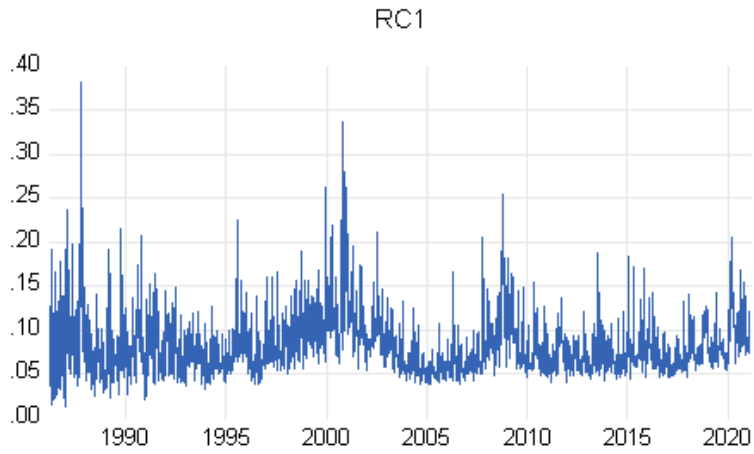


Chart 8: Neperian logarithm of the DJ values

6.2 Co-Integrating Analysis

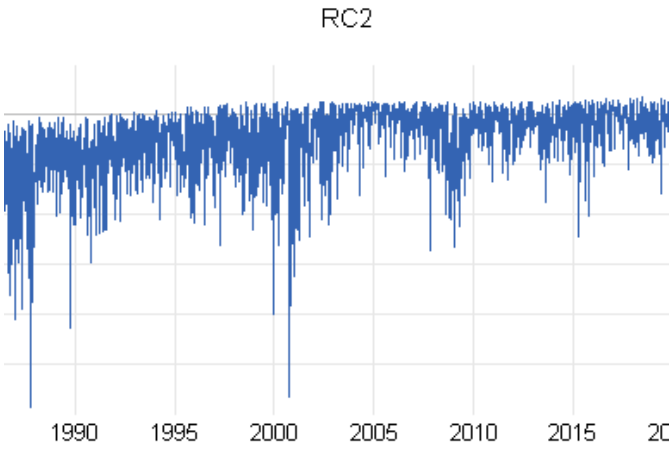
In order to study the possible co-integration relationships between the high, low and closing prices of Orcacle Corporation, the Johansen Test has been performed by means of Eviews .
The resulting co-integrating equations from Johansen Test are the following:

The first co-integrating equation (RC1) is: rc1=lmax-0.992375*lmin



Graph 10: 1st co-integrating relation

The second co-integrating equation (RC2) is : rc2=lmin-0.996045*lult



Graph 11: 2nd co-integrating relation

This study revealed the presence of two co-integrating equations, one between the high and closing prices and the other between the low and closing prices.
Now that they are both understood, VEC models can be used to investigate the "semi-strong efficiency."

CR1 and CR2 will be added to the vector as additional variables in the general model. The knowledge now it is broader and linked to the share prices.

Also, an analysis of a CR 3 far the variables V'LMIN and V'LULT was conducted, and it was concluded that it should not be used because it is a linear combination of the others and is not independent.

6.3 VECM Model (Semi strong efficiency)

The general VEC model has the form:

$$\Delta y_t = Bz_{t-1} + \Gamma_1 \Delta y_{t-1} + \Gamma_2 \Delta y_{t-2} + \ldots + \Gamma_{p-1} \Delta y_{t-(p-1)} + a_t$$

Yt is a 4x l vector made up of the 4 stationary variables; zr - 1 is a 2x l vector made up of the co-integrating relations; B is a 4x2 matrix of coefficients associated to the co-integrating relations; and r is a 4x4 matrix of coefficients associated to the lags of the stationary variables.

In this case, the VECM order is 1, as the VAR order in levels is 2. Therefore, only one lag from each variable will be used for the elaboration of the VEC model.

VAR Lag Order Selection Criteria
Endogenous variables: LMAX LMIN LULT LDJ
Exogenous variables: C

Lag	LogL	LR	FPE	AIC	SC	HQ

0	3777.240	NA	1.83e-07	-4.160132	-4.147997	-4.155655
1	16567.74	25510.49	1.40e-13	-18.24448	-18.18380*	-18.22209
2	16626.29	116.5117	1.34e-13	-18.29139	-18.18217	-18.25109
3	16659.95	66.83679	1.31e-13	-18.31086	-18.1531	-18.25265*
4	16681.06	41.83207	1.30e-13	-18.31649	-18.1102	-18.24037
5	16704.56	46.46240	1.29e-13	-18.32477	-18.06993	-18.23073
6	16722.78	35.93754	1.29e-13	-18.32721	-18.02384	-18.21527
7	16746.28	46.24035	1.28e-13	-18.33548	-17.98356	-18.20562
8	16766.77	40.22619*	1.27e-13*	-18.34042*	-17.93997	-18.19266

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

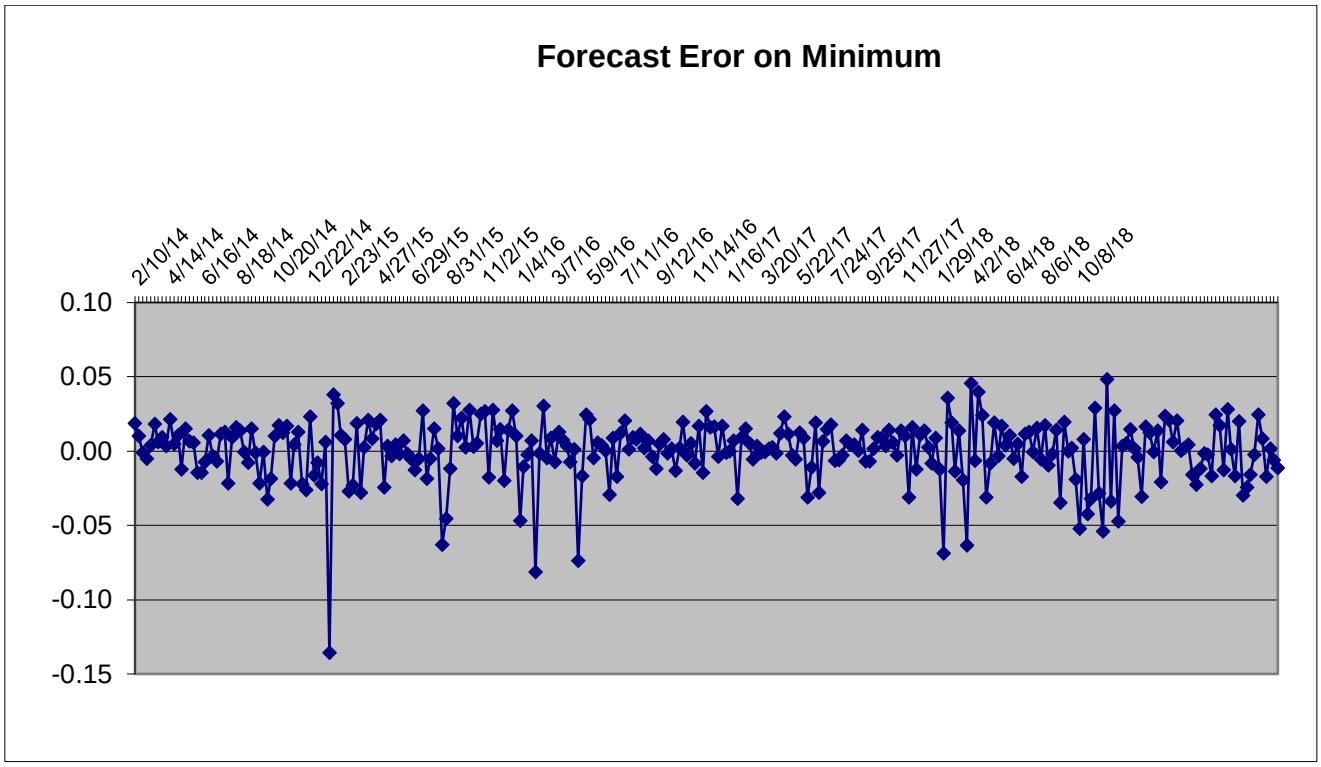
When building VECM models, the two cointegrating realtions with one lag, the four original variables with 1-period lags and finally a vector of constants is added. The following table summarises the results obtained from the model estimation.

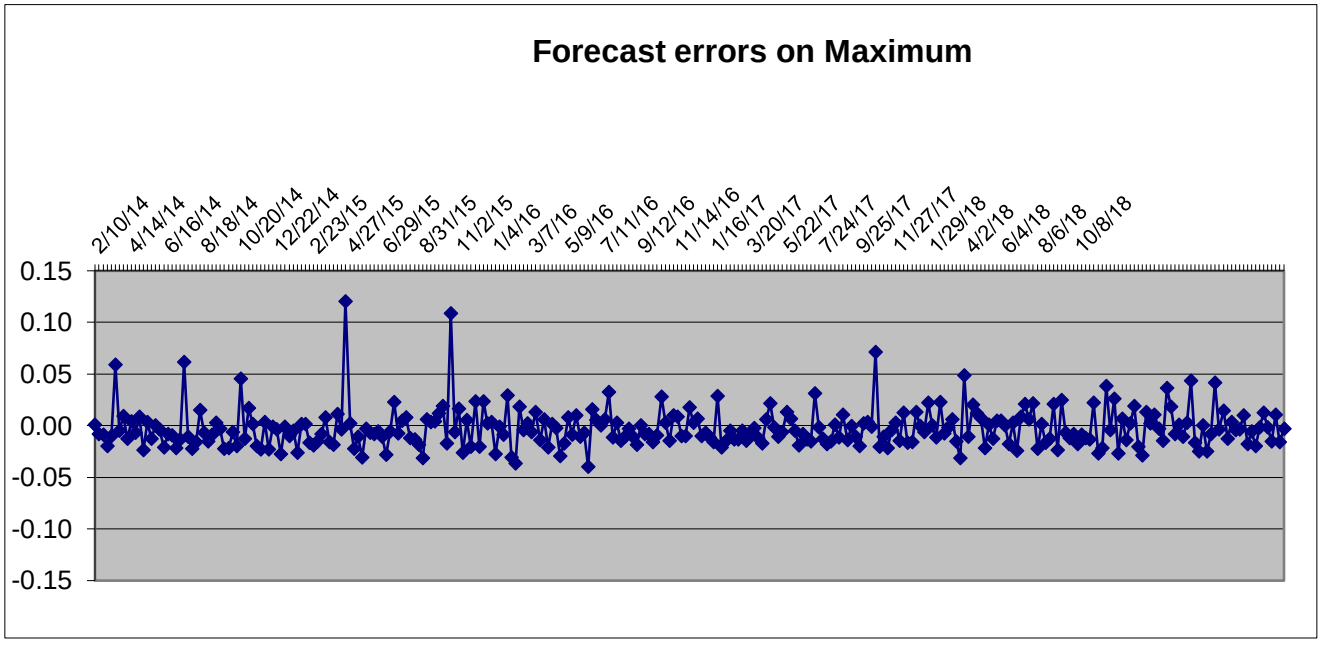
	dlmax	dlmin	dlult	dldj
c	0.022973	-0.007999	0.010116	0.00585
d1-med/ult	0	0	0	0
rc1	-0.737244	-0.44579	0	0
rc2	0.948152	1.109413	-0.137127	-0.092177
dlmax-1	-0.044908	0.26388	0.104452	0
dlmin-1	0.114813	-0.170165	-0.078126	-0.070797
dlult-1	-0.087369	-0.095421	0	0.093555
dldj-1	0	0.071043	0	0
dlmax-2	-0.086418	0.066401	-0.082896	0
dlmin-2	0	-0.14633	-0.115552	-0.057665
dlult-2	0	0	0.124885	0.048026
dldj-2	0	0.074996	0	0.056754
dlmax-3	-0.041542	0	0	0
dlmin-3	0	-0.057239	-0.061049	0
dlult-3	0.095141	0.078194	0.152358	0
Adjusted R2	0.00394	0.438308	0.011171	0.325215
S. D dependent	0.029938	0.031086	0.044149	0.030923

The stock markets have a high R2 value for the variables of maximum, low, and index prices. In the one hand, it is possible to claim that the past influences the current while ignoring the semi-strong efficiency between these two factors. In the other hand, because of the low value of R2, it is possible to consider semi-strong efficiency in the closing price, implying that this parameter represents a random walk.

8.Conclusion and Strategy

8.1 Strategy





As it can be observed, most of the errors are situated between 0, the interval oscillates between (-.05, 0.5). Which guarantees if we stablish a scale around this range, we will be turning to the market most of the time.
The strategy has been the following to buy at 0.15 below the estimation, and selling always at the last weekly price, per say, at the closing of markets. Supposing we invest a weekly capital of 60.000 USD to invest, the results estimate between 10/02/2014 up to date we would have made up an output yield of 77.161.84, which means of a 128.60% of benefits against the beginning capital.

8.2 Conclusion

The results are in line with the research results. With autoregressive models we have learned that we univariate random walks exist, due to white noise. To conclude, the questions presented in Caporin et al. (2013), and motivated in the introduction section, are responded.

On the other hand, there is a model that allows us to make forecasts, the error correction model. A model that takes into account the public past of the variable, and therefore rejects with that model the semi-strong efficiency that could be present, therefore, the performance is predictable.

When attributing business efficiency, it is possible to prove the nature of low efficiency since all of the factors almost obey a random walk. Again, it will affirm the rejection of semi-strong productivity far maximum and minimum values, presenting a predictable price.

According to the regression model fits the observed data (R^2), it indicates that from the past data obtained from the variables on Oracle Corporation stocks, the maximum variability values can be estimated with a 39.09 % of yield and a 43.83 % of yield, respectively from past pricings. The closing price, on the other hand, is unpredictably volatile.

In terms of strategy, it can be shown that the simple strategies of "buy and hold" analysis can be improved. More than positive performance has been achieved with the model used in this work with the performance of Oracle Corporation.

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