The performance of MACD indicator in Forex

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Abstract— *Lately, automating trading is becoming a very important issue in the finance sector. Transactions constitute the fundamental principle of the automated trading process allowing obtaining different technical indicators of Forex. It should be noted that each indicator has strengths and weaknesses. The purpose of this article is to focus on the MACD indicator through four currency pairs which are: EURUSD, GBPUSD, USDCHF and USDJPY. The study will be done on each couple separately, in order to verify their performance by evaluating the profit obtained, and by exploiting the time bands of the market increase between 2001 and 2010. VHTS virtual historical trading software is set up to measure the indicator based on basic equations; to demonstrate the assumptions; for trading which is carried out following the alerts of sales or purchases transactions received by the MACD indicator.*

Keywords:
Trading – Investment- Forex- Indicators of forex -MACD-Performance.

1 INTRODUCTON

Since 1973, the use of currencies in the markets has expanded by stopping the application of the Bretton Woods convention, which is based on the valuation of money by gold in central bank funds. The liberal character of the Forex market stems from the determination of prices by supply and demand concerning any currency. The financial market differs from other markets because it is characterized by the following points:

- Open market during day and night except on weekends
- A virtual market without a specific place

Furthermore, Forex transactions are the largest since they record a daily debit of 3.2 trillion US dollars, so currency exchange is not limited by the central bank. Ding (2010), states that the perpetual evolution of technology has created favorable conditions for the increase in performance of Forex trading, as a result, the market has experienced a large-scale increase by crossing geographic boundaries and reducing transaction costs.

A. Basic studies on the Forex market

The results of fundamental studies are the most suitable tool for measuring assets. The essential principles in Forex trading are used to assess the currency of the country, and at the same time they reflect its economic situation and predict its progress in the future. Therefore, the determination of the value of the currency of one country in relation to the other is based on the interest rate.

B.Technical studies on Forex

The previous data on the market feed the various technical or graphical studies concerning prices and volumes and forecast As it is suggest below, policies designed for promoting the exchange of exchange rates. These studies have not been supported by academic entities, although they were actually used during the previous century.

The technical studies are based on the quality and volume aspects. Among the studies focused on the volume, the indicator of Macd and P-SAR, while, the studies focused on the quality are linked to the model of geometric reasons such as the degrees of supports and contracting and the duplicate funds, here, the credibility of technical studies depends on these three factors.

C. Profitability

According several researchs, the technical study can reveal predictions on financial movements, and even the followers of this study conform to it, such as Sweeney (1986, 1988); Brock, Lakonishok and LeBaron (1992); Blume, Easley and O'Hara (1994); Neely, Weller and Dittmar (1997); Chan, Jegadeesh and Lakonishok (1996, 1999); Gencay (1996, 1998, 1999); Brown, Goetzmann and Kumar (1998); Rouwenhorst (1998); Neely and Weller (1999); Chang and Osler (1999); Lo, Mamaysky and Wang (2000); Chan, Hameed and Tong (2000); and Hsu and Kuan (2004.

The reputation of technical study is better than fundamental study because it has the ability to "beat the market". In addition, (Papadamou and Tsopoglou, 2001) indicate that the technical study approach can yield positive results by comparing it to the "buy and hold" process. In the early 1990s, analysts attempted to discover the effectiveness of the technical study through the evaluation of the USDDEM and the USDGBP. Furthermore, it should be noted that the majority of Forex traders in Hong

Kong have used both technical and fundamental studies to forecast price movements, instead of using only technical study.

II. INDICATORS

The Metrics from quantity and price data on currencies, such as opening price, upper and lower levels, and Forex technical study generated by MACD indicator (Seyed Hadi Mir Yazdi and Ziba Habibi Lashkari). The purpose of setting up indicators is to be able to make forecasts of price fluctuations based on results. These indicators are also used to centralize market data and make it available to traders and investors in order to optimize decision-making. It should be indicated that these indicators are categorized into four types: orientation indicators, volume indicators, volatility indicators and momentum indicators.

This indicator shows the evolution direction of the exchange rate during a specified term. So, the orientation is directed towards three orientations: either to the side, upwards or downwards. Indeed, the orientation indicators are based on the different data available on the market in order to determine its trend based on several dynamic averages such as the MACD, the P-SAR.

III. MACD

The MACD indicator means "Moving Average Convergence Divergence", is one of the orientation indicators aimed at clarifying the interaction between prices and moving averages. This indicator was created in the 1990s to treat the differences between the exponential moving averages between 12 and 26; however, there is a graph of another exponential average articulated on a lower and more effective number of days of the MACD in terms of long- or short-term benefits. This is an indicator made up of a number of alerts and which is called "trigger" according to Appel (2008).

Note that investors can understand and interpret the MACD. Indeed, research has claimed that when the MACD grows above zero in growth, this is explained by a good buying opportunity. While if the MACD exceeds zero in decline, indicates that it is a sales opportunity as shown in the following figure:

Figure 1: Buy and sell signal from MACD indicator

On the other hand, when the MACD is less than zero during the first hour and becomes greater than zero during the second and third hours, this triggers an alert which must be bought in the fourth hour. Of course, if the MACD during the first hour proves positive and during the second and third hour the value becomes negative, in this case, the sale will be the best choice.

A. Benefits and properties of MACD

Among the main opportunities of the MACD indicator is its ability to bring together the characteristics of orientations and triggers in a single indicator. Furthermore, like every orientation indicator, the margin of error does not last long. The use of dynamic averages shows that the MACD implicitly adapts with the evolution of securities prices. In addition, by using exponential dynamic means and not simple, existing gaps will be cleaned up. This trigger indicator provides the possibility of predicting security variations.

The differences resulting from the MACD constitute an essential foundation to have an idea on the future variations of the trend. It is enough to have alert following differences that have arisen from the bullish trigger which begins to decrease or vice versa, and which provides for a change in the orientation. As a result, investors are warned of possible long and short term opportunities. In addition, the other advantage of the MACD is its convenience to the graphs which process the daily, weekly or monthly data.

In this sense, the differences and commonalities of the two dynamic means are treated by the MACD indicator. Indeed, this indicator is mainly characterized by the divergence between the number of days calculated by the exponential moving average: 12 or 26 days, it is possible to combine between the different moving averages and simultaneously use the most suitable according to each situation. Speaking of dynamic averages, there are two types: fast averages which are more suited to weekly graphs, however, slow averages are more suitable for the most unstable stocks. The flexibility of the MACD indicator makes it adaptable to all kinds of investors and threats to their objectives.

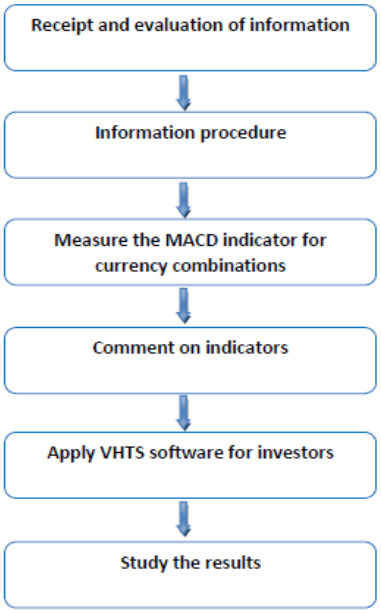
IV. STUDY FRAMEWORK

The analysis was based on information on transactions carried out within a timetable defined between 2001 and 2010, in order to obtain more efficient results. The objective of this analysis is to determine the value of the essential indicator that provides the best time to buy and sell while protecting against possible losses. In addition, the analysis was done on four currency pairs (EURUSD, USDJPY, GBPUSD and USDCHF), which are examined when using the MACD indicator and the alerts generated during the ten years. In addition, each currency was analyzed independently to be able to separate between the resulting impacts of the indicator on the investors' transaction decisions compared to the combinations of currencies.

V. METHODOLOGY, DATA ACQUISITION AND ASSUMPTIONS

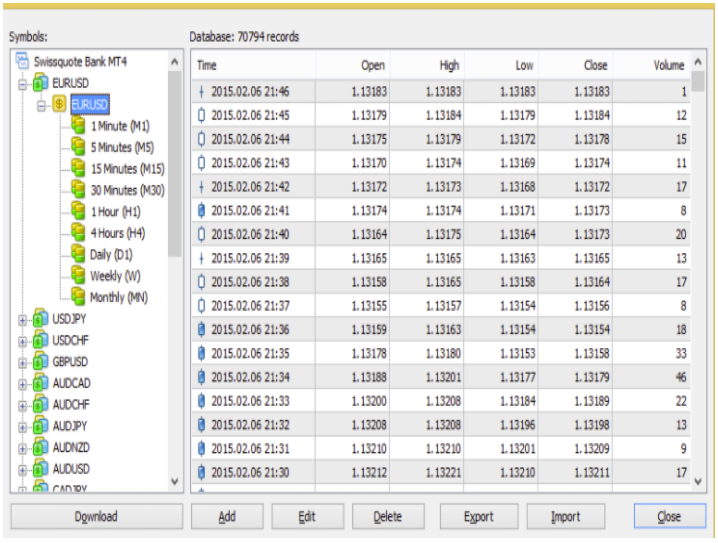
Literally, the analysis carried out was based on the concepts of methodological research to achieve the desired goal as mentioned in Figure 2. The important information that feeds this analysis are the opening and closing hours, the minimum price and maximum, the quantity of transactions relating to the currency currencies chosen for the study seven days a week during the entire 10-year period. All this information comes from the MetaTrader software.

Figure 2: The research procedure organization chart



The information collected on quarter currencies is calculated and interpreted rigorously during the 10 years. FIG. 3 represents an example of the interpretation of this information on the MetaTrader software with the aim of determining the responses on the amplitude in buying and selling operations, the maximum ends and minimums of the prices of currencies.

Figure 3: An example of the data on MetaTrader software



Furthermore, this analysis has taken the MatatTraders as an important trading base for Forex, now this software allows investors to carry out buy and sell operations easily. Also, this software provided graphs and clues to be used in decision making for invistors. Another software more accessible to the

general public, that of Microsoft Excel which constitutes an analytical support and its capacity to process a large number of information and to bring out important indicators, which constitutes a basis for evolving the Virtual Historical Trader software (VHTS) using past experience to be able to create forecasts and eventual assumptions.

In addition, the addition of TA-Lib software to Excel allows the support and improvement of the accuracy of the planned calculations. The Virtual Historical Trader (VHTS) provides for traders a virtual platform constituting the same conditions of the real platform in order to allow them to test the different assumptions calculated. Indeed, this software has the possibility of providing calculations during defined time intervals, therefore, the operations launched and closed to buy or sell are made following indices and alerts and even the outcomes of each operation carried out are calculated and recorded by the indicator.

It is necessary to assess the usefulness of the indicator by applying an empirical method on the Meta Trader software and its manipulation of information and by proceeding with an exclusive equation set up by its founder. In this sense, before launching the Virtual Historical Trader (VHTS) software, numerous tests were carried out on the proposed equations and hypotheses to ensure the credibility and effectiveness of the results. However, what about the time intervals to adopt and the indicators to choose according to the characteristics of each currency?

VI. DATA COLLECTION AND ASSUMPTIONS

Once the MACD indicator is calculated, the Virtual Historical Trader (VHTS) software has started to announce the concluded balance sheets for the four currencies under the same conditions as trading, assumptions and explanations. In addition, it turned out that the MACD indicator is more profitable and beneficial for the EURUSD combination by comparing it with the effects on other currency combinations; however, the profit does not increase capital.

Table 1 explains the balance sheets of the implementation of the MACD indicator for the combinations of currencies interpreted in the four rows in detail. The first three rows reflect the gains generated whether it be sales or purchases. The third three lines show the total balance sheet and the distribution of sales and purchases. The third and fourth lines show the volume of sales and purchases and the overall result of operations for each currency combination.

Then, the last three rows reflect the final balance sheet at the end of the duration provided for in the analysis which presents several hypotheses in different environments available to investors, and the results obtained are the result of the findings and tests of the investigators' experts and amateurs in the Forex market, in capital and risk management.

- In order to guarantee the reliability of the results of the analysis, the chosen duration of 10 years, even if it is long, but barely sufficient to deeply examine the transactions made.
- One of the following currency combinations has been traded by investors (USD / CHF, EUR / USD, GBP / USD and USD / JPY). According to Oh (2007), these currencies were selected and studied in theory on the Forex market in Europe, North America and Japan, this could minimize the impact of other aspects on the balance sheets.
- The investor has the possibility of launching a transaction and this action also serves at the same time to close the previous transaction.
- Arriving at 30 pips, the operation becomes beneficial, although the profit is low; the threats of loss remain low.
- It is mandatory that the value of each transaction does not exceed 7% of the capital of the investors.
- The minimum amount of capital to invest is 10,000 dollars.
- Once the indicator launches a buy or sell alert, it is the time to discuss the transaction to be made for 5 days a week, or 120 hours.
- When there is no operation launched because the operation already executed does not face either the profit threshold or the loss threshold, the operation is involuntarily closed after 10 a.m., therefore, the calculation the balance is based on the last 10 hours.
- Operation orders are not subject to any constraint since their value does not exceed 7% of the capital.
- The minimum transaction amount is 0.01 per lot.

Table 1: Inventory of the effects of interpretations of the MACD indicator

Combinaisons de devises	MACD			
	EURUSD (pips)	GPBUSD (pips)	USDCHF (pips)	USDJPY (pips)
Incomes from sales	11259	11555	10259	11010
Profit from buying	13165	12836	10146	10655
Total profit	24424	24391	20405	21665
Sell loss	12783	14562	12670	11428
Buy loss	11459	13143	12455	11417
Total loss	24242	27705	25125	22845
Profit/ loss	182	3314	4720	1180
Profit/ loss sell	1524	3007	2411	418
Profit/ loss buy	1706	307	2309	762
Sell register	955	926	832	848
Buy register	944	930	846	854
Total operation	1899	1856	1678	1702
Ending balance	8068,53	674,36	142,32	2224,02
Date of closing trader	29/12/2010	31/12/2010	30/04/2009	22/12/2010
Commission amount (dollar)	16072,69	7588,6	9721,2	10788,02

The brokerage rate is calculated on the basis of the effective market rate, although this rate is not the same for each currency and the time of its execution.

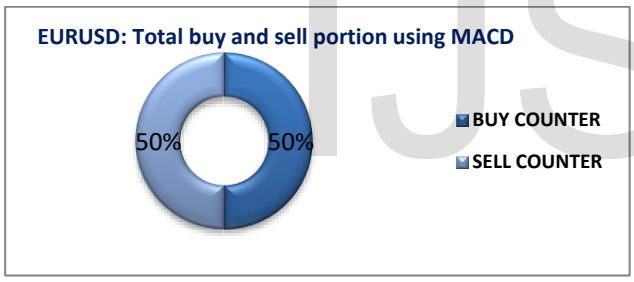
VII. PROCESS

The analysis findings are announced according to the method adopted for gathering information, assessing the information, examining and analyzing information and measuring the P-SAR in the Virtual Historical Trader (VHTS) software software. . This then makes it possible to interpret the indicators for the four currencies under analysis. As a result, four virtual investors are assumed to be applying the indicators for each currency according to the software.

A. EURUSD

1899 operations were launched including 955 purchase operations and 944 sale operations, applying the MACD indicator for EURUSD. The totality of these operations during the decade is detailed in table 5.

Figure 4 : Result of the breakdown of purchases and sales of EURUSD (2001-2010) using MACD indicator



The closing of the operation remained open during the 10 years of the analysis. In addition, the final result from the purchase operations with 1706 pips, the difference between the loss and profit pips. In addition, the final result of the purchase operations posted a positive 1,524 pips. It should be concluded that the profit generated by the buying operations is higher than the loss generated by the selling operations by 182 pips, the difference between the profits 1706 and 1524 pips. Table II shows a general balance sheet on the use of the indicator for the EURUSD and shows a positive result of 183 pips over the 10 years.

TABLE 2: Annual trading report EURUSD using MACD indicator

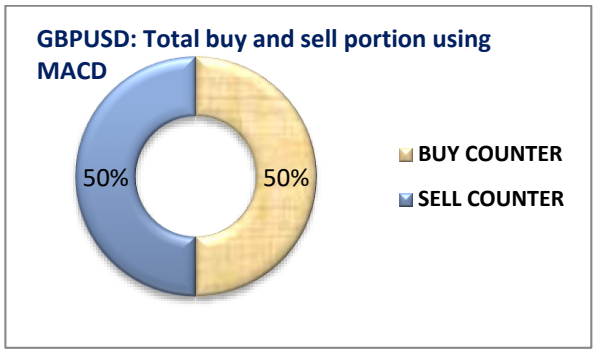
Year	Profit/ Loss Buy	Profit/ Loss Sell	Profit/ Loss
2001	74	36	38
2002	134	72	62
2003	238	238	0
2004	302	115	187
2005	28	279	307
2006	44	252	296
2007	104	293	189
2008	510	34	476
2009	243	787	544
2010	233	6	239
Result	1706	1524	182

Purchasing operations have been more beneficial than sales operations which have generated negative results for the majority of 10 years. In addition, the forecasts proposed by the MACD indicator were beneficial for 5 years and negative for 4 years and 1 year indifferent. In addition, Table 4.8 states that the MACD indicator initiates cheaper buy alerts than sell alerts. However, the final balance sheet is advantageous even if the capital has not increased due to the duration of the transactions. Indeed, this explains that the starting capital remains approximately the same because each transaction carried out does not exceed 7% of the capital. Therefore, the positive or negative result at the start of the analysis period is essential to determine the result at the end of the period.

B. GBPUSD

1856 trades were made using the MACD indicator for the GBPUSD pair, 926 buy trades and 930 sell trades during the entire analysis period. The total balance of MACD buying and selling operations for the same pair is detailed in Figure 6.

Figure 5: Result of the breakdown of purchases and sales of GBPUSD (2001-2010) using MACD indicator



These trades caused a loss of 3314 pips, following the difference between 24391 pips in profit and 27705 pips in loss. In fact, during the 10 years, the final result was negative, recording 3314 pips of loss following the addition of 3007 pips from sales

operations and 307 pips from purchasing operations.
As a result of these transactions, a loss of 3,314 pips was recorded, including 24,391 pips in profit and 27,705 pips in loss. In other words, 3,007 pips of loss of sale transactions and 307 pips of purchase transactions generated 3,314 pips of terminal loss in ten years.

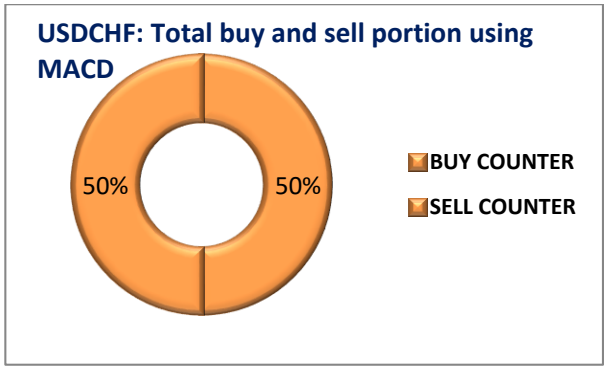
TABLE 3: Annual trading report GBPUSD using MACD indicator

Year	Profit/ Loss Buy	Profit/ Loss Sell	Profit/ Loss
2001	124	651	775
2002	557	681	1238
2003	350	598	248
2004	334	286	48
2005	395	131	264
2006	120	630	510
2007	69	175	106
2008	407	124	531
2009	338	469	131
2010	103	126	229
Result	307	3007	3314

C. USDCHF

Like other currency pairs, the MACD indicator has also been applied to USDCHF at the Forex level. 1,678 operations have been launched and contain 832 purchase operations and 846 sale operations. The total balance of these operations using the MACD indicator during the 10 years of study is displayed in Figure 6:

Figure 6: Result of the breakdown of purchases and sales of USDCHF (2001-2010) using MACD indicator



For the USDCHF pair, the transactions were closed in April 2009 due to insufficient capital. In this case, the MACD indicator was not performing well enough as it caused losses which caused the depletion of capital before reaching the end of the study period. On the one hand, the buying operations generated a negative result of 2309 pips, the difference between a loss of 12455 pips and a profit of 10146 pips. On the other hand, the sales operations also generated a total loss of 2,411 pips, the difference between a total profit of 10,259 and a total loss of 12,670 pips. Total balance sheet shows loss in both buy and sells transactions of 4,720 pips
Table 4 shows that the buying and selling operations are not linked since during one period of years, the purchasing orders contradict with the sales operations, yet the link becomes straight during another period. It should be noted that, in the end, the losses evoked by the sales and buying operations are getting closer.

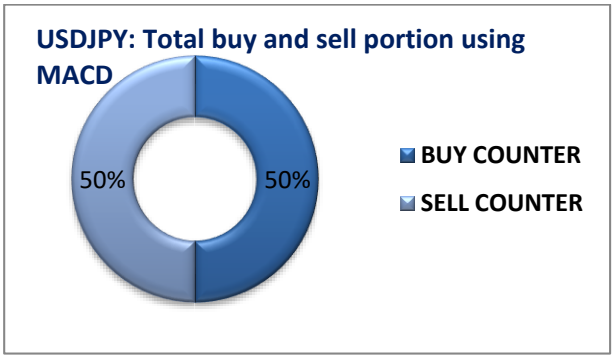
TABLE 4: Annual trading report USDCHF using MACD indicator

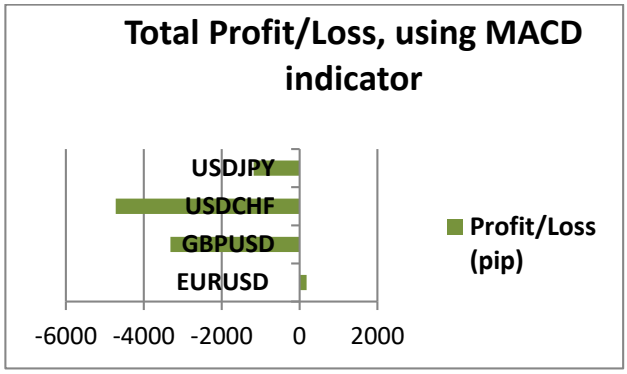
Year	Profit/ Loss Buy	Profit/ Loss Sell	Profit/ Loss
2001	408	19	389
2002	174	526	352
2003	364	696	1060
2004	326	210	536
2005	591	444	1035
2006	114	73	41
2007	286	297	11
2008	214	906	1120
2009	180	18	198
Result	2309	2411	4720

D. USDJPY

MACD indicator alerts for the USDJPY currency pair caused a loss of 1180 pips, the difference between a profit of 21665 pips and a loss of 22845 pips. In detail, the sales operations generated a loss of 418 and the purchasing operations generated 762 pips as a loss. The general balance sheet of the purchase or sales operations carried out for the USDJPY combination is displayed in Figure 7 according to the assumptions of the MACD indicator:

Figure 7: Result of the breakdown of purchases and sales of USDJPY (2001-2010) using MACD indicator





On the other hand, the sales operations concluded a loss of 418 pips resulting from a profit of 11010 pips and a loss of 11428 pips, however, the purchase operations resulted from a loss of 762 pips resulting from the profits of 10655 and a loss of 11,417 pips.

Table 5 shows the evolution of buying and selling operations during the years of the study, during the years 2002, 2006, 2009 and 2010, the alerts launched by the MACD indicator recorded profits which could not exceed and compensate for the amount of losses generated by other years.

TABLE 5: Annual trading report USDJPY using MACD indicator

Year	Profit/ Loss Buy	Profit/ Loss Sell	Profit/ Loss
2001	148	180	32
2002	31	20	51
2003	290	198	92
2004	159	21	138
2005	137	533	650
2006	345	301	44
2007	135	376	511
2008	309	148	161
2009	166	476	310
2010	90	109	19
Result	762	418	1180

VIII. STUDY

The evolution of the application of the MACD indicator for even pairs of currencies is detailed in Figure 8.

Figure 8: Final profit/loss using MACD indicator for trading during (2001-2010)

IX. CONCLUSION

The evolution of the profitability of the MACD indicator buy and sell alerts for the currency combinations chosen for the EURUSD, GBPUSD, USDCHF and USDJPY study was analyzed in detail in order to determine its profitability and whether the hypotheses concluded are effective. The quarter combinations of currencies have been studied in the same transaction circumstances to make a fair reconciliation of balance sheets; several hypotheses have been practiced according to the following instructions:

- Set a duration of 10 years for transactions
- Investor transactions are limited to the four combinations of currencies selected
- A single operation to be carried out by investors, and in the event of the launch of a new operation, the previous one will be automatically closed.
- The deductions on each transaction are 30 pips, whether a profit or a loss stopped by a stop loss order.
- The amount of each transaction must be less than 7% of the capital of each investor.
- The starting amount of capital for each trader is 10,000 dollars.
- Transactions are carried out 5/7 days, an operation begins from the launch of a sale or purchase alert.
- In the event that the operation launched does not reach its profit point (take profit) or the permissible point of loss (stop loss) and without launching a new operation, the first will be closed necessarily after 10 am, the calculation of the result is based on the last 10 hours.
- The amount of a transaction is not defined; the only condition is not to exceed 7% of the capital
- The minimum volume is 0.01 of the batch. The followers of this study on the Forex market were able to propose hypotheses following their research concerning the conduct of capital and risks.

According to this study, several findings were concluded:

- The most advantageous results of the MACD indicator were raised for the EURUSD combination.
- The effectiveness of the MACD indicator in terms of profit growth was concluded in the evolution of the EURUSD

combination. The profit generated reached an amount of $ 8,068.53 once the 10 years of the study were closed as shown in table 1.

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