

Exchange Rates in Foreign Currencies Using Fundamental Intelligent System to Predict the Spike Direction of Analysis Method

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Abstract: One of the skills that must be possessed by market participants in financial markets is the ability to predict trends in price changes in the future well. A market participant in financial markets needs to carry out various analyzes to avoid sustained losses and increase investment portfolios. The analysis that is popularly used by market participants today is technical analysis, one of the drawbacks of technical analysis is that it cannot predict exactly when there will be a large movement in the price of a currency or other investment instruments. This requires market participants to be in front of the monitor screen to monitor price movements. In an intelligent system that is built, with input in the form of economic consensus data, official release data, revised release and the presence or absence of related party conferences on the relevant day processed in the role-based fundamental analysis, outputs can be obtained in the form of spike directions, large spikes, time of spike and estimates the profit. This study uses fundamental analysis formulated with historical data to estimate the direction of the increase in the value of foreign currencies. The results of this study are estimates of the direction of market spike, the size of the market spike and the duration of the market spike. This research is expected to help decision-makers or financial market participants to increase investment portfolios and avoid ongoing losses or even bankruptcy.

Keywords: Fundamental analysis, Financial markets, Intelligent system, Market spike, Role-based

1. INTRODUCTION

One of the skills that must be possessed by market participants in financial markets is the ability to predict future price change trends properly and correctly (Bagheri et al., 2014 [1]). Errors in decision making in financial markets can result in huge losses and even bankruptcy, whereas an accurate analysis can be the basis for making the right decision to generate profits from financial markets.

Market participants generally use 2 methods to analyze future market trends, namely technical analysis and fundamental analysis. But the method commonly used by market participants is to use technical analysis (Bagheri et al., 2014[1]). Technical analysis relies heavily on charts (charts) and past data (historical data) in the hope that history will repeat in the future. By analyzing past data, future trends in market price changes can be predicted (Marshall et al., 2007 [2]).

One weakness of technical analysis is that it only focuses on past charts and data without taking into account the factors that cause fluctuations in price changes. Fundamental analysis predicts future trends based on the overall economic and financial condition of a country.

Previous research in 2014 by advancing technical analysis using Adaptive Network-based Fuzzy Inference Systems (ANFIS) can predict the direction of market movements with an accuracy of 69% (Bagheri et al., 2014 [1]). With enthusiasm to produce predictions with better accuracy, this study was then prepared by prioritizing fundamental analysis formulated in an intelligent system to produce rule-based which can predict the direction, range of magnitude and duration of fluctuations in currency rate with better accuracy. This intelligent system is expected to help investors, investment managers and policy makers in the capital market to make short-term trading decisions in the financial markets to increase profits and investment portfolios.

2. THEORETICAL FRAMEWORK

2.1. Fundamental Analysis

Fundamental analysis is essentially a study that studies why markets move and what causes them to move (Chen, 2009 [3]). Fundamental analysis is a technique that studies the reaction of capital market players to the condition of a country, which behavior will be reflected in the prices formed in the market. In this case, it is

as if economic conditions affect prices, whereas what influences prices is market participants' responses to economic conditions that are reflected in prices.

The condition of a country which is published in the form of a news release has 2 types, the scheduled and the unexpected (Kritzer, 2012 [4]). The unexpected news covers climate conditions, politics, economy, finance, natural disasters, war and others. The scheduled news is the release of scheduled economic indicators issued by official government and private institutions. Each economic indicator has its own release schedule in accordance with its period, including weekly, monthly, quarterly and annually.

For this type of scheduled news release, each scheduled economic indicator to be released has an estimated number issued by economists consensus, market participants only react if the actual release has a significant difference from the estimated number (Taylor, 2003 [5]). Fundamental news might not make the market move directly if the release is in accordance with estimates (Michalowsky, 2011 [6]). The exchange rate reacts very strongly to very good news (news surprises) or very bad news (negative news). The fundamental distribution of news releases can be seen in figure 1

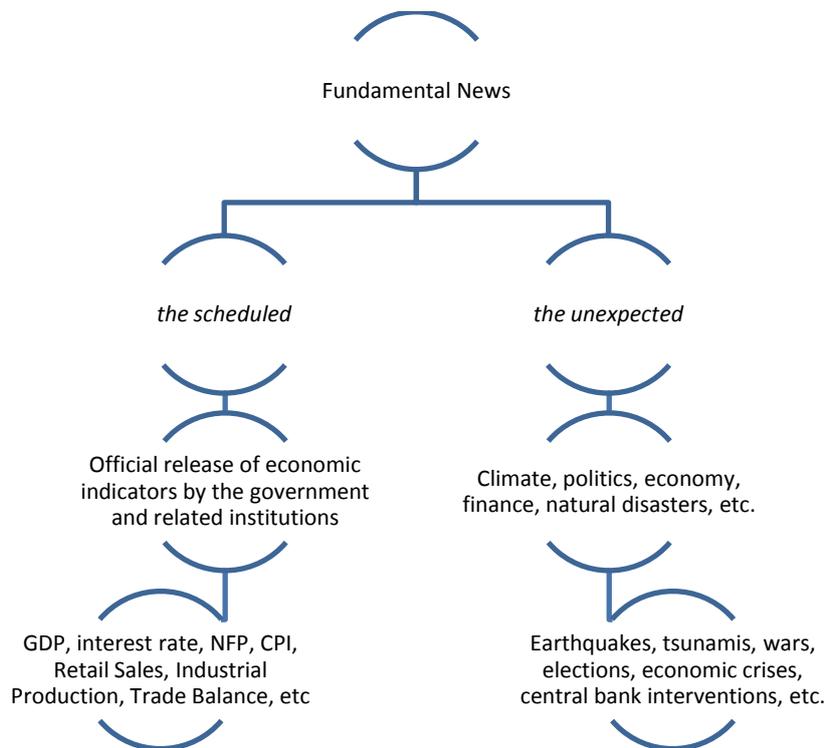


Figure 1. Classification of fundamental news releases

The order between last month's news releases, estimates and the latest releases can be seen in figure 2. When applied in trading, fundamental analysis has two objectives, anticipating the impact of short-term prices and long-term price forecasting (Norris et al., 2010 [7]).

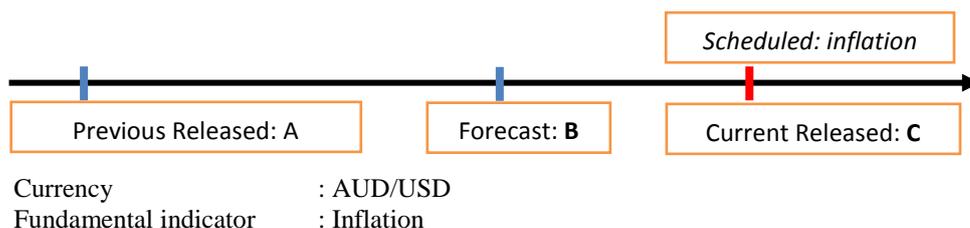


Figure 2. The fundamental pattern of news schedule

From figure 2 it appears that the fundamental news sequence has a sequential pattern of previous releases, forecast and current releases. The important point of the release of scheduled news is not the good or bad data, but how the data is compared with the forecast figures, the greater comparison number, the greater the impact on strengthening or weakening the value of a currency (Kritzer, 2012 [4]). If the news current release (actual) is better than the forecast figures, this shows the economic performance is better than expected (surprise), it means the value of the country's currency will be appreciated (strengthened) with a significant jump, and vice versa. If current news release is the same as the forecast figures, this shows that economic performance is in accordance with the figures that should be, in this case nothing special. That means the value of the currency will be stable and not experience a surge. In general, fundamental analysis can be modeled in role based as follows:

$$\text{IF } C > B \text{ THEN USD Appreciated} \tag{1}$$

$$\text{IF } C < B \text{ THEN USD Depreciated} \tag{2}$$

$$\text{IF } C = B \text{ THEN USD Sideway} \tag{3}$$

In this case, what affects the magnitude of the spike is the difference between the estimated number and the actual release value, hereinafter referred to as the impact factor (i) which can be modeled in equation (4)

$$i = | C - B | \tag{4}$$

where *i* is the impact factor, which is the absolute value of the difference between actual and estimated numbers. *C* is the current release and *B* is the forecast estimated release.

The greater the value of the impact factor, the greater spike that occurs. So the impact factor and the magnitude of the spike can be modeled in equation (5) and one example of the spike can be seen in figure 3.

$$\text{impactfactor} \propto \text{spike} \tag{5}$$

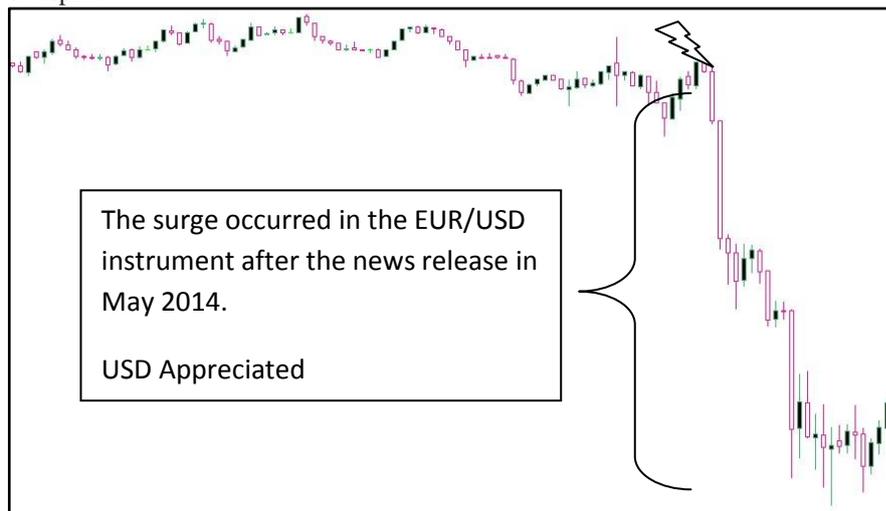


Figure 3. The increase in value of the instrument after the news release

From figure 3 we see a spike market after the fundamental news release. By observing the movement patterns of the graph, it appears that spike markets have a range of depth (price movement) and a span of time (time movement). Price movement or large spikes can be defined as price changes from the point of spike to the highest price for a spike up or the lowest price for a spike down on the day concerned in units of basis points or pips. Price movement can be modeled in equation (6)

$$PM = | P_t - P_0 | \tag{6}$$

where *PM* is the price movement, *P_t* is the highest price for a spike up or the lowest price for a spike down on the day, *P₀* is the price of the currency exchange rate at the time of the spike.

Besides having a price range (price movement), spike also have time movement. Time movement or duration of a spike can be defined as the change in time from the point of spike to the time the highest exchange rate is reached for a spike up or the lowest exchange rate for a spike down on the day concerned in minutes. Time movement can be modeled in equation (7)

$$TM = T_1 - T_0 \tag{7}$$

where *TM* is the time movement, *T₁* is the time of the highest exchange rate, *P₀* is the time of the spike. And then to calculate the average size of the spike using the ATR method. Average True Range (ATR) is an indicator to measure volatility, a measure that states how likely a price can move up or down in a certain time

period. This indicator was developed by J. Welles Wilder in 1978. Wilder started with a concept called true range, which is the difference between the opening price and closing price between trading periods as shown in figure 4.

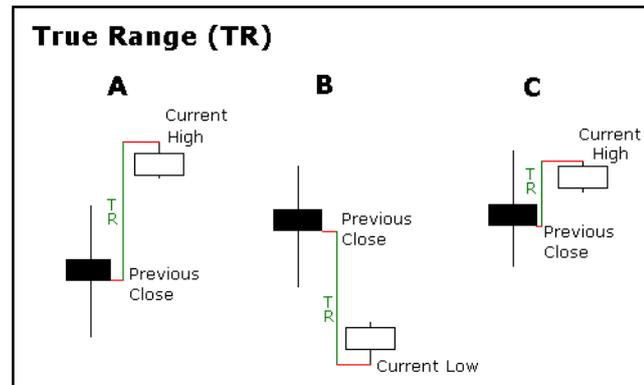


Figure 4. Illustration of True Range

From figure 4 it is known that true range can be calculated with 3 conditions. Condition A shows that the market is moving up. Condition B describes the condition of the market in a state of decline. Condition C shows market conditions that are not moving or experiencing very small movements (sideways). The explanation of the three conditions is as follows:

Condition A

High-low range of prices formed after prices rise. True range is a calculation of the absolute value between the highest price (current high) and the previous closing price (previous close).

Condition B

High-low range of prices formed after the price drops. True range is a calculation of the absolute value between the lowest price (current low) and the previous closing price (previous close).

Condition C

Even though the closing price is at the previous high and low range, the high and low price range is very small True Range can be formulated in equation (8) as follows:

$$TR = \max [(high-low), \text{abs}(high-\text{close}_{prev}), \text{abs}(low-\text{close}_{prev})] \quad (8)$$

2.2. Reference Study

Several previous studies using technical statistics indicators to predict variations in prices of various instruments in the financial markets, including studies to find optimal policies for the EUR/USD exchange rate have been carried out, in this study researchers sought a causal relationship between the exchange rate of EUR/USD and 3 key macroeconomic variables. Empirical investigations were carried out using an autoregressive (ECVAR) error correction vector framework. The results provide evidence of a long-term relationship between the interest rate and the exchange rate of the EUR/USD currency (Nicholas et al., 2011 [8]). Research has also been conducted to determine the effect of interventions with inflation targets on the exchange rates in 4 Latin American countries, including Chile, Colombia, Mexico and Peru. By using the GARCH-type model, it is found that the rule-based formulated in the intervention can suppress the movement of currency exchange rates (Broto, 2013 [9]).

Other research was conducted by analyzing the relationship between economic fundamentals and exchange rates by investigating the importance of real-time data. The results found that economic news in America, Germany and Europe had been the driving force behind the development of the EUR/USD exchange rate in the 1993-2003 period. The most important part of macroeconomic news in America can be seen from the previous release compared to the actual release. Exchange rates show a stronger response in periods when market uncertainty occurs (Ehrmann and Fratzscher, 2005 [10]).

Similar research has also been carried out to measure the effect of macroeconomics on the price of the daily currency (intraday). At intervals of 5 minutes, the estimation of the intraday model uses order flow between dealers. Order flow can significantly affect currency prices at all time intervals. Currency prices can fluctuate shortly after a news release is announced (Evans and Lyons, 2008 [11]).

Meanwhile in Europe, researchers shared questionnaires and interview surveys with financial journalists in Frankfurt, London, Vienna and Zurich. The research shows that investors use both approaches (technical analysis and fundamental analysis) in trading decision making. The results show that technical analysis or what is commonly called a chartist dominated more in the era of the past decade. Fundamentalists are market participants who predict market developments by analyzing economic conditions that are assumed to affect the exchange rate. On the other hand Chartist studies the movement of currency values and believes that past exchange rates can be an indicator for future price development (Oberlechner, 2001 [12]).

In one study, determined a set of fundamental information that has the potential for high impact on the Euro currency, and the currency pair under study is EUR/USD associated with 6 fundamental information. Price changes data 5 minutes before the news release and after release are measured to determine the size or percentage of price movements before and after the news release. The results of the news release have an influence on changes in the exchange rate of EUR/USD (Vajda et al., 2015 [13])

Another study was conducted using a 15 minutes interval dataset on EUR/USD currency pairs from 1999 to 2002. The study measures how macroeconomic shocks affect the EUR/USD currency pair on an intraday basis using the linearly distributed lag dummy variable. The result is that macroeconomic shocks have an effect on the exchange rate of the EUR/USD currency pair in 1 trading day and do not cause long-term effects (Han, 2008 [14]). Recent research has been conducted with a novel approach to predict direct movements of currency exchange rates on an intraday scale based on the text of financial news headlines using the text mining method (Nassirtoussi et al., 2015 [15]).

3. METHODOLOGY

3.1. Research Materials

The materials used in this study include:

- a. Data on the exchange rate of the AUD/USD currency pair at 5 minute intervals in 2017
- b. Australia's economic consensus data for 2017
- c. Data release of Australian economic indicators in 2017

3.2 Research Tools

The tools used in this study include:

- a. Microsoft Excel 2016
- b. Microsoft Windows 10
- c. MetaQuotes MetaTrader5
- d. Core i3 PC with 4 GB RAM

3.3 Research Procedure

In conducting this research, the steps taken are as follows:

1. Data collection

The data to be collected is as follows:

- a. Data of exchange rates in 2017
Obtained by request and then download the currency pair exchange rate data from the Metatrader 5 platform. Currency data used in this study is AUD/USD at 5 minutes intervals.
- b. Economic consensus data
Obtained from economic consensus data. Consensus data used in this study is consensus data for economic indicators that have a high impact status on fluctuations in exchange rates of currency pairs.
- c. Data release of economic indicators
Obtained by request and then download economic release documents from the official website of each country

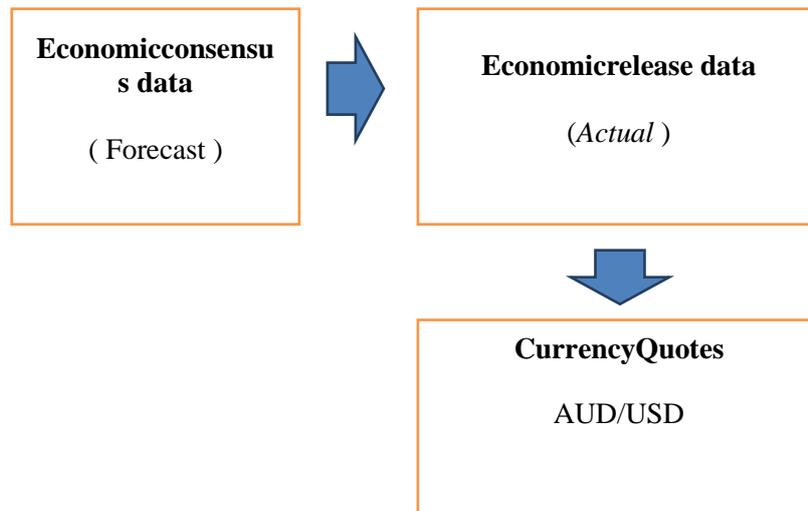


Figure 5. Research data

2. Data processing

1. Adjustment of data format

a. Economic release data

Data obtained from each publisher information is still shaped flat documents average thickness of 30-40 pages. For the need of research data for 1 year, the documents needed are approximately 60 documents. The documents to be obtained are then extracted in a database together with the consensus data, as shown in table 1.

Table 1. Consensus data table and economic indicator releases

Month	Economic Indicators	Consensus	Release
September 2014	US Non-farm Payroll	226,000	142,000

b. Currency quotes data

Data quotes of the currency obtained is used to see the magnitude of the increase in the value of the currency at the time of the release of economic indicators until the close of trading on the day concerned. The initial value during a news release is denoted by the symbol N_1 and the highest value after the news release until the close of trading on the day concerned is denoted by the symbol N_t , so that the magnitude of the increase in value can be modeled in equation (9) as follows:

$$\text{Spike} = | N_t - N_1 | \tag{9}$$

2. Calculation of data

- a. The calculation of the *impact factors* for the fundamental indicators from table 1 uses equation (5).
- b. Estimation of the spike direction uses *role based* on equation (1-3).
- c. Calculation great value and time fluctuations and using methods of *average true range* which is processed from the data history for the year 2017 using equation (8).

In general, the data processing carried out in this study can be seen in figure 6.

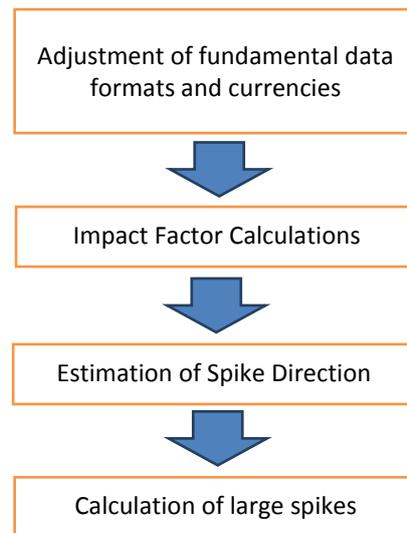


Figure 6 . Processing data research

3. System development

This intelligence system is built using the information system framework as shown in figure 7.

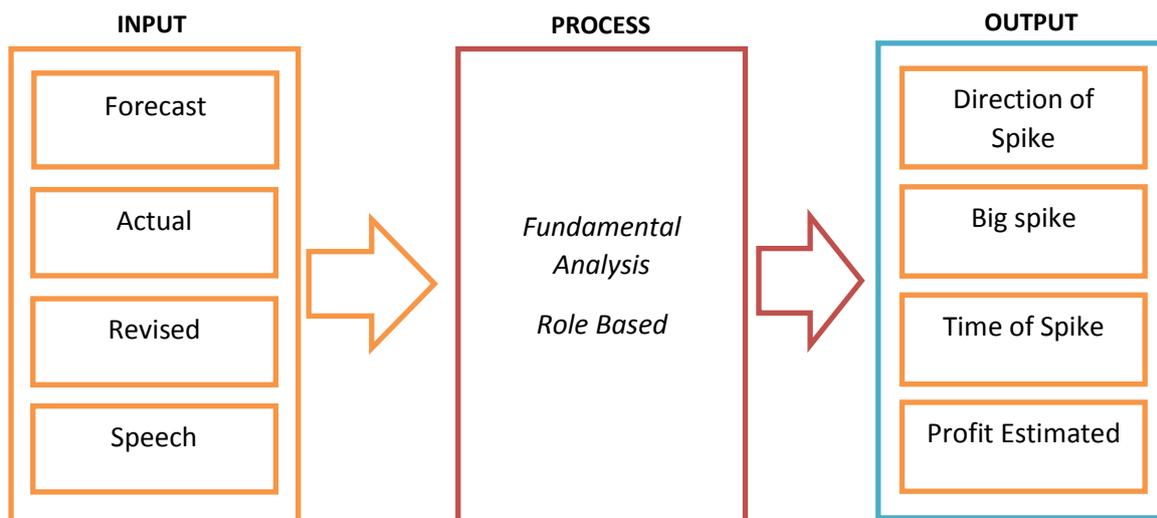


Figure 7. Information system framework

Framework system information that is built has 4 inputs, namely in the form of data the forecast (consensus economic), official data releases (actual), the revised release and there is absence of conference parties related to the day in question are processed in the fundamental analysis of role-based, can be obtained the output in the form of directions spike, big spike, time of spike and profit estimated.

4. RESULTS AND DISCUSSION

From the results of the collection of data releases economies of Australia, gained 14 indicators of the economy which could potentially result in a spike in the value of currency AUD/USD, including :

1. Retail Sales m/m
2. Employment Change
3. Unemployment Rate
4. CPI q/q
5. Trimmed Mean CPI q/q
6. Cash rate
7. RBA Rate Statement

8. RBA Monetary Policy Statement
9. Monetary Policy Meeting Minutes
10. Private Capital Expenditure q/q
11. GDP q/q
12. Trade Balance
13. Annual Budget Release
14. Current Account

In this study, the authors took 1 indicator release sample as research material, namely Retail Sales. Retail Sales is an indicator of the economy which measures the magnitude of the percentage change in the value of sales at the retail level. Indicator is released every month by the Australian Bureau of Statistics. If the value of the release (actual) is higher than the value estimated (forecast), then it is good for the eyes of money Australian Dollar, appearing in the chart the pair currency AUD/USD will soar upwards. Conversely, if the value of the release is lower than the value estimated, then the pressure for currency Australian Dollar, appearing in the chart the pair currency AUD/USD will jump down.

Processing of data aims to generate value impact factor for indicators of economy which released a country. Impact factor data is calculated using equation (4). While the data Directions spike, big spike and time of spikes obtained from the data value of exchange that is illustrated in the graph on the application Metatrader5. The results of data processing in the form of data impact factors, the direction of the spike, the magnitude of the spike and the time of spike.

4.1. Direction of spike

The direction of the spike is obtained from a comparison of official release figures (actual) and estimated figures (forecast). If the official release rate is greater than the estimated number, then the direction of the market spike will rise. If the official release rate is smaller than the estimated number, the direction of the market spike will decrease. If the official release figures are the same as the estimated figures, then the market will not jump. In pairs currency AUD/USD there are three conditions of the market, including :

- a. Jumped up
If the financial market soaring rises, it shows the currency Australian Dollar (AUD) was experiencing gains (appreciation). It is caused by the release of the news that is considered to be good and or beneficial to the economy of Australia.
- b. Jumped down
If the financialmarket jumped down, it shows the currency Australian Dollar (AUD) was experiencing weakening (depreciate). This is caused by the release of news that is considered bad and or detrimental to the Australian economy.
- c. Sideway
If the financialmarket does not move or only move in a range of small, it shows the currency Australian Dollar (AUD) was under the condition sideway. It is caused the release of the news that is considered to be not so important for the economy of Australia. In research it determined the market in conditions of sideway if the movement is less than 10 basis points.

From the data in table 2 is known that all of the data showed the spike in the number varies, only the data on the date of 6 March which moves 8 basis points or sideway. With such direction the market moves in accordance with the foundation of the theory. If the official release rate is higher than the estimated figure, then the Australian Dollar will strengthen/appreciate, in this condition the AUD/USD chart jumps up. Conversely, if the official release rate is lower than the estimated figure, then the Australian Dollar will weaken/depreciate, in this condition the AUD/USD chart jumps down. Then if figures released officially equal to the number estimated, then the Australian dollar will be stable/sideways, under the conditions of this graph AUD/USD did not move or shift within the range of the very small, the study is set at less than 10 basis points. From the data in table 2 it appears that the direction of the spike is entirely moving in the expected direction so that it is in accordance with the theoretical basis.

Table 2. spike direction and figures release official

Month	Date	Official release (Actual)	Number Estimate (Forecast)	Expected of spike directions	The actual direction of the spike
Jan	10	0.20%	0.40%	Down	Down

Feb.	6	-0.10%	0.30%	Down	Down
Mar.	6	0.40%	0.40%	Sideway	Sideway
Apr	3	-0.10%	0.30%	Down	Down
May	9	-0.10%	0.30%	Down	Down
Jun	1	1.00%	0.30%	Up	Up
Jul	4	0.60%	0.20%	Up	Up
Aug	4	0.30%	0.20%	Up	Up
Sep	7	0.00%	0.20%	Down	Down
Oct	5	-0.60%	0.30%	Down	Down
Nov	3	0.00%	0.40%	Down	Down
Dec	5	0.50%	0.30%	Up	Up

4.2. Big spike

In theory, the more substantial the difference between the value of the official released and the numbers estimated or who later called the impact factor then increasingly large spike that occurred. However, the data research are obtained, a large spike varied.

Table 3. impact factor and a large spike

Month	Date	Official release (Actual)	Number Estimate (Forecast)	Previous Released	Impact Factor	TM (point)
Jan	10	0.20%	0.40%	0.50%	0.2	14
Feb.	6	-0.10%	0.30%	0.10%	0.4	11
Mar.	6	0.40%	0.40%	-0.10%	0	8
Apr	3	-0.10%	0.30%	0.40%	0.4	43
May	9	-0.10%	0.30%	-0.20%	0.4	63
Jun	1	1.00%	0.30%	-0.20%	0.7	31
Jul	4	0.60%	0.20%	1.00%	0.4	10
Aug	4	0.30%	0.20%	0.60%	0.1	39
Sep	7	0.00%	0.20%	0.20%	0.2	39
Oct	5	-0.60%	0.30%	-0.20%	0.9	68
Nov	3	0.00%	0.40%	-0.50%	0.4	65
Dec	5	0.50%	0.30%	0.10%	0.2	46

From the data in the table, looked that the data impact factor that is big is not always followed by a spike that big as in theory. After compared with the data table indicator of the economy, can be known that the misalignment amount of spike is influenced by several factors, including :

- a. There has been a big spike before
In this case the investors have taken market action at the previous fundamental event. So when the release takes place, the market shows only a slight correction.
- b. There is the release of the news that his time at the same
In the case of this the perpetrators of market experience difficulty in making decisions because there is the release of news is important that rises simultaneously with a value that is different.
- c. There are important news releases that haven't been published on the same day.
If on the day that the same are indicators that are considered more important, then the perpetrators of the market took a stance waiting for the release of the more important such. It 's led to the release of the news as if no effect despite having impact factor that is significant.

4.3. Time of Spike

Time of spike data is important to take a decision when the need to enter the market and how long will survive and decide out of the market. Time of spike data on average lasted only 5 minutes after the release of the news, but the effect may affect up to closure of the market on a day that is concerned. It is visible in table 4. From the data table 4 shown that the spike occurred ranging from 5 minutes up to the closing of the market.

Table 4. impact factor and time of spike

Month	Date	Official release	Number Estimate	Impact Factor	PM (point)	TM (minutes)
Jan	10	0.20%	0.40%	0.2	14	30
Feb.	6	-0.10%	0.30%	0.4	11	5
Mar.	6	0.40%	0.40%	0	8	10
Apr	3	-0.10%	0.30%	0.4	43	440
May	9	-0.10%	0.30%	0.4	63	480
Jun	1	1.00%	0.30%	0.7	31	10
Jul	4	0.60%	0.20%	0.4	10	5
Aug	4	0.30%	0.20%	0.1	39	365
Sep	7	0.00%	0.20%	0.2	39	280
Oct	5	-0.60%	0.30%	0.9	68	1140
Nov	3	0.00%	0.40%	0.4	65	885
Dec	5	0.50%	0.30%	0.2	46	270

5. CONCLUSION

Actual released which rises to a value that is higher than the numbers estimated showed indications are good for the eyes of money Australian Dollar. It 's visible on the chart the pair currency AUD/USD will soar upwards. Conversely, if the release of the actual rise in value is lower than the value estimated, then the pressure for currency Australian Dollar, appearing in the chart the pair currency AUD/USD will jump down.

The amount of the value of impact factor is not always followed by a spike that big, things that are influenced by several factors, including the happen big spike before, release of news that time is the same, release of important news that has not been published on the same day. Time of spike in average lasted only 5 minutes after the release of the news, but the effect may affect up to closure of the market on a day that the relevant

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