FIBONACCI NUMBERS AS A TOOL FOR TECHNICAL ANALYSIS IN THE FOREX MARKET – THE ATTEMPT OF APPLICATION

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Summary

Forex is the world's largest financial market. Fibonacci numbers are one of the tools for technical analysis. The study examined the effectiveness and efficiency of patterns based on Fibonacci numbers. Forty patterns were used in the research: twenty Bat patterns and twenty Butterfly ones. The Bat Pattern proved to be more effective and efficient.

Keywords: Forex, technical analysis, Fibonacci numbers, the XABCD Patterns, the Bat Pattern, the Butterfly Pattern

1. General description of Fibonacci numbers and their application to technical analysis

"It is hard to state unambiguously who was the first to draw attention to these interesting structures. In the literature concerning the subject, these groups are often mentioned and numerous authors attach a lot of significance to them (…). Even in 1935 the legendary trader and technical analyst H. M. Gartley described the ABCD formations in detail in his most important book 'Profits in the Stock Market'. However, not everyone agrees with the opinion that Gartley was the first to introduce the discussed patterns into the trading universe. Irrespective of who discovered them, it is necessary to admit objectively that these simple regular systems are distinguished by a great functionality and have a considerable prognostic potential"[1]. XABCD formations are the patterns appearing in markets and after their appearance in all probability the market implements a complex scenario. They consist of four segments. The first segment is a part of the current trend, while the three remaining are segments – which according to the Elliott Wave Principle – constitute a correction.

"In 1935 H. M. Gartley published a book, which is already a classic today, 'Profits in the Stock Supermarket'. It was indeed an unusually groundbreaking work, and it is necessary to mention that the book is still regarded by many investors as one of the most important positions from the huge set of widely understood trading literature. Several dozen years later an outstanding American trader, Larry Pesavento, admitted that the formation which occurs on page 222 of Gartley's book is one of his favourite and is the most often used in his own investments. Pesavento named it '**Gartley 222',** and this name most often appears in reference books (…). However, it is a well-known fact that the greatest discoverer and researcher of XABCD formation (including the 'Gartley 222' formation) in the world is Scott Carney. This is the man who – having examined

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[1]P. Danielewicz, *Geometria Fibonacciego Praktyczny kurs inwestowania na rynkach finansowych*, WIG-Press, Warszawa 2006, p.52.

thousands of structures of this type – described regular relations appearing in them based on Fibonacci factors. This knowledge has already become a universally regarded standard"[2].
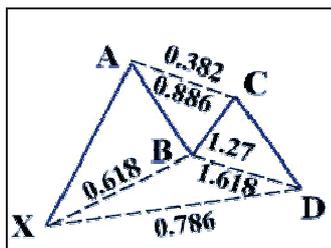

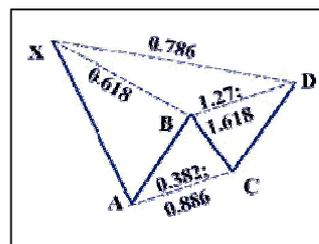*Image 1. The Gartley pattern in a growth trend*

Source: http://www.harmonictrader.com /gartleybullre.jpg.

Image 2. The Gartley pattern in a downward trend

Source: *http://www.harmonictrader.com/ga rtleybear re.jpg.*

The 'Butterfly' pattern was introduced by a legend of financial markets – Bruce Gilmore. In spite of that, the notations which have been universally accepted, and particularly formations based on them, were developed by Scott Carney – who is considered the greatest specialist on Fibonacci numbers.
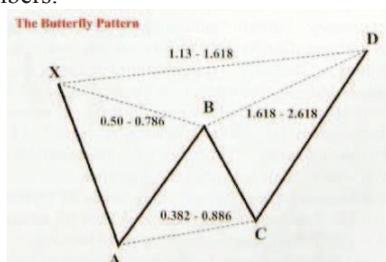

Image 3. The Butterfly pattern in a downward trend

Source: P. Danielewicz, Geometria Fibonacciego Praktyczny kurs inwestowania na rynkach finansowych, WIG-Press, Warszawa 2006, p.135.
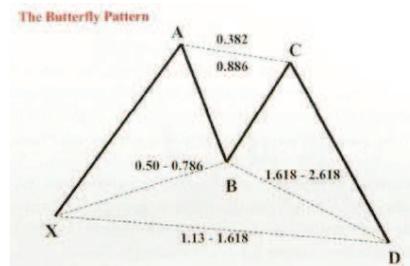

Image 4. The Butterfly pattern in a growth trend

Source: P. Danielewicz, Geometria Fibonacciego Praktyczny kurs inwestowania na rynkach finansowych, WIG-Press, Warszawa 2006, p.135.

Another formation is the **'Bat Pattern'.** "This interesting regular relation was discovered several years ago by Scott Carney. The 'Bat Pattern' quite often occurs on various liquid values (shares, contracts, options, indices, etc.), and the occurrence of such a structure usually heralds the appearance of some vital turning point. Therefore, the credibility of this formation is really satisfactory. If grouped, Fibonacci's suppressions are additionally included to the analysis, obviously

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[2] *Ibidem, p.113.*

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the probability of the vital turning point occurrence in such a defined area is growing all the more"[3].

Image 5. The Bat pattern in a growth trend

Source: P. Danielewicz, Geometria Fibonacciego Praktyczny kurs inwestowania na rynkach finansowych, WIG-Press, Warszawa 2006, p.154.
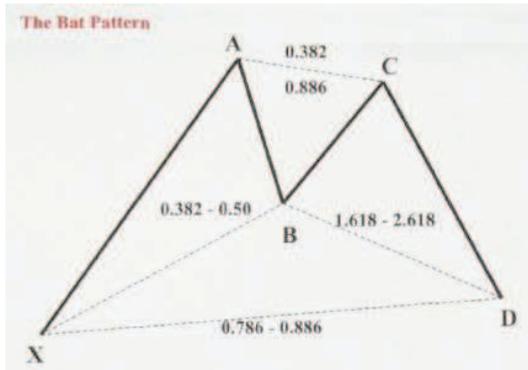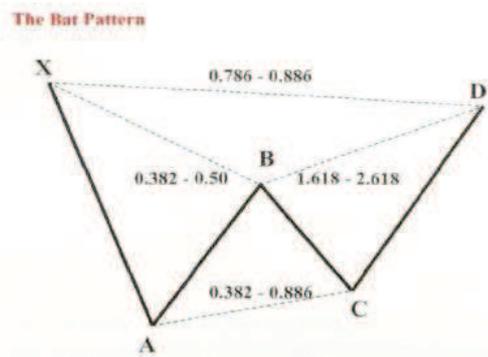

Image 6. The Bat pattern in a downward trend

Source: P. Danielewicz, Geometria Fibonacciego Praktyczny kurs inwestowania na rynkach finansowych, WIG-Press, Warszawa 2006, p.155.

The usage of the above-mentioned regular patterns is an element of technical analysis. This analysis, besides the fundamental analysis, is the main method of predicting fluctuations in prices on markets. John J. Murphy defines it as "examining behaviours of the market, especially applying charts, whose aim is to predict future price trends"[4]. A more elaborate definition, but with an identical meaning, is presented by Zenon Komar: "A technical analysis is defined as a process of studying share quotations, numbers of carried out transactions, both current ones and those occurring in last periods, and a whole range of market indicators, reflecting changes of demand and supply on the stock exchange, in order to determine future, probable tendencies of exchange quotations"[5]. It should be emphasized that the technical analysis is closely bound with the human psyche. Decisions which have been taken by investors for about one hundred years are reflected in charts. Assuming a relative permanence of humane behaviours, based on them it is possible to predict future fluctuations in prices.

Fibonacci numbers are an inherent element of permanent systems. They constitute a kind of 'mystical' part of reality. They appear in numerous elements of the world we live in; for example: in the structure of plants, the structure of DNA, the proportions of the human body. They depict the harmony which is an indicator of beauty. It turns out that relations, observed in nature, occur also in financial markets, including the Forex market. Thanks to this knowledge, it is possible to achieve profitable investment results.

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[3] *Ibidem, p.154.*
[4] *J. J. Murphy, Analiza techniczna rynków finansowych, WIG-Press, Warszawa 1999, p. 1.*
[5] *Z. Komar, Sztuka spekulacji, Wydawnictwo PRET, Warszawa 1993, p. 92.*

The first person who applied Fibonacci numbers for technical analysis was Ralph Nelson Elliott: "Introducing (the) Fibonacci series to the market analysis is considered as the greatest of Elliott's credits". He wrote, "Later I realised that the basis of my discoveries was the law of nature known even by people who designed the Great Pyramid of Giza, built perhaps 5,000 years ago. Fibonacci had been in Egypt, and after his return he revealed the existence of the series[6]". "R. N. Elliott was the very person who stated that the share market is the creation of the man, and – as every human activity – it has three characteristic features: form, time and proportion which meet the conditions of (the) Fibonacci series"[7].

Three methods of using Fibonacci numbers for analysing the situation on financial markets are distinguished as:

1) time analysis;
2) price analysis;
3) time and price analysis.

Time analysis is bound with the Elliott Wave principle. Elliott claimed that the length of impulse lasting presented by natural time units (e.g. months, days) is expressed in integers from Fibonacci series[8]. In case when „… the trend lasted longer than the number belonging to the series, he assumed that it must last until the number of days is equal of the following Fibonacci number. For example, if the trend lasts for 4 days, it should be assumed that it will last for at least 5 days, if it lasts for 9 days, it is assumed to last at least for 13 days"[9].

Image 7. Time analysis

Source: Real data from the Forex market, Dom Maklerski X-Trade Brokers.

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[6]*R. Fischer, Liczby Fibonacciego na giełdzie, WIG-Press, Warszawa 1996, p.15.*
[7]*W. Tarczyński, Rynki kapitałowe. Metody ilościowe, Wydanie I, Placet, Warszawa 1997, p. 179.*
[8]*Por.:Ibidem, p. 181.*
[9] *R. Fischer, op. cit., pp. 85-86.*

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Image 7 depicts Elliott's assumptions perfectly. It is the chart presenting the pair of EUR/USD from March 2009, a daily interval – what means that each mark on the chart stands for a day of quotations. The growth impulse, initiated on March 3, 2009, lasted precisely for 13 days. The thirteenth day was a turning point. After reaching the maximum (the value of 1.3736 value – horizontal line), it started heading in the other direction.

The price analysis consists in using Fibonacci factors with reference to the price that is the essence of the market trading and forming charts. In this context, Fibonacci factors can be used for determining the zones of supports and resistances. "The resistance might be defined as the price level at which sellers appear at the market, stopping a further price rise"[10]. Analogically, the resistance is also this price levels at which buyers appear, stopping a further price decrease, if a decreasing trend is prevailing on the market. In summary, the resistance is a price level, which is determined by various methods, and which is a turning point of the thus far existing trend.

Image 8. Determining the resistance

Source: Real data from the Forex market, Dom Maklerski X-Trade Brokers.

Image 8 illustrates determining the resistance with the use of one of Fibonacci measurements. The chart presents real data from the Forex market from 2008. The currency pair of USD/CHF (American dollars/ Swiss francs) in a weekly interval is represented by this chart. The turning point was determined with great accuracy thanks to Fibonacci factor of 1.618 (the highest line). The resistance was so strong that a dynamically growing value of securities suddenly curbed and started dropping rapidly.

Determining the points of resistance or turning points is undoubtedly difficult to achieve. In some way it stands in contradiction to the assumptions supposed by the pioneers of technical analysis. Both Ralph N. Elliott and Charles H. Dow claimed that there is a greater plausibility of continuing the current trend than its turning. For this reason many analysts applying Fibonacci num-

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[10] *E. Gartley, Cena i czas. Zarys metod analizy technicznej, WIG-Press, Warszawa 1999, p. 31.*

bers use them only to determine the supports. "Support might be determined as a price level of given securities at which buyers enter the market, creating the base supporting the price at this level"[11].

It should be emphasized that the levels of supports and resistances appear at any perspective and on every market. However, the greater the time perspective of the support/ resistance is the more powerful the impact. For example, the reaction of the market to the support determined by a daily chart is usually disproportionately greater than the support determined by a minute chart.

The majority of investors, particularly those investing on just developing financial markets, know only basic **Fibonacci factors**, whereas their range used by more advanced investors is considerably wider.

Table 1. Fibonacci factors – known and universally applied in Poland

Fibonacci factors - known and universally applied in Poland	
0.236	$0.236 = (0.618)^3$
0.382	$0.382 = (0.618)^2$
0.500	It does not derive from "the golden section". It is possible to earn it by carrying out simple mathematical operations on the numbers from the series.
0.618	phi (0.618)
1.000	A number from Fibonacci series (1, 1, 2, 3, 5, 8, 13…)
1.618	Phi (1.618)
2.000	A number from Fibonacci series (1, 1, 2, 3, 5, 8, 13…)
2.618	$2.618 = (1.618)^2$

Source: worked out on the basis of *P. Danielewicz, Geometria Fibonacciego Praktyczny kurs inwestowania na rynkach finansowych, WIG-Press, Warszawa 2006, p. 9.*

There is no doubt that indisputable Fibonacci factors are Phi (1.618) and phi (0.618). They can be obtained in a simple way by carrying out uncomplicated mathematical operations. Their approximate value might be gained by making simple mathematical operations on numbers from the Fibonacci series. Automatically, a question arises whether the rest of the factors might be also classified as belonging to the Fibonacci factors. On the one hand, it might be regarded as some overinterpretation of reality; on the other hand, reference books use just those values. Exploring the genesis of each factor in greater depth, it is possible to assume that rating them as Fibonacci factors does not infringe upon the widely accepted principles and terminology. Some of them might be obtained by carrying out uncomplicated mathematical operations on the numbers belonging to the series, and the rest of them by the operations on Phi (1.618) and phi (0.618)[12].

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[11] *Ibidem, p. 29.*

[12]*Por.: P. Danielewicz, op. cit., p. 11.*

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Table 2. Fibonacci factors – known and universally applied around the world

Values of factors	The power of the 1.618 factor
0.146	4
0.186	3.5
0.236	3
0.300	2.5
0.382	2
0.486	1.5
0.618	1
0.786	0.5
0.886	0.25
1.000	0
	The power of the 1.618 factor
1.128	0.25
1.272	0.5
1.618	1
2.058	1.5
2.618	2
3.330	2.5
4.236	3
5.388	3.5
6.854	4

Source: P. Danielewicz, Geometria Fibonacciego Praktyczny kurs inwestowania na rynkach finan-
sowych, WIG-Press, Warszawa 2006, p.12.

It might be assumed that all values presented in the above table are titled as Fibonacci factors. It is not a serious malfeasance as such an expression is universally applied in reference books (in the context of the mentioned factors).

The first traders who experimented with obtaining factors basing on Phi (1.618) and Phi (0.618) were Bryce Gilmore and Larry Pesavento. They introduced into the investment world such crucial factors as 0.786 and 1.272. Among well-known, world-famous experts in the field of applying Fibonacci numbers on the world markets there are also Jim Kane, Robert Miner and Scott M. Carney[13]. Fibonacci factors might be applied to taking a variety of measurements.

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[13] *Por.: Ibidem, p.11.*

2. Types of measurements

2.1. Internal suppresion

Image 9. Internal suppression

Source: Real data from the Forex market, Dom Maklerski X-Trade Brokers.

It consists in taking the measurement of the correction scope in comparison with the earlier growth or decreasing impulse. It is often called an 'internal suppression' because the correction scope can never be larger than the impulse preceding this correction. Therefore, the highest possible value is 1,000 (100%). Outbidding this value even by one point automatically creates an alert that such suppression is not an internal one. That is why to measure the counter-attacking suppressions, values higher than 0% but lower than 100% are used.

2.2. External suppression

Image 10. External suppression

Source: Real data from the Forex market, Dom Maklerski X-Trade Brokers.

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The basic difference between an external suppression and an earlier discussed internal suppression is their scope. The external suppression is applied to measure the price moves which reached the value higher than 1,000 (100%) of a preceding move. Similarly to internal suppressions, they might be used to determine supports and resistances, but they are mainly applied to determine resistances. The resistances are often the places where corrections appear or even the places where the existing trend is reversed; therefore, the possibility of predicting them is really valuable. At these crucial levels investors often close the entire or at least part of the position. While determining the resistance with the usage of an external suppression, the known quantity is the correction drawn in the chart, whereas the wanted quantity is the scope of the impulse harmonious with the tendency.

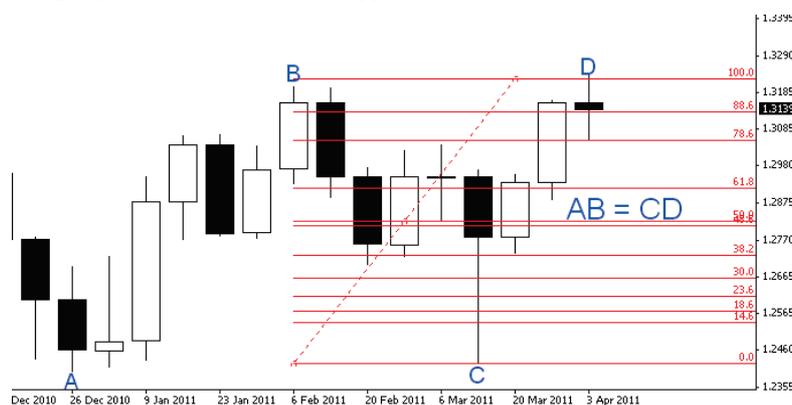## 3. Price projections (directional suppressions)

Image 11. Price projections

Source: Real data from the Forex market, Dom Maklerski X-Trade Brokers.

Directional suppressions, in contrast to the earlier discussed counter-attacking ones, are marked by the measurement of two moves in the same direction: The impulse keeping with the trend to the impulse harmonious with the trend or the correction of the correction. In the case of measuring impulses, the aim usually is to determine the scope of the waves and the resistances bound with them. 0.500 or 0.618 of the preceding impulse is usually regarded as a minimal scope. However, in strong trends these values can considerably exceed 1.000. An important feature of directional measurements is the fact that it is possible to compare impulses which do not follow each other. For example, Wave 1 can be compared to Wave 5.

4. Examining the effectiveness and the efficiency of permanent patterns in practice

In order to compare the effectiveness and the efficiency of individual XABCD formations, research was carried out based on real historic data coming from the Forex market. The Bat pattern and the Butterfly patterns were chosen as subjects of the examination because of their popularity among investors and their relatively frequent appearance in the markets. XABCD formations are

formations correlated with tendencies on markets (their effectiveness depends largely on the tendency strength), so their searches in examinations carried out took place in periods of strong tendencies on individual currency pairs.

They were sought for based on eight currency pairs:
1. USD/CHF (American dollar/ Swiss franc), in the period from 01.06.2010 to 05.11.2010
2. EUR/USD (euro/American dollar), in the period from 22.04.2009 to 25.11.2009 and in the period from 25.11.2009 to 07.06.2010
3. AUD/USD (Australian dollar/ American dollar), in the period from 02.02.2009 to 16.11.2009
4. EUR/CHF (euro/ Swiss franc), in the period from 14.05.2006 to 18.02.2007
5. USD/JPY (American dollar /yen), in the period from 04.06.2010 to 16.03.2011
6. EUR/GBP (euro/ British pound), in the period from 10.01.2011 to 29.04.2011
7. NZD/USD (New Zealand dollar / American dollar), from 25.08.2010 to 14.10.2010
8. GBP/USD (British pound / American dollar), from 20.05.2010 to 04.11.2010

In the examination the following assumptions were adopted: exceeding point A belonging to XABCD formation by at least one point/ tick was regarded as a successful move. In the examination assumptions, exceeding point A by one point/ tick was a target level, after reaching it any further market moves were not taken into consideration. Whereas as an unsuccessful move was regarded the formation, which after point D had been determined, exceeded first this point, following the current trend. Regardless of the later behaviours of the market, such a move was considered as unsuccessful.

The final result of the formation consists of the distance between the minimum of the mark indicating point D and the maximum of the mark indicating point A, and a possible point/ tick exceeding point A of the formation. In case of an unsuccessful move, the final result is -1, that is the point/ tick which exceeded point D of the XABCD formation.

It is worth noting that the examination methodology did not take into account the differences between the purchase price and the sale price (spread) existing on the market. Also, individual values of prices, in spite of the fact that they come from the real market, may be different depending on a brokerage house which is a service supplier (prices on the Forex market are not the same for all the market participants). The assessment of the effectiveness and efficiency of individual XABCD formations is objective but difficult to implement during the real market game as it is practically impossible to open the position at the level of the minimum mark indicating point D. In individual investment strategies, stop loss orders higher than one point above the level of the opening position are also usually applied.

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Table 3. Findings of authors' own examinations

Item num-ber	Bat				Butterfly			
	Currency pair	Size of the segment AD	Ex-ceeding	Final result	Currency pair	Size of the seg-ment AD	Ex-ceeding	Final result
1.	USD/CHF	194	1	195	USD/CHF	-	-1	-1
2.	EUR/USD	-	-1	-1	USD/CHF	-	-1	-1
3.	EUR/USD	573	1	574	EUR/USD	-	-1	-1
4.	EUR/USD	528	1	529	AUD/USD	325	1	326
5.	AUD/USD	325	1	326	AUD/USD	372	1	373
6.	AUD/USD	248	1	249	AUD/USD	-	-1	-1
7.	AUD/USD	164	1	165	AUD/USD	-	-1	-1
8.	AUD/USD	291	1	292	AUD/USD	291	1	292
9.	AUD/USD	117	1	118	GBP/USD	216	1	217
10.	AUD/USD	186	1	187	GBP/USD	0	-1	-1
11.	EUR/USD	192	1	193	GBP/USD	225	1	226
12.	EUR/USD	298	1	299	GBP/USD	454	1	455
13.	EUR/CHF	-	-1	-1	EUR/USD	229	1	230
14.	EUR/CHF	111	1	112	EUR/CHF	-	-1	-1
15.	EUR/CHF	61	1	62	EUR/CHF	111	1	112
16.	USD/JPY	124	1	125	USD/JPY	109	1	110
17.	EUR/GBP	169	1	170	USD/JPY	167	1	168
18.	EUR/GBP	108	1	109	USD/JPY	123	1	124
19.	EUR/GBP	74	1	75	EUR/GBP	108	1	109
20.	NZD/USD	179	1	180	NZD/USD	179	1	180
	TOTAL:			3,958	TOTAL:			2,915

Source: Authors' own study.

The table above presents the comparison of twenty Bat patterns and twenty Butterfly patterns observed in the above-mentioned areas of strong trends.

In some cases the change of point X's location might cause a change in the pattern from Bat to Butterfly or vice versa, resulting in the identical investment result. These patterns were presented in bold in the table.

A formulated hypothesis reads as follows: "moves on the Forex market with the use of the Bat pattern are more effective and more efficient than moves with the use of the Butterfly pattern"' as proven.

The effectiveness measured by the summary result unambiguously proved that the moves with the use of Bat pattern are more effective. After twenty moves, thanks to this pattern 3,958 points were gained, while thanks to the Butterfly pattern 2,915 points were earned. The difference was 1,043 points.
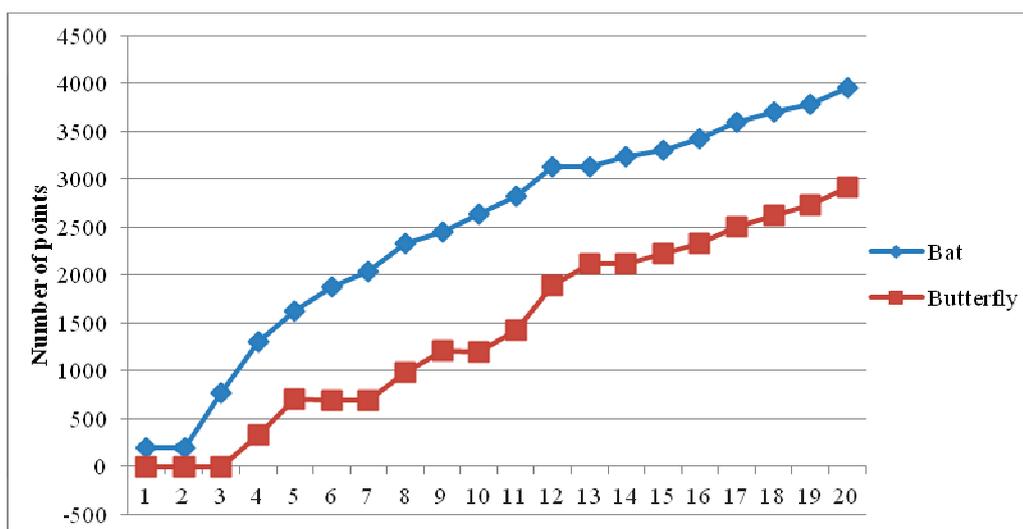
Image 12. Changes of investment results gained thanks to the Bat patterns
and the Butterfly patterns

Source: Authors' own study.

The effectiveness measured as the number of successful moves with respect to unsuccessful moves also proved the superiority of the moves with the use of the Bat formation.

Table 4. The effectiveness and the efficiency of moves

	Bat	Butterfly
Unsuccessful moves	2	7
Successful moves	18	13
Ratio of the number of successful moves to the total number of moves (%)	90%	70%
Average quantity of a successful move (points)	220	224.77

Source: Authors' own study.

In the case of the Bat pattern as many as 18 moves were successful (an effectiveness of 90%), while in the case of the Butterfly pattern 13 moves closed with the success (the effectiveness of 70%). Admittedly, the average quantity of the move was higher in the case of the Butterfly pattern, but it was bound with a lesser number.

In spite of the lower effectiveness and efficiency of the moves with the use of the Butterfly pattern, this pattern is also a very attractive proposal for investors. However, there is no doubt that both permanent patterns provided enviable investment results. Repeating them in real-time moves would be a tremendous success.

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LICZBY FIBONACCIEGO JAKO INSTRUMENT ANALIZY TECHNICZNEJ NA RYNKU FOREX – PRÓBA ZASTOSOWANIA

Streszczenie

*Forex jest największym rynkiem finansowym na świecie. Liczby Fibonacciego
stanowią jeden z instrumentów analizy technicznej. W pracy zbadano skuteczność
oraz efektywność stałych układów opartych na liczbach Fibonacciego. W badaniach
wykorzystano czterdzieści formacji: po dwadzieścia Bat oraz Butterfly. Formacja
Bat okazała się bardziej skuteczna i efektywna.*

Słowa kluczowe: analiza techniczna, Forex, liczby Fibonacciego, formacje ABCD, formacja motyla

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