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SINGLE STOCK FUTURES QUOTATIONS AS A FORECASTING TOOL FOR STOCK PRICES

Abstract: One of the main functions of futures contracts, apart from risk management and boosting the efficacy of financial market, is forecasting future cash prices of the underlying instruments. According to the model of expectancy, quotations of futures contracts should be determined by the expected future prices of the underlying instruments. The aim of the study is to make the tests of quality of stock prices forecasts on the Warsaw Stock Exchange, based on quotations of single stock futures contracts. The research analyses the volume and direction of variation of stock prices forecasts from their empirical prices on the expiry dates (the size of underestimations and overestimations) and their formation over time. The period covered by the analysis is 2010–2013. The studies show that single stock futures quotations are not a good predictor of the cash prices of stocks on WSE and they should not be used for this purpose. In addition, investors who make the forecasts are influenced by the situation prevailing on the stock market. Both underestimation and overestimation of the forecasts can be explained also by different expectations of investors, that is speculators and hedgers (according to the theory of Keynes and Hicks).

Keywords: Futures contract, forecasting ability, stock prices.

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1. Introduction

One of the major functions of futures contracts mentioned in literature, apart from the possibility of risk management and boosting the efficacy of financial market, is forecasting future prices of the underlying instruments of contracts. The hypothesis that current price of futures contract equals an expected cash price of an underlying asset in the future is often doubted. Some researchers verify it positively and some others negatively depending on: a research method they choose, a period they decide to investigate or a type of analyzed contracts.

The main aim of the following study is to make the tests of quality of investors' forecasts as to the level of share prices on Warsaw Stock Exchange on the basis of quotations of single stock futures contracts. The period under consideration, that is the years 2010–2013, allowed for testing the accuracy of forecasts during both

stock market growths and slumps. In the current study, I analyze the volume and direction of deviations of share prices forecasts from their real levels on the day when contracts expire (the scale of underestimation and overestimation) and their formation over time.

2. Between cash prices and futures prices

A futures price is a market price of a contract which is determined during exchange quotation. It is a result of the play between supply and demand. At the same time, the moment a position is opened, a futures price describes an expected price of an underlying instrument in a specified moment in the future (when a contract expires).

The difference between price of the underlying instrument (spot price, cash price) and futures price is called a basis. When the cash price is higher than the futures price, a basis is positive, and a contract is quoted at a discount. A market, where this situation takes place, is called the cash market and is typical of instruments such as currencies with high interest rate and shares belonging to companies paying high dividends. On the contrary, futures market (where futures prices are higher than cash prices) most often occurs in the case of contracts on commodities and currencies with low interest rates. Here, the basis is negative and a contract is quoted with a premium in relation to the underlying instrument [Zalewski 2010].

There are a few theoretical models explaining dependencies between spot prices and futures prices. One of those models is based on spot-futures parity. If an investor wants to hold an underlying instrument in a specific moment in the future, one has to buy it for a cash price in force S and keep it up to the point in time T , or one can buy a contract with an expiry date T entitling one to buy the underlying instrument for a price F and, at the same time, invest some amount of money at risk-free interest rate, which in the moment T will reach the value F [Gajdka, Walińska 2000]. Since in both cases the expenditure should be the same – apart from the margin deposit and commission – there should occur the following equality (if continuously compounded rate is the case):

$$S = \frac{F}{e^{rT}},$$
$$F = Se^{rT},$$

where: S – spot price; F – futures price; r – risk-free interest rate; T – time to an expiry date of the contract.

The level of futures prices can also be calculated on the basis of costs of carry. This relates particularly to commodity futures. In this case, the costs of carry include mainly costs of storage and insurance. If an investor was bound by the contract to deliver the underlying instrument, one should not to take the risk, at the same time

buy it on the spot market and keep it up to the date when the contract is executed. This means that the futures price should equal the spot price increased by the storage costs [Hull 1999]:

$$F = (S + U)e^{rT},$$

$$F = Se^{(r+u)T},$$

where: U – the storage costs; u – the storage costs in relation to the spot price.

For most commodities, due to the storage costs, F is higher than S , and the basis is negative.

In the case of financial instruments, the storage costs equal zero. Instead, one has to deal with financial costs connected with the necessity of purchasing financial assets. An owner of those assets can get additional income, though, e.g. from dividends, when one owns the shares. The costs of carry, then, must be understood generally as the costs of storage increased by the costs of financing a position on the spot market and decreased by the costs of having this position. The volume of costs of carry can be either positive or negative. When the costs of financing are higher than the profitability of the underlying instrument, the basis is negative. Similarly, when the profitability of the underlying instrument is higher than the cost of financing it, the basis is positive [Dębski 2010]. To summarise:

$$F = Se^{cT},$$

where: c – cost of carry in relation to the spot price.

For companies which do not pay a dividend the costs of carry amount to r ; for companies paying a dividend – $(r - q)$ (where q – dividend yield), for commodities charged with the storage costs – u (where u – the storage costs in relation to the spot price), and for currencies – $(r - r_f)$, (r_f – risk-free interest rate achievable for a foreign currency) [Hull 1999].

A convenience yield includes additional benefits connected with possessing the underlying instrument, which are not available for an owner of a contract, e.g. those generated by temporary deficits of a given good or the necessity to maintain the continuity of production. Thus:

$$F = Se^{(c-y)T},$$

where: y – a convenience yield.

A convenience yield is difficult to estimate and changeable because it originates in individual feelings and experiences. Most often it appears when a long-term increase in prices is slower than the one which has been forecast [Piaskowska 2011].

3. Expectancy theory

According to the expectancy theory, a current price of futures contract F is determined by expectations of investors as to the level of spot price S in the moment a contract expires T :

$$F = E(S_T),$$

where: $E(S_T)$ – an expected value of a spot price in the moment T .

The reason for this assumption is that only in this situation the market is balanced. If a futures price did not equal an expected spot price, an arbitrage argument would begin. If a spot price were higher than a current price of futures contract, investors would buy contracts expecting a profit amounting to $E(S_T - F)$, and this would force an increase in contract prices. If, on the other hand, an expected spot price were lower than a current contract price, investors would sell contracts, which would result in the drop of their prices. Consequently, a balance $F = E(S_T)$ would occur [Hull 1999].

Keynes and Hicks prove that there are exceptions from the expectancy theory. They are a result of the activity of speculators on the market, and also hedgers having other goals. They are ready to incur the losses on the futures exchange (when investors' anxieties prove wrong) because of other profits, which they make thanks to hedging (maintaining the value of a hedged item). Speculators, in turn, expect remuneration for the risk incurred.

The futures contract price can run into the level above an expected spot price (so called report, contango), when most speculators take up short positions on the futures market, and most hedgers take up long positions (fearing an increase in spot prices). To compensate speculators for the risk incurred, a drop in futures prices should happen over time [Hicks 1975]. This drop does not mean losses for hedgers as long as they hold a hedging and hedged position jointly.

The futures contract price is less than an expected spot price (deport, normal backwardation) when most speculators buy contracts and most hedgers sell them [Kolb, Overdahl 2010]. A speculator can expect a profit since a lower futures price aims at a cash price along with approaching the date of the execution of the contract [Luenberger 2003].

A current price of futures contract does not have to equal a future cash price of underlying asset, but cash and futures prices should become similar as the expiry date of a contract approaches (the phenomenon of convergence). It means that as this date is closer, a futures price should be a better forecast of a cash price [Tarczyński 2003]. On the expiry day, both prices should be equal.

Dependencies between a futures price and a spot price can also be explained by dependencies between risk and an expected rate of return. Whereas an unsystematic risk should not influence an expected rate of return because it is diversifiable, a

higher systematic risk boosts the expectations of investors as to the rate of return. Investors expect, then, a higher rate of return if a systematic risk is positive.

A current value of speculator's investment, who opened a long position, is [Hull 1999]:

$$-Fe^{-rT} + E(S_T)e^{-kT} = 0,$$

where: k – required rate of return, other symbols as above.

Thus:

$$F = E(S_T)e^{(r-k)T}.$$

The value k depends on the systematic risk of investment. If an investment is characterised by a zero systematic risk, then $k = r$, and $F = E(S_T)$. If a systematic risk is positive (that is when spot prices are correlated positively with a market index), then $k > r$, and $F < E(S_T)$. Futures prices should increase then, and a speculator will make a profit when s/he takes up a long position. When spot prices are correlated negatively with a market index, an investment is characterised by a negative systematic risk, and $F > E(S_T)$. The conclusion is that, in the case of a zero correlation, a futures price will equal a spot price expected in the future. When beta is greater than 1, the futures price must be lower than the expected spot price to compensate the long position for the greater risk [Hull 1999].

Investors compare a current price of futures contract with a spot price predicted for the moment of contract expiry. If a futures price is lower than a current spot price, they expect a drop of prices on the cash market and an increase of prices on the futures market which will compensate them for the risk incurred. An expected risk premium depends on the volume of futures price deviation from an expected spot price [Piaskowska 2011]:

$$E[P(t, T)] = F_t - E(S_T),$$

where: $E[P(t, T)]$ – an expected risk premium in the period from t to T ; F_t – a futures price in the moment t ; $E(S_T)$ – an expected spot price in the moment T .

The volume of the basis is determined by investors' expectations as to the level of a premium for the risk incurred and as to prices of the underlying instrument [Asche, Guttormsen 2002]:

$$F_t - S_t = E[P(t, T)] + E(S_T - S_t),$$

where: S_t – a spot price in the moment t ; $E(S_T - S_t)$ – an expected change of a spot price in the period from t to T , other symbols as above.

If over the duration of the contract there are no changes as to the risk premium required by investors, then basis fluctuation and, at the same time, futures price fluctuation are a reflection of changes in the expectations as to the future price of the underlying instrument.

The results of research conducted so far into the formation of futures prices in relation to an expected spot price are diverse and ambiguous. Most of this research was concerned with commodity futures contracts. Studies by Houthakker prove that there is a positive systematic risk on the corn market and $F < E(S_T)$. Tesler's and Gray's studies on cotton and wheat markets prove, in turn, the hypothesis that contract prices are a good estimation of investors' expectations as to cash prices. Dusak's research, who analyzed a systematic risk on corn, wheat and soybean market, indicates that the risk is zero, which would also confirm the hypothesis that $F = E(S_T)$. This has been contradicted by Changa's studies, where he explains that $F < E(S_T)$ on commodity markets [Hull 1999]. The results of research conducted on oil market are also ambiguous. They differ depending on a research method assumed [Piaskowska 2011].

Yet another perspective is taken by Zalewski, who believes that changes in the level of futures contracts prices and the basis do not have any significance in forecasting (on the basis of analyzed examples of behaviour of index futures market on Warsaw Stock Exchange). Still, as much as 55.16% of questioned investors (in the survey by Brokerage House BOŚ from 2006) were of a different opinion [Zalewski 2010].

4. Methodology of research

In order to investigate whether prices of futures contracts available on Warsaw Stock Exchange are a good price forecast of shares being the underlying instruments of contracts, I have compared prices of selected futures contracts with the level of cash prices of corresponding shares on the days of contract expiry. The comparison was drawn between closing prices. Because of the changeable liquidity of futures contracts, three classes of contracts have been chosen, which can be characterised by the highest liquidity measured by the volume of trade in the years 2010–2013. Research has been conducted on futures contracts on the following companies: KGHM, PKN ORLEN and PKO BP. All the series of contracts have been examined within the aforementioned classes expiring in the period from the beginning of 2011 till the end of 2013, which is 12 series for each class. By doing so, it has been established whether the prices of contracts under investigation constituted good forecasts of share prices of KGHM, PKN ORLEN and PKO BP in the period from July 2010 till December 2013. The analyzed series and their characterization are presented in Table 1.

Table 1. The analyzed series and their characterization

No.	Series	First trading date	Expiry date
1	FKGHH11, FPKNH11, FPKOH11	2010-06-21	2011-03-18
2	FKGHM11, FPKNM11, FPKOM11	2010-09-20	2011-06-17
3	FKGHU11, FPKNU11, FPKOU11	2010-12-20	2011-09-16
4	FKGHZ11, FPKNZ11, FPKOZ11	2011-03-21	2011-12-16
5	FKGHH12, FPKNH12, FPKOH12	2011-06-20	2012-03-16
6	FKGHM12, FPKNM12, FPKOM12	2011-09-19	2012-06-15
7	FKGHU12, FPKNU12, FPKOU12	2011-12-19	2012-09-21
8	FKGHZ12, FPKNZ12, FPKOZ12	2012-03-19	2012-12-21
9	FKGHH13, FPKNH13, FPKOH13	2012-06-18	2013-03-15
10	FKGHM13, FPKNM13, FPKOM13	2012-09-24	2013-06-21
11	FKGHU13, FPKNU13, FPKOU13	2012-12-27	2013-09-20
12	FKGHZ13, FPKNZ13, FPKOZ13	2013-03-18	2013-12-20

Source: own study on the basis of [<http://www.gpwinfostrefa.pl/GPWIS2/pl/quotes/archive/>].

For each series on each session, a forecast error has been calculated. It is understood as a deviation of the forecast value (the contract price being a forecast of cash price) from the level of share price on the expiry day of a contract:

$$E_A = F_t - S_T,$$

$$E_R = \frac{F_t - S_T}{S_T},$$

where: E_A – the absolute error of the forecast; E_R – the relative error of the forecast, F_t – the value of the forecast – futures contract price on t -th session; S_T – the realization of the forecast – the price of the underlying instrument on the cash market (share price) on the day of contract expiry on T -th session.

In particular, an error of the first forecast has been pointed out for each series of contracts. This error indicates the accuracy of an estimate of a share price on the day of contract expiry, made on the basis of an actual quotation of futures contract on the first session during which the turnover occurred. The positive value of an error means overestimation of forecast, the negative value, in turn, means underestimation. The forecast error has been expressed in Polish zloty (trading units of shares and futures on shares) and the percentage of realization of the forecast.

As far as the accuracy of estimates of all the quotations of futures contracts from a given series is concerned, it is described by the mean error of all forecasts. The

mean error of all forecasts has been calculated from the following equations (absolute values have been taken into account in order to avoid situation where positive and negative values cancel each other out):

$$ME_A = \frac{\sum_{t=1}^T |F_t - S_T|}{T},$$

$$ME_R = \frac{\sum_{t=1}^T \left| \frac{F_t - S_T}{S_T} \right|}{T} = \frac{\sum_{t=1}^T \left| \frac{F_t}{S_T} - 1 \right|}{T},$$

where: ME_A – the mean absolute error of all forecasts; ME_R – the mean relative error of all forecasts; T – the number of forecasts, other symbols as above.

Apart from these indicators, for each class of contracts, the mean error of the first forecasts and the mean error of all forecasts has been set (in PLN and in percentage).

5. Results of research

The results of research have been presented in Tables 2, 3 and 4. The first forecasts of share prices, which were predicted 9 months in advance, were characterised by a considerable error, however, for particular series those quantities were significantly different. The most considerable errors of the first forecasts were observed in the case of contracts on the shares of KGHM and PKN ORLEN. The most overestimated ones were the forecasts for December 2011. On the other hand, the most underestimated ones were for March 2011 (in the case of KGHM) and December 2012 (in the case of PKN ORLEN). Apart from the standard deviation, initial forecasts differed from the realizations on average on 30% in the case of contracts on the shares of KGHM and on almost 25% in the case of contracts on the shares of PKN ORLEN.

Analyzing a standard deviation, one can assume that overestimation and underestimation of initial forecast of an actual price were equally frequent. That was determined by the situation on the market. It has to be emphasised, though, that a general situation on the stock exchange was not a decisive element but rather it was a situation of a company and in the branch. That is why forecasts were largely influenced by the news from the sector and the forecasts of different share prices did not always have the same standard deviation, even though the forecasts were prepared in the same moment.

The first forecasts made in the first half of 2011, when the overall economic situation was fairly good, were largely overestimated for all the shares under investigation. On the other hand, forecasting in December 2011 and the first half of 2012 was

burdened with a considerable error of underestimation, especially in the case of fuel and raw material sector. Undoubtedly, the introduction of new severance taxes for companies in this sector, announced in November 2011, had a negative impact on forecast levels of share prices. During the next months of the second half of 2012 and the beginning of 2013, forecasts were overestimated. An exception was the forecast for the prices of PKO BP shares in March 2013, which resulted from the dominating trend in this branch.

Table 2. Evaluation of the accuracy of forecasts of KGHM prices on the basis of quotations of stock futures contracts

No.	Series	First forecast error		Mean error of all forecasts		The number of overestimated forecasts in %
		in PLN	in %	in PLN	in %	
1	FKGHH11	-81.90	-46.80	41.33	23.61	7.34
2	FKGHM11	-72.50	-38.98	36.73	19.74	17.02
3	FKGHU11	-14.80	-8.94	8.23	4.97	70.21
4	FKGHZ11	63.10	59.98	31.75	30.18	99.47
5	FKGHH12	21.90	14.32	10.95	7.16	42.33
6	FKGHM12	19.05	13.41	9.53	6.70	30.43
7	FKGHU12	-56.80	-37.32	28.40	18.66	1.57
8	FKGHZ12	-51.85	-27.51	25.93	13.75	3.13
9	FKGHH13	-48.40	-28.54	24.20	14.27	43.01
10	FKGHM13	34.10	27.72	17.05	13.86	99.44
11	FKGHU13	46.65	36.89	23.33	18.45	68.31
12	FKGHZ13	35.00	30.70	17.50	15.35	91.05
Mean		45.50	30.33	40.95	27.29	47.60

Source: own calculations on the basis of [<http://www.gpwinfostrefa.pl/GPWIS2/pl/quotes/archive/>].

Further forecasts for the share prices of KGHM and PKN ORLEN were also burdened with significant errors. Mean error for all forecasts for share prices of KGHM was over 27%, and for the shares of PKN ORLEN was over 15%. On this basis, it can be assumed that the quotations of futures contracts for those shares did not have any considerable forecast potential.

The first forecasts of PKO BP share prices were characterized by definitely less serious errors than in the case of the rest of shares under consideration. On average, they differed from empirical prices by almost 13%. Also, in the case of further forecasts, those errors were significantly lesser. Mean error of all forecasts for PKO BP share prices was barely 6.60%, and for each series it fell even to 1–3% (Table 4).

Table 3. Evaluation of the accuracy of forecasts of PKN ORLEN prices on the basis of quotations of stock futures contracts

No.	Series	First forecast error		Mean error of all forecasts		The number of overestimated forecasts in %
		in PLN	in %	in PLN	in %	
1	FPKNH11	-13.78	-26.50	7.02	13.49	0.00
2	FPKNM11	-12.80	-24.24	6.65	12.59	18.62
3	FPKNU11	11.06	29.57	5.56	14.87	89.67
4	FPKNZ11	17.98	51.94	9.11	26.30	97.34
5	FPKNH12	13.59	36.42	6.80	18.21	49.46
6	FPKNM12	-1.65	-4.58	0.82	2.29	62.43
7	FPKNU12	-9.90	-23.08	4.95	11.54	3.66
8	FPKNZ12	-15.20	-29.86	7.60	14.93	1.56
9	FPKNH13	-14.91	-27.23	7.46	13.62	5.41
10	FPKNM13	-1.54	-3.38	0.77	1.69	83.43
11	FPKNU13	7.21	16.06	3.61	8.03	83.61
12	FPKNZ13	10.50	25.93	5.25	12.96	99.46
Mean		10.84	24.57	6.89	15.61	49.79

Source: own calculations on the basis of [<http://www.gpwinfostrefa.pl/GPWIS2/pl/quotes/archive/>].

Table 4. Evaluation of the accuracy of forecasts of PKO BP prices on the basis of quotations of stock futures contracts

No.	Series	First forecast error		Mean error of all forecasts		The number of overestimated forecasts in %
		in PLN	in %	in PLN	in %	
1	FPKOH11	-4.80	-11.16	2.57	5.97	35.08
2	FPKOM11	-1.90	-4.43	1.00	2.33	71.28
3	FPKOU11	11.61	36.39	5.86	18.35	96.28
4	FPKOZ11	10.71	33.26	5.45	16.94	90.43
5	FPKOH12	8.58	24.63	4.29	12.31	42.55
6	FPKOM12	-2.57	-7.79	1.29	3.90	65.03
7	FPKOU12	-3.80	-10.33	1.90	5.16	2.66
8	FPKOZ12	-2.22	-6.10	1.11	3.05	14.66
9	FPKOH13	0.04	0.11	0.02	0.06	82.01
10	FPKOM13	2.51	7.37	1.26	3.68	86.89
11	FPKOU13	1.00	2.77	0.50	1.39	17.49
12	FPKOZ13	-5.35	-13.31	2.68	6.65	12.04
Mean		4.59	12.62	2.40	6.60	50.52

Source: own calculations on the basis of [<http://www.gpwinfostrefa.pl/GPWIS2/pl/quotes/archive/>].

If we skip, then, the most long-term forecasts, taking into account in the analysis only forecasts prepared on the basis of the contract with the closest expiry date, we can regard the quotations of contracts on PKO BP as a good prognostic sign of share prices of this company. An example of this company, though, does not allow for any generalization of this conclusion. As a result, the research confirms the lack of forecast potential of the quotations of futures contracts.

According to the essence of convergence of spot prices and futures prices, as the expiry date of contract approaches, further forecasts of share prices were burdened with lesser prognostic error. It did not result, though, only from the construction of contracts itself as the basis did not decrease systematically but it exhibited fluctuations and it even changed its sign. Figures 1, 2, 3 present the comparison of the levels of prices forecast 9, 3 and 1 month in advance with actual levels of prices on the day of contract expiry. As it can be observed, the forecasts done 3 and 1 month in advance were burdened with a considerably lesser error.

Analyzing the number of overestimated and underestimated forecasts, one can assume that in the case of all three analyzed companies there were as many overestimated forecasts as underestimated ones. It can be a proof of an equal number of optimists and pessimists among the investors, which in the case of the lack of strong medium- and long-term trends is understandable.

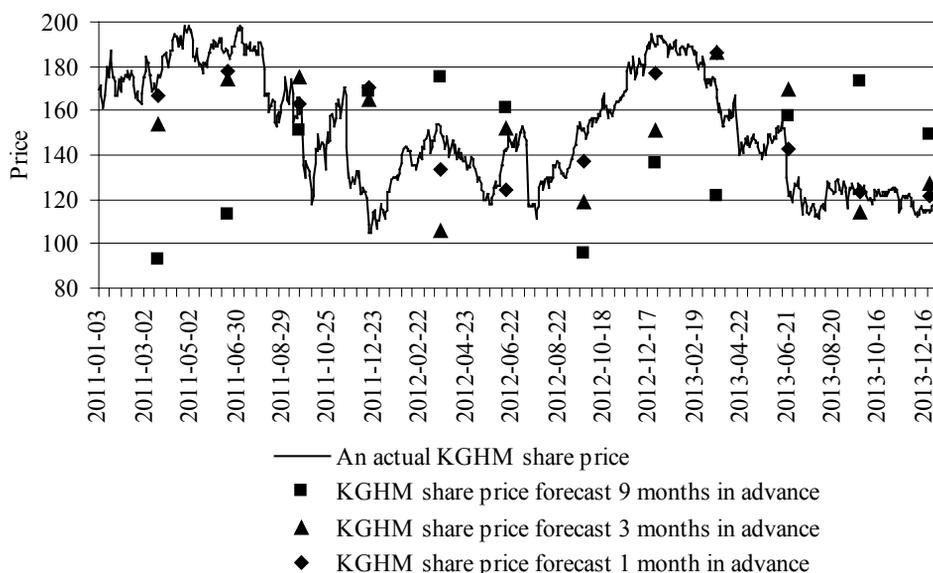


Figure 1. Forecast of KGHM share prices against actual prices

Source: own study on the basis of [<http://www.gpwinfostrefa.pl/GPWIS2/pl/quotes/archive/>].

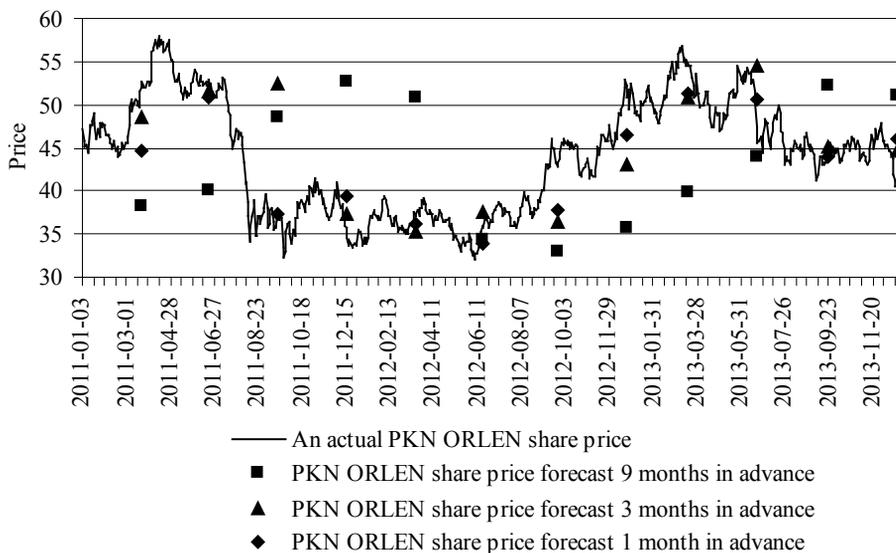


Figure 2. Forecast of PKN ORLEN share prices against actual prices

Source: own study on the basis of [<http://www.gpwinfostrefa.pl/GPWIS2/pl/quotes/archive/>].

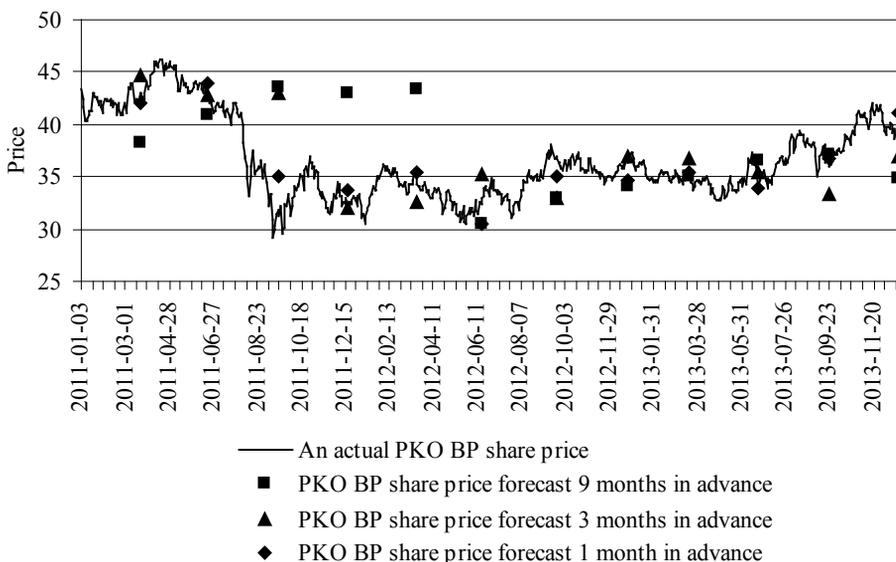


Figure 3. Forecast of PKO BP share prices against actual prices

Source: own study on the basis of [<http://www.gpwinfostrefa.pl/GPWIS2/pl/quotes/archive/>].

The highest number of overestimated trends was in 2011. It was a result of significant stock market growth at the beginning of the year. The number of overestimated forecasts proves, though, that investors had not expected much worse situation in the second half of the year. Forecasts were most often underestimated, in turn, in 2012. Investors did not expect such strong growth in the second half of 2012.

6. Conclusions

The empirical research conducted on the Warsaw Stock Exchange does not allow for confirming the hypothesis that the quotations of futures contracts are good forecasts of share prices in the future. It showed that particularly long-term forecasts were burdened with a considerable forecast error. Forecasts with shorter time horizons were more precise and most often reflected investor mood resulting from the situation of a company and a branch. This means that they were determined by past and current information, which, in turn, determined the expectations for the future. These expectations often failed to overlap with a real situation on the stock market in the future.

Undoubtedly, the first forecasts (as such were understood the quotations of contracts during the first session, where a turnover took place) expressed real expectations of investors. They usually differed in a few percent from the reference prices, which for the first sessions are fair values of futures contracts. Further forecasts for share prices burdened with a lesser forecast error, which did not only result from the construction of contracts. It was confirmed by the fact that the basis did not decrease systematically, but it fluctuated significantly and even changed its sign. The research conducted before proved also that the quotations of futures contracts on the Polish market diverge from their fair values.

The best forecast potential was manifested by contracts on PKO BP shares. It is difficult to judge, though, what caused this situation. One should not expect that the situation is a constant trait. It has to be confirmed with further research.

In conclusion, negative verification of the research hypothesis indicates the inability to forecast stock prices by the quotations of single stock futures contracts. Investors should not use them to predict stock prices.

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NOTOWANIA KONTRAKTÓW *FUTURES* NA AKCJE JAKO PROGNOZA PRZYSZŁYCH CEN AKCJI

Streszczenie: Podstawowym celem opracowania jest zbadanie sprawdzalności prognoz inwestorów co do poziomu cen akcji na Giełdzie Papierów Wartościowych w Warszawie, w oparciu o notowania kontraktów akcyjnych. Analizie poddane zostały wielkości i kierunki odchyłeń prognoz cen akcji od ich rzeczywistych poziomów w dniu wygasania kontraktów i ich kształtowanie się wraz z upływem czasu. Okres badawczy objął lata 2010–2013. Badania wykazały, iż notowania kontraktów akcyjnych nie są dobrą prognozą cen akcji na GPW w Warszawie i nie mogą być wykorzystywane do skutecznego ich prognozowania.

Słowa kluczowe: kontrakty *futures*, zdolności prognostyczne, ceny akcji.