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ARBITRAGE ON ROMANIAN STOCK MARKET

Abstract: *No arbitrage is one of the fundamental principles in the financial market, of similar importance to conservation principles in physics. Options and shares valuation (CAPM model) are based on a perfect market, which implies no arbitrage. Although the no arbitrage principle is recognized and applied on all markets, we determined that on the Romanian capital market there were long periods in which arbitrage was possible with good yields. We concluded that a better hypothesis, more appropriate than "no free lunch", can be formulated. If investors' expectations for the stock market is to perform at a much higher yield that the interest rate of the bonds, it is logical that investors will not resort to arbitrage (even if the opportunity arises), regardless of the risks involved.*

Keywords: *Arbitrage, Securities, Spot, Futures, Stock Exchange.*

JEL Classification: G13, G12

Introduction

No arbitrage principle, acknowledged in the phrase: "There is no such a thing as a free lunch", is economically fundamental in any free market. It stipulates that there cannot be systemic and safe gains from arbitrage, without an initial investment. The explanation is simple: if such an opportunity arises, everyone will want to take advantage of it, hence, the forces that govern the market will quickly close the gap.

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Knowing this how was it possible that during the boom of the capital market in Romania (the period before the ”hard landing” in 2008) there were substantial arbitrage opportunities? And not for short periods, but over several years. In addition, we will expose (describe) a logical justification as to why many qualified investors have not turned to arbitrage and why that was a good decision.

Arbitrage consists of simultaneous buying and selling the same security (or a derivative directly related to the underline) on two different markets. The difference between the two quoted prices is the profit realized through arbitrage, which is virtually risk free: it is safe, regardless of market developments, and exactly numerically anticipated at the date of initializing the arbitrage. As long as the profit is relatively small or non-existent, arbitrage is not profitable and will not be used unless investors decide to hedge, which is an insurance of a held position and is intended to reduce the risk of market evolution.

According to [1], if we consider a bond with Continuous Compounding of Interest Rates r, its price S_t, at moment t, than it is precisely determinable considering its initial value S_0:

$$S_t = S_0 \cdot e^{rt} \tag{1}$$

If r is constant over the entire period of analysis, a bond investment is risk-free, because we can always determine its value.

If a higher gain is desired, it is natural to turn to riskier assets such as stocks or futures. Again, it is natural that they do not offer the possibility of a regular win from arbitrage, higher than riskless bonds.

We specify that the investment in financial instruments (according to IFRS 7 Financial Instruments: Disclosures [2]) has a series of risks attached – apart from market risk - including: credit risk, currency risk, interest rate risk, liquidity risk, etc.

We call **arbitrage opportunity**, the situation where there are trading strategies involving profit generating available instruments, granting riskless investments. One may assume that such situations do not exist in reality; but the truth is that these situations constantly arise on stock markets. Considering that everyone wants to take advantage of these situations of gains without risks, it leads to price changes and implicitly the disappearance of arbitrage. A consequence is a fundamental observation in the valuation of financial instruments: **two portfolios that have the same price at maturity should have the same initiation price.**

The arbitrage problem arises in a perfect market. For a market to be perfect these assumptions must be met [3]:

- The market is friction free – no transaction costs, no bid-ask differences, no fees, no margin accounts;
- No restrictions on short sales – assets which we do not possess can be sold;

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- The market is competitive – we prefer getting a higher gain at the expense of a lower gain;
- There is no credit risk – no possibility for the involved parties to go bankrupt;
- There are no arbitrage possibilities.

The Current State of Art

Moosa (2003) [4] shows that the no arbitrage principle implies that the difference between buying and selling rates of currencies in the two markets must cover transaction costs (taxes, brokerage fees, bid-ask spread).
Reverre (2001) [5] presents most of the technical and practical aspects of arbitrage opportunities in financial markets. He highlighted some risks of arbitrage, confirmed in our example on Romanian market manipulation.
Delbaen and Walter Schachermayer (2006) [6] show that the no arbitrage principle is the base of the mathematical apparatus of modern finance, underpinning the valuation of shares and options.
Javaheri (2005) [7] treats the subject of arbitrage in the context of volatility.
Dubil (2011) [8] illustrates the principle of arbitrage, analyzing i) most financial instruments (spot, futures, options, swap); ii) financial schemes based on the arbitrage between these markets and iii) strategies for each major category of players involved (banks, investment funds, individuals).
A book dedicated to individual investors, who prefer hedging to naked positions, is Whistler (2004) [9].
Fernholz (2015) [10] shows that there is a possibility of relative arbitrage (between a title and the market) in specific market models and in short intervals.
Farinelli (2015) [11] addresses the issue of arbitration in terms of Geometric Arbitrage Theory, showing where there is no-free-lunch-with-vanishing-risk condition.
Tehranchi (2015) [12] develops the theory of arbitrage without the assumption of existence of a numéraire asset (asset whose price is determined based on another marketable asset).
Aïd et. al. (2015) propose an alternative approach to convergence at maturity, between the spot price and the forward contracts for commodities [13].
Bid-ask spread was analyzed [14] in terms of arbitrage by Rola (2013), Cox-Ross-Rubinstein model being presented as an application of study results.
Göncü (2014) [15] demonstrates the existence of arbitrage opportunities in the Black-Scholes model. He revises statistical arbitrage, which has zero initial cost, but has the possibility of losing money.
Pal and Wong (2013) analyze in their work [16] the performance of a portfolio relative to a benchmark market index and proves that relative results depend on three components: one in terms of energy and two with entropy value.
Franke (2015) demonstrates that an entire financial theory can be built based upon the principle of no arbitrage [17].

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All studied materials assume the no arbitrage hypothesis, implicitly or explicitly referred. Forward, futures and option contracts' price deduction, is based on mathematical building of similar portfolios at a given moment. Based on the no arbitrage principle they need to have the same value at any time past or future. Therefore, refutation of the no arbitrage principle leads to the impossibility of applying an entire series of subsequent financial theories.

Theoretical underpinnings regarding the financial instruments

Markets

The Bucharest Stock Exchange, BSE, mainly represents spot market in Romania. Stock trading is done through brokerage companies, called SSIF's; most of these trading platforms offer customers online trading, in real time. In the period under review, fees were reduced, usually being located at values around 0.3÷0.5% (excluding intraday players, for which brokers offered commissions close to their own costs).

Futures and options market has venue in Sibiu, the market called SIBEX. The standard futures contract had the following definition: *« The futures contract is an agreement between a seller and a buyer to sell/buy a standard amount of actives with delivery in the future called „maturity" at a price negotiated at the time of the transaction, all based on standard clauses»*. The open positions could be closed by adopting an opposite position or automatically, at maturity, when they were closed by the Clearing House.

Underlying asset of futures contract is the spot on BSE, the most traded titles being SIF2, SIF5, TLV, SNP, RRC, BRD. Usually a futures contract had a multiplier, corresponding to 1.000 shares. The fees were low (1.5 RON/contract) and the margin was 15% of the spot price. Underlying assets were not accepted as collateral margins, so that arbitrage was not pure free-lunch (an initial amount had to be immobilized).

The gain from arbitrage was certain and was well above the yields of bond or bank deposits. Because arbitrage opportunities were numerous and persistent, some brokers even introduced facilities for willing customers, in the sense of alerts for opportunities of closing positions before maturity, when the spread between markets became too small.

No arbitrage theory

Moosa (2003) presented a complete calculus of arbitrage on Forex markets. The no arbitrage condition can be mathematically expressed by the relationship:

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$$S_A = S_B - (\beta_A + \beta_B) \quad (2)$$

where S_A and S_B represent the quotations of the same financial asset on market A respectively B, and β represents transaction costs (brokerage related) in the two markets. In the presence of fees (costs), the relationship does not change, but the yield proportionally decreases with the arbitrage related fees.

The main weakness of this calculus is that it does not set a lower limit for arbitrages' rate-of-return. If we denote with π the profit from arbitrage with tax fee τ on capital gain, results:

$$\pi = (1-\tau)\cdot|S_A - S_B| \quad (3)$$

If this profit is lower than the yield of bonds or bank interest (considered safe investments in the sense that total profit is determined a priori, at the initiation of the contract) it is unnecessary to open arbitrage; the investor prefers the easiest alternative. Anyway, the market will tend to close this gap because the hedger can take advantage of it.
Considering the no arbitrage principle, the price of a long forward contract at time t, S(t), with no dividends and costs, is given by the current price S(0) and by the capitalization rate r, as Franke (2015):

$$S(t) = S(0)\cdot e^{rt} \quad (4)$$

It also states that the futures contract has the same price as the forward one, if r is constant during the studied period.

Empirical study regarding arbitrage on Romanian capital market

Possible arbitrage opportunities analysis was performed for 2006÷2008, period when Romanian stock markets were functioning at a satisfactory liquidity, including foreign investors' funds.
We take into consideration:
- Bucharest Stock Exchange, BSE [18], which gave the spot price of the shares;
- Financial and Commodities Exchange from Sibiu, SIBEX [19], on which financial derivatives had liquidity.

We take into consideration passive bank deposits [20] instead of bonds for comparing yields, since corporate bonds were not listed, municipal bonds had no liquidity, and state bonds were mostly traded in the interbank market and less on the stock market.
During 2007, the average deposit bank interest was 7.09%/year, according to data released by the central bank BNR. Hence, to abide the no arbitrage principle, the

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spread between spot and futures contracts should not exceed this value, plus any transaction costs and fees.

Futures Spot arbitrage

The most traded derivatives were taken into consideration, DESIF5, which represent at SIBEX, futures for BSE ticker SIF5, an atypical investment fund with good results [21]. For diversification, we also resorted to SIF2 ticker with a similar pattern. Another liquid title, Banca Transilvania (TLV) was not taken into consideration, because of their frequent issues of shares, which would have required artificial price corrections.

Figure 1 shows the evolution of futures DESIF5, with maturity in December 2007, in comparison with SIF5 sport price.

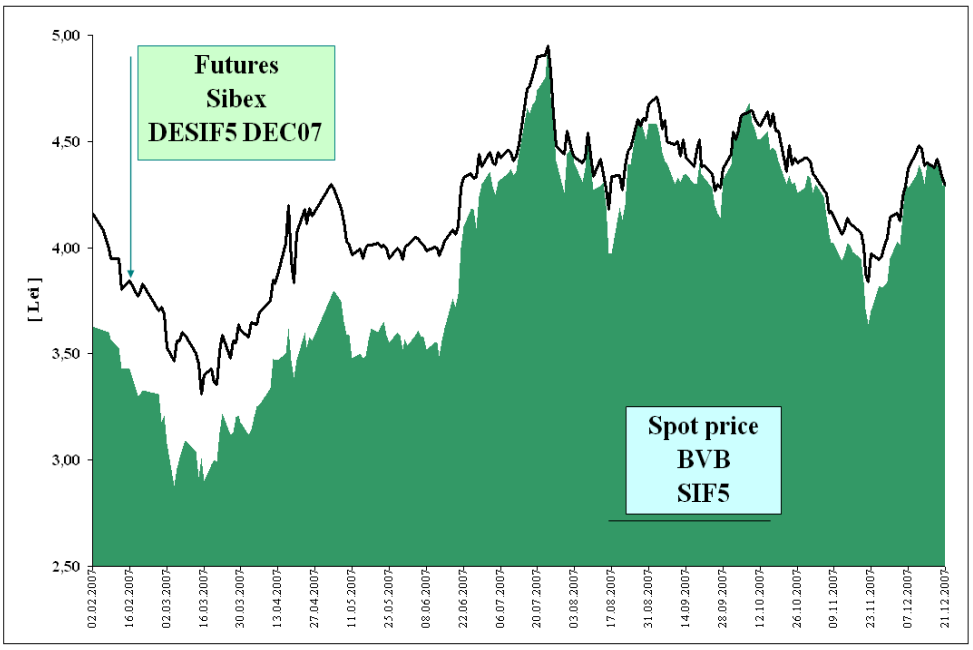

Figure 1. Arbitrage on DESIF5 DEC07

Arbitrage opportunities are obvious, where the spread (distance between the two graphs) is large. Nevertheless, because the markets are not perfect, the posed question is how large should the spread (distance) be in order to benefit from arbitrage.

Being a bull market, it is natural that investors expect large increases in share prices, reflected in the futures quotation much higher than the market price (at least for distant maturities).

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Arbitrage is obvious: the more expensive asset is sold (short futures position) and simultaneously the cheaper asset is bought (long spot). At maturity, the two courses will be equal (closing futures position is made at spot price), so the final value of the portfolio is known from the outset (lacks market risk). Being different markets both will require an initial investment: a margin correlated with the amount of investment, respectively the spot rate. The initial investment is not zero, but there is a final guaranteed win.

Two types of yields are calculated and compared:

- Arbitrage profitability, as the ratio between realized gain (futures-spot) and initial investment, annualized at 365 days (for a comparison with bank interest);
- Profitability of maintaining futures position, i.e. the difference between the futures price, at maturity versus day price, also annualized.

The result is graphically shown in Figure 2. At least until values of increase in stock price were reasonable, both annualized yields are situated well above the bank interest rate. Let us remember that the period was „credit only with ID" so it seems incomprehensible why arbitrage did not become a frequent strategy on the stock market.

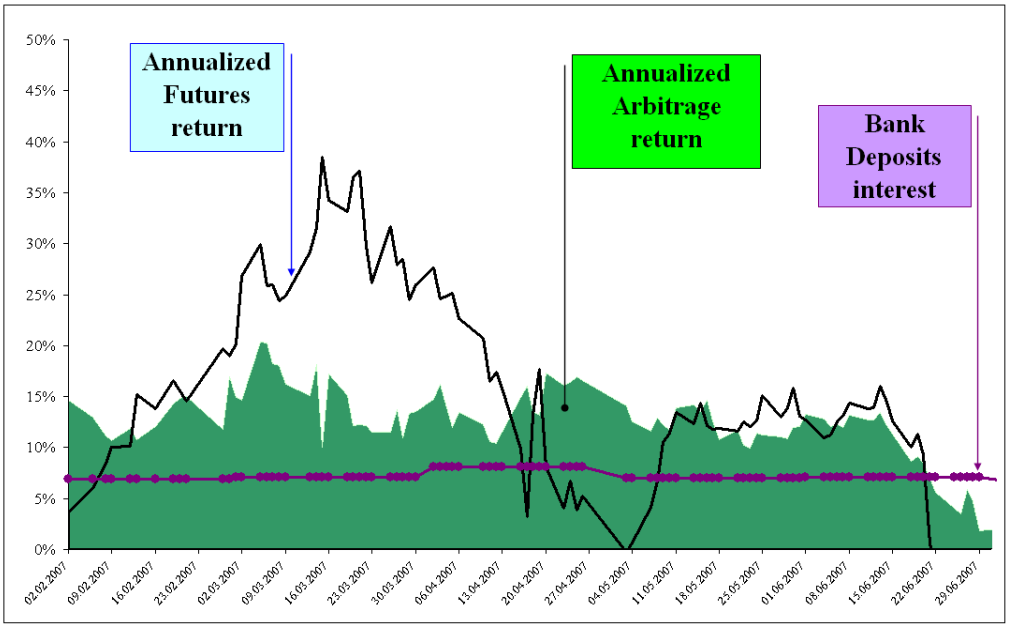

Figure 2. Arbitrage' yield vs. futures' yield

The explanation is given by the graph in Figure 2. Investors' expectations, regarding the market increase rate, were extremely high, so that relying on arbitrage would have done nothing but reduce the potential gains. The period of euphoria wiped out any caution, investors being unsatisfied with small and safe

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gains. Incidentally, this assertion was also valid on mature markets, although previous crisis have been known, hence caution should have been adopted.

Figure 3 confirms, on long term, investors' optimism. By the summer of 2007, investors acted correctly by betting on price rising in detriment of arbitrage. Linear graphs represent futures contract at different maturities (as it approaches expiration it is natural that the spread to fall below the profitability line of arbitrage, and the opportunity to be taken by opening a new contract with later maturity).

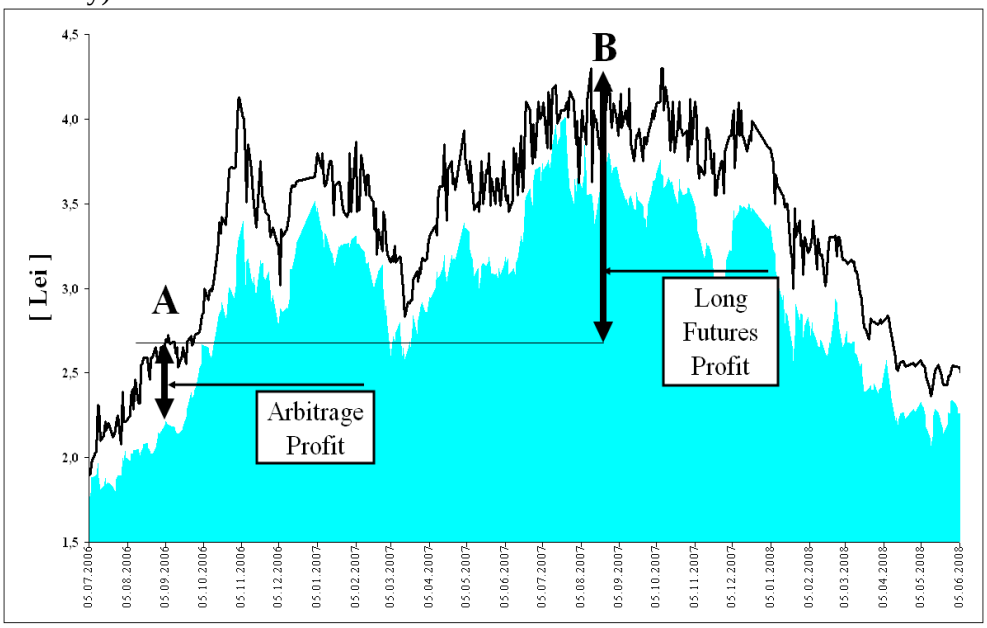

Figure 3. Investors' risk appetite confirmed by SIF2 chart

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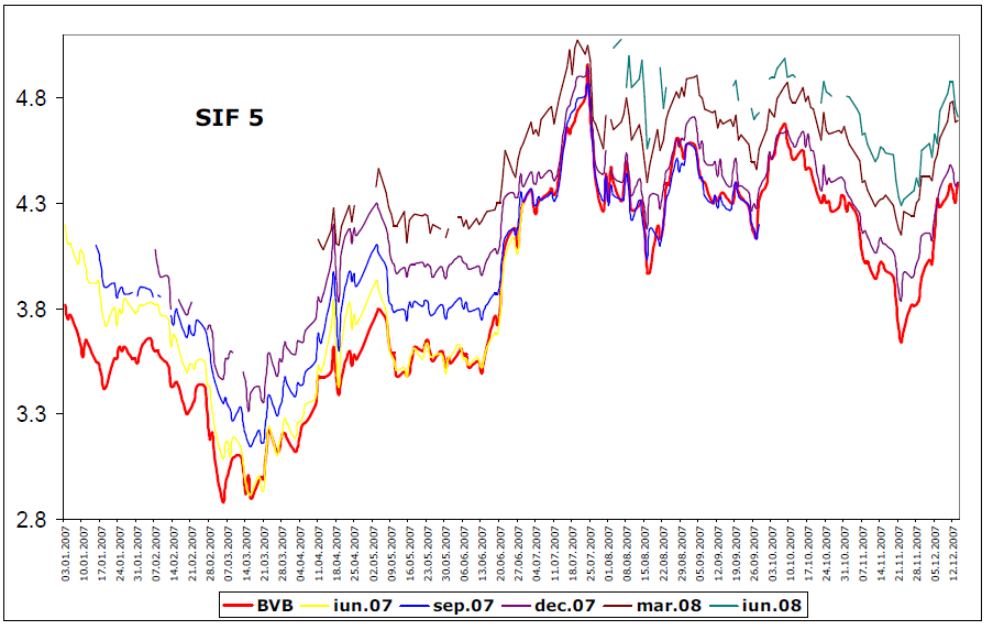

Figure 4. Dynamic arbitrage with different maturities

Market manipulation suspicions

In this example, the widely publicized case of Amonil SA, where SSIF MOBINVEST SA broker and affiliates have performed spot transactions to substantially increase the stock price, subsequently acting on the derivatives market (DEAMO – MAR07), by taking short futures positions, will be presented. Speculators motivated their short futures positions through arbitrage, but in reality they sold their shares, leading to a price collapse, thereby obtaining wrongful incomes, not available to other investors [22], [23], [24].
Market manipulation is evidenced by the issuer evolution chart (Figure 5), where the operation in December 2006 revealed an atypical price evolution. Following notification that the market was artificially influenced, SIBEX suspended the trading of derivatives and brokers' activity, charged with manipulation, so that it could not close the positions and complete the operation. It is one of the few cases where arbitrage can fail: if one position cannot be closed at maturity.

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Figure 5. Market manipulation signal Amonil

Regardless of the manipulation character of the transaction, arbitrage opportunities were available to all investors, but they preferred to risk long positions on spot in order to win big without being hedged.

The logarithmic evolution of the stock market

We conclude that the hypothesis of no arbitrage must be completed and rephrased, taking into consideration the following elements:

- Market trend and growth estimates;
- Discounted rate;
- Adopted strategy.

Stock markets follow logarithmic growths on long term [25], sometimes softer, sometimes agitated. As shown in Figure 1, both overall progress as well as ascending subtrends may be considered logarithmic. Getting back to formula (1) and determining the regression slope of the logarithmic graph (using, for instance, Excel SLOPE function), we obtain daily values of the discount rate ρ. This way we can obtain the annual discount rate R, performed by the Romanian capital market multiplied by 365, the number of days corresponding to a year:

$$\rho = \ln\left(\frac{P_1}{P_0}\right) = \ln(P_1) - \ln(P_0) \Rightarrow R = 365 \cdot \rho \qquad (5)$$

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where P_1 and P_0 are two daily consecutive values.
Franke (2015) determines the relationship between the annual discount rate R and continuous compounded rate r, in the form:

$$r = \ln(1+R) \tag{6}$$

Formula

$$\rho = \ln\left(\frac{P_1}{P_0}\right) = \ln(P_1) - \ln(P_0) \Rightarrow R = 365 \cdot \rho \tag{5}$$

is applied for the evolution of the issuer SIF5, which we will consider distinct on two periods:

- First period, before the start of the crisis (January 2000 to mid-2007);
- Second period, crisis and post-crisis (from January 2009 until the end of 2014)

For issuer SIF5 the annual discount rate R on the Romanian market:

- For the first period R=69%;
- For the second period R=8.1%.

Obviously, the value 69%, achieved in the pre-crisis euphoria is aberrant, and what seems to be the current pessimism (a rate of only 8%) is, in fact, a logical justified value.

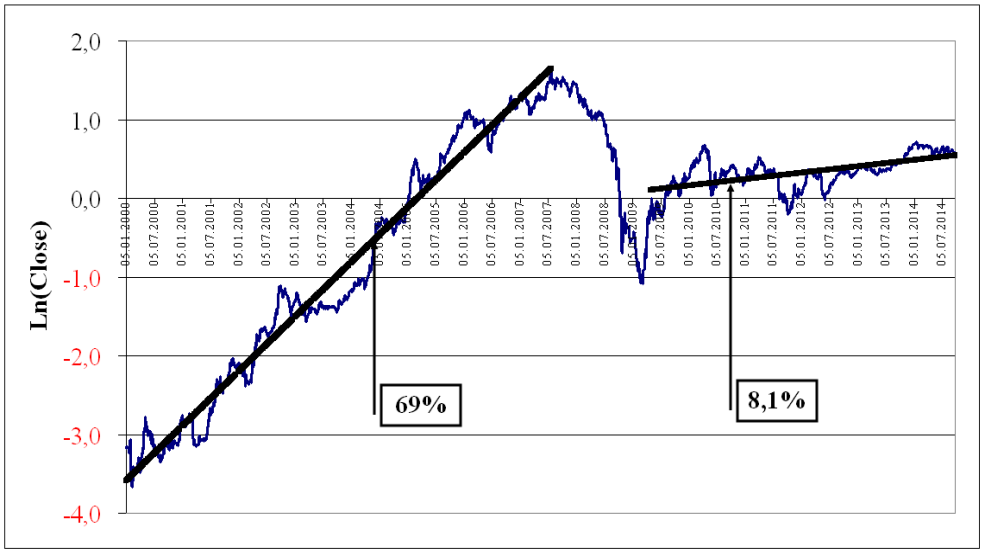

Figure 6. Logarithmic evolution of the issuer SIF5 on BSE

Studying mature stock exchanges (DJIA Figure 8 and DAX Figure 7, data from [26]), we can conclude which values would be reasonable for the stock discount rate.

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We must note that the logarithmic evolution is relatively well respected on mature markets, and it is normal to be so: to act on a market, ROI (rate of return determined on logarithmic values) is the fundamental factor.

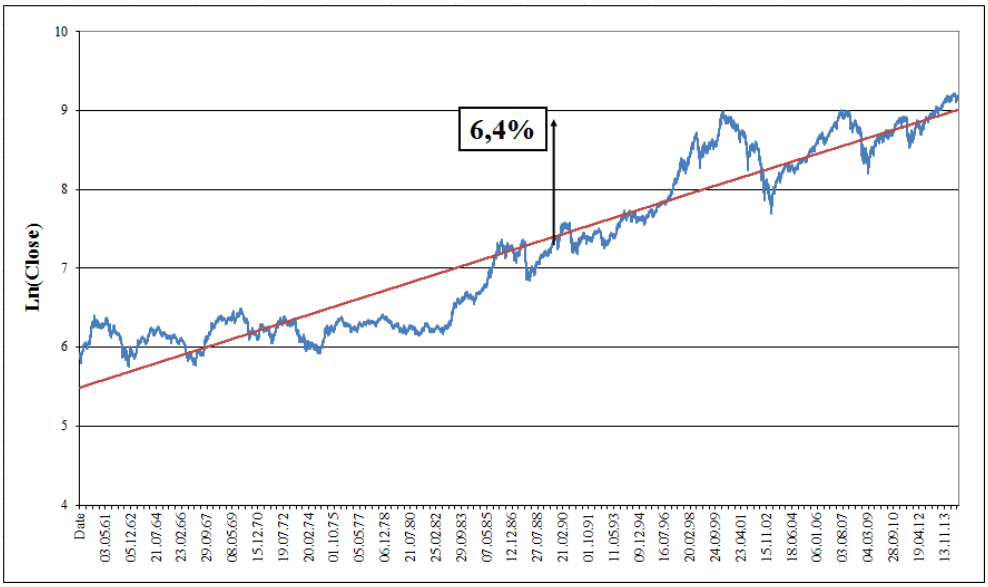

Figure 7. Logarithmic evolution of DAX

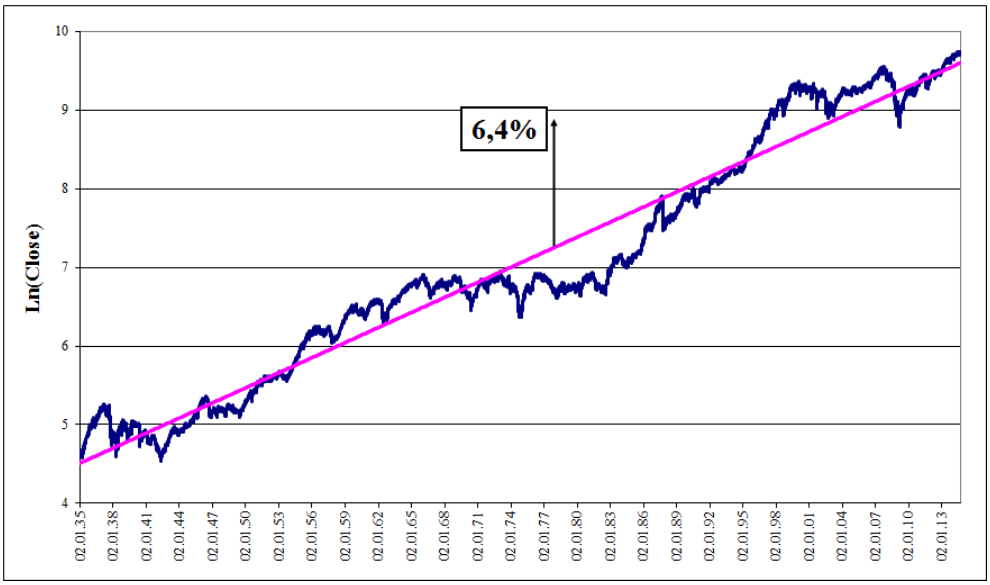

Figure 8. Logarithmic evolution of DJIA

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Influence of the discount rate

On the date of analysis, the yield of American bonds UST30YR was 3.10%, of the German on 10 years was 0.91%, Italian bonds CTITL10Y of 2.34% [27]. It is therefore normal that the riskier stock market to provide an average discount rate of 6%. On the Romanian market, at a coupon rate of 6.1÷7.4% in corporate bonds listed on BSE, a discount rate of 8% on the stock market is not satisfactory, since the difference in profit does not cover the difference between incumbent risks. This may be one explanation for why the Romanian market is going through a period of insufficient liquidity, resulting in a stagnation of prices due to lack of investors' interest.

Conclusions

Given that investors expected the discount rate of the stock market to perform better than bond yields or passive bank deposits, it is rational for them not to seek arbitrage, even if the opportunity arises. Risks were higher but were rewarded with lungful earnings; some speculators completely abandoned caution.

Table 1. Arbitrage yields on Romania Market, at 18th of April 2008

Issuer	Spot (BSE)	Expires	Futures	Diffe-rence	Invest-ment*	Profit	Period (month)	Annualized profit
SIF2	**2.26**	Jun-08	2.40	0.14	2.960	4.81%	2.3	24.76%
		Sep-08	2.52	0.26		8.78%	5.3	19.76%
		Dec-08	2.61	0.35		11.84%	8.3	17.05%
SIF5	**2.78**	Jun-08	2.91	0.13	3.680	3.48%	2.3	17.89%
		Sep-08	3.04	0.26		7.04%	5.3	15.84%
		Dec-08	3.23	0.45		12.23%	8.3	17.61%
TLV	**0.71**	Jun-08	0.75	0.04	910	4.42%	2.3	22.72%
BRK	**1.38**	Jun-08	1.47	0.09	1.980	4.72%	2.3	24.26%
* Investment = 1000 x (Spot BVB) + 2 x (SIBEX margin)								

In the period taken into consideration, given the higher yields on the stock market, the investors systematically refused arbitrage. Arguments involving stock market risks were not taken into consideration, nobody thought that the stock market might collapse, as it happened in 2008÷2009. In addition, after the revival in the spring of 2009, the market registered a more reasonable growth trend and arbitrage opportunities disappeared.

Furthermore, in the same period, systematic deviations of options according to Black-Scholtz theory were reported, as shown in Table **2**. For a call option is not logical the increase in price in accordance with the exercise price, as it happened at the date of analysis.

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Table 2. Call options listing on SIBEX (Ask)

Issuer	Spot BSE	Expires	Futures Sibex	Type	Strike	Price (Prime)
SIF 5	**1.65**	Dec-08	**1.76**	**call**	1.7	0.285
					1.8	0.300
		Sep-08	**1.69**		1.9	0.180
					2.2	0.200
Call Options 2008-08-23 07:52:21						

Along with direct arbitrage, market volatility, high yields, investor, and speculators' optimism determined arbitrage opportunities through elaborate combined positions and options schemes. Basically, they consist of purchasing options out-of-money, with low cost, but with chances to make money until maturity, even if, for a short interval of time. An example of such a strategy is „fence", which can be carried out in the structure from Figure 9.

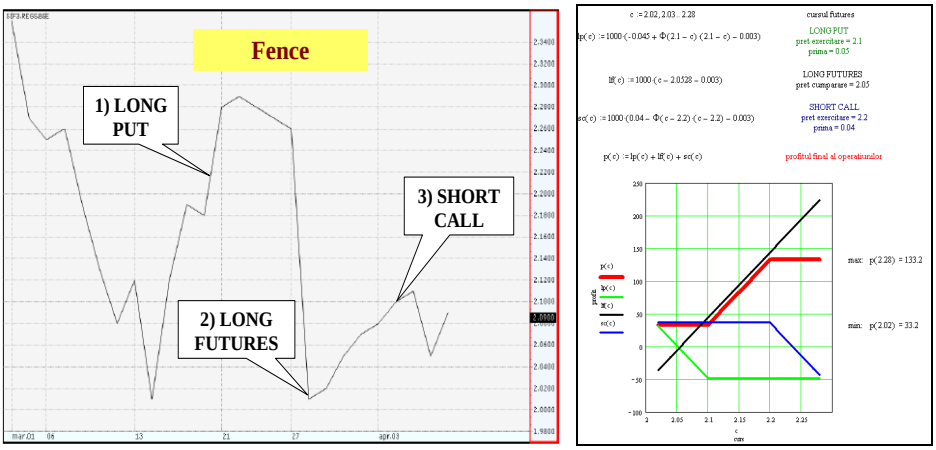

Figure 9. Dynamic fence strategy

The strategy [28] is not arbitrage in the true sense of the word, it involves initial investments, determined by the remoteness's of futures options quotations, as well as high potential gains, but convinced the investors to take a stab. Another advantage is that the strategy consisted of taking position „against" the market (long put and short call on bull, long futures on bear market), hence ensuring a counterparty.

After the financial crisis, the SIBEX market has lost investors' interest, most of them being disappointed with the suffered loss. Unfortunately, we cannot guarantee that the lesson has been correctly learned: the market evolution is not

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necessarily to be blamed, but rather speculators' desire to make quick profits, neglecting any trace of caution.

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