IDENTIFYING ARBITRAGE OPPORTUNITIES ON SIBEX MARKET

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1. Introduction

Both individual and institutional investors that own either real or financial assets are exposed to price fluctuation risk, being forced to protect themselves against such risks. Financial derivatives are considered to be the best solution to these needs, being recognized as irreplaceable risk management instruments. It is highly acknowledged that the main purpose of financial instruments' use is the control and management of risk. The risk of price changes until the maturity date is very high.

In Romania, importers and exporters are most affected by this type of risk. In most cases, importers purchase goods with payment in euros from foreign suppliers and sell them on the domestic market in RON. Usually, between national currency encashment and the payment in euros there is a time period during which the exchange rate fluctuates either in benefits or against the importer's advantage generating currency risk. Financial derivatives market provides these users with instruments that protect against foreign currency risk.

Financial institutions use the financial derivatives not only for hedging purposes but also for speculative reasons. The presence of speculators in the market is disputed. Some economists believe that speculators are those who generate the speculative bubbles and implicitly financial crisis. Most believes however that the speculators provide market liquidity, contributing to enhancing its price efficiency, because they reduce the differences between the purchase price and the sale price. By assuming the risk and providing liquidity and capital, speculators contribute to the stability of the futures market.

Another important category on the futures market is the arbitragers that interfere for a gain when they identify arbitrage opportunities on the market, resetting the market equilibrium.

The mixed presence of these three categories of market participants increases the market efficiency. By their simultaneous action, capital market participants, hedgers, speculators or arbitrageurs are able to provide market liquidity, to determine cost savings, to transfer partially or totally the risk, and not least to reduce or eliminate any price differences between markets.

During the last three decades the standardized financial derivatives market has registered a continuous expansion, becoming more and more important in the finance field. The increasing volume of transactions with these instruments is due to financial markets opening, to the diversification of these instruments as a result of the ever increasing needs of market participants, and to the continuous development of more and more sophisticated strategies. As far as the domestic situation is concerned, the Romanian futures market trend follows the global dynamics, validating the expansion expectations. The year 2006 has been an important one for the Sibiu

Stock Exchange (SIBEX) because the number of positions has increased six times in comparison to the previous year.

2. Arbitrage - Theoretical framework

Unlike speculation which involves exposure to risk, arbitrage is considered a risk-free operation because it consists in buying an asset on a market on which the price is low and selling it immediately on another market at a higher price. In other words, arbitrageurs always operate with real prices and not with their estimates as the speculators do, having the possibility to obtain profit without assuming any risk.

Arbitrage involves taking advantage of temporary price anomalies that occur as a result of discrepancies between the supply and demand or temporary gaps of titles on the market. Such disequilibrium occurs rarely and is a temporary situation. As market participants initialize arbitrage operations, the prices gradually equalize and a new equilibrium is being reached. This rule is considered a golden rule for financial theory and it is known in literature as the principle of non arbitrage. It is important to know that one must take into account the transaction costs that may cancel any arbitrage earnings.

Depending on the prices of the arbitrage, several types of arbitrage have been identified (Pop I.M., 2011: 110): cash-futures arbitrage, forward-futures arbitrage, cash and carry arbitrage, reverse cash and carry arbitrage, national-international arbitrage or computerized arbitrage.

Cash-futures arbitrage includes taking a position on the futures market and simultaneously trading the underlying asset on the spot market. Differences in price between the two markets are generated by the cost of carry and the effect of investors' expectations. If the difference between prices on both markets is greater than the cost of carry, there is an arbitrage opportunity. When the spot market price is lower than the futures market price, arbitrageurs will buy the underlying on the spot market and they will sell it on the futures market, making a long arbitrage. On the other hand, if the spot price is higher than the futures price, arbitrageurs will buy the underlying on the futures market and they will sell it on the spot market, making a short arbitrage.

Forward-futures arbitrage can be achieved when there are differences between the price of a futures contract for a certain currency with a certain maturity and the forward quotations for the same currency and maturity. Usually, these differences are relatively small, but trading significant volumes can generate significant gains for arbitrageurs.

Cash and carry arbitrage is a version of the cash-futures arbitrage which involves to buy the underlying on the spot market and to sell it through a futures contract, but the asset must be held until maturity.

Reverse cash and carry arbitrage is the opposite cash and carry arbitrage and is to sell an asset on the spot market while buying a futures contract on the same asset. Since the sale is before the buying, the arbitrageur has to borrow the sold assets, until maturity of the futures contract, so that the cost of borrowing reduces the arbitrageur's profit. It should be noted that in practice short selling is not always allowed.

National-international arbitrage involves simultaneous trading of similar assets on the arbitrageur's national market and on another market outside its home country. The price of an asset that is quoted on several markets, but has the same characteristics varies due to temporary differences between the supply and demand on the market, thereby creating arbitrage opportunities.

Computerized arbitrage (Program trading) is to make arbitrage operations using computer systems that continuously supervise the spot and

futures prices, allowing easily the identification of differences in price between the two markets. Due to the real-time opportunities exploitation, significant price changes may occur. As these price changes aren't due to the arrival of new information on the market they will lead to high volatility and implicitly to some criticism towards the program trading.

3. Evidence on SIBEX market arbitrage opportunities

In the following, we intend to identify the arbitrage opportunities appeared on SIBEX market for DESIF5 futures contracts with a maturity of three months, during January 3, 2005 - August 26, 2011. Therefore, it is necessary to determine the theoretical futures price and to compare it with the actual futures price. Some general considerations regarding the valuation of forward contracts must be stated as a preamble to evaluate futures contracts.

Unlike futures contracts, forward contracts are easier to analyze because there is no marking to market, the only cash flow being generated at maturity. After we managed to price a forward contract will be much easier to calculate the futures price because we consider the following reasoning: forward price and futures price are very close in value when the two contracts have the same maturity.

The most important pricing mechanism principle in case of forward contracts is that the price at maturity must equal the spot price. Immediately, the holder of such a contract will require delivery of the underlying asset. Thus, forward contract is simply a spot transaction and its price must be identical with the spot price (D. Chance, 1998: 367):

$$F_T = S_T$$

If this statement weren't true, there would appear arbitrage opportunities either by buying the underlying and selling a forward contract matured, or by selling the underlying asset and buying a forward contract matured. As the futures contract approaches maturity, the futures price approaches the spot price of the underlying asset so that at the maturity the two prices are identical or almost identical - the *convergence property*. If the two prices would be different, investors would rush to buy the asset at a lower price and sell it at a higher price. Such an arbitrage could not continue without a gradual price adjustment which will finally eliminate the arbitrage opportunity.

The value of the forward contract is zero at time 0. At a later time, this value may become positive or negative. Suppose that F_0 is the current forward price for a contract that was signed some time ago, the maturity is over *T* years, *r* is the risk-free interest rate, the contract delivery price is *X* and *f* is the value of a forward contract for which a long position has been taken. The general formula for determining the value of forward contracts is:

$$f = (F_0 - X)e^{-rT}$$

To verify the previous equation, we compare a forward contract (long) that has the price of delivery F_0 with another forward contract (long) where *X* is the delivery price. The difference between the two consists of the amount to be paid for the underlying asset at time *T* (for the first the sum is F_0 while for the second it is *X).* The amount payable at maturity ($F_0 - X$) is now equivalent to $(F_0 - X)e^{-rT}$. The contract with the price F_0 worth less with $(F_0 - X)e^{-rT}$ than the contract of which price is *X*. The value of the contract of which price is F_0 is by definition zero. This means that the value of the contract with the price *X* is

$(F_0 - X)e^{-rT}$ which proves the above equation. Similarly, the value of a short forward contract price *X* is:

$$f = (X - F_0)e^{-rT}$$

If the risk-free interest rate is constant and the same for all maturities, the forward price for a contract with a certain maturity equals the price of a futures contract with similar maturity. When interest rates vary unpredictably, as often happens in the real world, forward and futures prices are not identical. We can understand the nature of the relationship between the two prices considering if the spot price of underlying asset, *S,* is strongly positively correlated with interest rates. If *S* increases, an investor who has opened a long position has immediately obtained a gain due to the daily settlement procedure. Positive correlation indicates that interest rates are likely to be increased. Therefore, the gain can be invested at a higher average interest rate. Similarly, when *S* decreases, the investor will record quickly a loss. This loss will be covered at an interest rate lower than the average interest rate. Unlike an investor owning a futures contract, an investor holding a forward contract is not affected by the change in interest rates. This means that a long futures contract will be more attractive than a similar long forward contract. Furthermore, when *S* is strongly positively correlated with interest rates, futures prices will tend to be higher than forward prices. Conversely, where *S* is strongly negatively correlated with interest rates, forward prices will tend to be higher than futures prices.

Theoretical differences between futures price and forward price for contracts with maturities up to several months are often small enough to ignore. In practice, there are many factors[1] which are not included in theoretical models and can cause differences between the two prices. The counterparty risk is lower for futures contracts due to the presence of the clearing house. Also, in some cases, futures are more liquid and more easily traded than forward contracts. Despite all these, in most cases it is reasonable to assume that the forward price and the futures price are equal.

There are few empirical studies which have examined the relationship between the forward and futures prices. Cornell & Reinganum (1981) studied the futures and the forward price for British pound, Canadian dollar, German mark, Japanese yen and Swiss franc in the period 1974-1979, identifying only a few statistically significant differences between the two sets of prices. Their results were confirmed by Park & Chen (1985), who analyzed British pound, German mark, Japanese yen and Swiss franc between 1977 and 1981.

As the life of the futures contract increases, the difference between futures and forward price becomes significant. So it is dangerous to assume that forward and futures prices are a perfect substitute for each other. Consequently, long-term futures contracts should have different approaches.

French (1983) analyzed the price of copper and silver in the period 1968-1980. The results concluded that the price of silver futures differs significantly from the forward (at a confidence level of 5%). Park & Chen analyzed the gold, silver, coin silver, platinum and copper between 1977 and 1981. Their results register on line with those of French: the two prices are significantly different, the futures price is higher than forward price.

Rendleman & Carbini (1979) analyzed the market of treasury bills during 1976-1978. Also found significant differences between futures and forward prices. According to these studies, it appears that the differences observed are caused by factors mentioned above (taxes, transaction costs, etc).

[1] These factors relate to taxes, transaction costs, system margins.

Table no. 1. **Cash and carry arbitrage on DESIF5 futures contracts**

Date	BSE	SIBEX
18/03/2005	SIF5 Price: 1.3 RON / share. Buy: 76,923 shares. Commission: 720 RON.	DESIF5 Price: 1.85 RON / share. Sell: 54 DESIF5 IUN05 contracts. Fee: 81 RON.
06/17/2005[3]	SIF5 Price: 1.29 lei / share. Sell: 76,923 shares. Commission: 714 RON.	DESIF5 Price: 1.29 lei / share. Buy: 54 contracts DESIF5 IUN05. Commission: 81 RON.
Results	No commissions: Loss: (1,29-1,3) * 76,923 = -769 RON The commission: Loss: -769-720-714 = -2203 RON	No commissions: Gain: (1,85-1,29) * 1000 * 54 = 30340 RON The commission: Win: 30340-81-81 = 30,178 RON
The final result	Profit without commissions: 30340-769 = 29571 RON Profit with commissions: 30178-2203 = 27974 RON	

Source: Authors' processing

In order to compute the theoretical price of the DESIF5 contract, we use the following formula:

$$F_t = S_t e^{(r_t - q_t)(T-t)}$$

where:

S_t - the spot price of the underlying asset;

r_t - the risk-free interest rate with continuous compounding;

q_t - the annual dividend yield with continuous compounding;

T - t - the time to maturity.

If $F_{actual} > F_{theoretical}$, arbitragers will buy SIF5 stocks on BSE and will sell DESIF5 futures contracts on SIBEX, this transaction representing a *cash and carry* arbitrage.

If $F_{actual} < F_{theoretical}$, they could sell SIF5 stocks on the spot market and they could buy DESIF5 contracts on the futures market, this transaction representing a *reverse cash and carry* arbitrage, but we didn't consider the second alternative because the short selling was not allowed in Romania during the analyzed period.

As mentioned already, the main issues that must be taken into account when initiating an arbitrage are the transaction costs which could entirely diminish the profit.

Thus, by comparing the futures price observed on the market to the theoretical futures price, we identified a total number of 1393 arbitrage opportunities, without considering transaction costs[2].

After including these costs, only 349 days remained, in which a *cash and carry* arbitrage could have been initialized (see Annexes 1, 2, 3, 4, 5, 6, 7). In order for such operations to be profitable, the difference between the two prices must be less than 0,09 RON / share[4].

Suppose that an investor holds the amount of 100.000 RON and decides to make a *cash and carry* arbitrage on the 18th of March, 2005[5] .The results are presented in the following table.

[2] On the spot market a transaction fee of 0.72% applied on the traded amount and an order fee of 1 RON per transaction are charged. On the futures market a fee of 1.5 RON / contract is retained.

[3] The day of maturity for the DESIF5 IUN05 futures contract was 17.06.2005.

[4] This is an average cost of trading for the analyzed period.

[5] Represents the moment at which the difference between the actual price and futures price has reached the maximum.

4. Conclusions

In this paper we identified the arbitrage opportunities during the last seven years for the most liquid contract on SIBEX, the futures contract of which underlying asset is represented by the SIF5 shares. Initially we identified 1393 opportunities that could have been exploited in the indicated timeline, but after considering the transaction costs, the number of gaining possibilities has significantly decreased to 349. This shows that the Romanian financial derivatives market is not exploited to its full potential. A possible explanation for this lack of interest shown for financial derivatives could be that the Romanian market is not adequately informed about the benefits provided by the use of futures or options.

Without any doubt, derivatives are generally considered sophisticated instruments of which use requires detailed knowledge of their characteristics, development and employ of appropriate valuation techniques and mechanisms, and handling experience when used by financial institutions. In this respect, SIBEX triggered an aggressive campaign meant to promote the derivatives instruments and to provide trading information for Romanian investors. All these considered, we are optimistic that over a few years we will analyze a mature and well developed Romanian derivatives market.

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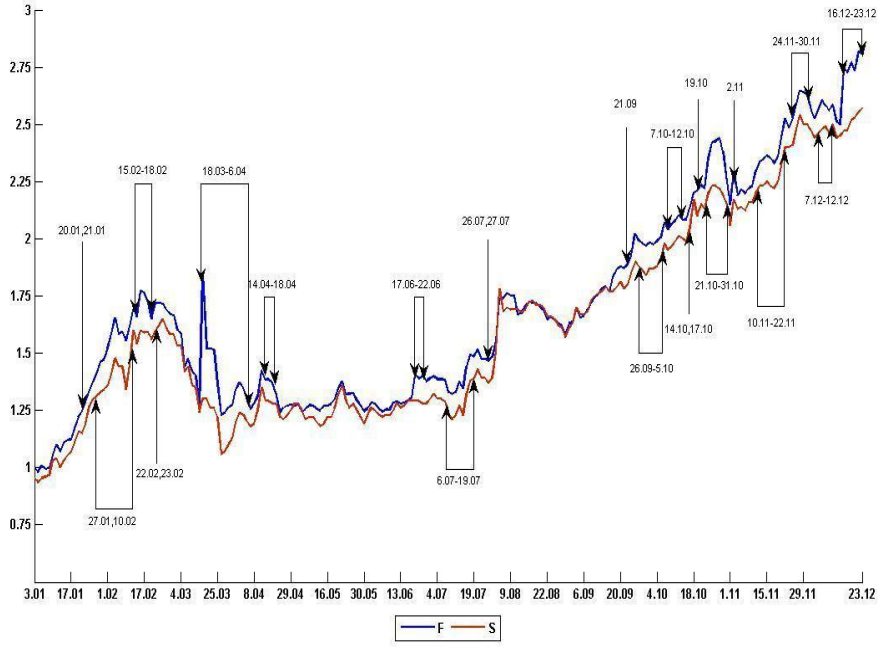
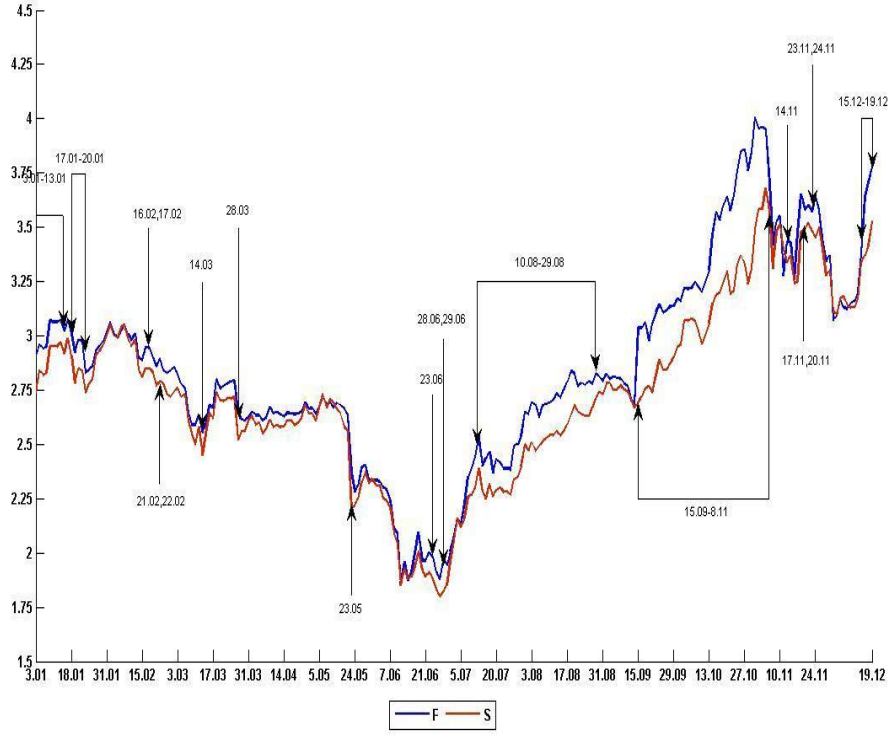
*****	www.sibex.ro.

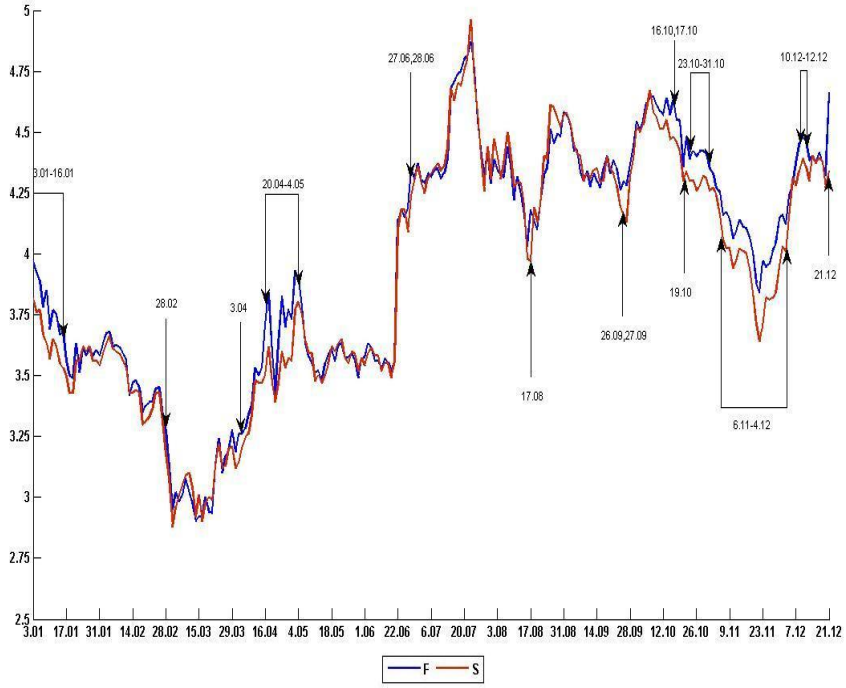
ANNEX NO. 1 The identification of arbitrage opportunities for DESIF5 futures contract in 2005



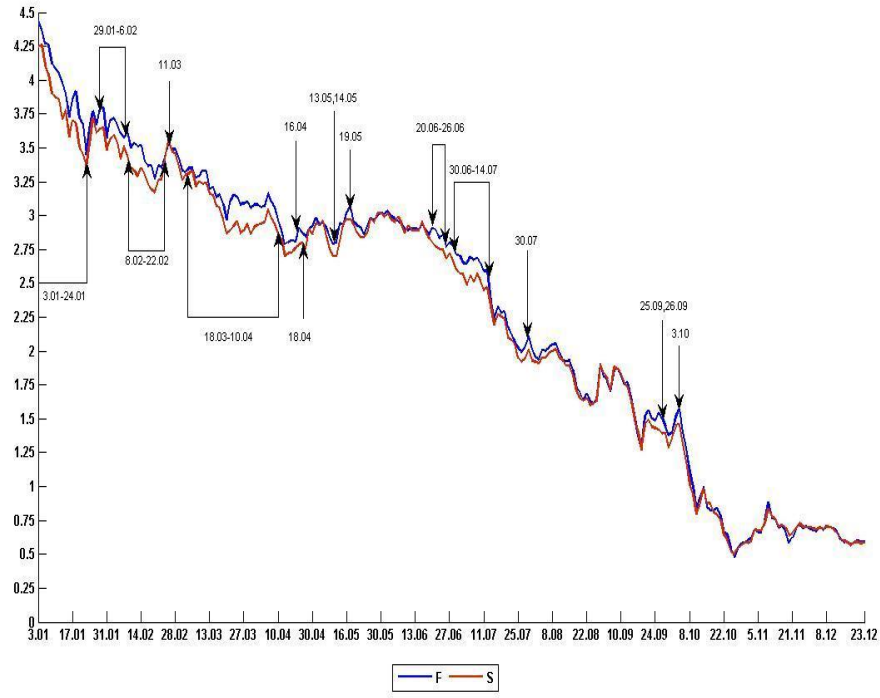
ANNEX NO. 2 The identification of arbitrage opportunities for DESIF5 futures contract in 2006



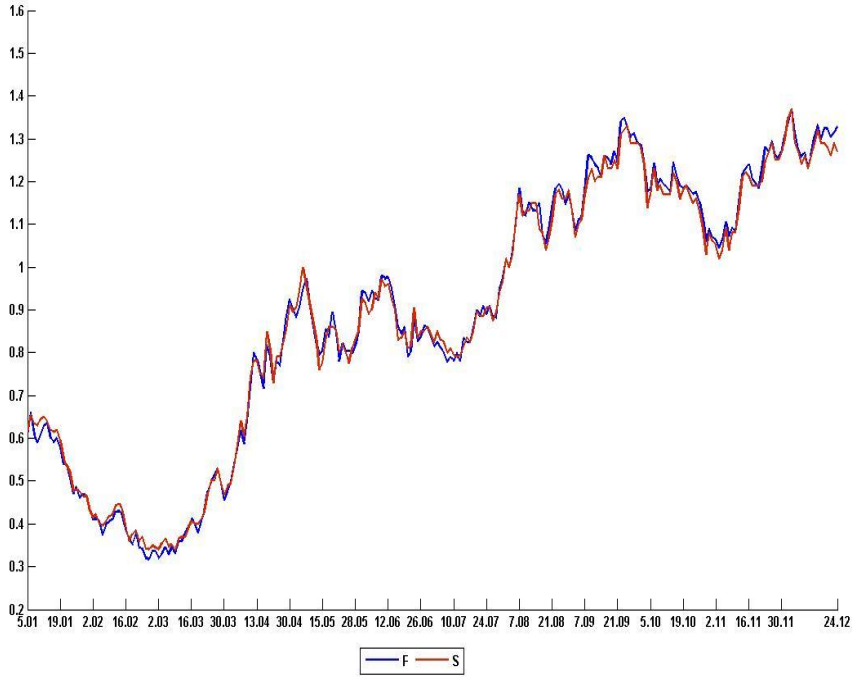
ANNEX NO. 3 The identification of arbitrage opportunities for DESIF5 futures contract in 2007



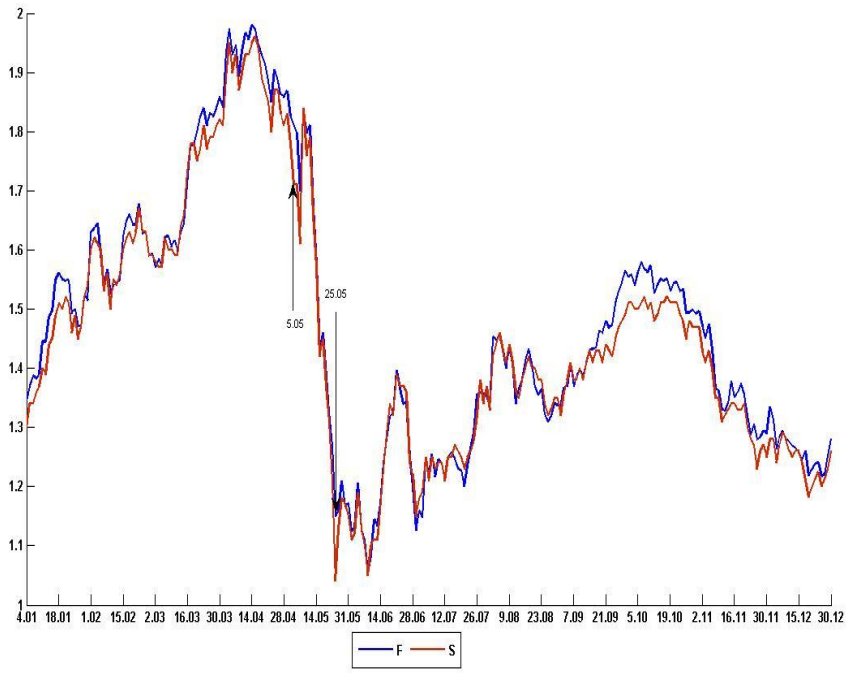
ANNEX NO. 4 The identification of arbitrage opportunities for DESIF5 futures contract in 2008



ANNEX NO. 5 The identification of arbitrage opportunities for DESIF5 futures contract in 2009



ANNEX NO. 6 The identification of arbitrage opportunities for DESIF5 futures contract in 2010



ANNEX NO. 7 The identification of arbitrage opportunities for DESIF5 futures contract in 2011