Testing the Weak-Form Market Eficiency of the Euronext Wheat

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Abstract: *Using a trading system based on various simple moving average crossings, the paper examines the weak-form market efficiency of the wheat traded at the Euronext exchange. After optimizing over the sample period, the best strategy is selected and then applied over the out-of-sample period. The profitability of this strategy is then compared with the simple buy and hold strategy. The methodology is then repeated for different sub-samples in order to check the results' robustness. The results show that the weak-form market efficiency hypothesis cannot be rejected for the wheat case.*

Keywords: efficient market hypothesis, technical analysis, simple moving average, adaptive market hypothesis
JEL Classifications: G14, G15, G17

INTRODUCTION

The efficient market hypothesis (EMH), developed by Fama (1970), postulates that prices comprise all available information in the market at a specific moment in time and therefore the market participants cannot perform better than the

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average on a risk adjusted basis in the long run. Fama (1970) also proposed three major versions of market efficiency: the weak form, the semi-strong form and the strong form. The theory of efficient markets gained important academic attention, Jensen (1978) stating that "there is no other proposition in economics which has more solid empirical evidence supporting it than the Efficient Market Hypothesis". Since the beginning of its development, the EMH found support in the results of various studies, such as Thompson (1978), Galai (1978), Nichols (1993) or Shanken and Smith (1996).
However, empirical findings contradicting the EMH appeared soon. For example, Brock et al. (1992) found that simple technical trading strategies can achieve higher returns than the buy and hold strategy in the case of the US equity market during the period between 1897 and 1986. Also, Jegadeesh and Titman (2001) found that momentum trading strategies were able to achieve abnormal profits. Lo (2004) proposed the adaptive market hypothesis (AMH), arguing that market participants not perfectly rational, but they adapt to a changing market environment. In this context, the level of market efficiency also varies, several studies confirming this approach: Kim and Shamsuddin (2008), Kim et al. (2011), Alvarez-Ramirez et al. (2012) and Abounoori et al. (2012).

The weak-form market efficiency is often tested through the effectiveness of several technical trading strategies for various markets. Boboc and Dinică (2013) employed a genetic algorithm to develop a trading strategy on the EUR/USD market, finding that the EMH can not be rejected. Other studies focused on equity markets (Kwon & Kish, 2002; Hsu & Kuan, 2005; Savin et al., 2007; Hsu et al., 2010) or commodity futures markets (Roberts, 2005; Park and Irwin, 2010; Szakmary et al., 2010).

The paper examines the weak-form market efficiency of the wheat traded at the Euronext exchange using a trading system based on technical analysis indicators. The trading signals are given by simple moving averages (SMA) crossings. Using optimization on the sample period, we select the best strategy and apply it over the out-of-sample period. The profitability of this strategy is then compared with the simple buy and hold strategy. The results of the paper show an inconsistency in finding rules that prove more profitable over the both periods, thus suggesting the overall weak-form efficiency of the wheat market. The reminder of the paper is constructed as follows. The second section describes the database and methodology, in the third section the results are discussed, while in the last section the conclusions of the research are given.

DATABASE AND METHODOLOGY

The database used for this research is represented by daily closing prices of the wheat nearby futures traded at Euronext Paris Exchange over the period 01.01.2002 – 31.12.2013. All prices are expressed in EUR/ton.

The trading signals are given by simple moving averages (SMA) crossings. Thus, a buying signal is given when a short period moving average (short SMA) crosses from below a long period moving average (long SMA). Similarly, a selling signal is given when a short SMA crosses from above a long SMA. The short SMA is computed over a period between 1 and 20 business days (up to approximately 1 month). The long SMA is computed over a period between 21 and 250 business days (approximately between 1 month and 1 year). Thus, the total number of possible combinations of short-long SMAs is 4.600 (20 short SMAs multiplied by 230 long SMAs). Notably is that the crossings of a 1 day period SMA with any long SMA represents actually a crossing of the price with the long SMA.

The computations are done using the Bloomberg backtesting (BT) function. Besides the number of periods over which a SMA is computed (1 to 20 for short SMAs and 21 to 250 for long SMAs) the other parameters used for computations are the initial capital (set at 1.000.000 EUR) and the size of a traded lot (set at 10 futures contracts). We also set the slippage and transaction costs to zero. This approach eased the computations and, taking into account the results, the conclusions were not affected.

Initially, we optimized the trading strategies over the sample period (01.01.2002 – 31.12.2009). During this step of the methodology, we computed the profit or loss of all 4.600 possible combinations of SMAs. Next, the strategies are sorted decreasing based on their profit. The best or the optimal trading strategy (SMAs crossing) is considered the one having the highest profit over the sample period. For this strategy is then computed the profit or loss over the out-of-sample period (01.01.2010 – 31.12.2013). This result is then compared with the result of the buy and hold (B&H) strategy over the out-of-sample period. If this result is better that the result of the B&H strategy, then one can find a strategy that is more profitable than the market based on past price information and there are reasons to consider that the Euronext wheat market is weak-form inefficient. Contrarily, if the B&H strategy is more profitable over the out-of-sample period, then we can not reject the weak-form market efficiency hypothesis.

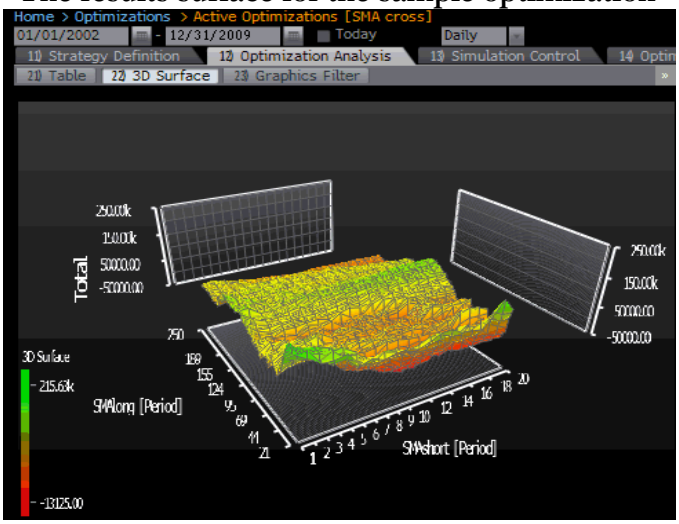
In order to check the robustness of the results, we repeated the same methodology for 3 subsamples: the first sample period is between 01.01.2002 and 31.12.2004, having an out-of-sample period between 01.01.2005 and 31.12.2005, the second sample period is between 01.01.2006 and 31.12.2008, with an out-of-sample period between 01.01.2009 and 31.12.2009, while the third sub-period comprise a sample period between 01.01.2010 – 31.12.2012 and an out-of-sample period between 01.01.2013 – 31.12.2013.

RESULTS

The results of the first optimization over the period 01.01.2002 – 31.12.2009 are represented in Figure 1. The horizontal axes represent the number of periods used to compute the SMA, while on the vertical axe are represented the results of the various combinations of SMAs. The surface presents a few areas where the profits are relatively high: short SMAs of just a few days combined with long SMAs computed over periods up to 40 days; short SMAs computed over periods of near 20 days combined with long SMAs computed over periods up to 40 days and short SMAs computed over periods of near 20 days combined with long SMAs computed over periods of around 150-180 days. The best result was obtained by the combination between a short SMA computed over a 1 day period (the price level actually) and a long SMA computed over a 27 days period.

Figure 1

The results surface for the sample optimization



Source: author's calculations with Bloomberg BT function

In Figure 2 are depicted the buy and sell signals given by the best performing trading rule over the sample period. Also, there is represented the evolution of the result obtained by this trading rule: the crossing between SMA(1) and SMA(27). It can be observed that the trading rule created a large number of trades and obtained the largest part of its profitability during the last period.

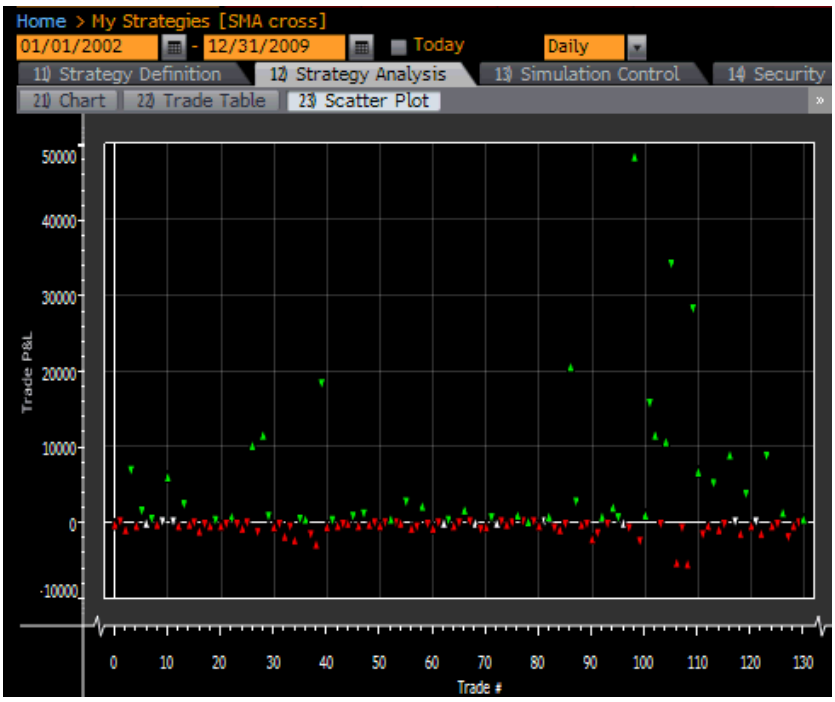
Figure 2

Trades and trading results of the best performing rule over the sample period

Source: author's calculations with Bloomberg BT function

In Figure 3 are represented all the results of the best performing trading rule over the sample period. It can be noticed that while the loosing trades have a small dispersion, the highest loss being under 10.000 EUR, the winning trades are characterized by a greater dispersion, the profits ranging between 0 and 50.000 EUR per trade.

Figure 3
Results of individual trades created by the best performing trading rule over the sample period



Source: author's calculations with Bloomberg BT function

Figure 4 presents the evolution of the wheat price over the sample period together with a comparison between the evolution of the result of the best performing trading rule and the result of the B&H strategy over the same period. It can be noticed that the results of the SMA crossing rule are net superior to those of the B&H strategy.

Figure 4

The results of the SMA(1,27) trading rule and the B&H results over the sample period

Source: author's calculations with Bloomberg BT function

Figure 5 plots the trading signals of the SMA(1,27) crossing rule over the out-of-sample period together with the results obtained by this trading rule over the same period. The rule still creates a large number of trades, but the profit that is obtained is much smaller this time (15.000 EUR). Also, this result is weaker than the result of the B&H rule for the same period (37.750 EUR), thus suggesting the weak-form efficiency of the Euronext wheat market over the studied period. The strategy that performed very well in the past was not able to repeat the performance over the next period. Thus, a trader would have not been able to obtain an abnormal profit by trading based on past price information and applying the methodology described above.

Figure 5

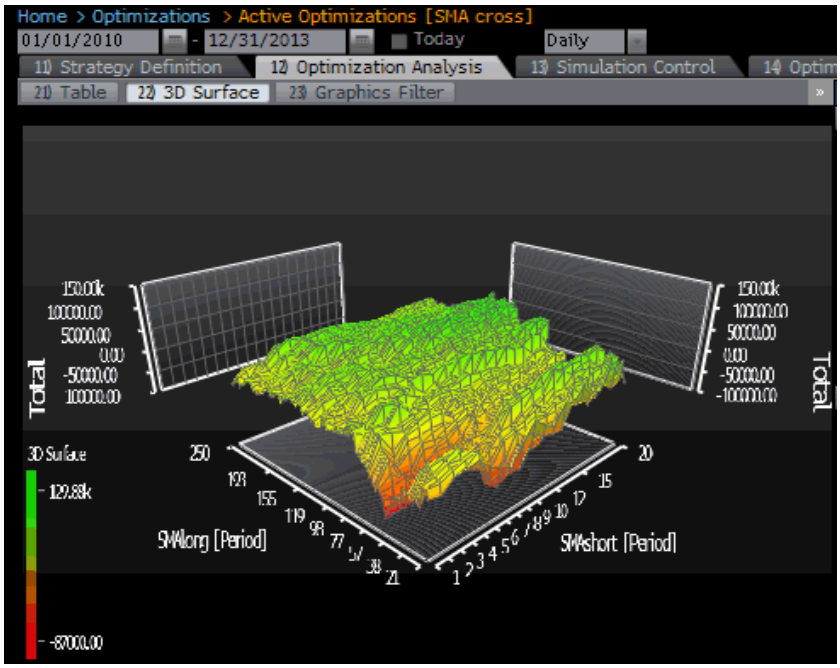
Trades and trading results of the SMA(1,27) trading rule over the out-of-sample period

Source: author's calculations with Bloomberg BT function

For comparison, in Figure 6 is plotted the results' surface for all SMAs crossing combinations over the out-of sample period. The area that obtained the best results over the sample period obtains the worst results over the out-of-sample period. However, other areas with good results over the sample period have good results over the out-of-sample period also.

Figure 6

The results surface for the out-of-sample optimization



Source: author's calculations with Bloomberg BT function

In order to check the robustness of the results, we repeated the same methodology for 3 subsamples. The main results for these subsamples, together with the results of the entire sample are synthetized in Table 1. For the entire period, the result of the B&H strategy are better that those of the SMA trading rule, as mentioned above. Also, the best performing rule during the sample period is one of the worst performing rules over the out-of-sample period, having a rank of 3,943 out of 4,600. For the first subsample, the results of the B&H strategy are again better over the out-of-sample period than those of the SMA trading rule. However, for the other two subsamples, the SMA trading rule proves to achieve higher results than the B&H strategy over the out-of-sample period. Also, the best performing rules of the sample periods of the subsamples continue to be among the best performing rules of the out-of-sample periods.

Table 1

The results for the entire sample and for the subsamples

Period	Type	Short period (days)	Long period (days)	SMA result (EUR)	Rank	B&H result (EUR)
01/01/2002-31/12/2009	In sample	1	27	215,625	1	3,125
01/01/2010-31/12/2013	Out of sample	1	27	15,000	3,943	**37,750**
01/01/2002-31/12/2004	In sample	18	54	55,250	1	-9,500
01/01/2005-31/12/2005	Out of sample	18	54	-250	595	**1,875**
01/01/2006-31/12/2008	In sample	1	27	156,125	1	14,250
01/01/2009-31/12/2009	Out of sample	1	27	**16,625**	60	-3,875
01/01/2010-31/12/2012	In sample	20	164	107,750	1	59,375
01/01/2013-31/12/2013	Out of sample	20	164	**22,250**	576	-21,625

Source: author's calculations with Bloomberg BT function

CONCLUSIONS

The paper examines the weak-form market efficiency of the wheat traded at the Euronext exchange using a trading system based on technical analysis indicators. The trading signals are given by SMA crossings. Using optimization on the sample period, the best strategy is selected and then applied over the out-of-sample period. The profitability of this strategy is then compared with the simple buy and hold strategy.

Initially, the methodology is applied for the entire period comprised by the database and the results show that the best performing SMA trading rule over the sample period fails to obtain better results than the B&H strategy over the out-of-sample period, even without accounting for transaction costs. This result suggests the overall weak-form efficiency of the Euronext wheat market.

In order to check the robustness of the initial result, we repeated the same methodology for 3 subsamples. For the first subsample, the results of the B&H strategy are again better over the out-of-sample period than those of the SMA trading rule. However, for the other two subsamples, the SMA trading rule proves to achieve higher results than the B&H strategy over the out-of-sample period. Also, the best performing rules of the sample periods of the subsamples continue to be among the best performing rules of the out-of-sample periods. These results suggest that for the Euronext wheat market the adaptive market hypothesis can be more suitable, periods of market efficiency alternating with periods of relative market inefficiency.

Also, the results suggest that using smaller optimization and out-of-sample periods can lead to the achievement of better trading results. The results also have shown that for the entire period the area that obtained the best results over the sample period obtains the worst results over the out-of-sample period. However, other areas with good results over the sample period have good results over the out-of-sample period also. Among others, a future direction for research can consist in using over the out-of-sample period a portfolio of rules, instead of a single rule (the best one over the sample period). Thus, instead of using one optimization point, the methodology can use an optimization area or areas.

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