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Hedging effectiveness of European wheat futures markets

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**Poster paper prepared for presentation at the EAAE 2014 Congress
'Agri-Food and Rural Innovations for Healthier Societies'**

August 26 to 29, 2014
Ljubljana, Slovenia

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Abstract

The instability of commodity prices and the hypothesis that speculative behaviour was one of its causes has brought renewed interest in futures markets. In this paper, the hedging effectiveness of European and US wheat futures markets were studied to test whether they were affected by the high price instability after 2007. Implicitly, this is a test of whether the increasing presence of speculation in futures markets have made them divorced from the physical markets. A multivariate GARCH model was applied to compute optimal hedging ratios. No important evidence was found of a change in the effectiveness of hedging after 2007.

Keywords: Futures prices, commodity prices, volatility, wheat, Europe.

1. Introduction

The relatively recent instability of commodity prices has brought back the interest on futures markets and their use for hedging as a device to reduce vulnerability to risk. Futures markets perform several functions as they provide the instruments to transfer price risk, they facilitate price discovery and they are offering commodities as an asset class for financial investors, such as fund and money managers who had not previously been present in these markets.

This paper focuses on the usefulness of futures prices for hedging against price risk. It is motivated by the relatively recent discussion on the effects that the increasing speculation may have brought to commodity markets (e.g., see Bohl and Stephan, 2012 for a recent literature review on the issue); in particular, whether the increasing speculation may have made futures markets divorced from physical markets and useless for hedging. Note that the fact that only price risk is considered in the paper means that it is dealing with the usefulness of exchange markets for most of the participants in the supply chain, except farmers, which as it is well known, are also affected by yield risk, not too mention the fact that only a minority of them tend to operate in futures markets (e.g., see Blank et al. 1997).

The paper is structured as follows: first, a description of the methods used in the paper (i.e., data and methodological approach) are provided followed by the presentation and discussion of the results. The last section offers some conclusions.

2. Empirical work

Data

The analysis was performed using data for feed wheat contracts from the London International Financial Futures and Options Exchange (NYSE LIFFE London abbreviated LIFFE) and for milling wheat contracts from the Marché à Terme International de France (NYSE LIFFE Paris abbreviated MATIF). In order to provide a comparison data from the Chicago Mercantile Exchange Group (abbreviated in CBOT) wheat contracts were also used.

For LIFFE and CBOT contracts the data comprised the period 1988 until 2013, while for MATIF contracts the data were available only since 1998. As hedging performance requires the contemporary evaluation of cash price changes, spot prices from East Anglia (UK), Rouen (France), Bologna (Italy) and Chicago (USA) were also collected. Descriptive statistics for the price data in levels and first difference are presented in Table 1.

Table 1. Descriptive statistics

| Prices in levels | Mean | Max | Min | SD | Skewness | Kurtosis | Jarque-Bera |
|----------------------|-------|---------|--------|-------|----------|----------|-------------|
| Spot Chicago (USA) | 399.0 | 1,194.5 | 192.0 | 145.7 | 1.6 | 5.3 | 5,877.7 |
| Spot UK | 106.5 | 216.7 | 53.1 | 36.7 | 0.9 | 3.2 | 851.8 |
| Spot France | 152.7 | 296.4 | 94.8 | 51.4 | 1.0 | 2.6 | 707.0 |
| Spot Italy | 174.8 | 293.0 | 120.5 | 47.5 | 0.9 | 2.6 | 627.6 |
| Nearby futures CBOT | 414.2 | 1,282.5 | 230.8 | 156.8 | 1.7 | 5.6 | 6,830.6 |
| Nearby futures LIFFE | 109.1 | 225.5 | 57.5 | 37.4 | 1.0 | 3.3 | 1,018.2 |
| Nearby futures MATIF | 153.1 | 286.8 | 99.0 | 49.5 | 1.0 | 2.7 | 721.5 |
| First differences | Mean | Max | Min | SD | Skewness | Kurtosis | Jarque-Bera |
| Spot Chicago (USA) | 0.16 | 275.0 | -260.0 | 20.4 | -0.3 | 19.8 | 107,042.7 |
| Spot UK | 0.04 | 20.2 | -21.1 | 3.1 | -0.2 | 13.8 | 32,069.7 |
| Spot France | 0.10 | 55.5 | -39.0 | 5.8 | 0.6 | 18.5 | 41,364.3 |
| Spot Italy | 0.09 | 30.0 | -52.5 | 4.4 | -3.6 | 50.2 | 390,289.7 |
| Nearby futures CBOT | -0.64 | 260.0 | -256.5 | 19.1 | 0.1 | 22.2 | 140,560.4 |
| Nearby futures LIFFE | -0.03 | 25.0 | -27.5 | 3.1 | 0.2 | 11.6 | 20,117.1 |
| Nearby futures MATIF | 0.24 | 44.0 | -36.0 | 5.3 | 0.3 | 12.1 | 14,187.5 |

Note: CBOT and Chicago prices are in US cts/bushel, Liffe and UK prices are in GBP/tonne, and MATIF and France and Italy prices are in Euro/tonne.

Methods

In this paper, the conditional variance and covariance of spot and future prices (and therefore the optimal hedging ratios) were estimated using a restricted version of the BEKK model, i.e., the diagonal BEKK model (Engle and Kroner, 1995, Chang et al., 2011). The BEKK model is a multivariate generalised autoregressive conditional heteroskedasticity model (MGARCH), which allows model the dynamics of conditional variance and covariance of the series of interest (i.e., in this case the spot price and the nearby futures price) and in addition it has the attractive property that the conditional covariance matrices are positive definite (therefore, the estimation will not produce negative variances).

The choice of restricted version of the BEKK model instead of its full version was not only due to the fact that it is more parsimonious but also because it was found to perform better than the full BEKK model (Chang, 2011). The diagonal BEKK model for MGARCH(1,1), i.e., one lag for the residuals and for the GARCH term, is given by:

$$H_t = C'C + A'\varepsilon_{t-1}\varepsilon'_{t-1}A + B'H_{t-1}B \quad (5)$$

With the parameters matrices defined as (for the bivariate case):

$$C = \begin{bmatrix} c_{11} & 0 \\ c_{21} & c_{22} \end{bmatrix}; A = \begin{bmatrix} a_{11} & 0 \\ 0 & a_{22} \end{bmatrix}; B = \begin{bmatrix} b_{11} & 0 \\ 0 & b_{22} \end{bmatrix}$$

with $a_{ii}^2 + b_{ii}^2 < 1$, $i=1,2$ for stationarity. The conditional means of the model were estimated following Moschini and Myers (2002) as:

$$R_{S,t} = \beta_0 + \beta_1(T-t) + \beta_2D_2 + \beta_3D_4 + \beta_4P_{t-1}^S + \beta_5P_{T,t-1}^F + u_{1t} \quad (6)$$

$$R_{F,t} = \delta_0 + u_{2t} \quad (7)$$

where $P_{T,t}^F$ is the nearby future price at t for delivery at expiration date T , P_t^S is the spot price at t , D_2 and D_4 are quarterly dummies for the 2nd and 4th quarters, $u_{1,t}$ and $u_{2,t}$ are

random shocks. In addition, the model considers the time to maturity (T-t). The returns were computed as the difference of the price series considering a span of 5 days between t and t-1 (i.e., a short-term hedge). The model comprising equations (5), (6) and (7) was estimated by quasi maximum likelihood (Moschini and Myers, 2002).

3. Results and discussion

The starting point of the estimation was checking the data for unit root tests using the Phillips-Perron unit root test. All the prices in levels showed unit roots, while the series in differences were free of them. The market efficiency hypothesis requires that the current futures prices and the future spot price are cointegrated, meaning that futures prices are unbiased predictors of spot prices at maturity (Chang et al., 2011). The Johansen test for cointegration between spot and futures prices showed that the two series were cointegrated and there exists at least one cointegrating vector in all the cases.

Table 2 and Table 3 present the results from the estimation of the models (i.e., one per country). Table 2 presents the results from the conditional means and Table 3 the results for the diagonal BEKK model (where the coloured panels are matrices). The results show that the parameters are in general statistically significant, for both the conditional means and variances.

Table 2. Conditional mean equations

| | | $\beta_0, \bar{\delta}_0$ | β_1 | β_2 | β_3 | β_4 | β_5 |
|--------------|--------|---------------------------|-----------------|---------------|--------------|---------------|--------------|
| US wheat | Spot | 0.004 | -0.00004 | -0.001 | 0.003 | -0.065 | 0.065 |
| | z-test | (1.8) | -(9.5) | -(2.8) | (9.2) | -(42.4) | (41.1) |
| | Nearby | -0.001 | | | | | |
| France wheat | z-test | -(4.4) | | | | | |
| | Spot | -0.048 | 0.00004 | 0.008 | 0.001 | -0.298 | 0.307 |
| | z-test | -(13.8) | (6.8) | (16.8) | (1.5) | -(73.4) | (72.1) |
| Italy wheat | Nearby | 0.000 | | | | | |
| | z-test | (1.5) | | | | | |
| | Spot | 0.069 | -0.00003 | -0.005 | 0.001 | -0.099 | 0.088 |
| UK wheat | z-test | (54.4) | -(14.4) | -(41.2) | (5.8) | -(77.9) | (77.6) |
| | Nearby | 0.000 | | | | | |
| | z-test | -(2.5) | | | | | |
| UK wheat | Spot | 0.000 | 0.0001 | 0.007 | 0.001 | -0.179 | 0.177 |
| | z-test | (0.2) | (21.4) | (19.2) | (3.1) | -(127.7) | (123.9) |
| | Nearby | 0.000 | | | | | |
| | z-test | (0.2) | | | | | |

Notes:

1/ The value of the log likelihood and the Akaike Information Criterion (AIC) is presented in Table 5 and the conditional mean and variance where estimated together.

Note that while the results of the estimations are interesting, the focus of this paper is on the effectiveness of the hedging activity, and in particular whether that effectiveness was affected by the price instability observed after 2007. For this purpose Table 4 was constructed and presents averages for the optimal hedging ratios and the hedging effectiveness for the entire sample and the broken down into two periods: before and since 2007 for all the markets. In addition, it reports statistical tests for differences in the means and variances of the series during the two mentioned periods.

When one considers the means for the optimal hedging ratios for the entire period, the value for the US is significantly higher than the ones for the European Exchanges. Thus, while for the US the ratio is close to 1 (i.e., 0.99), while the highest value for the other

markets is for France (0.53), with Italy and UK exhibiting ratios of 0.17 and 0.28, respectively.

The ranking observed on the optimal hedging ratios is also reflected on the hedging effectiveness reached. Whilst hedging with CBOT reduces the price variability by 77 per cent, the European exchanges only reduces the price variability by 28.2 per cent at most (France).

Table 3. Estimation of the diagonal BEKK model

| Markets | Matrices | | | | | |
|----------------------------|----------|--------|--------|--|---------|--|
| | C | | A | | B | |
| US wheat market | | | | | | |
| Coefficient | 0.006 | | 0.724 | | 0.676 | |
| z-test | (103.3) | | (78.6) | | (187.5) | |
| Coefficient | 0.012 | 0.013 | 0.735 | | 0.636 | |
| z-test | (58.0) | (72.0) | (78.5) | | (162.0) | |
| Log-likelihood | 45,153.7 | | | | | |
| AIC | -9.8 | | | | | |
| France wheat market | | | | | | |
| Coefficient | 0.004 | | 0.846 | | 0.148 | |
| z-test | (4.2) | | (55.7) | | (9.8) | |
| Coefficient | 0.012 | 0.005 | 0.700 | | 0.717 | |
| z-test | (38.8) | (53.4) | (47.2) | | (111.8) | |
| Log-likelihood | 22,076.5 | | | | | |
| AIC | -10.6 | | | | | |
| Italy wheat market | | | | | | |
| Coefficient | 0.003 | | 1.063 | | -0.119 | |
| z-test | (13.5) | | (70.9) | | -(10.1) | |
| Coefficient | 0.003 | 0.003 | 0.705 | | 0.762 | |
| z-test | (13.3) | (41.1) | (57.2) | | (156.0) | |
| Log-likelihood | 24,001.0 | | | | | |
| AIC | -11.6 | | | | | |
| UK wheat market | | | | | | |
| Coefficient | 0.008 | | 0.896 | | -0.108 | |
| z-test | (64.3) | | (68.7) | | -(9.2) | |
| Coefficient | 0.006 | 0.008 | 0.818 | | 0.525 | |
| z-test | (44.2) | (58.4) | (59.9) | | (64.6) | |
| Log-likelihood | 36,095.3 | | | | | |
| AIC | -11.0 | | | | | |

Notes:

1/ AIC stands for Akaike Information Criterion.

The above results of the European exchanges show that they are not sufficiently attractive for firms and coincide with those results from Revoredo-Giha and Zuppiroli (2013).

When one compares the periods before and since 2007 (see Table 4), it is clear that broadly on average the US optimal hedging ratios remained around 1 (0.98 and 1.01 before and since 2007, respectively). In fact, the test for the difference in variances could not reject the hypothesis that the variance of the ratios remained the same, although the t test rejected that average ratios remained the same in both periods.

In contrast with the US case, France, UK and Italy ratios showed statistically significant changes in both their mean and variance for the periods before and after 2007. The average optimal hedging ratio for France and Italy (i.e., using the MATIF exchange) decreased between the two samples from 0.63 to 0.40 and from 0.22 to 0.10, respectively. In the case of the UK, the ratio increase from 0.23 to 0.40, respectively.

The comparison of hedging effectiveness before and since 2007 indicates that these changed in all the countries (in all cases, the tests rejected the hypothesis that the means and variances remained the same). In fact, in most of the cases, there were only slightly increases

in the effectiveness of the hedges (i.e., they remained almost the same). Only in the UK that change was more pronounced as the effectiveness went from 22.9 to 36.6 per cent.

Table 4. Evaluation of hedging strategy

| Market | Optimal hedging ratio | | | | | | | | Hedging effectiveness (%) | | | | | | | |
|--------------|-----------------------|------------|------------|---------|------|---------|------|--|---------------------------|------------|------------|---------|------|---------|------|--|
| | Entire period | Until 2007 | Since 2007 | Test 1/ | Sig. | Test 2/ | Sig. | | Entire period | Until 2007 | Since 2007 | Test 1/ | Sig. | Test 2/ | Sig. | |
| US wheat | 1.01 | 0.99 | 1.07 | 1.4 | 0.0 | 46.0 | 0.0 | | 77.6 | 77.3 | 79.1 | 1.1 | 0.2 | 9.8 | 0.0 | |
| France wheat | 0.61 | 0.70 | 0.50 | 1.7 | 0.0 | 144.9 | 0.0 | | 34.3 | 34.6 | 34.0 | 1.6 | 0.0 | 0.6 | 0.4 | |
| Italy wheat | 0.13 | 0.15 | 0.10 | 3.0 | 0.0 | 7.9 | 0.0 | | 17.9 | 16.3 | 19.9 | 1.4 | 0.0 | 39.8 | 0.0 | |
| UK wheat | 0.34 | 0.33 | 0.35 | 1.6 | 0.0 | 1.3 | 0.2 | | 27.4 | 25.5 | 32.1 | 1.5 | 0.0 | 107.7 | 0.0 | |

Notes:

1/ Test of the hypothesis that variances of the series are equal before and since 2007 (F test).

2/ Test of the hypothesis that the means of the series are equal before and since 2007 (t test).

4. Conclusions

The primary aim of this paper has been to study whether hedging in futures markets can be considered as a useful instrument for price risk reduction for commercial entities operating with commodities along the wheat supply chain. The focus was on two European wheat futures markets, LIFFE and MATIF, using the CBOT market for comparison purposes. In all the cases the data spanned up to the end of 2013.

The results show that in the case of the short-term hedge used in the paper, the US market performs better than the European wheat markets. In fact, the hedging in the US market reduces the price variances of the portfolio by 77 per cent whilst in the European market the reductions are below 30 per cent of the price risk. This result implies that very short-term hedges (1 week only) are not of great utility for participants of the wheat supply chain, except for those firms operating on the US market.

As regards the divorce between the spot and futures market after 2007, it is clear that speculation did not make or made the situation worse, as all the cases showed an increase in the hedging effectiveness (despite the fact that in some cases this is poor). In fact, the results indicate that both prices got closer after 2007.

5. References

- Blank, S., Carter, C. and McDonald, J. (1997). Is The Market Failing Agricultural Producers Who Wish To Manage Risks?, *Contemporary Economic Policy*, 15:103-112.
- Bohl, M., and Stephan, P. (2012). Does Futures Speculation Destabilize Spot Prices? New Evidence for Commodity Markets. Available: at SSRN 1979602, 2012 - papers.ssrn.com
- Chang, C., McAleer, M. and Tansuchat R. (2011). Crude Oil Hedging Strategies using Dynamic Multivariate GARCH. *Energy Economics*, 33: 912-923.
- Engle, R.F. and Kroner, K.F. (1995). Multivariate Simultaneous Generalized ARCH. *Econometric Theory*, 11: 122-150.
- Moschini, G. and Myers, R. J. (2002). Testing for constant hedge ratios in commodity markets: a multivariate GARCH approach, *Journal of Empirical Finance*, 9: 589-603.
- Revoredo-Giha, C. and Zuppiroli, M. (2013). Commodity futures markets: are they an effective price risk management tool for the European wheat supply chain?. *Bio-based and Applied Economics*, 2: 237-255.