A FUNCTIONAL EFFICIENCY INDEX OF ENERGY FUTURES MARKETS

Javier García-Verdugo Sales, Chief Economist, Comisión Nacional de Mercados y Competencia (CNMC)
e-mail: fgarcia-verdugo@cee.uned.es
Meliyara Consuegra Diaz Granados, Research Assistant, Universidad Nacional de Educación a Distancia (UNED)
Phone: (+34) 913986322, e-mail: meliyara@bec.uned.es
Paseo Senda del Rey, 11, 28040 Madrid, Spain

Overview

This research proposes a method to estimate the functional efficiency of energy futures markets in terms of social welfare and analyses the variables that explain its variation. In this paper the functional efficiency of energy futures markets is assessed estimating the social loss derived from allocation errors that are committed when the prices of futures contracts are used as estimators for prices in the physical markets. Therefore, the social welfare associated with the presence of energy futures markets can be measured using a social loss (SL) statistic. The higher the SL statistic the worse the functional efficiency of the market. Considering that this resource misallocation could be closely related to the type and quantity of participants in each market, we evaluate how the SL statistic changes during the study period are related to the changes in the open interest of speculators, commercials and small commercials.

Methods

The basis of the model used in this paper was developed by Stein (1986). This basic model is explained in the first section. Second, we develop the theoretical and empirical indicators for the quantitative estimation of social welfare loss in futures markets. Third, we present the empirical results of the SL statistic for WTI crude oil, heating oil and natural gas contracts traded in the New York Mercantile Exchange (Nymex), for eight maturities with data from April 1992 through December 2012. Then we present the determinants which explain variations in the functional efficiency of energy futures markets, and finally, our concluding remarks.

From the equation $MSE(k) = \frac{1}{n}\sum_{t=1}^{n}[lnp(t+k) - lnq_{t+k}(t)]^2$, we can obtain the SL statistic for the estimation of social welfare loss: $SL(k) = \frac{MSE(k)}{MSE(1)}$. Since the empirical approximation to SL(k) includes squared terms, the absolute differences between the values of the statistic are exaggerated and the informative content of the computed mean of forecast deviations is reduced. Following the method applied by Ma (1989) in his efficiency contrasts, the squared root of the mean squared error can be used as an alternative, so that the SL is calculated as $SL(k) = \frac{RMSE(k)}{RMSE(1)}$.

After finding the results of the SL, we aim to study the determinats of its variations. For each market and period, the dependent variable was the SL(k). The independent variables were the open interest and its components according to the break-down data published by the CFTC (long and short positions held by large and small commercial entities and spectulators) and a measure of the volatility of the underlying commodity spot price.

Results

SL	k=2	k=3	k=4	k=5	k=6	k=7	k=8
Heating oil							
Total	1.19	1.42	1.63	1.84	2.03	2.17	2.31
1992-1996	1.12	1.29	1.44	1.59	1.75	1.90	2.08
1997-2006	1.14	1.30	1.38	1.44	1.48	1.50	1.52
2007-2012	1.37	1.78	2.18	2.55	2.85	3.04	3.16
Natural gas							
Total	1.32	1.50	1.67	1.82	1.93	2.02	2.13
1992-1996	1.27	1.41	1.43	1.45	1.49	1.51	1.53
1997-2006	1.34	1.48	1.65	1.77	1.83	1.91	2.01
2007-2012	1.36	1.64	1.97	2.27	2.49	2.68	2.87
WTI crude oil							
Total	1.62	2.07	2.47	2.80	3.08	3.31	3.46
1992-1996	1.64	2.13	2.37	2.57	2.68	2.71	2.75
1997-2006	1.58	1.94	2.25	2.54	2.85	3.16	3.41
2007-2012	1.66	2.21	2.73	3.13	3.42	3.61	3.70

Conclusions

For almost every year as well as for the whole period 1992-2012, SL statistic values increased for every product with the distance to contract maturity, showing as expected that futures prices see their capacity for prediction reduced when k increases. However, SL values corresponding to natural gas and heating oil contracts increase less markedly with the distance to maturity than those of WTI crude oil futures. More specifically, for the whole period, the SL values of natural gas increased the least (slightly over 61% for values of k between 2 and 8) and those of WTI the most (almost 113% for the same maturities).

Natural gas and heating oil were the futures contracts which, on average, showed less social loss in terms of welfare, i.e. presented a lower value of the statistic SL. WTI future contrats presented the worst SL values of the three markets, showing the highest social loss in terms of welfare.

Heating oil futures contracts presented the lowest values of the SL statistic (less social welfare loss), while WTI futures presented the greatest for all maturities, during the period studied. However, the ranking varies somewhat as k increases. Significantly, the futures contracts whose associated SL values increased most with the time to maturity are usually those that fare worse when considering the absolute SL values and vice versa.

References

Avsar, S.G. and Goss, B.A. (2001), 'Forecast errors and efficiency in the US electricity futures market', Australian Economic Papers 40(4), 479-499.

Brooks, R.D. (1989), 'A Social Loss Approach to Testing the Efficiency of Australian Finanacial Futures', Monash University Dept. of Economics, Working Paper.

Crowder, W.J. and Hamed, A. (1993), 'A cointegration test for oil futures market efficiency', The Journal of Futures Markets 13, 933-941.

Gülen, S. (1998), 'Efficiency in the crude oil futures market', Journal of Energy Finance and Development 3, 13-21.

Hong, B.G. (1989), 'Speculation and Market Performance', PhD thesis, Brown University.

Kawamoto, K. and Hamori, S. (2011), 'Market Efficiency Among Futures With Different Maturities: evidence from the crude oil futures', The Journal of Futures Markets, 31(5), 487-501.

Kumar, M.S. (1991), 'Forecasting Accuracy of Crude Oil Futures Prices', International Monetary Fund Working Paper.

Ma, C.W. (1989), 'Forecasting Efficiency of Energy Futures Prices', Journal of Futures Markets, 5, 393-419.

Maslyuk, S. and Smyth, R. (2009), 'Cointegration between oil spot and futures prices of the same and different grades in the presence of structural change', Energy Policy, 37, 1687-1693.

Pennings, J.M. and Garcia, P. (2010), 'Risk and Hedging behavior: the role and determinants of latent heterogeneity', Journal of financial research XXXIII, No. 4, 373-401.

Peroni, E. and McNown, R. (1998), 'Noninformative and informative tests of efficiency in three energy futures markets', The Journal of Futures Markets 18, No. 8, 939-964.

Pindick, R.S. and Rotemberg, J.J. (1988), 'The excess co-movement of commodity Prices', NBER working paper series, 2671.

Snaders,D.R, Irwin S.H. and Merrin R.P (2010). 'The Adequacy of Speculation in Agricultural Futures Markets: Too Much of a Good Thing?', Applied Economic Perspectives and Policy, 32(1), 77–94.

Stein, J. (1991), 'An Evaluation of the Performance of Speculative Markets', Commodity Futures and Financial Markets, 153-178.

Stein, J. (1986), The Economics of Futures Markets, Basil Blackwell.

Stein, J. (1981), 'Speculative Price: Economic Welfare and the Idiot of Chance', Review of Economics and Statistics, 63 (2), 565-583.

Stevens, J. (2013), 'Testing the efficiency of futures market for crude oil using weighted least squares', Applied Economics Letters, 20(18), 1611-1613.

Switzer, L.N. and El-Khoury, M. (2007), 'Extreme volatility, speculative efficiency, and the hedging effectiveness of the oil futures markets', The Journal of Futures Markets, 27, 61-84.