# Multivariate-GARCH in Hedge Ratio

Several papers have investigated the optimal hedge ratio estimation methodology starting with the Figlewski paper published in 1984. [Baillie and Myers (1991)](http://www.sciencedirect.com/science?_ob=ArticleURL&_udi=B6VGT-4XY5DX4-1&_user=107833&_coverDate=12%2F16%2F2009&_alid=1178695472&_rdoc=10&_orig=search&_cdi=6047&_sort=r&_st=4&_docanchor=&_ct=371&_acct=C000008378&_version=1&_urlVersion=0&_userid=107833&_fmt=full&_pii=S1042443109000535&_issn=10424431&md5=ef9cb821773fabdf7fd6bcca40a9cb89" \l "bib2) estimate the optimal hedge ratio for six different commodities. They show how a bivariate [previous term](http://www.sciencedirect.com/science?_ob=ArticleURL&_udi=B6VGT-4XY5DX4-1&_user=107833&_coverDate=12%2F16%2F2009&_alid=1178695472&_rdoc=10&_orig=search&_cdi=6047&_sort=r&_st=4&_docanchor=&_ct=371&_acct=C000008378&_version=1&_urlVersion=0&_userid=107833&_fmt=full&_pii=S1042443109000535&_issn=10424431&md5=ef9cb821773fabdf7fd6bcca40a9cb89#hit20)GARCH[next term](http://www.sciencedirect.com/science?_ob=ArticleURL&_udi=B6VGT-4XY5DX4-1&_user=107833&_coverDate=12%2F16%2F2009&_alid=1178695472&_rdoc=10&_orig=search&_cdi=6047&_sort=r&_st=4&_docanchor=&_ct=371&_acct=C000008378&_version=1&_urlVersion=0&_userid=107833&_fmt=full&_pii=S1042443109000535&_issn=10424431&md5=ef9cb821773fabdf7fd6bcca40a9cb89#hit22) model can improve hedge ratios estimation in commodity markets and how the assumption of a constant hedge ratio is costly, in terms of higher return variance. [Kroner and Sultan (1993)](http://www.sciencedirect.com/science?_ob=ArticleURL&_udi=B6VGT-4XY5DX4-1&_user=107833&_coverDate=12%2F16%2F2009&_alid=1178695472&_rdoc=10&_orig=search&_cdi=6047&_sort=r&_st=4&_docanchor=&_ct=371&_acct=C000008378&_version=1&_urlVersion=0&_userid=107833&_fmt=full&_pii=S1042443109000535&_issn=10424431&md5=ef9cb821773fabdf7fd6bcca40a9cb89" \l "bib18) estimate the risk minimizing futures hedge ratios with a bivariate Error Correction Model with a [previous term](http://www.sciencedirect.com/science?_ob=ArticleURL&_udi=B6VGT-4XY5DX4-1&_user=107833&_coverDate=12%2F16%2F2009&_alid=1178695472&_rdoc=10&_orig=search&_cdi=6047&_sort=r&_st=4&_docanchor=&_ct=371&_acct=C000008378&_version=1&_urlVersion=0&_userid=107833&_fmt=full&_pii=S1042443109000535&_issn=10424431&md5=ef9cb821773fabdf7fd6bcca40a9cb89#hit21)GARCH[next term](http://www.sciencedirect.com/science?_ob=ArticleURL&_udi=B6VGT-4XY5DX4-1&_user=107833&_coverDate=12%2F16%2F2009&_alid=1178695472&_rdoc=10&_orig=search&_cdi=6047&_sort=r&_st=4&_docanchor=&_ct=371&_acct=C000008378&_version=1&_urlVersion=0&_userid=107833&_fmt=full&_pii=S1042443109000535&_issn=10424431&md5=ef9cb821773fabdf7fd6bcca40a9cb89#hit23) error structure, showing that the [previous term](http://www.sciencedirect.com/science?_ob=ArticleURL&_udi=B6VGT-4XY5DX4-1&_user=107833&_coverDate=12%2F16%2F2009&_alid=1178695472&_rdoc=10&_orig=search&_cdi=6047&_sort=r&_st=4&_docanchor=&_ct=371&_acct=C000008378&_version=1&_urlVersion=0&_userid=107833&_fmt=full&_pii=S1042443109000535&_issn=10424431&md5=ef9cb821773fabdf7fd6bcca40a9cb89#hit22)GARCH[next term](http://www.sciencedirect.com/science?_ob=ArticleURL&_udi=B6VGT-4XY5DX4-1&_user=107833&_coverDate=12%2F16%2F2009&_alid=1178695472&_rdoc=10&_orig=search&_cdi=6047&_sort=r&_st=4&_docanchor=&_ct=371&_acct=C000008378&_version=1&_urlVersion=0&_userid=107833&_fmt=full&_pii=S1042443109000535&_issn=10424431&md5=ef9cb821773fabdf7fd6bcca40a9cb89#hit24) model provides greater risk reduction than traditional models. [Bera et al. (1997)](http://www.sciencedirect.com/science?_ob=ArticleURL&_udi=B6VGT-4XY5DX4-1&_user=107833&_coverDate=12%2F16%2F2009&_alid=1178695472&_rdoc=10&_orig=search&_cdi=6047&_sort=r&_st=4&_docanchor=&_ct=371&_acct=C000008378&_version=1&_urlVersion=0&_userid=107833&_fmt=full&_pii=S1042443109000535&_issn=10424431&md5=ef9cb821773fabdf7fd6bcca40a9cb89" \l "bib3) show how the use of random coefficient autoregressive model allows to improve hedging performance compared to traditional OLS models. The analysis is applied to spot and futures prices of corn and soybeans. [Yang and Awoke, 2003](http://www.sciencedirect.com/science?_ob=ArticleURL&_udi=B6VGT-4XY5DX4-1&_user=107833&_coverDate=12%2F16%2F2009&_alid=1178695472&_rdoc=10&_orig=search&_cdi=6047&_sort=r&_st=4&_docanchor=&_ct=371&_acct=C000008378&_version=1&_urlVersion=0&_userid=107833&_fmt=full&_pii=S1042443109000535&_issn=10424431&md5=ef9cb821773fabdf7fd6bcca40a9cb89" \l "bbib26) J. Yang and T.O. Awoke, Asset storability and hedging effectiveness in commodity futures markets, *Applied Economics Letters* **10** (2003), pp. 487–491. [**Full Text** via CrossRef](http://www.sciencedirect.com/science?_ob=RedirectURL&_method=outwardLink&_partnerName=3&_originPage=article&_zone=art_page&_targetURL=http%3A%2F%2Fdx.doi.org%2F10.1080%252F1350485032000095366&_acct=C000008378&_version=1&_userid=107833&md5=4acdd2c179008329409eba7e17811ce9) | [View Record in Scopus](http://www.sciencedirect.com/science?_ob=RedirectURL&_method=outwardLink&_partnerName=655&_originPage=article&_zone=art_page&_targetURL=http%3A%2F%2Fwww.scopus.com%2Finward%2Frecord.url%3Feid%3D2-s2.0-0042315320%26partnerID%3D10%26rel%3DR3.0.0%26md5%3D33cc8d9a3899405b676ee99c7e0954ff&_acct=C000008378&_version=1&_userid=107833&md5=55e3658a55b9b00b10e90f066a16f58e) | [Cited By in Scopus (7)](http://www.sciencedirect.com/science?_ob=RedirectURL&_method=outwardLink&_partnerName=656&_originPage=article&_zone=art_page&_targetURL=http%3A%2F%2Fwww.scopus.com%2Finward%2Fcitedby.url%3Feid%3D2-s2.0-0042315320%26partnerID%3D10%26rel%3DR3.0.0%26md5%3D33cc8d9a3899405b676ee99c7e0954ff&_acct=C000008378&_version=1&_userid=107833&md5=6874d427d575be009b5876611a75fb93)[Yang and Awoke (2003)](http://www.sciencedirect.com/science?_ob=ArticleURL&_udi=B6VGT-4XY5DX4-1&_user=107833&_coverDate=12%2F16%2F2009&_alid=1178695472&_rdoc=10&_orig=search&_cdi=6047&_sort=r&_st=4&_docanchor=&_ct=371&_acct=C000008378&_version=1&_urlVersion=0&_userid=107833&_fmt=full&_pii=S1042443109000535&_issn=10424431&md5=ef9cb821773fabdf7fd6bcca40a9cb89#bib26) examine the risk hedging effectiveness of different models for major storable and non-storable agricultural commodity futures markets over the period 1997–2001. Using the bivariate [previous term](http://www.sciencedirect.com/science?_ob=ArticleURL&_udi=B6VGT-4XY5DX4-1&_user=107833&_coverDate=12%2F16%2F2009&_alid=1178695472&_rdoc=10&_orig=search&_cdi=6047&_sort=r&_st=4&_docanchor=&_ct=371&_acct=C000008378&_version=1&_urlVersion=0&_userid=107833&_fmt=full&_pii=S1042443109000535&_issn=10424431&md5=ef9cb821773fabdf7fd6bcca40a9cb89#hit23)GARCH[next term](http://www.sciencedirect.com/science?_ob=ArticleURL&_udi=B6VGT-4XY5DX4-1&_user=107833&_coverDate=12%2F16%2F2009&_alid=1178695472&_rdoc=10&_orig=search&_cdi=6047&_sort=r&_st=4&_docanchor=&_ct=371&_acct=C000008378&_version=1&_urlVersion=0&_userid=107833&_fmt=full&_pii=S1042443109000535&_issn=10424431&md5=ef9cb821773fabdf7fd6bcca40a9cb89#hit25) approach they find a strong effectiveness for all storable commodities, unfortunately weaker for non-storable commodities.

[Lien et al. (2002)](http://www.sciencedirect.com/science?_ob=ArticleURL&_udi=B6VGT-4XY5DX4-1&_user=107833&_coverDate=12%2F16%2F2009&_alid=1178695472&_rdoc=10&_orig=search&_cdi=6047&_sort=r&_st=4&_docanchor=&_ct=371&_acct=C000008378&_version=1&_urlVersion=0&_userid=107833&_fmt=full&_pii=S1042443109000535&_issn=10424431&md5=ef9cb821773fabdf7fd6bcca40a9cb89#bib20) compare the performance of hedge ratios estimated using different models on three currency futures contracts, five commodity futures and two stock index futures contracts in the period 1988–1998. Their results show that in general [previous term](http://www.sciencedirect.com/science?_ob=ArticleURL&_udi=B6VGT-4XY5DX4-1&_user=107833&_coverDate=12%2F16%2F2009&_alid=1178695472&_rdoc=10&_orig=search&_cdi=6047&_sort=r&_st=4&_docanchor=&_ct=371&_acct=C000008378&_version=1&_urlVersion=0&_userid=107833&_fmt=full&_pii=S1042443109000535&_issn=10424431&md5=ef9cb821773fabdf7fd6bcca40a9cb89#hit24)GARCH[next term](http://www.sciencedirect.com/science?_ob=ArticleURL&_udi=B6VGT-4XY5DX4-1&_user=107833&_coverDate=12%2F16%2F2009&_alid=1178695472&_rdoc=10&_orig=search&_cdi=6047&_sort=r&_st=4&_docanchor=&_ct=371&_acct=C000008378&_version=1&_urlVersion=0&_userid=107833&_fmt=full&_pii=S1042443109000535&_issn=10424431&md5=ef9cb821773fabdf7fd6bcca40a9cb89#hit26) strategy cannot outperform the OLS hedge strategy. [Rossi and Zucca (2002)](http://www.sciencedirect.com/science?_ob=ArticleURL&_udi=B6VGT-4XY5DX4-1&_user=107833&_coverDate=12%2F16%2F2009&_alid=1178695472&_rdoc=10&_orig=search&_cdi=6047&_sort=r&_st=4&_docanchor=&_ct=371&_acct=C000008378&_version=1&_urlVersion=0&_userid=107833&_fmt=full&_pii=S1042443109000535&_issn=10424431&md5=ef9cb821773fabdf7fd6bcca40a9cb89" \l "bib22) suggest that [previous term](http://www.sciencedirect.com/science?_ob=ArticleURL&_udi=B6VGT-4XY5DX4-1&_user=107833&_coverDate=12%2F16%2F2009&_alid=1178695472&_rdoc=10&_orig=search&_cdi=6047&_sort=r&_st=4&_docanchor=&_ct=371&_acct=C000008378&_version=1&_urlVersion=0&_userid=107833&_fmt=full&_pii=S1042443109000535&_issn=10424431&md5=ef9cb821773fabdf7fd6bcca40a9cb89#hit25)GARCH[next term](http://www.sciencedirect.com/science?_ob=ArticleURL&_udi=B6VGT-4XY5DX4-1&_user=107833&_coverDate=12%2F16%2F2009&_alid=1178695472&_rdoc=10&_orig=search&_cdi=6047&_sort=r&_st=4&_docanchor=&_ct=371&_acct=C000008378&_version=1&_urlVersion=0&_userid=107833&_fmt=full&_pii=S1042443109000535&_issn=10424431&md5=ef9cb821773fabdf7fd6bcca40a9cb89#hit27) hedging strategy is more effective than the traditional methods when applied to a portfolio of Italian fixed income government bonds hedged with futures contracts traded at Liffe. [Brooks et al. (2002)](http://www.sciencedirect.com/science?_ob=ArticleURL&_udi=B6VGT-4XY5DX4-1&_user=107833&_coverDate=12%2F16%2F2009&_alid=1178695472&_rdoc=10&_orig=search&_cdi=6047&_sort=r&_st=4&_docanchor=&_ct=371&_acct=C000008378&_version=1&_urlVersion=0&_userid=107833&_fmt=full&_pii=S1042443109000535&_issn=10424431&md5=ef9cb821773fabdf7fd6bcca40a9cb89" \l "bib6) estimate optimal hedge ratio for the FTSE 100 index and FTSE 100 futures over the period 1985–1999. They find that asymmetric models yield improvements in forecast accuracy in sample but not on hedging performances out of sample. [Copeland and Zhu (2006)](http://www.sciencedirect.com/science?_ob=ArticleURL&_udi=B6VGT-4XY5DX4-1&_user=107833&_coverDate=12%2F16%2F2009&_alid=1178695472&_rdoc=10&_orig=search&_cdi=6047&_sort=r&_st=4&_docanchor=&_ct=371&_acct=C000008378&_version=1&_urlVersion=0&_userid=107833&_fmt=full&_pii=S1042443109000535&_issn=10424431&md5=ef9cb821773fabdf7fd6bcca40a9cb89" \l "bib10) compute dynamic hedge ratios for contracts on the major stock market index of six countries (Australia, Germany, Japan, Korea, UK and USA) from 1995 to 2005. The results are extremely mixed so authors conclude that the more sophisticated model benefits are likely to be very small or even negative.

[Ahmed (2007)](http://www.sciencedirect.com/science?_ob=ArticleURL&_udi=B6VGT-4XY5DX4-1&_user=107833&_coverDate=12%2F16%2F2009&_alid=1178695472&_rdoc=10&_orig=search&_cdi=6047&_sort=r&_st=4&_docanchor=&_ct=371&_acct=C000008378&_version=1&_urlVersion=0&_userid=107833&_fmt=full&_pii=S1042443109000535&_issn=10424431&md5=ef9cb821773fabdf7fd6bcca40a9cb89#bib1) in a study applied to US Treasury Market demonstrates that time varying hedge ratio have superior hedging performances compared to the traditional duration-based constant ratio. Time varying hedge ratio, estimated using CCC-[previous term](http://www.sciencedirect.com/science?_ob=ArticleURL&_udi=B6VGT-4XY5DX4-1&_user=107833&_coverDate=12%2F16%2F2009&_alid=1178695472&_rdoc=10&_orig=search&_cdi=6047&_sort=r&_st=4&_docanchor=&_ct=371&_acct=C000008378&_version=1&_urlVersion=0&_userid=107833&_fmt=full&_pii=S1042443109000535&_issn=10424431&md5=ef9cb821773fabdf7fd6bcca40a9cb89#hit26)GARCH[next term](http://www.sciencedirect.com/science?_ob=ArticleURL&_udi=B6VGT-4XY5DX4-1&_user=107833&_coverDate=12%2F16%2F2009&_alid=1178695472&_rdoc=10&_orig=search&_cdi=6047&_sort=r&_st=4&_docanchor=&_ct=371&_acct=C000008378&_version=1&_urlVersion=0&_userid=107833&_fmt=full&_pii=S1042443109000535&_issn=10424431&md5=ef9cb821773fabdf7fd6bcca40a9cb89#hit28) shows a clear advantage in minimizing the variance of portfolio returns over a period of 10 years. [Ku et al. (2007)](http://www.sciencedirect.com/science?_ob=ArticleURL&_udi=B6VGT-4XY5DX4-1&_user=107833&_coverDate=12%2F16%2F2009&_alid=1178695472&_rdoc=10&_orig=search&_cdi=6047&_sort=r&_st=4&_docanchor=&_ct=371&_acct=C000008378&_version=1&_urlVersion=0&_userid=107833&_fmt=full&_pii=S1042443109000535&_issn=10424431&md5=ef9cb821773fabdf7fd6bcca40a9cb89" \l "bib19) apply dynamic conditional correlations [previous term](http://www.sciencedirect.com/science?_ob=ArticleURL&_udi=B6VGT-4XY5DX4-1&_user=107833&_coverDate=12%2F16%2F2009&_alid=1178695472&_rdoc=10&_orig=search&_cdi=6047&_sort=r&_st=4&_docanchor=&_ct=371&_acct=C000008378&_version=1&_urlVersion=0&_userid=107833&_fmt=full&_pii=S1042443109000535&_issn=10424431&md5=ef9cb821773fabdf7fd6bcca40a9cb89#hit27)GARCH[next term](http://www.sciencedirect.com/science?_ob=ArticleURL&_udi=B6VGT-4XY5DX4-1&_user=107833&_coverDate=12%2F16%2F2009&_alid=1178695472&_rdoc=10&_orig=search&_cdi=6047&_sort=r&_st=4&_docanchor=&_ct=371&_acct=C000008378&_version=1&_urlVersion=0&_userid=107833&_fmt=full&_pii=S1042443109000535&_issn=10424431&md5=ef9cb821773fabdf7fd6bcca40a9cb89#hit29) models to estimate fluctuations that distinguish futures markets. DCC shows the best hedging performance both in the Japanese and the British futures markets. [Kenourgios et al. (2008)](http://www.sciencedirect.com/science?_ob=ArticleURL&_udi=B6VGT-4XY5DX4-1&_user=107833&_coverDate=12%2F16%2F2009&_alid=1178695472&_rdoc=10&_orig=search&_cdi=6047&_sort=r&_st=4&_docanchor=&_ct=371&_acct=C000008378&_version=1&_urlVersion=0&_userid=107833&_fmt=full&_pii=S1042443109000535&_issn=10424431&md5=ef9cb821773fabdf7fd6bcca40a9cb89" \l "bib16) show that, compared to OLS, the Error Correction Model provides better results in terms of risk reduction, forecasts and stability of the estimated hedge ratio. They apply their analysis to stock portfolios and the S&P500 futures contract for the period 1992–2002.

[Chiang et al. (2007)](http://www.sciencedirect.com/science?_ob=ArticleURL&_udi=B6VGT-4XY5DX4-1&_user=107833&_coverDate=12%2F16%2F2009&_alid=1178695472&_rdoc=10&_orig=search&_cdi=6047&_sort=r&_st=4&_docanchor=&_ct=371&_acct=C000008378&_version=1&_urlVersion=0&_userid=107833&_fmt=full&_pii=S1042443109000535&_issn=10424431&md5=ef9cb821773fabdf7fd6bcca40a9cb89#bib8) implement a model based on DCC to study whether there is a contagion effect in Asian equity markets. They show that the DCC model is able to catch the dynamic behaviour of stock return correlations, more than other approaches. With a similar approach, [Savva (2009)](http://www.sciencedirect.com/science?_ob=ArticleURL&_udi=B6VGT-4XY5DX4-1&_user=107833&_coverDate=12%2F16%2F2009&_alid=1178695472&_rdoc=10&_orig=search&_cdi=6047&_sort=r&_st=4&_docanchor=&_ct=371&_acct=C000008378&_version=1&_urlVersion=0&_userid=107833&_fmt=full&_pii=S1042443109000535&_issn=10424431&md5=ef9cb821773fabdf7fd6bcca40a9cb89" \l "bib23) estimates price, volatility linkage effects and correlation coefficients from the US equity market to the European ones and vice versa, after the euro introduction. DCC models are preferable to alternative methods for the skewness characterizing the stock returns. Focusing on electricity markets there are some papers investigating the effectiveness of hedging strategies performed using different hedge ratios model estimation or that apply [previous term](http://www.sciencedirect.com/science?_ob=ArticleURL&_udi=B6VGT-4XY5DX4-1&_user=107833&_coverDate=12%2F16%2F2009&_alid=1178695472&_rdoc=10&_orig=search&_cdi=6047&_sort=r&_st=4&_docanchor=&_ct=371&_acct=C000008378&_version=1&_urlVersion=0&_userid=107833&_fmt=full&_pii=S1042443109000535&_issn=10424431&md5=ef9cb821773fabdf7fd6bcca40a9cb89#hit28)GARCH[next term](http://www.sciencedirect.com/science?_ob=ArticleURL&_udi=B6VGT-4XY5DX4-1&_user=107833&_coverDate=12%2F16%2F2009&_alid=1178695472&_rdoc=10&_orig=search&_cdi=6047&_sort=r&_st=4&_docanchor=&_ct=371&_acct=C000008378&_version=1&_urlVersion=0&_userid=107833&_fmt=full&_pii=S1042443109000535&_issn=10424431&md5=ef9cb821773fabdf7fd6bcca40a9cb89#hit30) models to investigate statistical properties of electricity prices. [Escribano et al. (2002)](http://www.sciencedirect.com/science?_ob=ArticleURL&_udi=B6VGT-4XY5DX4-1&_user=107833&_coverDate=12%2F16%2F2009&_alid=1178695472&_rdoc=10&_orig=search&_cdi=6047&_sort=r&_st=4&_docanchor=&_ct=371&_acct=C000008378&_version=1&_urlVersion=0&_userid=107833&_fmt=full&_pii=S1042443109000535&_issn=10424431&md5=ef9cb821773fabdf7fd6bcca40a9cb89" \l "bib15) use six different [previous term](http://www.sciencedirect.com/science?_ob=ArticleURL&_udi=B6VGT-4XY5DX4-1&_user=107833&_coverDate=12%2F16%2F2009&_alid=1178695472&_rdoc=10&_orig=search&_cdi=6047&_sort=r&_st=4&_docanchor=&_ct=371&_acct=C000008378&_version=1&_urlVersion=0&_userid=107833&_fmt=full&_pii=S1042443109000535&_issn=10424431&md5=ef9cb821773fabdf7fd6bcca40a9cb89#hit29)GARCH[next term](http://www.sciencedirect.com/science?_ob=ArticleURL&_udi=B6VGT-4XY5DX4-1&_user=107833&_coverDate=12%2F16%2F2009&_alid=1178695472&_rdoc=10&_orig=search&_cdi=6047&_sort=r&_st=4&_docanchor=&_ct=371&_acct=C000008378&_version=1&_urlVersion=0&_userid=107833&_fmt=full&_pii=S1042443109000535&_issn=10424431&md5=ef9cb821773fabdf7fd6bcca40a9cb89#hit31) models to study mean reversion, [previous term](http://www.sciencedirect.com/science?_ob=ArticleURL&_udi=B6VGT-4XY5DX4-1&_user=107833&_coverDate=12%2F16%2F2009&_alid=1178695472&_rdoc=10&_orig=search&_cdi=6047&_sort=r&_st=4&_docanchor=&_ct=371&_acct=C000008378&_version=1&_urlVersion=0&_userid=107833&_fmt=full&_pii=S1042443109000535&_issn=10424431&md5=ef9cb821773fabdf7fd6bcca40a9cb89#hit30)GARCH[next term](http://www.sciencedirect.com/science?_ob=ArticleURL&_udi=B6VGT-4XY5DX4-1&_user=107833&_coverDate=12%2F16%2F2009&_alid=1178695472&_rdoc=10&_orig=search&_cdi=6047&_sort=r&_st=4&_docanchor=&_ct=371&_acct=C000008378&_version=1&_urlVersion=0&_userid=107833&_fmt=full&_pii=S1042443109000535&_issn=10424431&md5=ef9cb821773fabdf7fd6bcca40a9cb89#hit32) behaviour and time-dependent jumps of spot electricity prices of five markets (Argentina, Australia, New Zealand, Nord Pool, and Spain). [Bystrom, 2003](http://www.sciencedirect.com/science?_ob=ArticleURL&_udi=B6VGT-4XY5DX4-1&_user=107833&_coverDate=12%2F16%2F2009&_alid=1178695472&_rdoc=10&_orig=search&_cdi=6047&_sort=r&_st=4&_docanchor=&_ct=371&_acct=C000008378&_version=1&_urlVersion=0&_userid=107833&_fmt=full&_pii=S1042443109000535&_issn=10424431&md5=ef9cb821773fabdf7fd6bcca40a9cb89" \l "bbib7) H.N.E. Bystrom, The hedging performance of electricity futures on the Nordic power exchange, *Applied Economics* **35** (2003), pp. 1–11. [View Record in Scopus](http://www.sciencedirect.com/science?_ob=RedirectURL&_method=outwardLink&_partnerName=655&_originPage=article&_zone=art_page&_targetURL=http%3A%2F%2Fwww.scopus.com%2Finward%2Frecord.url%3Feid%3D2-s2.0-0037428277%26partnerID%3D10%26rel%3DR3.0.0%26md5%3D3dbc36cec3554277fd77b0355fd12534&_acct=C000008378&_version=1&_userid=107833&md5=ab8915a803ad324f134b83bd7153f9c1) | [Cited By in Scopus (22)](http://www.sciencedirect.com/science?_ob=RedirectURL&_method=outwardLink&_partnerName=656&_originPage=article&_zone=art_page&_targetURL=http%3A%2F%2Fwww.scopus.com%2Finward%2Fcitedby.url%3Feid%3D2-s2.0-0037428277%26partnerID%3D10%26rel%3DR3.0.0%26md5%3D3dbc36cec3554277fd77b0355fd12534&_acct=C000008378&_version=1&_userid=107833&md5=67c4cfaa9ec4bf07616b2932b71e269d)[Bystrom (2003)](http://www.sciencedirect.com/science?_ob=ArticleURL&_udi=B6VGT-4XY5DX4-1&_user=107833&_coverDate=12%2F16%2F2009&_alid=1178695472&_rdoc=10&_orig=search&_cdi=6047&_sort=r&_st=4&_docanchor=&_ct=371&_acct=C000008378&_version=1&_urlVersion=0&_userid=107833&_fmt=full&_pii=S1042443109000535&_issn=10424431&md5=ef9cb821773fabdf7fd6bcca40a9cb89#bib7) analyses variances and covariances of Nord Pool electricity price returns over the period 1996–1999. He compares traditional models with the constant correlation bivariate [previous term](http://www.sciencedirect.com/science?_ob=ArticleURL&_udi=B6VGT-4XY5DX4-1&_user=107833&_coverDate=12%2F16%2F2009&_alid=1178695472&_rdoc=10&_orig=search&_cdi=6047&_sort=r&_st=4&_docanchor=&_ct=371&_acct=C000008378&_version=1&_urlVersion=0&_userid=107833&_fmt=full&_pii=S1042443109000535&_issn=10424431&md5=ef9cb821773fabdf7fd6bcca40a9cb89#hit31)GARCH and the Orthogonal GARCH[next term](http://www.sciencedirect.com/science?_ob=ArticleURL&_udi=B6VGT-4XY5DX4-1&_user=107833&_coverDate=12%2F16%2F2009&_alid=1178695472&_rdoc=10&_orig=search&_cdi=6047&_sort=r&_st=4&_docanchor=&_ct=371&_acct=C000008378&_version=1&_urlVersion=0&_userid=107833&_fmt=full&_pii=S1042443109000535&_issn=10424431&md5=ef9cb821773fabdf7fd6bcca40a9cb89#hit33) model ([Ding, 1994](http://www.sciencedirect.com/science?_ob=ArticleURL&_udi=B6VGT-4XY5DX4-1&_user=107833&_coverDate=12%2F16%2F2009&_alid=1178695472&_rdoc=10&_orig=search&_cdi=6047&_sort=r&_st=4&_docanchor=&_ct=371&_acct=C000008378&_version=1&_urlVersion=0&_userid=107833&_fmt=full&_pii=S1042443109000535&_issn=10424431&md5=ef9cb821773fabdf7fd6bcca40a9cb89" \l "bib11)). Short term hedging of electricity spot prices with electricity futures reduces the variability of the portfolio returns. However the traditional hedging models perform as well as more elaborated models when the performances of hedging are evaluated on the basis of their ability to reduce the portfolio variance. [Malo and Kanto (2005)](http://www.sciencedirect.com/science?_ob=ArticleURL&_udi=B6VGT-4XY5DX4-1&_user=107833&_coverDate=12%2F16%2F2009&_alid=1178695472&_rdoc=10&_orig=search&_cdi=6047&_sort=r&_st=4&_docanchor=&_ct=371&_acct=C000008378&_version=1&_urlVersion=0&_userid=107833&_fmt=full&_pii=S1042443109000535&_issn=10424431&md5=ef9cb821773fabdf7fd6bcca40a9cb89" \l "bib21) compare the hedging performances of a broader range of multivariate [previous term](http://www.sciencedirect.com/science?_ob=ArticleURL&_udi=B6VGT-4XY5DX4-1&_user=107833&_coverDate=12%2F16%2F2009&_alid=1178695472&_rdoc=10&_orig=search&_cdi=6047&_sort=r&_st=4&_docanchor=&_ct=371&_acct=C000008378&_version=1&_urlVersion=0&_userid=107833&_fmt=full&_pii=S1042443109000535&_issn=10424431&md5=ef9cb821773fabdf7fd6bcca40a9cb89#hit32)GARCH[next term](http://www.sciencedirect.com/science?_ob=ArticleURL&_udi=B6VGT-4XY5DX4-1&_user=107833&_coverDate=12%2F16%2F2009&_alid=1178695472&_rdoc=10&_orig=search&_cdi=6047&_sort=r&_st=4&_docanchor=&_ct=371&_acct=C000008378&_version=1&_urlVersion=0&_userid=107833&_fmt=full&_pii=S1042443109000535&_issn=10424431&md5=ef9cb821773fabdf7fd6bcca40a9cb89#hit34) models to check the robustness of the selected models.

[Wickens and Wimschulte (2007)](http://www.sciencedirect.com/science?_ob=ArticleURL&_udi=B6VGT-4XY5DX4-1&_user=107833&_coverDate=12%2F16%2F2009&_alid=1178695472&_rdoc=10&_orig=search&_cdi=6047&_sort=r&_st=4&_docanchor=&_ct=371&_acct=C000008378&_version=1&_urlVersion=0&_userid=107833&_fmt=full&_pii=S1042443109000535&_issn=10424431&md5=ef9cb821773fabdf7fd6bcca40a9cb89#bib25) make evident that EEX electricity prices suffer of biases, generally due to the spot price level and the remaining time to maturity of futures. According to the authors, there is not an outstanding model able to reduce residuals in forecasting price changes.[Koopman et al. (2007)](http://www.sciencedirect.com/science?_ob=ArticleURL&_udi=B6VGT-4XY5DX4-1&_user=107833&_coverDate=12%2F16%2F2009&_alid=1178695472&_rdoc=10&_orig=search&_cdi=6047&_sort=r&_st=4&_docanchor=&_ct=371&_acct=C000008378&_version=1&_urlVersion=0&_userid=107833&_fmt=full&_pii=S1042443109000535&_issn=10424431&md5=ef9cb821773fabdf7fd6bcca40a9cb89" \l "bib17) show how conditional [previous term](http://www.sciencedirect.com/science?_ob=ArticleURL&_udi=B6VGT-4XY5DX4-1&_user=107833&_coverDate=12%2F16%2F2009&_alid=1178695472&_rdoc=10&_orig=search&_cdi=6047&_sort=r&_st=4&_docanchor=&_ct=371&_acct=C000008378&_version=1&_urlVersion=0&_userid=107833&_fmt=full&_pii=S1042443109000535&_issn=10424431&md5=ef9cb821773fabdf7fd6bcca40a9cb89#hit33)GARCH[next term](http://www.sciencedirect.com/science?_ob=ArticleURL&_udi=B6VGT-4XY5DX4-1&_user=107833&_coverDate=12%2F16%2F2009&_alid=1178695472&_rdoc=10&_orig=search&_cdi=6047&_sort=r&_st=4&_docanchor=&_ct=371&_acct=C000008378&_version=1&_urlVersion=0&_userid=107833&_fmt=full&_pii=S1042443109000535&_issn=10424431&md5=ef9cb821773fabdf7fd6bcca40a9cb89#hit35) models allow to model the day of the week periodicity in the autocovariance function of electricity spot prices on Nord Pool, EEX, Powernext and APX.

[Torró (2008)](http://www.sciencedirect.com/science?_ob=ArticleURL&_udi=B6VGT-4XY5DX4-1&_user=107833&_coverDate=12%2F16%2F2009&_alid=1178695472&_rdoc=10&_orig=search&_cdi=6047&_sort=r&_st=4&_docanchor=&_ct=371&_acct=C000008378&_version=1&_urlVersion=0&_userid=107833&_fmt=full&_pii=S1042443109000535&_issn=10424431&md5=ef9cb821773fabdf7fd6bcca40a9cb89#bib24) demonstrates that Nord Pool electricity prices are characterized by particular statistical features, particularly a low correlation between spot and futures prices, due to high volatility and kurtosis, and no storability property of the underlying which avoids the cash-and-carry relation. This means that hedging strategies could generate ineffective performances, unless more sophisticated models are applied. Torró obtains a better performance employing the [Ederington and Salas (2008)](http://www.sciencedirect.com/science?_ob=ArticleURL&_udi=B6VGT-4XY5DX4-1&_user=107833&_coverDate=12%2F16%2F2009&_alid=1178695472&_rdoc=10&_orig=search&_cdi=6047&_sort=r&_st=4&_docanchor=&_ct=371&_acct=C000008378&_version=1&_urlVersion=0&_userid=107833&_fmt=full&_pii=S1042443109000535&_issn=10424431&md5=ef9cb821773fabdf7fd6bcca40a9cb89" \l "bib12) model, in order to minimize the hedge ratio variance by the spot price forecast, assuming the spot price changes in the electricity market are partially predictable.