



Short-run deviations and time-varying hedge ratios: Evidence from agricultural futures markets[☆]

Taufiq Choudhry^{*}

School of Management, University of Southampton, Highfield, Southampton SO17 1BJ, UK

ARTICLE INFO

Article history:

Received 28 March 2007

Received in revised form 17 July 2008

Accepted 21 November 2008

Available online 3 December 2008

JEL classification:

G1

G13

G15

Keywords:

Hedge ratio

GARCH

BEKK GARCH

GARCH-X

BEKK GARCH-X and variance

ABSTRACT

This paper investigates the hedging effectiveness of time-varying hedge ratios in the agricultural commodities futures markets using four different versions of the GARCH models. The GARCH models applied are the standard bivariate GARCH, the bivariate BEKK GARCH, the bivariate GARCH-X and the bivariate BEKK GARCH-X. Futures data for corn, coffee, wheat, sugar, soybeans, live cattle and hogs are applied. Comparison of the hedging effectiveness is done for the within sample period (1980–2004), and two out-of-sample periods (2002–2004 and 2003–2004). Results indicate superior performance of the portfolios based on the GARCH-X model estimated hedge ratio during all periods.

© 2008 Elsevier Inc. All rights reserved.

1. Introduction

Transfer of risk is one of the main functions of the futures markets. Risks are transferred to those willing to bear them, as hedgers reduce their risk by paying a premium to speculators. For agricultural commodities, risk may occur due to drought, near record production, an increase in demand, a decrease in international production, etc. Hedging by the agricultural producers generally involves selling the commodity futures because producers of the commodity want to lock in a price floor. Simultaneously speculators and investors looking to lock in a price ceiling are buying the contract. The commodity futures markets thus provide a means to transfer risk between persons holding the physical commodity (hedgers) and investors speculating in the market.¹ This paper empirically investigates the hedging effectiveness in the agricultural commodity futures' market. Our paper is motivated by Yang and Awokuse (2003) who indicated that knowledge of how

effective hedging function performs on the commodity futures market is essential to understanding these markets.

This paper tries to expand the knowledge in this area by investigating and comparing the risk-reducing ability of different optimal time-varying hedge ratios for the futures of seven agricultural commodities: corn, coffee, wheat, sugar, soybeans, live cattle and hogs. An optimal hedge ratio is defined as the proportion of a cash position that should be covered with an opposite position on a futures market. Corn, coffee, wheat, sugar, and soybeans are storable commodities and live cattle and hogs are non-storable commodities.² According to Covey and Bessler (1995) commodity futures markets with different storability characteristics may perform in different manners. Yang and Awokuse (2003) provide some proof of it by showing that hedging effectiveness is stronger for storable agricultural commodities than non-storable commodities.

The traditional constant hedge ratio obtained by means of the ordinary least square (OLS) has been discarded as being inappropriate, because it ignores the heteroskedasticity often encountered in price series. Baillie and Myers (1991) further claim that if the joint distribution of cash price and futures prices is changing over time, estimating a constant hedge ratio may not be appropriate. In this paper time-varying hedge ratios are estimated and employed. They

[☆] The author thanks two anonymous referees and the editor for several useful comments and suggestions. The author also thanks the participants of the European Financial Management Association conference 2006 Madrid, Spain for valuable comments and suggestions on an earlier draft of the paper. Any remaining errors and omissions are the author's responsibility alone.

^{*} Tel.: +44 2380599286; fax: +44 2380593844.

E-mail address: T.Choudhry@soton.ac.uk.

¹ Brorsen and Fofana (2001) provide and discuss several characteristics as important to the success or failure of agricultural commodities futures contracts.

² According to Covey and Bessler (1995) no asset is perfectly storable or non-storable. An asset with minimum storage costs is an asset which does not easily spoil and can be stored cheaply relative to its value.

are estimated using four different types of the generalized autoregressive conditional heteroskedasticity (GARCH) models: the standard bivariate GARCH, bivariate BEKK GARCH, the bivariate GARCH-X, and the bivariate BEKK GARCH-X.³ Haigh and Holt (2002), Bera, Garcia, and Roh (1997), Sephton (1993), Baillie and Myers (1991) and Myers (1991) using agricultural commodities futures show that GARCH hedge ratios are superior to the ones based on the traditional regressions.

The GARCH-X and the BEKK GARCH-X models applied in this paper are different from the other two GARCH models because they take into consideration the effects of the short-run deviations from the long-run relationship between the cash and futures prices on the conditional variance and covariance (second conditional moments of the bivariate distribution) of log difference of the cash and the futures prices. The BEKK GARCH and the BEKK GARCH-X models are also unique because they allow time variation in the conditional correlations as well as the conditional variance. To our knowledge, no other paper applies the GARCH-X and/or the BEKK GARCH-X in the estimation and comparison of time-varying hedge ratios for agricultural futures market. All GARCH methods applied take into consideration the effects of the short-run deviations on the first moment (mean) of the bivariate distributions of the variables.

If the four time-varying hedge ratios are different, then more than one interesting question arises: first, which method is more effective? And second, does taking into consideration the effects of the short-run deviations make the hedge ratio more effective? A further inquiry and contribution of this paper is comparing the strength of the hedging effectiveness for storable commodities against the non-storable commodities, especially talking into consideration the short-run deviations.

The short-run deviations are represented by the error correction term from a cointegration relationship between the commodities cash and the futures prices.⁴ Long-run relationship between the commodities cash price and the futures price is determined by means of the Engle and Granger (1987) cointegration test. Yang, Bessler, and Leatham (2001) claim that prevalent cointegration between cash and futures prices on commodity markets suggest that cointegration should be incorporated into commodity hedging decisions.⁵ Even when the GARCH effect is considered, allowance for the existence of cointegration is argued to be an indispensable component when comparing ex-post performance of various hedging strategies. To check for the effects of cointegration on hedging effectiveness in agricultural futures markets via the GARCH-X and BEKK-X is one of the main objectives of the paper.

The risk-reducing effectiveness of the time-varying hedge ratios is investigated by checking performance of the ratios in the within sample period (1980–2004) and two out-of-sample periods (2002–2004 and 2003–2004). The hedging effectiveness is estimated and compared by checking the variance of the portfolios created using these hedge ratios. The lower the variance of the portfolio, the higher is the hedging effectiveness of the hedge ratio.

The structure of the paper is as follows: Section 2 describes and discusses the optimal hedge ratio and the four GARCH models; the data and its basic statistics are described in Section 3; the empirical results are presented in Section 4; and Section 5 is the conclusion.

2. Optimal hedge ratios and the GARCH models

2.1. The hedge ratio

The returns on the portfolio of an investor trying to hedge some proportion of the cash position in a futures market can be represented by:

$$r_t = r_t^c - \beta_{t-1} r_t^f \quad (1)$$

where r_t is the return on holding the portfolio between $t-1$ and t ; r_t^c is the return on holding the cash position for the same period; r_t^f is the return on holding the futures position for the same period; and β_{t-1} is the hedge ratio. The variance of the return on the hedged portfolio is given by

$$V_t = V_t^c - \beta_{t-1}^2 V_t^f - 2\beta_{t-1} V_t^{cf} \quad (2)$$

where V_t , V_t^c , V_t^f , represent the conditional variances of the portfolio, cash and futures positions respectively, while V_t^{cf} represents conditional covariance between the cash and futures position.

The value of β_{t-1} , which minimises the conditional variance of the hedged portfolio return (Eq. (2)), is the optimal hedge ratio (Baillie and Myers, 1991).⁶ It is given by:

$$\beta_{t-1} = V_t^{cf} / V_t^f \quad (3)$$

Commonly, the value of the hedge ratio is less than unity, so that the hedge ratio that minimises risk in the absence of basis risk turns out to be dominated by β when basis risk is taken into consideration.⁷

Time-varying optimal hedge ratio can also be based on utility maximization. Based on Myers (1991), under this scenario an individual investor wants to determine the optimal allocation of initial wealth between two investment opportunities: purchase of a risky asset, and purchase of a risk-free asset. There is a futures market in the risky asset and the investor can therefore hedge by selling contracts which mature at or after the period. Using the von Neumann–Morgenstern utility function and a time-varying conditional covariance, Myers (1991) is able to show that optimal hedge ratio is equal to the one presented by Eq. (3). In this model, it is assumed that optimal hedge ratio is preference-free but the demand for the asset depends upon investor risk preferences, as well as on the probability distribution of asset price.

Brorsen (1995) presents a different theory of hedging involving agricultural commodities which assumes that producers are risk neutral, forward pricing is costly, and that borrowing costs are nonlinear. With nonlinear borrowing costs, highly leveraged farm firms hedge more than low leveraged firms and optimal hedge ratios increase as output price variability increases. Thus, according to Brorsen (1995) the presence of risk-averse preferences is not required for future markets to exist. Turvey and Baker (1989) provide an expected utility model of optimal hedging that explicitly takes into consideration that capital structure of the farm firm. They show that hedging increases as farms debt relative to assets increases. This is because the farmer's use of the futures, which decreases business risk, offsets to some extent the increased financial risk due to leverage.

³ See Choudhry, 2004; Moschini and Myers, 2002; Baillie and Myers, 1991; Kroner and Sultan, 1993 for application of the ARCH and GARCH models in estimation of time-varying hedge ratios.

⁴ Baillie and Myers (1991), Covey and Bessler (1992), Fortenbery and Zapata (1993, 1997) provide studies of cointegration between commodities spot and future prices.

⁵ Ghosh (1995), Ghosh and Clayton (1996) and Kroner and Sultan (1993) have shown that hedge ratios and hedging performance may change considerably if cointegration between the cash and futures prices is omitted from the statistical models and estimations.

⁶ As indicated by Cecchetti et al. (1988), the return on a hedged position will normally be exposed to risk caused by unanticipated changes in the relative price between the position being hedged and the futures contract. This 'basis risk' ensures that no hedge ratio completely eliminates risk.

⁷ According to Cecchetti et al. (1988), the optimal hedge ratio β can be expressed as $\rho\sigma^c/\sigma^f$, where ρ is the correlation between futures price and cash price, σ^c is the cash standard deviation, and σ^f is the futures standard deviation. Thus, if the futures have the same or higher price volatility than the cash, the hedge ratio can be no greater than the correlation between them, which will be less than unity.

متن کامل مقاله

دریافت فوری ←

ISIArticles

مرجع مقالات تخصصی ایران

- ✓ امکان دانلود نسخه تمام متن مقالات انگلیسی
- ✓ امکان دانلود نسخه ترجمه شده مقالات
- ✓ پذیرش سفارش ترجمه تخصصی
- ✓ امکان جستجو در آرشیو جامعی از صدها موضوع و هزاران مقاله
- ✓ امکان دانلود رایگان ۲ صفحه اول هر مقاله
- ✓ امکان پرداخت اینترنتی با کلیه کارت های عضو شتاب
- ✓ دانلود فوری مقاله پس از پرداخت آنلاین
- ✓ پشتیبانی کامل خرید با بهره مندی از سیستم هوشمند رهگیری سفارشات