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Optimal hedging under departures from the cost-of-carry valuation: Evidence from the Spanish stock index futures market

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Abstract

We provide an analytical discussion of the optimal hedge ratio under discrepancies between the futures market price and its theoretical valuation according to the cost-of-carry model. Assuming a geometric Brownian motion for spot prices, we model mispricing as a specific noise component in the dynamics of futures market prices. Empirical evidence on the model is provided for the Spanish stock index futures. Ex-ante simulations with actual data reveal that hedge ratios that take into account the estimated, time varying, correlation between the common and specific disturbances, lead to using a lower number of futures contracts than under a systematic unit ratio, without generally losing hedging effectiveness, while reducing transaction costs and capital requirements. Besides, the reduction in the number of contracts can be substantial over some periods. Finally, a mean–variance expected utility function suggests that the economic benefits from an optimal hedge can be substantial.

JEL classification: C51; G11; G13
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1. Introduction

Since its launching in January 1992, the Ibex 35 futures contract quickly became the most actively traded derivative contract in *Meff Renta Variable*, the Spanish

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equity derivatives exchange. In fact, the futures market on the Spanish Ibex 35 stock index is also one of the most active futures stock index markets in the world. Acceptance of a market for a stock index futures contract is related to the hedging ability of this derivative instrument. Operating with futures, it is not only possible to guarantee a certain profit, but to also bound the losses obtained over a given time period. Hedging spot positions in the Spanish stock market became especially relevant in recent years, because the systematic decrease in interest rates as a consequence of the fiscal and monetary policies aimed to achieve the European Union, caused a dramatic reallocation of private savings from riskless assets to stock exchange positions.

The relevant issue in a hedging operation is to determine the hedge ratio, which provides the number of futures contracts that must be sold to counteract the opposite evolution in spot prices, so that, the potential losses in one market can be offset by the gains obtained in the other. A biased estimation of the hedge ratio implies that the losses in one market will be higher or lower than the profits in the other one. This is troublesome for a hedging strategy, whose aim is to transform a position in the spot market into a riskless portfolio.

According to the cost-of-carry valuation (the standard forward pricing model), which assumes perfect markets and non-stochastic interest rates and dividend yields, the theoretical price at time t ($F^*_{t,T}$) of an index futures contract maturing at time T equals the opportunity cost of keeping a basket replicating the spot index between t and T:

$$F^*_{t,T} = S_t \mathrm{e}^{(r-d)(T-t)}, \tag{1}$$

where S_t is the index value and $(r-d)$ is the net cost of carry associated to the underlying stocks in the index, i.e., the riskless rate of return minus the dividend yield of the stocks in the index. Alternatively, Eq. (1) can be written

$$r_{s,t} = r_{f^*,t} + (r-d), \tag{2}$$

where $r_{s,t} = \ln(S_t/S_{t-1})$ and $r_{f^*,t} = \ln(F^*_{t,T}/F^*_{t-1,T})$, the spot and theoretical futures returns, respectively. Under the previous assumptions, the relationship in (2) implies that: (a) the variance of returns in the spot market equals the variance of returns in the futures market, (b) the contemporaneous rates of return of the underlying stock index and the futures contract are perfectly and positively correlated, and (c) the non-contemporaneous rates of return are uncorrelated and no lead–lag relationships between returns should appear. However, in the presence of market imperfections such as transactions costs, asymmetric information, capital requirements and short-selling restrictions, there could be discrepancies between the traded futures price and its theoretical valuation according to the cost-of-carry model (see Mackinlay and Ramaswamy, 1988; Lim, 1992; Miller et al., 1994; Yadav and Pope, 1990, 1994; Bühler and Kempf, 1995; among others).

Market imperfections may also produce a lead–lag relationship between spot and futures market returns, as well as between their volatilities. Then, it may be possible to anticipate price movements and risk fluctuations in one market from past information in the other market, a relevant question when using the futures contract as