REALISED HEDGE RATIO PROPERTIES, PERFORMANCE AND IMPLICATIONS FOR RISK MANAGEMENT: EVIDENCE FROM THE SPANISH IBEX 35 SPOT AND FUTURES MARKETS

DAVID G MCMILLAN
RAQUEL QUIROGA GARCÍA
De conformidad con la base quinta de la convocatoria del Programa de Estímulo a la Investigación, este trabajo ha sido sometido a evaluación externa anónima de especialistas cualificados a fin de contrastar su nivel técnico.

ISSN: 1988-8767

La serie DOCUMENTOS DE TRABAJO incluye avances y resultados de investigaciones dentro de los programas de la Fundación de las Cajas de Ahorros. Las opiniones son responsabilidad de los autores.
REALISED HEDGE RATIO PROPERTIES, PERFORMANCE AND IMPLICATIONS FOR RISK MANAGEMENT: EVIDENCE FROM THE SPANISH IBEX 35 SPOT AND FUTURES MARKETS

David G McMillan*
Raquel Quiroga García**

Abstract
This paper analysis the properties and performance of daily realised futures hedge ratios. Using five-minute data for the Spanish IBEX-35 equity spot and futures market realised variances, covariances and hedge ratios are constructed. To measure performance we compared a hedged portfolio based upon the realised hedge ratio with hedged portfolios constructed using a constant regression based hedge ratio, a time-varying rolling regression hedge ratio favoured within the finance industry and a time-varying bivariate-GARCH hedge ratio favoured within the academic community. Our results suggest that solely in terms of minimising portfolio variance the static regression, rolling regression and GARCH based methods obtain the smallest portfolio variances; however, this was often at the expense of negative mean values. In contrast, measuring performance that takes into account portfolio mean and variance using the Sharpe ratio, the portfolio based on the realised hedge ratio is almost unanimously favoured.

Keywords: Realised Variance, Hedge Ratio, Futures Market
JEL classification: C22, G13

Corresponding author: Raquel Quiroga García, Dept. Quantitative Economics, Faculty of Economics and Business, University of Oviedo, Spain (33006). E-mail: rquiroga@uniovi.es
*School of Management, University of St Andrews
**Dept. Quantitative Economics, Faculty of Economics and Business, University of Oviedo
1. Introduction.

It is argued that futures markets are one of the most important innovations that affect the quality of information about future price movements (Figlewski, 1984). A futures contract is an agreement between two parties in which they commit to engage in trade at a point in the future for a prespecified price. Thus, futures markets provide two main functions, risk transfer and price discovery. Risks are transferred to those willing to bear them, that is, hedgers reduce their risk by paying a premium to speculators. While the existence of futures trading enhances the ability of traders to form expectations about future spot prices (Silber, 1985). Thus, the analysis of futures markets tends to focus on either risk management and the appropriate use of futures contracts to optimally hedge risk or price discovery, the aim of this paper is to examine the former.

The traditional approaches to the use of futures for hedging purposes has been either to adopt a naive one-to-one hedging ratio, where an equal and opposition position in futures is taken relative to the position in cash, or to determine the optimal hedge ratio using simple regression techniques but to assume that this ratio will remain constant over the relevant time horizon. However, empirical financial markets research over the past two decades has supported the view that asset returns volatility is time-varying and, in particular, exhibits ‘clustering’, such that large (small) returns follow large (small) returns of random sign (Mandelbrot, 1963, Fama, 1965). The development of the academic literature has been conducted along lines such that the standard way of specifying volatility is through the generalised autoregressive conditional heteroscedasticity (GARCH) model (Engle, 1982, Bollerslev, 1986) and its variants. However, such a model is typically viewed as too cumbersome in risk management practice due to the large number of parameters required in estimated and various other restrictions required to ensure stability of the model. Standard risk management practice is thus to estimate the least squares model and introduce time-variation through windowed estimation.

Thus, a key question remains, given time-variation in variances and correlations, how is it best to understand and formally characterise their properties, and estimate and forecast their values, in order to obtain optimal
hedge ratios. Furthermore, recent developments in the academic field on volatility prediction have provided methods to obtain both accurate volatility forecasts and characterisations of volatility dynamics, including the nature of time-variation and its persistence properties, which are simple in construction and avoid large parameterisation. This recent literature should be more appealing to risk management practice and the finance industry at large.

The aim of this paper is thus to apply these recently developed techniques, which come under the general heading of ‘realised volatility’ to the study of time-variation in the Spanish futures market. In particular, we apply intra-day five-minute observed data to the question of the appropriate daily hedge ratio. The Spanish market is chosen as, in addition to a standard futures contract, in November 2001 the Spanish Official Exchange for Financial Futures and Options launched the mini IBEX-35 futures. The purpose of introducing this contract was to complement the pre-existing futures contract operating in the market by allowing smaller investors and individual traders access to futures markets, and thus allowing for enhanced portfolio management amongst these trader types. Specifically, the mini futures differs from the pre-existing futures contract by having a larger tick size and a smaller multiplier (that is, the tick size of the mini contract is five index points as opposed to one index point on the standard contract, and the multiplier is one euro per index point on the mini contract, as opposed to ten euros per index point on the standard contract). Therefore, this gives us a further opportunity to examine the impact of this new futures contract on the existing contract and whether improved opportunities for hedging arise from its introduction.

The remainder of the paper is as follows. Section 2 reviews the principles underlying hedge ratios and the recent empirical literature. Section 3 reviews the realised variance literature, while Section 4 introduces the data and examines the properties of the constructed realised series. Section 5 presents our main empirical results on the performance of portfolios constructed using different hedge ratios. Section 6 summarises and concludes.
2. Optimal Hedge Ratio and Recent Literature.

Futures contracts play an important role in financial markets by allowing market agents the opportunity to introduce assets that exhibit a negative correlation with their portfolio, which is not typically found with cash markets only. Thus, futures contracts allow market agents to avoid, or hedge, market risk that they otherwise could not avoid due to restrictions upon short selling. The return on a portfolio of an investor who wishes to hedge some of their cash position by holding futures contracts can be represented by:

$$r_t^p = r_t^c - \beta_{t-1} r_t^f$$  

where $r_t^p$ is the return on the portfolio from time period $t-1$ to $t$, $r_t^c$ is the return on the cash position over the same period, $r_t^f$ the return on holding the futures position over the time period $t-1$ to $t$ and where $\beta_{t-1}$ is the hedge ratio. The conditional variance of the hedged portfolio, $h_t^p$, using information up to time $t-1$ is given by:

$$h_t^p = h_t^c - \beta_{t-1}^2 h_t^f - 2 \beta_{t-1} h_t^{cf}$$

where $h_t^p$, $h_t^c$, $h_t^f$ represent the conditional variances of the portfolio, cash and futures positions respectively, while $h_t^{cf}$ represents conditional covariance between the cash and futures position. The optimal hedge ratio is defined as the value of $\beta_{t-1}$, which minimises the conditional variance of the hedged portfolio (2) and is given by:

$$\beta_{t-1}^* = h_t^{cf} / h_t^f$$

where $\beta_{t-1}^*$ is the optimal hedge ratio (OHR). Where the conditional variance-covariance matrix is assumed to be constant (for example, see the earlier work of Ederington, 1979; and Anderson and Danthine, 1981), such that the optimal hedging ratio will also be constant, then an estimate of $\beta_{t-1}^*$ can be found by the estimated slope coefficient, $b$, in the simple linear regression of:

$$r_t^c = a + b r_t^f + u_t .$$

However, as noted in the Introduction, the existing empirical consensus is that both variance and covariance from which the hedge ratio is constructed are time-varying, such that the parameter $b$ in equation (4) which is fixed will not be optimal at each point in time. Moreover, Park and Switzer (1995) argue that if the joint distribution of cash and futures prices is changing over
time then a constant hedge ratio may not be appropriate, while Baillie and Myers (1991) likewise suggest that hedge ratios will vary over time as the conditional distribution between cash and futures price changes. Whilst, therefore, common practice in the risk management industry is to estimate equation (4) over a rolling window, the preference within the academic research is to estimate such time-variation through a bivariate-GARCH model.

Consequently, several researchers have examined the ability of time-varying optimal hedge ratios, typically estimated through the GARCH methodology, to outperform constant hedge ratios in risk reduction effectiveness. The majority of this extant research has focused upon bond or equity cash and futures markets, examples of which include Cecchetti, Cumby and Figlewski (1988), Park and Switzer (1995), Butterworth and Holmes (2001), Brooks, Henry and Persand (2002) and Choudhry (2003), while Baillie and Myers (1991) examined time-variation in the optimal hedge ratios of six commodities. Furthermore, while the work of Cecchetti, Cumby and Figlewski estimated individual GARCH models for the returns volatility of cash and futures markets and assumed a constant correlation between cash and futures prices, the remaining papers allowed for time-variation in the conditional covariance matrix by employing a bivariate GARCH specification. Additionally, Brooks, Henry and Persand allowed for asymmetry of positive and negative shocks in the GARCH specifications, while Choudhry allowed for the influence of short-run (squared) deviations from a cointegrating cash-futures relationship on the conditional covariance matrix.1

3. Realised Volatility and Correlation.

As noted in the Introduction one drawback of the GARCH methodology in estimating time-varying variances, covariances and hedge ratios is the large number of parameters required to obtain estimates. Thus, conventional risk management practise is to prefer a model such as that given by equation (4) and introduce time-variation by conducting estimation of the model over a rolling sample, typically 60 days. Although, and furthermore, both these approaches suffer from the drawback that volatilities are constructed from

1 Also see Abdulnasser and Roca (2006), Lien et al (2002) and Ahmad and Manesh (2006).
past values, and that volatility itself is essentially unobserved. However, recent developments in academic research have provided a methodology in which volatility can in essence be observed and thus allow for direct modelling. Building upon a line of research that began with Andersen and Bollerslev (1998), Andersen, Bollerslev, Diebold and Labys (2003) define realised volatility on day $t$ as:

$$h^r_{t} = \sum_{j=1}^{1/\Delta} r^2_{t-1+j, \Delta}$$

where $\Delta$ is the intra-day frequency, such that $1/\Delta$ is the number of intra-day intervals. Thus, realised volatility is the sum of squared intra-day returns. In principle, letting $\Delta$ go to zero, that is continuous sampling, then the measure approaches the true integrated volatility of the underlying continuous time process, and theoretically free from measurement error. This measure thus allows a market participant to essentially treat volatility as an observed variable and to allow direct estimation.

Generalising the realised volatility idea, we can similarly obtain realised covariances between two assets, say asset $i$ and asset $k$, in the following fashion:

$$h^{r cv}_{i} = \sum_{j=1}^{1/\Delta} r_{i, t-1+j, \Delta} r_{k, t-1+j, \Delta}.$$  

As with the realised variance term, the realised covariance can be treated as observed and directly used in estimation. Finally, and for the purposes within the current paper, we can use the realised variances and covariances to construct the realised hedge ratio:

$$\beta_{t-1}^{*} = h^{r cv}_{i} / h^{r f}_{i}.$$  

where $h^{r cv}_{i}$ and $h^{r f}_{i}$ are used to represent the realised covariance between the spot and futures returns and the realised variances of the futures return respectively. As with the realised variance series, the realised covariance and realised hedge ratio can be regarded as the realisations of the underlying integrated processes and be consistent for the integrated covariance and hedge ratio respectively.
4. Data and Properties of Realised Variables.
In this work we use data from the Ibex 35 index, which is the most important index within the Spanish stock market as it contains the top 35 stocks on the basis of market capitalisation. We also use the data from the futures contracts negotiated in the Spanish derivative market which have the Ibex 35 as underlying asset. There are two Ibex 35 index future, the Ibex plus, with a multiplier of 10€, and the Ibex mini, with a multiplier of 1€. The Ibex mini started in November 2001, while the Ibex plus started in 1992. The data from the index has been taken from the website www.agmercados.com which is used by market participants to operate in the market. The data of both derivative contracts has been facilitated by MEFF, S. H. The period of study goes from January 2nd, 2001 up to December 31st, 2003, and we have used five minutes prices for every asset. For the mini future there is only data from 2nd January, 2002, while as its negotiation started on November 2001, it is not until 2002, when the contract became liquid.

2 Mercado Español de Futuros Financieros, Sociedad Holding.
In order to generate the realised series, the 5-minute data is transformed into continuously compounded returns by taking logs and then first differences. The realised variance series is then generated using equation (5) where the returns are squared and summed over the trading day. The realised covariances are generated using equation (6), that is, in turn the Ibex spot and two futures series are multiplied and summed over the day. Finally, using equation (7) we generate the realised hedge ratio from the realised covariance and realised variance series.
Plots of the daily realised variance and covariance between the spot, futures and mini-futures are presented in Figures 1 and 2 respectively. As can be seen from these plots the realised variance of each series is similar, with infrequent but large spikes, which tend to be more pronounced in the futures market. Similarly, the time series patterns associated with the realised covariances between the three variables are similar. Finally, Figure 3 plots the realised hedge ratios between the three assets. Here we can see that although the three hedge ratios follow roughly the same pattern, of having a mean close to 0.8 with departures therefrom, there is much greater diversity in the timing and extent of the deviations.
To compliment this analysis, Table 1 presents some summary statistics for the realised variance, covariance and hedge ratios, and the correlations between each series. From this table we can see that the mean and standard deviations for the realised variance, realised covariance and realised hedge ratios respectively are of a similar magnitude for the three series. Furthermore, the realised variance and covariance series are characterised by very strong autocorrelation at both short and longer lags, the latter indicating the possibility of long memory. However, for the realised hedge ratios the autocorrelations are much reduced, especially for the spot/futures and futures/mini hedge ratios. Nevertheless, all variances, covariances and ratios are stationary. Finally, an examination of the correlation coefficients between the variances, covariances and hedge ratios supports the graphical evidence that while the generated realised variance and covariance series are similar between the three stock market series, this cannot be said for the realised hedge ratios. That is, correlations for the former two measures are in the
region of 0.91-0.98, while correlations for the latter measure range from 0.27-0.67 suggesting wide variation in the produced ratios.

Table 1. Realised Data Descriptive Statistics

<table>
<thead>
<tr>
<th>Country</th>
<th>Realised Variance</th>
<th>Realised Covariance</th>
<th>Realised Hedge Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Spot</td>
<td>Futures</td>
<td>Mini</td>
</tr>
<tr>
<td>Mean</td>
<td>0.026</td>
<td>0.028</td>
<td>0.027</td>
</tr>
<tr>
<td>Std Dev</td>
<td>0.035</td>
<td>0.039</td>
<td>0.034</td>
</tr>
<tr>
<td>Q1</td>
<td>115.7</td>
<td>158.8</td>
<td>110.4</td>
</tr>
<tr>
<td>Q12</td>
<td>723.7</td>
<td>776.3</td>
<td>763.6</td>
</tr>
<tr>
<td>ADF</td>
<td>-4.89</td>
<td>-5.36</td>
<td>-3.60</td>
</tr>
<tr>
<td>$d$</td>
<td>0.49</td>
<td>0.55</td>
<td>0.53</td>
</tr>
</tbody>
</table>

Notes: Mean and standard deviation for realised variance and covariance multiplied by 100. $Q$ refers to serial correlation Q-statistics of lags one and twelve. ADF is the augmented Dickey-Fuller test with lag length selected by the BIC and a 5% critical value of ~2.86. $d$ is the estimated fractional integration parameter, with standard errors in parentheses.

The evidence from the Q-statistics and the ADF tests suggests the possibility of long-memory dynamics within the realised variances and covariances. Moreover, Andersen et al (2003) have argued that realised volatility measures exhibit long memory and possible fractional behaviour. To compliment the above analysis and to test for possible fractional integration we plot in Figure 4 the first 50 lags of the autocorrelation function for the realised variance, covariance and hedge ratio respectively. These figures suggest that the autocorrelation functions for the realised variance and covariance series decay only very slowly, such that long lags still have a (albeit weak) conditioning effect on current values. The same, however, is not
true for the realised hedge ratios, where the autocorrelation function decays towards zero relatively quick.

Figure 4. ACF for Realised Series

These results are consistent with potential fractional integration behaviour in the realised variance and covariance. Furthermore, the fact that the hedge ratio, which is a combination of these two variables, does not appear to exhibit the same long memory property suggests possible common factors, or fractional cointegration. That is, in the language of Engle and Kozacki (1993), the potential for common features (co-persistence) between variance and covariance exists, where two variables exhibit a characteristic (i.e. long-memory) that a combination of them (the hedge ratio variable) does not.³

³ If we accept the possibility of fractional integration in realised variances and covariances, then this suggests the presence of fractional cointegration (Cheung and Lai, 1993). A result similar to this was reported by Andersen et al (2004) in the context of realised CAPM betas.
To provide further evidence of this we estimate the fractional integration parameter. Specifically, we implement the (log-)periodogram regression estimator proposed by Geweke and Porter-Hudak (1983; \( d_{\text{GPH}} \)), based on the smoothed periodogram using the Parzen window. More formally, the spectral density of a time series can be given by:

\[
 f(\lambda) = \left| 1 - \exp(-i\lambda) \right|^{-2d} f^*(\lambda)
\]

where \( d \) is the long memory parameter and \( f^*(\lambda) \) represents short-run dependency. Geweke-Porter-Hudack (1983) propose the following estimator based on the first \( m \) periodogram ordinates:

\[
 I_j = \frac{1}{2\pi n} \left| \sum_{i=1}^{n} y_i \exp(i\lambda_j t) \right|^2 \quad \text{for } j = 1, \ldots, m
\]

where \( \lambda_j = 2\pi j / n \), \( j=0,1,2,\ldots,m \), defines the set of harmonic frequencies. The least squares regression is thus:

\[
 \{ \log(I_j) : j = 1, \ldots, m \} = \alpha_0 + \alpha_1 [\log(1 - \exp(-i\lambda_j))] + e_j
\]

where \( \hat{d} = -\left( \hat{\alpha}_1 / 2 \right) \). Estimates of \( d \) are presented in Table 1 and these support the general observations made from the Q-statistics and the plots of the autocorrelation function. That is, there appears to be long-memory fractional integration in the realised variance and covariance series but not the realised hedge ratios, supporting the belief that the variances and covariances exhibit common fractional integration behaviour in the ratio

5. Hedge Ratio and Portfolio Performance.

The hedge ratios based upon the realised variance and covariances are plotted in Figure 3 as noted above. These show substantial time-variation in the optimal hedge ratio and thus in the appropriate number of futures contracts to buy. The aim of this section is to note whether taking into account this measure of the optimal hedge ratio improves portfolio performance over more traditional measures of computing the hedge ratio, such as the static OLS regression which produces a constant hedge ratio, a 60-day rolling OLS regression and a bivariate-GARCH model. Of particular note, the first measure is usually considered as a base measure against which to compare the other, time-varying, methods, the second method is simple to
compute and preferred within the finance industry, while the final method is more involved but preferred within the academic community.

Figure 5. Spot/Futures Hedge Ratios

For comparison, Figure 5 presents the hedge ratios for the full sample spot/standard futures calculated by each method. As can be seen from this figure the hedge ratio obtained from the realised variance and covariance series exhibits a much greater degree of variability than that obtained by the other methods. More specifically, the range of values taken by the realised hedge ratio is from –0.1 to 0.96, whilst for the rolling regression model ranges from 0.85 to 0.99 and 0.92 to 0.99 for the bivariate-GARCH model. Furthermore, the mean value for the realised hedge ratio is 0.8 while for the regression, rolling regression and GARCH model the mean values are 0.92, 0.92 and 0.98 respectively.

In order to assess the ability of each method of constructing the hedge ratio, we examine the performance of the portfolio described by equation (1) in terms of the average daily return, standard deviation and the Sharpe ratio.
based on annualised values. These values are presented in Table 2 for the spot and standard futures contract and for both the full sample and the two sub-samples either side of the introduction of the mini-futures contract. Table 3 presents similar statistics of hedged portfolios involving the mini-futures contract.

<table>
<thead>
<tr>
<th></th>
<th>OLS</th>
<th>Rolling OLS</th>
<th>GARCH</th>
<th>RV</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Full Sample</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>-0.002</td>
<td>0.0001</td>
<td>-0.0002</td>
<td>0.003</td>
</tr>
<tr>
<td>Std Dev</td>
<td>0.35</td>
<td>0.34</td>
<td>0.36</td>
<td>0.41</td>
</tr>
<tr>
<td>Sharpe</td>
<td>-0.07</td>
<td>0.002</td>
<td>-0.01</td>
<td>0.12</td>
</tr>
<tr>
<td><strong>Pre-Mini</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>0.001</td>
<td>0.007</td>
<td>0.002</td>
<td>0.006</td>
</tr>
<tr>
<td>Std Dev</td>
<td>0.34</td>
<td>0.34</td>
<td>0.36</td>
<td>0.43</td>
</tr>
<tr>
<td>Sharpe</td>
<td>0.03</td>
<td>0.34</td>
<td>0.09</td>
<td>0.21</td>
</tr>
<tr>
<td><strong>Post-Mini</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>-0.003</td>
<td>-0.003</td>
<td>-0.001</td>
<td>0.002</td>
</tr>
<tr>
<td>Std Dev</td>
<td>0.35</td>
<td>0.34</td>
<td>0.36</td>
<td>0.40</td>
</tr>
<tr>
<td>Sharpe</td>
<td>-0.12</td>
<td>-0.12</td>
<td>-0.06</td>
<td>0.07</td>
</tr>
</tbody>
</table>

Notes: Spot and futures portfolios constructed on the basis on hedge ratios constructed using the static regression model (OLS), a rolling regression model (Rolling OLS), a bivariate-GARCH model (GARCH) and the realised variance method (RV). Sharpe is the Sharpe ratio obtained by the annualised mean dividend by the annualised standard deviation.

The results from Table 2 for both the full sample and two sub-samples suggest the following broad conclusions. First, for all hedged portfolios the daily mean value is close to zero, although typically higher for the portfolio constructed using the realised hedge ratio. Furthermore, for the constant regression based portfolio and the GARCH portfolio the mean values are negative over the full sample and the sample after the introduction of the mini-futures, indeed in this latter period only the realised hedge ratio based portfolio has a positive mean value. Second, the standard deviation of the regression, rolling regression and GARCH portfolios are all of a similar
magnitude, while the realised hedge ratio based portfolio has a higher standard deviation. Finally, examining the performance of the portfolio through the Sharpe ratio then the realised hedge ratio based portfolio outperforms all the other constructed portfolios over the full sample and the post-mini futures introduction sample. Only in the sample prior to the introduction of the mini futures contract does the rolling regression outperform the realised hedge ratio portfolio, which in turn outperforms the remaining two portfolios.

| Table 3. Hedged Portfolio - Spot and Standard Futures With Mini Futures |
|--------------------------|--------------------------|--------------------------|
|                          | OLS                      | Rolling OLS              | GARCH                   | RV            |
| Spot and Mini Futures    |                          |                          |                          |
| Mean                    | -0.003                   | 0.001                    | -0.002                  | 0.003         |
| Std Dev                 | 0.35                     | 0.34                     | 0.35                    | 0.44          |
| Sharpe                  | -0.13                    | 0.03                     | -0.10                   | 0.10          |
| Standard Futures and Mini Futures |            |                          |                          |
| Mean                    | -0.0002                  | 0.0004                   | -0.0002                 | 0.009         |
| Std Dev                 | 0.17                     | 0.16                     | 0.17                    | 0.35          |
| Sharpe                  | -0.02                    | 0.04                     | -0.02                   | 0.43          |

Notes: Spot and futures portfolios constructed on the basis on hedge ratios constructed using the static regression model (OLS), a rolling regression model (Rolling OLS), a bivariate-GARCH model (GARCH) and the realised variance method (RV). Sharpe is the Sharpe ratio obtained by the annualised mean dividend by the annualised standard deviation.

Turning to Table 3 which reports the portfolio mean, standard deviation and Sharpe ratio for the spot/mini-futures and the two futures hedged portfolios, the results are broadly similar to those reported for the spot/standard futures hedged portfolio. More specifically, the mean values are all close to zero and negative for the constant OLS regression based hedge ratio and the GARCH based measure, while the highest mean values are found for the realised hedge ratio based portfolio. The standard deviations for the OLS regression, rolling regression and GARCH based hedge portfolio are similar while the standard deviation for the realised hedge ratio portfolio is higher. Finally, the Sharpe ratio of portfolio performance is highest for the
realised hedge ratio portfolio for both the spot/mini futures hedged portfolio and the two futures hedged portfolio.

In sum, the results from this exercise suggest that the best performing hedged portfolio is constructed by obtaining the realised hedge ratio. Although portfolio variance is lower for portfolios constructed using regression and GARCH techniques, these often produce negative mean values for the portfolio, the best return-risk combination occurs for the realised hedge ratio based portfolios. Furthermore, the realised hedge ratio is relatively simple in construction and so the results here will be of interest to the finance industry as improved hedging performance could be obtained through using realised hedge ratios as opposed to rolling regressions. Finally, the introduction of the mini futures contract appears to have no significant impact on hedging performance of the existing futures contract.

6. Summary and Conclusion.
The introduction of futures markets are one of the most important innovations within the finance industry, allowing for improved quality of information about future price movements and risk transfer. The traditional approaches to the use of futures for hedging purposes had been to adopt constant hedge ratios either though a naive one-to-one hedging ratio, or to determine the optimal hedge ratio using a simple regression. However, it is well known that asset variances and covariances are time-dependent and can vary substantially over even short periods of time. This has led to the question of what is the most appropriate technique to model such time-variation. The academic literature has typically focussed on the GARCH methodology as providing the most accurate methods to model variances and covariances. However, the finance industry has shied away from these techniques as they are highly involved and require a large number of parameters in estimation as well as constraints on parameter values to ensure non-negativity and stationarity. Furthermore, there are a variety of GARCH models that can capture different aspects of the data (for example, asymmetry, long memory). As such the finance industry typically introduces time-variation into hedge ratio estimation through rolling regression techniques that are simple to execute.
The aim of this paper is to re-examine the ability of several models to estimate hedge ratio in the light of recent academic research that has led to the development of realised variance and covariance modelling techniques. Furthermore, realised volatility measures are simple in construction, do not involve estimating a large number of parameters and allow for straightforward construction of realised hedge ratios and so are of interest to those engaged within the finance industry.

Using five-minute data for the Spanish IBEX-35 equity spot and futures market daily realised variances, covariances and hedge ratios are constructed. This data is chosen as during our sample the Spanish Official Exchange for Financial Futures and Options launched the mini IBEX-35 futures. The purpose of introducing this contract was to complement the pre-existing futures contract operating in the market by allowing smaller investors access to futures markets, and thus allowing for enhanced portfolio management amongst these investors. Hence, this gives us a further opportunity to examine the impact of this new futures contract on the existing contract. Preliminary results within this paper show that daily realised variances and covariances for the Spanish IBEX-35 equity spot and futures market exhibit long memory dependency consistent with extant research on other markets, while the constructed hedge ratios do not exhibit the same property. Furthermore, while the realised variances of the three assets and the realised covariances between the three assets all follow a similar time series pattern, and exhibit a high correlation, the realised hedge ratios differ across time and exhibit a lower correlation.

In terms of hedge ratio performance we compared a hedged portfolio based upon the realised hedge ratio for the spot/futures portfolio, spot/mini futures portfolio and a standard future/mini future portfolio with hedged portfolios constructed using a constant regression based hedge ratio, a time-varying rolling regression hedge ratio favoured within the finance industry and a time-varying bivariate-GARCH hedge ratio favoured within the academic community. Our results suggest the following conclusions. First, on the basis on solely minimising portfolio variance then the static regression, rolling regression and GARCH based methods obtain smaller portfolio variances than the realised volatility based method, however, this was often at the
expense of negative mean values, whereas the portfolio utilising realised hedge ratios always yields positive mean values. Second, and perhaps most importantly, a comparison of portfolio performance which takes into account both portfolio mean and variance using the Sharpe ratio, almost unanimously supports the portfolios constructed using the realised hedge ratios, in only one case does the rolling regression based portfolio outperform the realised hedge ratio based portfolio and this was prior to the introduction of the mini-futures contract and so characterised by a market environment which no longer exists. Finally, the introduction of the min-futures contract appears to have had almost no impact on the hedging performance of the spot-standard futures contract market, although of note portfolios constructed by any means other than the realised hedge ratio exhibit a negative mean value in the post-mini period to the end of the sample. In this respect the mini-futures contract could be regarded as successful in allowing new participants to the market but without diminishing the hedging efficiency of the original contract.

In sum, the results presented here have important implications for the practice of risk management and the calculation of futures market hedge ratios. That is, the finance industry has typically shied away from models preferred within the academic community designed to capture time-variation in asset variances and covariances due to their complexity, instead preferring models that are relatively simpler in construction. Our results suggest that the recent development within the academic literature for the calculation of realised variances, covariance and in this case, realised hedge ratios provides for improved performance and yet are simple in construction.
References


Últimos números publicados

159/2000 Participación privada en la construcción y explotación de carreteras de peaje
Ginés de Rus, Manuel Romero y Lourdes Trujillo

160/2000 Errores y posibles soluciones en la aplicación del Value at Risk
Mariano González Sánchez

161/2000 Tax neutrality on saving assets. The spahish case before and after the tax reform
Cristina Ruza y de Paz-Curbera

162/2000 Private rates of return to human capital in Spain: new evidence
F. Barceinas, J. Oliver-Alonso, J.L. Raymond y J.L. Roig-Sabaté

163/2000 El control interno del riesgo. Una propuesta de sistema de límites
riesgo neutral
Mariano González Sánchez

164/2001 La evolución de las políticas de gasto de las Administraciones Públicas en los años 90
Alfonso Utrilla de la Hoz y Carmen Pérez Esparrells

165/2001 Bank cost efficiency and output specification
Emili Tortosa-Ausina

166/2001 Recent trends in Spanish income distribution: A robust picture of falling income inequality
Josep Oliver-Alonso, Xavier Ramos y José Luis Raymond-Bara

167/2001 Efectos redistributivos y sobre el bienestar social del tratamiento de las cargas familiares en el nuevo IRPF
Nuria Badenes Plá, Julio López Laborda, Jorge Onrubia Fernández

168/2001 The Effects of Bank Debt on Financial Structure of Small and Medium Firms in some European Countries
Mónica Melle-Hernández

169/2001 La política de cohesión de la UE ampliada: la perspectiva de España
Ismael Sanz Labrador

170/2002 Riesgo de liquidez de Mercado
Mariano González Sánchez

171/2002 Los costes de administración para el afiliado en los sistemas de pensiones basados en cuentas de capitalización individual: medida y comparación internacional.
José Enrique Devesa Carpio, Rosa Rodríguez Barrera, Carlos Vidal Meliá

172/2002 La encuesta continua de presupuestos familiares (1985-1996): descripción, representatividad y propuestas de metodología para la explotación de la información de los ingresos y el gasto.
Llorence Pou, Joaquín Alegre

173/2002 Modelos paramétricos y no paramétricos en problemas de concesión de tarjetas de crédito.
Rosa Puertas, María Bonilla, Ignacio Olmeda
174/2002 Mercado único, comercio intra-industrial y costes de ajuste en las manufacturas españolas.
José Vicente Blanes Cristóbal

175/2003 La Administración tributaria en España. Un análisis de la gestión a través de los ingresos y
de los gastos.
Juan de Dios Jiménez Aguilera, Pedro Enrique Barrilao González

Santiago Carbó Valverde, Rafael López del Paso, David B. Humphrey

177/2003 Effects of ATMs and Electronic Payments on Banking Costs: The Spanish Case.
Santiago Carbó Valverde, Rafael López del Paso, David B. Humphrey

178/2003 Factors explaining the interest margin in the banking sectors of the European Union.
Joaquín Maudos y Juan Fernández Guevara

179/2003 Los planes de stock options para directivos y consejeros y su valoración por el mercado de
valores en España.
Mónica Melle Hernández

180/2003 Ownership and Performance in Europe and US Banking – A comparison of Commercial, Co-
operative & Savings Banks.
Yener Altunbas, Santiago Carbó y Phil Molyneux

181/2003 The Euro effect on the integration of the European stock markets.
Mónica Melle Hernández

182/2004 In search of complementarity in the innovation strategy: international R&D and external
knowledge acquisition.
Bruno Cassiman, Reinhilde Veugelers

183/2004 Fijación de precios en el sector público: una aplicación para el servicio municipal de sumi-
ñistro de agua.
Mª Ángeles García Valiñas

184/2004 Estimación de la economía sumergida es España: un modelo estructural de variables latentes.
Ángel Alañón Pardo, Miguel Gómez de Antonio

185/2004 Causas políticas y consecuencias sociales de la corrupción.
Joan Oriol Prats Cabrera

186/2004 Loan bankers’ decisions and sensitivity to the audit report using the belief revision model.
Andrés Guiral Contreras and José A. Gonzalo Angulo

Marta Tolentino García-Abadillo y Antonio Díaz Pérez

188/2004 Does market competition make banks perform well?.
Mónica Melle

189/2004 Efficiency differences among banks: external, technical, internal, and managerial
Santiago Carbó Valverde, David B. Humphrey y Rafael López del Paso
190/2004 Una aproximación al análisis de los costes de la esquizofrenia en españa: los modelos jerárquicos bayesianos
F. J. Vázquez-Polo, M. A. Negrín, J. M. Cavasés, E. Sánchez y grupo RIRAG

191/2004 Environmental proactivity and business performance: an empirical analysis
Javier González-Benito y Óscar González-Benito

192/2004 Economic risk to beneficiaries in notional defined contribution accounts (NDCs)
Carlos Vidal-Meliá, Inmaculada Domínguez-Fabian y José Enrique Devesa-Carpio

193/2004 Sources of efficiency gains in port reform: non parametric malmquist decomposition tfp index for Mexico
Antonio Estache, Beatriz Tovar de la Fé y Lourdes Trujillo

194/2004 Persistencia de resultados en los fondos de inversión españoles
Alfredo Ciriaco Fernández y Rafael Santamaría Aquilué

195/2005 El modelo de revisión de creencias como aproximación psicológica a la formación del juicio del auditor sobre la gestión continuada
Andrés Guiral Contreras y Francisco Esteso Sánchez

196/2005 La nueva financiación sanitaria en España: descentralización y prospectiva
David Cantarero Prieto

197/2005 A cointegration analysis of the Long-Run supply response of Spanish agriculture to the common agricultural policy
José A. Mendez, Ricardo Mora y Carlos San Juan

198/2005 ¿Refleja la estructura temporal de los tipos de interés del mercado español preferencia por la liquidez?
Magdalena Massot Perelló y Juan M. Nave

199/2005 Análisis de impacto de los Fondos Estructurales Europeos recibidos por una economía regional: Un enfoque a través de Matrices de Contabilidad Social
M. Carmen Lima y M. Alejandro Cardenete

200/2005 Does the development of non-cash payments affect monetary policy transmission?
Santiago Carbó Valverde y Rafael López del Paso

201/2005 Firm and time varying technical and allocative efficiency: an application for port cargo handling firms
Ana Rodríguez-Álvarez, Beatriz Tovar de la Fé y Lourdes Trujillo

202/2005 Contractual complexity in strategic alliances
Jeffrey J. Reuer y Africa Ariño

203/2005 Factores determinantes de la evolución del empleo en las empresas adquiridas por opa
Nuria Alcalde Fradejas y Inés Pérez-Soba Aguilar

Elena Olmedo, Juan M. Valderas, Ricardo Gimeno and Lorenzo Escot
205/2005 Precio de la tierra con presión urbana: un modelo para España
Esther Decimavilla, Carlos San Juan y Stefan Sperlich

206/2005 Interregional migration in Spain: a semiparametric analysis
Adolfo Maza y José Villaverde

207/2005 Productivity growth in European banking
Carmen Murillo-Melchor, José Manuel Pastor y Emili Tortosa-Ausina

Santiago Carbó Valverde, David B. Humphrey y Rafael López del Paso

209/2005 La elasticidad de sustitución intertemporal con preferencias no separables intratemporalmente: los casos de Alemania, España y Francia.
Elena Márquez de la Cruz, Ana R. Martinez Cañete y Inés Pérez-Soba Aguilar

210/2005 Contribución de los efectos tamaño, book-to-market y momentum a la valoración de activos: el caso español.
Begoña Font-Belaire y Alfredo Juan Grau-Grau

211/2005 Permanent income, convergence and inequality among countries
José M. Pastor and Lorenzo Serrano

212/2005 The Latin Model of Welfare: Do 'Insertion Contracts' Reduce Long-Term Dependence?
Luis Ayala and Magdalena Rodríguez

213/2005 The effect of geographic expansion on the productivity of Spanish savings banks
Manuel Illueca, José M. Pastor and Emili Tortosa-Ausina

214/2005 Dynamic network interconnection under consumer switching costs
Ángel Luis López Rodriguez

215/2005 La influencia del entorno socioeconómico en la realización de estudios universitarios: una aproximación al caso español en la década de los noventa
Marta Rahona López

216/2005 The valuation of spanish ipos: efficiency analysis
Susana Álvarez Otero

217/2005 On the generation of a regular multi-input multi-output technology using parametric output distance functions
Sergio Perelman and Daniel Santín

218/2005 La gobernanza de los procesos parlamentarios: la organización industrial del congreso de los diputados en España
Gonzalo Caballero Miguez

219/2005 Determinants of bank market structure: Efficiency and political economy variables
Francisco González

220/2005 Agresividad de las órdenes introducidas en el mercado español: estrategias, determinantes y medidas de performance
David Abad Díaz
Tendencia post-anuncio de resultados contables: evidencia para el mercado español
Carlos Forner Rodríguez, Joaquín Marhuenda Fructuoso y Sonia Sanabria García

Human capital accumulation and geography: empirical evidence in the European Union
Jesús López-Rodríguez, J. Andrés Faïña y Jose Lopez Rodriguez

Auditors' Forecasting in Going Concern Decisions: Framing, Confidence and Information Processing
Waymond Rodgers and Andrés Guiral

José Ramón Cancelo de la Torre, J. Andrés Faïña and Jesús López-Rodriguez

The effects of ownership structure and board composition on the audit committee activity: Spanish evidence
Carlos Fernández Méndez and Rubén Arrondo García

Cross-country determinants of bank income smoothing by managing loan loss provisions
Ana Rosa Fonseca and Francisco González

Incumplimiento fiscal en el irpf (1993-2000): un análisis de sus factores determinantes
Alejandro Estellér Moré

Region versus Industry effects: volatility transmission
Pilar Soriano Felipe and Francisco J. Climent Diranzo

Concurrent Engineering: The Moderating Effect Of Uncertainty On New Product Development Success
Daniel Vázquez-Bustelo and Sandra Valle

On zero lower bound traps: a framework for the analysis of monetary policy in the ‘age’ of central banks
Alfonso Palacio-Vera

Reconciling Sustainability and Discounting in Cost Benefit Analysis: a methodological proposal
M. Carmen Almansa Sáez and Javier Calatrava Requena

Can The Excess Of Liquidity Affect The Effectiveness Of The European Monetary Policy?
Santiago Carbó Valverde and Rafael López del Paso

Inheritance Taxes In The Eu Fiscal Systems: The Present Situation And Future Perspectives
Miguel Angel Barberán Lahuerta

Bank Ownership And Informativeness Of Earnings
Víctor M. González

Waymond Rodgers, Paul Pavlou and Andres Guiral.

Francisco J. André, M. Alejandro Cardenete y Carlos Romero.

238/2006 Trade Effects Of Monetary Agreements: Evidence For Oecd Countries. Salvador Gil-Pareja, Rafael Llorca-Vivero y José Antonio Martínez-Serrano.


240/2006 La interacción entre el éxito competitivo y las condiciones del mercado doméstico como determinantes de la decisión de exportación en las Pymes. Francisco García Pérez.

241/2006 Una estimación de la depreciación del capital humano por sectores, por ocupación y en el tiempo. Inés P. Murillo.


244/2006 Did The European Exchange-Rate Mechanism Contribute To The Integration Of Peripheral Countries?. Salvador Gil-Pareja, Rafael Llorca-Vivero y José Antonio Martínez-Serrano.


252/2006 “The momentum effect in the Spanish stock market: Omitted risk factors or investor behaviour?”. Luis Muga and Rafael Santamaria.

José M. Pastor, Empar Pons y Lorenzo Serrano

255/2006 Environmental implications of organic food preferences: an application of the impure public goods model. 
Ana María Aldanondo-Ochoa y Carmen Almansa-Sáez

José Félix Sanz-Sanz, Desiderio Romero-Jordán y Santiago Álvarez-García

257/2006 La internacionalización de la empresa manufacturera española: efectos del capital humano genérico y específico. 
José López Rodríguez

María Martínez Torres

259/2006 Efficiency and market power in Spanish banking. 
Rolf Färe, Shawna Grosskopf y Emili Tortosa-Ausina.

Helena Chuliá y Hipòlit Torró.

José Antonio Ortega.

262/2006 Accidentes de tráfico, víctimas mortales y consumo de alcohol. 
José Mª Arranz y Ana I. Gil.

263/2006 Análisis de la Presencia de la Mujer en los Consejos de Administración de las Mil Mayores Empresas Españolas. 
Ruth Mateos de Cabo, Lorenzo Escot Mangas y Ricardo Gimeno Nogués.

Ignacio Álvarez Peralta.

Jaime Vallés-Giménez y Anabel Zárate-Marco.

266/2006 Health Human Capital And The Shift From Foraging To Farming. 
Paolo Rungo.

Juan Luis Jiménez y Jordi Perdigueró.

Desiderio Romero-Jordán y José Félix Sanz-Sanz.

269/2006 Banking competition, financial dependence and economic growth 
Joaquín Maudos y Juan Fernández de Guevara

270/2006 Efficiency, subsidies and environmental adaptation of animal farming under CAP 
Werner Kleinhans, Carmen Murillo, Carlos San Juan y Stefan Sperlich
A. García-Lorenzo y Jesús López-Rodriguez

272/2006 Riesgo asimétrico y estrategias de momentum en el mercado de valores español
Luís Muga y Rafael Santamaría

273/2006 Valoración de capital-riesgo en proyectos de base tecnológica e innovadora a través de la teoría de opciones reales
Gracia Rubio Martín

274/2006 Capital stock and unemployment: searching for the missing link
Ana Rosa Martínez-Cañete, Elena Márquez de la Cruz, Alfonso Palacio-Vera and Inés Pérez-Soba Aguilar

275/2006 Study of the influence of the voters' political culture on vote decision through the simulation of a political competition problem in Spain
Sagrario Lantarón, Isabel Lillo, Mª Dolores López and Javier Rodrigo

276/2006 Investment and growth in Europe during the Golden Age
Antonio Cubel and Mª Teresa Sanchis

277/2006 Efectos de vincular la pensión pública a la inversión en cantidad y calidad de hijos en un modelo de equilibrio general
Robert Meneu Gaya

278/2006 El consumo y la valoración de activos
Elena Márquez y Belén Nieto

279/2006 Economic growth and currency crisis: A real exchange rate entropic approach
David Matesanz Gómez y Guillermo J. Ortega

280/2006 Three measures of returns to education: An illustration for the case of Spain
María Arrazola y José de Hevia

281/2006 Composition of Firms versus Composition of Jobs
Antoni Cunyat

282/2006 La vocación internacional de un holding tranviario belga: la Compagnie Mutuelle de Tramways, 1895-1918
Alberte Martínez López

283/2006 Una visión panorámica de las entidades de crédito en España en la última década.
Constantino García Ramos

Alberte Martínez López

285/2006 Los intereses belgas en la red ferroviaria catalana, 1890-1936
Alberte Martínez López

286/2006 The Governance of Quality: The Case of the Agrifood Brand Names
Marta Fernández Barcala, Manuel González-Díaz y Emmanuel Raynaud

287/2006 Modelling the role of health status in the transition out of malthusian equilibrium
Paolo Rungo, Luis Currais and Berta Rivera

288/2006 Industrial Effects of Climate Change Policies through the EU Emissions Trading Scheme
Xavier Labandeira and Miguel Rodriguez
289/2006 Globalisation and the Composition of Government Spending: An analysis for OECD countries
Norman Gemmell, Richard Kneller and Ismael Sanz

290/2006 La producción de energía eléctrica en España: Análisis económico de la actividad tras la liberalización del Sector Eléctrico
Fernando Hernández Martínez

291/2006 Further considerations on the link between adjustment costs and the productivity of R&D investment: evidence for Spain
Desiderio Romero-Jordán, José Félix Sanz-Sanz and Inmaculada Álvarez-Ayuso

292/2006 Una teoría sobre la contribución de la función de compras al rendimiento empresarial
Javier González Benito

293/2006 Agility drivers, enablers and outcomes: empirical test of an integrated agile manufacturing model
Daniel Vázquez-Bustelo, Lucía Avella and Esteban Fernández

294/2006 Testing the parametric vs the semiparametric generalized mixed effects models
Maria José Lombardía and Stefan Sperlich

295/2006 Nonlinear dynamics in energy futures
Mariano Matilla-García

Esteban Fernández Vázquez, Matías Mayor Fernández and Jorge Rodríguez-Valez

297/2006 Optimización fiscal en las transmisiones lucrativas: análisis metodológico
Félix Domínguez Barrero

298/2006 La situación actual de la banca online en España
Francisco José Climent Diranzo y Alexandre Momparler Pechuán

299/2006 Estrategia competitiva y rendimiento del negocio: el papel mediador de la estrategia y las capacidades productivas
Javier González Benito y Isabel Suárez González

300/2006 A Parametric Model to Estimate Risk in a Fixed Income Portfolio
Pilar Abad and Sonia Benito

301/2007 Análisis Empírico de las Preferencias Sociales Respecto del Gasto en Obra Social de las Cajas de Ahorros
Alejandro Esteller-Moré, Jonathan Jorba Jiménez y Albert Solé-Ollé

302/2007 Assessing the enlargement and deepening of regional trading blocs: The European Union case
Salvador Gil-Pareja, Rafael Llorca-Vivero y José Antonio Martínez-Serrano

303/2007 ¿Es la Franquicia un Medio de Financiación?: Evidencia para el Caso Español
Vanessa Solís Rodríguez y Manuel González Díaz

304/2007 On the Finite-Sample Biases in Nonparametric Testing for Variance Constancy
Paulo M.M. Rodrigues and Antonio Rubia

305/2007 Spain is Different: Relative Wages 1989-98
José Antonio Carrasco Gallego
Poverty reduction and SAM multipliers: An evaluation of public policies in a regional framework
Francisco Javier De Miguel-Vélez y Jesús Pérez-Mayo

La Eficiencia en la Gestión del Riesgo de Crédito en las Cajas de Ahorro
Marcelino Martínez Cabrera

Optimal environmental policy in transport: unintended effects on consumers' generalized price
M. Pilar Socorro and Ofelia Betancor

Agricultural Productivity in the European Regions: Trends and Explanatory Factors
Roberto Ezcurra, Belen Iráizoz, Pedro Pascual and Manuel Rapún

Long-run Regional Population Divergence and Modern Economic Growth in Europe: a Case Study of Spain
María Isabel Ayuda, Fernando Collantes and Vicente Pinilla

Financial Information effects on the measurement of Commercial Banks' Efficiency
Borja Amor, María T. Tascón and José L. Fanjul

Neutralidad e incentivos de las inversiones financieras en el nuevo IRPF
Félix Domínguez Barrero

The Effects of Corporate Social Responsibility Perceptions on The Valuation of Common Stock
Waymond Rodgers, Helen Choy and Andres Guiral-Contreras

Country Creditor Rights, Information Sharing and Commercial Banks’ Profitability Persistence across the world
Borja Amor, María T. Tascón and José L. Fanjul

¿Es Relevante el Déficit Corriente en una Unión Monetaria? El Caso Español
Javier Blanco González y Ignacio del Rosal Fernández

The Impact of Credit Rating Announcements on Spanish Corporate Fixed Income Performance: Returns, Yields and Liquidity
Pilar Abad, Antonio Díaz and M. Dolores Robles

Indicadores de Lealtad al Establecimiento y Formato Comercial Basados en la Distribución del Presupuesto
Cesar Augusto Bustos Reyes y Óscar González Benito

Migrants and Market Potential in Spain over The XXth Century: A Test Of The New Economic Geography
Daniel A. Tirado, Jordi Pons, Elisenda Paluzie and Javier Silvestre

El Impacto del Coste de Oportunidad de la Actividad Emprendedora en la Intención de los Ciudadanos Europeos de Crear Empresas
Luis Miguel Zapico Aldeano

Los belgas y los ferrocarriles de vía estrecha en España, 1887-1936
Alberte Martínez López

Competición política bipartidista. Estudio geométrico del equilibrio en un caso ponderado
Isabel Lillo, Mª Dolores López y Javier Rodrigo

Human resource management and environment management systems: an empirical study
Mª Concepción López Fernández, Ana Mª Serrano Bedía and Gema García Piqueres
358/2007 Effects of a reduction of working hours on a model with job creation and job destruction
Emilio Domínguez, Miren Ullibarri y Idoya Zabaleta

359/2007 Stock split size, signaling and earnings management: Evidence from the Spanish market
José Yagüe, J. Carlos Gómez-Sala and Francisco Poveda-Fuentes

360/2007 Modelización de las expectativas y estrategias de inversión en mercados de derivados
Begoña Font-Belaire

361/2008 Trade in capital goods during the golden age, 1953-1973
Mª Teresa Sanchis and Antonio Cubel

362/2008 El capital económico por riesgo operacional: una aplicación del modelo de distribución de pérdidas
Enrique José Jiménez Rodríguez y José Manuel Feria Domínguez

363/2008 The drivers of effectiveness in competition policy
Joan-Ramon Borrell and Juan-Luis Jiménez

364/2008 Corporate governance structure and board of directors remuneration policies: evidence from Spain
Carlos Fernández Méndez, Rubén Arrondo García and Enrique Fernández Rodríguez

365/2008 Beyond the disciplinary role of governance: how boards and donors add value to Spanish foundations
Pablo De Andrés Alonso, Valentin Azofra Palenzuela y M. Elena Romero Merino

366/2008 Complejidad y perfeccionamiento contractual para la contención del oportunismo en los acuerdos de franquicia
Vanesa Solís Rodríguez y Manuel González Díaz

367/2008 Inestabilidad y convergencia entre las regiones europeas
Jesús Mur, Fernando López y Ana Angulo

368/2008 Análisis espacial del cierre de explotaciones agrarias
Ana Aldanondo Ochoa, Carmen Almansa Sáez y Valero Casanovas Oliva

369/2008 Cross-Country Efficiency Comparison between Italian and Spanish Public Universities in the period 2000-2005
Tommaso Agasisti and Carmen Pérez Esparrells

370/2008 El desarrollo de la sociedad de la información en España: un análisis por comunidades autónomas
María Concepción García Jiménez y José Luis Gómez Barroso

371/2008 El medioambiente y los objetivos de fabricación: un análisis de los modelos estratégicos para su consecución
Lucía Avella Camarero, Esteban Fernández Sánchez y Daniel Vázquez-Bustelo

372/2008 Influence of bank concentration and institutions on capital structure: New international evidence
Víctor M. González and Francisco González

373/2008 Generalización del concepto de equilibrio en juegos de competición política
Mª Dolores López González y Javier Rodrigo Hitos

374/2008 Smooth Transition from Fixed Effects to Mixed Effects Models in Multi-level regression Models
Maria José Lombardía and Stefan Sperlich
375/2008  A Revenue-Neutral Tax Reform to Increase Demand for Public Transport Services  
Carlos Pestana Barros and Juan Prieto-Rodriguez

376/2008  Measurement of intra-distribution dynamics: An application of different approaches to the European regions  
Adolfo Maza, María Hierro and José Villaverde

377/2008  Migración interna de extranjeros y ¿nueva fase en la convergencia?  
María Hierro y Adolfo Maza

378/2008  Efetos de la Reforma del Sector Eléctrico: Modelización Teórica y Experiencia Internacional  
Ciro Eduardo Bazán Navarro

379/2008  A Non-Parametric Independence Test Using Permutation Entropy  
Mariano Matilla-García and Manuel Ruiz Marín

380/2008  Testing for the General Fractional Unit Root Hypothesis in the Time Domain  
Uwe Hassler, Paulo M.M. Rodrigues and Antonio Rubia

381/2008  Multivariate gram-charlier densities  
Esther B. Del Brio, Trino-Manuel Ñíguez and Javier Perote

382/2008  Analyzing Semiparametrically the Trends in the Gender Pay Gap - The Example of Spain  
Ignacio Moral-Arce, Stefan Sperlich, Ana I. Fernández-Sainz and Maria J. Roca

383/2008  A Cost-Benefit Analysis of a Two-Sided Card Market  
Santiago Carbó Valverde, David B. Humphrey, José Manuel Liñares Zegarra and Francisco Rodríguez Fernandez

384/2008  A Fuzzy Bicriteria Approach for Journal Deselection in a Hospital Library  
M. L. López-Avello, M. V. Rodríguez-Uría, B. Pérez-Gladish, A. Bilbao-Terol, M. Arenas-Parra

385/2008  Valoración de las grandes corporaciones farmaceúticas, a través del análisis de sus principales intangibles, con el método de opciones reales  
Gracia Rubio Martín y Prosper Lamothe Fernández

386/2008  El marketing interno como impulsor de las habilidades comerciales de las pymes españolas: efectos en los resultados empresariales  
Mª Leticia Santos Vijande, Mª José Sanzo Pérez, Nuria García Rodríguez y Juan A. Trespalacios Gutiérrez

387/2008  Understanding Warrants Pricing: A case study of the financial market in Spain  
David Abad y Belén Nieto

388/2008  Aglomeración espacial, Potencial de Mercado y Geografía Económica: Una revisión de la literatura  
Jesús López-Rodríguez y J. Andrés Faíña

389/2008  An empirical assessment of the impact of switching costs and first mover advantages on firm performance  
Jaime Gómez, Juan Pablo Maícas

390/2008  Tender offers in Spain: testing the wave  
Ana R. Martínez-Cañete y Inés Pérez-Soba Aguilar
La integración del mercado español a finales del siglo XIX: los precios del trigo entre 1891 y 1905
Mariano Matilla García, Pedro Pérez Pascual y Basilio Sanz Carnero

Cuando el tamaño importa: estudio sobre la influencia de los sujetos políticos en la balanza de bienes y servicios
Alfonso Echazarra de Gregorio

Una visión cooperativa de las medidas ante el posible daño ambiental de la desalación
Borja Montaño Sanz

Efectos externos del endeudamiento sobre la calificación crediticia de las Comunidades Autónomas
Andrés Leal Marcos y Julio López Laborda

Technical efficiency and productivity changes in Spanish airports: A parametric distance functions approach
Beatriz Tovar & Roberto Rendeiro Martín-Cejas

Network analysis of exchange data: Interdependence drives crisis contagion
David Matesanz Gómez & Guillermo J. Ortega

Explaining the performance of Spanish privatised firms: a panel data approach
Laura Cabeza García and Silvia Gomez Anson

Technological capabilities and the decision to outsource R&D services
Andrea Martínez-Noya and Esteban García-Canal

Hybrid Risk Adjustment for Pharmaceutical Benefits
Manuel García-Goñi, Pere Ibern & José María Inoriza

The Team Consensus–Performance Relationship and the Moderating Role of Team Diversity
José Henrique Dieguez, Javier González-Benito and Jesús Galende

The institutional determinants of CO2 emissions: A computational modelling approach using Artificial Neural Networks and Genetic Programming
Marcos Álvarez-Díaz, Gonzalo Caballero Miguez and Mario Solíño

Alternative Approaches to Include Exogenous Variables in DEA Measures: A Comparison Using Monte Carlo
José Manuel Cordero-Ferrera, Francisco Pedraja-Chaparro and Daniel Santín-González

Efecto diferencial del capital humano en el crecimiento económico andaluz entre 1985 y 2004: comparación con el resto de España
Mª del Pópulo Pablo-Romero Gil-Delgado y Mª de la Palma Gómez-Calero Valdés

Análisis de fusiones, variaciones conjeturales y la falacia del estimador en diferencias
Juan Luis Jiménez y Jordi Perdiguero

Política fiscal en la uem: ¿basta con los estabilizadores automáticos?
Jorge Uxó González y Mª Jesús Arroyo Fernández

Papel de la orientación emprendedora y la orientación al mercado en el éxito de las empresas
Óscar González-Benito, Javier González-Benito y Pablo A. Muñoz-Gallego

La presión fiscal por impuesto sobre sociedades en la unión europea
Elena Fernández Rodríguez, Antonio Martínez Arias y Santiago Álvarez García
408/2008 The environment as a determinant factor of the purchasing and supply strategy: an empirical analysis
Dr. Javier González-Benito y MS Duilio Reis da Rocha

409/2008 Cooperation for innovation: the impact on innovatory effort
Gloria Sánchez González and Liliana Herrera

410/2008 Spanish post-earnings announcement drift and behavioral finance models
Carlos Forner and Sonia Sanabria

411/2008 Decision taking with external pressure: evidence on football manager dismissals in Argentina and their consequences
Ramón Flores, David Forrest and Juan de Dios Tena

Raúl Serrano y Vicente Pinilla

413/2008 Voter heuristics in Spain: a descriptive approach elector decision
José Luis Sáez Lozano and Antonio M. Jaime Castillo

414/2008 Análisis del efecto área de salud de residencia sobre la utilización y acceso a los servicios sanitarios en la Comunidad Autónoma Canaria
Ignacio Abásolo Alessón, Lidia García Pérez, Raquel Aguiar Ibáñez y Asier Amador Robayna

415/2008 Impact on competitive balance from allowing foreign players in a sports league: an analytical model and an empirical test
Ramón Flores, David Forrest & Juan de Dios Tena

416/2008 Organizational innovation and productivity growth: Assessing the impact of outsourcing on firm performance
Alberto López

417/2008 Value Efficiency Analysis of Health Systems
Eduardo González, Ana Cárcaba & Juan Ventura

418/2008 Equidad en la utilización de servicios sanitarios públicos por comunidades autónomas en España: un análisis multinivel
Ignacio Abásolo, Jaime Pinilla, Miguel Negrín, Raquel Aguiar y Lidia García

419/2008 Piedras en el camino hacia Bolonia: efectos de la implantación del EEES sobre los resultados académicos
Carmen Florido, Juan Luis Jiménez e Isabel Santana

420/2008 The welfare effects of the allocation of airlines to different terminals
M. Pilar Socorro and Ofelia Betancor

421/2008 How bank capital buffers vary across countries. The influence of cost of deposits, market power and bank regulation
Ana Rosa Fonseca and Francisco González

422/2008 Analysing health limitations in Spain: an empirical approach based on the European Community household panel
Marta Pascual and David Cantarero
Regional productivity variation and the impact of public capital stock: an analysis with spatial interaction, with reference to Spain
Miguel Gómez-Antonio and Bernard Fingleton

Average effect of training programs on the time needed to find a job. The case of the training schools program in the south of Spain (Seville, 1997-1999).
José Manuel Cansino Muñoz-Repiso and Antonio Sánchez Braza

Medición de la eficiencia y cambio en la productividad de las empresas distribuidoras de electricidad en Perú después de las reformas
Raúl Pérez-Reyes y Beatriz Tovar

Acerando posturas sobre el descuento ambiental: sondeo Delphi a expertos en el ámbito internacional
Carmen Almansa Sáez y José Miguel Martínez Paz

Determinants of abnormal liquidity after rating actions in the Corporate Debt Market
Pilar Abad, Antonio Díaz and M. Dolores Robles

Export led-growth and balance of payments constrained. New formalization applied to Cuban commercial regimes since 1960
David Matesanz Gómez, Guadalupe Fugarolas Álvarez-Ude and Isis Mañalich Gálvez

La deuda implicita y el desequilibrio financiero-actuarial de un sistema de pensiones. El caso del régimen general de la seguridad social en España
José Enrique Devesa Carpio y Mar Devesa Carpio

Efectos de la descentralización fiscal sobre el precio de los carburantes en España
Desiderio Romero Jordán, Marta Jorge García-Inés y Santiago Álvarez García

Euro, firm size and export behavior
Silviano Esteve-Pérez, Salvador Gil-Pareja, Rafael Llorca-Vivero and José Antonio Martínez-Serrano

Does social spending increase support for free trade in advanced democracies?
Ismael Sanz, Ferran Martínez i Coma and Federico Steinberg

Potencial de Mercado y Estructura Espacial de Salarios: El Caso de Colombia
Jesús López-Rodríguez y Maria Cecilia Acevedo

Persistence in Some Energy Futures Markets
Juncal Cunado, Luis A. Gil-Alana and Fernando Pérez de Gracia

La inserción financiera externa de la economía francesa: inversores institucionales y nueva gestión empresarial
Ignacio Álvarez Peralta

¿Flexibilidad o rigidez salarial en España?: un análisis a escala regional
Ignacio Moral Arce y Adolfo Maza Fernández

Intangible relationship-specific investments and the performance of r&d outsourcing agreements
Andrea Martínez-Noya, Esteban Garcia-Canal & Mauro F. Guillén

Friendly or Controlling Boards?
Pablo de Andrés Alonso & Juan Antonio Rodríguez Sanz
<table>
<thead>
<tr>
<th>No.</th>
<th>Año</th>
<th>Título</th>
<th>Autor(es)</th>
</tr>
</thead>
<tbody>
<tr>
<td>440/2009</td>
<td>2009</td>
<td>Continental bias in trade</td>
<td>Salvador Gil-Pareja, Rafael Llorca-Vivero &amp; José Antonio Martínez Serrano</td>
</tr>
<tr>
<td>441/2009</td>
<td>2009</td>
<td>Determining operational capital at risk: an empirical application to the retail banking</td>
<td>Enrique José Jiménez-Rodriguez, José Manuel Feria-Dominguez &amp; José Luis Martín-Marín</td>
</tr>
<tr>
<td>442/2009</td>
<td>2009</td>
<td>Costes de mitigación y escenarios post-kyoto en España: un análisis de equilibrio general para España</td>
<td>Mikel González Ruiz de Eguino</td>
</tr>
<tr>
<td>443/2009</td>
<td>2009</td>
<td>Las revistas españolas de economía en las bibliotecas universitarias: ranking, valoración del indicador y del sistema</td>
<td>Valentín Edo Hernández</td>
</tr>
<tr>
<td>444/2009</td>
<td>2009</td>
<td>Convergencia económica en España y coordinación de políticas económicas. un estudio basado en la estructura productiva de las CC.AA.</td>
<td>Ana Cristina Mingorance Arnáiz</td>
</tr>
<tr>
<td>445/2009</td>
<td>2009</td>
<td>Instrumentos de mercado para reducir emisiones de co2: un análisis de equilibrio general para España</td>
<td>Mikel González Ruiz de Eguino</td>
</tr>
<tr>
<td>446/2009</td>
<td>2009</td>
<td>El comercio intra e inter-regional del sector Turismo en España</td>
<td>Carlos Llano y Tamara de la Mata</td>
</tr>
<tr>
<td>447/2009</td>
<td>2009</td>
<td>Efectos del incremento del precio del petróleo en la economía española: Análisis de cointegración y de la política monetaria mediante reglas de Taylor</td>
<td>Fernando Hernández Martínez</td>
</tr>
<tr>
<td>449/2009</td>
<td>2009</td>
<td>Global Economy Dynamics? Panel Data Approach to Spillover Effects</td>
<td>Gregory Daco, Fernando Hernández Martínez &amp; Li-Wu Hsu</td>
</tr>
<tr>
<td>450/2009</td>
<td>2009</td>
<td>Pricing levered warrants with dilution using observable variables</td>
<td>Isabel Abínzano &amp; Javier F. Navas</td>
</tr>
<tr>
<td>452/2009</td>
<td>2009</td>
<td>A Detailed Comparison of Value at Risk in International Stock Exchanges</td>
<td>Pilar Abad &amp; Sonia Benito</td>
</tr>
<tr>
<td>453/2009</td>
<td>2009</td>
<td>Understanding offshoring: has Spain been an offshoring location in the nineties?</td>
<td>Belén González-Diaz &amp; Rosario Gandoy</td>
</tr>
<tr>
<td>454/2009</td>
<td>2009</td>
<td>Outsourcing decision, product innovation and the spatial dimension: Evidence from the Spanish footwear industry</td>
<td>José Antonio Belso-Martinez</td>
</tr>
</tbody>
</table>
Does playing several competitions influence a team’s league performance? Evidence from Spanish professional football
Andrés J. Picazo-Tadeo & Francisco González-Gómez

Does accessibility affect retail prices and competition? An empirical application
Juan Luis Jiménez and Jordi Perdiguero

Cash conversion cycle in smes
Sonia Baños-Caballero, Pedro J. García-Teruel and Jordi Martínez-Solano

Un estudio sobre el perfil de hogares endeudados y sobreendeudados: el caso de los hogares vascos
Alazne Mujika Alberdi, Iñaki García Arrizabalaga y Juan José Gibaja Martínez

Imposing monotonicity on outputs in parametric distance function estimations: with an application to the spanish educational production
Sergio Perelman and Daniel Santín

Key issues when using tax data for concentration analysis: an application to the Spanish wealth tax
José Mª Durán-Cabré and Alejandro Esteller-Moré

¿Se está rompiendo el mercado español? Una aplicación del enfoque de feldstein –horioka
Saúl De Vicente Queijeiro, José Luis Pérez Rivero y María Rosalía Vicente Cuervo

Financial condition, cost efficiency and the quality of local public services
Manuel A. Muñiz & José L. Zafra

Including non-cognitive outputs in a multidimensional evaluation of education production: an international comparison
Marián García Valiñas & Manuel Antonio Muñiz Pérez

A political look into budget deficits. The role of minority governments and oppositions
Albert Falcó-Gimeno & Ignacio Jurado

La simulación del cuadro de mando integral. Una herramienta de aprendizaje en la materia de contabilidad de gestión
Elena Urquía Grande, Clara Isabel Muñoz Colomina y Elisa Isabel Cano Montero

Análisis histórico de la importancia de la industria de la desalinización en España
Borja Montaño Sanz

The dynamics of trade and innovation: a joint approach
Silviano Esteve-Pérez & Diego Rodríguez

Measuring international reference-cycles
Sonia de Lucas Santos, Inmaculada Álvarez Ayuso & Mª Jesús Delgado Rodríguez

Measuring quality of life in Spanish municipalities
Eduardo González Fidalgo, Ana Cárcaba García, Juan Ventura Victoria & Jesús García García

¿Cómo se valoran las acciones españolas: en el mercado de capitales doméstico o en el europeo?
Begoña Font Belaire y Alfredo Juan Grau Grau

Patterns of e-commerce adoption and intensity. evidence for the european union
Maria Rosalia Vicente & Ana Jesús López
472/2009  On measuring the effect of demand uncertainty on costs: an application to port terminals
Ana Rodríguez-Álvarez, Beatriz Tovar & Alan Wall

473/2009  Order of market entry, market and technological evolution and firm competitive performance
Jaime Gómez, Gianvito Lanzolla & Juan Pablo Maicas

474/2009  La Unión Económica y Monetaria Europea en el proceso exportador de Castilla y León (1993-2007): un análisis de datos de panel
Almudena Martínez Campillo y Mª del Pilar Sierra Fernández

475/2009  Do process innovations boost SMEs productivity growth?
Juan A. Mañez, María E. Rochina Barrachina, Amparo Sanchis Llopis & Juan A. Sanchis Llopis

476/2009  Incertidumbre externa y elección del modo de entrada en el marco de la inversión directa en el exterior
Cristina López Duarte y Marta Mª Vidal Suárez

477/2009  Testing for structural breaks in factor loadings: an application to international business cycle
José Luis Cendejas Bueno, Sonia de Lucas Santos, Inmaculada Álvarez Ayuso & Mª Jesús Delgado Rodríguez

478/2009  ¿Esconde la rigidez de precios la existencia de colusión? El caso del mercado de carburantes en las Islas Canarias
Juan Luis Jiménez y Jordi Perdiguero

479/2009  The poni test with structural breaks
Antonio Aznar & María-Isabel Ayuda

480/2009  Accuracy and reliability of Spanish regional accounts (CRE-95)
Verónica Cañal Fernández

481/2009  Estimating regional variations of R&D effects on productivity growth by entropy econometrics
Esteban Fernández-Vázquez y Fernando Rubiera-Morollón

482/2009  Why do local governments privatize the provision of water services? Empirical evidence from Spain
Francisco González-Gómez, Andrés J. Picazo-Tadeo & Jorge Guardiola

483/2009  Assessing the regional digital divide across the European Union-27
María Rosalía Vicente & Ana Jesús López

484/2009  Measuring educational efficiency and its determinants in Spain with parametric distance functions
José Manuel Cordero Ferrera, Eva Crespo Cebada & Daniel Santín González

485/2009  Spatial analysis of public employment services in the Spanish provinces
Patricia Suárez Cano & Matías Mayor Fernández

486/2009  Trade effects of continental and intercontinental preferential trade agreements
Salvador Gil-Pareja, Rafael Llorca-Vivero & José Antonio Martínez-Serrano

487/2009  Testing the accuracy of DEA for measuring efficiency in education under endogeneity
Salvador Gil-Pareja, Rafael Llorca-Vivero & José Antonio Martínez-Serrano

488/2009  Measuring efficiency in primary health care: the effect of exogenous variables on results
José Manuel Cordero Ferrera, Eva Crespo Cebada & Luis R. Murillo Zamorano
489/2009 Capital structure determinants in growth firms accessing venture funding
Marina Balboa, José Martí & Álvaro Tresierra

490/2009 Determinants of debt maturity structure across firm size
Victor M. González

491/2009 Análisis del efecto de la aplicación de las NIIF en la valoración de las salidas a bolsa
Susana Álvarez Otero y Eduardo Rodríguez Enríquez

492/2009 An analysis of urban size and territorial location effects on employment probabilities: the Spanish case
Ana Viñuela-Jiménez, Fernando Rubiera-Morollón & Begoña Cueto

493/2010 Determinantes de la estructura de los consejos de administración en España
Isabel Acero Fraile y Nuria Alcalde Fradejas

494/2010 Performance and completeness in repeated inter-firm relationships: the case of franchising
Vanesa Solis-Rodriguez & Manuel Gonzalez-Diaz

495/2010 A Revenue-Based Frontier Measure of Banking Competition
Santiago Carbó, David Humphrey & Francisco Rodríguez

496/2010 Categorical segregation in social networks
Antoni Rubí-Barceló

497/2010 Beneficios ambientales no comerciales de la directiva marco del agua en condiciones de escasez: análisis económico para el Guadalquivir
Julia Martín-Ortega, Giacomo Giannoccaro y Julio Berbel Vecino

498/2010 Monetary integration and risk diversification in eu-15 sovereign debt markets
Juncal Cuñado & Marta Gómez-Puig

José Antonio Carrasco Gallego

500/2010 The role of learning in firm R&D persistence
Juan A. Mañez, María E. Rochina-Barrachina, Amparo Sanchis-Llopis & Juan A. Sanchis-Llopis

501/2010 Is venture capital more than just money?
Marina Balboa, José Martí & Nina Zieling

502/2010 On the effects of supply strategy on business performance: do the relationships among generic competitive objectives matter?
Javier González-Benito

503/2010 Corporate cash holding and firm value
Cristina Martínez-Sola, Pedro J. García-Teruel & Pedro Martínez-Solano

504/2010 El impuesto de flujos de caja de sociedades: una propuesta de base imponible y su aproximación contable en España
Lourdes Jerez Barroso y Joaquín Texeira Quirós

505/2010 The effect of technological, commercial and human resources on the use of new technology
Jaime Gómez & Pilar Vargas
506/2010 ¿Cómo ha afectado la fiscalidad a la rentabilidad de la inversión en vivienda en España? 
Un análisis para el periodo 1996 y 2007
Jorge Onrubia Fernández y María del Carmen Rodado Ruiz

507/2010 Modelización de flujos en el análisis input-output a partir de la teoría de redes
Ana Salomé García Muñiz

508/2010 Export-led-growth hypothesis revisited. a balance of payments approach for Argentina, Brazil, Chile and Mexico
David Matesanz Gómez & Guadalupe Fugarolas Álvarez-Ude

509/2010 Realised hedge ratio properties, performance and implications for risk management: evidence from the spanish ibex 35 spot and futures markets
David G McMillan & Raquel Quiroga García