PERSISTENCE IN SOME ENERGY FUTURES MARKETS

JUNCAL CUNADO
LUIS A. GIL-ALANA
FERNANDO PÉREZ DE GRACIA

FUNDACIÓN DE LAS CAJAS DE AHORROS
DOCUMENTO DE TRABAJO
Nº 434/2008
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.
Abstract

In this paper, we examine the possibility of long range dependence in some energy futures markets for different maturities. In order to test for persistence, we use a variety of techniques based on non-parametric, semiparametric and parametric methods. The results indicate that there is little or no evidence of long memory in gasoline, propane, oil and heating oil at different maturities. However, when we focus on the volatility process, proxied by the absolute returns, we find strong evidence of long memory in all the variables at different contracts.

Key words: Persistence; Long memory; Futures; Energy prices; Volatility.

JEL classification: C32; C59; Q40.
1. Introduction

It is commonly accepted that the dynamics of energy prices explain some of the main economic indicators. For example, Hamilton (2008) in a recent survey of the literature on the macroeconomic effects of oil shocks documented that nine out of ten of the US recessions were preceded by increases in the oil price, suggesting then its role as an explanatory variable of economic recessions. Many empirical papers show evidence that energy prices affect macroeconomic variables (e.g., Hamilton, 1983; Hooker, 1996; Kilian, 2008a,b; Tatom, 1988 and Mork, 1989 among many others). Other studies not only consider the change in oil price as a main determinant of inflation and economic activity but also the oil price volatility as a proxy variable of the level of uncertainty about future oil prices. Papers analysing the relevance of the relationship between oil price volatility and the macroeconomy are Hamilton (1996, 2003) and Guo and Kliesen (2005). Thus, for example, Guo and Kliesen (2005) find that a volatility measure constructed using daily crude oil future prices has a negative and significant effect on GDP growth over the period 1984-2004.

As we have shown in the preceding paragraph, it is relevant to understand the dynamic behavior of energy prices. In this paper we focus on the persistence in both energy price returns and their associated volatility processes. Starting with the level of the series, a number of papers have analyzed mean reversion in energy prices (see, e.g., Serletis, 1992; Gil-Alana, 2001 and Postali and Picchetti, 2006). Serletis (1992) using daily crude oil, heating oil and unleaded gasoline tests for unit roots using standard methods. His results support the unit root hypothesis when a structural break is taken into account. More recently, Postali and Picchetti (2006) argue against the existence of unit roots when a period longer than a century is considered. However, if structural
breaks are taken into account, unit roots remain in shorter periods. Other authors focus
the interest on the volatility processes (see, for example, Sadorsky, 2006; Tabak and
univariate and multivariate models to estimate and forecast daily volatility in energy
futures prices. Tabak and Cajueiro (2007) also analyze volatility in crude oil markets
using long range dependence techniques, based on the rescaled range (R/S) statistic
(Hurst, 1951). In another recent paper, Elder and Serletis (2008) test for fractional
integration in energy futures markets using semiparametric wavelet estimation methods.
Studies on volatility in futures markets use absolute returns (see, for example, Elder and
Jin, 2007) or alternative statistical models (i.e., the family of GARCH models) (see, for
example, Sadorsky, 2006).

In a similar vein to the above papers, we also examine the degree of persistence
in some energy future markets, using various procedures for estimating and testing long
range dependence. We use alternative methods, based on non-parametric (i.e., Lo, 1991,
Giraitis et al., 2003), semiparametric (i.e., Robinson, 1995) and parametric (i.e., Sowell,

The paper embraces two principal contributions. First, we focus on futures of
energy analyzing persistence in both levels and volatility processes. Previous studies
only focus on prices or volatility. Second, we use three alternative approaches to
document the persistence in futures markets, based on non-parametric, semiparametric
and parametric techniques. It is well known that the results on persistence can
substantially vary depending on the methodology employed. In this respect, the use of a
variety of methods with different distributional assumptions may contribute to
achieving a better overall picture of the degree of persistence of the series.
The structure of the paper is as follows. Section 2 briefly describes the methods of long range dependence that will be employed in the paper. In Section 3, the procedures presented in Section 2 are applied in both the returns and their associated volatility processes. Section 4 contains some concluding comments.

2. Methodology

In this section we present a brief description of the methods employed in Section 3 for estimating and testing long range dependence in some energy futures markets. In all cases we consider the possibility that the underlying model is long memory.

We can provide two definitions of long memory, one in the time domain and the other in the frequency domain. Let us consider a zero-mean process \( \{ x_t, t = 0, \pm 1, \ldots \} \) with \( \gamma_u = E(x_t x_{t-u}) \). The time domain definition of long memory states that:

\[
\sum_{u=-\infty}^{\infty} |\gamma_u| = \infty.
\]

Now, assuming that \( x_t \) has an absolutely continuous spectral distribution, so that it has spectral density function

\[
f(\lambda) = \frac{1}{2\pi} \left( \gamma_0 + 2 \sum_{u=1}^{\infty} \gamma_u \cos(\lambda u) \right),
\]

the frequency domain definition of long memory states that the spectral density function is unbounded at some frequency in the interval \([0, \pi)\). Most of the empirical work carried out so far has concentrated on the case where the singularity or pole in the spectrum takes place at the zero frequency. This is the standard case of \( I(d) \) models of the form:

\[
(1 - L)^d x_t = u_t, \quad t = 0, \pm 1, \ldots,
\] (1)
with \( d > 0 \), where \( L \) is the lag-operator \((Lx_t = x_{t-1})\) and \( u_t \) is \( I(0) \). Note that the polynomial in the left-hand-side in (1) can be expressed in terms of its Binomial expansion, such that, for all real \( d \),

\[
(1-L)^d = \sum_{j=0}^{\infty} \binom{d}{j} L^j (-1)^j = 1 - dL + \frac{d(d-1)}{2}L^2 - \ldots,
\]

and (1) can be written as:

\[
x_t = d x_{t-1} - \frac{d(d-1)}{2} x_{t-2} + \ldots + u_t.
\]

If \( d \) is an integer value, \( x_t \) will be a function of a finite number of past observations, while if \( d \) is not an integer, \( x_t \) depends strongly upon values of the time series far away in the past. (See, e.g., Granger and Ding, 1996; Dueker and Startz, 1998). Moreover, the higher the \( d \) is, the higher the level of association will be between the observations. Thus, \( d \) is an indicator of the degree of persistence of the series.\(^1\)

The parameter \( d \) also plays a crucial role from the statistical viewpoint. Thus, if \( d = 0 \), \( x_t \) is stationary \( I(0) \) and is commonly denoted as “short memory”; on the contrary, if \( d > 0 \), \( x_t \) is said to be “long memory” so-named because of the strong degree of association between observations in the far distant past, and if \( 0 < d < 0.5 \), the series is still covariance stationary; however, if \( d \geq 0.5 \), the series is no longer stationary and as \( d \) increases beyond 0.5 and through 1 the series is becoming “more nonstationary” in the sense, for example, that the partial sums increase in magnitude with \( d \) being non-summable. In the following we describe some methods for testing long memory (and fractional integration) in univariate time series.

\(^1\) For recent surveys of fractional integration see the papers of Robinson (2003), Doukhan et al. (2003) and more recently, Gil-Alana and Hualde (2008).
2.1 A non-parametric approach

We start with the non-parametric procedures. The two methods presented here test the null hypothesis of short memory (i.e. $d = 0$ in (1)) against long memory ($d > 0$) and/or anti-persistence ($d < 0$). First we describe a procedure developed by Lo (1991). The modified R/S statistic (Lo, 1991) is:

$$Q_T(q) = \frac{1}{\hat{\sigma}_T(q)} \left( \max_{1 \leq k \leq T} \sum_{j=1}^{k} (x_t - \bar{x}) - \min_{1 \leq k \leq T} \sum_{j=1}^{k} (x_t - \bar{x}) \right),$$

where $\hat{\sigma}_T^2(q) = \hat{\sigma}_x^2 + 2 \sum_{j=1}^{q} \omega_j(q) \hat{\gamma}_j$, and $\omega_j(q) = 1 - \frac{j}{q+1}$, $1 \leq j < T$,

and $x_t$ is a stationary series (-0.5 < $d$ < 0.5) of sample size $T$, with sample mean $\bar{x}$, sample variance $\hat{\sigma}_x^2$, and sample autocovariance at lag $j$ given by $\hat{\gamma}_j$. This statistic was further normalized as:

$$V_T(q) = \frac{Q_T(q)}{\sqrt{T}}. \quad (2)$$

The null hypothesis of I(0) includes ARMA models, though as pointed out by Haubrich and Lo (2001) does not contain a trend-stationary model. The limiting distribution of $V_T(q)$ is derived in Lo (1991) and the 95% confidence interval with equal probabilities in both tails is [0.809, 1.862]. Several Monte Carlo experiments conducted by Teverovsky et al. (1999) and Willinger et al. (1999) show that this method is biased in favor of accepting the null of no long memory as the bandwidth parameter $q$ increases. Therefore, these authors were cautionary about using Lo’s modified method in isolation.

Another recent non-parametric approach is the rescaled-variance V/S statistic proposed by Giraitis, Kokoszka, Leipus and Teyssiere (2003), which is given by
\[ M_T(q) = \frac{Var(S_1^*, S_2^*, \ldots, S_T^*)}{T \hat{\sigma}^2_T(q)}, \]

where \( S_k^* = \sum_{j=1}^{k}(x_t - \bar{x}), \) and \( Var(S_1^*, S_2^*, \ldots, S_T^*) = \frac{1}{T} \sum_{j=1}^{T} (S_j^* - \bar{S}^*) \) is their sample variance. According to Giraitis et al. (2003) the V/S test is more suitable for series that exhibit high volatility, and various Monte Carlo experiments conducted by these authors show that the V/S test is shown to be less sensitive to the choice of the bandwidth number \( q. \) The asymptotic distribution of \( M_T(q) \) coincides with the limiting distribution of the standard Kolmogorov statistic.

A final comment is worthy of mention at this point and it is related with the choice of the optimal bandwidth number \( q^* (q^*) \) in the two methods described above: \( q = 0 \) correspond to the classic Hurst-Mandelbrot R/S statistic. Haubrich and Lo (2001) suggested using Andrew’s (1991) data-dependent procedure to determine the optimal bandwidth, which is given by

\[ q^* = \left( \frac{3 \hat{\rho} T}{2} \right)^{\frac{1}{3}}, \]

with

\[ a^* = \frac{4 \hat{\rho}^2}{(1 - \hat{\rho}^2)^2}, \]

where \( \hat{\rho} \) is the first order AR coefficient.

### 2.2 A semi-parametric approach

The method presented here is based on equation (1), where \( u_t \) is simply supposed to be I(0). We describe a procedure developed by Robinson (1995), which is essentially a
local ‘Whittle estimator’ in the frequency domain, using a band of frequencies that
degenerates to zero. The estimator is implicitly defined by:

\[
\hat{d} = \arg \min_d \left( \log C(d) - 2d \frac{1}{m} \sum_{s=1}^{m} \log \lambda_s \right),
\]

\[
C(d) = \frac{1}{m} \sum_{s=1}^{m} I(\lambda_s) \lambda_s^{2d}, \quad \lambda_s = \frac{2 \pi s}{T}, \quad \frac{m}{T} \to 0,
\]

where \( I(\lambda_s) \) is the periodogram of the raw time series, \( x_t \), given by:

\[
I(\lambda_s) = \frac{1}{2 \pi T} \left| \sum_{t=1}^{T} x_t e^{i \lambda_s t} \right|^2,
\]

and \( d \in (-0.5, 0.5) \). Under finiteness of the fourth moment and other mild conditions, Robinson (1995) proved that:

\[
\sqrt{m} (\hat{d} - d_o) \to_d N(0, 1/4) \quad \text{as } T \to \infty,
\]

where \( d_o \) is the true value of \( d \).

Though there exist further refinements of this procedure, (Velasco, 1999, Phillips and Shimotsu, 2004, 2005; etc.), these methods require additional user-chosen parameters and then, the results concerning the estimation of \( d \) may be very sensitive to the choice of these parameters. In this respect, the method of Robinson (1995) seems computationally simpler.

### 2.3 A parametric approach

There exist several methods for estimating and testing the fractional differencing parameter in parametric contexts (e.g., Sowell, 1992; Beran, 1993; Tanaka, 1999; etc.). In this paper we perform a suitable method suggested by Robinson (1994). There are several reasons for using this method. First, it permits us to include deterministic terms...
such as an intercept or a linear time trend unlike what happens with other methods such as Lo’s (1991) non-parametric approach. Another advantage of this method is that it is valid for any real value of $d$, therefore encompassing stationary ($d < 0.5$) and nonstationary ($d \geq 0.5$) hypotheses, unlike the methods described in Section 2.1 and 2.2 that require first differencing to render the series stationary prior to the estimation of $d$. We employ here the following model,

$$y_t = \beta_0 + x_t, \quad t = 1, 2, ...$$  \hspace{1cm} (6)

$$(1 - L)^d x_t = u_t, \quad t = 1, 2, ..., \hspace{1cm} (7)$$

where $u_t$ is assumed to be I(0), and given the parametric nature of this method, $u_t$ has to have a parametric form, that may be a white noise process, or more generally, allowing some type of weak autocorrelation (i.e, ARMA) structure. In this approach we test the null hypothesis:

$$H_0: \quad d = d_o,$$

for any real value $d_o$ in (6) and (7), and the limit distribution is standard $N(0, 1)$. The functional form of the test statistic can be found in any of the numerous empirical applications of his tests (e.g. Gil-Alana and Robinson, 1997, Gil-Alana, 2000, etc.).

3 Evidence of persistence in energy futures markets

The time series data analysed in this section correspond to the log-transformation of daily energy futures prices. All data are obtained from the Energy Information Agency. The sample period for each of the variables is described in Appendix 1.

We use four alternative energy futures prices: crude oil, gasoline, heating oil and propane. For each variable we have four different maturity contracts. Contract 1 is defined as a futures contract specifying the earliest delivery date. Contracts 2 to 4
represent the successive delivery months following Contract 1. For detailed information relating to future energy contracts see the Energy Information Agency web site. Contracts for gasoline, heating oil, and propane expire on the last business day of the month preceding the delivery month. Thus, the delivery month for Contract 1 is the calendar month following the trade date. For crude oil, each contract expires on the third business day prior to the 25th calendar day of the month preceding the delivery month. If the 25th calendar day of the month is a non-business day, trading ceases on the third business day prior to the business day preceding the 25th calendar day. After a contract expires, Contract 1 for the remainder of that calendar month is the second following month.

In this section we examine the possibility of long memory in both the returns and their associated volatility processes in the oil futures with different maturities using alternative methods.

3.1 Persistence in energy future returns

Initially, we implement the test of Lo (1991) described in Section 2.1 to the returns of the four futures of energy prices. Table 1 reports the modified R/S statistic for gasoline, propane, oil and heating oil at different contracts. All futures returns present evidence of I(0) suggesting that the four series are stationary at all contracts. This result holds for all values of the bandwidth number q, including the one based on Andrew’s (1991) procedure in (4). However, using the V/S statistic proposed by Giraitis et al. (2003), (see, Table 2), the results reject the null hypothesis of I(0) processes in all cases.²

² The rejection of the null in the Giraitis et al.’s (2003) procedure may be related with the existence of long memory volatility in the underlying processes. See Section 3.2.
The disparity of the results based on the non-parametric methods suggest that we should try with other approaches. Next we implement the Whittle semiparametric method of Robinson (1995). Figure 1 presents the estimates of d based on Robinson (1995) (see equation (5)) using the whole range of values of the bandwidth number m (displayed in the horizontal axe). We also display in the plots the 95% confidence interval corresponding to the I(0) case. We find mixed evidence. First, we only find evidence of I(d > 0) for propane in contracts 1 and 2 for some bandwidth numbers. Second, we obtain some evidence of I(d < 0) (i.e., anti-persistence) in the following cases: contracts 1 and 4 of gasoline, and contract 1 of oil and heating oil. A similar result of anti-persistence is found by Elder and Serletis (2008), showing that the variance of energy futures prices may be dominated by high frequency components. Finally, for the remaining cases, the estimated values of d are within the I(0) interval.

Finally, we use Robinson’s (1994) parametric tests to determine the degree of persistence in the future energy markets. Table 3 reports the results based on white noise, AR(1) and Bloomfield disturbances. The latter is a non-parametric approach of modelling the I(0) disturbances that produce autocorrelations decaying exponentially as in the AR case. Using this method, the first thing we observe is that the results are consistent across the three types of disturbances. We report in the table the estimates of d along with the 95% confidence intervals of the non-rejection values of d. The I(0) null hypothesis cannot be rejected in many cases and some estimates of d are above 0

---

3 In case of the Whittle estimator of Robinson (1995), the use of optimal values has not been theoretically justified. Some authors, such as Lobato and Savin (1998) use an interval of values for m. We have preferred to report the results for the whole range of values of m.

4 The confidence intervals were constructed using the following strategy. First, choose a value of d from a grid. Then, form the test statistic testing the null for this value. If the null is rejected at the 95% level, discard this value of d. Otherwise, keep it. An interval is then obtained after considering all the values of d in the grid.
while others are below 0. The main results can be summarized as follows. Firstly, for gasoline, the I(0) hypothesis cannot be rejected in the cases of contracts 1, 2 and 3 if the disturbances are white noise. However, this hypothesis is rejected in favor of a negative d for contract 4 with white noise u_t, and for the four gasoline series if the disturbances are autocorrelated. Secondly, for the propane, the estimated d’s are in all cases positive though the I(0) case cannot be rejected in the majority of cases. The exceptions are contracts 1, 2 and 3 with uncorrelated (white noise) errors. Third, for oil prices, we observe negative values of d in practically all cases, and, if u_t is autocorrelated the I(0) hypothesis is always rejected in favor of d < 0. Finally, for heating oil, we also obtain negative values of d, but now the I(0) hypothesis is practically never rejected. The exceptions are contract 1 in all cases, and contracts 2 and 4 with white noise u_t. Thus, the overall picture in this table indicates that the order of differencing is negative or zero in the majority of the cases.

### 3.2. Evidence of persistence in volatility

In this sub-section we conduct the same type of analysis as in Section 3.1 but now we focus on the volatility measured as the absolute returns of energy futures prices.5

We start again with the non-parametric methods. Using the modified R/S statistic of Lo (1991) the results for the four series reject the null of I(0) in favour of long memory behaviour. (see Table 4). Table 5 present the results using the V/S statistic (Giraitis et al., 2003) and, in this case, the results also support the long memory hypothesis (I(d, d > 0)) in all series for different maturities.
Figure 2 reports the results based on the Whittle semiparametric method of Robinson (1995). We see that for all the variables and contracts, the value of d is found to be statistically significantly above 0, suggesting once more long memory in the volatility process.

Finally, we perform the parametric procedure of Robinson (1994). For all the energy variables and contracts, the estimates are positive and the intervals exclude the I(0) hypothesis. The lowest degree of persistence in the volatility processes seems to take place for gasoline (contracts 2 and 4) and heating oil (contracts 2 and 4) especially if the disturbances are uncorrelated. On the other extreme, the highest values occur in propane and oil for all different contracts, with values above 0.250 if the disturbances are autocorrelated. The same happens for heating and oil in contract 1.

When we observe the impact of maturity, the results are not very conclusive. Comparing contracts 1 and 4 across series and types of disturbances, in Table 6, it is observed that the estimated orders of integration in contract 1 are higher than in contract 4 in ten out of the twelve cases presented, however, the overlapping confidence intervals indicate that the results are inconclusive.

4. Conclusions and comments

The dynamic behavior in energy prices is one of the most relevant issues in the global economy. In this paper we have documented evidence of the persistence on futures price returns and volatility in several energy markets (crude oil, gasoline, heating oil and propane) for different maturities. To test this hypothesis we used various alternative

---

5 Previous studies on volatility in futures markets also use absolute returns (see, for example, Elder and Jin, 2007).
long-range dependence procedures based on non-parametric, semiparametric and parametric techniques.

The main findings of the paper can be summarized as follows: We found little or no evidence of long memory in the energy future prices returns, and this was observed across different maturity rates. However, we found strong evidence of long memory in the volatility processes (measured as absolute returns) in all the four variables. These results are consistent with other financial variables where long range dependence is found exclusively on the volatility processes. When we examine persistence in levels, the estimated values of $d$ are positive for propane and negative for the rest of the variables. We found the highest values of $d$ in contract 1 for propane and oil. If we focus on the volatility processes, the estimated values of $d$ are in all cases positive, and higher for contract 1 in propane and heating oil. In addition, for propane, the persistence decays as the maturity of the contract increases. Finally, the degree of persistence seems to be higher in contract 1 for gasoline, propane and heating oil compared with contract 4.

Long memory is a relevant feature for energy future markets because its presence can be interpreted as evidence of predictable behavior. Energy price and volatility persistence are key variables for risk and portfolio managers. Some degree of predictability would be interpreted as there existing a possibility of exploiting the dependence in order to generate some extraordinary profits. In this context we find evidence of some degree of volatility persistence in all energy futures markets. For example, it seems to be the case that the degree of volatility persistence is higher in the oil market than in the gasoline market. This result would suggest that there exists more profit opportunities for investors in oil than in gasoline markets, because there is more time to respond to changes in volatility in oil than in gasoline.
This paper can be extended in several directions. Thus, longer periods of time can be examined and the possibility of structural breaks should be incorporated into the models. Asymmetric behaviour in energy futures prices is another interesting issue, and models combining fractional integration with non-linearities should be elaborated. Finally, multivariate models including all future contracts in a single framework will also be examined in future papers.
References


Energy Information Agency, (http://www.eia.doe.gov/)


Table 1: Lo’s (1991) modified R/S statistic results (VT(q))

<table>
<thead>
<tr>
<th>Series / q</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>10</th>
<th>50</th>
<th>100</th>
<th>500</th>
<th>q*</th>
</tr>
</thead>
<tbody>
<tr>
<td>GASOC1</td>
<td>0.988</td>
<td>0.971</td>
<td>0.967</td>
<td>0.973</td>
<td>0.980</td>
<td>0.987</td>
<td>1.034</td>
<td>1.079</td>
<td>1.190</td>
<td>1.553</td>
<td>0.973</td>
</tr>
<tr>
<td>GASOC2</td>
<td>0.945</td>
<td>0.939</td>
<td>0.944</td>
<td>0.947</td>
<td>0.953</td>
<td>0.960</td>
<td>0.991</td>
<td>1.030</td>
<td>1.123</td>
<td>1.390</td>
<td>0.939</td>
</tr>
<tr>
<td>GASOC3</td>
<td>1.103</td>
<td>1.086</td>
<td>1.080</td>
<td>1.081</td>
<td>1.085</td>
<td>1.089</td>
<td>1.128</td>
<td>1.106</td>
<td>1.180</td>
<td>1.416</td>
<td>1.081</td>
</tr>
<tr>
<td>GASOC4</td>
<td>0.998</td>
<td>1.022</td>
<td>1.037</td>
<td>1.045</td>
<td>1.054</td>
<td>1.061</td>
<td>1.097</td>
<td>1.163</td>
<td>1.257</td>
<td>1.349</td>
<td>1.045</td>
</tr>
<tr>
<td>PROPC1</td>
<td>1.323</td>
<td>1.275</td>
<td>1.245</td>
<td>1.237</td>
<td>1.237</td>
<td>1.235</td>
<td>1.240</td>
<td>1.194</td>
<td>1.258</td>
<td>1.503</td>
<td>1.235</td>
</tr>
<tr>
<td>PROPC2</td>
<td>1.339</td>
<td>1.305</td>
<td>1.287</td>
<td>1.281</td>
<td>1.282</td>
<td>1.279</td>
<td>1.282</td>
<td>1.214</td>
<td>1.257</td>
<td>1.495</td>
<td>1.282</td>
</tr>
<tr>
<td>PROPC3</td>
<td>1.292</td>
<td>1.261</td>
<td>1.245</td>
<td>1.234</td>
<td>1.237</td>
<td>1.235</td>
<td>1.250</td>
<td>1.185</td>
<td>1.213</td>
<td>1.447</td>
<td>1.237</td>
</tr>
<tr>
<td>PROPC4</td>
<td>1.241</td>
<td>1.225</td>
<td>1.216</td>
<td>1.206</td>
<td>1.207</td>
<td>1.201</td>
<td>1.224</td>
<td>1.145</td>
<td>1.164</td>
<td>1.396</td>
<td>1.216</td>
</tr>
<tr>
<td>OILC1</td>
<td>0.942</td>
<td>0.943</td>
<td>0.961</td>
<td>0.981</td>
<td>0.989</td>
<td>1.001</td>
<td>1.057</td>
<td>1.043</td>
<td>1.081</td>
<td>1.330</td>
<td>0.943</td>
</tr>
<tr>
<td>OILC2</td>
<td>1.05</td>
<td>1.043</td>
<td>1.050</td>
<td>1.063</td>
<td>1.068</td>
<td>1.076</td>
<td>1.114</td>
<td>1.078</td>
<td>1.106</td>
<td>1.373</td>
<td>1.050</td>
</tr>
<tr>
<td>OILC3</td>
<td>1.127</td>
<td>1.117</td>
<td>1.124</td>
<td>1.136</td>
<td>1.139</td>
<td>1.147</td>
<td>1.183</td>
<td>1.128</td>
<td>1.149</td>
<td>1.338</td>
<td>1.117</td>
</tr>
<tr>
<td>OILC4</td>
<td>1.120</td>
<td>1.120</td>
<td>1.130</td>
<td>1.144</td>
<td>1.149</td>
<td>1.157</td>
<td>1.195</td>
<td>1.129</td>
<td>1.142</td>
<td>1.349</td>
<td>1.120</td>
</tr>
<tr>
<td>HEATC1</td>
<td>0.981</td>
<td>0.987</td>
<td>0.991</td>
<td>1.004</td>
<td>1.015</td>
<td>1.027</td>
<td>1.096</td>
<td>1.126</td>
<td>1.166</td>
<td>1.423</td>
<td>0.991</td>
</tr>
<tr>
<td>HEATC2</td>
<td>1.043</td>
<td>1.061</td>
<td>1.068</td>
<td>1.074</td>
<td>1.081</td>
<td>1.088</td>
<td>1.127</td>
<td>1.183</td>
<td>1.236</td>
<td>1.354</td>
<td>1.074</td>
</tr>
<tr>
<td>HEATC3</td>
<td>1.189</td>
<td>1.184</td>
<td>1.184</td>
<td>1.191</td>
<td>1.196</td>
<td>1.206</td>
<td>1.248</td>
<td>1.138</td>
<td>1.150</td>
<td>1.463</td>
<td>1.184</td>
</tr>
<tr>
<td>HEATC4</td>
<td>1.127</td>
<td>1.153</td>
<td>1.163</td>
<td>1.166</td>
<td>1.171</td>
<td>1.175</td>
<td>1.205</td>
<td>1.208</td>
<td>1.230</td>
<td>1.378</td>
<td>1.166</td>
</tr>
</tbody>
</table>

The 95% confidence interval for the I(0) null hypothesis is [0.809, 1.862].
<table>
<thead>
<tr>
<th>Series / q</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>10</th>
<th>50</th>
<th>100</th>
<th>500</th>
<th>q*</th>
</tr>
</thead>
<tbody>
<tr>
<td>GASOC1</td>
<td>0.0254</td>
<td>0.0245</td>
<td>0.0243</td>
<td>0.0246</td>
<td>0.0253</td>
<td>0.0278</td>
<td>0.0303</td>
<td>0.0368</td>
<td>0.0628</td>
<td>0.0246</td>
<td></td>
</tr>
<tr>
<td>GASOC2</td>
<td>0.0342</td>
<td>0.0337</td>
<td>0.0342</td>
<td>0.0344</td>
<td>0.0348</td>
<td>0.0353</td>
<td>0.0376</td>
<td>0.0407</td>
<td>0.0483</td>
<td>0.0740</td>
<td>0.0337</td>
</tr>
<tr>
<td>GASOC3</td>
<td>0.0395</td>
<td>0.0383</td>
<td>0.0379</td>
<td>0.0379</td>
<td>0.0382</td>
<td>0.0385</td>
<td>0.0413</td>
<td>0.0398</td>
<td>0.0453</td>
<td>0.0652</td>
<td>0.0379</td>
</tr>
<tr>
<td>GASOC4</td>
<td>0.0430</td>
<td>0.0451</td>
<td>0.0464</td>
<td>0.0472</td>
<td>0.0480</td>
<td>0.0486</td>
<td>0.0520</td>
<td>0.0584</td>
<td>0.0682</td>
<td>0.0786</td>
<td>0.0472</td>
</tr>
<tr>
<td>PROPC1</td>
<td>0.0510</td>
<td>0.0474</td>
<td>0.0452</td>
<td>0.0446</td>
<td>0.0446</td>
<td>0.0445</td>
<td>0.0448</td>
<td>0.0415</td>
<td>0.0461</td>
<td>0.0659</td>
<td>0.0445</td>
</tr>
<tr>
<td>PROPC2</td>
<td>0.0516</td>
<td>0.0490</td>
<td>0.0477</td>
<td>0.0472</td>
<td>0.0473</td>
<td>0.0471</td>
<td>0.0473</td>
<td>0.0424</td>
<td>0.0455</td>
<td>0.0643</td>
<td>0.0473</td>
</tr>
<tr>
<td>PROPC3</td>
<td>0.0557</td>
<td>0.0530</td>
<td>0.0516</td>
<td>0.0508</td>
<td>0.0510</td>
<td>0.0509</td>
<td>0.0521</td>
<td>0.0468</td>
<td>0.0491</td>
<td>0.0698</td>
<td>0.0510</td>
</tr>
<tr>
<td>PROPC4</td>
<td>0.0579</td>
<td>0.0564</td>
<td>0.0556</td>
<td>0.0547</td>
<td>0.0548</td>
<td>0.0542</td>
<td>0.0564</td>
<td>0.0493</td>
<td>0.0510</td>
<td>0.0733</td>
<td>0.0556</td>
</tr>
<tr>
<td>OILC1</td>
<td>0.0389</td>
<td>0.0381</td>
<td>0.0404</td>
<td>0.0422</td>
<td>0.0428</td>
<td>0.0440</td>
<td>0.0489</td>
<td>0.0477</td>
<td>0.0511</td>
<td>0.0775</td>
<td>0.0381</td>
</tr>
<tr>
<td>OILC2</td>
<td>0.0408</td>
<td>0.0401</td>
<td>0.0407</td>
<td>0.0417</td>
<td>0.0421</td>
<td>0.0428</td>
<td>0.0455</td>
<td>0.0429</td>
<td>0.0452</td>
<td>0.0696</td>
<td>0.0407</td>
</tr>
<tr>
<td>OILC3</td>
<td>0.0593</td>
<td>0.0582</td>
<td>0.0590</td>
<td>0.0603</td>
<td>0.0606</td>
<td>0.0615</td>
<td>0.0654</td>
<td>0.0594</td>
<td>0.0616</td>
<td>0.0836</td>
<td>0.0582</td>
</tr>
<tr>
<td>OILC4</td>
<td>0.0514</td>
<td>0.0513</td>
<td>0.0523</td>
<td>0.0536</td>
<td>0.0540</td>
<td>0.0548</td>
<td>0.0584</td>
<td>0.0522</td>
<td>0.0534</td>
<td>0.0746</td>
<td>0.0513</td>
</tr>
<tr>
<td>HEATC1</td>
<td>0.0459</td>
<td>0.0465</td>
<td>0.0460</td>
<td>0.0481</td>
<td>0.0492</td>
<td>0.0503</td>
<td>0.0573</td>
<td>0.0605</td>
<td>0.0649</td>
<td>0.0966</td>
<td>0.0460</td>
</tr>
<tr>
<td>HEATC2</td>
<td>0.0436</td>
<td>0.0451</td>
<td>0.0458</td>
<td>0.0462</td>
<td>0.0468</td>
<td>0.0474</td>
<td>0.0509</td>
<td>0.0561</td>
<td>0.0613</td>
<td>0.0735</td>
<td>0.0462</td>
</tr>
<tr>
<td>HEATC3</td>
<td>0.0697</td>
<td>0.0691</td>
<td>0.0691</td>
<td>0.0699</td>
<td>0.0705</td>
<td>0.0712</td>
<td>0.0767</td>
<td>0.0638</td>
<td>0.0652</td>
<td>0.1054</td>
<td>0.0691</td>
</tr>
<tr>
<td>HEATC4</td>
<td>0.0556</td>
<td>0.0582</td>
<td>0.0591</td>
<td>0.0595</td>
<td>0.0600</td>
<td>0.0604</td>
<td>0.0635</td>
<td>0.0638</td>
<td>0.0662</td>
<td>0.0831</td>
<td>0.0595</td>
</tr>
</tbody>
</table>

The critical value at the 95% level is $1.36/\sqrt{T}$, that is, 0.0183 for GASOC1; 0.0183 for GASOC2; 0.0183 for ASC3; and 0.0241 for GASOC4. 0.0231 for PROC1; 0.0232 for PROC3; and 0.0231 for PROC4. 0.0173 for OILC1; 0.0180 for OILC2; and 0.0180 for OILC4. 0.0163 for HEAC1; 0.0232 for HEAC2; 0.0163 for HEAC3; and 0.0232 for HEAC4.
Figure 1: Semiparametric estimates of $d$ based on Robinson (1995)
Figure 1: Semiparametric estimates of $d$ based on Robinson (1995) (cont.)

<table>
<thead>
<tr>
<th>OILC1</th>
<th>OILC2</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1" alt="Graph OILC1" /></td>
<td><img src="image2" alt="Graph OILC2" /></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>OILC3</th>
<th>OILC4</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image3" alt="Graph OILC3" /></td>
<td><img src="image4" alt="Graph OILC4" /></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>HEATC1</th>
<th>HEATC2</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image5" alt="Graph HEATC1" /></td>
<td><img src="image6" alt="Graph HEATC2" /></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>HEATC3</th>
<th>HEATC4</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image7" alt="Graph HEATC3" /></td>
<td><img src="image8" alt="Graph HEATC4" /></td>
</tr>
</tbody>
</table>
Table 3: Estimates of d and 95% confidence band using Robinson’s (1994) approach

<table>
<thead>
<tr>
<th></th>
<th>White noise</th>
<th>AR (1)</th>
<th>Bloomfield (1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>GASOC1</td>
<td>0.002 [-0.016, 0.022]</td>
<td><strong>-0.063 [-0.094, -0.029]</strong></td>
<td><strong>-0.049 [-0.078, -0.018]</strong></td>
</tr>
<tr>
<td>GASOC2</td>
<td>-0.010 [-0.033, 0.016]</td>
<td><strong>-0.050 [-0.086, -0.009]</strong></td>
<td><strong>-0.048 [-0.085, -0.008]</strong></td>
</tr>
<tr>
<td>GASOC3</td>
<td>0.010 [-0.008, 0.029]</td>
<td><strong>-0.031 [-0.060, 0.000]</strong></td>
<td><strong>-0.054 [-0.083, -0.024]</strong></td>
</tr>
<tr>
<td>GASOC4</td>
<td>-0.046 [-0.065, -0.023]</td>
<td><strong>-0.042 [-0.077, -0.004]</strong></td>
<td><strong>-0.046 [-0.077, -0.006]</strong></td>
</tr>
<tr>
<td>PROPC1</td>
<td><strong>0.054 [0.031, 0.078]</strong></td>
<td>0.008 [-0.030, 0.051]</td>
<td><strong>0.015 [-0.016, 0.048]</strong></td>
</tr>
<tr>
<td>PROPC2</td>
<td><strong>0.036 [0.014, 0.061]</strong></td>
<td>0.006 [-0.030, 0.045]</td>
<td><strong>0.005 [-0.026, 0.038]</strong></td>
</tr>
<tr>
<td>PROPC3</td>
<td><strong>0.033 [0.011, 0.057]</strong></td>
<td>0.003 [-0.033, 0.042]</td>
<td><strong>0.008 [-0.029, 0.041]</strong></td>
</tr>
<tr>
<td>PROPC4</td>
<td><strong>0.019 [-0.002, 0.042]</strong></td>
<td>0.007 [-0.027, 0.045]</td>
<td><strong>0.007 [-0.030, 0.040]</strong></td>
</tr>
<tr>
<td>OILC1</td>
<td>-0.034 [-0.050, -0.016]</td>
<td><strong>-0.079 [-0.101, -0.052]</strong></td>
<td><strong>-0.082 [-0.113, -0.060]</strong></td>
</tr>
<tr>
<td>OILC2</td>
<td>-0.010 [-0.027, 0.008]</td>
<td><strong>-0.051 [-0.076, -0.021]</strong></td>
<td><strong>-0.046 [-0.073, -0.023]</strong></td>
</tr>
<tr>
<td>OILC3</td>
<td>0.007 [-0.022, 0.012]</td>
<td><strong>-0.039 [-0.064, -0.015]</strong></td>
<td><strong>-0.041 [-0.068, -0.020]</strong></td>
</tr>
<tr>
<td>OILC4</td>
<td>-0.016 [-0.032, 0.002]</td>
<td><strong>-0.040 [-0.064, -0.016]</strong></td>
<td><strong>-0.039 [-0.060, -0.010]</strong></td>
</tr>
<tr>
<td>HEATC1</td>
<td>-0.033 [-0.049, -0.016]</td>
<td><strong>-0.066 [-0.091, -0.037]</strong></td>
<td><strong>-0.059 [-0.079, -0.034]</strong></td>
</tr>
<tr>
<td>HEATC2</td>
<td>-0.035 [-0.056, -0.012]</td>
<td><strong>-0.034 [-0.069, 0.004]</strong></td>
<td><strong>-0.035 [-0.072, 0.005]</strong></td>
</tr>
<tr>
<td>HEATC3</td>
<td>-0.003 [-0.018, 0.012]</td>
<td><strong>-0.022 [-0.045, 0.003]</strong></td>
<td><strong>-0.049 [-0.058, 0.039]</strong></td>
</tr>
<tr>
<td>HEATC4</td>
<td>-0.034 [-0.053, -0.012]</td>
<td><strong>-0.015 [-0.048, 0.021]</strong></td>
<td><strong>-0.015 [-0.052, 0.018]</strong></td>
</tr>
</tbody>
</table>
Table 4: Lo’s (1991) modified R/S statistic results (VT(q))

<table>
<thead>
<tr>
<th>Series / q</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>10</th>
<th>50</th>
<th>100</th>
<th>500</th>
<th>q^*</th>
</tr>
</thead>
<tbody>
<tr>
<td>GASOC1</td>
<td>5.554</td>
<td>5.161</td>
<td>4.857</td>
<td>4.597</td>
<td>4.394</td>
<td>4.219</td>
<td>3.639</td>
<td>2.236</td>
<td>1.774</td>
<td>1.308</td>
<td>4.597</td>
</tr>
<tr>
<td>GASOC2</td>
<td>5.323</td>
<td>5.140</td>
<td>5.001</td>
<td>4.853</td>
<td>4.730</td>
<td>4.611</td>
<td>4.201</td>
<td>2.789</td>
<td>2.220</td>
<td>1.270</td>
<td>5.140</td>
</tr>
<tr>
<td>GASOC3</td>
<td>6.591</td>
<td>6.109</td>
<td>5.743</td>
<td>5.437</td>
<td>5.188</td>
<td>4.967</td>
<td>4.214</td>
<td>2.520</td>
<td>1.968</td>
<td>1.445</td>
<td>5.437</td>
</tr>
<tr>
<td>GASOC4</td>
<td>5.860</td>
<td>5.530</td>
<td>5.317</td>
<td>5.135</td>
<td>4.980</td>
<td>4.830</td>
<td>4.322</td>
<td>2.822</td>
<td>2.283</td>
<td>1.279</td>
<td>5.135</td>
</tr>
<tr>
<td>PROPC4</td>
<td>5.993</td>
<td>5.485</td>
<td>5.092</td>
<td>4.797</td>
<td>4.552</td>
<td>4.350</td>
<td>3.689</td>
<td>2.323</td>
<td>1.928</td>
<td>1.306</td>
<td>5.092</td>
</tr>
<tr>
<td>OILC2</td>
<td>5.942</td>
<td>5.431</td>
<td>5.039</td>
<td>4.699</td>
<td>4.436</td>
<td>4.214</td>
<td>3.508</td>
<td>2.026</td>
<td>1.591</td>
<td>1.390</td>
<td>5.039</td>
</tr>
<tr>
<td>OILC3</td>
<td>5.271</td>
<td>4.749</td>
<td>4.364</td>
<td>4.056</td>
<td>3.815</td>
<td>3.612</td>
<td>2.968</td>
<td>1.658</td>
<td>1.279</td>
<td>0.965</td>
<td>4.749</td>
</tr>
<tr>
<td>HEATC4</td>
<td>5.888</td>
<td>5.677</td>
<td>5.476</td>
<td>5.291</td>
<td>5.132</td>
<td>4.961</td>
<td>4.399</td>
<td>2.882</td>
<td>2.280</td>
<td>1.300</td>
<td>5.291</td>
</tr>
</tbody>
</table>

The 95% confidence interval for the I(0) null hypothesis is [0.809, 1.862].
<table>
<thead>
<tr>
<th>Series / q</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>10</th>
<th>50</th>
<th>100</th>
<th>500</th>
<th>q*</th>
</tr>
</thead>
<tbody>
<tr>
<td>GASOC1</td>
<td>2.7801</td>
<td>2.4002</td>
<td>2.1261</td>
<td>1.9045</td>
<td>1.7399</td>
<td>1.6038</td>
<td>1.1937</td>
<td>0.4507</td>
<td>0.2838</td>
<td>0.1542</td>
<td>1.9045</td>
</tr>
<tr>
<td>GASOC2</td>
<td>2.5228</td>
<td>2.3517</td>
<td>2.2265</td>
<td>2.0969</td>
<td>1.9923</td>
<td>1.8933</td>
<td>1.5711</td>
<td>0.6928</td>
<td>0.4388</td>
<td>0.1436</td>
<td>2.3517</td>
</tr>
<tr>
<td>GASOC3</td>
<td>3.7290</td>
<td>3.2032</td>
<td>2.8316</td>
<td>2.5371</td>
<td>2.3102</td>
<td>2.1179</td>
<td>1.5240</td>
<td>0.5452</td>
<td>0.3324</td>
<td>0.1794</td>
<td>2.5371</td>
</tr>
<tr>
<td>GASOC4</td>
<td>2.9574</td>
<td>2.6337</td>
<td>2.4352</td>
<td>2.2709</td>
<td>2.1365</td>
<td>2.0091</td>
<td>1.6089</td>
<td>0.7155</td>
<td>0.4490</td>
<td>0.1410</td>
<td>2.2709</td>
</tr>
<tr>
<td>PROPC1</td>
<td>3.1903</td>
<td>2.6505</td>
<td>2.2369</td>
<td>1.9320</td>
<td>1.7138</td>
<td>1.5421</td>
<td>1.0564</td>
<td>0.4051</td>
<td>0.3081</td>
<td>0.1856</td>
<td>1.5421</td>
</tr>
<tr>
<td>PROPC2</td>
<td>3.3748</td>
<td>2.7821</td>
<td>2.3771</td>
<td>2.0766</td>
<td>1.8423</td>
<td>1.6592</td>
<td>1.1312</td>
<td>0.4286</td>
<td>0.3144</td>
<td>0.1810</td>
<td>1.8423</td>
</tr>
<tr>
<td>PROPC3</td>
<td>3.6527</td>
<td>3.0538</td>
<td>2.6123</td>
<td>2.2973</td>
<td>2.0442</td>
<td>1.8457</td>
<td>1.2788</td>
<td>0.4884</td>
<td>0.3487</td>
<td>0.1783</td>
<td>2.0442</td>
</tr>
<tr>
<td>PROPC4</td>
<td>3.6671</td>
<td>3.0721</td>
<td>2.6474</td>
<td>2.3495</td>
<td>2.1159</td>
<td>1.9318</td>
<td>1.3897</td>
<td>0.5511</td>
<td>0.3795</td>
<td>0.1742</td>
<td>2.6474</td>
</tr>
<tr>
<td>OILC1</td>
<td>2.1101</td>
<td>1.6922</td>
<td>1.4303</td>
<td>1.2312</td>
<td>1.0909</td>
<td>0.9805</td>
<td>0.6748</td>
<td>0.2139</td>
<td>0.1278</td>
<td>0.0744</td>
<td>1.6922</td>
</tr>
<tr>
<td>OILC2</td>
<td>2.0623</td>
<td>1.7227</td>
<td>1.4828</td>
<td>1.2899</td>
<td>1.1494</td>
<td>1.0372</td>
<td>0.7186</td>
<td>0.2399</td>
<td>0.1478</td>
<td>0.1128</td>
<td>1.4828</td>
</tr>
<tr>
<td>OILC3</td>
<td>2.2410</td>
<td>1.8190</td>
<td>1.5367</td>
<td>1.3264</td>
<td>1.1749</td>
<td>1.0522</td>
<td>0.7109</td>
<td>0.2213</td>
<td>0.1319</td>
<td>0.0751</td>
<td>1.8190</td>
</tr>
<tr>
<td>OILC4</td>
<td>3.0081</td>
<td>2.4546</td>
<td>2.0922</td>
<td>1.8325</td>
<td>1.6248</td>
<td>1.4632</td>
<td>1.0046</td>
<td>0.3239</td>
<td>0.1978</td>
<td>0.1446</td>
<td>2.4546</td>
</tr>
<tr>
<td>HEATC1</td>
<td>3.1489</td>
<td>2.6474</td>
<td>2.2481</td>
<td>1.9564</td>
<td>1.7473</td>
<td>1.5806</td>
<td>1.0974</td>
<td>0.3661</td>
<td>0.2331</td>
<td>0.1094</td>
<td>2.2481</td>
</tr>
<tr>
<td>HEATC2</td>
<td>2.9301</td>
<td>2.8030</td>
<td>2.6081</td>
<td>2.4335</td>
<td>2.2857</td>
<td>2.1392</td>
<td>1.6774</td>
<td>0.7073</td>
<td>0.4614</td>
<td>0.1772</td>
<td>2.4335</td>
</tr>
<tr>
<td>HEATC3</td>
<td>3.1651</td>
<td>2.6684</td>
<td>2.2973</td>
<td>2.0185</td>
<td>1.8113</td>
<td>1.6393</td>
<td>1.1452</td>
<td>0.3705</td>
<td>0.2250</td>
<td>0.1022</td>
<td>2.2973</td>
</tr>
<tr>
<td>HEATC4</td>
<td>3.4902</td>
<td>3.2444</td>
<td>3.0182</td>
<td>2.8184</td>
<td>2.6512</td>
<td>2.4779</td>
<td>1.9480</td>
<td>0.8365</td>
<td>0.5234</td>
<td>0.1703</td>
<td>3.0182</td>
</tr>
</tbody>
</table>

The critical value at the 95% level is $1.36/\sqrt{T}$, that is, 0.0183 for GASOC1; 0.0239 for GASOC2; 0.0183 for GASOC3; and 0.0241 for GASOC4. 0.0231 for PROC1; 0.0232 for PROC3; and 0.0231 for PROC4. 0.0173 for OILC1; 0.0180 for OILC2; and 0.0180 for OILC4. 0.0163 for HEATC1; 0.0232 for HEATC2; 0.0163 for HEATC3; and 0.0232 for HEATC4.
Figure 2: Semiparametric estimates of $d$ based on Robinson (1995)

<table>
<thead>
<tr>
<th>GASOC1</th>
<th>GASOC2</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1" alt="Graph" /></td>
<td><img src="image2" alt="Graph" /></td>
</tr>
<tr>
<td>GASOC3</td>
<td>GASOC4</td>
</tr>
<tr>
<td><img src="image3" alt="Graph" /></td>
<td><img src="image4" alt="Graph" /></td>
</tr>
<tr>
<td>PROPC1</td>
<td>PROPC2</td>
</tr>
<tr>
<td><img src="image5" alt="Graph" /></td>
<td><img src="image6" alt="Graph" /></td>
</tr>
<tr>
<td>PROPC3</td>
<td>PROPC4</td>
</tr>
<tr>
<td><img src="image7" alt="Graph" /></td>
<td><img src="image8" alt="Graph" /></td>
</tr>
</tbody>
</table>

(cont.)
Figure 2: Semiparametric estimates of $d$ based on Robinson (1995) (cont.)
Table 6: Estimates of $d$ and 95% confidence band using Robinson’s (1994) approach

<table>
<thead>
<tr>
<th></th>
<th>White noise</th>
<th>AR (1)</th>
<th>Bloomfield (1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>GASOC1</td>
<td>0.143 [0.131, 0.157]</td>
<td>0.207 [0.189, 0.227]</td>
<td>0.216 [0.198, 0.239]</td>
</tr>
<tr>
<td>GASOC2</td>
<td>0.075 [0.062, 0.091]</td>
<td>0.103 [0.084, 0.127]</td>
<td>0.107 [0.084, 0.130]</td>
</tr>
<tr>
<td>GASOC3</td>
<td>0.156 [0.144, 0.168]</td>
<td>0.216 [0.199, 0.235]</td>
<td>0.233 [0.213, 0.258]</td>
</tr>
<tr>
<td>GASOC4</td>
<td>0.099 [0.085, 0.117]</td>
<td>0.115 [0.096, 0.140]</td>
<td>0.117 [0.095, 0.141]</td>
</tr>
<tr>
<td>PROC1</td>
<td>0.190 [0.175, 0.205]</td>
<td>0.291 [0.267, 0.316]</td>
<td>0.321 [0.292, 0.346]</td>
</tr>
<tr>
<td>PROC2</td>
<td>0.188 [0.173, 0.204]</td>
<td>0.267 [0.244, 0.291]</td>
<td>0.289 [0.256, 0.313]</td>
</tr>
<tr>
<td>PROC3</td>
<td>0.177 [0.163, 0.194]</td>
<td>0.261 [0.237, 0.287]</td>
<td>0.280 [0.251, 0.313]</td>
</tr>
<tr>
<td>PROC4</td>
<td>0.171 [0.156, 0.188]</td>
<td>0.241 [0.216, 0.269]</td>
<td>0.254 [0.225, 0.285]</td>
</tr>
<tr>
<td>OILC1</td>
<td>0.195 [0.184, 0.206]</td>
<td>0.259 [0.243, 0.277]</td>
<td>0.274 [0.255, 0.294]</td>
</tr>
<tr>
<td>OILC2</td>
<td>0.182 [0.172, 0.194]</td>
<td>0.259 [0.243, 0.276]</td>
<td>0.289 [0.264, 0.303]</td>
</tr>
<tr>
<td>OILC3</td>
<td>0.188 [0.178, 0.199]</td>
<td>0.262 [0.245, 0.279]</td>
<td>0.281 [0.262, 0.301]</td>
</tr>
<tr>
<td>OILC4</td>
<td>0.193 [0.183, 0.205]</td>
<td>0.262 [0.246, 0.278]</td>
<td>0.284 [0.260, 0.304]</td>
</tr>
<tr>
<td>HEATC1</td>
<td>0.168 [0.159, 0.179]</td>
<td>0.257 [0.241, 0.275]</td>
<td>0.277 [0.258, 0.296]</td>
</tr>
<tr>
<td>HEATC2</td>
<td>0.080 [0.068, 0.095]</td>
<td>0.149 [0.125, 0.175]</td>
<td>0.161 [0.133, 0.198]</td>
</tr>
<tr>
<td>HEATC3</td>
<td>0.163 [0.153, 0.173]</td>
<td>0.237 [0.221, 0.251]</td>
<td>0.252 [0.233, 0.272]</td>
</tr>
<tr>
<td>HEATC4</td>
<td>0.087 [0.074, 0.101]</td>
<td>0.132 [0.112, 0.157]</td>
<td>0.140 [0.114, 0.169]</td>
</tr>
</tbody>
</table>
Appendix 1.

**Sample period**

<table>
<thead>
<tr>
<th></th>
<th>Starting date</th>
<th>Ending date</th>
<th>Number of Observations</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Gasoline</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Contract 1</td>
<td>January 02, 1985</td>
<td>December 29, 2006</td>
<td>5514</td>
</tr>
<tr>
<td>Contract 2</td>
<td>January 20, 1994</td>
<td>November 30, 2006</td>
<td>3218</td>
</tr>
<tr>
<td>Contract 3</td>
<td>December 03, 1984</td>
<td>October 31, 2006</td>
<td>5492</td>
</tr>
<tr>
<td>Contract 4</td>
<td>January 28, 1994</td>
<td>September 29, 2006</td>
<td>3170</td>
</tr>
<tr>
<td><strong>Propane</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Contract 1</td>
<td>December 17, 1993</td>
<td>October 02, 2007</td>
<td>3447</td>
</tr>
<tr>
<td>Contract 2</td>
<td>February 02, 1994</td>
<td>October 02, 2007</td>
<td>3416</td>
</tr>
<tr>
<td>Contract 3</td>
<td>February 08, 1994</td>
<td>October 02, 2007</td>
<td>3412</td>
</tr>
<tr>
<td>Contract 4</td>
<td>December 17, 1993</td>
<td>October 02, 2007</td>
<td>3447</td>
</tr>
<tr>
<td><strong>Oil</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Contract 1</td>
<td>April 04, 1983</td>
<td>October 02, 1985</td>
<td>6143</td>
</tr>
<tr>
<td>Contract 2</td>
<td>January 02, 1985</td>
<td>October 02, 2007</td>
<td>5705</td>
</tr>
<tr>
<td>Contract 3</td>
<td>March 30, 1983</td>
<td>October 02, 2007</td>
<td>6145</td>
</tr>
<tr>
<td>Contract 4</td>
<td>January 02, 1985</td>
<td>October 02, 2007</td>
<td>5705</td>
</tr>
<tr>
<td><strong>Heating Oil</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Contract 1</td>
<td>January 02, 1980</td>
<td>October 02, 2007</td>
<td>6159</td>
</tr>
<tr>
<td>Contract 2</td>
<td>February 02, 1994</td>
<td>October 02, 2007</td>
<td>3418</td>
</tr>
<tr>
<td>Contract 3</td>
<td>January 02, 1980</td>
<td>October 02, 2007</td>
<td>6159</td>
</tr>
<tr>
<td>Contract 4</td>
<td>January 14, 1994</td>
<td>October 02, 2007</td>
<td>3433</td>
</tr>
</tbody>
</table>
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 Euro-  
          pean 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

          y propuestas de metodología para la explotación de la información de los ingresos y el gasto.  
          Llorec Pou, Joaquín Alegre

173/2002  Modelos paramétricos y no paramétricos en problemas de concesión de tarjetas de credito.  
          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- 
nistro de agua. 
Mª Ángeles García Valiñas

184/2004 Estimación de la economía sumergida en 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 national 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 Cirriaco 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 Rodriguez-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-Melchior, 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. Martínez 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 Rodriguez

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 Míguez

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 Diaz
221/2005 Tendencia post-anuncio de resultados contables: evidencia para el mercado español
Carlos Forner Rodríguez, Joaquín Marhuenda Fructuoso y Sonia Sanabria García

222/2005 Human capital accumulation and geography: empirical evidence in the European Union
Jesús López-Rodriguez, J. Andrés Faíña y Jose Lopez Rodriguez

223/2005 Auditors' Forecasting in Going Concern Decisions: Framing, Confidence and Information Processing
Waymond Rodgers and Andrés Guiral

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

225/2005 The effects of ownership structure and board composition on the audit committee activity: Spanish evidence
Carlos Fernández Méndez and Rubén Arrondo García

226/2005 Cross-country determinants of bank income smoothing by managing loan loss provisions
Ana Rosa Fonseca and Francisco González

Alejandro Estellér Moré

228/2005 Region versus Industry effects: volatility transmission
Pilar Soriano Felipe and Francisco J. Climent Diranzo

Daniel Vázquez-Bustelo and Sandra Valle

Alfonso Palacio-Vera

231/2005 Reconciling Sustainability and Discounting in Cost Benefit Analysis: a methodological proposal
M. Carmen Almansa Sáez and Javier Calatrava Requena

232/2005 Can The Excess Of Liquidity Affect The Effectiveness Of The European Monetary Policy?
Santiago Carbó Valverde and Rafael López del Paso

Miguel Angel Barberán Lahuerta

Víctor M. González

Waymond Rodgers, Paul Pavlou and Andres Guiral.

Francisco J. André, M. Alejandro Cardenete y Carlos Romero.
<table>
<thead>
<tr>
<th>Year</th>
<th>Title</th>
<th>Authors</th>
</tr>
</thead>
<tbody>
<tr>
<td>238/2006</td>
<td>Trade Effects Of Monetary Agreements: Evidence For Oecd Countries.</td>
<td>Salvador Gil-Pareja, Rafael Llorca-Vivero y José Antonio Martínez-Serrano.</td>
</tr>
<tr>
<td>240/2006</td>
<td>La interacción entre el éxito competitivo y las condiciones del mercado doméstico como determinantes de la decisión de exportación en las Pymes.</td>
<td>Francisco García Pérez.</td>
</tr>
<tr>
<td>241/2006</td>
<td>Una estimación de la depreciación del capital humano por sectores, por ocupación y en el tiempo.</td>
<td>Inés P. Murillo.</td>
</tr>
<tr>
<td>244/2006</td>
<td>Did The European Exchange-Rate Mechanism Contribute To The Integration Of Peripheral Countries?</td>
<td>Salvador Gil-Pareja, Rafael Llorca-Vivero y José Antonio Martínez-Serrano</td>
</tr>
<tr>
<td>245/2006</td>
<td>Intergenerational Health Mobility: An Empirical Approach Based On The Echp.</td>
<td>Marta Pascual and David Cantarero</td>
</tr>
<tr>
<td>247/2006</td>
<td>Testing For Structural Breaks In Variance Withadditive Outliers And Measurement Errors.</td>
<td>Paulo M.M. Rodrigues and Antonio Rubia</td>
</tr>
<tr>
<td>252/2006</td>
<td>“The momentum effect in the Spanish stock market: Omitted risk factors or investor behaviour?”</td>
<td>Luis Muga and Rafael Santamaria</td>
</tr>
</tbody>
</table>
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 Maria Aldanondo-Ochoa y Carmen Almansa-Sáez

José Felix Sanz-Sanz, Desiderio Romero-Jordán y Santiago Álvarez-Garcia

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 Perdiguero.

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-Rodríguez

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

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 Sanchís

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
Maria 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 Rodríguez
<table>
<thead>
<tr>
<th>Year</th>
<th>Title</th>
<th>Authors</th>
</tr>
</thead>
<tbody>
<tr>
<td>289/06</td>
<td>Globalisation and the Composition of Government Spending: An analysis for OECD countries</td>
<td>Norman Gemmell, Richard Kneller and Ismael Sanz</td>
</tr>
<tr>
<td>290/06</td>
<td>La producción de energía eléctrica en España: Análisis económico de la actividad tras la liberalización del Sector Eléctrico</td>
<td>Fernando Hernández Martínez</td>
</tr>
<tr>
<td>291/06</td>
<td>Further considerations on the link between adjustment costs and the productivity of R&amp;D investment: evidence for Spain</td>
<td>Desiderio Romero-Jordán, José Félix Sanz-Sanz and Inmaculada Álvarez-Ayuso</td>
</tr>
<tr>
<td>292/06</td>
<td>Una teoría sobre la contribución de la función de compras al rendimiento empresarial</td>
<td>Javier González Benito</td>
</tr>
<tr>
<td>293/06</td>
<td>Agility drivers, enablers and outcomes: empirical test of an integrated agile manufacturing model</td>
<td>Daniel Vázquez-Bustelo, Lucía Avella and Esteban Fernández</td>
</tr>
<tr>
<td>294/06</td>
<td>Testing the parametric vs the semiparametric generalized mixed effects models</td>
<td>María José Lombardía and Stefan Sperlich</td>
</tr>
<tr>
<td>295/06</td>
<td>Nonlinear dynamics in energy futures</td>
<td>Mariano Matilla-García</td>
</tr>
<tr>
<td>296/06</td>
<td>Estimating Spatial Models By Generalized Maximum Entropy Or How To Get Rid Of W</td>
<td>Esteban Fernández Vázquez, Matías Mayor Fernández and Jorge Rodríguez-Valez</td>
</tr>
<tr>
<td>297/06</td>
<td>Optimización fiscal en las transmisiones lucrativas: análisis metodológico</td>
<td>Félix Domínguez Barrero</td>
</tr>
<tr>
<td>298/06</td>
<td>La situación actual de la banca online en España</td>
<td>Francisco José Climent Diranzo y Alexandre Momparler Pechuán</td>
</tr>
<tr>
<td>299/06</td>
<td>Estrategia competitiva y rendimiento del negocio: el papel mediador de la estrategia y las capacidades productivas</td>
<td>Javier González Benito y Isabel Suárez González</td>
</tr>
<tr>
<td>300/06</td>
<td>A Parametric Model to Estimate Risk in a Fixed Income Portfolio</td>
<td>Pilar Abad and Sonia Benito</td>
</tr>
<tr>
<td>301/07</td>
<td>Análisis Empírico de las Preferencias Sociales Respecto del Gasto en Obra Social de las Cajas de Ahorros</td>
<td>Alejandro Esteller-Moré, Jonathan Jorba Jiménez y Albert Solé-Ollé</td>
</tr>
<tr>
<td>302/07</td>
<td>Assessing the enlargement and deepening of regional trading blocs: The European Union case</td>
<td>Salvador Gil-Pareja, Rafael Llorca-Vivero y José Antonio Martínez-Serrano</td>
</tr>
<tr>
<td>303/07</td>
<td>¿Es la Franquicia un Medio de Financiación?: Evidencia para el Caso Español</td>
<td>Vanesa Solís Rodríguez y Manuel González Díaz</td>
</tr>
<tr>
<td>304/07</td>
<td>On the Finite-Sample Biases in Nonparametric Testing for Variance Constancy</td>
<td>Paulo M.M. Rodrigues and Antonio Rubia</td>
</tr>
<tr>
<td>305/07</td>
<td>Spain is Different: Relative Wages 1989-98</td>
<td>José Antonio Carrasco Gallego</td>
</tr>
</tbody>
</table>
Wood and industrialization. evidence and hypotheses from the case of Spain, 1860-1935. Iñaki Iriarte-Goñi and María Isabel Ayuda Bosque

New evidence on long-run monetary neutrality. J. Cunado, L.A. Gil-Alana and F. Perez de Gracia

Monetary policy and structural changes in the volatility of us interest rates. Juncal Cuñado, Javier Gomez Biscarri and Fernando Perez de Gracia

The productivity effects of intrafirm diffusion. Lucio Fuentelsaz, Jaime Gómez and Sergio Palomas

Unemployment duration, layoffs and competing risks. J.M. Arranz, C. García-Serrano and L. Toharia

El grado de cobertura del gasto público en España respecto a la UE-15 Nuria Rueda, Begoña Barruso, Carmen Calderón y Mª del Mar Herrador

The Impact of Direct Subsidies in Spain before and after the CAP’92 Reform Carmen Murillo, Carlos San Juan and Stefan Sperlich

Determinants of post-privatisation performance of Spanish divested firms Laura Cabeza García and Silvia Gómez Ansón

¿Por qué deciden diversificar las empresas españolas? Razones oportunistas versus razonas económicas Almudena Martínez Campillo

Dynamical Hierarchical Tree in Currency Markets Juan Gabriel Brida, David Matesanz Gómez and Wiston Adrián Risso

Los determinantes sociodemográficos del gasto sanitario. Análisis con microdatos individuales Ana María Angulo, Ramón Barberán, Pilar Egea y Jesús Mur

Why do companies go private? The Spanish case Inés Pérez-Soba Aguilar

The use of gis to study transport for disabled people Verónica Cañal Fernández

The long run consequences of M&A: An empirical application Cristina Bernad, Lucio Fuentelsaz and Jaime Gómez

Las clasificaciones de materias en economía: principios para el desarrollo de una nueva clasificación Valentín Edo Hernández

Reforming Taxes and Improving Health: A Revenue-Neutral Tax Reform to Eliminate Medical and Pharmaceutical VAT Santiago Álvarez-García, Carlos Pestana Barros y Juan Prieto-Rodriguez

Impacts of an iron and steel plant on residential property values Celia Bilbao-Terol

Firm size and capital structure: Evidence using dynamic panel data Víctor M. González and Francisco González
¿Cómo organizar una cadena hotelera? La elección de la forma de gobierno
Marta Fernández Barcala y Manuel González Díaz

Análisis de los efectos de la decisión de diversificar: un contraste del marco teórico “Agencia-Stewardship”
Almudena Martínez Campillo y Roberto Fernández Gago

Selecting portfolios given multiple eurostoxx-based uncertainty scenarios: a stochastic goal programming approach from fuzzy betas
Enrique Ballestero, Blanca Pérez-Gladish, Mar Arenas-Parra and Amelia Bilbao-Terol

“El bienestar de los inmigrantes y los factores implicados en la decisión de emigrar”
Anastasia Hernández Alemán y Carmelo J. León

Andrea Martínez-Noya and Esteban García-Canal

Diferencias salariales entre empresas públicas y privadas. El caso español
Begoña Cueto y Nuria Sánchez- Sánchez

Effects of Fiscal Treatments of Second Home Ownership on Renting Supply
Celia Bilbao Terol and Juan Prieto Rodriguez

Auditors’ ethical dilemmas in the going concern evaluation
Andres Guiral, Waymond Rodgers, Emiliano Ruiz and Jose A. Gonzalo

Convergencia en capital humano en España. Un análisis regional para el periodo 1970-2004
Susana Morales Sequera y Carmen Pérez Esparrells

Socially responsible investment: mutual funds portfolio selection using fuzzy multiobjective programming
Blanca Mª Pérez-Gladish, Mar Arenas-Parra, Amelia Bilbao-Terol and Mª Victoria Rodriguez-Uria

Persistencia del resultado contable y sus componentes: implicaciones de la medida de ajustes por devengo
Raúl Iñiguez Sánchez y Francisco Poveda Fuentes

Wage Inequality and Globalisation: What can we Learn from the Past? A General Equilibrium Approach
Concha Betrán, Javier Ferri and María A. Pons

Eficacia de los incentivos fiscales a la inversión en I+D en España en los años noventa
Desiderio Romero Jordán y José Félix Sanz Sanz

Convergencia regional en renta y bienestar en España
Robert Meneu Gaya

Tributación ambiental: Estado de la Cuestión y Experiencia en España
Ana Carrera Poncela

Salient features of dependence in daily us stock market indices
Luis A. Gil-Alana, Juncal Cuñado and Fernando Pérez de Gracia

La educación superior: ¿un gasto o una inversión rentable para el sector público?
Inés P. Murillo y Francisco Pedraja
<table>
<thead>
<tr>
<th>Year</th>
<th>Title</th>
<th>Authors</th>
</tr>
</thead>
<tbody>
<tr>
<td>2007</td>
<td>Effects of a reduction of working hours on a model with job creation and job destruction</td>
<td>Emilio Domínguez, Miren Ullibarri y Idoya Zabaleta</td>
</tr>
<tr>
<td>2007</td>
<td>Stock split size, signaling and earnings management: Evidence from the Spanish market</td>
<td>José Yagüe, J. Carlos Gómez-Sala and Francisco Poveda-Fuentes</td>
</tr>
<tr>
<td>2007</td>
<td>Modelización de las expectativas y estrategias de inversión en mercados de derivados</td>
<td>Begoña Font-Belaire</td>
</tr>
<tr>
<td>2008</td>
<td>Trade in capital goods during the golden age, 1953-1973</td>
<td>Mª Teresa Sanchis and Antonio Cubel</td>
</tr>
<tr>
<td>2008</td>
<td>El capital económico por riesgo operacional: una aplicación del modelo de distribución de pérdidas</td>
<td>Enrique José Jiménez Rodríguez y José Manuel Feria Domínguez</td>
</tr>
<tr>
<td>2008</td>
<td>The drivers of effectiveness in competition policy</td>
<td>Joan-Ramon Borrell and Juan-Luis Jiménez</td>
</tr>
<tr>
<td>2008</td>
<td>Corporate governance structure and board of directors remuneration policies: evidence from Spain</td>
<td>Carlos Fernández Méndez, Rubén Arrondo García and Enrique Fernández Rodríguez</td>
</tr>
<tr>
<td>2008</td>
<td>Beyond the disciplinary role of governance: how boards and donors add value to Spanish foundations</td>
<td>Pablo De Andrés Alonso, Valentín Azofra Palenzuela y M. Elena Romero Merino</td>
</tr>
<tr>
<td>2008</td>
<td>Complejidad y perfeccionamiento contractual para la contención del oportunismo en los acuerdos de franquicia</td>
<td>Vanesa Solís Rodríguez y Manuel González Díaz</td>
</tr>
<tr>
<td>2008</td>
<td>Inestabilidad y convergencia entre las regiones europeas</td>
<td>Jesús Mur, Fernando López y Ana Angulo</td>
</tr>
<tr>
<td>2008</td>
<td>Análisis espacial del cierre de explotaciones agrarias</td>
<td>Ana Aldanondo Ochoa, Carmen Almansa Sáez y Valero Casanovas Oliva</td>
</tr>
<tr>
<td>2008</td>
<td>Cross-Country Efficiency Comparison between Italian and Spanish Public Universities in the period 2000-2005</td>
<td>Tommaso Agasisti and Carmen Pérez Esparrells</td>
</tr>
<tr>
<td>2008</td>
<td>El desarrollo de la sociedad de la información en España: un análisis por comunidades autónomas</td>
<td>María Concepción García Jiménez y José Luis Gómez Barroso</td>
</tr>
<tr>
<td>2008</td>
<td>El medioambiente y los objetivos de fabricación: un análisis de los modelos estratégicos para su consecución</td>
<td>Lucía Avella Camarero, Esteban Fernández Sánchez y Daniel Vázquez-Bustelo</td>
</tr>
<tr>
<td>2008</td>
<td>Influence of bank concentration and institutions on capital structure: New international evidence</td>
<td>Víctor M. González and Francisco González</td>
</tr>
<tr>
<td>2008</td>
<td>Generalización del concepto de equilibrio en juegos de competición política</td>
<td>Mª Dolores López González y Javier Rodrigo Hitos</td>
</tr>
<tr>
<td>2008</td>
<td>Smooth Transition from Fixed Effects to Mixed Effects Models in Multi-level regression Models</td>
<td>Maria José Lombardía and Stefan Sperlich</td>
</tr>
<tr>
<td>Year</td>
<td>Title</td>
<td>Authors</td>
</tr>
<tr>
<td>------</td>
<td>----------------------------------------------------------------------</td>
<td>---------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>375/2008</td>
<td>A Revenue-Neutral Tax Reform to Increase Demand for Public Transport Services</td>
<td>Carlos Pestana Barros and Juan Prieto-Rodriguez</td>
</tr>
<tr>
<td>376/2008</td>
<td>Measurement of intra-distribution dynamics: An application of different approaches to the European regions</td>
<td>Adolfo Maza, María Hierro and José Villaverde</td>
</tr>
<tr>
<td>377/2008</td>
<td>Migración interna de extranjeros y ¿nueva fase en la convergencia?</td>
<td>María Hierro y Adolfo Maza</td>
</tr>
<tr>
<td>378/2008</td>
<td>Efectos de la Reforma del Sector Eléctrico: Modelización Teórica y Experiencia Internacional</td>
<td>Ciro Eduardo Bazán Navarro</td>
</tr>
<tr>
<td>379/2008</td>
<td>A Non-Parametric Independence Test Using Permutation Entropy</td>
<td>Mariano Matilla-García and Manuel Ruiz Marín</td>
</tr>
<tr>
<td>380/2008</td>
<td>Testing for the General Fractional Unit Root Hypothesis in the Time Domain</td>
<td>Uwe Hassler, Paulo M.M. Rodrigues and Antonio Rubia</td>
</tr>
<tr>
<td>381/2008</td>
<td>Multivariate gram-charlier densities</td>
<td>Esther B. Del Brio, Trino-Manuel Ñíguez and Javier Perote</td>
</tr>
<tr>
<td>382/2008</td>
<td>Analyzing Semiparametrically the Trends in the Gender Pay Gap - The Example of Spain</td>
<td>Ignacio Moral-Arce, Stefan Sperlich, Ana I. Fernández-Sainz and Maria J. Roca</td>
</tr>
<tr>
<td>385/2008</td>
<td>Valoración de las grandes corporaciones farmacéuticas, a través del análisis de sus principales intangibles, con el método de opciones reales</td>
<td>Gracia Rubio Martín y Prosper Lamothe Fernández</td>
</tr>
<tr>
<td>386/2008</td>
<td>El marketing interno como impulsor de las habilidades comerciales de las pymes españolas: efectos en los resultados empresariales</td>
<td>Mª Leticia Santos Vijande, Mª José Sanzo Pérez, Nuria García Rodríguez y Juan A. Trespalacios Gutiérrez</td>
</tr>
<tr>
<td>388/2008</td>
<td>Aglomeración espacial, Potencial de Mercado y Geografía Económica: Una revisión de la literatura</td>
<td>Jesús López-Rodríguez y J. Andrés Faiña</td>
</tr>
<tr>
<td>389/2008</td>
<td>An empirical assessment of the impact of switching costs and first mover advantages on firm performance</td>
<td>Jaime Gómez, Juan Pablo Maícas</td>
</tr>
<tr>
<td>390/2008</td>
<td>Tender offers in Spain: testing the wave</td>
<td>Ana R. Martínez-Cañete y Inés Pérez-Soba Aguilar</td>
</tr>
</tbody>
</table>
391/2008 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

392/2008 Cuando el tamaño importa: estudio sobre la influencia de los sujetos políticos en la balanza de bienes y servicios
Alfonso Echazarra de Gregorio

393/2008 Una visión cooperativa de las medidas ante el posible daño ambiental de la desalación
Borja Montaño Sanz

394/2008 Efectos externos del endeudamiento sobre la calificación crediticia de las Comunidades Autónomas
Andrés Leal Marcos y Julio López Laborda

395/2008 Technical efficiency and productivity changes in Spanish airports: A parametric distance functions approach
Beatriz Tovar & Roberto Rendeiro Martín-Cejas

396/2008 Network analysis of exchange data: Interdependence drives crisis contagion
David Matesanz Gómez & Guillermo J. Ortega

397/2008 Explaining the performance of Spanish privatised firms: a panel data approach
Laura Cabeza García and Silvia Gomez Anson

398/2008 Technological capabilities and the decision to outsource R&D services
Andrea Martínez-Noya and Esteban García-Canal

399/2008 Hybrid Risk Adjustment for Pharmaceutical Benefits
Manuel García-Goñi, Pere Ibern & José María Inoriza

400/2008 The Team Consensus–Performance Relationship and the Moderating Role of Team Diversity
José Henrique Dieguez, Javier González-Benito and Jesús Galende

401/2008 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 Soliño

402/2008 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

403/2008 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

404/2008 Análisis de fusiones, variaciones conjeturales y la falacia del estimator en diferencias
Juan Luis Jiménez y Jordi Perdigueró

405/2008 Política fiscal en la uem: ¿basta con los estabilizadores automáticos?
Jorge Uxó González y Mª Jesús Arroyo Fernández

406/2008 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

407/2008 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 Luís 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

Acercando 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 implícita 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 María Cecilia Acevedo

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