Spurious Spillover Effects between Spot and Derivatives Markets

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Abstract

Research on the relationship between spot and derivatives markets has attracted the interest by many analysts. According to many analysts there still exists a puzzle regarding the lead-lag effect and the causality of possible spillover effects between these markets. Although in most cases derivatives markets produce the means for price discovery and play a leading role in the transmission mechanism of information, many research papers derive opposite conclusions. Consequently, the empirical findings of the extant literature are either model or sample specific, while lack of the appropriate financial theory is responsible for spurious spillover effects.

The paper contributes to the literature by examining three European Financial Markets under a markov switching econometric framework on the second order moments of the time series after controlling for the long run equilibrium relationships among the time series examined.

According to the empirical findings of the paper there exist spillover effects, the financial interpretation of which plays a key role in the functioning of the derivatives markets.

Keywords: Spurious Spillover Effects, Markov Switching

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1. Introduction

During the past decades derivatives markets have contributed substantially to the effectiveness of financial markets. **Merton (1997)**[3], argued that, initially, the establishment of derivatives markets, contributed to risk management through hedging processes and later on the informational value of financial derivatives products increasing thus the investment opportunity set of financial markets.

Research on the relationship between spot and derivatives markets is voluminous. As a result, many researchers focus either on the long run or on the short run relation between derivatives and spot yields. The long run relationship between spot and derivatives products is based on the hypothesis that derivatives contracts' prices express the investors' expectations, given all available information till the date the contract has been purchased. On the other hand, the transmission process of information governs the short run structure of the abovementioned relationship, since the lead-lag and the spillover effects imply an effective functioning of derivatives markets. Nevertheless, previous papers investigate separately the unbiasedness hypothesis[4] and the lead-lag effects between these markets, deriving spurious spillover effects which depend on the sample examined and the econometric methodology applied.

The objective of this paper is to investigate the spillover effects between spot and derivatives financial products in a framework that takes into account the time properties of their long run equilibrium relationship. More specifically this paper

[3] *Merton, R. C. 'The Nobel Foundation 1997' (the lecture Robert C.Merton delivered in Stockholm, Sweden, December 9, 1997, when he received the Alfred Nobel Memorial Prize in Economic Sciences)*
[4] The unbiasedness hypothesis states that the yields of derivatives are efficient and unbiased estimators of future spot yields given all the available information

examines spillover effects based on the long run cointegration relationship, the lead-lag effects and the relative informational value of spot and derivatives yields.

The rest of the paper is organized as follows. Section 2 includes the theoretical framework of our objective. Section 3 provides a brief discussion of the literature, while section 4 describes the data and the econometric methodology. Section 5 presents the empirical findings, while Section 6 concludes our analysis.

2. Theoretical Considerations

According to the normal backwardation theory the expected spot prices are greater than derivatives prices and consequently from spot prices. The positive deviation between derivatives and spot prices represents the insurance premium that speculators require from hedgers in order to undertake the risk that arises from future spot price fluctuations.

The informational value of derivatives markets contributes to the efficiency and completeness of financial markets, mainly because derivatives' yields represent the unbiased estimators and/or expectations of future spot yields. The long run equilibrium relationship between spot and derivatives markets is very often disturbed by short run deviations, caused by the trading imbalances in the way demand and supply forces interact. Hence, hedgers and speculators are active units in the derivatives markets and jointly contribute to the formulation of the fundamental values.

The flow of information between these markets is jointly investigated with possible spillover effects that represent the mechanism according to which economic units react in the accumulation of new information, formulate efficient risk-return regimes and contribute to effective risk allocation.

3. Literature Review

Grossman (1977) argued that financial information is traded in derivatives markets and as a result, derivatives' yields should include the cost of the accumulated new information. However, he points out that in developed and efficient markets the informational transmission process is publicly available and hence, is uniformly distributed to investors, eliminating any arbitrage opportunities. In the absence of noise, the information is costless and is distributed by informed to non-informed units. However, the noise, which is apparent in most financial environments, would allow the well-informed investors to speculate. In equilibrium, where the short position contracts would equalize the long position contracts, it is possible to eliminate any short run imbalance.

Many analysts, among them **Fama** and **French** (**1987**), **Brenner** and **Kronner** (**1995**), **Norrbin** and **Reffett** (**1996**), **Abhyankar** (**1998**), **Pizzi**, **Economopoulos** and **O'Neil** (**1998**), **Tse** (**1998**, **1999**), **Min** and **Najand** (**1999**), **Illueca** and **Lafuente** (**2003**), **Chung**, **Campbell** and **Hendry** (**2007**), **Villanueva** (**2007**) and **Kavussanos**, **Visvikis** and **Alexakis** (**2008**), investigated the long run equilibrium relationship between spot and derivatives yields. Furthermore, they considered the informational efficiency of financial products and found that very often derivatives markets contribute substantially in the price discovery process.

In this direction, many analysts investigate the relationship between spot and derivatives, on the second moments of the yields. In this framework there are many analysts, among them **Kawalleer**, **Koch** and **Koch** (**1990**) (S&P500), **Koutmos** and **Tucker** (**1996**) (S&P500), **Sim** and **Zurbreugg** (**1999**), **Silvapulle** and **Moosa** (**1999**) (WTI crude oil) and **Kavussanos**, **Visvikis** and **Menachof** (**2004**) (FFA – Forward Freight Agreements), who considered the spillover effects between these markets. According to the empirical evidence of these papers, derivatives markets, in most cases, play a key role in the accumulation of information, since derivatives' yields play a leading role in the pricing formulation. However, the extant literature is inconclusive regarding the direction of the spillover effects. That is, the aforementioned spillover effects are either sample or model specific, without any financial interpretation. On the basis of the above, existing research on the relationship between the second moment of spot and derivatives markets, results in spurious spillover effects.

4. Research Methodology

Our dataset consists of the major financial indices of three European financial markets, the *FTSE-100* from UK, the *Ibex-35* from Spain and the *FTSE/ASE-20* from Greece. The database is either of daily or monthly frequency for the spot and futures yields depending on the applied research methodology. The time period examined covers a time span of twenty-four years for UK (03/05/1984-18/01/2008), sixteen years for Spain (20/04/1992-18/01/2008) and three years for Greece (02/01/2004-18/01/2007).

For the purposes of our analysis, we adopt regime shift econometric methodologies for both the long run equilibrium relationship as well as for the short run readjustments.

The first step of our analysis is the examination of the stationary properties of the time series in a univariate framework, through conventional (ADF and KPSS), and non linear methodologies (**Lee** and **Strazicich** (**2002**)).

The second step of the analysis is the examination of the cointegration relationship between spot and derivatives products. The unbiasedness hypothesis states that futures' yields represent the expectations regarding the future spot yields, given the available present informational set:

$$f_{t|t-k} = E_{t-k}\left(s_t \mid \Omega_{t-k}\right)$$

where:

$f_{t|t-k}$: the futures contract yield at *t-k* with delivery date *t*

$E_{t-k}\left(. \mid \Omega_{t-k}\right)$: the mathematical expectation of the random variable (.) given the information set at *t-k*

s_t: the yield of the underlying asset at *t*

Ω_{t-k}: the information set at *t-k* with respect to the examined financial random variables

The unbiasedness hypothesis is examined through the *future* LL, or the *current* LL, or the *derivatives premium* regression, according to the following equations:

a) *future* LL regression $s_{t+1} = \alpha+\beta f_t+d_{t+1}$

b) *current* LL regression $s_t = \alpha+\beta f_t+d_{t+1}$

c) *derivatives premium* regression $(s_{t+1}-s_t) = \alpha+\beta(s_t-f_t)+d_{t+1}$

Most researchers apply the **Johansen** (**1988**, **1990**) model and test for (1 -1) cointegration relationship in order to examine the unbiasedness hypothesis:

$$\Delta x_t = \Pi \cdot x_{t-1} + \sum_{i=1}^{N}\sum_{j=1}^{k-1}\Gamma_{ij} \cdot \Delta x_{i,t-j} + \varepsilon_t$$

where the elements of Π matrix (*Π=αβ'*)[5] represent the long run cointegration relationship and the elements of the Γ matrix represent the short run deviations around the equilibrium state. Our analysis is based on the current LL regression where the unbiasedness hypothesis is tested under the following pair of alternative hypothesis:

H_0: β=1 &

H_1: β≠1.

However, this procedure is not appropriate, since there exist exogenous factors that govern the financial system. For that reason, we recruit the methodology proposed by **Gregory** and **Hansen** (**1996**), which allows the cointegration vector to readjust its parameters, according to the '*τ*' parameter, that represents the timing of structural breaks:

L/S $$futures_t = \mu_1 + \mu_2 \cdot \phi_{i\tau} + a_{\perp} \cdot spot_t + e_t$$

C/T $$futures_t = \mu_1 + \mu_2 \cdot \phi_{i\tau} + \beta \cdot t + a_{\perp} \cdot spot_t + e_t$$

C/S $$futures_t = \mu_1 + \mu_2 \cdot \phi_{i\tau} + a_{1\perp} \cdot spot_t + a_{2\perp} \cdot \phi_{i\tau} + e_t$$

where $\phi_{i\tau} = \begin{cases} 0, t \le [n\tau] \\ 1, t > [n\tau] \end{cases}$, τ Є (0,1)

In order to investigate the informational efficiency (*price discovery*) of spot and derivatives yields, the vector error components model (*VECM*) is applied on the

[5] where '*α'* contains the adjustment coefficients to the long run relations and '*β'* represents the eigenvectors or else the cointegration vector of the system

whole sample and on the sub periods, separately, as they are determined by the **Gregory-Hansen** (**1996**) structural break model:

$$\Delta x_t = \sum_{v=1}^{N-r} \alpha_v \cdot VECM_{v,t-1} + \sum_{i=1}^{N} \sum_{j=1}^{k-1} \Gamma_{ij} \cdot \Delta x_{i,t-j} + \varepsilon_t ,$$

where the a_v parameters represent the long run equilibrium of spot-derivatives yields and the elements of the Γ matrix, the short run readjustments around the common trend.

Furthermore, we adopt the 2-state markov switching model (*MS-VECM*) of **Krozlig** (**1996**, **1997**) which allows for regime shifts in the parameter space:

$$\Delta x_t = \sum_{v=1}^{N-r} \alpha_v \left(s_t\right) \cdot VECM_{v,t-1} + \sum_{i=1}^{N} \sum_{j=1}^{k-1} \Gamma_{ij} \left(s_t\right) \cdot \Delta x_{i,t-j} + \varepsilon_t$$

The MS-VECM model offers a better understanding of the cointegration process, since the parameter set is changing under a markov switching structure.

In order to investigate the lead-lag and the spillover effects between spot and derivatives financial products, we apply the multivariate GARCH models of **Ledoit**, **Pedro** and **Wolf** (**2002**) (*Flexible Diagonal GARCH* - FDG) and **Engle** and **Shepaprd** (**2001**) (*Dynamic Conditional Correlation - DCC*), based on the long run cointegration relationship, as is determined by the unbiasedness hypothesis. Thus, we apply the *MS-VECM-GARCH* for the whole sample and for each sub period taking into account the long run properties of the time series. The *FDG* estimation procedure is simple and offers a flexible tool for researchers, especially for high dimension data sets. The *DCC* estimation procedure consists of two steps. Initially, we estimate the volatility in a univariate level and in the second step, we estimate the time varying covariance matrix H_t according to the following equations:

$$\varepsilon_t \mid \Psi_{t-1} \sim N_n\left(0,H_t\right)$$

$$H_t = D_t \cdot R_t \cdot D_t$$

where the diagonal matrix D_t consists of the univariate conditional volatility $\sqrt{h_{it}}$, the correlation matrix R_t is derived by the unconditional variance-covariance matrix $\overline{Q}$:

$$Q_t = \left(1 - a - \beta\right) \cdot \overline{Q} + a \cdot \varepsilon^{*}_{t-1} \cdot \varepsilon^{*'}_{t-1} + \beta \cdot Q_{t-1}$$

$$R_t = Q_t^{*-1} \cdot Q_t \cdot Q_t^{*-1}$$

where ε^{*} are the standardized residuals of the first step analysis:

$$\left\{\varepsilon^{*}\right\}_{it} = \left\{\varepsilon_{it} / \sqrt{h_{it}}\right\}$$

$$Q_t^{*} = \left\{\sqrt{q_{ij}}\right\}$$

$$\rho_{ijt} = q_{ijt} / \sqrt{q_{ii} \cdot q_{jj}}$$

Finally, we apply causality tests on the diagonal elements of the estimated variance-covariance matrix using the results of the *MS-VECM-GARCH* model, in order to investigate the direction and the causality of the spillover effects between cash and derivatives markets. The causality tests are examined for various lag values, with a span of 1 to 40 trading days.

5. Empirical Findings

According to the results (**Table 1**) of the ADF (existence of a unit root), KPSS (stationarity) tests for spot prices and yields of the financial indices *FTSE-100*, *Ibex-35* and *FTSE/ASE-20*, the data are *I(1)* processes. By application of the *LM* methodology, we derive useful results regarding the timing of possible structural changes in the system, which are the same either for spot or derivatives prices.

After the examination of the stationarity conditions, we investigate the long run spot - derivatives relationship of the three indices, based on Johansen's cointegration framework (**Table 2**). The unbiasedness hypothesis is tested through a (1 -1) cointegration vector. It is shown that there is one long run equilibrium relationship between spot and derivatives yields for Greece and Spain, and two for the case of UK. Furthermore, it is shown that the unbiasedness hypothesis is valid only for *FTSE/ASE-20* and *Ibex-35* financial indices, with an exception for *FTSE-100*. In order to take into account the unobserved factors that govern the financial system, we apply the **Gregory-Hansen** (**1996**) methodology deriving sub periods for which the long run cointegration relationship has a structural change[6]. According to this methodology, the unbiasedness hypothesis is valid for every sub period in the Spanish market, while in the case of Greece and UK is valid only in the second sub period.[7]

The next step of the analysis is the investigation of the price discovery process. Under the *VECM* methodology in the case of the *FTSE-100* we conclude that in the second sub period (where the UH is valid) the spot and derivatives markets do not contribute significantly in the formulation of the common trend, in contrast to the other two sub periods, where the derivatives market plays a leading role. In the case of the *Ibex-35,* it is shown that the derivatives market contributes substantially in the informational efficiency. Finally, with respect to the *FTSE/ASE-20* financial index, for the second sub period, where the UH is valid, the derivatives market jointly with the common trend between spot and derivatives products contributes significantly to the informational efficiency.

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[6] Greece: 1st period: 02/01/04-31/01/05, 2nd period: 01/02/05-02/05/06, 3rd period: 01/06/06-18/01/07
UK: 1st period: 03/05/84-29/01/93, 2nd period: 01/02/93-31/12/99, 3rd period: 03/01/00-18/01/08
Spain: 1st period: 20/04/92-30/10/98, 2nd period: 02/11/98-31/10/01, 3rd period: 01/11/01-18/01/08

[7] The unbiasedness hypothesis under the Gregory-Hansen (1996) methodology derives a significant (1 -1) relationship in the second sub period, even if the conventional methodology does not support such a relationship in the whole sample.

Furthermore, we enrich our analysis with the *MS-VECM* methodology, in order to investigate the price discovery process under regime shifts in the parameter set. For the case of the UK, in the second sub period, where the unbiasedness hypothesis is valid, the derivatives' yields have a leading role in the informational efficiency of the index, only in the first regime of the system. For the *Ibex-35* financial index the derivatives market contributes substantially in the price discovery only in the second sub period and under the first regime of the system. Finally, in the case of Greece, in the second sub period where the unbiasedness hypothesis is valid, the derivatives market has a significant contribution on the pricing formulation of the *FTSE/ASE-20*, under the first regime of the system. For the above analysis, it is shown that application of non-linear models, offers higher degrees of freedom in the investigation of lead-lag effects between spot and derivatives markets, in contrast to the conventional methodologies that the extant literature is based on.

The last part of the analysis consists of the investigation of the spillover effects between spot and derivatives yields (*MS-VECM-GARCH*), under the validity of the unbiasedness hypothesis. The likelihood ratio statistic of the comparison between conventional and non-linear models shows that the incorporation of regime shifts derives better results. As it is shown in the comprehensive **Table 3** for UK, in the second sub period where the UH is valid, the spillover effects are driven by the derivatives market. The same result is derived for each sub period in the case of the Spanish market, and for the case of the *FTSE/ASE-20* index, in the second sub period where the UH is valid. In order to understand better the direction of the spillover effects, we run causality tests, the empirical results of which show that the derivatives market plays a leading role in the formulation procedure and in the price discovery process.

One useful conclusion is that the incorporation of structural changes of the parameter set of the econometric methodology derives better results, offering higher degrees of freedom in the interpretation of the estimated parameters. Thus, the conventional cointegration analysis failed to accept the UH, in contrast to the non-linear methodology which derived significant (1 -1) cointegration relationships in sub periods. Moreover, in the case of UK the linear model failed to find significant contribution of the derivatives market in the price discovery process in contrast to the *MS-VECM* methodology, according to which in the second sub period and especially in the first regime of the system, the derivatives market play a leading role in the informational efficiency. The investigation of the spillover effects, under the validity of the unbiasedness hypothesis is very important, since it derives unbiased results. The causality tests indicate that when the lag lengths are increased then the direction of the spillover effects is two-way, because of the transmission of information of the derivatives markets to the spot market and vice versa.

6. Conclusions

The objective of our paper is the investigation of the price discovery process and the lead-lag effects between spot and derivatives markets. Our results indicate that the futures yields are efficient estimators of future spot yields although non-rational investors' behaviour could cause short run deviations from the long run equilibrium. These deviations are impossible to be modelled through linear and conventional econometric methodologies and for that reason, we recruit markov switching models.

It is worth mentioning that the investigation of spillover effects without the presence of control variables that could interpret the empirical findings, yield more often than not conflicting results and/or spurious spillover effects. For that reason, the incorporation of the first moment conditions in our analysis, explains the way the spot and derivatives markets react in the transmission of new information.

According to the empirical findings of our analysis, when the derivatives prices represent the expectations of future spot regimes, then derivatives yields are the means for price discovery process and play a leading role in the transmission of information.

Appendix

Table 1 Unit Root and Stationarity Tests for the whole sample and for the subsamples

Unit Root & Stationarity Tests for the whole sample & for the three subperiods												
	Greece				**UK**				**Spain**			
panel A: whole sample	(Gr: 02/01/04-18/01/07, UK: 03/05/84-18/01/08 & Spain: 20/04/92-18/01/08)											
	ADF*		**KPSS****		**ADF***		**KPSS****		**ADF***		**KPSS****	
	level	**1st d**	**level**	**1st d**	**level**	**1st d**	**level**	**1st d**	**level**	**1st d**	**level**	**1st d**
spot	-2,158	-25,704	0,150	0,054	-1,933	-49,538	0,784	0,062	-1,632	-62,556	0,699	0,097
futures	-2,158	-27,720	0,137	0,032	-1,993	-49,918	0,783	0,059	-1,736	-64,984	0,701	0,092
* crit.values: -3,970 (1%), -3,416 (5%), -3,130 (10%)												
** **crit.values**: 0,216 (1%), 0,146 (5%), 0,119 (10%)												
panel B: first subperiod	(Gr: 02/01/04-31/01/05, UK: 03/05/84-29/01/93 & Spain: 20/04/92-30/10/98)											
spot	-0,770	-15,763	0,407	0,106	-2,875	-44,027	0,264	0,027	-2,377	-6,660	0,979	0,060
futures	-0,914	-17,536	0,411	0,087	-3,036	-46,071	0,269	0,025	-1,693	-40,129	0,979	0,056
* crit.values: -3,992 (1%), -3,426 (5%), -3,136 (10%)												
** **crit.values**: 0,216 (1%), 0,146 (5%), 0,119 (10%)												
panel C: second subperiod	(Gr: 01/02/05-02/05/06, UK: 01/02/93-31/12/99 & Spain: 02/11/98-31/10/01)											
spot	-2,484	-14,740	0,340	0,039	-2,730	-38,743	0,900	0,025	-2,005	-27,298	0,679	0,027
futures	-2,331	-15,663	0,322	0,040	-2,784	-41,914	0,903	0,027	-2,157	-28,960	0,676	0,026
* crit.values: -3,988 (1%), -3,424 (5%), -3,135 (10%)												
** **crit.values**: 0,216 (1%), 0,146 (5%), 0,119 (10%)												
panel D: third subperiod	(Gr: 01/06/06-18/01/07, UK: 03/01/00-18/01/08 & Spain: 01/11/01-18/01/08)											
spot	-3,955	-9,936	1,479	0,196	-2,193	-48,182	1,384	0,084	-2,349	-41,004	0,895	0,113
futures	-4,085	-9,565	0,048	0,080	-2,194	-30,012	1,385	0,084	-2,398	-41,032	0,897	0,112
* crit.values: -4,018 (1%), -3,439 (5%), -3,144 (10%)												
** **crit.values**: 0,216 (1%), 0,146 (5%), 0,119 (10%)												

Table 2 Cointegration Tests and the Unbiasedness Hypothesis for the whole sample and for the subsamples

Johansen's Cointegration Test and the Unbiasedness Hypothesis for the whole sample and for the three subperiods

panel A: whole sample (Gr: 02/01/04-18/01/07, UK: 03/05/84-18/01/08 & Spain: 20/04/92-18/01/08)

	λTrace					**λMax**				
	crit.val.* 5%	crit.val.* 1%	**Greece**	**UK**	**Spain**	crit.val. 5%	crit.val. 1%	**Greece**	**UK**	**Spain**
λ<1	25,32	30,45	43,498	2803,015	219,056	18,98	23,65	39,404	1612,300	216,416
λ<2	12,25	26,26	4,093	1190,715	2,639	12,25	16,26	4,093	1190,715	2,639

* Osterwald Lennum 1992 crit. Values

Chi-square Tests on the Restrictions of the Cointegration Relation

		Greece		**UK**		**Spain**	
H0: βf = 0	**x2** (p-value)	47,127	<0,000	1.004,412	<0,001	353,452	<0,001
H0: (βf βs) = (1 -1)	**x2** (p-value)	5,508	0,019	49,922	<0.001	6,900	0,009

panel B: first subperiod (Gr: 02/01/04-31/01/05, UK: 03/05/84-29/01/93 & Spain: 20/04/92-30/10/98)

	crit.val.* 5%	crit.val.* 1%	**Greece**	**UK**	**Spain**	crit.val. 5%	crit.val. 1%	**Greece**	**UK**	**Spain**
λ<1	25,32	30,45	17,437	85,241	109,256	18,98	23,65	14,087	75,308	104,930
λ<2	12,25	26,26	3,350	9,933	4,325	12,25	16,26	3,349	9,933	4,325

* Osterwald Lennum 1992 crit. Values

Chi-square Tests on the Restrictions of the Cointegration Relation

		Greece		**UK**		**Spain**	
H0: βf = 0	**x2** (p-value)	13,668	<0,001	80,765	<0,001	199,181	<0,001
H0: (βf βs) = (1 -1)	**x2** (p-value)	0,575	0,447	6,280	0,012	0,423	0,515

panel C: second subperiod (Gr: 01/02/05-02/05/06, UK: 01/02/93-31/12/99 & Spain: 02/11/98-31/10/01)

	crit.val.* 5%	crit.val.* 1%	**Greece**	**UK**	**Spain**	crit.val. 5%	crit.val. 1%	**Greece**	**UK**	**Spain**
λ<1	25,32	30,45	36,067	59,942	81,298	18,98	23,65	29,716	50,055	75,780
λ<2	12,25	26,26	6,351	6,887	5,519	12,25	16,26	6,351	6,887	5,519

* Osterwald Lennum 1992 crit. Values

Chi-square Tests on the Restrictions of the Cointegration Relation

		Greece		**UK**		**Spain**	
H0: βf = 0	**x2** (p-value)	31,083	<0,001	73,049	<0.001	107,981	<0,001
H0: (βf βs) = (1 -1)	**x2** (p-value)	1,383	0,239	3,125	0.077	0,490	0,484

panel D: third subperiod (Gr: 01/06/06-18/01/07, UK: 03/01/00-18/01/08 & Spain: 01/11/01-18/01/08)

	crit.val.* 5%	crit.val.* 1%	**Greece**	**UK**	**Spain**	crit.val. 5%	crit.val. 1%	**Greece**	**UK**	**Spain**
λ<1	25,32	30,45	18,782	54,210	62,171	18,98	23,65	11,181	49,286	54,702
λ<2	12,25	26,26	7,601	4,924	7,469	12,25	16,26	7,601	4,924	7,469

* Osterwald Lennum 1992 crit. Values

Chi-square Tests on the Restrictions of the Cointegration Relation

		Greece		**UK**		**Spain**	
H0: βf = 0	**x2** (p-value)	0,375	0,54	70,596	<0,001	54,563	<0,001
H0: (βf βs) = (1 -1)	**x2** (p-value)	3,486	0,061	23,537	<0,001	0,401	0,526661

Table 3 Comprehensive results for the price discovery process and the spillover effects for the whole sample and the subsamples

Comprehencive Table of the Unbiasedness Hypothesis, the Price Discovery & the Spillover Effects for the whole sample and for the three subperiods	Greece	UK	Spain
panel A: whole sample (Gr: 02/01/04-18/01/07, UK: 03/05/84-18/01/08 & Spain: 20/04/92-18/01/08)			
Unbiasedness Hypothesis	significant	not significant	significant
Price Discovery Process	futures, spot (1st regime)	futures	futures
Spillover Effects	not significant	not significant	from futures to spot market
panel B: first subperiod (Gr: 02/01/04-31/01/05, UK: 03/05/84-29/01/93 & Spain: 20/04/92-30/10/98)			
Unbiasedness Hypothesis	not significant	not significant	significant
Price Discovery Process	not significant	futures	futures, futures (1st regime) ,spot (1st regime)
Spillover Effects	not significant	not significant	from futures to spot market
panel C: second subperiod (Gr: 01/02/05-02/05/06, UK: 01/02/93-31/12/99 & Spain: 02/11/98-31/10/01)			
Unbiasedness Hypothesis	significant	significant	significant
Price Discovery Process	futures, futures (1st regime)	futures (1st regime)	spot, futures
Spillover Effects	from futures to spot market	from futures to spot market	from futures to spot market
panel D: third subperiod (Gr: 01/06/06-18/01/07, UK: 03/01/00-18/01/08 & Spain: 01/11/01-18/01/08)			
Unbiasedness Hypothesis	not significant	not significant	significant
Price Discovery Process	not significant	spot, spot (2nd regime), futures (2nd regime)	not significant
Spillover Effects	not significant	not significant	from futures to spot market

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