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Rolling over EUAs and CERs*

Óscar Carchano, Vicente Medina and Ángel Pardo**

Abstract

Whatever derivative contract has a finite life limited by their maturity. The construction of long series, however, is of interest for academic, hedging and investments purposes. In this study, we analyze the relevance of the choice of the rollover date on European Union Allowances (EUAs) and Certified Emissions Reduction (CERs) futures contracts. We have used five different methodologies to construct long series and the results show that, regardless of the criterion applied, there are not significant differences between the resultant return distribution series. Therefore, the least complex method, which is to roll on the last trading day, can be used in order to reach the same conclusions. Additional liquidity analysis confirms this method as the optimum method to link EUAs and CERs series, indicating that simplicity when linking EUAs and CERs series is not at odds with liquidity.

Keywords: Rollover date, futures contracts, European Union Allowances, Certified Emission Reductions.

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** O. Carchano, V. Medina and A. Pardo: University of Valencia. Corresponding author: O. Carchano, email: oscar.carchano@uv.es.

1. Introduction

The first decision to take before carrying out an empirical analysis with EUAs and CERs prices both for hedging and for academic purposes is to decide which data they are going to take. Hedgers that face carbon risk price for a series of years/periods can use a "strip" of derivative contracts to avoid such risk, each with a different delivery date, or alternatively, use a stack hedge, in which the most nearby and/or liquid contract is used, and it is rolled over to the next-to-nearest contract as time passes.

In the first case, we find papers by Uhrig-Homburg and Wagner (2009), Chevallier and Benoit (2010), Rittler (2012) and Palao and Pardo (2012), that employ the entire lifespan of each EUA futures contract for the econometric estimation, and therefore, carry out their analysis using directly the available series. In the second case, researchers have to decide how to construct a continuous futures series using the different maturity contracts available. Some papers linked the different maturities using the expiration day as the timing for the rollover. This is the case for papers such as Mansanet-Bataller et al. (2011), who study EUA and CER price drivers; Chevallier (2010), who analyzes the inter-relationships between EUAs and CERs price series; Chevallier (2011), who proposes a model of carbon price interactions with macroeconomic and energy dynamics; and Mansanet-Bataller and Pardo (2011), who consider EUAs as an additional investing option in the framework of portfolio management. Another criterion is followed by Koenig (2011). He studies correlation in carbon and energy markets using daily observations from April 2005 to August 2010. To construct a reference price for EUAs, he combines three maturities into one single EUA future price series, labeled "EUA Tracker". During Phase I, "EUA Tracker" is equal to the price of the December 2007 contract. In Phase II, "EUA Tracker" switches to the December 2009 contract, until its date of maturity, after which it switches to the December 2010 contract. Finally, the study of the evolution of liquidity in carbon futures markets by Medina et al. (2011) analyses the timeline of the liquidity in the European carbon market and uses the maximum volume criterion in order to obtain the most tradable contract series. After this selected review of several CO_2 studies which offer a variety of criteria to link series, the question is, can the election of the rollover date affect the empirical results obtained in these papers? The analysis that follows tries to provide an answer to this question.

The literature on rolling over futures contracts used to link the data of the nearest future contract up to its maturity with the following contract on the next day. This was the most popular method until Samuelson (1965) detected an abnormal volatility in the last weeks of life of futures contracts, which did not appear in the spot series. Thus, if continuous series were constructed taking as reference the prices of the nearest futures contract up to its maturity, the (abnormal) volatility could distort the conclusions reached from the statistical inferences. Due to this finding, some papers proposed different methodologies to try to avoid the possible abnormal volatility. Junkus (1986) constructs series without taking into account the data from the first day of the month of delivery until the day of maturity when studying weekend and day of the week effects in returns on stock index futures. Ma et al. (1992), in addition to this criterion and the delivery day method, use also the first notice day to link the different contracts and compare the different series obtained. The first notice day is defined as the date on which the broker warns their customers that the date of delivery is near, which is done two weeks prior to delivery. Finally, Geiss (1995) suggests an alternative method that constructs continuous futures series producing a price index which is a weighted average of observed prices for contracts with different expiration dates.

Ma et al. (1992) analyzed the rollover date in several futures contracts with different underlying assets and concluded that the differences between the return series obtained with different criteria were significant, and the best methodology depended on the underlying asset. Carchano and Pardo (2009) analyzed the relevance of the choice of the rolling over date using several methodologies for the case of stock index futures and they concluded that regardless of the criterion applied, there are not significant differences between the series obtained. Finally, Saunier (2010) studied the effect of using different rollover methodologies from the point of view of the investor's commodities portfolio yield, and determined that a trader's profit depends on the rollover choice. On the whole, the miscellany of results obtained in these studies implies that a specific empirical analysis must be carried out for each individual futures contract.

Unlike previous studies, in this paper we carry out not only an analysis in terms of returns distribution, but also a liquidity analysis. Although different rollover criteria can provide similar long return series, following specific criteria to do the rollover might not offer appropriate market liquidity conditions. For this reason, using the number of transactions, we create long future transaction series based on the different rollover criteria and we compare their levels of trading activity. Doing that, we can test if the methodology considered proper for constructing long futures return series offers also the most suitable liquidity context.

The behavior of the prices of European Union Allowances (EUAs) and Certified Emission Reductions (CERs) are of interest for polluting companies, investors and academics. Although EUAs and CERs spot markets exist, Uhrig-Homburg and Wagner (2009) and Rittler (2012) identify the price traded in the futures markets as the main reference in the price discovery process when analyzing the relationships between spot and future markets within the first and second commitment period of the European Union emission trading scheme, respectively.

This paper analyzes the relevance of the choice of the rollover date for European Union Allowances and Certified Emission Reductions futures contracts. Section 2 details the data used in the study. Section 3 describes the different methodologies reported in the most relevant works in this line of research. Then, taking them into account, different return series are constructed. Section 4 studies if there are significant differences between the distributions of the different return series depending on the criterion applied. Section 5 repeats sections 3 and 4 for the transaction series. Section 6 summarizes the paper with some concluding remarks.

2. The Data

EUAs and CERs are the most important assets traded in the European Union Emissions Trading Scheme (EU ETS). Since 2005, many companies included in the 2003/87/CE Directive have the obligation to cover their real verified emissions with rights which allow them to emit one tonne of CO_2 or equivalent gas into the atmosphere. At the beginning of each year, each company receives entitlements (EUAs) to fulfill its requirements. Any excess or requirement of allowances can be trade off in the market. In addition, the 2004/101/CE Directive provides the opportunity to satisfy their hedge obligations with CERs, but only up to a determinate percentage, which varies amongst the different countries. Taken together, these two assets represent the base for any potential empirical study on carbon markets. For more details of the market, an excellent description of its particularities is presented in Mansanet-Bataller and Pardo (2008). Nevertheless, it is important to highlight that this market is divided into different phases, and because of their special characteristics, Phase I allowances cannot be used into Phase II. As a consequence, Phase I and Phase II allowances are two different assets.[1]

From its beginnings in April 2005, most of the derivative volume has been concentrated in the ICE ECX EUA Futures Contracts quoted in the ICE Futures Europe. This pattern is repeated with the ICE ECX CER Futures Contracts after their starts in March 2008. All in all, for our study we will concentrate on these futures contracts and in particular on those with maturity in December, being the ones which show higher volumes and a larger number of transactions. As an exception and because of being this contract being

[1] Phase I went from 2005 to 2007, Phase II is running from 2008 to 2012 and Phase III will cover 2013 to 2020.

the last Phase I futures contract traded, we will also use the EUA Futures Contract with maturity in March 2008.

Our database is composed not only by all the available daily data for both EUAs and CERs Futures Contracts with maturity in December, but also March 2008 contract, from their start (April 22nd, 2005, and March 14th, 2008, for the EUAs and CERs Futures Contracts, respectively) to October 13th, 2011. Additionally and in order to obtain information related to the number of transactions, we have employed all the intraday data available, for all the futures contracts used. For each day the daily database contains the open, high, low and settlement prices (in Euros), the total volume (in lots) and the open interest (in lots). In addition, the intraday database contains for each trade the price (in Euros) and the transaction size (in lots).

3. Methodology

3.1. Rollover criteria

This section discusses 5 different criteria in order to determine the point in time when the switching from the maturing contract to the next one in order to link the series takes place. The first criterion is the "Delivery Day" or "Last Day" criterion (LD in tables). In this case, the switch occurs when the nearest contract expires. However, if abnormal volatility occurs in the sessions prior to the contract maturity, the researcher would construct a series with the maximum distortion.

The next 4 criteria seek the appropriate market liquidity conditions for the rollover. The rationale of these criteria is that if a trader was long or short in a futures contract and wished to hold it indefinitely, he would try to find the liquidity peak to switch the contract. The second criterion of "volume", defined as the number of contracts traded, (Vol in the following tables) implies the switching of the contract on the day when the volume of the first maturity is always lower than the volume of the second maturity.

The third "open interest" method (OI in tables) indicates the jump between series when the open interest of the second maturity is always bigger than the first one. The rationale behind this criterion is that many traders consider the open interest as a more reliable indicator of liquidity than volume. The reason is that high trading volume could be the result of closed positions and this would imply less liquidity in the market. In addition to this, we add a new criterion, the fourth one, which we call the "maximum open interest" (M.OI in the tables). In this case (and it is the only one) we allow jumping from one contract to another with a maturity different from the next-to-maturity contract that has the highest open interest until maturity.[2] By doing this, we can capture the particular behavior of the CO_2 futures markets and achieve some interesting conclusions.

The last criterion is based on the measure proposed by Lucia and Pardo (2010). In this case, the jump would occur on the day in which the number of closed positions is always larger than the number of opened positions for the nearby contract. This is, when the ratio

$$R3_t = \frac{O_t}{O_t + C_t} - \frac{C_t}{O_t + C_t}$$

is less than zero until maturity, where $O_t = V_t + \Delta OI_t$ and $C_t = V_t - \Delta OI_t$, being O_t and C_t respectively the overall number of open and closed positions in the period *t*, while V_t and OI_t are the volume and the open interest of the period *t*. This methodology seeks to anticipate the fall of the open interest of the nearest maturity contract. With this criterion, the analyst avoids taking into account information on days in which the nearby contract has lost the interest of traders.

In the financial literature, there exists one additional criterion, the "Distortion free" methodology proposed by Geiss (1995). As it is pointed out by Saunier (2010), this criterion is not found to be adequate to run praxis-oriented tests. This method implies a continuous rebalancing each day due to the changing contract proportions. This would not be good enough for practitioners because the resultant series doesn't reveal the true prices quoted in the market and as a consequence investors could not use these prices in their investment strategies. For this reason, this last methodology is not included in our study.

Finally, it is important to highlight that the choice of the rollover date matters depending on what is being tested. For example, in some futures contracts the deferred months are more actively traded than the nearby ones. In these cases, the choice among liquidity-seeking criteria is likely to be more reliable when constructing a continuous series of liquidity-related measures, such as volume or open interest.

3.2. Timing of rollover

Next, we consider how many days before the expiration date the rollover would be made effective by each of the 5 proposed methods. In the "last day" method, by definition, there are zero days between the contract expiration and the rollover date, and

[2] Applying this rule to volume or R3 does not produce a new series.

this would indicate that the last price with which the first maturity series contributes to the continuous series is the delivery price.

Concerning the methods based on the search of liquidity, we compute the days when the second contract volume or open interest values are persistently higher than those of the first one up to maturity. In order to construct a price series, we take prices from the contract with more volume or open interest, respectively. In the case of the "maximum open interest" we count the days when any contract systematically exhibits the maximum open interest until its expiration date, among all the existing contracts.

In the R3 criterion, the period computed ranges from the day when the R3 variable is negative up to the maturity day. This is, when the closed positions surpass the open ones in the expiring contract until the maturity day, both included. During those days, second contract prices replace the first ones.

Table I presents the mean and the standard deviation of the number of days between the rollover date and the front contract expiration date for the three assets considered: Phase I EUAs, Phase II EUAs, and Phase II CERs. In the case of the mean, this table informs about the average number of days before maturity, in which the information of the nearest contract is not used anymore in the construction of the long series. In the case of the "maximum open interest" criterion (M.OI), as this method allows jumping to the contract with the highest open interest, regardless of its maturity, this parameter cannot be calculated because data from several front contracts are not used for Phase II CERs and EUAs.

Table I. Rollover timing for each criterion

This table indicates the mean and the standard deviation of the number of days between the rollover date and the expiration date of the contract for each of the 5 proposed methods. *LD, Vol, OI, M.OI, and R3* stand for last day, volume, open interest, maximum open interest, and R3 criteria, respectively. Sample period from April 22nd, 2005 to March 31st, 2008 for Phase I EUAs (Panel A), from April 22nd, 2005 to October 13th, 2011 for Phase II EUAs (Panel B), and from March 14th, 2008 to October 13th, 2011 for Phase II CERs (Panel C).

Panel A: Phase I EUAs	LD	Vol	OI	M.OI	R3
Mean	0	13.3	10.67	11.3	2.3
Std. Deviation	0	11.6	15.08	19.6	1.5

Panel B: Phase II EUAs	LD	Vol	OI	M.OI	R3
Mean	0	5.7	0.33	-	2.7
Std. Deviation	0	3.2	0.47	-	3.8

Panel C: Phase II CERs	LD	Vol	OI	M.OI	R3
Mean	0	5.3	27.72	-	4.7
Std. Deviation	0	7.5	18.80	-	4.7

Note that the diverse criteria show results very different in terms of mean and standard deviation, especially in the case of Phase II CERs, and therefore, the resultant constructed series will be expected to be quite divergent.

3.3. Percentage of data that differs between series

Table II displays the percentage differences on the number of data that varies between the different series. Now, the implications of Table I can be seen more clearly. Table II shows that the "maximum open interest" series are the most different in Phase II EUAs and Phase II CERs, followed by the "open interest" series for Phase II CERs. This is because the open interest methodologies jump to the next contract far sooner than the rest of the criteria, as there is a contract with a later expiry date which dominates the remaining contracts in terms of OI. The rest of the series only vary up to 5.21% for the Phase I EUAs case, 1.03% for the Phase II EUAs series, and finally 2.63% for the Phase II CERs data.

Table II. Percentage data that differs between long futures return series.

This table indicates the difference in percentage between the number of observations that is different when constructing continuous futures series following each criterion. *LD, Vol, OI, M.OI, and R3* stand for last day, volume, open interest, maximum open interest, and R3 criteria, respectively. Sample period from April 22nd, 2005 to March 31st, 2008 for Phase I EUAs (Panel A), from April 22nd, 2005 to October 13th, 2011 for Phase II EUAs (Panel B), and from March 14th, 2008 to October 13th, 2011 for Phase II CERs (Panel C).

Panel A: Phase I EUAs	LD	Vol	OI	M.OI
Vol	5.21%			
OI	4.01%	3.60%		
M.OI	4.01%	3.60%	0.00%	
R3	0.67%	4.54%	3.60%	3.60%

Panel B: Phase II EUAs	LD	Vol	OI	M.OI
Vol	1.03%			
OI	0.06%	0.97%		
M.OI	22.02%	22.81%	21.96%	
R3	0.48%	0.54%	0.42%	22.32%

Panel C: Phase II CERs	LD	Vol	OI	M.OI
Vol	1.75%			
OI	44.91%	43.15%		
M.OI	99.34%	99.34%	76.23%	
R3	1.53%	2.63%	43.37%	99.45%

Taking into account these results, the disparity in the number of data of each of the series could make it possible to work with different samples, taken from the same raw data. This is what we analyze in the following sections.

4. Empirical analysis

Before testing the equality of the distributions, it is important to clarify how to link the series of the different maturities. Note that when we switch from one contract to another, a jump in prices takes place. We correct this abnormal return by calculating the rollover day return as the log of the quotient between the closing price of the second maturity contract and the previous closing price of such maturity. Then, considering the return series calculated by making this adjustment only on the rollover day, we have tested the equality of means, medians and variances among the futures return series constructed following the 5 criteria explained in Section 3.

Table III. Equality tests of long futures return series

Equality tests of means, medians and variances between the continuous return series constructed following the criteria explained in Section 3. *LD, Vol, OI, M.OI, and R3* stand for last day, volume, open interest, maximum open interest, and R3 criteria, respectively. The equality of means, medians and variances has been tested with the parametric Anova F-test, the non-parametric Kruskal-Wallis test and the Brown-Forsythe's statistic, respectively. The corresponding percentage p-values appear in all panels at the end of the column. Sample period from April 22nd, 2005 to March 31st, 2008 for Phase I EUAs (Panel A), from April 22nd, 2005 to October 13th, 2011 for Phase II EUAs (Panel B), and from March 14th, 2008 to October 13th, 2011 for Phase II CERs (Panel C). H0 stands for the p-value of the equality tests of means, medians and variances between all the continuous return series constructed.

Panel A: Phase I EUAs	Mean	Median	Std. Deviation
LD	-0.009053	0.000000	0.120161
Vol	-0.009048	0.000000	0.120147
OI	-0.009013	0.000000	0.120177
M.OI	-0.009013	0.000000	0.120177
R3	-0.009042	0.000000	0.120162
H0	100	100	100

Panel B: Phase II EUAs	Mean	Median	Std. Deviation
LD	-0.000350	0.000400	0.026587
Vol	-0.000350	0.000400	0.026589
OI	-0.000349	0.000400	0.026587
M.OI	-0.000347	0.000000	0.026599
R3	-0.000349	0.000400	0.026591
H0	100	100	100

Panel C: Phase II CERs	Mean	Median	Std. Deviation
LD	-0.000835	0.000000	0.023127
Vol	-0.000830	0.000000	0.023130
OI	-0.000792	0.000700	0.023143
M.OI	-0.000829	0.000000	0.022975
R3	-0.000881	0.000000	0.023099
H0	100	100	100

The equality of these parameters has been tested with the parametric Anova F-test, the non-parametric Kruskal-Wallis test and the Brown-Forsythe's statistic, respectively. The results are displayed in Table III. Panel A (Phase I EUAs), Panel B (Phase II

EUAs) and Panel C (Phase II CERs) present similar results. The p-values indicate that it is not possible to reject the null hypothesis of equality of means, medians and variances in any case.

Therefore, independently of the method used to elaborate a unique and continuous future return series, we would reach the same conclusions in terms of means and variance. However, given that two series with the same parameters of position and dispersion could result in different distributions, we have applied the Wilcoxon/Mann-Whitney test**,** a non-parametric test based on ranks in order to determine if two groups (in this case series) have the same general distribution or not. The results of these tests are reported in Table IV. It can be shown that the null hypothesis of equality between distributions cannot be rejected in any case as all the p-values are far above 10%. Therefore, returns distributions of linked series are not conditioned by the criterion used to elaborate them.

Table IV. Distribution tests of long futures return series

This table shows the percentage p-values of the Wilcoxon/Mann-Whitney test that tests the null hypothesis that two continuous return series have the same general distribution. *LD, Vol, OI, M.OI, and R3* for last day, volume, open interest, maximum open interest, and R3 criteria, respectively. Sample period from April 22nd, 2005 to March 31st, 2008 for Phase I EUAs (Panel A), from April 22nd, 2005 to October 13th, 2011 for Phase II EUAs (Panel B), and from March 14th, 2008 to October 13th, 2011 for Phase II CERs (Panel C).

Panel A: Phase I EUAs	LD	Vol	OI	M.OI
Vol	97.99			
OI	99.66	98.38		
M.OI	99.66	98.38	100	
R3	98.91	99.14	99.24	99.24

Panel B: Phase II EUAs	LD	Vol	OI	M.OI
Vol	99.67			
OI	99.78	99.45		
M.OI	99.99	99.66	99.78	
R3	99.92	99.59	99.86	99.94

Panel C: Phase II CERs	LD	Vol	OI	M.OI
Vol	99.98			
OI	95.06	95.10		
M.OI	93.51	93.39	88.22	
R3	96.11	96.07	91.05	97.67

5. Liquidity analysis

The previous analysis confirms the "last day" criterion as the simplest methodology to construct long futures return series. However, given that the rest of the methodologies are focused on different seeking-liquidity criteria, the question is: does the "last day" criterion offer appropriate market liquidity conditions?

To determine possible differences in market liquidity among the criteria, we have chosen the variable "number of transactions" (the number of agreements between a buyer and a seller to exchange any number of contracts for payment) as the most relevant due to the fact that a large number of transactions is indicative of high trading activity and this is directly related to market liquidity. Furthermore, it is interesting to highlight that given that this variable is based on intraday data, this part of the study could be of great interest for microstructure researchers. As high frequency data is not always easily at hand, this study would help researchers in their decision of choosing the most suitable rollover criterion, when their objective is to obtain the most representative series in terms of liquidity.

Firstly, following the steps described in Section 3, we have constructed the continuous transactions series. Then, we have carried out equality and distribution tests over the long series to determine possible significant differences among them in terms of liquidity. Table V presents the equality tests of means, medians and variances between the continuous transaction series, for Phase I EUA, Phase II EUA and Phase II CER, respectively.

The results of Table V are different for Phase I EUAs and for Phase II EUAs and CERs. In the first case, there are not significant differences among the long transactions series constructed, but in the second case, we reject the assumption of equality in terms of mean, median and standard deviation when we compare the five constructed series (H0). This is due to the significantly lower level of transactions for the M.OI series. For these two assets, we take a second step and repeat the test, but now comparing all the series except M.OI. Again, we reject the hypothesis of equality of the analyzed parameters because of the OI series. Although OI series present a higher level of number of transactions than M.OI, it is not as high as in the rest of the methodologies. Finally, we repeat the tests for the rest of the transaction series constructed and no significant differences are found. Table VI confirms the previous results, giving evidence of the existence of significant differences in the transactions distribution for OI and M.OI and the rest of the series.[3]

Table V. Equality tests of long futures transaction series

Equality tests of means, medians and variances between the continuous transaction series constructed following the criteria explained in Section 3. *LD, Vol, OI, M.OI, and R3* stand for last day, volume, open interest, maximum open interest, and R3 criteria, respectively. The equality of means, medians and variances has been tested with the parametric Anova F-test, the non-parametric Kruskal-Wallis test and the Brown-Forsythe's statistic, respectively. The corresponding percentage p-values appear in all panels at the end of the column. Sample period from April 22nd, 2005 to March 31st, 2008 for Phase I EUAs (Panel A), from April 22nd, 2005 to October 13th, 2011 for Phase II EUAs (Panel B), and from March 14th, 2008 to October 13th, 2011 for Phase II CERs (Panel C). H0 stands for the p-value of the equality tests of means, medians and variances between all the continuous transaction series constructed. H1 stands for the p-value of the equality tests of means, medians and variances between all the continuous transaction series constructed except M.OI. H2 stands for the p-value of the equality tests of means, medians and variances between all the continuous transaction series constructed except OI and M.OI.

Panel A: Phase I EUAs	Mean	Median	Std. Deviation
LD	45.92719	36	46.66387
Vol	47.70877	39	47.09651
OI	46.40862	37	46.60285
M.OI	46.40862	37	46.60285
R3	46.23398	36	46.63303
H0	96.83	93.91	99.91

Panel B: Phase II EUAs	Mean	Median	Std. Deviation
LD	644.3489	525.5	636.0245
Vol	646.0522	532	635.5692
OI	535.5655	365.5	567.6467
M.OI	457.2538	251	545.0133
R3	645.2008	528	635.8774
H0	0	0	0
H1	0	0	0
H2	99.98	99.98	100

Panel C: Phase II CERs	Mean	Median	Std. Deviation
LD	69.94469	58	53.3494
Vol	69.89823	58	53.43603
OI	61.10188	49	49.73536
M.OI	39.24832	21	49.18852
R3	70.10066	58	53.50176
H0	0	0	0.09
H1	0.04	0	85.10
H2	99.96	99.87	99.95

[3] These results are qualitatively similar to those obtained using other measures of trading activity as liquidity indicators. Specifically, we have repeated all the analysis in Section 5 by using both screen transactions and volume as trading activity measures. These results are available upon request from the authors.

Table VI. Distribution tests of long futures transaction series

This table shows the percentage p-values of the Wilcoxon/Mann-Whitney test that tests the null hypothesis that two continuous transaction series have the same general distribution. *LD, Vol, OI, M.OI, and R3* for last day, volume, open interest, maximum open interest, and R3 criteria, respectively. Sample period from April 22nd, 2005 to March 31st, 2008 for Phase I EUAs (Panel A), from April 22nd, 2005 to October 13th, 2011 for Phase II EUAs (Panel B), and from March 14th, 2008 to October 13th, 2011 for Phase II CERs (Panel C).

Panel A: Phase I EUAs	LD	Vol	OI	M.OI
Vol	39.84			
OI	77.27	58.00		
M.OI	77.27	58.00	99.99	
R3	85.84	50.26	91.00	91.00

Panel B: Phase II EUAs	LD	Vol	OI	M.OI
Vol	93.15			
OI	0	0		
M.OI	0	0	0	
R3	96.57	96.60	0	0

Panel C: Phase II CERs	LD	Vol	OI	M.OI
Vol	96.37			
OI	0	0		
M.OI	0	0	0	
R3	95.90	92.33	0	0

Therefore, traders following “open interest” or “maximum open interest” rollover methodologies will face a more unfavorable intraday liquidity environment for the period considered, in both Phase II EUAs and Phase II CERs cases. This can be due to the fact that traders in Phase II EUAs and CERs maintain open positions in non-nearest-to-maturity futures contracts sooner than traders did in Phase I. The most striking case is the Phase II ICE ECX CER Futures Contract with maturity in December 2008 that began to be traded on March 14th, 2008. Only four trading days later, on March 20th, 2008, the open interest of the Phase II ICE ECX CER Futures Contract with maturity in December 2011 was higher than the open interest in the nearest-to-maturity futures contracts (December 2008).

Finally, it is worth noticing the results in the case of the “last day” method. This criterion offers the same level of transactions as the seeking-liquidity criteria and, as a consequence, this methodology grants a convenient liquidity frame to switch the contract or close the present position.

6. Summary and conclusions

The purpose of this study is to analyze the relevance of the choice of the rollover date when constructing continuous futures contract series in the ICE ECX futures market. The main methodologies related to the construction of long futures series have been revised, as well as the different adjustments to be made when linking them. One new criterion, “maximum open interest”, has been added to the previous literature accordingly with the specific futures contract analyzed. Therefore, five criteria have been applied to link all the EUAs and CERs futures contracts with maturities between April 22nd, 2005 and October 13th, 2011.

Our findings indicate that there are not significant discrepancies between the different continuous futures return series in terms of mean, median and variance. Identical conclusions are observed when comparing in pairs the general distribution among the different futures series. To sum up, the findings obtained here are consistent with Carchano and Pardo (2009) conclusions for the stock index futures. We confirm that the simplest methodology, which consists in jumping on the last trading day, can be used in order to reach the same results. A liquidity analysis gives robustness to this finding, given that the “last day” method offers the same level of transactions as the liquidity-seeking criteria. Therefore, in the case of EUAs and CERs futures contracts, the ease of construction of log return series is not at odds with the search for liquidity.

References

Carchano, O., & Pardo, A. (2009). Rolling over stock index futures contracts. Journal of Futures Markets, 29, 684-694.

Chevallier, J. (2010). EUAs and CERs: Vector autoregression, impulse response function and cointegration analysis. Economics Bulletin, 30.

Chevallier, J. (2011). A model of carbon price interactions with macroeconomic and energy dynamics. Energy Economics, 33 (6), 1295–1312.

Chevallier, J. & Benoit, S. (2010). On the Realized Volatility of the ECX CO2 Emissions 2008 Futures Contract: Distribution, Dynamics and Forecasting, Fondazione Eni Enrico Mattei Working Paper 377.

Directive 2003/87/EC of the European Parliament and of the Council of 13 October 2003 establishing a scheme for greenhouse gas emission allowance trading within the Community and amending Council Directive 96/61/EC. (http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2003:275:0032:0032:EN:PDF). Last access on December 1st, 2011.

Directive 2004/101/EC of the European Parliament and of the Council of 27 October 2004 amending Directive 2003/87/EC establishing a scheme for greenhouse gas emission allowance trading within the Community, in respect of the Kyoto Protocol's project mechanisms, (http://ec.europa.eu/health/files/eudralex/vol-1/dir_2004_27/dir_2004_27_en.pdf). Last access on December 1st, 2011.

Geiss, G. (1995). Distortion-free futures price series. The Journal of Futures Markets, 15, 805–831.

Junkus, C. (1986). Weekend and day of the week effects in returns on stock index futures. The Journal of Futures Markets, 6, 397–407.

Koenig, P. (2011). Modelling Correlation in Carbon and Energy Markets. Working Paper 1107 and Cambridge Working Paper in Economics 1123.

Lucia, J., & Pardo, A. (2010). On measuring hedging and speculative activities in futures markets from volume and open interest data. Applied Economics, 42, 12.

Ma, K., Mercer, M., & Walker, M. (1992). Rolling over futures contracts: A note. The Journal of Futures Markets, 12, 203–217.

Mansanet, M., Chevallier, J., Hervé, M., & Alberola, E. (2011). EUA and sCER Phase II price drivers: Unveiling the reasons for the existence of the EUA–sCER spread Energy Policy 39, 1056–1069.

Mansanet-Bataller, M., & Pardo, A. (2008). What you should know about carbon markets. Energies, 1, 3, 120-153.

Mansanet-Bataller, M., & Pardo, A. (2011). CO_2 prices and portfolio management. International Journal of Global Energy Issues, 35, Nos. 2/3/4, 154-177.

Palao, F. & Pardo, A. (2012). Assessing price clustering in European Carbon Markets". *Applied Energy,* 92, 51–56.

Medina, V., Pardo, A. & Pascual, R. (2011). The Timeline of Trading Frictions in the European Carbon Market. SSRN Working Paper Series. Available at SSRN: http://ssrn.com/abstract=1949259 or doi:10.2139/ssrn.1949259.

Rittler, D. (2012). Price discovery and volatility spillovers in the European Union Emissions Trading Scheme: a high-frequency analysis. Journal of Banking & Finance, 36 (3), 774-785.

Samuelson, P. (1965). Proof that properly anticipated prices fluctuate randomly. Industrial Management Review, 6, 41–49.

Saunier, T. (2010). How rolling over yield affects portfolio performance? Working paper, Maastricht University, http://arno.unimaas.nl/show.cgi?fid=22089.

Uhrig-Homburg, M. & Wagner, M. (2009). Futures prices dynamics of CO_2 emission allowances: an empirical analysis of the trial period. The Journal of derivatives, 17, 73-88.

Ivie

Guardia Civil, 22 - Esc. 2, 1º
46020 Valencia - Spain
Phone: +34 963 190 050
Fax: +34 963 190 055

Website: www.ivie.es
E-mail: publicaciones@ivie.es