Contrarian Long-Short Futures Arbitrages and Market Efficiency: Evidence in the Index Futures Markets around the Globe

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Andrew H. Chen, Distinguished Professor of Finance
Southern Methodist University, Dallas, Texas, U.S.A.

Joseph Kang*, Associate Professor of Finance
Nanyang Business School, NTU, Singapore

Donald Lien, Richard S. Liu Distinguished Chair in Business
University of Texas at San Antonio, Texas, U.S.A.

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***Corresponding author.** Phone: (65) 6790-4639, Fax: (65) 6791-3697, E-mail: acskang@ntu.edu.sg. The authors have received valuable comments from R. Daigler and C.Y. Hwang. We acknowledge the research grants (both RCC20/2002 and RCC4/2003) of the Nanyang Business School, Singapore and the research assistance of Dr. Joe Charnwut, MFC Asset Management PLC, Thailand.

Abstract

The contrarian long-short futures arbitrages of holding for H days after simultaneously selling winners and buying losers in the past E days are analyzed in the 39 index futures markets around the globe in the 1992-2002 period. The excess normalized profits of {5,5} long-short futures arbitrages were statistically significant in all markets except the US index futures market. While these were particularly significant on Thursdays/Fridays in the September spot months, they were mainly driven by return reversals and bear-market conditions. Our findings therefore suggest, among other things, that the long-short futures arbitrages may persist to be profitable in most index futures markets.

1. Introduction

An extensive body of finance literature documents that past stock returns can predict the future stock returns in short-term, intermediate-term, and long-term horizons, although the predictability weakens over longer horizons. For example, Jegadeesh (1990) and Lehmann (1990) find strong return reversals in relatively short-term horizons (one month and six months, respectively). Jegadeesh and Titman (1993) document return continuations in intermediate horizons (three to twelve months) during which past winners outperform past losers on average. DeBondt and Thaler (1985) report long-term (e.g., three to five years) pattern of price reversals where past long-term losers tend to outperform past long-term winners on average.

Since the patterns in shorter horizons tend be relatively persistent even in efficient markets, one can formulate return-based trading strategies to profit from the regularities of short-term reversals and intermediate-term continuations in asset returns. The short-run contrarian (intermediate-term momentum) portfolios are based on the belief that shorting (buying) past winners and buying (shorting) past losers can produce significant excess/active returns relative to benchmark portfolios. In essence, Fama (1991) noted that the predictability of asset returns over longer horizons and the profitability of return-based trading strategies are among the most controversial issues on asset market weak-form efficiency. This controversy has led to studies of competing explanations and multiple sources of return-based contrarian and momentum profits in stock and other primary asset markets.[1]

[1] For early studies, see Lo and Mackinlay (1990) and Jegadeesh and Titman (1993) who in essence posited that such contrarian (momentum) profits were mainly attributable to over-reaction (under-reaction) of investors to new information. A summary of recent studies on equity return predictability is provided in Kang, et al. (2002) and Kang and Ding (2005).

Can such return-based trading strategies produce arbitrage profits in speculative derivatives markets? Futures markets are among the most heavily-studied speculative markets partially because these are among the most liquid derivatives markets with least market frictions and highest liquidity. There is, however, little research on the profitability of return-based contrarian arbitrages in the futures markets. There are several reasons for such lack of the important research.

First, futures contracts are short-lived securities as they typically expire within one year (e.g., most currency futures) or two years (e.g., most long-term bond price futures).[2] Furthermore, their active trading horizons are only few months because due to extreme uncertainty in the spot-futures basis particularly during expiration months only regular nearest-to-expiry futures contracts are actively traded during their spot month period (i.e., the period of few months from the earlier contracts' expiration month to the month prior to their expiration month). Hence, the relatively short life of active trading should have discouraged the important research on the short-run return-based contrarian arbitrages.

Second, as a result of futures exchanges' concerns with both liquidity and short squeeze, the number of futures contracts sharing similar underlying assets is limited to a few and the number of types of futures contracts in each futures segment is thus limited. This limitation in the futures segment should have discouraged the portfolio-based analysis of contrarian arbitrages, which is essential for producing robust results.

Third, most theoretical research on futures pricing has focused on providing cross-sectional explanations on the futures risk premiums, while most empirical research

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[2] There are exceptions. For example, short-term interest rate futures (e.g., Treasury Bill and Eurodollar futures contracts) have ten years or longer maturity. For early empirical analysis of interest rate futures, see Chen, et al. (1993).

has employed complex econometric models to explain the futures returns with multiple risk factors.[3] Hence, the futures pricing literature might have not been useful for guiding the empirical research on return-based contrarian arbitrages in the futures markets. Furthermore, complex institutional details on futures trading might have deterred researchers from conducting the important research in the futures markets.

The analysis in this article attempts to fill in the gap in the empirical asset pricing literature by addressing the afore-mentioned technical problems and providing a portfolio-based analysis of the contrarian arbitrages in the 39 index futures markets around the globe (involving 32 futures exchanges located in 29 countries).[4]

Our analysis is focused on the stock index futures markets for several reasons. *First*, these markets are among the most important futures markets to both practitioners and academic researchers because these index futures contracts are written on well-diversified baskets of the most important financial assets. *Second*, the presence or absence of arbitrage profits in these markets would provide a stronger test of futures market efficiency because the disproportionately large number of institutional and sophisticated traders in these markets should have arbitraged away the profitability of return-based short-run contrarian arbitrages. *Third*, since the contrarian futures arbitrages would be among the important long-short hedge fund strategies implemented in the index futures markets, our analysis could also contribute to the literature on hedge fund strategies.[5]

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[3] The econometric models of futures returns become necessarily complex for handling the ARCH effect, error corrections, structural breaks, errors-in-variables especially when the information on the maturity structure of futures prices are deemed relevant.

[4] These markets are classified into six index futures sectors/segments: namely, the US, Non-US, EU, Non-EU, Asia Seasoned and Asia Unseasoned sectors. For details, see Section 2.

[5] As documented in the literature on index-futures lead-lag relations, index futures would move before stock index moves. Hence, our analysis would provide valuable insights also on the index-futures

The main analysis is based on the short-run return-based {E,H} contrarian strategies of holding for H-days after simultaneously selling and buying the past E-day winners and losers for 25 symmetric arbitrages constructed from the combinations of E = 1, 2, 3, 4, 5 and H = 1, 2, 3, 4, 5 trading days. The methodology for contrarian arbitrages in Lo and Mackinlay (1990) were applied for evaluating the arbitrage profits in the six index futures sectors. The data for 39 regular nearest-to-expiry futures for the 12/1992-08/2002 period are used to implement the long-short futures arbitrages on a daily rollover basis.[6]

In this article, the main results of the most significant and representative symmetric arbitrage profits---e.g., {5,5}, {10,10} and {20,20} arbitrage profits---were discussed by futures sectors, sample subperiods, futures' spot months and trading weekdays. Two interesting results obtained from the analysis are that (1) the excess normalized profits of {5,5} long-short futures arbitrages were most statistically significant in all sectors except the US sector and (2) while these profits were mainly due to return reversals and bear-market conditions, they were particularly significant on Thursdays/Fridays in the September spot months. Our results therefore suggest that the {5,5} long-short futures arbitrages may persist to produce significant profits in most index futures markets.

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arbitrages as well. For this implication and related discussions, see, e.g., Stoll and Whaley (1990), Subrahmanyam (1991), Hasbrouck (1995) and Ahn et al. (2002).

[6] The daily horizons were chosen because due to margin-based leverages (e.g., 15 times), the daily horizon in futures markets could be equivalent to (or even longer than) the biweekly horizon in equity markets in terms of return volatility. One of many benefits using the spot-month data for the cash-settled index futures is that the prices of the next-nearest-to-expiry futures contracts during regular delivery months are free of traders' manipulations even when the position limits that vary across types of futures contracts and futures exchanges were suboptimal ones. For this implication and related discussions, see, e.g., Kumar and Seppi (1992), Grossman (1993), Garbade and Silber (2000) and Dutt and Harris (2005). However, the futures prices in the spot-month data are subject to price limits. The effects of such price limits on the short-run futures returns and contrarian arbitrage profits would be negligible because daily rollovers will average them out. For recent studies on the effects of such price limits on futures returns, see, e.g., Harel et al. (1995).

This article is organized as follows. In Section 2, we describe our spot-month data and the 39 index futures contracts that are allocated to one of six index futures sectors. In Section 3, we provide detailed explanations on the methodology for contrarian long-short arbitrages in the futures markets. In Section 4, we discuss the main results: namely, the contrarian arbitrage profits and their main sources. In Section 5, we discuss additional results on the seasonal patterns in arbitrage profits and the profitability of contrarian arbitrages with longer horizons. In Section 6, we summarize the results and their implications.

2. Data

2.1 39 Index Futures Contracts and Six Index Futures Sectors

Table 1 summarizes by index futures sectors the basic features on the 39 equity index futures contracts actively traded at one of the 32 futures exchanges in 29 countries during the 1992-2002 sample period. In the US trading zone, twelve index futures were traded at six futures exchanges in four countries including the U.S. and Canada. In the Europe trading zone, 18 index futures were traded at 17 futures exchanges in EU countries including Germany and France and non-EU countries including the U.K. In the Asia trading zone, nine index futures were actively traded at eight futures exchanges in eight countries including Japan and Australia.

[Insert Table 1 about Here]

Among twelve index futures traded in the US trading zone, six index futures are written on the US equity market indices and therefore allocated to the US sector. During the sample period, these futures in the US sector were actively traded at the CME

(Chicago Mercantile Exchange), CBOT (Chicago Board of Trade) and NYFE (New York Futures Exchange).[7] Six other index futures allocated to the Non-US sector were actively traded also in their respective local currency at respective futures exchanges in the U.S. (CME)[8], Canada (MSE), Mexico (MDX) and Brazil (BMF). These futures in the US trading zone are traded in both floor (i.e., open outcry) and electronic trading platforms. Their typical contract size is 250 times its respective index points whereas their typical tick size is 0.1 index point. Hence, their typical tick value is about 25 dollars in their respective local currency.

Among 18 index futures traded in the Europe trading zone, seven futures contracts are written on seven EU member countries' respective equity market indices and therefore allocated to the EU sector. These futures were actively traded in their respective currency during the pre-Euro subperiod but in the Euro currency during the post-Euro subperiod at their respective futures exchanges located in Germany, France, Italy, Spain, Netherlands, Belgium and Austria. Eleven other index futures written on ten non-EU countries' respective equity market indices were allocated to the Non-EU sector. These futures were also actively traded in their respective local currency at respective futures exchanges located in the U.K., Switzerland, Norway, Finland, Sweden, South Africa, Russia, Poland, Hungary, and Czech Republic. These index futures in the Europe trading zone are typically traded in electronic trading platform. But, their contract sizes,

[7] Due to the sample cut-off point (and data availability), current analysis did not include in the US sector several futures contracts that were newly introduced during the 1997-2002 period: e.g., NASDAQ 100 (1997), DJIA (1997), E-Mini S&P500 (1997), E-Mini NASDAQ 100 (1999) and E-Mini DJIA (2002).
[8] Due to the sample cut-off point (and data availability), current analysis did not include in the Non-US sector several futures contracts that were newly introduced during the 1997-2002 period: e.g., Euro-DAX (1997), Nikkei 225-SIMEX (1997), FTSE 100-LIFFE (1998), S&P TSE 60-Montreal (1999) and E-Mini Russell 2000 (2002).

tick sizes and tick values vary a lot by different types of index futures and across futures exchanges.

Among nine index futures in the Asia trading zone, six seasoned index futures were actively traded during the sample period in their respective local currency at respective futures exchanges located in Japan, Australia, New Zealand, Hong Kong and Singapore. Three unseasoned index futures were also actively traded during the post-Euro subperiod in their respective local currency at respective futures exchanges in Korea, Taiwan and Malaysia.[9] These futures in the Asia trading zone are typically traded in electronic trading platform. But, their contract sizes, tick sizes and tick values vary a lot by different types of futures and across futures exchanges.

2.1 Spot-Month Data

In all futures markets, only the nearest-to-expiry futures contracts are actively traded during their spot months---i.e., few months before the expiration month---because, due to extreme uncertainty on the spot-futures basis especially during the expiration month, nearly all futures traders want to rewind their positions before expiration month (and rollover their positions, if necessary, to the next nearest-to-expiry futures). Furthermore, only the futures contracts that expire on the regular/generic expiration months are actively traded. In all six index futures sectors/markets, the regular/generic expiration months are the March-quarterly months (i.e., March, June, September and

[9] We separately consider the contrarian arbitrage profits in the Asia Seasoned and Asia Unseasoned sectors because the informational efficiency and price discovery in the futures exchanges that trade unseasoned stock index futures contracts could be different from those in the futures exchanges that trade seasoned contracts. For recent research motivated by such differences, see, e.g., Bae, Kwon and Park (2004). For recent research that did not find such differences, see, e.g., Huang (2002).

December). Hence, the spot months are typically three months prior to the regular expiration month.[10]

The daily spot-month data on open price, settlement price, open interest and trading volume for all generic nearest-to-expiry index futures contracts were collected from both the Datastream 2002 and the Bloomberg Professional for the 12/1992 - 08/2002 period. Since high quality data from liquid trading are essential for the analysis of short-run return-based arbitrages, we selected only the 39 index futures that were deemed actively traded according to their respective trading volume and open interest. These did not have any missing observations in terms of either data source. As a result, the price data for 29 futures contracts were obtained from the Datastream 2002 and those for ten futures contracts---e.g., KOSPI 200, TAIEX and NZSE Top10 index futures---from the Bloomberg Professional.

As explained before, these 39 index futures were allocated into the US (6 futures), Non-US (6 futures), EU (7 futures), Non-EU (11 futures), Asia Seasoned (6 futures) and Asia Unseasoned (3 futures) sectors in order to facilitate the portfolio-based analysis of long-short futures arbitrages. We removed the three calendar months from 09/1998 to 11/1998 (i.e., December 1998 spot-month period) to control for the possible contamination effect on the index future pricing of the Euro-currency introduction in January 1999. To control for structural breaks around the time of the Euro currency introduction, we divided the sample period into the early 12/1992-11/1995 subperiod (i.e., 03/1993–12/1995 spot-month period), pre-Euro 12/1995-08/1998 subperiod (i.e., 03/1996–09/1998 spot-month period) and post-Euro 12/1998-08/2002 subperiod (i.e.,

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[10] For example, the June (September) spot-month period refers to March-May (June-August) three-month period.

03/1999–09/2002 spot-month period). Hence, there are twelve spot months (i.e., 36 months) in the early subperiod, eleven spot months (i.e., 33 months) in the pre-Euro subperiod and 15 spot months (i.e., 45 months) in the post-Euro subperiod.

3. Methodology for Return-based Contrarian Long-Short Arbitrages

Our research methodology closely follows the methodology employed in Lo and Mackinlay (1990) for evaluating contrarian arbitrages in the U.S. equity market. The short-run return-based {E,H} contrarian strategies of holding the arbitrage portfolios for H-days after selling and buying the past E-day winners and losers are considered for 25 arbitrages from combinations of E = 1, 2, 3, 4, 5 and H = 1, 2, 3, 4, 5 trading days. In the current analysis, winners (losers) are the futures whose long-position returns in the E evaluation horizon are larger (smaller) than the benchmark return or the equal-weighted return of the respective sector. The long-position returns for E evaluation horizon are computed as:

$$R_t^i = (SP_t^i - OP_{t-E}^i)/OP_{t-E}^i \tag{1}$$

where R_t^i is the i-th futures' return for the E evaluation horizon at time t and OP^i and SP^i are the i-th futures' opening and settlement prices, respectively.

The long-short futures portfolio weights for winners ($\omega_t^{W_i}$) and losers ($\omega_t^{L_i}$) in each sector are computed as:

$$\omega_t^{W_i} = -N^{-1}(R_t^{W_i} - R_t^S) < 0 \text{ as } (R_t^{W_i} - R_t^S) > 0 \tag{2a}$$

$$\omega_t^{L_i} = -N^{-1}(R_t^{L_i} - R_t^S) > 0 \text{ as } (R_t^{L_i} - R_t^S) < 0 \tag{2b}$$

where $R_t^{W_i}$ and $R_t^{L_i}$ are the returns of winners and losers, respectively, and

$R_t^S = N^{-1}(\sum_{i=1}^{N} R_t^i) = N^{-1}(\sum_{W_i} R_t^{W_i} + \sum_{L_i} R_t^{L_i})$ is the respective sector's equal-weighted benchmark return for the E evaluation horizon.

The long-short futures portfolio weights for multiple winners (losers) are negative (positive). The long-short futures arbitrages are self-financing in that net long (or short) position is zero. The H-holding non-normalized returns of long-short futures arbitrages (R_{t+H}^C) are computed as:

$$R_{t+H}^C = \sum_{W_i} \omega_t^{W_i} R_{t+H}^{W_I} + \sum_{L_i} \omega_t^{L_i} R_{t+H}^{L_i} \quad (3a)$$

The contrarian long-short arbitrage expects that the previous losers' future long-position returns will be larger than the equal-weighted benchmark long-position return. Hence, past losers' future long position returns equal the product: (the positive weight for the long position)*(long-position return). The strategy also expects that the past winners' future long-position returns will be smaller than the sector's future long-position return. Hence, past winners' future short-position returns equal the product: (the negative weight for the short position) * (long-position return).

Hence, the non-normalized returns of long-short futures arbitrages can be computed also as:

$$R_{t+H}^C = -N^{-1}\{\sum_{W_i} (R_t^{W_i} - R_t^S)(SP_{t+H}^{W_i} - OP_t^{W_I}) / OP_t^{W_i} + \sum_{L_i} (R_t^{L_i} - R_t^S)(SP_{t+H}^{L_i} - OP_t^{L_i}) / OP_t^{L_i}\} \quad (3b)$$

Taking positions in futures contracts do not require investment expenditure and the short-run arbitrages are constructed to be self-financing. Transaction costs (e.g., brokerage commissions for a round trip and the opportunity cost of the required deposits for initial futures exchange margins) are non-negligible only for longer horizons. In such case, the cost of implementing a contrarian arbitrage portfolio containing big multiple winners and big multiple losers is relatively large because the aggregate number of long and short futures positions must be relatively large. Since one half the absolute sum of portfolio weights is linearly related to such non-negligible cash outflows for a holding horizon, we compute the normalized returns (R_{t+H}^{NC}) from dividing the non-normalized returns by one half the absolute sums of portfolio weights:

$$R_{t+H}^{NC} = R_{t+H}^{C} \div (0.5 \times \sum_{i=1}^{N} \left|\omega_t^i\right|) \tag{4}$$

The normalized returns would therefore account for the extent of normalized short-run return reversals. This measure for return reversal is a useful one for explaining the profits of contrarian long-short futures arbitrages because as winners and losers seldom repeat their status over trading time, the patterns in individual/segment futures returns will not provide any clues about the contrarian profits/losses.

In current analysis, the returns of long-short futures arbitrage portfolios are measured by the normalized active returns (R_{t+H}^{NA}). They are computed as the normalized returns minus the normalized benchmark returns of the equal-weighted sector portfolio (R_{t+H}^{NB}). Namely,

$$R_{t+H}^{NA} = R_{t+H}^{NC} - R_{t+H}^{NB} \tag{5}$$

where $R_{t+H}^{NB} = R_{t+H}^{B} \div \sum_{i=1}^{N} \left|N^{-1}\right| = R_{t+H}^{B}$.

Here, we do not consider adjusting the returns according to futures pricing models as doing so is beyond the scope of the current analysis. To see this, note that the risk-adjusted return approach will generate different results as the covariance-risk adjustment would lead to different set of winners/losers and different measures for profits. But these results are not comparable and their statistical test becomes a joint test of both the cross-sectional futures risk premia model and the profitability of long-short futures arbitrages over varying evaluation/holding horizons.

The statistical significance of normalized returns (i.e., return reversals) and active returns (i.e., contrarian profits) for each spot-month horizon (i.e., three-month period) is tested by the t-values computed from dividing the respective averages of the rollover normalized returns and active returns by respective standard deviations.[11] The statistical significance of return reversals and contrarian profits for the entire sample period and each subperiod is tested by the t-values computed from dividing the respective averages of return reversals and contrarian profits across respective spot-month horizons by respective standard deviations.[12]

4. Main Findings on the {5,5} Contrarian Long-Short Futures Arbitrages

Among 25 contrarian arbitrages, the {5,5} contrarian profits were most statistically significant for most sectors. Without any loss of generality, our discussion below are primarily based on the results of the {5,5} contrarian profits.[13]

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[11] E.g., for Mar 1993 spot month, the {5,5} strategy implemented on a daily rollover basis will observe its first profits/losses at the 10th trading day, whereas the last implementation (profit) is conducted (observed) at the 56th (66th) trading day. Hence, the return reversal and contrarian profit for the Mar 1993 spot month are the respective averages of about 56 observations. In the case of {1,1} strategy, their respective averages are based on 64 observations. Once we complete all the computations for all sectors, then we move on to the next (i.e., Jun 1993) spot month period, which starts from 01 Mar 1993 and ends 31 May 1993. In other words, our analysis does not concatenate or pool the respective spot month data. Their t-test is comparable to the t-test in the Fama-Macbeth methodology.

[12] Since the number of spot-month periods is limited, the t-tests for periods can be biased *against* the statistical significance of return reversals and contrarian profits. Our test did not adjust for this potential bias as our alternative hypothesis was the statistical significance of contrarian profits.

[13] In the Non-US sector, {4,4} arbitrages provided even more significant profits than {5,5} arbitrages. The details will be provided later when our discussion of the weekday seasonality effect focuses on this sector.

4.1. {5,5} Contrarian Profits in the US and Non-US Futures Sectors

We summarize in **Table 2** the {5,5} arbitrage results in the US trading zone by the US and Non-US futures sectors. The results in the US futures sector indicate that return reversals were statistically significant in five spot-month horizons (15 months) in the post-Euro subperiod, whereas contrarian profits were statistically significant only in two spot-month horizons (6 months). Return reversals and contrarian profits for entire sample period (114 months), post-Euro subperiod (45 months) and pre-Euro subperiod (33 months) were not statistically significant.[14]

[Insert Table 2 about Here]

The results in the Non-US futures sector indicate that return reversals were statistically significant in one spot-month horizon (four spot-month horizons) in the pre-Euro bull (post-Euro bear) market subperiod, whereas contrarian profits were significant for two (three) spot-month horizons in the pre-Euro bull (post-Euro bear) market subperiod. Return reversals for entire sample period and pre-Euro and post-Euro subperiods were all statistically significant, whereas contrarian profits for entire sample period and post-Euro subperiod were statistically significant.[15] The significant {5,5}contrarian profits in the Non-US futures sector especially during post-Euro subperiod are mainly due to frequent return reversals and bear market conditions.

[14] The {5,5} contrarian profits in early (12/1992-11/1995) subperiod were not statistically significant. Although not shown here, however, the {5,5} non-normalized return reversals and active returns were statistically significant for 21 spot-month periods (63 months) and 9 spot-month periods (27 months), respectively. This unimpressive result in the US futures sector contrasts with the result reported in Lin, et al. (1999).

[15] Although not shown here, return reversals in the early period (i.e., 12/1992-11/1995 period) were statistically significant for both {5,5} and {4,4} contrarian arbitrages.

4.2. {5,5} Contrarian Profits in the EU and Non-EU Futures Sectors

We summarize in **Table 3** the {5,5} arbitrage results in the Europe trading zone by the EU and Non-EU futures sectors. The results in the EU futures sector indicate that contrarian profits were significant for one spot-month horizon (three spot-month horizons) in the pre-Euro bull (post-Euro bear) market subperiod. Return reversals were statistically significant for entire sample period (114 months) and pre-Euro subperiod (33 months), whereas contrarian profits were statistically significant only for post-Euro subperiod (45 months). Since return reversals in the post-Euro subperiod were not statistically significant, the {5,5} contrarian profits in the EU futures sector appear to be driven mainly by bear market conditions in the post-Euro subperiod.

[Insert Table 3 about Here]

The results in the Non-EU futures sector indicate that contrarian profits were significant for two (four) spot-month horizons in the pre-Euro bull (post-Euro bear) market subperiod. Both return reversals and contrarian profits were not statistically significant for entire sample period and pre-Euro and post-Euro subperiods.

4.3. {5,5} Contrarian Profits in the Asia Seasoned and Unseasoned Sectors

We summarize in **Table 4** the {5,5} arbitrage results in the Asia trading zone by Asia Seasoned and Asian Unseasoned futures sectors. The results in the Asia Seasoned futures sector indicate that contrarian profits were significant for two spot-month horizons (one spot-month horizon) in the pre-Euro bull (post-Euro bear) market subperiod. Both return reversals contrarian profits were statistically significant only for entire post-Euro subperiod.

[Insert Table 4 about Here]

The results in the Asia Unseasoned futures sector indicate that both return reversals and contrarian profits were statistically significant in four spot-month horizons in the post-Euro subperiod, three of which were identical spot-month horizons. The statistical significance of contrarian profits in this sector must be heavily discounted, however, because this sector/portfolio contains only three index futures and hence the results might have been driven by some extraneous forces beyond our control.[16]

4.4. Main Sources of the Profits in the {5,5} Contrarian Long-Short Arbitrages

In the US futures sector, both return reversals and contrarian profits were not statistically significant in entire sample period and three subperiods. This result indicates that main reasons for the lack of contrarian profits were insignificant return reversals.

In the Non-US futures sector, both return reversals and contrarian profits were significant in entire sample period and post-Euro subperiod. In the pre-Euro subperiod, only return reversals (but not contrarian profits) were statistically significant. This result indicates that main sources of contrarian profits in the post-Euro subperiod were significant return reversals coupled with bear market conditions, whereas main reasons for the lack of contrarian profits in the pre-Euro subperiod were the bull market condition despite the presence of significant return reversals.

In the EU futures sector, contrarian profits were significant only in the post-Euro subperiod, whereas return reversals were significant in entire sample period and pre-Euro subperiod. This result indicates that main sources of contrarian profits in the post-Euro

[16] Furthermore, the three countries in which these futures are traded were plagued by the Asian financial crisis during the post-Euro subperiod. Hence, the results in this sector could have been unusual ones.

subperiod were the bear market conditions despite the absence of significant return reversals, whereas main reasons for the lack of contrarian profits in the pre-Euro subperiod were the bull market conditions despite the presence of significant return reversals.

In the Non-EU futures sector, both return reversals and contrarian profits were not statistically significant in entire sample period and pre-Euro and post-Euro subperiods. Since this futures sector as a whole cannot be regarded as a developed sector like the US futures sector, the lack of significant contrarian profits in this sector is surprising.[17]

In the Asia Seasoned futures sector, both return reversals and contrarian profits were not significant in entire sample period and pre-Euro subperiod. However, both return reversals and contrarian profits were significant in the post-Euro subperiod. This result indicates that main sources of contrarian profits in the post-Euro subperiod were significant return reversals and bear market conditions.

In Asia Unseasoned futures sector, only contrarian profits were statistically significant only in the post-Euro subperiod. Although this result might have been biased because only three related types of futures contracts were used to implement contrarian arbitrages, the strong result seems to suggest that main reasons for contrarian profits in the post-Euro subperiod were return reversals and bear market conditions.

These results in the six index futures sectors imply that return reversals and bear market conditions were the two main necessary (not sufficient) conditions for contrarian

[17] It might have been driven by the excessive diversity in the Non-EU futures sector. This sector contained eleven futures contracts written on eleven different equity indices of ten non-EU member countries that had been going through different development stages. To have an idea on the possible effect of the excessive diversity, we also implemented contrarian arbitrages in the Non-EU sector by dropping the two futures contracts (FTSE 100 and FTSE Eurotop 100) traded at the U.K. London International Financial Futures Exchange (LIFFE). Although not shown here, this result is not qualitatively different from the result reported in **Table 3**.

profits.[18] The nature of return reversals as a necessary condition is not surprising because in the current analysis, return reversals would reflect the positive combined effect on the normalized returns (but not the benchmark returns) of both the negative own serial correlations and the positive cross serial correlations among futures contracts in respective sectors.

The nature of bear market condition as a necessary condition for contrarian profits in futures markets is a new finding, for which we do not have any sensible explanations. However, we have several conjectures. The first conjecture is that during bearish market conditions, the cross serial correlations between large-cap index futures and small-cap or broad-based index futures would be positive like the way that during bearish market conditions, the lead-lag effect in the equity market (i.e., positive cross serial correlations between large and small cap stocks) would become stronger.[19] The second conjecture is that during the spot months in the post-Euro bear market subperiod, multidirectional information transmissions among the six index futures sectors might have taken place. Although not shown here, the cross serial correlations among the normalized active returns of {5,5} contrarian arbitrages in the six sectors were statistically significant only for few spot months.[20] The third conjecture is that the bear market conditions may

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[18] To see if there were any futures-specific sources, we checked if there were any persistent winners or losers for respective spot-month periods. We could only find that there were on average two equally persistent winners or losers in all sectors for all spot-month periods and these did not frequently repeat across spot-month periods. This result partially implies that futures-specific sources did not exist. We also checked the five-day lagged serial correlations of for each of these two respective frequent winners or losers in all sectors. Nearly all of these serial correlation estimates ranged from negative 0.10 to positive 0.10 and were not statistically significant for nearly all spot-month periods for nearly all sectors.

[19] For the related reasoning in the equity market, see Petkova and Zhang (2002) who in essence highlighted the possibility that small-cap stocks are relatively more (less) risky than large-cap growth stocks in bad (good) times.

[20] We did not further examine the spot-month-lagged serial correlations in the normalized active returns of contrarian arbitrages in the six futures sectors because such details on the information transmission were beyond the scope of this article. For recent research on the information transmission between index futures

account for futures return volatility and/or investors' extreme bearish sentiments (e.g., extreme fear), which could have increased the short-run normalized contrarian returns, thereby strengthening the contrarian profits.[21] Testing such conjectures is beyond the scope of the current analysis on the short-run return-based contrarian arbitrages.

5. Additional Findings

5.1 Spot-Month and Day-of-the-Week Effects

Our main results also indicate that return reversals and contrarian profits tend to be more frequent in the September and December spot- month periods and in the post-Euro subperiod of bear market conditions. In fact, significant return reversals occurred most frequently in the September spot-month horizons (18 times): EU sector (five times), Non-EU sector (four times), Non-US sector (four times), Asia Seasoned sector (three times) and Asia Unseasoned sector (two times). More than 50% of the 34 total spot-month horizons with significant return reversals was the September spot-month horizon (i.e., three trading months from June to August), while the two-third (twelve) of these September spot-month horizons occurred in the post-Euro subperiod.

Similarly, significant contrarian profits (active contrarian returns) occurred most frequently in the September spot-month horizon (thirteen times): EU sector (three times), Non-EU sector (three times), Non-US sector (three times), Asia Seasoned sector (two times) and Asia Unseasoned sector (two times). More than 70% of the total 18 spot-

(not sectors) traded in different zones or different futures segments, see, e.g., Wu, Li and Zhang (2005) and Darbarl and Deb (2002).

[21] For recent futures research related to the volatility effect on futures risk premia, see, e.g., Fung and Patterson (2001), Heaney (2002), Wang (2002), Pan, Liu & Roth (2003) and Pindyck (2004). This literature suggests a positive (negative) relation between volatility and trading volume (market depth). For futures research related to effect of investors' sentiment or sentiment indicators on futures risk premia, see Gay, Kale, Kolb & Noe (1994), Wang (2001) and Simon and Wiggins (2001). This literature suggests that the sentiment indicator tends to be a contrarian indicator.

month horizons with significant contrarian profits was the September spot-month horizon, while nine of these September spot-month horizons occurred in the post-Euro subperiod.

If spot-month seasonals are related with either return reversals or bear market conditions, then it is most likely that the spot-month seasonals would be correlated with both return reversals and bear market conditions because return reversals are highly correlated with bear market conditions. Note that the September spot-month share of total spot-months with significant return reversals is about 50%, whereas the same with significant contrarian profits is about 70%. Since this September spot-month seasonality effect in contrarian profits is not fully accounted for by return reversals, this spot-month seasonality effect would qualify as an additional source of the contrarian profits in index futures markets.

The (September) spot-month seasonality effect in the contrarian profits is an interesting new result because the seasonality effect is based on the spot-month horizon (i.e., three-month horizon), which is relevant to active traders in futures markets. Since it is detected in the short-run return-based contrarian arbitrage portfolio profits, however, it can not be directly compared to extant research findings on monthly seasonality effect (especially the seasonals in the December/January returns of small-cap index futures contracts).

Unfortunately, we do not have any sensible explanations on this September spot-month seasonality effect. Furthermore, the strong September (mild December) spot-month seasonals cannot be directly compared with results in extant literature.[22]

[22] Although the recent evidence on the lack of January/turn-of-the-year seasonals in the small-cap equity index futures (proxied by S&P 400 and Russell 2000 index futures) in Szakmary and Kiefer (2004) suggests that seasonals may disappear over time, it is interesting to note the implications of monthly seasonals documented in an early study. Gay and Kim (1987) found higher (lower) commodity futures

In addition to the spot-month seasonals, short-run contrarian profits in the index futures markets may exhibit a weekday seasonality effect since the index futures prices on certain weekdays may be very volatile consistently and hence the contrarian profits could be quite sensitive to these weekdays. **Table 5** summarizes the results on the weekday variations in the {5,5}contrarian profits in the six index futures sectors.

[Insert Table 5 about Here]

The Monday and Wednesday weekday seasonals on contrarian profits were not observed for any futures sectors. In Asia Unseasoned futures sector, the Tuesday seasonality effect on contrarian profits was observed. Since the contrarian profits in this sector were deemed unreliable, the Tuesday seasonals should be deemed unreliable. In the Non-EU (Asia Seasoned) futures sector, the Thursday seasonality effect on contrarian profits (momentum profits) was detected. We do not have any sensible conjectures on this Thursday seasonality effect especially on the momentum profits in the Asia Seasoned futures sector.[23]

Since the contrarian profits in the Non-US futures sector were most significant, it is important to thoroughly check on the weekday seasonality effect in all short-run contrarian profits in this sector. **Table 6** summarizes these results on the weekday seasonals in five symmetric arbitrage profits in the Non-US futures sector.

[Insert Table 6 about Here]

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returns in January, March and July (December) statistically significant, among which July belongs to the September spot-month horizon.

[23] Using data on ten (mostly financial) futures contracts for a sample period ending on December 1989, Bessembinder and Hertzel (1993) found low (even negative) correlation between Monday and Tuesday returns in several financial (S&P 500) futures contracts and usually positive correlations between Friday returns and Monday returns.

Consistent with findings reported in **Table 5**, the Monday and Wednesday seasonals were not detected for any contrarian arbitrages. Only the Friday seasonals for the {4,4} contrarian profits was statistically significant.

Again, we do not have any sensible explanations on this Friday seasonals. One wild conjecture is that like many managers of equity portfolios, many managers of futures portfolios make their weekly evaluation of respective index futures returns by the end of Thursday and without waiting for the weekend uncertainty, they trade mostly on Friday for the required weekly revisions in their futures portfolios.

Although the day-of-the-week seasonals in our portfolio-based results on contrarian profits cannot be directly compared with those in futures returns, it is interesting to note that Junkus (1986) did not find any weekday seasonals in futures returns but Gay and Kim (1987) and Herbst and Maberly (1990) found that higher futures returns on Friday and Thursday were statistically significant. Note that the last trading day for index futures in the US futures sector is Thursday preceding the third Friday, whereas the cash settlement is based on the "special" Friday opening for the underlying index. Although many index futures contracts around the globe by and large follow the cash settlement practice in the US and, hence, may share the Thursday/Friday seasons in the US-index futures contracts, there is no reasons why the common weekday seasonals in the futures returns should carry over to the day-of-the-week seasonality effect in contrarian arbitrage profits.

5.2 The Profitability of Long-Short Futures Arbitrages with Longer Horizons

In equity markets, the statistical significance of contrarian profits tends to weaken in evaluation or holding horizon. Since the profitability of contrarian arbitrages in the US, Non-US and EU sectors would be of great importance to institutional futures investors, we checked the sensitivity of contrarian profits to longer evaluation and holding horizons in these sectors. Since short-run momentum profits appear to kick in between {10,10}and {20,20} arbitrages, we report in **Table 7** the summary results of the {10,10} and {20,20} arbitrage profits in the three sectors.

[Insert Table 7 about Here]

In the US futures sector, the {10,10} contrarian profits were statistically significant in the pre-Euro subperiod, whereas the {20,20} contrarian losses were statistically significant in the post-Euro subperiod. Surprisingly, the {10,10} contrarian profits were observed during the pre-Euro bull market conditions in the absence of significant return reversals, whereas the {20,20} contrarian losses (i.e., momentum profits in the current analysis) were observed during the post-Euro bear market conditions in the absence of significant return continuations. Although we do not have any sensible explanations on these mildly significant profits, this result appears to suggest that in the US futures sector, return-based arbitrages with relatively longer horizons (e.g., {20,20}) tend to generate momentum profits without much reliance on return continuations and bull market conditions.[24]

In the Non-US futures sector, both {10,10} contrarian profits and {20,20} momentum profits were statistically significant in entire sample period and pre- and post-

[24] The lack of such reliance might be partially related to the stylized fact that futures returns have only very short memory whereas the return volatility tends to have a relatively longer memory. See, e.g., Crato and Ray (2000).

Euro subperiods, while corresponding return reversals were statistically insignificant but all negative (i.e., return continuations). Although these profits were mildly significant, they seem to suggest that return-based arbitrages with relatively long horizons became less dependent on return reversals or return continuations and started producing momentum profits as in the US futures sector.

In the EU futures sector, the {10,10} contrarian profits were statistically significant in subperiod, whereas the {20,20} contrarian profits was statistically significant only in the post-Euro subperiod. Although these profits were mildly significant, they seem to suggest that they became less dependent on return reversals or return continuations but, unlike the US and Non-US futures sectors, the return-based arbitrages with relatively long horizons did not start producing momentum profits.

We do not have any sensible explanations on the lack of any momentum profits for the {20,20} arbitrages in this sector. One may conjecture that the signs of momentum profits may show up in return-based arbitrages with horizons longer than {25,25}. We could not test this conjecture using the spot-month data because even the daily implementations would produce too few observations (at most 15) to yield a reliable test of statistical significance. Another conjecture is that since the index futures in the EU zone are typically traded in electronic trading platform, the difference in trading platforms might have led to the lack of momentum profits in the EU sector. The test of this conjecture remains as a future research topic.

6. Conclusions

In this article, we examined the profitability of return-based short-run contrarian arbitrage portfolio strategies in the six index futures sectors that were made of 39 index futures contracts actively traded around the globe during the 1992-2002 sample period. Our analysis is based on the data for nearby contracts and the application of the methodology for contrarian arbitrages in Lo and Mackinlay (1990). The two main findings are that (1) the excess normalized profits of {5,5} contrarian arbitrages were most statistically significant in all markets except the US index futures market and (2) these profits were mainly due to return reversals and bear-market conditions and were particularly significant on Thursdays/Fridays in the September spot months.

Our results indicate that the {5,5} long-short futures contrarian arbitrages may persist to produce significant profits in most index futures markets because they were mainly driven by return reversals. In the longer run, however, the profitability of short-run return-based arbitrages will reduce as, among other things, the integrations among index futures markets around the globe and the relative importance of screen/electronic trading (E-Mini futures) versus floor trading (regular futures) will increase over time.[25] Although such varying degrees of weak-form market inefficiency in these markets are by and large consistent with evidence in most commodity and many financial futures markets[26], the weak-form market inefficiency in the conventional sense may not properly

[25] For recent discussions on the increasing importance of E-Mini futures and screen/electronic trading, see, e.g., Martens (1998), Franke and Hess (2000), Tse and Zabotina (2001), Hasbrouck (2003), and Ates and Wang (2005). For related research on futures market design, also see Chng (2004).

[26] For recent evidence, see Olszewski (1998) and Kellard, Newbold, Rayner & Ennew (1999).

describe the degree of informational inefficiency because the serial dependence in futures returns (and return volatility) might have been induced by time-varying risk premia.[27]

Our results also indicate that in explaining/discussing the presence/absence of the index-futures lead-lag relations and index-futures arbitrages, the relevant literature might have ignored the important futures-specific seasonality effects (i.e., the bear market conditions, spot month and day-of-the-week seasonality effects). Several other important research questions that were not answered in this article are the following: (a) evaluation of the profitability of short-run arbitrages using alternative risk-adjusted performance measures (e.g., Sortino ratio and upside-potential ratio)[28]; (b) economic significance of the bear market and seasonality effects on portfolio-based arbitrages involving cash, futures and futures options; (c) the effect of different trading platforms on the return-based arbitrage profits.

The answers to these questions might be greatly influenced by the varying degree frictions and restrictions in the index futures and equity markets: e.g., the severity of position limits, price limits and other circuit breakers, margin requirements, restrictions on short-selling and foreign ownership as well as the intensity of institutional investors' program trading and the sophistication of non-institutional investors, which vary across index futures contracts, futures exchanges and underlying equity markets. We encourage readers to join us in addressing these future research agenda also in other types of futures markets.

[27] For earlier work on conditional asset pricing and its implication on the informational efficiency of financial markets, see, e.g., Fama (1991), Fersons & Harvey (1993), Evans (1994), Ferson & Korajczyk (1995) and Harvey (1995).

[28] For mathematical relations between Sharpe ratio and these alternative ratios, see Lien (2002).

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Table 1: Index Futures Contracts and Markets/Sectors around the Globe

Sector	Contract	Exchange (Country)	IP Size (Tick)
Panel A: US Trading Zone (12 index futures)			
US (6 futures)	S&P 500	CME* (US)	250 (0.1)
	NYSE Composite	NYFE (US)	500 (0.1)
	S&P500 Barra Growth	CME* (US)	250 (0.1)
	S&P500 Barra Value	CME* (US)	250 (0.1)
	NASDAQ 100	CME* (US)	100 (0.5)
	Dow Jones IA	CBOT* (US)	10 (1.0)
Non-US (6 futures)	Nikkei 225	CME* (US)	5 (5.0)
	Goldman Sachs	CME* (US)	250 (0.1)
	Russell 2000	CME* (US)	500 (0.1)
	Bovespa Index	BMF* (Brazil)	3 (5.0)
	MEX BOLSA Index	MDX (Mexico)	10 (1.0)
	S&P Canada 60 Index	MSE (Canada)	200 (0.1)
Panel B: EU Trading Zone (18 index futures)			
EU (7 futures)	AEX Index	EOE (Netherlands)	200 (0.1)
	CAC 40 Index	MNP (France)	10 (0.5)
	DAX Stock Index	EUX (Germany)	25 (0.5)
	IBEX 35 Index	MFM* (Spain)	10 (1.0)
	Bel 20 Index	BFO (Belgium)	20 (0.1)
	MIB 30 Index	MIL (Italy)	5 (5.0)
	Austria Traded Index	AFO (Austria)	10 (0.1)
Non-EU (11 futures)	Swiss Market Index	EUZ (Switzerland)	10 (1.0)
	OMX Index Future	OM (Finland)	100 (0.1)
	OBX Index	OBX (Norway)	100 (0.3)
	All Share Index	SAF (South Africa)	10 (1.0)
	FTSE 100 Index	LIFFE* (UK)	10 (0.5)
	FTSE Eurotop 100	LIFFE* (UK)	20 (0.5)
	KFX Stock Index	COP (Sweden)	100 (0.1)
	Czech Traded Index	AFO (Czech Republic)	5 (0.1)
	Polish Traded Index	AFO (Poland)	5 (0.1)
	BUX Index	BSE (Hungary)	100 (0.5)
	Russia Traded Index	AFO (Russia)	10 (0.1)
Panel C: Asia Trading Zone (9 index futures)			
Asia Seasoned (6 futures)	Straits Times Index	SGX* (Singapore)	10 (1.0)
	SiMsci S'pore Index	SGX* (Singapore)	200 (0.1)
	Nikkei 225	OSE (Japan)	1000 (10.0)
	Hang Seng Index	HKG (Hong Kong)	50 (1.0)
	NZSE Top 10 Index	NZSE (New Zealand)	25 (1.0)
	SPI 200 Index	SFE* (Australia)	25 (1.0)
Asia Un-seasoned (3 futures)	KL Composite Index	MDE (Malaysia)	100 (0.1)
	KOSPI 200 Index	KSE (Korea)	500 (0.1)
	TAIEX Futures	FTX (Taiwan)	200 (1.0)

Exchanges with * employ both open outcry and electronic trading system. IP refers to Index Point.

Table 2. The {5,5} Return Reversals and Contrarian Profits in the US Zone

The six US index futures traded in the CME, CBOT and NYFE are allocated to the US sector, whereas the six non-US index futures traded in the CME (U.S.), MSE (Canada), MDX (Mexico) and BMF (Brazil) are allocated to the Non-US sector. The {5,5} contrarian profits for 5-days holding after selling/buying past 5-day winners/losers are computed on a daily rollover basis. Futures' long-position return for 5-days is computed as $R_t^i = (SP_t^i - OP_{t-5}^i)/OP_{t-5}^i$, where OP^i and SP^i are open and settlement prices. All winners' returns ($R_t^{W_i}$) are larger and losers' returns ($R_t^{L_i}$) are smaller than the sector return (R_t^S). Using portfolio weights for winners and losers, $\omega_t^{W_i} = -N^{-1}(R_t^{W_i} - R_t^S) < 0$ and $\omega_t^{L_i} = -N^{-1}(R_t^{L_i} - R_t^S) > 0$, the normalized contrarian return and active contrarian return are computed as: $R_{t+5}^{NC} \approx R_{t+5}^{C} \div (0.5 \times \sum_{i=1}^{N} |\omega_t^i|$ and $R_{t+5}^{NA} = R_{t+5}^{NC} - R_{t+5}^{NB}$, respectively. The **(*) indicates 5% (10%) t-test level of statistical significance of the normalized returns (i.e., return reversals) and normalized active returns (i.e., contrarian profits).

Spot-month horizon	**US Sector (6 futures)**		**Non-US Sector (6 futures)**	
	R^{NC}	**R^{NA}**	**R^{NC}**	**R^{NA}**
Mar 93 – Sep 02	0.003	0.004	**0.006***	**0.011***
Mar 96 - Sep 98	0.002	0.002	**0.010***	0.012
Mar 99 - Sep 02	0.004	0.006	**0.004****	**0.009****
1996 Mar	-0.009	-0.014	0.004	-0.001
Jun	0.002	-0.001	0.001	-0.006
Sep	-0.002	0.002	0.001	0.001
Dec	0.002	-0.008	**0.006****	0.000
1997 Mar	-0.001	-0.003	-0.002	-0.004
Jun	0.002	-0.002	0.003	-0.004
Sep	-0.004	-0.010	0.006	0.006
Dec	0.001	-0.004	0.007	0.010
1998 Mar	-0.005	-0.012	-0.003	-0.004
Jun	0.002	-0.001	0.001	**0.006***
Sep	-0.004	0.003	-0.009	**0.008***
1999 Mar	**0.004***	-0.002	-0.001	-0.010
Sep	**0.004***	0.001	0.000	-0.004
Dec	-0.003	-0.009	0.001	-0.009
2000 Mar	-0.003	-0.005	0.005	-0.012
Jun	0.001	-0.001	-0.002	0.004
Sep	-0.004	-0.008	**0.005***	-0.001
Dec	**0.007****	**0.017****	**0.005***	**0.016****
2001 Mar	-0.004	0.003	**0.009****	0.009
Jun	0.002	0.000	-0.001	-0.001
Sep	-0.009	0.001	0.001	**0.010****
Dec	**0.010***	0.006	0.003	0.003
2002 Mar	-0.010	-0.009	-0.002	-0.007
Jun	**0.003***	**0.011****	0.004	0.005
Sep	-0.003	0.007	**0.009****	**0.018****

Table 3. The {5,5} Return Reversals and Contrarian Profits in the EU Zone

The seven EU index futures traded in Germany, France, Italy, Spain, Netherlands, Belgium and Austria are allocated to the EU sector, whereas the eleven non-EU index futures traded in U.K., Switzerland, Norway, Finland, Sweden, South Africa, Russia, Poland, Hungary, and Czech Republic are allocated to the Non-EU sector. The {5,5} contrarian profits for 5-days holding after selling/buying past 5-day winners/losers are computed on a daily rollover basis. Futures' long-position return for 5-days is computed as $R_t^i = (SP_t^i - OP_{t-5}^i)/OP_{t-5}^i$, where OP^i and SP^i are open and settlement prices. All winners' returns ($R_t^{W_i}$) are larger and losers' returns ($R_t^{L_i}$) are smaller than the sector return (R_t^S). Using portfolio weights for winners and losers, $\omega_t^{W_i} = -N^{-1}(R_t^{W_i} - R_t^S) < 0$ and $\omega_t^{L_i} = -N^{-1}(R_t^{L_i} - R_t^S) > 0$, the normalized contrarian return and active contrarian return are computed as: $R_{t+5}^{NC} \approx R_{t+5}^C \div (0.5 \times \sum_{i=1}^N |\omega_t^i|$ and $R_{t+5}^{NA} = R_{t+5}^{NC} - R_{t+5}^{NB}$, respectively. The **(*) indicates 5% (10%) t-test level of statistical significance of the normalized returns (i.e., return reversals) and normalized active returns (i.e., contrarian profits).

Spot-month horizon	**EU Sector (7 futures)**		**Non-EU Sector (11 futures)**	
	R^{NC}	**R^{NA}**	**R^{NC}**	**R^{NA}**
Mar 93 – Sep 02	**0.005***	0.005	0.004	0.009
Mar 96 - Sep 98	**0.006***	0.004	0.004	0.010
Mar 99 - Sep 02	0.003	**0.006***	0.003	0.007
1996 Mar	**0.005***	0.000	-0.002	-0.006
Jun	-0.003	-0.005	**0.005***	**0.004***
Sep	**0.005***	**0.009****	-0.002	-0.003
Dec	0.002	-0.006	-0.001	-0.006
1997 Mar	-0.002	-0.009	0.002	-0.016
Jun	**0.008****	0.005	**0.004***	0.000
Sep	**0.005***	0.000	**0.003***	-0.001
Dec	0.003	0.001	0.006	0.006
1998 Mar	0.017	0.001	-0.004	-0.013
Jun	-0.008	-0.031	0.002	-0.002
Sep	-0.019	-0.015	**0.006***	**0.018***
1999 Mar	0.003	0.004	0.003	0.000
Sep	**0.004****	0.002	0.000	-0.002
Dec	-0.007	-0.013	-0.004	-0.012
2000 Mar	-0.005	-0.013	-0.003	-0.008
Jun	**0.005***	0.006	0.002	0.000
Sep	**0.002***	0.001	0.001	-0.004
Dec	0.001	**0.009****	**0.004***	**0.010***
2001 Mar	-0.003	-0.002	0.001	0.004
Jun	0.004	0.004	**0.006***	0.005
Sep	-0.001	**0.006****	**0.004***	**0.011***
Dec	**0.004***	0.006	0.002	0.002
2002 Mar	-0.004	-0.009	0.000	-0.002
Jun	0.001	0.003	0.002	**0.006***
Sep	**0.008****	**0.023****	**0.005***	**0.020***

Table 4. The {5,5} Return Reversals and Contrarian Profits in the Asia Zone

The six index futures traded in Japan, Australia, New Zealand, Hong Kong and Singapore are allocated to the Asia Seasoned sector, whereas the three index futures traded in Korea, Taiwan and Malaysia are allocated to the Asia Unseasoned sector. The {5,5} contrarian profits for 5-days holding after selling/buying past 5-day winners/losers are computed on a daily rollover basis. Futures' long-position return for 5-days is computed as $R_t^i = (SP_t^i - OP_{t-5}^i)/OP_{t-5}^i$, where OP^i and SP^i are open and settlement prices. All winners' returns ($R_t^{W_i}$) are larger and losers' returns ($R_t^{L_i}$) are smaller than the sector return (R_t^S). Using portfolio weights for winners and losers, $\omega_t^{W_i} = -N^{-1}(R_t^{W_i} - R_t^S) < 0$ and $\omega_t^{L_i} = -N^{-1}(R_t^{L_i} - R_t^S) > 0$, the normalized contrarian return and active contrarian return are computed as: $R_{t+5}^{NC} \approx R_{t+5}^{C} \div (0.5 \times \sum_{i=1}^{N} |\omega_t^i|$ and $R_{t+5}^{NA} = R_{t+5}^{NC} - R_{t+5}^{NB}$, respectively. The **(*) indicates 5% (10%) t-test level of statistical significance of the normalized returns (i.e., return reversals) and normalized active returns (i.e., contrarian profits).

Spot-month horizon		Asia Seasoned (6 futures)		Asia Unseasoned (3)	
		R^{NC}	R^{NA}	R^{NC}	R^{NA}
Mar 93 – Sep 02		-0.016	-0.040	**0.017***	**0.014***
Mar 96 - Sep 98		0.005	0.012	n.a.	n.a.
Mar 99 - Sep 02		**0.006****	**0.006***	**0.017***	**0.014***
1996	**Mar**	0.001	-0.004	n.a.	n.a.
	Jun	0.001	0.001	n.a.	n.a.
	Sep	0.001	0.003	n.a.	n.a.
	Dec	-0.001	-0.006	n.a.	n.a.
1997	**Mar**	0.000	0.003	n.a.	n.a.
	Jun	0.000	-0.003	n.a.	n.a.
	Sep	**0.007****	0.012	n.a.	n.a.
	Dec	0.003	0.009	n.a.	n.a.
1998	**Mar**	0.004	0.003	n.a.	n.a.
	Jun	0.004	**0.014****	n.a.	n.a.
	Sep	0.016	**0.030***	n.a.	n.a.
1999	**Mar**	-0.005	-0.015	-0.019	-0.040
	Sep	**0.009****	0.005	**0.027****	0.019
	Dec	-0.004	-0.008	0.015	0.014
2000	**Mar**	0.002	0.002	0.000	-0.009
	Jun	-0.004	-0.002	-0.001	0.004
	Sep	**0.007****	0.001	**0.012****	**0.021****
	Dec	-0.005	0.005	**0.014***	**0.028****
2001	**Mar**	-0.005	0.000	-0.002	-0.007
	Jun	-0.003	-0.002	-0.015	-0.009
	Sep	0.002	**0.011****	-0.017	-0.017
	Dec	-0.022	-0.027	0.012	0.006
2002	**Mar**	-0.003	-0.005	0.006	-0.010
	Jun	-0.012	-0.010	**0.007***	**0.008***
	Sep	-0.030	-0.014	0.003	**0.010***

Table 5. Weekday Variations of the {5,5} Contrarian Profits by Sectors

Total 39 index futures that were actively traded in the 32 futures exchanges located 29 countries are allocated to one of the six sectors/markets for the 12/1992-08/2002 sample period. The profits of the {5,5} contrarian arbitrages are computed on a daily rollover basis. Futures' long-position return for 5-days is computed as $R_t^i = (SP_t^i - OP_{t-5}^i)/OP_{t-5}^i$, where OP^i and SP^i are open and settlement prices. All winners' returns ($R_t^{W_i}$) are larger and losers' returns ($R_t^{L_i}$) are smaller than the sector return (R_t^S). The normalized contrarian return and active contrarian return are computed as: $R_{t+5}^{NC} \approx R_{t+5}^{C} \div (0.5 \times \sum_{i=1}^{N} |\omega_t^i|$ and $R_{t+5}^{NA} = R_{t+5}^{NC} - R_{t+5}^{NB}$, respectively. The **(*) indicates 5% (10%) t-test level of statistical significance of the normalized returns (i.e., return reversals) and normalized active returns (i.e., contrarian profits).

Sector	Monday		Tuesday		Wednesday		Thursday		Friday	
	R^{NC} (t-value)	R^{NA} (t value)	R^{NC} (t-value)	R^{NA} (t value)	R^{NC} (t-value)	R^{NA} (t value)	R^{NC} (t-value)	R^{NA} (t value)	R^{NC} (t-value)	R^{NA} (t value)
US (6 futures)	-0.004	-0.001	**0.004**	0.001	-0.006	-0.003	-0.007	-0.006	-0.003	-0.001
	(-0.328)	(-0.955)	**(2.388)****	(1.230)	(-0.553)	(-0.648)	(-0.647)	(-1.101)	(-1.300)	(-1.340)
Non-US (6 futures)	0.002	-0.001	-0.001	0.003	-0.001	-0.003	0.001	-0.001	**0.004**	-0.005
	(0.828)	(-0.938)	(-0.225)	(0.230)	(-0.448)	(-0.082)	(0.527)	(-0.092)	**(1.744)***	(-0.110)
EU (7 futures)	-0.002	-0.001	0.002	-0.001	-0.001	-0.002	0.001	-0.004	**0.005**	0.003
	(-0.846)	(-0.967)	(0.175)	(-1.188)	(-1.068)	(-0.264)	(0.112)	(-0.806)	**(1.835)***	(1.055)
Non-EU (11 futures)	-0.006	0.002	-0.002	0.002	0.004	-0.002	**0.003**	**0.001**	-0.001	0.002
	(-1.645)	(0.905)	(-0.881)	(0.347)	(0.2415)	(-0.277)	**(2.517)**	**(2.047)***	(-0.521)	(1.073)
Asia Seasoned (6 futures)	-0.003	-0.002	-0.003	-0.002	-0.002	0.004	**-0.002**	**-0.001**	-0.003	-0.002
	(-5.389)	(-5.458)	(-3.165)	(-2.355)	(-0.2164)	(1.075)	**(-3.501)**	**(-2.217)**	(-1.993)	(0.896)
Asia Unseasoned (3 futures)	-0.007	-0.005	**0.010**	**0.008**	-0.002	-0.001	-0.002	-0.003	0.002	0.006
	(-0.882)	(-0.972)	**(3.210)****	**(2.969)****	(-0.403)	(-0.484)	(-1.777)	(-1.711)	(0.327)	(0.012)

Table 6. Weekday Variations of Contrarian Profits in the Non-US Sector by Five Short-run Symmetric Arbitrages

The six index futures traded in the CME (U.S.), MSE (Canada), MDX (Mexico) and BMF (Brazil) are allocated to the Non-US sector. The profits of five symmetric short-run contrarian arbitrages are computed on a daily rollover basis. The normalized contrarian return and active contrarian return are computed as: $R_{t+H}^{NC} \approx R_{t+H}^{C} \div (0.5 \times \sum_{i=1}^{N} |\omega_t^i|$ and $R_{t+H}^{NA} = R_{t+H}^{NC} - R_{t+H}^{NB}$, respectively. The **(*) indicates 5% (10%) t-test level of statistical significance of the normalized returns (i.e., return reversals) and normalized active returns (i.e., contrarian profits).

Week Day	{E,H} Contrarian Profits									
	{1-1}		{2-2}		{3-3}		{4-4}		{5-5}	
	R^{NC} (t-value)	R^{NA} (t value)	R^{NC} (t-value)	R^{NA} (t value)	R^{NC} (t-value)	R^{NA} (t value)	R^{NC} (t-value)	R^{NA} (t value)	R^{NC} (t-value)	R^{NA} (t value)
Mon	-0.0014	-0.0017	0.0002	0.0003	0.0007	0.0011	0.0008	0.0002	0.0007	0.0009
	(-1.9910)	(-2.1553)	(0.2260)	(0.3595)	(1.0436)	(1.3773)	(1.0417)	(0.2793)	(0.8280)	(0.9379)
Tue	**0.0023**	0.0019	-0.0019	-0.0024	-0.0013	-0.0037	0.0012	0.0009	0.0003	0.0004
	(2.258)*	(1.5738)	(-0.8326)	(-1.0015)	(-0.8803)	(-1.9733)	(1.0206)	(0.6111)	(0.2247)	(0.2309)
Wed	-0.0005	-0.0017	-0.0018	-0.0040	0.0020	-0.0009	0.0005	0.0006	-0.0012	0.0003
	(-0.1782)	(-0.6091)	(-1.0580)	(-1.7908)	(1.2923)	(-0.3988)	(0.3223)	(0.3112)	(-0.4483)	(0.0817)
Thur	-0.0006	-0.0037	0.0024	-0.0004	0.0014	-0.0012	**0.0052**	0.0047	0.0016	0.0003
	(-0.2127)	(-1.1655)	(1.3690)	(-0.1536)	(0.4594)	(-0.3613)	**(1.7827)***	(1.5096)	(0.5272)	(0.0916)
Fri	0.0040	0.0004	0.0037	0.0013	**0.0063**	0.0032	**0.0074**	**0.0061**	**0.0035**	0.0003
	(1.1939)	(0.1184)	(1.0712)	(0.3527)	**(2.0689)****	(0.9677)	**(2.4395)****	**(1.8301)***	**(1.7443)***	(0.1099)

Table 7. The {10,10}, {20,20} Contrarian Profits in the US, Non-US and EU Sectors

These {E,H} contrarian profits/losses are computed on a daily rollover basis. Futures' long-position returns are computed by $R_t^i = (SP_t^i - OP_{t-H}^i)/OP_{t-H}^i$, where OP^i and SP^i are open and settlement prices. All winners' returns ($R_t^{W_i}$) are larger and losers' returns ($R_t^{L_i}$) are smaller than the sector return (R_t^S). Using portfolio weights for winners and losers, $\omega_t^{W_i} = -N^{-1}(R_t^{W_i} - R_t^S) < 0$ and $\omega_t^{L_i} = -N^{-1}(R_t^{L_i} - R_t^S) > 0$, the normalized contrarian return and active contrarian return are computed as: $R_{t+H}^{NC} \approx R_{t+H}^{C} \div (0.5 \times \sum_{i=1}^{N} |\omega_t^i|$ and $R_{t+H}^{NA} = R_{t+H}^{NC} - R_{t+H}^{NB}$, respectively. The **(*) indicates 5% (10%) t-test level of statistical significance of the normalized returns (i.e., return reversals) and normalized active returns (i.e., contrarian profits).

Panel A: {10,10} Contrarian Profits/Losses

Profits	Early Subperiod	Pre-Euro Subperiod	Post-Euro Subperiod
		US (6 futures)	
R^{NC}	**0.0002 (1.72)***	0.0034 (1.06)	**0.0030 (2.37)****
R^{NA}	0.0028 (1.58)	**0.0038(1.84)***	0.0017 (1.32)
		Non-US (6 futures)	
R^{NC}	-0.0047 (1.61)	-0.0014(1.46)	-0.0079 (1.75)
R^{NA}	**0.0024 (1.91)***	**0.0010 (1.83)***	**0.0038 (1.84)***
		EU (7 futures)	
R^{NC}	**0.0060 (1.70)***	-0.0007 (1.54)	**-0.0113 (1.86)***
R^{NA}	**0.0027 (1.87)***	**0.0014 (1.73)***	**0.0039 (1.80)***

Panel B: {20,20} Contrarian Profits/Losses

Profits	Early Subperiod	Pre-Euro Subperiod	Post-Euro Subperiod
		US (6 futures)	
R^{NC}	0.0061 (0.39)	-0.0039 (-1.42)	-0.0060 (0.40)
R^{NA}	**-0.0184 (2.06)***	-0.0184 (0.25)	**-0.0164 (1.91)***
		Non-US (6 futures)	
R^{NC}	-0.0049 (-0.06)	-0.0072 (-1.23)	-0.0026 (1.11)
R^{NA}	**-0.0091 (1.87)***	**-0.0090 (1.93)***	**-0.0092 (1.85)***
		EU (7 futures)	
R^{NC}	**0.0022 (1.85)***	**0.0039 (1.96)***	**0.0005 (1.73)***
R^{NA}	-0.0070 (1.52)	-0.0166 (0.90)	**0.0026 (1.90)***