Stock Index Arbitrage in the Turkish Market

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Abstract

For the first time in the Turkish stock market, the width of the zero arbitrage band for BIST 30 stock index arbitrage was measured and decomposed into distinct contributions arising from commissions, fees, bid/offer spreads, and stock loan costs. Intraday data was used to compute returns for forward and reverse BIST 30 arbitrage once per minute daily for 2014 and 2015 futures contracts. The absence of profitable trades and the unusual persistence of BIST 30 futures priced below the costless theoretical fair value were explained by their position within the zero arbitrage band. Measurement of arbitrage cost elements confirmed the need for regulatory policies to encourage development of domestic stock loan capabilities. The status of BIST 30 index arbitrage was compared with that occurring a decade ago, thereby contributing to the growing literature on the evolution of futures pricing efficiency in global markets after introduction of index futures.

Keywords: **index arbitrage, futures, Turkey, BIST 30**

JEL Classification: G10, G13, G14, G15

Paper Submission Date : September 12, 2015 ; Paper sent back for Revision : October 5, 2015 ; Paper Acceptance Date : October 12, 2015

Stock index arbitrage has been frequently studied since first appearing in the 1980s. This important transaction leading to price discovery occurs daily in global stock index futures markets and plays a central role in keeping futures prices near their fair value. For developed markets, excellent surveys of important features of index arbitrage are available to scholars and practitioners (Brennan & Schwartz, 1990 ; Canina & Figlewski, 1994 ; Chung, 1991 ; Maniar, Maniar, & Bhatt, 2006 ; Pathak, Ranajee, & Kumar, 2014 ; Yadav & Pope, 1994). Academic textbooks on derivatives often address the basic steps necessary to setup such arbitrage. By contrast, literature on index arbitrage in developing markets is comparatively scarce, even though this transaction is critical to futures pricing efficiency.

In Turkey, there are studies relating to hedging with BIST 30 stock index futures, but very few are directly related to index arbitrage. For example, the effectiveness of BIST 30 index futures in hedging the holdings of 28 Turkish Securities Investment Trusts was measured by Avci and Cinko (2010) over the period from 2007 and 2008, but none of the trusts were designed to track the BIST 30 index. Kalayci and Zeynel (2009) also concluded that BIST 30 futures were effective in hedging market risks during the financial crisis of 2008, but once again, their study did not focus on hedging the BIST 30 index. Olgun and Yetkiner (2009) studied time varying hedges using BIST 30 futures for periods of varying lengths, but did not address index arbitrage. Basdas (2009) examined the lead-lag relationship between the BIST 30 index and index futures as did Ilter and Alguner (2013) over the period from 2006 - 2011 but neither addressed the matter of index arbitrage. Çaği and Mandaci (2013) examined the spot-futures relationship, observing delays in spot responses to changes in futures prices.

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Table 1. Data Collected and Data Sources

Data Type	Source	Collected
BIST 30 Index	Bloomberg	1 minute interval prices for each trading day
TRLIBOR	Banks Association of Turkey	O/N, 30 and 60 day rates each trading day
Dividend Yields	Bloomberg	Daily Yields
BIST 30 Futures Prices	Bloomberg	1 minute interval prices for each trading day
Commissions on Futures / ETFs	Turkish Brokerage Firms	Typical Commissions
Banking & Insurance Transactions Tax	Revenue Administration of Turkey	Banking and Insurance Transactions Tax
Bid/Offer Spreads on Futures/ETFs	Bloomberg	Typical Bid/Offer Spreads
IST 30 ETF Prices	Bloomberg	1 minute interval prices for each trading day

In one paper, however, Kusakci and Kusakci (2012) compared market pricing against the cash-and-carry fair value price for BIST 30 futures contracts during 2005 and 2006. The authors found BIST 30 futures were below fair value offering opportunities for reverse stock index arbitrage. These opportunities were not being pursued because of the difficulties in Turkey of locating stock to sell short. In the most complete study of index arbitrage by McMillan and Ülkü (2009), systematic underpricing of BIST 30 futures relative to their fair value was found over the period from 2005 - 2006. The mispricing of index futures was once again attributed largely to the difficulty and cost of locating stock to sell short as part of the reverse arbitrage transaction. With the exception of these two articles, no further literature has been found that deals with the practical analysis and implementation of arbitrage transactions in Turkey.

This paper undertakes a detailed study of stock index arbitrage in the Turkish market for the period including 2014 and early 2015. Its purpose is to answer questions about the status of index arbitrage in Turkey and to explore ways to improve futures pricing efficiency. For example, why Turkish index futures are priced consistently at a discount to spot and theoretical fair values begs an answer. Furthermore, whether the width of the zero arbitrage band has changed from levels observed a decade ago in Turkey following the introduction of stock index futures can reveal an important characteristic of this market. Knowledge of the arbitrage band components may suggest to regulators actions that could improve futures pricing efficiency and make the market more attractive to foreign investors. The results of a meticulous analysis of zero arbitrage band components provide answers to some of these questions and insights into others. Implications for regulators, arbitrageurs, and foreign institutions are explored.

Our research contributes to the literature in several ways. To the best of our knowledge, the width of the zero arbitrage band in Turkey has not been previously measured. In this study, the total width of the zero arbitrage band is measured and divided into two sub-bands. In the forward arbitrage band, futures are sold against a holding in the index ; while in the reverse arbitrage band, futures are purchased against a short index position. Component contributions to the width of each band are calculated. These originate separately from commissions, fees, bid/offer spreads, and stock loan costs. Second, the absence of profitable arbitrage trades, both forward and reverse, is explained by identifying futures pricing clustered inside the zero arbitrage band. The resulting lack of demand for futures helps to explain the persistence of pricing below both the spot index level and futures theoretical fair value. Next, a comparison of results with a study completed almost a decade ago contributes to the literature on the evolution of futures pricing efficiency following the introduction of stock index futures markets. Fourth, knowledge of the elements of the zero arbitrage band suggests where regulatory and exchange officials might take action to further increase market efficiency, thereby making Turkey more attractive to foreign investors.

Table 2. Arbitrage Calculation Statistics

Futures Contract	Arbitrage Calculations*	Trade Dates
Apr-14	381	3-Apr-14
Jun-14	13,652	9 May 14 - 30 Jun 14
Aug-14	15,721	1 Jul 14 - 29 Aug 14
Oct-14	12,083	1 Sep 14 - 16 Oct 14
Dec-14	27,844	9 May 14 - 31 Dec 14
Feb-15	17,605	2 Jan 15 - 27 Feb 15

*Separately for Forward and Reverse Arbitrage

Table 3. One-Way Transaction Costs for Forward Arbitrage of BIST 30

Cost	ETFs	Futures
Commissions*	0.0005 x ETF Value in TRY	0.0006 x Futures Contract Size in TRY
BITT**	5% x Commissions	5% x Commissions
Bid/Offer Spread***	0.10% of ETF Value in TRY	0.17% of Futures Contract Size in TRY

*Turkish Brokers
** Banking & Investment Transaction Tax
***Bloomberg

Data and Methodology

The data collected and used in this study is described in the Table 1 along with the data sources. Although Turkey's primary stock index is the BIST National 100 index, the country's two equity ETFs and sole stock index futures contract are referenced to the BIST 30 index. Prior to a name change by the Istanbul Stock Exchange, this index was called the ISE 30. For consistency in this study, the index underlying ETFs and futures is referred to as the BIST 30. The BIST 30 Index measures the performance of the 30 most active stocks traded on the Istanbul Stock Exchange. The index contains 30 selected stocks trading either on the National Market or on the Collective Products Market. Stock index futures and two ETFs are based upon this index.

Intraday prices of futures and of the BIST 30 index ETFs are used to calculate arbitrage returns once per minute and identify the frequency with which profitable arbitrage was possible during trading days in 2014 and 2015. When taken together with zero arbitrage band calculations, it is possible to explain the observed persistence of futures priced below their costless fair value and below the spot index level.

BIST 30 stock index futures are quoted in index units divided by 1000. Contracts have a currency size calculated by dividing the index level by 1,000 and multiplying the quotient by 100 Turkish Lira (TRY). Futures contracts are cash settled with a T+1 settlement period and contract expiration months are February, April, June, August, October, and December. In this study, the 2014 futures contracts examined expired in April, June, August, October, and December ; while in 2015, only the February contract was included. This span of time and intraday frequency were judged sufficient for achieving the objectives of this study. In forward (reverse) stock index arbitrage, stocks are purchased (sold short), and an equivalent currency amount of futures is sold (bought). The number of arbitrage opportunities examined for each contract is displayed in the Table 2 along with the trade dates covered. Collectively, for all six contracts, over 87,000 arbitrage returns were calculated for forward arbitrage and then again, for reverse arbitrage.

The most liquid Turkish ETF based upon the BIST 30 index is the IST30 issued by Finansbank and managed by Finans Asset Management. This ETF was the first of its kind listed in Turkey. A second, far less liquid ETF not considered in this analysis is the ISY 30 ETF created by IS Investment, a subsidiary of İşbank . Both ETFs track the BIST 30 index and are quoted in TRY per ETF share. Use of the ISY30 ETF in this study was severely inhibited by the lack of intraday trading volume. Typical examples include March 25, 2014 (May 8, 2014) on which there were nine (9) (was only 1) ISY30 transactions vs. 50 (124) for the IST30 ETF. Furthermore, ISY30 transactions appear concentrated in time vs. IST30 trades, which are spread more evenly throughout the day. Frequent intraday trades minimize potentially misleading computational results arising from non-contemporaneous pricing, making the IST30 ETF the preferred vehicle for this study.

As using a basket of BIST 30 stocks for index arbitrage in Turkey is both difficult and unnecessarily costly, the IST 30 ETF was employed as an index fund proxy. On each trading day, TRLIBOR interest rates for overnight, 30, and 60 days were collected from The Banks Association of Turkey website and recorded along with the index dividend yield from Bloomberg. When computing arbitrage returns, the TRLIBOR rate chosen was the one most closely matching the remaining time to futures expiration.

The calculation of arbitrage returns employed a standard cost of carry model. A fair value for costless arbitrage, FV_0 , formed the central futures price from which adjustments were made to cover all transaction costs. For BIST 30 futures :

$$FV_0 = (I_0/1000)\,[1+(r-d)\,n/365\,] \qquad (1)$$

where,
FV_0 = Index future costless fair value,
I_0 = BIST 30 index level,
r = TRLIBOR rate for n days converted to 365 day basis,
d = dividend yield,
n = number of days until futures expiration.

One objective of this paper is to describe and calculate in detail the width of the zero arbitrage band within which no arbitrage is profitable. This calculation requires knowledge of transaction costs and their individual contribution to the band width. The separate calculation of the forward and reverse band widths then allows assessment of what policies are best to pursue if the entire band is to be narrowed.

Transaction costs for arbitrage include commissions, bid-offer spreads, and regulatory fees. Typical commissions for futures and ETFs were provided by Turkish brokerage firms, and bid/offer spreads were observed from Bloomberg data. Commission rates are negotiable and lower (higher) rates will decrease (increase) the arbitrage band width. Bid-offer spreads depend upon market conditions and also, will affect calculations of band width. However, both commissions and observed bid-ask spreads are believed to be representative and reliable for use in this study. A standard Banking and Insurance Transactions Tax (BITT) of 5% on commissions was applied on all transactions, thereby completing the estimate for forward arbitrage costs. These established and representative costs appear in Table 3.

Forward arbitrage will not take place until all transaction costs are covered and same is the case for reverse arbitrage. The futures quote above which forward arbitrage is profitable is the upper futures price threshold. The futures quote below which reverse arbitrage is profitable is the upper (lower) futures price threshold. The need to cover costs before arbitrageurs are willing to execute transactions creates these futures price boundaries outside of which arbitrage is profitable and inside of which there are only losses and ,therefore, no arbitrage activity. The absolute difference between costless fair value, FV_0 , and the upper (lower) threshold is the width of the forward (reverse) zero arbitrage band measured in index points. The difference between the upper and lower threshold is the total width of the zero arbitrage band in index points and is the futures price range within which no profitable arbitrage is possible. When divided by FV_0, the widths of the arbitrage bands are expressed in percentages. Stock markets in developed countries typically have a band width between plus and minus 0.50% of costless fair value.

In developing markets such as China and India (Table 4), the widths are larger due to higher commissions, fees, and taxes, and get increased further by the high costs of borrowing stocks when executing reverse arbitrage. The data collected in this study permits calculation of zero arbitrage band widths for comparison with other stock markets, and this provides a measure of relative futures pricing efficiency within those markets.

Including in the cost of carry model, a TRY cost (C_f) for a single futures-ETF arbitrage allows the calculation of a futures price, F_f, at which forward arbitrage produces zero profit. Expressed as a percentage of FV_0, the result is :

$$\frac{F_f}{FV_0} = 1 + C_f/(100FV_0) = 1 + \frac{2C_1}{100FV_0} + C_2/(100\,FV_0) \qquad (2)$$

$C_f = 2\,C_1 + C_2$ = TRY transaction cost for a single future – ETF forward arbitrage.
$2\,C_1$ = TRY two- way costs for commissions and fees.
C_2 = TRY full bid - offer costs.

$\frac{C_f}{100FV_0}$ = percentage width of forward zero arbitrage band.

$\frac{2C_1}{100FV_0}$ = percentage width of forward zero arbitrage band from commissions and fees.

$\frac{C_2}{100FV_0}$ = percentage width of forward zero arbitrage band from bid - offer spreads.

Similarly, for reverse arbitrage including a TRY cost (C_r) for a single futures - ETF arbitrage results in a future price, F_r, at which reverse arbitrage produces zero profit. Expressed as a percentage of FV_0, the result is :

$$\frac{F_r}{FV_0} = 1 + \frac{C_r}{100FV_0} = 1 + \frac{2C_1}{100FV_0} + \frac{C_2}{100FV_0} + C_3/(100\,FV_0) \qquad (3)$$

$C_r = 2\,C_1 + C_2 + C_3$ = TRY transaction cost for a single future – ETF reverse arbitrage.
$2\,C_1$ = TRY two-way costs for commissions and fees.
C_2 = TRY full bid - offer costs.
C_3 = TRY costs for stock loan.

$\frac{C_r}{100FV_0}$ = percentage width of reverse zero arbitrage band.

$\frac{2C_1}{100FV_0}$ = percentage width of reverse zero arbitrage band from commissions and fees.

$\frac{C_2}{100FV_0}$ = percentage width of reverse zero arbitrage band from bid-offer spreads.

$\frac{C_3}{100FV_0}$ = percentage width of reverse zero arbitrage band from stock loan.

Professional arbitrageurs are intensely aware of occasional additional costs that need to be considered. Most of these are small relative to the costs identified so far and vary with market conditions. For example, it is possible during the life of an arbitrage that the mix of stocks comprising the underlying index will be changed by the index provider. Stocks migrating out of the index are replaced by ones entering the index, and if futures are arbitraged against a basket of stocks, rather than an ETF share, then a tracking error will be introduced necessitating estimation of a potential hidden cost when unwinding the arbitrage position. We assume this cost is not present in our calculations since both the ETF and futures automatically track any changes in index composition.

If the size of the futures or ETF order is outside the normal transaction volume on the bid or offer side, then the bid and offer can move, creating an additional cost for setting up or unwinding the arbitrage. Arbitrageurs are well aware of this potential "impact cost" and as a standard practice, carefully avoid it by choosing a transaction size that avoids this cost. Accordingly, we make no provision for this normally avoidable cost.

Finally, as the last reported transaction price for an ETF or futures can be on the bid or offer side, there is an uncertainty in the price spread of the execution that requires estimation. This uncertainty translates into a cost that must be covered to assure a profitable transaction. In our analysis, this cost is adequately estimated by including the combined bid/offer costs for ETFs and futures. Arbitrageurs normally recognize this pricing uncertainty in this manner.

Stock lending in Turkey is generally a very costly business with stock rebate rates often approximating short-term interest rates. Calculations in this paper assume a stock loan rebate rate of 15% of the TRLIBOR rate, although that rate is often lower. *C1* and *C2* are a fixed percentage of the traded cost of a futures contract, while *C3* has a time-dependent component arising from the remaining stock borrow rate until futures expiration. All arbitrage returns in this paper assume holding a position until futures expiration.

Up to and including the futures contract expiration, an index level, a futures quotation, and an ETF price were captured each minute of each trading day. Forward and reverse arbitrage returns were computed using costs in Table 3. Knowing the upper and lower arbitrage futures thresholds, F_f and F_r, the frequency of profitable transactions was determined for each futures contract prior to expiration. Comparing the results with arbitrage studied by McMillan and Ülkü (2009) in the earliest 2 years of trading for BIST 30 futures (2005-2006) revealed insights into the evolution of futures fair value pricing as the Turkish market matured.

Analysis, Results, and Discussion

The minute by minute annualized arbitrage returns for April 2014 futures are shown in Figure 1 for trade date April 3, 2014. Returns are identified according to local times for the morning trading session (09:10 - 12:30) and afternoon session (13:55 - 17:45). They are further naturally clustered according to forward and reverse arbitrage returns. Reverse arbitrage returns are consistently more negative than forward returns by about 5%. These returns are typical of our findings in all futures examined in the study period in that returns were clustered in a relatively narrow negative range, revealing not one profitable opportunity found on that date.

The frequency histogram for one-minute interval April futures prices as a percentage of costless fair value appears in Figure 2 for April 3, 2014. The vertical dashed line at 100% marks the point where futures market prices would exactly equal their costless fair value. None of the futures prices on that day achieved a level at or above costless fair value. The locations for the upper and lower zero arbitrage thresholds are separately identified by vertical dashed lines above and below the 100% mark. The distance from 100% to these thresholds respectively correspond to the band widths for forward and reverse arbitrage. It can be seen from the Figure 2 that all of the futures prices lay within the zero arbitrage band ; so, no positive arbitrage returns occurred for the study data on this date.

The composition of both the forward and reverse arbitrage bands was determined and is shown in the Table 4 along with a comparison of zero arbitrage bands in the China (Slivka, Zhang, & Zhang, 2010) and India markets

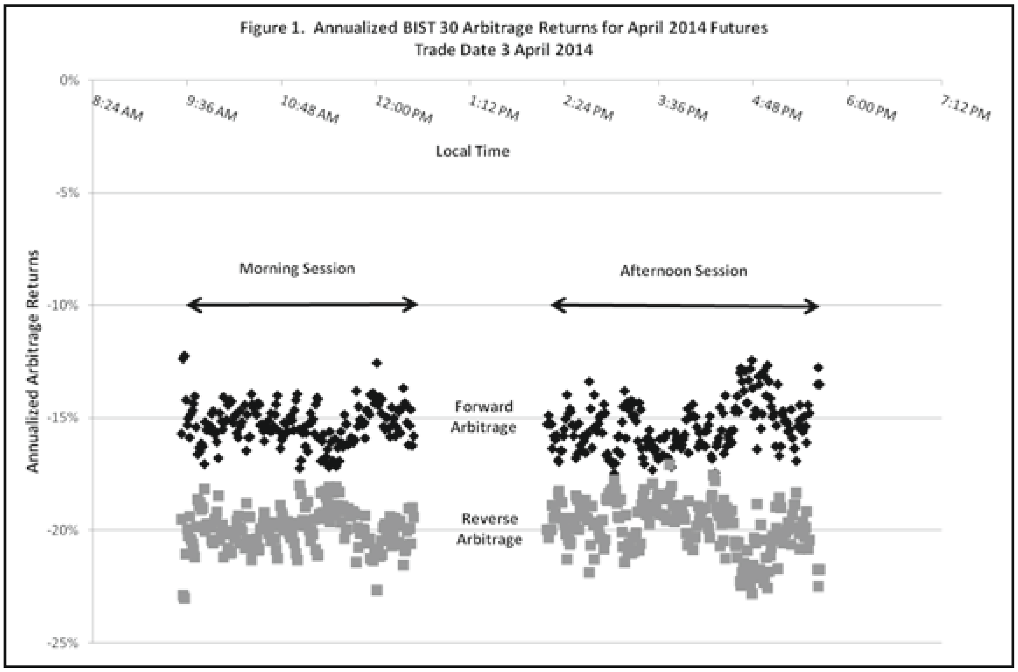

Figure 1. Annualized BIST 30 Arbitrage Returns for April 2014 Futures
Trade Date 3 April 2014

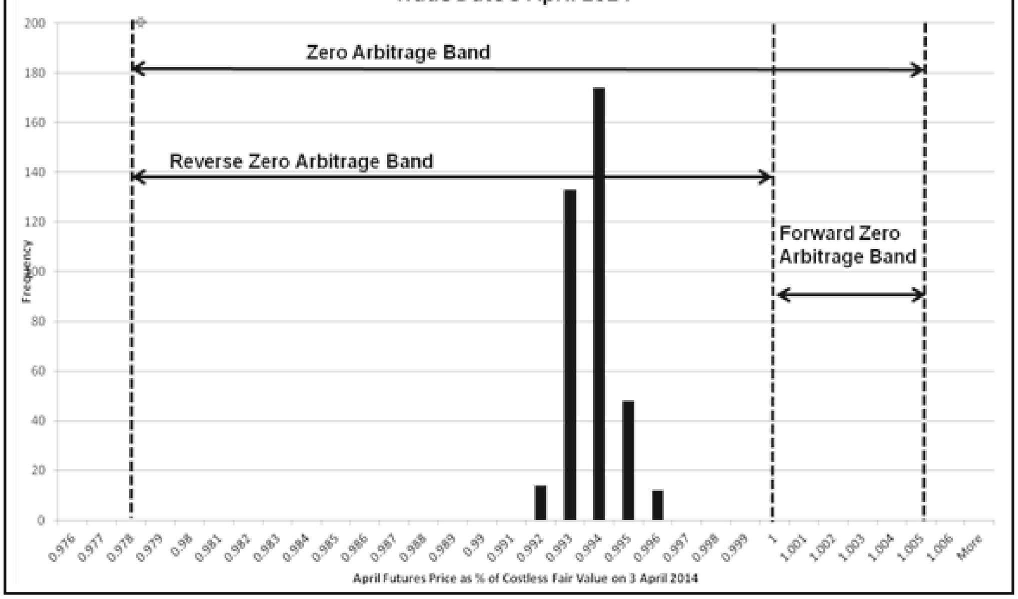

Figure 2. Frequency Histogram for April Futures as % of Costless Fair Value
Trade Date 3 April 2014

(Slivka, Chang, & Yu, 2014). The forward arbitrage band width in Turkey of 0.50% was found split into approximately equal parts originating first from commissions and fees (0.23%) and then from the combined bid/offer spreads in stocks and futures. In China and India, the forward band width is higher, but there is no similar breakout of the contributing sources. The Turkish reverse arbitrage band width in Table 4 is significantly greater than those for India and China with the primary contribution originating from stock borrowing costs. Numerical results for the April futures are typical of all contracts in this study. It may be possible for some arbitrageurs to negotiate commissions as low as 0.00001 times the futures's aggregate value. Taken together with a futures bid/offer spread as little as one tick, the width of the full zero arbitrage band in Table 4 would adjust to

Table 4. Zero Arbitrage Bandwidths as a Percentage of Fair Value

Zero Arbitrage Band Widths (ZAB)	Turkey*	China**	India***
Forward Arbitrage Band Width	**BIST 30 April Futures vs. ETF**	**CSI 300 Futures vs ETF**	**JWSTEEL Futures vs. Stock**
Forward ZAB width from Commissions & Fees	0.23%	-	-
Forward ZAB width from B/O spread in stocks and futures	**0.27%**	-	-
Forward ZAB width	0.50%	0.76%	0.90%
Reverse Arbitrage Band Width			
Reverse ZAB width from Commissions & Fees	0.23%	-	-
Reverse ZAB width from B/O spread in stocks and futures	0.27%	-	-
Reverse ZAB width from Stock Borrow Costs	**1.70%**	-	-
Reverse ZAB width	2.19%	1.20%	1.57%
Full Zero Arbitrage Band Width	2.69%	1.96%	2.47%

* Trade date April 3, 2014
** Slivka, Zhang, & Zhang (2010)
*** Slivka, Wu, & Shah (2012)

2.19% from 2.69%. However, all of the returns displayed in Figure 2 still remain comfortably inside the zero arbitrage band, which is typical of the results for other futures in this study.

Research/Policy Implications

In most stock markets, the asymmetry between forward and reverse bands is attributable to regulatory and short sales constraints. Mostly, the cost of stock borrowing in all three countries in Table 4 creates this asymmetry by making it far more costly to undertake reverse arbitrage than forward arbitrage. The resulting absence of reverse arbitrage until all costs are covered allows futures to remain under their fair value for extended periods of time. Knowing about this market inefficiency, China's regulators have strongly encouraged the growth of their stock lending business. The ability of arbitrageurs to locate and cheaply borrow stock for short sales is essential if reverse arbitrage is to produce frequent profitable transactions. A developed stock loan business facilitates reverse arbitrage in sufficient size to put upward price pressure on futures that in turn lessens negative mispricing. Introducing and encouraging a liquid stock lending business is known to reduce arbitrage asymmetry. In Korea (Gay & Jung, 1999), for example, negative mispricing of futures was mitigated following the introduction of stock borrowing facilities.

In Turkey, stock lending is regulated by the Capital Markets Board and implemented through the Securities Lending and Borrowing Market, which is itself operated by the BIST Settlement and Custody Bank (Takasbank). Collateral for stock loan can be cash, treasury bills, government bonds, equities, investment funds, ETFs, and other approved securities. The market value of any single order cannot exceed TRY 1.5 million, which, because of its size, is unlikely to act as a constraint on any single reverse arbitrage transaction. The Capital Markets Board classifies equities traded on the Istanbul Stock Exchange into A, B, C, D groups according to specific criteria. Only A-classified stocks are eligible for stock lending. Normally, this includes all BIST 30 stocks and the IST 30 ETF. Prices for the borrowing stock are called commission rates and are quoted on an annualized basis. Other than the limitations of being an A group stock with a size not exceeding TRY 1.5 million, the only other regulatory constraint is normally the uptick rule for short sales, which is standard in most capital markets. All stocks in the BIST 30 are exempt from the uptick rule. However, the rule does apply to the IST 30 ETF.

Regulators and securities dealers have often struggled with how to manage trading restrictions and constraints

Table 5. BIST 30 Arbitrage Observations 2005-06 and 2014-15

Typical Arbitrage Element	McMillan and Ülkü (2009)	Current Study (2014-15)
Futures prices below spot index	3% - 4% below	0.17% below
Futures prices above spot index (infrequent)	more than1% - 3% above	1.38% above
Futures prices as % of costless fair value	5% - 8% below	1.03% above to 1.19% below
Average futures prices as % of costless fair value	6.5% below (est)	0.61% below
Futures Commissions (One Way)	0.05%	0.06%
Stock Commissions (One Way)	0.08%	0.05%
Arbitrage Commissions plus bid/offer spreads (Two-Way)	0.80% - 1.0%	0.50%
Forward Arbitrage Band width as % of costless fair value	3+% (est)	0.50%
Reverse Arbitrage Band width as % of costless fair value	5% - 8% (est)	1.79 - 2.19%

to maximize participation in stock index arbitrage. Faced with persistent price discounts to Nikkei futures fair value, Japan's Ministry of Finance in 1986 permitted U.S. financial institutions to become members of the Tokyo Stock Exchange and the U.S. Commodities Futures Trading Commission allowed U.S. nationals to trade on Nikkei stock index futures. These changes allowed an increase in market participants willing to execute stock index arbitrage. Soon afterwards, prohibitions on the lending of shares by mutual funds and pension plans were eased ; thereby, increasing the number of shares available for lending. The increased availability of stock lending led directly to an increased ability to execute reverse arbitrage. In 1989, the Ministry of Finance considered a plan from the Japanese securities industry to improve conditions for stock index arbitrage. The proposal allowed for easing short selling constraints and was accepted. A reduction in the securities transfer tax separately followed. The combined efforts of regulators and securities firms brought about an increase in arbitrage activity and a subsequent decline in the magnitude of futures mispricing.

In Turkey, it is surprising that after nearly a decade of stock index futures trading that BIST 30 futures remain consistently priced below costless fair value and remain within a wide zero arbitrage band. If regulators wish to eliminate this market inefficiency, cooperative efforts will be required by relevant market participants. The Japanese experience suggests some helpful initiatives. First, regulators and securities dealers must agree that reducing the zero arbitrage band width provides a benefit to the market worth spending effort on. Presently, domestic and foreign market participants seeking to hedge the market risk in Turkish stock portfolios are most likely quite reluctant to sell futures contracts below their fair value , thereby creating a sure loss when futures converge to the index level at expiration. Continued pricing below the fair value removes futures as an effective risk management tool when short hedging is needed. If attracting and retaining global foreign capital is a worthwhile goal, especially for developing markets, then it will be necessary to create an environment that permits effective use of derivatives for risk control. Index futures play a primary role in most global stock markets for such risk control.

Our measurements of the forward arbitrage band reveal that the level of commissions, when combined with other costs, create a band width comparable to that found in developed markets. This suggests reducing the forward band width further will be less effective in facilitating arbitrage than reducing the reverse arbitrage band width. Reverse arbitrage can be executed in two ways. ETF shares can be borrowed and sold short against the purchase of futures, or a basket of stocks replicating the BIST 30 index can be borrowed and sold short against futures. Executed in sufficient size and frequency, either form of arbitrage creates desirable upward pressure on the price of futures, moving that price toward fair value. Easing impediments to stock borrowing and short selling, then become desirable regulatory and industry goals.

Both forms of reverse arbitrage require the borrowing of stocks, and with it come the associated obstacles. The reverse arbitrage band width in Turkey is influenced by the cost of stock borrowing, the uptick rule, and the supply of lendable stock. The stock lending commission rate in Turkey often rises to nearly the cash borrowing rate, which then makes reverse arbitrage prohibitive. The uptick rule applies to ETF shares but not to BIST 30 individual shares, providing a much smaller barrier to overcome. However, the supply of lendable stock for term borrowing remains a significant limiting factor. Creating an environment conducive to reverse arbitrage will require combined regulatory and industry actions on each of these impediments.

As an example of how this might be accomplished, China's regulators may soon consider granting tax incentives to attract participants to its futures markets. A similar grant might be considered in Turkey. To further reduce the cost of borrowing, the initial margin ratio, which was set by the Capital Markets Board to 70% in 2011, could be reset to the prior lower level of 50%. At a 70% level, an arbitrageur must pledge collateral equivalent to 2.33 times the current market value of securities that must be sold short. At the 50% level, the collateral is only 1.00 times the current market value. Also, as in Japan, the uptick rule could be suspended for equity ETFs to increase opportunities for reverse arbitrage.

To facilitate growth in the domestic supply of securities available for stock borrowing, some of the following steps might be considered. Current lending restrictions on the percentage of stocks in domestic mutual and pension fund portfolios could be eased, as was done in Japan. Any restrictions on allocations to equities within fund portfolios could be eased as well. This might increase the shares held by institutions willing to lend them. Presently, much of the Turkish stock lending by foreign holders takes place away from Takasbank in financial centers such as London. Large foreign holders of Turkish equities could be encouraged to join Takasbank on favorable terms, thereby increasing the domestic lendable share supply for arbitrage purposes.

The way in which the results obtained from this study differ from those obtained by McMillan and Ülkü (2009) on index arbitrage in Turkey gives some insight into how the market has evolved since BIST 30 futures were first introduced in January 2005, almost a decade ago. The Table 5 lists the arbitrage elements from that study and those observed in the current study covering six futures contracts expiring in 2014 and early 2015.

In the current study, futures prices moved in a narrow range about the spot index level (1.38% above to 0.17% below) rather than persistently appearing in 2005-2006 at 3% to 4% below spot or infrequently at 1% - 3% above fair value and ,therefore, above spot. While in each study, futures persistently traded below costless fair value, the magnitude of mispricing was far less in the current study (typically 0.61% below compared with estimated 6.5% below). A narrowing of the spread in futures mispricing is also reflected in the Table 5 (1.03% above to 1.19% below vs. 5% to 8% below in the prior study). In Figure 2, the lower magnitude and narrowed range of futures mispricing is illustrated for the April futures prices which cluster in a range of 0.40% of costless fair value and are centered 0.67% below. If futures and stock commissions changed little over the past decade, the Table 5 difference between the two studies in the sum of two-way commissions and bid/offer spreads could be primarily attributed to the narrowing of bid/offer spreads. It is more likely that both futures commissions and bid/offer spreads have declined, thereby contributing to this narrowing. McMillan and Ülkü (2009) observed futures purchases occurring when pricing reached 3% to 4% below spot. Also observed was less frequent positive mispricing of 1% to 3% above spot, which was not helpful in inducing arbitrage. By inference, these two observations suggest a 5% to 8% range of the reverse arbitrage band width and a forward zero arbitrage band width of approximately 3% or higher. Taken together, these suggest that both the forward and reverse arbitrage band widths have declined sharply to their respective 0.50% and the maximum of 2.19% levels in the current study.

Summary and Conclusions

To the best of our knowledge, the width of the zero arbitrage band in Turkey has not been previously measured and reported. In this study, the total width of the zero arbitrage band was measured and further divided into two : the forward and reverse arbitrage bands. Component contributions to the width of each band were calculated as they originated separately from commissions, fees, bid/offer spreads, and stock loan costs. Returns for forward and reverse BIST 30 index arbitrage were computed using these costs and intraday data in one-minute intervals for six futures with differing monthly expirations. The computed returns enabled identification of the frequency of profitable executions net of all costs. By observing that futures prices consistently reside within their zero arbitrage band, the regular absence of profitable arbitrage trades and the seemingly abnormal persistence of BIST 30 futures priced below the costless theoretical fair value could both be understood.

In the intervening years, since the introduction of BIST 30 index futures in 2005, the magnitude of mispricing from spot and from costless fair value has significantly declined into a far narrower range. The sharp reduction in the width of the full zero arbitrage band originated primarily from improvements in the two-way bid/offer spread and from the probable reduction in the cost of stock borrowing. Such evolution in the Turkish futures market was to be expected if other markets are any guide. In the U.S., Japan, Korea, and Greece, as observed by McMillan and Ülkü (2009), futures mispricing following the introduction of stock index futures gradually lessened with time as market participants increased and transaction costs declined. The current study verifies that the Turkish evolutionary path is consistent with other futures markets.

The size of the full zero arbitrage band width in Turkey is consistent with other developing markets. The forward zero arbitrage band for BIST 30 futures appears to be approximately the same as that observed in most mature futures markets (about 0.50%). This suggests reducing the reverse zero arbitrage band width is the more attractive way to facilitate further arbitrage. Such a reduction could be most effectively accomplished primarily by lowering the cost of stock borrowing and increasing the supply. Without lowering impediments to locating and borrowing stocks or ETFs for short sales, reverse index arbitrage will remain unprofitable. To increase reverse arbitrage, policies and incentives -from regulators, with backing from exchanges, dealers and stock loan agents - are needed to encourage the further development of the domestic stock loan business in Turkey. Arbitrageurs will then happily expedite more efficient futures and market pricing.

Limitations of the Study and Scope for Further Research

Scholars seeking a more detailed understanding of how market efficiency evolves when new derivatives are introduced will want to extend this study to include the period between the McMillan and Ülkü (2009) study and this one. It is not clear that from 2005 to 2014 why there were no periods in which index arbitrage was profitable. It could be that there were occasional times for positive returns. Indeed, it would be somewhat surprising if this were not the case. Identification of when profitable periods might have occurred could provide insights for regulators on how to devise policies that encourage systematic arbitrage and so lead to greater market efficiency. For example, Turkish arbitrage opportunities may arise during particularly volatile periods such as during the global financial crisis of 2008 and the more recent downturn of the China market. However, confirmation of the same requires a separate set of data and analysis.

As discussed in this paper, regulatory policies in Turkey have a major influence on the economics of stock index arbitrage. Regulators interested in promoting market efficiency will have an interest in a detailed comparison of the historical results of changing policies in Japan, China, and Korea. A study of what policies worked to improve arbitrage opportunities and what policies did not could assist regulators and practitioners to focus on where to make changes that create hospitable market conditions leading to index arbitrage and improved market efficiency.

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