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A TEST OF LIMITS TO ARBITRAGE: DEMONSTRATION FROM NIGERIAN FOREIGN EXCHANGE MARKET

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Abstract

This paper empirically examines limits of Arbitrage in Nigeria. The aim of the study is to demonstrate that there exist arbitrage gains in Nigerian foreign exchange market. This study employed survey and descriptive research design to demonstrate the existence of arbitrage gains in foreign exchange market in Nigeria using different Naira to Dollar rates for different purpose (Pilgrimage, Budget, Western union, BDC, Travelex, Inter –bank, Foreign medical trip and Special airline funds). The findings of the study reveal that convergence was close between BDC, Western union and parallel market rates. The “widest” margin was visible in that of pilgrim’s rate, budget rate and inter-bank rate. The paper therefore recommends that the Central Bank of Nigeria (CBN) being the regulatory authority in Foreign exchange market should have a single exchange rate in the market so that convergence can be attained.

Keywords: Exchange rate, Arbitrage, Regulatory authority, Convergence

Jel Classification Codes: F31, M48, O49

1. INTRODUCTION

In finance, theory frequently posits that markets are efficient, that is, that prices completely mirror their central values. It is also extensively assumed that the foreign exchange market is one of the utmost efficient markets. In certainty, conversely, there exist abrasions, insider information, and non-synchronous trading that originates market inefficiency (Ryoo, 2006). The degree of this market imperfection is still under consideration as practically several pricing variance can be inferred in a rational way. However, the minimum uncertain proof against market imperfection may be the presence of arbitrage. Over the last periods, empirical test of the Limits to Arbitrage has spawned the finance literature. Empirical asset pricing tests of the predictions of the Sharpe-Lintner CAPM of positive return anomalies – small value stocks, value stocks generally, recent winners, and positive earnings surprises small stocks, have thus been the subject of empirical tests. Researchers in behavioural finance argue that asset pricing anomalies result from the influence of unmodeled irrational behaviour on security price. Since

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rational behaviour is implied in the assumption used to test asset pricing model, the test of Limits to Arbitrage becomes discernible (Brav, Heaton & Li, 2009).

The Arbitrage theory holds that financial anomalies are likely, given the fact that irrationality-generated anomalies would be exploited and eliminated by rational arbitrageurs. The limits of arbitrage argument counters this objection by asserting that arbitrage is difficult because idiosyncratic risk and noise trader momentum risk make arbitrage difficult. This argument is testable because it implies that financial anomalies should be strongest where limits to arbitrage (i.e., idiosyncratic risk and noise trader momentum risk) are greatest. Following the assumption of the Limits to Arbitrage, the dominance of value stocks should be highest for stocks exhibiting “loser” momentum trends, since arbitrageurs, who are aware of these momentum characteristics, are presumably reluctant to purchase value stocks that are more likely to continue to underperform in the short run. Similarly, the underperformance of growth stocks should be stronger for firms exhibiting recent high price appreciation, namely, momentum “winners,” because arbitrageurs will not want to bet against growth stocks that are more likely to continue to appreciate in price.

Studies contend that asset pricing abnormalities result from the influence of unmodeled irrational behaviour on security prices (see Barberis & Thaler, 2003). To invalidate the arbitrage objection, some researchers argued that arbitrage is more difficult than recognized by those offering the arbitrage objection. Barberis and Thaler (2003) categorize three sources of limits to arbitrage: idiosyncratic risk, noise trader momentum risk, and implementation costs. In the conventional arbitrage model, the hypothesis is that greater idiosyncratic volatility protects the existence of greater levels of mispricing, where the issue is on categorizing securities on the size of their residual variability from (as a measure of idiosyncratic risk), and whether financial anomalies increase in magnitude with the amount of residual variability. Under this hypothesis, momentum in the same direction protects greater levels of mispricing, and earns abnormal positive returns because irrational investors extrapolate past bad performance into the future (Lakonishok, Shleifer & Vishny, 1994, cited in Brav, Heaton & Li, 2009). Following this, investors will thus categorize stocks into those exhibiting negative momentum and those exhibiting positive momentum, testing the prediction that arbitrage against loser-value stocks is riskier and thus should deter arbitrage and allow for the survival of higher abnormal returns to value stocks. Instead, these anomalies are stronger when idiosyncratic risk is low. These results are robust to alternative specifications of idiosyncratic risks and transactions costs.

In fact, the high positive correlations between total and residual volatility and other generally accepted measures of limits of arbitrage, including the extent of institutional holding, analyst coverage, and stock price level suggest that, it is unlikely that any alternative measures of idiosyncratic risk or transactions costs could change the general inferences. It is difficult to imagine such alternative measures retaining plausible interpretation as limits of arbitrage. The evidence is not consistent with the limits of arbitrage argument for the survival of irrationality-induced undervaluation of small value stocks; value stocks generally, recent winners, and positive earnings surprises. Evidences have shown instances of negative returns to these anomalies among stocks with high residual variability. This finding has further generated empirical investigation to validate or invalidate the Limits to Arbitrage assumption to

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demonstrate it within the context of foreign exchange market. Against this background, the cardinal research question raised in this study is: Is there evidence of Limit to arbitrage in the Nigerian foreign exchange Market? In line with the research question, the fundamental objective of this study is to investigate whether the limits to arbitrage holds in the Nigerian foreign exchange Market

2. LITERATURE REVIEW

2.1 Conceptual Framework

2.1.1 Evidences of Limit to Arbitrage

2.1.1.1 Index inclusions

Overtime, one of the companies in the S&P 500 is taken out of the index because of a merger or bankruptcy, and is swapped to another firm. Two initial studies of such index inclusions, Harris and Gurel (1986) and Shleifer (1986), document a notable fact: when a stock is added to the index, it jumps in price by an average of 3.5%, and much of this jump is stable. In one dramatic illustration of this phenomenon, when Yahoo was added to the index, its shares jumped by 24% by first day. If a stock jumps in value upon inclusion is once again clear evidence of mispricing: the price of the share changes even though its fundamental value does not. Standard and Poor's emphasizes that in selecting stocks for inclusion, they are simply trying to make their index representative of the U.S. economy, not to convey any information about the level or riskiness of a firm's future cash flows. This example of a deviation from fundamental value is also evidence of limited arbitrage. When one thinks about the risks involved in trying to exploit the anomaly, its persistence becomes less surprising. An arbitrageur needs to short the included security and to buy as good a substitute security as he can. This requires significant fundamental risk because individual stocks hardly have good substitutes. It also carries substantial noise trader risk: whatever caused the initial jump in price – in all likelihood, buying by S&P 500 index funds – may continue, and cause the price to rise still further in the short run; indeed, Yahoo went from \$115 prior to its S&P inclusion announcement to \$210 a month later.

Wurgler and Zhuravskaya (2002) in their study provide additional support for the limited arbitrage view of S&P 500 inclusions. They hypothesize that the jump upon inclusion should be predominantly large for those stocks with the worst substitute securities, in other words, for those stocks for which the arbitrage is riskiest. By constructing the best possible substitute portfolio for each included stock, they are able to test this, and find strong support. Their analysis also shows just how hard it is to find good substitute securities for individual stocks.

2.1.1.2. Internet carve-outs

In March 2000, 3Com sold 5% of its wholly owned subsidiary Palm Inc. in an initial public offering, retaining ownership of the remaining 95%. After the IPO, a shareholder of 3Com indirectly owned 1.5 shares of Palm. 3Com also announced its intention to spin off the remainder of Palm within 9 months, at which time they would give each 3Com shareholder 1.5 shares of

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Palm. When trading on the first day after the IPO ended, Palm shares stood at \$95, placing a lower bound on the value of 3Com at \$142. In fact, 3Com's price was \$81, indicating a market valuation of 3Com's significant businesses outside of Palm of about \$60 per share! This position surely denotes a severe mispricing, and it persisted for several weeks. To gain from it, an arbitrageur could buy one share of 3Com, short 1.5 shares of Palm, and wait for the spin-off, thus earning certain profits at no cost. This strategy entails no fundamental risk and no noise trader risk. Why, then, is arbitrage limited?

Lamont and Thaler (2003), who analyze this case in detail, argue that implementation costs played a major role. Many investors who tried to borrow Palm shares to short were either told by their broker that no shares were available, or else were quoted a very high borrowing price. This barrier to shorting was not a legal one, but one that arose endogenously in the marketplace: such was the demand for shorting Palm, that the supply of Palm shorts was unable to meet it. Arbitrage was therefore limited, and the mispricing persisted. Some financial economists (Barberis & Thaler; 2003 and Brav, Heaton & Li; 2010) react to these examples by arguing that they are basically isolated cases with little broad significance. The "twin shares" illustrates that in positions where arbitrageurs face only one type of risk – noise trader risk – securities can become mispriced by almost 35%. This suggests that if a typical stock trading on the NYSE or NASDAQ becomes subject to investor sentiment, the mispricing could be an order of magnitude larger. Not only would arbitrageurs face noise trader risk in trying to correct the mispricing, but fundamental risk as well, not to mention implementation costs.

2.1.2. Twin shares

In 1907, Royal Dutch and Shell Transport, at that time wholly independent businesses, decided to merge their interests on a 60:40 basis while remaining distinct entities. Shares of Royal Dutch, which are primarily traded in the USA and in the Netherlands, are a claim to 60% of the entire cash flow of the two companies, while Shell, which trades primarily in the UK, is a claim to the remaining 40%. If prices equal fundamental value, the market value of Royal Dutch equity should always be 1.5 times the market value of Shell equity. Remarkably, it isn't. Moreover, the deviations are not small. Royal Dutch is sometimes 35% underpriced relative to parity, and sometimes 15% overpriced. This evidence of mispricing is concurrently evidence of limited arbitrage, and it is not hard to see why arbitrage might be limited in this case. If an arbitrageur wanted to exploit this phenomenon – and several hedge funds, Long-Term Capital Management included, did try to – he would buy the relatively undervalued share and short the other. Since one share is a good substitute for the other, fundamental risk is nicely hedged: news about fundamentals should affect the two shares equally, leaving the arbitrageur immune. Nor are there any major implementation costs to speak of: shorting shares of either company is an easy matter.

The one risk that remains is noise trader risk. Whatever investor sentiment is causing one share to be undervalued relative to the other could also cause that share to become *even more* undervalued in the short term. As discussed earlier, when a mispriced security has a perfect substitute, arbitrage can still be limited if (i) arbitrageurs are risk averse and have short horizons and (ii) the noise trader risk is systematic, or the arbitrage requires specialized skills, or there are

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costs to learning about such opportunities. It is very plausible that both (i) and (ii) are true, thereby explaining why the mispricing persisted for so long. It took until 2001 for the shares to finally sell at par.

2.1.3 Empirical Evidence on the Limits to Arbitrage

Ali, Hwang, and Trombley (2003) sought to empirically test the Limits to Arbitrage. In achieving this, they investigate if spread in returns between value and growth firms is cross-sectionally correlated with proxies for arbitrage costs such as idiosyncratic risk. The test result show that book-to-market (i.e., value versus growth) effect is likely to be due to market mispricing. The evidence further show that the difference between value and growth size-adjusted is larger when limits idiosyncratic risks becomes large.

Mendenhall (2004) investigates the nexus between arbitrage risk and the post-earnings announcement drift. He finds that both positive and negative drift increase in absolute value as one holds portfolios of high residual variability stocks, a proxy for limits to arbitrage. His evidence is inconsistent with our finding that the positive drift is actually confined to low limit to arbitrage environments. Mendenhall's design considers non-implementable event-time analysis, in which returns are equally weighted and risk or factor adjustment is made only with respect to size matched portfolios. Using a market model to form estimates of residual volatility, leaving common factors in returns due to size, book to market and momentum, which are therefore included in his measure of residual variability, the evidence show that idiosyncratic risk largely accounts for investors' irrational behaviour.

Zhang (2006), investigates the Limits to Arbitrage by focussing on the interface or interplay between profits to momentum strategies and gauges of information uncertainty such as firm specific characteristics which includes size, age, analyst coverage, dispersion in analyst forecasts, cash flow volatility, and stock volatility measured as the standard deviation of weekly excess returns in relation to market portfolio measured over the one-year pre formation period. The outcome of the study reveal that loser (winner) stocks tend to earn larger negative (positive) abnormal returns in high uncertainty milieu that are rationally expressed as high limits to arbitrage settings. The findings of the results for losers show that losers achieve poorly only in high limits to arbitrage environments – but the outcome for recent winners are varying with both the finding in this paper and that reported in Ang et al. (2006).

Lewellen (2011) investigates the nexus corporate investors and the limits to arbitrage using the returns and stock holdings of institutional investors that spanned from 1980 to 2007. The empirical results provide little evidence of stock-picking skill. The findings display that institutions as a whole were found to closely follow the path of market portfolio, with pre-cost returns with a correlation value for weighted index and an insignificant capital asset pricing model alpha of 0.08% quarterly. The firms also show minute propensity to bet on any of the core characteristics identified to forecast stock returns, such as book-to-market and momentum. While specific sets of institutions have uncertain stock-picking skill relative to the CAPM, their performance is virtually exclusively elucidated by the book-to-market and momentum effects in

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returns. Additionally, the findings display that no group holds a portfolio that deviates efficiently from the market portfolio.

Zeremba (2015), in his study surveys the link between investor sentiment, limits on arbitrage, and the performance of stock market anomalies using cross-country evidence. This is built on the idea that anomalies suggest that mispricing shoots from investor irrationality that could not easily be arbitrated or diversified away. The study explicitly sought to explore if market-wide processes of investor sentiment and arbitrage limits affect the performance of cross-country stock market variances. The findings show that disparity in market sentiment displays a vital role in returns on cross-country value strategies, whereas tight arbitrage conditions negatively influence momentum profits.

Godfrey and Brooks (2015) test the Limits to Arbitrage assumption by investigating the relationship between negative credit risk premium puzzle within and excess stock returns. In doing this, the study to provide empirical evidence to validate or invalidate the view that a model incorporating limits-to-arbitrage factors is capable of explaining this apparent anomaly. The empirical test results show that that the negative pricing of credit stocks is propelled by the underperformance of stocks, which have both high credit risk and which have relatively underperformed, and that the poor performance can be explained by a combination of four limits-to-arbitrage factors – idiosyncratic risk, turnover, illiquidity and bid-ask spreads. These according to the researchers impede the correction of mispricing by arbitrageurs, particularly, where commonly reported returns are unattainable. The study thus counter-intuitively, refute the view that high credit risk stocks earn lower – not higher – returns than low credit risk stock.

In the study carried out by Brav, Heaton & Li (2010), to test the limits of arbitrage argument for the survival of irrationality-induced financial anomalies by sorting securities on their individual residual variability as a proxy for idiosyncratic risk, which is a commonly asserted limit to arbitrage – and comparing the strength of anomalous returns in low versus high residual variability portfolios. The findings of the study did not find experimental support for the limits of arbitrage argument to elucidate undervaluation variances but strong support for the limits of arbitrage argument to explain overvaluation anomalies. The study also invalidated the limits of arbitrage argument for the existence of overvaluation variances and submit that at least some of the factor premiums for size, book-to-market, and momentum are unconnected to irrationality protected by limits to arbitrage.

Tayal (2016) carried out an empirical test of the Limits to Arbitrage, by examining if market imperfections can be explicated by arbitrage limitations, particularly organisations' peculiar risk. In line with the limits to Arbitrage hypothesis, evidence of abnormal return of -1.74% for high risks with high unsystematic risk is recorded. However, for similar level of high stocks, abnormal returns are economically and statistically significant with low idiosyncratic volatility. For low stocks, the returns are found to be positively related to idiosyncratic volatility. These findings obviously indicate that unsystematic risk is a possible motivation for the incapacity of arbitrageurs to abstract returns from high and low risks portfolios. From the fairly large volume of literature, it appears that the findings of empirical tests on the Limits to

Arbitrage are rather mixed and non-conclusive for the developing countries, hence warranting further empirical investigations, particularly in the context of the Nigerian Capital Market.

3. METHODOLOGY

This paper employed survey and descriptive research design to demonstrate the existence of arbitrage gains in foreign exchange market in Nigeria. Official multiple exchange rates by the Central Bank of Nigeria on the 17th of August, 2017 and the parallel market's (Black market) price for the United States of American dollar for the same day were used to ascertain the arbitrage gain owing to the price differentials from both markets.

4. FINDINGS AND DISCUSSIONS

In this section, the various data extracted from Central Bank official rate and parallel market rate from financial derivatives respectively are presented in the table below. In demonstrating that arbitrage opportunities in this study, it is hypothetically assumed that an investor enjoys insider dealings to get access from Central Bank of Nigeria.

Table 1:

Date	Currency	Purpose	Multiple rate	Parallel market rate	Spread rate	Dollar	Total arbitrage gained at ₦2,000,000
17/08/2017	Dollar	Pilgrims	199	368	169	\$10,050.3	₦1,698,510.4k
		Budget 2017	306	368	62	\$6,535.9	₦405,211.0k
		Inter-bank	306.10	368	61.9	\$6,533.8	₦404,438.4k
		Travelex	360	368	8	\$5,555.6	₦44,460.8k
		Western union	355	368	13	\$5,633.8	₦73,238.4k
		BDC	367	368	1	\$5,449.6	₦5,452.8k
		International bank card	369	368	(1)	\$5,420.1	₦5,403.2k
		Foreign medical trips	323	368	45	\$6,192.00	₦2781,656.00k
		Special funds airline	325		43	\$6,153.8	₦264,598.4k

Source: Authors computation, (2020)

From the table above, it can be observed that arbitrage opportunities exist in Nigeria's foreign exchange market. This is occasioned by official multiple exchange rates of the United States of America dollar and the parallel market rate. The Central Bank of Nigeria has some special exchange rates for some specific purpose or preferred sectors of the economy. These rates are prevalent in Pilgrims, Budget, Interbank, western union, Travelex, BDC, international bank card, foreign medical trips and special funds airline. For instance, on 17/08/2017, the arbitrage gain from the pilgrim rate is ₦1, 698,510.4k if the investor traded ₦2, 000,000.00. The arbitrage gain from 2017 budget rate and inter-bank rate is ₦405, 211.2k and ₦404, 438.4k respectively if the investor traded with the hypothesized sum. For Travelex rate, western union

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rate, BDC rate, foreign medical trips rate and special funds airline rate, their respective Arbitrage gains are ₦44, 460.8k, ₦73, 238.4k, ₦5, 452.8k, ₦278, 656k and ₦264,598.4k respectively. For the international bank card rate, the investor recorded a loss owing to lesser rate at the parallel market. From the analyses above, convergence was close between BDC, Western union and parallel market rates. The “widest” margin was visible in that of pilgrim’s rate, budget rate and inter-bank rate. All these aforementioned rates (pilgrims, budget and inter-bank) will give room to massive round tripping owing to insider information or insider abuse.

5. CONCLUSION AND RECOMMENDATIONS

The dollar being a global currency, any significant change in its value ripples throughout the financial markets. The multiple exchange rates for the dollar in Nigerian’s foreign exchange market have created arbitrage opportunities in the market. Convergence of the parallel market and the official exchange rate will be difficult to be attained because of the proliferations of official multiple rates in the Fx market by the monetary authority saddled with the responsibility to ensure stability in the market. From the above, it has been established that arbitrage windows exist in Nigerian’s foreign exchange market owing to non-convergence of rates between the official exchange rate and parallel market rate. This study strongly recommends that the Central Bank of Nigeria (CBN) being the regulatory authority in Fx market should have a single exchange rate in the market so that convergence can be attained, if the monetary authority can reduce the multiple exchange rates to one official rate, round-tripping will be reduced to the barest minimum. The preferential rates given to pilgrims, medical tourism, travel, and budget should be the same with the prevailing market official rate of the CBN so that the interplay of supply and demand will equilibrate the rate.

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