RESEARCH PAPER

Reassessing the Law of One Price and Informational Efficiency across India's Twin Stock Exchanges

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Abstract
The owners of many Indian stocks have two prices for the same share traded at two exchanges, the Bombay Stock Exchange (BSE) and the National Stock Exchange (NSE). Apart from transaction costs, the two prices, if the Law of One Price is valid and markets are informationally efficient, should be equal. In this article, they are presented with theory that allows for an understanding as to why they might not, and what any remaining differential would talk about efficiency. It brings together the most widely discussed published findings on Indian and foreign dual listings in a unified framework, which is drawn from the efficient-market hypothesis, the limits-of-arbitrage literature, liquidity-based asset pricing and price-discovery econometrics. But the evidence suggests that occasionally and, in some stocks, there are small, short-lived deviations that are justified by the risk and arbitrage costs, but not irrational pricing, and that there is time-varying leadership of pricing discovery. The article makes four propositions which can be tested and an empirical design for further BSE–NSE research and talks about implications for investors, exchanges and regulators.

Keywords: *Law of one price, Market efficiency, Dual-listed stocks, Price discovery, Limits to arbitrage, BSE, NSE*
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Introduction

A purchase of a share on either of the two exchanges provides the same claim on the cash flows of the company and the same vote. The BSE–NSE pair is thus one of the least polluted natural laboratories for testing the efficiency of the market. As usual, efficiency tests require no assumptions about expected returns: two prices are for the same asset, and if the spread persists, then it is a gap in the market, not in the researcher's expectations.

According to the Law of One Price, once the frictions are considered, the same asset or security should trade at the same price everywhere in the world because otherwise the traders can buy at low prices and sell at high prices without any risk (Fama, 1970; Shleifer & Vishny, 1997). But the evidence from dual-listed firms in other countries suggests that the idea of equality is only an approximation (Froot & Dabora, 1999; de Jong et al., 2009). Indian studies on BSE – NSE price disparity show that the disparity can be significant in the price of the individual large stocks and can increase following market-wide shocks (Muthu Pandian and Vishal, 2019).

This article poses two questions. First of all, why are there price differences and can they exist in identical stocks on both BSE and NSE? Second, what do these differentials, and how they close, tell us about the informational efficiency of the two markets? It responds to their questions theoretically, or through the incorporation of four bodies of work, and substantively, by reporting on the most salient published literature findings, not presenting new evidence.

1. Theoretical Foundations

1.1 The Law of One Price and the efficient-market benchmark

According to Fama (1970), the efficient market is a market where the price reflects all the available information. The efficient-market significance of the twin stocks is stark: If they are efficient markets, new information should be priced in simultaneously, meaning the difference between them should be small enough to be shielded by the cost of trading. Any deviation from it is profitable to exploit and it should be eliminated by arbitrageurs. Two things are necessary for efficiency across venues: the first, quick incorporation of information into each venue's price; the second, quick correction of any gap between these venues.

1.2 Limits to arbitrage

The benchmark assumes the cost of and risk associated with arbitrage are zero. Grossman and Stiglitz (1980) made this point: if prices were perfectly efficient, then it would not make sense to pay someone to obtain information, since they would not need it. The same applies to arbitrage: traders will just close a gap if the expected profit is larger than the cost and risk of closing the gap. Shleifer and Vishny (1997) demonstrated that the professional arbitragers work with a relatively small amount of capital which is performance sensitive, and therefore, they may decrease their positions just when mispricing is increasing. For dual-listed companies De Jong et al. (2009) reported abnormal returns up to nearly 10% annually with uncertainty about convergence horizons; deviations were

volatile; and the trading strategies had large negative returns frequently enough to discourage arbitrage. Thus, it is possible for mispricing to exist between two twin stocks without irrational motives of arbitrageurs.

1.3 Liquidity and the venue effect

The same stock can have different liquidity in two different venues. Amihud and Mendelson (1986) demonstrated that investors require higher returns on assets with a wider bid–ask spread, and thus the prices include a liquidity premium. One exchange may have wider spreads or thinner order books, and so the price in that exchange is not as prone to short-term order flow pressures, and will be more responsive to news. Froot and Dabora (1999) identified that the market where trading takes place has an impact on the stock price, since the stocks that trade more in the market are co-moving with the market. Combined, these findings suggest that the observed BSE–NSE differential could be due to a lack of liquidity and order-flow at the NSE rather than a pricing mistake.

1.4 Efficiency as an adaptive property

Lo (2004) introduced the adaptive markets hypothesis, the efficiency is not a constant but depends on the competition, the behaviour of the participants and the market environment. This perspective is consistent with the evidence of the twin listings: Environment of stress or regime change may cause cross-venue differentials to expand, while arbitrage capital adapts, causing them to contract.

2. Conceptual Framework

These strands are combined in Figure 1. An identical claim is available at two venues, each with different frictions, such as spreads, liquidity, and the makeup of informed and uninformed order flow, and execution speed. The price difference is visible due to these tensions. Arbitrage trading leads to convergence, price discovery, and efficiency, stemming from the differential. But the correcting force is bounded by transaction cost, risk, limited capital, and the uncertainty of the duration of a gap, which means that small corrections may take place within a no-arbitrage zone.

Figure 1. Conceptual framework linking identical listings, venue frictions, price differentials, arbitrage and efficiency. Source: author's synthesis of Fama (1970), Shleifer and Vishny (1997) and Amihud and Mendelson (1986).

From this framework four propositions follow, which structure the evidence reviewed below.

P1: Price differentials between BSE and NSE for the same stock are small on average but non-zero, and they are larger for stocks with weaker liquidity on at least one exchange.: Differentials widen following market-wide shocks, because both arbitrage capital and liquidity become scarcer.

P3: Price-discovery leadership between the two exchanges is time-varying rather than fixed, and is concentrated in the venue with the deeper order book.

P4: Differentials that exceed the no-arbitrage band are corrected quickly, so the two prices are cointegrated and the effective violation of one price is brief.

3. Prominent Evidence from the Literature

Table 1 collects the most prominent published results relevant to the propositions. The evidence is deliberately restricted to findings reported in the cited studies; it does not rest on new estimation.

Table 1. Prominent published results on dual-listing price differentials, price discovery and arbitrage.

Study	Setting	Prominent result
Muthu Pandian & Vishal (2019)	BSE–NSE, four large pharma stocks, daily prices	Dr. Reddy's Laboratories showed the highest price disparity; disparity was especially large after demonetisation.
Jain & Biswal (2015)	NSE cash vs single-stock futures, 50 Nifty stocks, 5-minute dat	Cash market led price discovery in 28 stocks and futures in 22; informed trading exists in both.

	a	
Karmakar & Inani (2019)	Indian spot vs futures, size and sector panels	Spot dominates overall, but information shares vary over time and with market state.
Sundararajan & Balasubramanian (2023)	Nifty futures on NSE and SGX vs spot, 5-minute data	SGX futures ranked first in price discovery, then NSE futures, then spot.
Kadapakkam, Misra & Tse (2003)	Indian stocks and London GDRs	Prices cointegrated despite arbitrage restrictions; both markets contribute almost equally to price discovery.
Study	**Setting**	**Prominent result**
de Jong, Rosenthal & van Dijk (2009)	12 dual-listed companies, 1980–2002	Trading rules earned abnormal returns of up to almost 10% a year, but with high idiosyncratic risk.
Liu & Bogomolov (2012)	Chinese ADRs, Hong Kong and New York	Arbitrage profits of 0.5%–3.8% a month after transaction costs and non-overlap trading time.

3.1 Evidence on price differentials in Indian twin listings

The most direct evidence of the BSE–NSE price differences is provided by Muthu Pandian and Vishal (2019), who look at price data from the two exchanges for four large pharmaceutical firms, obtained from their daily open-high-low-close prices. Dr Reddy's Laboratories had the maximum price difference among the four, which has been significantly high after demonetisation. This is along the lines of P1 and P2: differentials are company-specific and tend to broaden following a market-wide shock. The study is based on the end-of-day prices, which may lead to some measured difference because of closing time differences, thus, intraday data is required.

3.2 Evidence on price discovery in Indian markets

The results of price-discovery across direct BSE–NSE market pairs are less frequently available than other market pairs in India, however the few studies available are informative of the structure of leadership. Jain and Biswal (2015) applied Hasbrouck (1995) and Gonzalo and Granger (1995) framework to 50 constituents of the Nifty and their individual stock futures, with five minute data. In 28 stocks, the higher share of information was in the cash market and in 22 stocks it was the futures market, showing that informed traders exist in both markets and that leadership is split (Figure 2a). In their work Karmakar and Inani (2019), they found that the spot market is the dominant market for the entire sample, but that there are time variations using periodic measures, and that market-state variables affect information sharing. This helps support P3 and the adaptive perspective of efficiency found in Lo (2004).

It goes the same way with offshore listings. Despite regulatory barriers to price discovery, Kadapakkam et al. (2003) observed that London and Mumbai markets were cointegrated, with a
nearly equal share of price discovery from the two, and that regulatory barriers to GDR trading were lessened by foreign ownership and GDR size. Most recently, Sundararajan and Balasubramanian (2023) have determined that Nifty futures contract does price discovery first as compared to spot index and Singapore Exchange offshore futures contract is the first to price discovery as compared to NSE futures contract. The cointegration across venues, as in P4, is a strong result and the leading venue varies by instrument, period and state of the market.

3.3 International evidence on arbitrage profitability

In other countries, dual-listing research attempts to measure the size and the riskiness of arbitrage opportunities. De Jong et al. (2009) found that up to nearly 10% of abnormal returns, after controlling for the risk of the stock, were earned annually on the parity trades of 12 dual-listed firms between 1980 and 2002, though with significant idiosyncratic

volatility. Even when transaction costs and non-overlapping trading hours have been taken into account, Liu and Bogomolov (2012) have discovered that arbitrageurs in China can achieve monthly returns of 0.5% to 3.8% on trading Chinese ADRs in Hong Kong and New York. These reported figures are summarised in figure 2. They demonstrate that there can be an economic cost to deviation, and thus, the way to explain this is through cost, risk, and frictions and not in terms of lack of opportunity.

Figure 2. Prominent reported results. Panels (a) to (c) show values as stated in Jain and Biswal (2015), Liu and Bogomolov (2012) and de Jong et al. (2009). The panels use different units and samples and should not be compared across panels.

4. Differentials Persist: The No-Arbitrage Band

The limits-to-arbitrage logic directly implies the persistence of small differentials. Compare and analyze the difference between the BSE and NSE prices of a single stock. A trade that is made on the cheaper venue and sold on the dearer one will involve a brokerage, exchange fees, taxes and cost of traversing the bid–ask spread on both venues, as well as operational and margin frictions between venues. The spread has to cover these costs, plus a compensation for if the trade involves risk. The no-arbitrage band, depicted in Figure 3, is the set of spreads that can not be considered for a trade.

Figure 3. A stylised mean-reverting spread and no-arbitrage band. The series is simulated for exposition only and does not represent observed BSE or NSE data.

In this case, there are mainly three implications follows. First, the spread wouldn't be expected to be zero most of the time and it would be reasonably expected to vary within the band and not be followed by any trading action hence a non-zero average differential is not proof of inefficiency. Second, deviations away from the band (as profitable points in Figure 3) lead to arbitrage and should be transitory and the length of the period of reversion the more informative efficiency measure. Third, the width of the band is a function of stock-level liquidity and costs, which vary
between firms and over time. P1 deals with the fact that a stock which is quoted with a wide spread on one exchange also has a wide band and thus has larger differentials.

5. Measuring Efficiency: A Proposed Empirical Design

The framework proposes a measurement approach that divides the three questions into how much, how fast and which venue leads.

5.1 Size of the differential

The proportional difference between the mid-quotes on the two trading floors can be calculated for each stock and compared with estimated round-trip trading costs, using synchronised intraday mid-quotes instead of the closing prices at the end of the day. The issue of synchronisation is important because daily studies as described above may confuse the actual mispricing with the timing difference, hence this factor needs to be taken into account.

5.2 Speed of correction

Two log price series are used in a vector error-correction model to test for cointegration and to determine the speed of adjustment of each price to long run relation. The half-life of a deviation can be reported directly if both prices change. If the average spread is non-zero, but the reaction is fast, with half-life in seconds or minutes, then the efficiency is high.

5.3 Leadership in price discovery

Both Hasbrouck (1995) and Gonzalo and Granger (1995) break down innovations in the price into components attributable to each venue. Applied to BSE-NSE pair on rolling windows, they will reveal the stability or time variations of leadership and whether it follows the framework of liquidity.

6. Implications

The point for investors is that if the spread is tight with a big company and a volume that makes it easy to execute trades, then execution venue is not very important, but it could be more important for a less liquid stock or when spreads are wider and more entrenched, as is often the case during stressed markets. Implicit costs will be lower if orders are routed to either the better quote venue, or both venues. For exchanges, competition is through the liquidity, with one exchange gaining price discovery leadership. For regulators, differentials and their half-lives serve as market-quality indicators, and other rules which contribute to increasing cross-venue trading frictions, such as margin and settlement rules, expand the no-arbitrage zone and decrease the price unification.

7. Limitations and Future Research

This article is a conceptual integration. It reports published results and doesn't contain new estimation, the propositions are still to be tested on high-frequency BSE–NSE data. The amount of direct evidence available on BSE–NSE price discovery is less compared to other market pairs and some of the studies cited are based on futures, depositary receipts or foreign dual listings for which the institutional environment is different. The results from those settings are thus intended to depict the mechanisms, and are not BSE–NSE estimates. It might be worthwhile to future research to integrate tick-level information with explicit estimates of costs and to see if leadership shifts to the more fluid

venue.

8. Conclusion

This test case is to check the Law of One Price and to check the informational efficiency as the identical stocks are listed in both the BSE and NSE. The theory presented here indicates that such small differentials are reasonably to be expected, since arbitrage is costly and risky, the liquidity of trading varies from venue to venue and efficiency itself varies over time. This is strongly suggested by the features this evidence highlights: price spread for individual Indian stocks can be significant; aftershocks, price spreads widen and the leadership in price discovery is divided and varies over time; international dual listings point to real but high-risk arbitrage profits. The question that matters is not whether or not the two prices ever differ, but by how much and how fast. What matters is who leads and how much does the price gap shrink relative to trading costs? The framework and propositions presented here can serve as a basis to answer this with high-frequency data.

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