Testing Stock Market Efficiency Using Risk-Return Parity Rule

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Although the concepts of efficiency have been extensively researched, an efficient stock market has remained elusive. The subject is of particular concern in India now because of the increasing dependence on the capital market for financing industrial growth.

S K Barua and V Raghunathan presented two articles in Vikalpa (July-September 1986 and July-September 1987) arguing that the Indian capital market was inefficient. Using Reliance share prices, they tried to demonstrate that schemes yielding returns unrelated to risk existed.

Srinivasan and Narasimhan in this article question the methodology used by Barua and Raghunathan and elaborate on the concepts of risk-return parity and efficiency, drawing a distinction between information efficiency and market efficiency.

An efficient capital market is indispensable for creating investors' confidence and for a proper allocation of capital among enterprises and sectors.

Is the Indian capital market efficient? Two different views have appeared in recent issues of Vikalpa.

Barua and Raghunathan argued in their article, 'Inefficiency of the Indian Capital Market,' (Vikalpa, July-September 1986), that the Indian capital market was inefficient. Using the Reliance example, hypothetical values, and applying the risk-return parity rule, they concluded that the market was inefficient. The market was unable to maintain risk-return parity.

Ramesh Gupta in his rejoinder, 'Is the Indian Capital Market Inefficient or Excessively Speculative?' (Vikalpa, April-June 1987) explained certain peculiarities of the Indian capital market and concluded that the violation of the risk-return parity might be due to excessive speculation and not due to the inefficiency of the market. Barua and Raghunathan in a second article, 'Inefficiency and Speculation in the Indian Capital Market,' (Vikalpa, July-September 1967), re-examined their hypothesis using real data on the Reliance issue which was available by then and held that their earlier conclusion remained valid. They held that the peculiarities of Indian capital market pointed out by Ramesh Gupta did not affect their conclusion.

Barua and Raghunathan's articles suffer from a misunderstanding about the concepts of market efficiency and risk-return parity. Their methodology is questionable. We have attempted below to:

- clarify the concepts of market efficiency and risk-return parity rule and explain the relationship between them
- show the inadequacy in the methodology
for evaluating market efficiency used by Barua and Raghunathan

• propose a framework for evaluating market efficiency using the risk-return parity rule.

Market Efficiency and Risk-Return Parity Rule

Capital market efficiency implies that information is widely and cheaply available to investors and that all relevant and ascertainable information is fully reflected in security prices.

There are three forms of capital market efficiency:

• **weak form**, in which security prices impound all historical prices
• **semi-strong form**, in which security prices impound all publicly available information
• **strong form**, in which security prices impound all public and private (inside) information.

The strong form of market efficiency does not seem possible. A number of empirical studies have found that markets can only achieve the semi-strong form of efficiency and therefore, the weak form also.

The semi-strong form of market efficiency implies that most investors cannot devise trading schemes based on publicly available information to earn excess (or abnormal) rates of return—returns above the level available to any investor bearing the same risk. It should be noted that under the semi-strong form of capital market efficiency, an investor with private or inside information can achieve an excess return.

Barua and Raghunathan have viewed market efficiency as its ability to maintain risk-return parity at all times through its pricing mechanism. Their view implies that a higher risk taken should actually be rewarded with higher return, commensurate with the risk assumed. This need not be so. For, risk is the exposure to a chance of injury or loss and not to actual or certain loss. Hence, the ex-post return may be much less or even be a loss compared with ex-ante expected return. A violation of the risk-return parity rule in the ex-post sense cannot be interpreted as sure evidence of market inefficiency. On the other hand, any evidence of abnormal return would indicate inefficiency only if the risk-return parity holds ex-ante.

Information Inefficiency

Empirical evidence in Western countries also shows that while over the long run there is the expected positive sign and relationship between risk and return, the shorter-term relationship between risk and return has been erratic. The shorter-term findings have not been explained satisfactorily. Furthermore, there is enough evidence in economic literature that markets are informationally inefficient. The implication is that informational inefficiency cannot be conclusive proof of capital market inefficiency. Evidence of abnormal returns can be due to informational inefficiency, not necessarily market inefficiency.

Barua and Raghunathan's approach of evaluating market efficiency on an ex post-facto basis can lead to wrong conclusions about market efficiency. To appreciate the issues, it may be useful consider the following two examples.

**Example 1:** Investors A, B and C are offered interest-free loans of Rs 1 lakh each subject to the following two conditions:

i) The loan is to be repaid after one year, and

ii) Each should invest either in:

a) government securities or bank deposits, or

b) one or more of 12 shares, all of which belong to a similar risk class.

All the three investors are risk-takers and hence prefer to invest in shares. Investor A, on the basis of some analysis of his own, chooses invest in the first six securities on the list. Investor B, invests in the last six securities on the list. Investor C selects three shares from the first six securities and three from the last six securities.

During the year, prices of the first six securities went up by 75 per cent whereas prices of the last six securities fell by 75 per cent. The reason for such wide variations can be due to peculiar incidents during the year, beyond our ability to forecast.

Investor A will have a 75 per cent return whereas investor B will suffer a loss of 75 per cent. Investor C will neither gain nor lose. Although all of them took similar risks, their actual returns varied widely. How do we use the risk-return parity rule to judge efficiency? Investor A can acclaim
that the market is efficient, but B will cry that the market is inefficient while C can conclude that it is erratic. Who is correct?

Example 2: Companies A and B, whose current share prices are Rs 12 (face value Rs 10), offer convertible debentures on a rights basis in the ratio of 10 debentures of Rs 100 each for every 100 shares. Each debenture will be converted into 10 shares of Rs 10 each at par at the end of first year. Investors X and Y, each of whom holds 100 shares of each company, apply for 10 debentures each.

There is a 50 per cent chance that the year-end market price of Company A's shares would be Rs. There is a similar chance for Company B's share prices. Let us assume that the correlation between share price movements of Company A and Company B shares is very weak (neither positive nor negative) and hence, portfolio theory cannot be to reduce the risk.

Both investors decide to sell their rights after conversion. Investor X decides to sell security A on a cash basis at the end of the year but pre-sells security B on the forward market to avoid a fall in its price. Investor Y decides to sell security B on a cash basis at the end of the year but pre-sells security A on the forward market. Each avoided the price fluctuations in one security while taking the risk of the other. Their risks were equal.

The year-end price of security A is Rs 15 and of security B is Rs 5. X gained Rs 5 (Rs 15 - Rs 10) from security A and was not affected by the fall in prices of security B. On the other hand, Y did not gain by the increase in the price of security of A (as he had already pre-sold it) but suffered a loss from security B. If X claims that the market is efficient then Y cannot. How do we interpret such conclusions?

An outside investment analyst can rightly point out that it is not a question of market efficiency but of individual investor efficiency. Investor X was luckier than investor Y. An ex-post facto analysis based on one or two securities is not a valid approach to test market efficiency.

Inadequacies in Methodology:

In their hypothetical example in the July-September 1986 article, Barua and Raghunathan concluded that the market was inefficient as risk-return parity had not been maintained for most of the assumed values of one security. There are certain inadequacies in their methodology which we discuss below:

Whenever a company announces a rights issue, there may be an increase in price for the following two reasons:

i) The existing investor who has shares 'with rights' can expect to enjoy the gain from such rights issue if he continues to hold the shares and exercises his rights.

ii) There could be an expectation of additional growth in the company's income i.e. EPS (Earning Per Share), as the additional amount raised through rights are normally used in profitable ventures.

There was an expectation of growth in the case of Reliance, the example used by Barua and Raghunathan. When the company announced its rights issue for a huge amount of Rs 400 crore, it had profitable ventures on hand. There was reason to expect that its Earnings Per Share (EPS) would grow several-fold with the completion of those projects. Given such a situation, calculating the ex-rights price by adjusting for reason (i) above alone may not be correct. In other words, if Rs 230 is the pre-announcement price and if the company has no profitable venture at the time of rights announcement the cum-rights price of Rs 272 may be reduced to the previous level of Rs 230. As this condition is not true, it is not correct to expect that the ex-rights price should be around Rs 230. In addition, one has to consider the share premium that would be added to the net worth after conversion. The book value per share would then increase from Rs 59.16 before the rights issue to Rs 84.36 after conversion. This would also influence an increase in the share price after conversion.

Unclear Assumptions

Apart from an ex-rights price of Rs 230, Barua and Raghunathan's conclusion is based on two other grounds:

1 In fact, when the Reliance rights issue opened in December '86 its share price was around Rs 212. It moved up continuously to Rs 270 before the budget announcement in February 1987. Subsequently, many abnormal things forced the price to fall to Rs 120 by mid 1987.
i) The ex-rights price of share would continue to be Rs 230 throughout the period from 15.9.86 to 15.9.87.

ii) When there is an indication that the price of the share is going to be lower than the current market price, it is better for an investor to sell in the forward market at Rs 272 and gain by closing the deal at a lower price.

They assume that by selling in a forward contract at Rs 230, an investor will gain 20 per cent interest (short term lending rate) for almost 11 months by continuously carrying forward the transaction. But a purchaser will carry forward and pay interest only if two conditions are satisfied:

i) he expects that prices of the share will increase in future, and

ii) the rate of increase in price will at least be equal to the interest rate.

When these conditions are not fulfilled E will square up the contract and stop interest payment. In other words, the purchaser also takes a risk by carrying forward the contract. If the future is as expected, both investors C and E will gain whereas investor D will not. Vice versa, C and E will suffer when D gains. Investors C and E, who took a risk, have an opportunity to get a higher reward than D. This opportunity to get a premium for a higher risk is risk-return parity and not actual or certain premium for higher risk.

In their computation of the holding of investors C and D, Barua and Raghunathan have assumed that both will apply for the additional 25 per cent above their eligible rights quotas. They fail to consider the same when calculating the ex-rights price. Even by the crude method, the ex-rights price after such an adjustment for the additional subscription would be Rs 204.

**Inadequacy in Real Example**

Barua and Raghunathan in their second article (Vikalpa, July-September 1987) used real data which were then available and showed how the market still violated the risk-return parity. Their calculations using the real example also suffer from similar limitations which are explained below.

In their example, both investors C and D applied for debentures on 1.12.86 and sold them on 1.5.87. Investor D in addition, sells two equity shares on a forward basis on 1-12-86 and carries forward the transaction till 30.4.87. Barua and Raghunathan show that the return to investor C is 38 per cent for five months while that to investor D is 104 per cent. Their argument is that as both investors C and D purchased and sold debentures on the same date, the additional gain to Investor D is derived solely from carrying the transaction forward. Here Barua and Raghunathan assume that D will carry forward the transaction for exactly five months. They provide no explanation or reason.

**Alternative Termination Periods**

Sale of debentures and the termination of carry forward transaction are two separate and independent decisions. Investor D could have terminated the contract at any time depending on his position. For example, seeing a continuous rise in price in the initial few periods (during that period when he had to pay a large sum to buyers) investor D could have squared out the contract, if he expected a further rise in prices. Table 1 below gives the cash inflow/cash outflow to investor D for various termination periods:

**Table 1: Cash Flow in Rupees to Investor D for various Termination Dates**

<table>
<thead>
<tr>
<th>Termination date</th>
<th>Cash Inflow to C</th>
<th>- Outflow* to D</th>
<th>Additional CIF-COF to Investor D</th>
<th>Risk-return Parity/Market efficiency</th>
</tr>
</thead>
<tbody>
<tr>
<td>12.2.86</td>
<td>0</td>
<td>-2</td>
<td>-2</td>
<td>Yes/Efficient</td>
</tr>
<tr>
<td>02.1.87</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>No/Inefficient</td>
</tr>
<tr>
<td>16.1.87</td>
<td>0</td>
<td>-74.50</td>
<td>-74.50</td>
<td>Yes/Efficient</td>
</tr>
<tr>
<td>19.1.87</td>
<td>0</td>
<td>-116.00</td>
<td>-116.00</td>
<td>Yes/Efficient</td>
</tr>
<tr>
<td>12.2.87</td>
<td>0</td>
<td>-121.50</td>
<td>-121.50</td>
<td>Yes/Efficient</td>
</tr>
<tr>
<td>05.3.87</td>
<td>0</td>
<td>-19.50</td>
<td>-19.50</td>
<td>Yes/Efficient</td>
</tr>
<tr>
<td>23.3.87</td>
<td>0</td>
<td>-32.50</td>
<td>-32.50</td>
<td>Yes/Efficient</td>
</tr>
<tr>
<td>03.4.87</td>
<td>0</td>
<td>11.90</td>
<td>11.90</td>
<td>No/Inefficient</td>
</tr>
<tr>
<td>16.4.87</td>
<td>0</td>
<td>31.60</td>
<td>31.60</td>
<td>No/Inefficient</td>
</tr>
<tr>
<td>30.4.87</td>
<td>0</td>
<td>101.00</td>
<td>101.00</td>
<td>No/Inefficient</td>
</tr>
</tbody>
</table>

* Based on amount paid/received on account of the price difference and carry forward charges till the termination date. A sum of Rs 55, being the price difference on sale of debentures (Rs 200 - Rs 145) is to be added to both C and D.
The cash inflow to C is zero for all periods as he has not entered into a forward transaction. But D's cash inflow varies depending on the termination date and ruling price on that date.

If we apply the risk-return parity rule as interpreted by Barua and Raghunathan, the market is efficient till 23.3.87 but suddenly becomes inefficient from 3.4.87. The full impact of inefficiency was felt on 30.4.87 when the risk-return parity was seriously affected. To arrest such inefficiency, the market price should move up.

Wisdom of Market

But an important incident that took place between 16.4.87 and 30.4.87 should be considered. At Reliance's annual general meeting on 29.4.87, it was confirmed that the results of the company for the year ending 31.12.86 were poor. The dividend was slashed from 50 per cent in the previous year to 25 per cent for 1986. Reliance share price which was ruling around Rs 190 dropped to Rs 140 on 29.4.87 and further to Rs 127 on 4.5.87. Barua and Raghunathan indirectly argue that in order to protect risk-return parity, the market should ignore these facts. But, if the market ignored these facts then it would make a good case for its own inefficiency. Wisely, the market did not ignore available information.

The termination dates in our analysis (Table 1) may be objected on to the ground that a forward contract should be compared with a cash transaction and not with 'no transaction'. To take care of such objections, the example can be modified as follows.

Modified Example

Investors C and D have two shares and, in addition, they apply for one debenture. Investor C is trading on a cash basis and investor D on the forward market. As D has two shares on hand and expects two additional shares on conversion, he could enter the forward market for four shares. Now let us assume, that at each termination period, C sells two shares on cash and D delivers two shares and squares out his obligation on the remaining two shares. This situation enables us to maintain an equal status between investors C and D.

1 Interestingly in their first article, they made a specific suggestion like adjustment in Debenture 'F' series price and share prices to maintain risk-return parity but fail to make any suggestion this time. To our knowledge this is the only alternative for maintaining risk-return parity.

<table>
<thead>
<tr>
<th>Terminations date</th>
<th>Ruling Price</th>
<th>Net Gain to C</th>
<th>Additional Gain to D</th>
<th>Risk-return parity/ market efficiency</th>
</tr>
</thead>
<tbody>
<tr>
<td>12.12.86</td>
<td>213</td>
<td>2</td>
<td>-2</td>
<td>-4 Yes/ Efficient</td>
</tr>
<tr>
<td>02.01.87</td>
<td>208</td>
<td>-8</td>
<td>1</td>
<td>9 No/ Inefficient</td>
</tr>
<tr>
<td>16.01.87</td>
<td>244</td>
<td>64</td>
<td>-74.50</td>
<td>-138.50 Yes/ Efficient</td>
</tr>
<tr>
<td>29.01.87</td>
<td>263</td>
<td>102</td>
<td>-116.00</td>
<td>-218.00 Yes/ Efficient</td>
</tr>
<tr>
<td>12.02.87</td>
<td>262</td>
<td>100</td>
<td>-127.50</td>
<td>-221.50 Yes/ Efficient</td>
</tr>
<tr>
<td>05.03.87</td>
<td>205</td>
<td>-14</td>
<td>-19.50</td>
<td>-6.50 Yes/ Efficient</td>
</tr>
<tr>
<td>23.03.87</td>
<td>210</td>
<td>-4</td>
<td>-32.50</td>
<td>-28.50 Yes/ Efficient</td>
</tr>
<tr>
<td>03.04.87</td>
<td>187</td>
<td>-50</td>
<td>11.90</td>
<td>61.90 No/ Inefficient</td>
</tr>
<tr>
<td>16.04.87</td>
<td>179</td>
<td>-66</td>
<td>31.60</td>
<td>97.60 No/ Inefficient</td>
</tr>
<tr>
<td>30.04.87</td>
<td>130</td>
<td>-164</td>
<td>101.00</td>
<td>265.00 No/ Inefficient</td>
</tr>
</tbody>
</table>

The results comparing forward with cash transaction (Table 2) and with 'no transaction (Table 1) are similar. Our discussion and conclusion based on Table 1 remain valid.

Ex Post facto Analysis Invalid

Another disturbing statement in Barua and Raghunathan's second article (Vikalpa, July-September, 1987) is as follows:

"The market could not maintain the risk-return parity. It is inefficient. This statement assumes that the actual drop in price of Reliance share is in line with the expectation of the market."

The exact meaning of their assumption is not clear. If it means that the fall in Reliance share price to Rs 130 was already expected, investor C could have sold his two shares between 12.12.86 and 29.1.87 to get the maximum gain and also sold the debenture for Rs 270 in an unofficial deal. No buyer would carry forward the transaction if the fall in price was strongly expected. There is another way of interpreting this statement. The fall in price is due to genuine demand and supply, based on market information, and is not artificially created. If so, their statement really endorses market efficiency.

Barua and Raghunathan's analysis of market efficiency suffers from two errors:

i) They have used ex-post facto analysis for evaluating risk-return parity and market efficiency. As already discussed, ex-post facto analysis is invalid.
ii) During the period of their analysis the market adjusted the price to available information. They have ignored or misused this adjustment.

Evaluating Market Efficiency: A Framework

An efficient market should maintain parity between risk and expected return. If the risk in a security is high it should have a higher expected return than for a lower risk security. If that security fails to provide the higher expected return, the function of an efficient market is to push its price down so as to give it a higher expected return. Similarly, if the risk of a security is low but its expected return is higher, then an efficient market should increase its price so as to reduce the security's expected return and maintain parity.

Testing market efficiency on the basis of a single security is totally inappropriate. Market efficiency should be evaluated by using ex-ante analysis, measuring risks and expected returns of a large number of securities. While doing so, differential risks of securities should be taken. This can be done through a joint test of the efficient market hypothesis and the Capital Asset Pricing Model (CAPM). In the joint test, the CAPM is used to adjust the risk. As per the CAPM, the only relevant risk is systematic risk—measured by beta. The return on a security will be conditional on its beta. Such tests have been based on widely held and heavily traded shares. For, when trading in a security is thin or sporadic, the market's ability to adjust expected returns gets impaired. For thinly traded shares, therefore, the possibility of an abnormal return does exist.

A long-term analysis is necessary for coming to any conclusion on market efficiency. We have neither argued that the Indian market is efficient nor supported the view that it is inefficient.