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Production Efficiency of Firms with Mergers and Acquisitions in India

Beena Saraswathy

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Abstract

Most often, the competition authorities approve combinations based on the tradeoff between the expected efficiency gains and the likely effect on market power creation. However, the realities may be different from the expected synergy creation since merger regulations are *ex ante* in nature. The present study is an attempt to understand how far the expected efficiency gains are actually achieved by the firms entering into consolidation in India, which experienced large number of mergers and acquisitions especially after the economic reforms of 1990s. Specifically, we have examined the technical efficiency of the firms involved in mergers and acquisitions, separately for cross-border and domestic deals.

JEL classification: *D43, G37, L40, F23, D24, 049*

Key words: *Market structure, Mergers and acquisitions, Anti-trust Issues, Multinational firms, Productivity and Efficiency*

Authors' Email: *vsbeena@gmail.com*

Production Efficiency of Firms with Mergers and Acquisitions in India

Beena Saraswathy

With the de-regulation of various government policies to facilitate market competition, there has been greater involvement of firms in the consolidation strategies such as mergers and acquisitions ("M&As), in order to face challenges posed by the new pattern of globalization, which has led to the greater integration of national and international markets. Even though the greater involvement in consolidation strategies has been a recent phenomenon in developing countries, it has been quite common in the developed countries such as USA and UK from the late nineteenth century. In India, owing to the pro-market policies of the government to attract FDI[1], consolidation strategies began to flourish from the late 20th century, which occurred around hundred years after that of US merger waves[2]. In this paper, our attempt is to examine, how far the projected efficiency gains are achieved by the firms entering into consolidation in India, separately for cross-border and domestic deals. The paper is organised in six sections. The next section deals with the nature, extent and structure of M&As in India, the second section discusses the link between consolidation and efficiency generation. Third section deals with data and methodology, fourth section deals with the estimation results, the fifth section deals with profitability and cost as indicators of efficiency and concluding observations and policy implications are discussed in the sixth section.

1. Nature, Extent and Structure of Mergers and Acquisitions

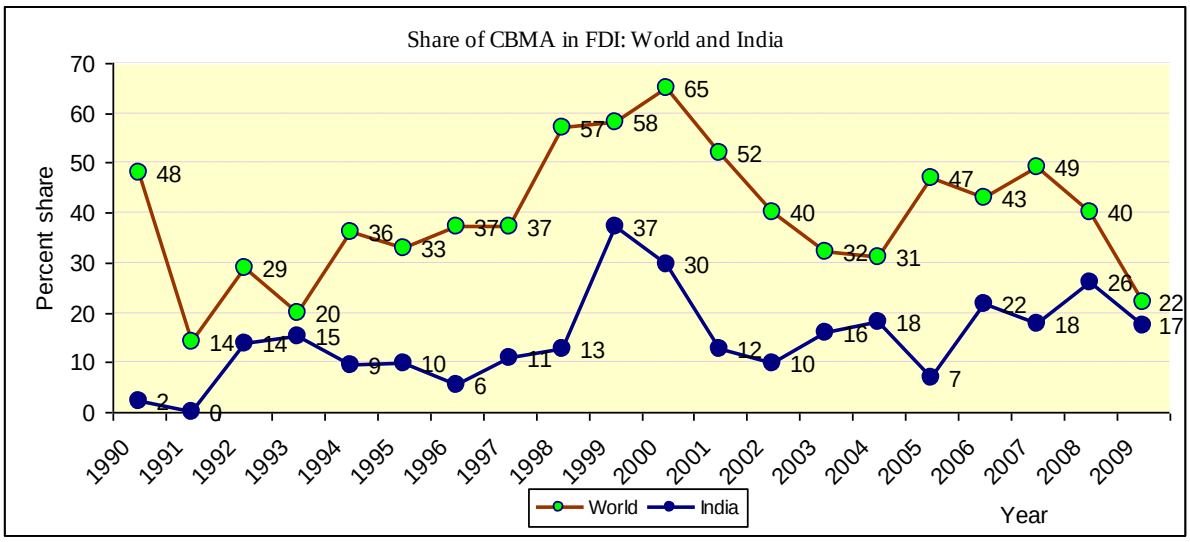
It is observed that M&As has been a major driver of world FDI throughout and M&As in turn are moving in line with the service sector deals[3]. In most of the years, more than 30 percent of the world FDI came through M&As route. In some years the share of M&As was very high. For example in 2000 it constituted 65 percent of the FDI. However, in 2012 and 2013, it was 25 and 24 percent respectively. The year 2000 registered a record FDI of $1401466 Million, which was again crossed in the year 2007.

Despite the recent surge in cross-border deals, the Indian cross-border merger scenario is still in a nascent stage. Initially its share was only 2 percent of the FDI inflows, which is around 17 percent in 2013[4]. From 1990 to 2011, it constituted around 20 percent of the FDI inflows in the country. Even though the share of Greenfield investment dominates almost entire period, the latter's contribution was very high in some years. For example in the year 1999 it was 37 percent and in 2011 it was 35.4 percent, which is even higher than the share of cross-border deals in world FDI in 2011 (32.7 percent). It is to be noticed in this context that, Indian FDI is not completely moving in tandem with global trend. To illustrate, in several years increase in FDI is not accompanied by similar increase in cross-border deals. It is also

[1] The FDI regulations were stringent before l990s. For example, FDI in various sectors were restricted, FERA, 1974 stipulated the foreign firms to have equity holding only 40 percent (Nagaraj, 2003).
[2] The first merger wave in USA started at the end of the nineteenth century (1890s) and lasted until 1905.
[3] See Beena, S (2013) for a detailed discussion.
[4] Calculated from World Investment Report (2014), UNCTAD.

evident that in general, the share of Brownfield FDI in India has been moving in line with that of the global trends. That is, whenever there is a hike in the share of world brownfield investment in the overall FDI, the Indian brownfield investment is also moving in same direction. However, there are slight variations in some years (see Figure 1). As per the Bloomberg estimation, in 2013, the value of inbound transactions in India is US$16 billion as compared to the outward transaction value of US$ 9 billion. Around 738 deals occurred in the year 2013, compared to 864 in the previous year. Out of this most of the transactions belong to the consumer goods and communication sector. 26% of the transactions are acquired by US based acquirers in 2013. Other acquirers are from Japan, Britain, France etc (as in Mallik et.al, 2015).

Figure 1: Share of CBMA in FDI: World and India



Source: Calculated from UNCTAD and FDI/TNC Database

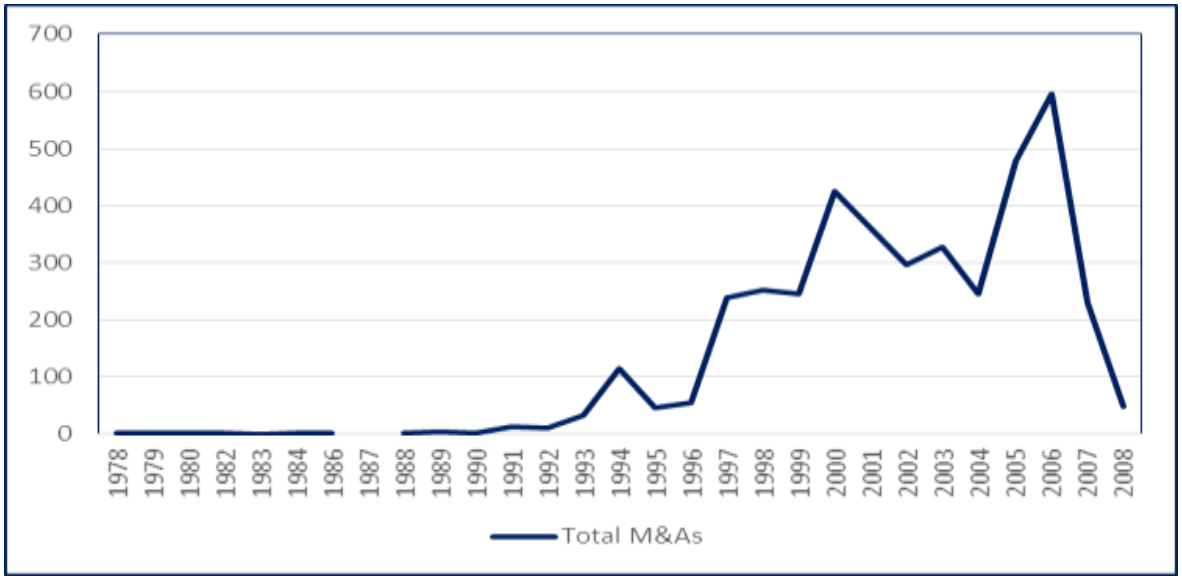
Data on Indian Mergers and Acquisitions in India: One of the major problems facing the mergers and acquisitions literature in India is the lack of a proper firm level database on mergers, acquisitions and the like consolidation strategies. Without having such a database we cannot get into the ground realities of this phenomenon. In the absence of a proper database normally what researchers has been doing is to build their own database based on various secondary sources of information such as CMIE and newspaper reports. Even though it is a tiresome job, the omissions and repetitions are common errors in this method. Further, data on the value of all deals are seldom available; this necessitates looking into the number of deals rather than the magnitude of value. We also built a database using different secondary sources such as Monthly Review of the Indian Economy, M&A Database, brought out by Centre for Monitoring Indian Economy, Newspaper reports, various company reports, SEBI. Cross-border deals are defined as the deals involving foreign firm. The study is restricted to the deals occurred within India.

Before getting into the details of our data, we shall discuss the overall trends of M&As in India based on Beena, P. L (2014). From Table 1, it can be observed that there has been

tremendous increase in the M&A activity particularly since the mid 1990s. During 1975-1980, the total number of deals were only 167, which increased to 736 during 1995-2000. Out of this, the contribution of manufacturing sector is 71 percent during 1975-80, which slightly declined to 69 percent during 1995-2000.

Our data consists of 4035 deals of which 1045 are mergers (26%) and 2990 (74%) are acquisitions occurred within India during 1978 to November 2007 (see Figure 2). Though the data is available only up to this period, it will not affect the analysis since the focus of analysis is to find out the impact of mergers, which requires adequate number of years for the post-merger analysis. Out of 4035 deals, 1415 (35 percent of the overall deals) are cross-border deals[5]. It is important to mention that there are three distinct phases of consolidation activity in India. The first phase, i.e., during the pre-liberalization era M&As in India were not common. During the second phase, i.e., the early 1990s, majority of the deals were between domestic firms, whereas since the mid-1990s, there has been a remarkable increase in consolidation activity with greater occurrence of cross-border deals. Nevertheless, the burgeoning number and value of foreign acquisitions (overseas acquisitions) made by Indian firms is a post 2000 phenomenon (i.e., the third phase of consolidation activity). Earlier, foreign firms were facilitating market expansion strategy through the setting up of wholly owned subsidiaries in overseas markets (Jones, 2005), which has now become a 'second best option' since it involves much time and effort that may not suit to the changed global scenario, which made cross-border mergers and acquisitions the 'first-best option' to the leaders and others started to follow the leader.(see Beena, S 2013).

Figure 2: Number of Mergers and Acquisitions in India



Source: Author's compilation

In this context, Beena, P. L (2008) noted that the total number of M&As during 1990-95 was only 291 (236 mergers and 55 takeovers), which increased to 736 (425 mergers and 311

[5] A detailed analysis on the nature and structure of Indian deals based on this database is discussed in Beena (2010).

takeovers) during 1995-200. This has been sharply increased to 1370 (897 mergers and 473 takeovers) during 2000-06. The study mentions that the involvement of MNCs in the M&A process increased during the second half of 1990s. The share of MNCs were 32 percent of the total M&As during 1995-2000 (see the table 1).

Our data shows that during the first phase of consolidation activity (pre 1995), the share of cross-border deals in total was only 23 percent, which increased to 42 percent in the second phase. During the third phase (2000-2008), the share of cross-border deals within India is 34 percent. Though the share of cross-border deals declined, the involvement of Indian firms in the overseas deals substantially increased during the third phase. There were 563 overseas acquisitions made by Indian firms during the year 1994 to November 2007. Out of this, most of the deals occurred after 2000.

It is observed from the data that even though India had dealings with more than fifty countries, USA, UK and Germany were prominent among them. In many cases, firms started with less stringent forms of consolidation such as joint ventures and at the later stage they resulted into mergers, which may be marking the successful integration during the post alliance period. Moreover, many Indian firms used the joint venture partnership relationship to acquire their foreign counterpart after a period of time. This has been the story of BPO sector acquisitions especially. As Kumar (2000) observed, we have also noticed that the Mauritius based firms acquired a good number of Indian firms. In many cases these firms are the subsidiaries of the US and UK based parent firms, which may be deriving the tax advantages offered by India to Mauritius (see Beena, 2010 for details).

Sector-wise, manufacturing had been the largest seller, whereas majority of the purchases were made by the service sector. The share of primary sector remained too small throughout. Within manufacturing, Drugs and Pharmaceutical industry, other chemicals, domestic appliances, automobiles were the dominant sectors and within services it was banking and finance. Recently, there has been a rush among the information technology firms to get into consolidation through mergers and acquisitions. Compared to other sectors, automobiles, electrical appliances, machinery, domestic appliances had high cross-border merger intensity, which means the overall deals consist of more foreign partners compared to domestic partners. In terms of the value of deals, majority of the deals were small, nevertheless, there were a good number of mega deals, which had been responsible for more than 87 percent of the total value involved. Mega mergers belong to banking and finance, post and telecom, information technology; cement and their foreign partners were mainly from USA and UK (see Beena, 2010 for details).

The increased extent of cross-border deals brought about different challenges as well as opportunities such as efficiency generation, market power creation amongst others. These issues are equally important for the domestic deals in the present scenario due to the gradual disappearance of national boundaries for the domestic firms and they are also facing global competition even within the domestic borders. In this context, the policy makers are facing a dilemma, whether to allow the firms to enter into consolidation, which is expected to generate efficiency and thereby enhance good quality products and low prices in future or to restrict

consolidation activity on the ground that it may lead to adverse effects on competition in the market. The occurrence of cross-border deals further aggravates these issues since it further brings the 'nationality' issues.

2. Efficiency Generation via Consolidation

The relationship between mergers and efficiency has been one of the most discussed issues in merger literature, and the debate is still continuing. Most of the early studies on M&As were concerned with the developed countries, especially USA and UK mergers as part of their state policy formulation during the initial merger waves. During this time the emphasis was on the welfare trade-off between the generation of market power and market efficiency through consolidation. According to Meeks (1977), the advocates of *laissez-faire* economists faced a dilemma over the state policy on mergers.

Two groups of conflicting views can be observed. One has argued that merger undermines the competitive conditions which are required if *laissez-faire* has to achieve allocative efficiency[6]. So they have supported the outright ban on M&As. The other group has argued against the state interference in the merger process, not only on political grounds but also on economic grounds emphasising that merger will be in the public interest[7]. Thus those who supported mergers based their argument on the efficiency defense, whereas the others raised competition concerns arising out of market power creation through mergers. However, separating the efficiency effects of merger is not an easy task.

Consolidation is expected to reduce the overall cost of production through economies of scale and scope. Synergy creation is considered to be more in the case of horizontal and vertical deals[8] since the firms are linked in similar or vertical products. According to Pesendorfer (2003), mergers are expected to generate more efficiency on three grounds. First is through the re-organization of production, second, more efficient allocation of inputs, especially in the case of vertical mergers it enables to get the inputs at lower prices, and third by providing enlarged sales and distribution network. A single network may function efficiently as compared to the previously operated two separate networks. Hindley (1973) also pointed out that a transaction occur only if the buyer of the firm expect higher returns and if it is satisfied, higher private profitability will be associated with social gains such as reduction in the cost of production per unit of output. Hindley based his argument on the expected gains in

[6] For instance, Rowley and Peacock (1975) emphasized, mergers are certainly against the conditions of perfect competition in which the *laissez-faire* ideals would be best fulfilled (as in Meeks, 1977).

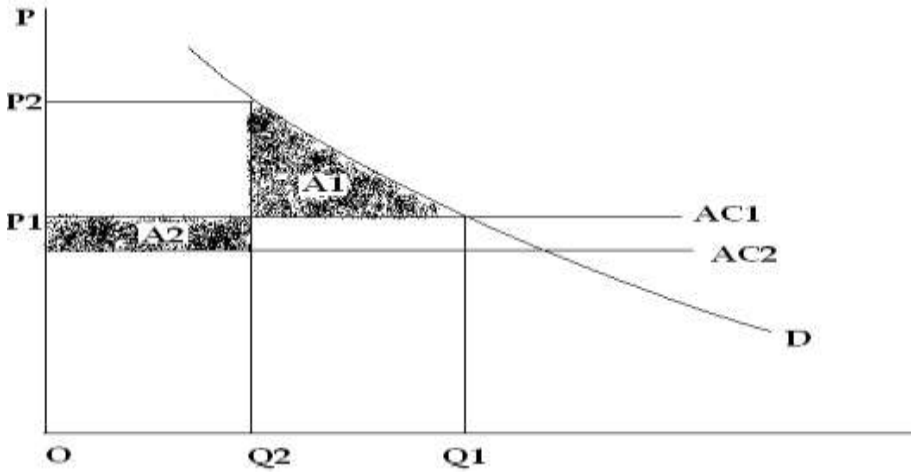
[7] Lord Robbins (1973) says that, "…my feeling about policy relating to mergers and takeovers is that there is a certain presumption against preventing people from buying or selling such property as seems them to be desirable" (as in Meeks, 1977).

[8] Horizontal deals are the joining together of two or more companies which are producing essentially same products or rendering same or similar services or their products and services directly to compete in the market with each other. In the case of vertical deals, two or more companies are complementary to each other getting into the deal (Company Secretaries of India, 2008).

economic efficiency and cost reduction through M&As. Consolidation is further expected to make management more efficient through hostile merger/takeover threat[9] (Meeks, 1977).

Williamson (1968) raised the question of 'trade-off' while framing the merger policies for US and favoured the net efficiency gains and says that, "even then the cost differential is too low; the net benefits will offset the losses" (see Figure 3). The shaded areas (that is, A1 and A2) indicate the approximate net welfare effects. Here A1 is the dead-weight loss[10] arising from the increased price from the initial level, P1 to P2, assuming that the cost remains the same. A2 represents cost saving since the merger reduces the average cost from AC1 to AC2. The net allocation effect is given by the difference the area between A2-A1. Thus if the cost reduction effect exceeds the dead-weight loss, then the net welfare effect is positive and vice versa.

Figure 3: Efficiency and Market Power Trade-off



Source: Williamson (1968)
Note: AI is dead-weight loss A2 is cost saving

Even though the economists are not in consensus regarding the net outcome, it seems merger may lead to increased efficiency via the reduced cost of production, which may increase the market power of the firms, and a consequent rise in prices can be expected after merger. However, we too believe that the implications of consolidation may be different from deal to deal. In this paper, our attempt is to understand whether the surviving firms[11] could generate the expected efficiency effects from M&As in India. It is to be noted in this context that, there has not been any previous attempt to study the efficiency effects of M&As in India. However, there are studies, which concentrated on the profitability aspect and found a declining trend in profitability after getting into mergers[12]. Adding to that, we have also focused on the cross-border and domestic deals separately in the study.

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9 Agency issues arising out of consolidation has been raised in the literature, which we are not taking up here since it is beyond the scope of the present paper.

10 It is the loss in economic efficiency arising due to the absence of Pareto efficient allocation.

11 Surviving firms are the firms exist in the market after consolidation.

12 For eg., Beena, 2004; 2008, 2014 etc. Overall productivity and efficiency of the Indian manufacturing sector has been widely debated. See for example, Brahmananda (1982), Goldar (1986), Ahluwalia (1991),

We shall discuss about the measurement of efficiency with M&As in the next section.

3. Data and Methodology for Measuring Efficiency

According to Farrell (1957), economic efficiency is classified into technical[13] and allocative[14] (see Coelli et.al, 2005). From the forgoing discussion, it is clear that merger affects both technical efficiency and allocative efficiency. With the limited data on price of various inputs used for production, the measurement of allocative efficiency is difficult. Hence, most of the studies concentrated on the measurement of Technical Efficiency alone. We are also following the same. Technical efficiency gains are the movement towards "best practices" or elimination of technical and organizational inefficiencies (OECD, 2001). The basic assumption underlying the measurement of technical efficiency is that normally there exists a gap between actual and potential levels of technical performance. For measuring TE, we do not have information on the potential level of output and hence, the studies used various alternative methodologies for estimating it. Various statistical packages estimate it via linear programming method (Kalirajan and Shand, 1994). It is needless to say that there are conceptual differences depending on the estimation technique used. We have used the stochastic production function approach (SFP) for estimation. SFP is discussed in detail by various studies including Greene (2011); Kalirajan and Shand (1994).

3.1 SFP Approach: Technical Efficiency (TE) and Allocative Efficiency (AE)

In neo-classical theory, firms operate at potential technical efficiency, at points along the frontier, FF1 as shown in Figure 4. Any inefficiency or deviation from this point is considered to be allocative inefficiency, not technical. At point A, profit will be Π_2, using X2 inputs and will be generating Y2 level of output. Its allocative/economic inefficiency will be measured as Π_2/Π_1. But due to various reasons, firms will be operating below the potential frontier, which is called actual or perceived frontier, AA1. At X2 inputs, the firm will be operating at C and produce Y3 output and earns Π_3 profit. At this point the firm is allocatively inefficient. In order to maximize profit, it should operate at point D, use X3 inputs, produce Y4 output and derive Π_4 profit. At point C, the economic efficiency can be measured by the ratio, Π_3/Π_1 and technical inefficiency is the ratio, Y3/Y2 for the input level X2. Thus the loss in economic efficiency in operating at C is Π_1-Π_3, of which loss from technical inefficiency is Π_2- Π_3 and allocative inefficiency is Π_1- Π_2. Thus point B on FF1 can be considered as the long run equilibrium position for the firm to achieve, given the technology represented by FF1. The technologies represented by some perceived production function such as AA1, any position on this curve shows disequilibrium the firm faces, given the potential frontier FF1. At point D, the firm equates its marginal value of product with its marginal cost. It can be considered as a short run or temporary equilibrium since it is in the

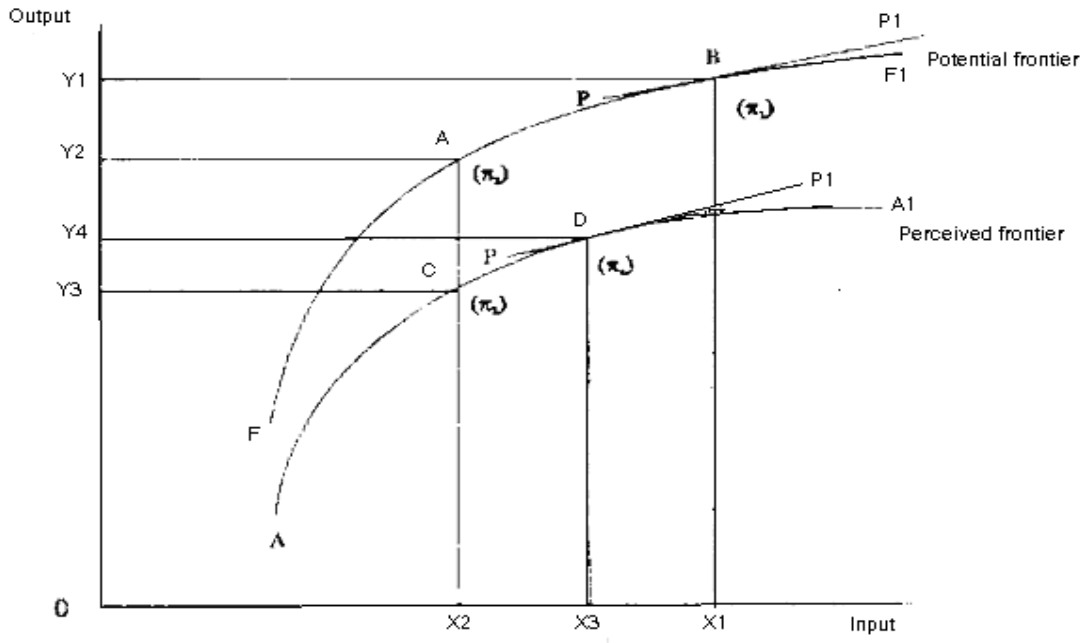
Balakrishnan and K Pushpangadan (1995, 1996, 1998), Balakrishnan, K. Pushpangadan and Suresh Babu (2000), Rao, J. M (1996), Pradhan and Barik (1998), Trivedi, Prakash and Sinate (2000), Goldar, B (2000), Unel, B (2003) etc., for related debates.

[13] Technical efficiency (TE) is defined as the ability of the firms to get maximum or potential level of output, given the inputs.

[14] Whereas, allocative efficiency (AE) is the ability of the firm to equate its marginal value product to its marginal cost.

perceived frontier. From D, firm may gradually move to B, the long run equilibrium point on FF1. However, the potential frontier itself shifts as new technologies are introduced in a dynamic situation and a new equilibrium is created. Thus attaining long run equilibrium on potential frontier is a very difficult task for the firm. An interesting thing to be noticed here is that, when the firm is facing such inefficiencies, undergoing a merger or acquisition is expected to generate synergies and derive economies of scale, which will enhance the firm to achieve a better equilibrium position.

Figure 4: The Concept of Technical and Allocative Efficiency



Source: Kalirajan and Shand (1994)

Further, we have followed the Battese and Coelli (1995) model for measuring technical inefficiency effects. We have applied the Translog production function, which is well-known for its less restrictive assumptions[15], which enables us to get more robust results. Next, we shall discuss the variables construction and the sources of data.

3.2 Variables Construction

Output: Deflated value of output for each sector is used[16].

Labour: After reviewing various studies, we have found that the feasible best measure is average wages paid per labour hour. We have followed Srivastava (1996), methodology to arrive at the actual labour hours employed for measuring labour content. For this, we have used Annual Survey of Industries (ASI) for calculating the average wages paid per labour

[15] Unlike some other specifications, it is not based on the assumptions of constant elasticity of substitution, Hicks-neutral technical progress and constant returns to scale (Parameswaran, 2002).

[16] Output includes the firm level sales and changes in the stock of finished and unfinished goods. Sectorwise Wholesale Price Index (WPI) is used for deflation.

hour at two digit level[17]. This rate is applied to the corresponding industrial classification of PROWESS, CMIE to get the firm level value[18]. It is to be noted that, though PROWESS gives information on the number of employees, here a separation between part time and full time employees is not been made, which inflates the labour counts.

Capital Stock: Hashim and Dadi (1973) cautions that there are several problems associated with the definition and measurement of capital stock. First of all capital stock is a "composite commodity", which consist of different types of goods and this will change over time. The changing composition of capital over time makes the measurement of capital stock a difficult task. Also the capital stock existing at any time has no linkage with current market valuations. The available data on capital stock is expressed in terms of historic prices. Each firm has to undergo several restructuring and replacement of its capital assets due to depreciation and other unexpected damages. If we are taking the value expressed in historic prices, we may be underestimating these expenses incurred over the years. Here arises the need for calculating the replacement value of capital in order to give importance to the replacement value incurred in the production process. Moreover, the productivity of the capital stock is not constant during its lifespan, which makes the measurement of capital in relation to its original cost difficult. This raises the controversy over the methods of depreciation and the concept of replacement cost etc. Majority of the studies on manufacturing sector productivity depended on the Perpetual Inventory Method (PIM) to construct the capital stock (see Srivastava, 1996; Parameswaran, 2002; Balakrishnan, Pushpangadan and Suresh Babu, 2000etc). We have also followed the methodology used by Srivastava (1996) to measure capital stock (see Appendix I for details).

Intermediary Inputs: Following Goldar (2004) and Balakrishnan and Pushpangadan, K (1994), we have taken the sum of the deflated values of raw material cost, power and fuel, and other intermediate inputs for measuring it. In order to deflate into real value of inputs, we have calculated the weighted average price indices. For this, the study used Input Output Transaction Table 2003-2004 published by CSO, GOI (2008) and the respective sector's Wholesale Price Indices published by the Office of the Economic Advisor, Ministry of Commerce & Industry, GOI[19]. Weights were assigned considering the respective share of each inputs in the total inputs used. We have added the purchase of materials done by 68 sectors in the manufacturing sector from various other sectors, which includes the supplies made by one industry to another as well as the intra-industry transactions. This data is used to construct the weight of each sector. Then the corresponding WPI is used to prepare Weighted Price Index. Similarly, we have created Energy input series separately. For deflating we have used fuel power light and lubricants price index[20] based on 1993-94 prices. Next is the services purchased by the industrial units such as outsourced professional jobs, insurance premiums paid etc, which makes a good proportion of the other input costs (Goldar, 2004).

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17 ASI provides mandays worked and total emoluments paid. Following the Srivastava (1996) methodology, we have calculated emoluments paid per labour hour (man hours is, mandays multiplied with 8 hrs).

18 We have taken the above mentioned average wages from ASI to apply with the amount of compensation paid as in PROWESS and calculated the labour hours worked.

19 We have used 1993-94 base year.

20 This is based on coal mining, mineral oils and electricity (GOI, Various years).

So we have calculated another deflated series for this. This is done by taking the service cost incurred by each sector from the Input Output Transaction Table and implicit deflator calculated from the Gross Domestic Product (GDP) at current and constant prices using National Accounts Statistics[21].

Variables in the Inefficiency Model

As we mentioned earlier, one major advantage of using SFP is that, we can capture the inefficiencies associated with production. We have included R&D Intensity (RD), Payments made for Royalties and Technical Knowhow (royal), Export Intensity (export), Raw Materials Import Intensity (rawimp), Age of firm (firmage), Year Dummy of Merger (yeardum), Domestic Mergers (domestic), Cross-border Mergers (cbdeals) and Time Variables (t and t^2) to assess this. Here, R&D Intensity is defined as the ratio of R&D to sales. Increased R&D intensity is expected to reduce the inefficiency by strengthening the already available technology. Payments made for royalties and technical knowhow is also taken as percentage of sales of the firm. It indicates the import of technology, which is considered to enhance the efficiency of the firms since under normal conditions, technology is imported only if it leads to improvements in production in future. Export intensity (export) will capture the competitiveness of the firms because the firms trading with other countries necessitate the firm to become more competitive, which may pressurize the firm to operate more efficiently. Higher quality of the imported raw materials, enhance the production efficiency. Moreover, the need for importing raw materials arises when the domestic market is facing supply shortage for perfect substitutes or if the prevailing price in the domestic market is higher than that of the international prices. Age of firm indicates the extent of experience a firm owns, which is expected to reduce the inefficiency. However, it can become the other way if the firm is operating with the outdated machineries for production. In order to understand whether the inefficiencies declined after getting into M&As, a dummy variable is added. This will take the value '0' up to the year of merger and'1' after that. In order to understand the influence of domestic and cross-border deals[22] on inefficiencies, the number of domestic deals and cross-border deals is used. The logic being that when more M&As occur, the inefficiency might tend to reduce, since M&As are expected to make the firms more efficient by using the resources more efficiently. Consolidation is expected to generate more labour productivity, because when two firms integrate their operation, it will get an opportunity to re-arrange their existing labour force, which results in better productivity of the labour. Similarly, capital and intermediaries' utility also increases due to the expanded scale of operation and synergy creation. When a cross-border merger (or acquisition) occurs, it is argued that normally they acquire those firms, which are already efficient comparing the other firms in the same sector (Griffith, et.al (2004) as in Schiffbauer et.al (2009)). In addition to that, foreign firms assumed better performance will bring more efficient operation of the firm. *Time Variables (t and t^2):* This is in order to allow the inefficiency effects to change with respect to time. However, this is different from the time

[21] Implicit deflator is calculated using the ratio of GDP at current and constant prices. The weights are based on the flows from service to the manufacturing sector. Base year of GDP used is 1999-2000.

[22] The term 'deal' is used to denote M&As in this paper.

variable included in the stochastic frontier, which accounts for the Hicks neutral technological change[23].

We have specified the model as follows:

$$\ln Y_{it} = \beta_k k_{it} + \beta_l l_{it} + \beta_m m_{it} + \beta_t t_{it} + 1/2\beta_{kk} k_{it} k_{it} + 1/2\beta_{ll} l_{it} l_{it} + 1/2\beta m_{it} m_{it} + 1/2\beta_{tt} t_{it} t_{it} + \beta_{kl} k_{it} l_{it} + \beta_{km} k_{it} m_{it} + \beta_{kt} k_{it} t_{it} + \beta_{lm} l_{it} m_{it} + \beta_{lt} l_{it} t_{it} + \beta_{mt} m_{it} t_{it} + V_{it} - U_{it} \ldots\ldots(1)$$

The model for technical inefficiency effects is assumed to be:

$$U_{it} = \delta_0 + \delta_1 RD + \delta_2 royal + \delta_3 \exp ort + \delta_4 rawimp + \delta_5 t + \delta_6 t^2 + \delta_7 firmage + \delta_8 yeardum + \delta_9 domestic + \delta_{10} cbdeals + W_{it} \ldots\ldots\ldots(2)$$

Where *i* denote the ith firm, t is tth year, k is the log of capital stock, l is the log of labour unit, m is the log of material inputs used in the production process, t is time trend included in the model to allow the frontier to shift over time. V_{it} is assumed to be independently and identically distributed N $(0, \sigma_v^2)$ random errors independently distributed of the U_{it}s. U_{it} is the non-negative random variable associated with technical inefficiency of production, which is assumed to be independently distributed, such that it is obtained by truncation (at zero) of the normal distribution with mean $z_{it}\delta$ and variance σ^2. z_{it} is a (1 × m) vector of explanatory variables associated with technical inefficiency of production of firms over time and δ is (m ×1) vector of unknown coefficients. W_{it} is defined by the truncation of the normal distribution with zero mean and variance σ^2 such that the point of truncation is $-z_{it}\delta$ that is, $W_{it} \geq - z_{it}\delta$ (see Battese and Coelli, 1995 for details). The technical efficiency of production for the ith firm at the tth year is defined as,

$$TE_{it} = \exp(-U_{it}) = \exp(-z_{it}\delta - W_{it}) \ldots\ldots\ldots(3)$$

For the analysis, we have taken M&As that occurred in the years 1994, 1997, 2002 and 2004[24] and then prepared an unbalanced panel data consisting of 20 years from 1988-89 to 2007-08. Many of the surviving firms go for multiple deals, which reduces the number of firms in the analysis considerably[25]. Hence, we restricted estimation of inefficiency effects to the aggregate level only, though we understand that sector-wise analysis would be more comprehensive[26].We have estimated the mean technical efficiency across sectors also. Mean Technical efficiency we have calculated for pre and post-merger. Pre-merger values are the average values for the years prior to merger and post-merger values are defined as the average values post-merger. We have restricted the analysis to the mergers occurred from 1994 and up to 2004 to allow a reasonably good pre and post-merger time period. The sample

[23] The distributional assumptions on the inefficiency effects permit the effect of technological change and time varying behavour of the inefficiency effects to be identified, in addition to the intercept parameters β_0 and δ_0 (Battese and Coelli, 1995).

[24] Logic being the number of mergers, data availability and distance between the years selected.

[25] This in turn means that if we are taking the deal number instead of the surviving firms' number, the coverage of the sample is more.

[26] This is mainly due to the data availability across various sectors also.

of firms across different sectors is given in Table 2. We have more number of deals in the 1997 sample (63 deals) followed by 1994 (38 deals), 2002 (37 deals) and 2004 (18 deals).

4. Empirical Estimation Results

Before getting into the results, we have tested the usual assumptions behind the frontier and inefficiency model in order to understand the adequacy of the model specified .

Testing of Hypothesis in the Battese and Coelli Model of Stochastic Frontier

Hypothesis (H_0)	1994	1997	2002	2004	Critical value*
Cobb-Douglass Production Function	888.29	1460	698.9	470.5	21.03
$\delta_1 = \delta_2 = ... = \delta_{10} = 0$	109.72	65.79	60.73	26.88	16.274
$\delta_5 = \delta_6 = 0$	24.94	14.16	41.32	11.35	5.99
$\gamma = \delta_1 = \delta_2 = ... = \delta_{10} = 0$	53.96	121.13	99.94	60.53	17.67**
LLF1	-202.80	-313.98	-116.82	-19.67	
No of firms	38	63	37	18	
Total no of observations in the unbalanced panel	587	773	468	229	

Source: Calculated from PROWESS, CMIE

Note: *Critical value corresponds to the 95th percentile for the corresponding chi-square distribution. **Critical value is taken from Kodde, David A and Franz C. Palm (1986).

The first assumption is regarding the production function. Our hypothesis is that the production function is of Cobb-Douglass form, given the translog production function. As it can be seen from the table, the generalized likelihood ratio-tests (LR statistic)[27] reject this hypothesis, which indicates that the input elasticity and substitution relationships are not constant across the firms. Thus the translog form better suits the data. The next hypothesis that the inefficiency effects are not linear function of the explanatory variables specified in the model is also rejected, which implies that the joint effect of these variables on the inefficiency of production is significant even if the individual effect of one or more of variables may not be statistically not significant. From the table it can be further seen that the assumption of no time effect is also rejected. The next hypothesis that inefficiency effects are absent from the model is also strongly rejected, which indicates that the production function is not same as the traditional average response function which can be estimated efficiently by ordinary least square method. The value of variance parameter, γ is close to one in all the years except 2004, which indicates that inefficiency effects are likely to be highly significant in the analysis of production except for 2004 deals.

Now we shall move to the estimation results of the inefficiency model (see Table 3). As we expected the spending on R&D induces a negative pressure on inefficiency. However, it is

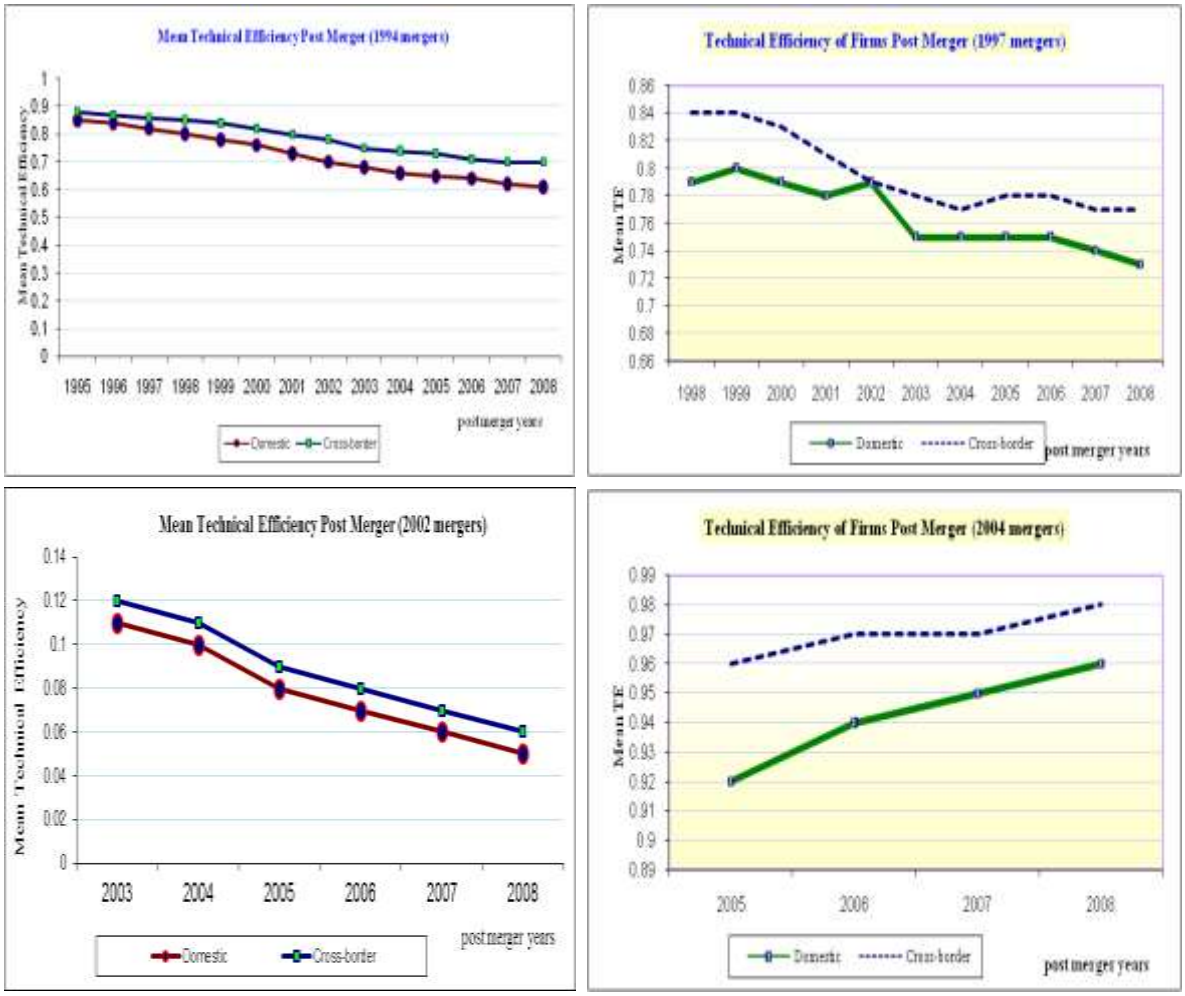
[27] LR statistic $\lambda = -2\{\log[Likelihood(H_0)] - \log[Likehihood(H_1)]\}$. It has a chi-square distribution (or a mixed chi-square distribution) with degrees of freedom equal to the difference between the parameters in the alternative and null hypothesis.

statistically significant only for 1997 deals. This is important since our own recent study[28] shows that M&As induce more spending on R&D. Here our result indicates that not only the spending on technology increases, but also it helps reducing the hindrances to achieve efficient utilization. Regarding the payments made for royalties and technical know-how, it is positive and significant only for firms which went for M&As in 1994. Import of raw materials was also expected to reduce the inefficiencies related to production. It is positive and significant in the case of mergers occurred in 2002 and 2004. Thus, the import of technology and raw materials are not reducing inefficiencies associated with production. Interestingly, the export performance of the firms is not helping them to reduce inefficiencies. Similarly, age of firms is also an inefficiency enhancing factor for the 1997 deals indicating the lack of modernization. All the three merger variables shows negative pressure on inefficiency related to production. However it is significant only in the case of 1994 deals. Here the cross-border deals have a strong negative pressure, whereas domestic ones are not significant anywhere. Thus we can infer that even though both cross-border and domestic deals exert negative pressure, like the R&D effects, we have discussed above, it is not enough to overcome production inefficiencies, which will be clear from the subsequent analysis. The mean technical efficiency of firms, which went for M&As, is shown in Table 4. It is evident that during the post deal period[29], the technical efficiency of domestic as well as cross-border firms declined except for 2004 deals. The sector-wise analysis also shows similar results that the technical efficiency declined for majority of the cases during the post merger period. However, the technical efficiency of the cross-border firms remained higher than that of domestic firms for majority of the cases (see Figure 5).

[28] See Beena, S (2009).

[29] Pre and post merger is defined in terms of the year of first merger. Pre merger constitute 1988-89 to the year of merger and post merger period constitute the year thereafter.

Figure 5: Technical Efficiency: Time Trend



Source: Calculated from the estimated model

In the case of drugs and pharmaceutical industry, the technical efficiency of domestic firms increased during the post-merger period for 1997 deals. In the case of 2004 deals, it improved in all cases. As mentioned earlier, our earlier study found that in majority of the cases, there has been an increase in the spending on technology—both in-house and import of technology. Here our result shows that there has been a decline in the technical efficiency after getting into M&As. In order to understand it better, we have decomposed the mean technical efficiency of firms, for which spending on technology increased during the post deal period[30]. Here also the same trend of declining efficiency is observed except for 2004 mergers during the post deal period (see Table 5).

We have also examined the pre and post merger technical efficiency of horizontal and vertical deals to understand the process closely. We have calculated the pre and post merger average technical efficiency. The results show that (see Table 6) except for the 2004 mergers, the technical efficiency declined for horizontal and vertical deals for both cross-border and

[30] Pre and post four year average has been taken (see Beena, S, 2009)).

domestic deals. This result is interesting because as we discussed earlier according to the theoretical prediction, horizontal and vertical deals create more synergies, which enhance efficiencies after getting into mergers. However the results did not validate this prediction, which may be indicating the absence of adequate synergies after getting into M&As. Further, for majority of the years the technical efficiency of the cross-border firms (both horizontal and vertical deals) remained above than that of domestic deals.

The estimated elasticity[31] of output with respect to different inputs are of considerable analytical interest. The elasticity reflects on the production technology. We have seen that in 50 percent of the cases labour is contributing more to the changes in production and capital is contributing less (see Table 7). It may be reflecting that in many cases firms may not be able to utilize the capital to the maximum capacity owing to two reasons. One is, through the operation of synergies the amount of capital required for the existing level of production reduces. Secondly, it leads to the excess capacity, if production is undertaken at the same production possibility frontier that is no expansion in production after mergers[32].

5. Profitability and Cost as Efficiency Indicators

We have calculated the cost and profitability per unit of output, since most of the merger studies in India concentrated on these measures. In order to understand the profit rate the profit to sales ratio has been used, which indicates the amount of profit per unit of sales. We have calculated the average for four years pre and post merger as well as all years post merger. Interestingly, this ratio declined for majority of years for both cross-border as well as domestic firms (see Table 8) except for a few sector-wise variations[33] (see Table 9). In order to calculate cost per unit of output, we have used the ratio Total Cost/Value of Output in the absence of a comparable input quantity across the firms and products[34]. It shows a general trend of increasing cost after getting into mergers (see Table 8), which is same across the sectors also (see Table 10). It validates the findings regarding profitability too.

This result is in accordance with most of the merger studies in India as well as the international context (see Meeks, 1971; Singh, 1977; Ravenscraft and Scherer, 1988). One major question that arises here is why post merger profit declined regardless of the theoretical prediction that consolidation increases profitability through the reduction of various costs.

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31 The elasticity t in translog production function are defined below.

$$\frac{\delta LnQ}{\delta LnK} = \beta_k + \beta_{kk} LnK + \beta_{kl} LnL + \beta_{km} LnM + \beta_{kt} LnT$$

$$\frac{\delta LnQ}{\delta LnL} = \beta_L + \beta_{lk} LnK + \beta_{ll} LnL + \beta_{lm} LnM + \beta_{lt} LnT$$

$$\frac{\delta LnQ}{\delta LnM} = \beta_m + \beta_{mk} LnK + \beta_{ml} LnL + \beta_{mm} LnM + \beta_{mt} LnT$$

32 A disaggregation across the industries would have provided more insights especially in the context of the technological intensity of the sectors. However since here the co-efficients are same for the entire group of firms, it is not possible to do it sectorwise.

33 For example, in the case of machinery, the profitability increased for mergers occurred in some years. Similarly, the profitability of pharmaceutical industry either remained the same or declined.

34 Majority of the firms are multi-product firms, difficult to capture unit cost of production.

Even though this question is beyond the scope of the present paper, it seems, the decline in profitability may be due to the acquisition of loss making or less efficient firm(s); decline in capacity utilization during the post merger period due to the lack of proper post merger integration of the firms; overall macro economic determinants and the problems associated with the financing of the deal etc. If the firm borrowed money to finance acquisition and the interest payments exceeds the expected earnings, then, this phenomenon can occur.

6. Concluding Observations and Policy Implication

One important consideration while approving M&As by the Competition authorities across the world is efficiency defense that is the possible generation of efficiencies. However, there has been dearth of literature empirically verifying the actual generation of efficiencies through consolidation strategies. The present study attempted to address the question, whether M&As actually generating efficiency as debated by the economists. The logic being that merger leads to cost reduction due to the operation of synergies. In order to understand it in a developing country context like India, we have used stochastic frontier production function along with inefficiency effects introduced by Battese and Coelli (1995). The major observation from our analysis has been that the post merger technical efficiency of the firms involved in mergers declined for majority of the firms and mergers has not significantly contributed to reduce the inefficiencies except for 1994 deals. The sector-wise analysis also supports the aggregate level findings. Further, in general, there is a clear decline in profitability during the post-merger period, which is also applicable to both cross-border and domestic deals. This result is in line with the earlier studies on post merger profitability of the firms both in the Indian and international context. This may be due to the increasing cost of mergers and acquisition or due to the acquisition of loss making counterpart, lack of proper integration of the firms during post merger period or it may be reflecting the increased interest payments after undertaking huge investment for mergers and acquisition.

In short, our study argues to rethink the efficiency defense argument put forward by the competition authorities while approving the combinations. Presently, there is no provision in the Indian Competition Act to examine, whether the approved deal is actually bringing efficiencies, technical know-how and ultimately the consumer satisfaction, since the merger control provisions are *ex ante* in nature. This is especially important for the deals, which are sanctioned based on efficiency criteria. It is to be noted that so far, almost all deals sanctioned by the Competition Commission of India (CCI) are based on the likely impact of the deal on market competition only. The efficiency criteria has not been given much importance while assessing the effect of the deal. However, in future, the Commission may have to look into the efficiency effects as well. Though the deals examined in our study pertains to the old regime, i.e., Monopolies and Restrictive Trade Practices Act[35], it is an indication on the impact of efficiency effects in general. We have not analysed the efficiency effects of the CCI sanctioned deals since it is too early to assess it. The merger regulations in India as per Competition Act, 2002, became effective since June 2011 only, which makes the number of

[35] We haven't analysed the CCI sanctioned deals since it is too early to assess it since the number of post merger years are too less to carry out meaningful efficiency analysis.

post-merger years too less to carry out any meaningful efficiency analysis. However, it seems there should be periodic review of the approved deals that, it is generating efficiency, or not or raising threat to competition, as the case may be, at least for the post three to five years from the approval of the deal. Otherwise, the 'competition enhancement' strategy adopted by the Government will in turn lead to enhance market power of the firms.

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TABLES AND FIGURES

Table 1: Trends of M&As during 1975 to 2010

Period	Mergers			Takeovers			M&As total
	NM	M	Total	NM	M	Total	
1975-1980	48	108	156	0	11	11	167
1980-1985	39	117	156	0	15	15	171
1985-1990	34	79	113	6	85	91	204
1990-1995	108	128	236	8	47	55	291
1995-2000	176	249	425	55	256	311	736
2000-2006	-	-	897	-	-	473	1370
2006-10	NA	NA	NA	NA	NA	1140	NA

Source: Compiled from Beena, P. L (2014), Beena, P. L (2008)

Note: 'NM' denotes non-manufacturing and 'M' denotes manufacturing

Table 2: Distribution of Sample Firms by Sector and Year of Merger

Sector	1994			1997			2002			2004		
	Dom	CB	All	Dom	CB	All	Dom	CB	All	Dom	CB	All
Drugs and Pharmaceutical	3	2	5	2	2	4	1	1	2	1	-	1
Chemicals	5	2	7	8	6	14	4	6	10	4	1	5
Machinery	7	3	10	7	5	12	2	7	9	1	4	5
Metals	2	1	3	6	3	9	2	1	3	2	1	3
Non-metallic	3	-	3	3	2	5	-	1	1			
Textiles	3	1	4	6	2	8	4	-	4	1	-	1
Food and Food Products	3	1	4	5	3	8	2	3	5	-	1	1
Transport Equipments	2	-	2	1	2	3	2	1	3	1	1	2
Total	28	10	38	38	25	63	17	20	37	10	8	18

Source: Database discussed in the text

Note: 'Dom' denotes Domestic deals and 'CB' denotes cross-border deals

Table 3: Maximum Likelihood Estimation Results of the Stochastic Frontier and Inefficiency Model

	1994		1997		2002		2004	
	coefficient	t-ratio	coefficient	t-ratio	coefficient	t-ratio	coefficient	t-ratio
Constant	9.14	8.24	9.08	13.61	6.97	7.46	5.55	5.62
β_k	-0.04	-0.83	0.06	1.79	0.03	0.71	-0.01	-0.15
β_l	-0.46	-2.40	-0.59	-5.10	-0.10	-0.61	0.14	0.72
β_m	2.03	8.37	1.76	16.13	1.10	5.12	0.97	4.52
β_t	-0.11	-1.99	-0.05	-1.17	-0.22	-2.81	0.00	0.05
$0.5\beta_{kk}$	0.00	-1.06	0.00	4.79	0.01	4.93	0.01	6.46
$0.5\beta_{ll}$	0.04	2.45	0.08	7.12	0.02	1.10	-0.02	-0.73
$0.5\beta_{mm}$	0.15	4.09	0.16	17.81	0.00	0.17	0.10	4.24
$0.5\beta_{tt}$	0.01	2.97	0.00	1.26	0.04	2.63	0.00	-1.36
β_{kl}	0.01	2.59	-0.01	-3.41	0.00	0.08	0.00	-0.18
β_{km}	0.01	2.09	-0.01	-1.96	-0.01	-1.27	-0.03	-6.38
β_{kt}	0.00	-2.93	0.00	1.06	0.00	0.90	0.00	-0.51
β_{lm}	-0.12	-6.41	-0.07	-7.16	-0.04	-2.16	-0.01	-0.39
β_{lt}	0.01	1.81	0.00	1.14	0.00	1.53	0.01	1.55
β_{mt}	-0.01	-1.74	-0.01	-3.01	0.00	-0.92	0.00	0.08
Constant	-2.58	-2.64	-3.14	-3.90	-1.74	-2.69	-0.07	-0.55
R&D	-0.01	-0.66	-0.33	-3.50	-0.01	-0.55	-0.05	-4.76
Royalties	9.66	2.48	-2.83	-1.66	2.59	0.99	0.74	0.75
Export	0.37	2.18	0.04	1.02	0.19	1.93	0.54	4.97
Import Rawm.	-0.80	-1.91	0.00	-0.90	0.87	3.95	0.21	3.31
Time (t)	0.40	2.93	0.16	1.75	0.12	1.01	0.06	3.27
t^2	-0.01	-2.44	0.00	-0.97	0.01	0.99	0.00	-4.15
Firm age	0.15	1.70	0.36	3.14	0.00	-0.02	-0.03	-1.38
Merger dummy	-0.71	-2.28	0.06	0.33	-0.04	-0.51	0.00	0.00
Domestic deals	0.00	-0.10	-0.01	-0.34	-0.01	-0.29	-0.07	-1.90
Cross-border	-0.22	-3.29	-0.05	-0.95	-0.03	-0.96	0.01	0.15
$\sigma^2 = \sigma_u^2+\sigma_v^2$	0.19	5.81	0.36	9.41	0.12	11.69	0.07	10.78
$\gamma = \sigma_u^2/\sigma_v^2+\sigma_u^2$	0.68	9.21	0.80	25.63	0.57	7.39	0.00	6.57
LR test of one sided error	114.78		89.39		60.73		26.88	
LLF1	-202.80		-313.98		-116.82		-19.67	
Mean TE	0.69		0.78		0.43		0.89	
Total No. of observations in the unbalanced panel	587		773		468		229	
No. of firms	38		63		37		18	

Source: Calculated the estimated model

Table 4: Pre and Post Deal Mean Technical Efficiency of Firms

	Domestic		Cross-border		All	
Deal year	pre	post	pre	post	pre	post
1994	0.84	0.62	0.87	0.71	0.85	0.64
1997	0.82	0.73	0.85	0.77	0.83	0.75
2002	0.74	0.09	0.75	0.11	0.74	0.1
2004	0.87	0.96	0.88	0.97	0.87	0.96

Source: Calculated from the estimated model.

Table 5: Average TE of Firms for which Technology Spending Increased Post Merger

Merger year	Category	Merger	R&D Intensity	Royalties*
1994	Domestic	Pre	0.86	0.84
		Post	0.61	0.62
	Cross-border	Pre	0.88	0.87
		Post	0.75	0.71
1997	Domestic	Pre	0.83	0.82
		Post	0.74	0.73
	Cross-border	Pre	0.86	0.85
		Post	0.75	0.77
2002	Domestic	Pre	0.78	0.74
		Post	0.09	0.09
	Cross-border	Pre	0.76	0.75
		Post	0.09	0.11
2004	Domestic	Pre	0.86	0.87
		Post	0.92	0.96
	Cross-border	Pre	0.87	0.88
		Post	0.98	0.97

Source: Calculated from the estimated model

Note:* Spending on Royalties and Technical Know-how

Table 6: Pre and Post Merger Technical Efficiency of Horizontal/Vertical Deals

Merger year	Category	Merger	Horizontal	Vertical
1994	Domestic	Pre	0.84	0.84
		Post	0.62	0.6
	Cross-border	Pre	0.88	0.86
		Post	0.66	0.8
1997	Domestic	Pre	0.8	0.85
		Post	0.72	0.76
	Cross-border	Pre	0.85	0.85
		Post	0.78	0.75
2002	Domestic	Pre	0.74	0.24
		Post	0.09	0.09
	Cross-border	Pre	0.6	0.75
		Post	0.1	0.11
2004	Domestic	Pre	0.86	0.97
		Post	0.95	0.9
	Cross-border	Pre	0.87	0.88
		Post	0.99	0.96

Source: Calculated from the estimated model

Table 7: Average Input Elasticity

Year of Merger	capital	labour	material
1994	0.12	0.46	0.52
1997	0.00	1.83	1.20
2002	0.02	0.16	0.64
2004	0.01	1.60	0.98

Source: Calculated from the estimated model

Table 8: Pre and Post Merger Mean Profit and Cost of Firms

Merger year	Category	Merger	PAT/Sales	Expenses/Value of Output
1994	Domestic	Pre	0.06	0.96
		Post four	0.06	1.17
		post merger	-0.22	1.37
	Cross-border	Pre	0.04	0.99
		Post four	0.05	0.98
		post merger	0.02	1.05
1997	Domestic	Pre	2.35	16.45
		Post four	-0.36	2.44
		post merger	-0.75	2.27
	Cross-border	Pre	0.6	13.81
		Post four	0.56	17.44
		post merger	0.17	10.15
2002	Domestic	Pre	0.03	1.21
		Post four	0.05	0.99
		post merger	0.06	1.11
	Cross-border	Pre	0.05	0.98
		Post four	0.07	1.24
		post merger	0.06	0.97
2004	Domestic	Pre	0.06	0.9
		Post four	0.01	0.99
	Cross-border	Pre	0.00	1.31
		Post four	0.03	7.87

Source: Calculated from the estimated model

Table 9: Sectoral Pre and Post Merger (four years) Profit to Sales

Year of Merger	Category	Merger	Drugs	Chemicals	Machinery	Metals	Non-metallic	Textiles	Food	Transport
1994	D	Pre	0.09	0.08	0.05	0.02	0.07	0.07	0.05	0.02
		Post	0.07	0.03	-0.04	0.01	0.06	0.06	0.01	0.03
	C	Pre	0.05	0.01	0.02	0.09	.	0.05		
		Post	0.05	0.07	0.00	0.04	.	0.02		
1997	D	Pre	0.13	8.97	0.14	0.10	0.06	0.08	0.05	0.09
		Post	0.13	-0.11	0.42	0.05	-0.19	-3.08	0.02	0.05
	C	Pre	0.11	0.08	0.07	3.48	0.06	0.07	0.05	0.04
		Post	0.00	-0.02	0.08	3.54	0.02	0.01	0.04	0.03
2002	D	Pre	0.09	0.04	-0.04	0.04		0.06	0.01	0.07
		Post	-0.02	0.06	0.10	0.05		0.06	-0.03	0.09
	C	Pre	.	0.06	0.05	0.11	0.03		0.00	-0.05
		Post	-0.02	0.07	0.08	0.08	0.11		0.07	.
2004	D	Pre	0.05	0.05	0.07	0.07				
		Post			0.04			-0.06		0.03
	C	Pre	0.01	-0.01	0.07	-0.02				
		Post			0.05			0.00		0.03

Source: Calculated from the estimated model

Table 10: Sectoral Pre and Post Merger (four years) Expenditure per unit of Output

Year of Merger	Category	Merger	Drugs	Chemicals	Machinery	Metals	Non-metallic	Textiles	Food	Transport
1994	D	Pre	0.93	0.95	0.97	6.32	0.94	0.96	0.98	1.01
		Post	1.01	1.01	1.11	1.00	0.95	0.98	1.05	0.99
	C	Pre	0.96	1.02	1.01	0.94	.	0.97		
		Post	0.98	0.96	1.03	0.99	.	0.99		
1997	D	Pre	0.94	61.65	1.61	0.81	0.66	1.13	0.96	0.92
		Post	0.91	1.13	3.27	0.82	1.07	8.48	0.99	0.95
	C	Pre	0.93	0.93	0.94	84.67	1.01	0.94	0.96	0.72
		Post	1.04	1.04	0.94	108.08	1.03	1.08	0.97	0.67
2002	D	Pre	1.18	0.99	2.70	0.98		0.98	1.02	0.95
		Post	1.03	0.97	1.19	1.00		1.49	1.05	0.93
	C	Pre	.	0.96	0.99	0.90	0.98		1.00	1.06
		Post	1.04	0.95	1.04	0.94	0.92		0.96	.
2004	D	Pre	0.93	0.87	0.79	0.97				
		Post			0.92			1.19		0.92
	C	Pre	0.83	1.18	3.15	1.77				
		Post			12.60			11.11		1.19

Source: Calculated from the estimated model

Note: ‘D’ denotes Domestic and ‘C’ denotes cross-border deals

APPENDIX I

Measurement of Capital Stock

Finding out the Replacement Cost of Capital is one of the major steps involved in efficiency estimation (see Parameswaran, 2002 for a detailed discussion). Replacement Cost of Capital is defined as the Revaluation factor (R^G) multiplied with the Value of Capital Stock at Historic Cost. Replacement Cost of Capital measurement is discussed here. It is important to note that this method is an approximation. Since no other better measure is available, we are also using it like the other studies in this context. R^G is defined as[36],

$$R^G = \frac{\left[(1+g)(1+\Pi)-1\right]}{g(1+\Pi)} \quad \ldots\ldots\ldots\ldots (1)$$

Where 'g' is the growth rate of investment and $\prod$ is the change in the price of capital. Growth rate of Investment can be obtained by using the formula, $g= I_t/I_{t-1}-1$. Here our assumption is that Investment (I) has increased for all the firms. Change in the price is measured through, $\prod=P_t/P_{t-1}-1$. Here P_t is obtained by constructing capital formation price indices[37] from the series for Gross Fixed Capital Formation in Manufacturing using various issues of National Accounts Statistics of India. Here more realistically, our assumption is that capital stock does not date back infinitely, but its earliest vintage is't' period, then the above equation becomes,

$$R^G = \frac{\left[(1+g)^{t+1}-1\right](1+\Pi)^t\left[(1+g)(1+\Pi)-1\right]}{g\left\{\left[(1+g)(1+\Pi)\right]^{t+1}-1\right\}} \quad \ldots\ldots\ldots (2)$$

We have assumed that the lifespan of capital stock is 20 years following the Report of Machine Tools-1986 (Government of India, 1989; Pillai, M and Srinivasan 1987). We have selected 1999-2000 as the base year[38]. So following Srivastava, no firm has any capital stock in the year 1999-2000 of a vintage earlier than 1979-80. In the case of firms incorporated before 1979-80, it is assumed that the earliest vintage capital in their capital mix dates back to the year of incorporation. As Srivastava notes, for some firms the vintage of the oldest capital in the firm's asset mix and incorporation year may not coincide. Since no other better alternative is available, we are also following this methodology. After getting the Revaluation factor (R^G). As we mentioned earlier, we calculated the Replacement Cost of Capital from the Revaluation factor (R^G) and the Value of Capital Stock at historic cost. We have used Gross

[36] See Srivastava (1996), Balakrishnan, Pushpangadan and Suresh Babu, (2000) Parameswaran (2002) for details.

[37] Price is equal to Gross Fixed Capital Formation at Current prices divided with the same at constant prices.

[38] Based on the data available from the PROWESS database, this year is having the largest number of M&As.

Fixed Assets[39] of the firms for the estimation. This enabled us to apply the Perpetual Inventory Method to construct the capital stock. This is defined as,

$$k_{t+1} = k_t + I_{t+1}$$

$$k_t = k_{t-1} + I_t$$

$$k_{t-2} = k_t - I_t - I_{t-1} \text{ and so on.}$$

[39] Deflated with the Wholesale Price Index for machinery and machine tools (Source: Office of the Economic Advisor, Ministry of Commerce & Industry, GOI, Various Years) with the base year 1999-2000.

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