Vertical Integration, Market Structure and Competition Policy: Experiences of Indian Manufacturing Sector during the Post-Reform Period

Rakesh Basant
Pulak Mishra

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Rakesh Basant[1] and Pulak Mishra[2]

Abstract

In the context of declining degrees of vertical integration in major industries of Indian manufacturing sector during the post-reform period, the present paper is an attempt to examine how such 'vertical disintegration' has affected firms' market power and its implications for competition policy. Using panel dataset of 49 majors industries of Indian manufacturing sector for the period 2003-04 to 2010-11 and applying the system GMM approach to estimate of dynamic panel data models, the paper finds that vertical integration does not cause any significant impact on average market power of firms in an industry. Instead, it is influenced by market size, and selling and technology related efforts. While selling intensity has a positive impact on market power, the impact of market size and technology intensity is found to be negative. Notably, like vertical integration, market concentration, import to export ratio, and capital intensity also do not have any significant impact on market power. The findings of this paper, therefore, have important implications for competition law and policy in general and policies and regulation relating to technology development and international trade in particular.

Keywords: Economic Reforms, Vertical Integration, Market Power, Competition Policy, India

[1]Professor of Economics, Indian Institute of Management Ahmedabad, Ahmedabad – 380 015 Email: rakesh@iimahd.ernet.in

[2]Associate Professor, Department of Humanities and Social Sciences, Indian Institute of Technology Kharagpur, Kharagpur – 721 302 Email: pmishra@hss.iitkgp.ernet.in

1. Introduction

The implications of vertical integration are generally analyzed through the lens of transaction cost economics (Coase, 1937; Williamson, 1971). In addition, the organizational theories also analyze vertical integration from the perspective of property rights or control rights (Grossman and Hart 1986, Hart 1995, Hart and Moore 1990). It is postulated that when there are information asymmetries between different parties and writing of contracts is costly, contracting may suffer from subjective or objective limitations on information. Such incompleteness in contracts potentially leads to contractual hazards that adversely affect investment incentives and efficiency. Under such circumstances, internal organizational allocation mechanisms through vertical integration are likely to harmonize the conflicting interests (that arise due to these contracts) and provide smoother and less costly adaptation process, enhancing investment and efficiency.

It is also argued that vertical integration promotes efficiency by eliminating successive monopoly mark-ups, internalizing services, and mitigating contractual problems between the firms (Williamson, 1971; Grossman and Hart, 1986). The studies by Kuhn and Vives (1999) and Riordan (1998) also suggest that vertical integration can bring down double-marginalization[3]. When it is so, vertical integration lowers prices and enhances consumers' welfare as it enables firms to reduce production costs, increase efficiency and restrict market competition (Koch, 1980). According to Carlton and Perloff (2005), vertical integration can benefit the economy and increase consumers' welfare when it results in lower costs of operations[4].

However, since vertical integration results in ownership and management control over neighbouring stages of production and/or distribution (Perry, 1989), it can facilitate market foreclosures and raise market power of an integrated firm. In addition, it can also facilitate

[3]This is so particularly when the downstream firms are unaware of the price mark-up by the upstream firm and is referred to as vertical externality (Tirole, 1988).

[4]In addition, firms consider vertical integration whenever there are uncertainties in the supply of inputs (Carlton, 1979). Vertical integration is also beneficial in the case of an infant industry which produces a new downstream input because demand for such inputs would be too small to support these infant industries (Stigler, 1951).

collusion[5]. Many studies (e.g., Riordan and Salop, 1995; Nocke and White, 2007; Normann, 2009) discuss the impact of vertical mergers on upstream collusion. As a result, the prices of final goods may increase resulting in a loss of consumers' welfare (Chipty, 2001).

In many situations, differences in price elasticity of demand for upstream intermediate goods across downstream firms create opportunities for the upstream firms to engage in third-degree price discrimination by charging higher prices to firms having less elastic demand and lower prices to firms with higher elasticity in demand. If there is downward vertical integration of firms having high elasticity of demand, prices of intermediate goods for the remaining buyers will be low (Perry 1978). Such pricing strategy may drive away the non-performing firms in the downstream market as they now have to pay a higher price for the intermediate good. As a result, monopoly power of the vertically integrated firms may increase. As regards vertical foreclosure, limited access to input or output markets following vertical integration lowers inter-firm competition, especially when there are barriers to entry. Thus, if there is no potential competition in the markets controlled by the integrated firms, vertical foreclosures may occur (Baumol, Panzar & Willig, 1982).

Broadly, existing literature suggests that vertical integration may be induced by transaction costs, demand variability and market power motives (Bhuyan, 2005). This makes the welfare implications of vertical integration inconclusive, especially with respect to efficiency gains (e.g., Salinger, 1988; Riordan, 1998). Precisely, the net impact of vertical integration depends on which of the diverse processes are dominant. This is in contrast to the propositions of the Chicago School of the 1960s and 1970s that vertical integration increases economic efficiency in the presence of perfect information, efficient markets and economies of scale (Riordan, 2005). According to the transaction cost economics of the 1970s and 1980s, although there is efficiency rationale for vertical integration, firms with market power may have strategic goals poorly aligned with consumer welfare (Riordan, 2005).

In India, competitive pressures unleashed by economic reforms seem to have resulted in an increase in importance of business strategies like outsourcing manufacturing jobs (Basant and

[5]The anti-trust laws of the USA were critical on vertical mergers on the ground that such combinations can reduce competition by removing resources from the input markets, foreclosing competitors and leveraging monopoly power from one market to another.

Mishra, 2016). It is expected that manufacturing outsourcing would allow rationalization of production wherein firms can exploit economies of scale and scope in specific segments while outsourcing activities in which they are not cost-competitive. In this sense, outsourcing has a very important strategic role in situations where firms compete with one another on production costs. While there has been a movement towards greater outsourcing at a reasonably high rate during the post-reform period, at the same time, as one would expect, degrees of vertical integration have recorded a decline (Basant and Mishra, 2016)[6]. This means that manufacturing outsourcing is emerging as an alternative to in-house production and hence can be seen as a strategy of vertical disintegration.

Although the importance of these strategies varies by major industries (Basant and Mishra, 2016), manufacturing outsourcing has increased in majority of industries and the rate of growth is high in all the cases possibly due to its low base. On the other hand, all major industries have recorded decline in degrees of vertical integration during the post-reform period. Thus, outsourcing manufacturing jobs is emerging as an alternative business strategy, particularly to vertical integration in most industries. Markets seem to be maturing but given that vertical integration can potentially reduce production and other transaction costs and/or uncertainties in output and input markets, understanding the impact of such policy shift on market power of firms and the emerging implications for competition policy is very important.

This is so because, as mentioned earlier, vertical integration can potentially enhance efficiencies by reducing production and transaction costs apart from reducing uncertainties in output and input markets. It is expected that a decline in its degree would reduce firms' competitiveness and market power[7]. On the other hand, high degrees of vertical integration in an industry also create entry barriers as integration may be necessary for successful entry by a new firm which is likely to be costly. A decline in vertical integration, therefore, is likely to facilitate entry and enhance market competition.

[6]At a broader level, however, it reflects maturing of outsourcing markets.

[7]However, if the upstream and downstream markets become more competitive, such a situation may not arise.

Similarly, market foreclosure following vertical integration seems to have important implications in competition policy analysis. This is particularly so when integration results in exit from upstream markets and increases costs of production of the downstream firms. It can also facilitate the dominant firms to exercise market power. Thus, there is a possibility of increase in market concentration and loss of consumer welfare following vertical integration. While competition in upstream markets may decline, firms in downstream markets may experience increase in costs of production and hence prices. However, the welfare loss due to higher prices may be offset by cost advantage of the dominant firms. Given all these possibilities, it is necessary to examine how has such 'vertical disintegration' affected market power of firms in different industries of Indian manufacturing sector and what are the implications of such strategic changes for competition policy. The present paper attempts to address these questions.

The rest of the paper is organized in five sections. The next section invokes the Structure-Conduct-Performance paradigm to develop conceptual relationships and identify the impact of different variables (including vertical integration) on market power. A functional model used for econometric investigation is then specified. The estimation techniques applied and the sources of data used are discussed in the third section, whereas the fourth section presents and analyzes the econometric findings. The final section of the paper highlights the major findings and their policy implications.

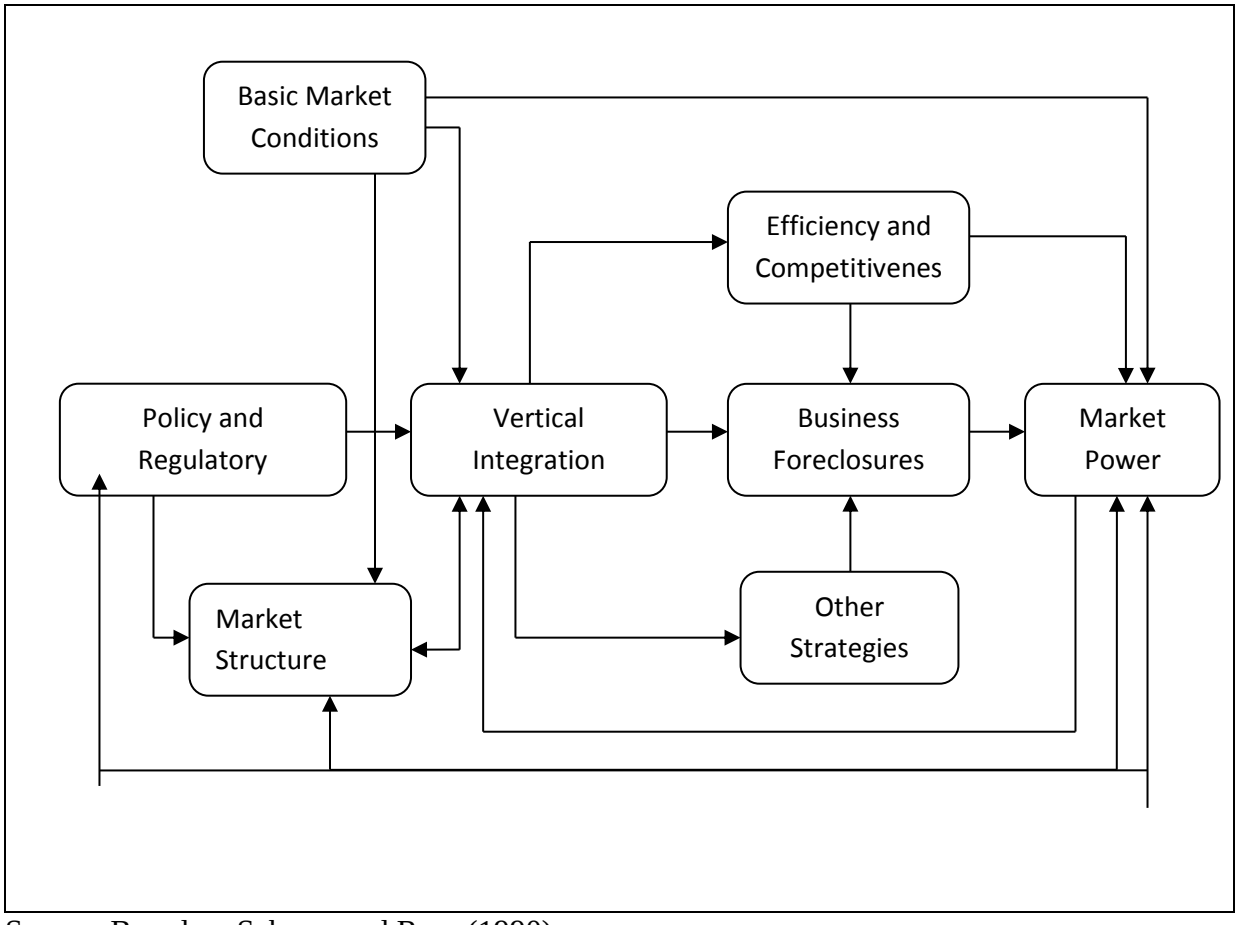
2. Determinants of Market Power – Specifying a Functional Model

In order to examine the impact of vertical integration on market power, the present paper uses the structure-conduct-performance (SCP) framework of Bain (1956). Although the traditional SCP paradigm postulates unidirectional relationships between market structure, firms' conduct and their performance, successive developments in the industrial organization literature suggest for multidirectional structure-conduct-performance framework (Scherer and Ross, 1990). This new framework recognises bidirectional causalities between structure and conduct, between conduct and performance and between structure and performance (Tirole, 1988). The other important development in the SCP paradigm is inclusion of public policies relating to taxes, subsidies, international trade, investment, etc. (Scherer and Ross, 1990).

Such multidirectional relationships suggest that impact of vertical integration on market power should be seen in a dynamic context[8].

Given these developments in the literature, the present paper considers vertical integration as a conduct variable and explores its impact on market power controlling for influences of various structural aspects of the market, other business strategies (conduct variables other than vertical integration) and changes in policies and regulations by the government. Further, the present paper also recognizes various feedback effects. Accordingly, the following analytical framework is envisaged to examine the impact of vertical integration on market power:

Figure 1: Multidirectional Relationships between Vertical Integration and Market Power



Source: Based on Scherer and Ross (1990)

[8]A number of studies in recent years have used dynamic framework to analyse industry level market power (e.g., Mishra, 2008) or firm-level profit margins (Kambhampati and Parikh, 2005) in Indian context

We use this broad analytical framework and available literature to specify a variety of structural and strategic (conduct) variables that can potentially affect market power in an industry. Accordingly, the following functional relationship is specified to examine impact of vertical integration on market power of firms in major industries of Indian manufacturing sector:

$$PCM_{it} = f(PCM_{i,t-1}, MSZ_{it}, CON_{it}, KIR_{i,t-1}, IMEX_{it}, SELL_{i,t-1}, TECH_{i,t-1}, VI_{i,t-1})$$

This paper uses price-cost margin (PCM) as an index of market power. Here, one-year lagged values of the dependent variable (PCM_{t-1}) stand for market power in previous years, whereas, current market size (MSZ_t) is included to take into account the demand conditions in the market. The structural aspects of markets are captured by using three variables, namely, current market concentration (CON_t), lagged capital intensity ratio (KIR_{t-1}) and current ratio of import to export ($IMEX_t$). In order to control firms' conduct, three variables, namely lagged selling intensity ($SELL_{t-1}$), lagged technology intensity ($TECH_{t-1}$) and lagged vertical integration (VI_{t-1}) are included. Thus, it is assumed that, in addition to vertical integration, average market power of firms in an industry depends on various structural characteristics of the market, their other business strategies and policy and regulatory measures of the government.

Some of these variables capture impact of changes in government policies and regulation as well. For example, in addition to technology strategies, the variable TECH is also expected to capture changes in policies in respect of innovation and import of foreign technology and regulatory measures in respect of protection of intellectual property rights. The new policy regime allows firms for technology agreements with foreign firms and the extent differs across industries depending on the priority. Industries with automatic approval provision for foreign technology purchase are likely to have higher technology intensity. Similarly, the ratio of import to export (IMEX) can be seen as a variable to control impact of policy changes relating to exports and imports. Industries with favourable exports measures are expected to record lower IMEX, whereas liberal policy measures for imports can raise the ratio. Further, following Kambhampati (1996), one-year lag has been introduced in the variables relating to business strategies (i.e., SELL, TECH and VI). It is assumed that these business strategies influence market power only after an interval of time.

We use two alternative measures of vertical integration, viz., ratio of value added to value of output and ratio of inventory of final good to sales to substantiate the findings[9]. Further, two alternative measures of market concentration, viz., the Herfindahl-Hirschman Index (HHI) and the GRS Index (GRS) are used to confirm robustness of the findings. This is so because the additive measures of market concentration suffer from various limitations (Mishra et al, 2011). While the HHI is a widely used measure of market concentration, the GRS gives the most accurate measure of market concentration for Indian manufacturing sector (Mishra et al., 2011).

We use average values of the independent variables over last three years with the year under reference being the starting year instead of their annual values. This helps in controlling for the possible problem of endogeneity. For the dependent variable also, three-year averages are used instead of its annual value to partly take account of the dynamics of firm behaviour[10]. In addition to making the data consistent, such averaging also helps in capturing deeper lags and hence the dynamic process of adjustments in a better way. Accordingly, the HHI for industry i in year t is constructed by using the formula,

$$HHI_{it} = \frac{\left(\sum_{j=1}^{n} s^2{}_{jt} + \sum_{j=1}^{n} s^2{}_{j,t-1} + \sum_{j=1}^{n} s^2{}_{j,t-2} \right)}{3}$$

Here, s_j stands for market share of j^{th} firm in i^{th} industry.

Similarly, the GRS Index for industry i in year t is defined as,

$$GRS_{it} = \frac{\sum_{j=1}^{n}\left(\frac{n^2 s_{1t} + 0.3 s_{jt}^2}{n^2 + 0.3 n s_{1t} s_{jt}} s_{jt} \right) + \sum_{j=1}^{n}\left(\frac{n^2 s_{1,t-1} + 0.3 s_{j,t-1}^2}{n^2 + 0.3 n s_{1,t-1} s_{j,t-1}} s_{j,t-2} \right) + \sum_{j=1}^{n}\left(\frac{n^2 s_{1,t-2} + 0.3 s_{j,t-2}^2}{n^2 + 0.3 n s_{1,t-2} s_{j,t-2}} s_{j,t-2} \right)}{3}$$

Here, s_1 is market share of the largest firm in j^{th} industry[11].

[9] These measures of vertical integration were first propounded by Adelman (1955). Although they have various limitations (Nugent and Hamblin, 1996), these measures, especially the ratio of value added to sales have been widely used in empirical research on vertical integration.

[10] Using such average measure of the dependent variable is very important in a multidimensional framework, as in such a framework, the adjustment process is likely to be slow and a single lag dependent variable based on annual values as an explanatory variable may not be enough to capture the entire dynamics of the model.

[11] For the details on GRS, see Ginevicius and Cirba (2009).

Possible Impact of the Independent Variables

Lagged Market Power: As mentioned, we use one-year lagged value of price-cost margin as a measure of previous market power. A high level of PCM strengthens firms' position in the industry as well as enables them to develop manufacturing, selling and technology related complementary assets. As a result, the incumbents are expected to enjoy a higher market power in the next period. However, higher PCM can also attract new firms into the industry. In the absence of effective entry barrier, such entry may reduce future market power of the firms. Higher price-cost margin can also result is X-inefficiency and hence lower market power in future. The effect of lagged market power on its current level, therefore, depends on the relative strength of these diverse forces.

Current Market Size: Size of the market affects firms' market power from both demand and supply sides. Larger market may comprise larger number of players and, therefore, result in lower market power. Conversely, larger market may facilitate the firms to operate at a larger and optimal scale exploiting scale economies. This lowers average costs of operation and thus raises price-cost margins. There is evidence of greater efficiency achieved through growth of sales and hence economies of large-scale operations (Kambhapati, 1996). However, when increase in market demand follows lowering of prices, market power may not improve. Larger markets may also encourage entry of new firms (Ghosh, 1975; Bhattacharya, 2002), and therefore enhance competitive pressures. Impact of market size on market power, therefore, depends on the relative strength of these diverse forces.

Current Market Concentration: It is generally argued that industries with concentrated markets facilitate collusion leading to supernormal profits (Bain, 1951; Chamberlin, 1933; Stigler, 1964). While the positive relationship between market concentration and price-cost margin or profitability is well documented in the literature (e.g. Weiss, 1974; Ravenscraft, 1983, Kambhampati, 1996; Goldar and Aggarwal, 2004), the strength of the relation differs depending on the behavior of firms (Mishra, 2008). Further, greater market concentration may not necessarily result in higher market power when firms' have varied strategic conjectures. Moreover, greater market concentration may not be sufficient for greater market power if there are limited or no barriers to entry (Hay and Morris, 1991). In the long-run, impact of market concentration on market power depends on which of these forces dominate

empirically. For example, using dynamic framework, Mishra (2008) found that the traditional positive relationship between market concentration and markup does not hold in a dynamic context when controlled for various structural aspects of the market, firms' business strategies and policies of the government.

Lagged Capital Intensity Ratio (KIR): High capital intensity can act as an absolute barrier to entry. A high KIR is likely to reflect existence of large sunk costs that create entry barriers and thereby give rise to monopoly profit (McDonald, 1999). Besides, capital market imperfections may lead to discrimination by offering preferential lending rates to large established firms in capital-intensive industries. This higher cost of capital makes the small firms less competitive and thereby restricts them from entering into the industry (Basant and Saha, 2005). On the other hand, high capital intensity may result in lesser flexibility in terms of adjusting to market turbulence and hence negative impact on margins. Thus, the nature of the relationship between capital intensity and market power is ambiguous and would depend on the relative strength of these diverse forces.

Current Import-Export Ratio: Greater penetration of imported goods increases competitive pressures in the domestic market. When such competitive pressures enhance efficiency, market power may improve. On the other hand, one may expect positive impact of exports on market power, particularly when the extent of competition differs between the domestic and the international market. When such penetration into the international is backed by greater efficiency and competitiveness, market power may improve. For example, Saluja (1968), Panchamukhi (1974), Katrak (1980) found that price-cost margin was higher in Indian manufacturing industries with relatively less import competition and high export orientation. Impact of imports vis-à-vis exports on market power is, therefore, largely an empirical issue.

Lagged Selling Intensity: Here, selling intensity is defined as the ratio of advertising, marketing and distribution related expenditures to sales. This variable is used to capture strategies towards creation of image related entry barriers, product differentiation and building of marketing and distribution network. Advertising creates image advantage over rivals. Besides, advertising can also cause product differentiation and create entry barriers

(Comanor and Wilson, 1967)[12]. Thus, industries with higher advertising intensity are expected to have greater market power[13]. However, informative advertising may not necessarily help in enhancing market power. Conversely, expenditure on marketing helps in promoting the products by reaching the consumers, whereas wider distribution networks satisfy the consumers with easy and timely access to the same. Thus, industries with greater selling efforts are expected to experience greater market power of firms in the industry[14].

Lagged Technology Intensity: Sustained in-house R&D can act as an important instrument of maintaining entry barriers (Mueller, 1990). According to Cefis (1998), persistent innovators earn above average profits. However, acquisition of foreign technologies helps in lowering operating costs and hence the price (Hinomoto, 1965; Balcer and Lippman, 1984). Use of such technologies can also enhance product quality and hence its demand in the domestic market. In addition, foreign technology also helps in creating strategic entry barriers. Therefore, industries with greater efforts of the firms towards purchasing foreign technology are likely to experience greater market power. However, in the absence of effective regulation, competitors may imitate the outcomes and the firms engaged innovation may lose the edge. Further, the existing accounting practices that allow firms to express R&D expenses entirely in the year incurred instead of amortizing it to recognize its future benefits creates the possibility of negative impact of in-house R&D on profitability (Mishra and Chandra, 2010)[15]. Similarly, reaping the benefits of these technologies requires their proper application. Besides, when the technologies purchased from abroad are obsolete, firms may not have any distinct edge, vis-à-vis the MNCs.

[12] High advertising intensity of existing firms may require the potential entrants to incur disproportionately high advertising expenses to win over the incumbents and this may discourage entry.

[13]There are evidences (e.g., Scherer and Ross, 1990) of positive relationship between profit margin and advertising intensity.

[14]It is observed that expenditure on distribution and marketing activities results in higher profitability (Majumdar, 1997).

[15] There are evidences (e.g., Mishra and Chandra, 2010; Mishra and Vikas, 2010) of no significant impact of in-house R&D on firms' profitability in Indian pharmaceutical industry.

Lagged Vertical Integration: As discussed, high vertical integration is expected to enhance firms' market power through greater access to input and/or output markets. Vertical integration also facilitates diffusion of innovation outcomes and distribution of the expenses across a wide range of products that are linked. The degree of vertical integration is also expected to act as an effective entry barrier with greater extent of vertical integration being less favorable to the potential entrants owing to its cost disadvantage relative to the existing rivals. According to Scherer and Ross (1990), firms may undertake vertical mergers to enhance market power not only at one stage but in successive stages of marketing. Vertical integration can also benefit the downstream division of an integrated firm by reducing competition in the upstream market (Ordover et al., 1990). Thus, it is expected that greater vertical integration would enhance market power. However, when vertical integration promotes efficiency by eliminating successive monopoly mark-ups, internalizing services, and mitigating contractual problems between the firms, prices may go down. There is evidence of fall in market price following vertical integration (Quirmbach, 1986).

Existing literature suggest that mergers and acquisitions (M&A) play a critical role in influencing firms' market power. According to the efficiency theory, M&A are planned and executed to reduce costs of production through scale economies (Porter, 1985; Shelton, 1988), whereas the monopoly theory considers such combinations as the routes to raise market power (Steiner, 1975; Chatterjee, 1986). Hence, M&A are expected to result in greater market power. Even efficiency gains can lead to greater market power in the long-run. However, when other structural aspects of the market, firms' business strategies (other than M&A), business performance in the past and policies and regulations of the government are controlled, impact, M&A may not necessarily cause any significant impact on market power. Importantly, M&A can be of horizontal type leading to greater market concentration or vertical in nature. Since both market concentration and vertical integration are included as independent variables in the present model and systematic data on different types of M&A are not available, it is not included as a separate independent variable. It is assumed that M&A would affect market power through market concentration and/or vertical integration depending on nature of the combinations.

From the above discussion it is evident that, in addition to vertical integration, industry-level market power depends on a variety of other factors and the nature and extent of impact

depends on balancing of various diverse forces. Hence, understanding the impact of vertical integration on market power requires systematic investigation through dynamic econometric modelling controlling effects of these diverse forces. What follows next is an attempt in this direction.

3. Estimation Techniques and Data Sources

The above functional relationship is examined using a panel dataset of 49 major industries of Indian manufacturing sector over the period from 2003-04 to 2010-11. Selection of the study period is based on primarily three reasons, viz., significant involvement of the MNCs in M&A during 1995-2000, amendments to the Indian Patent Act (1970) since the late 1990s, and stable economic conditions and changes in macroeconomic policies since the early 2000s. Such panel data analysis is expected to help in capturing variations in the variables both across industries as well as over time. This relaxes the assumption made in cross-section analyses that the same structure-conduct-performance relationships prevail among all industries at a particular point of time. Necessary data are sourced from the Prowess database of the Centre for Monitoring Indian Economy (CMIE). The details on measurement of the variables are given in Table 1.

In the present paper, the dynamic panel data model of the following form is estimated to examine the impact of vertical integration on market power:

$$y_{it} = \alpha + \beta y_{i,t-1} + \sum_{j=1}^{m} \gamma_j x_{j,it} + u_{it}$$

The estimation techniques for the above model are based on the generalized method of moments (GMM). As compared to the method of instrumental variables (e.g., Balestra and Nerlove, 1966; Anderson and Hsiao, 1981; Bhargava and Sargan, 1983), the GMM estimators can bring in more information on data (Ahn and Schmidt, 1995). The GMM estimators are also consistent and more efficient than the Anderson-Hsiao (1981) estimators. In addition, the GMM estimators have generalizations that can address the problem of autocorrelation, heteroscedasticity, specification errors, etc.

Table 1: Measurement of the Variables	
Variable	Measurement
Dependent Variables	
Price-Cost Margin	Ratio of value added less expenditure for salaries and wages to sales in the current year
Independent Variables	
Current Market Size (MSZ_t)	Natural logarithm of current industry sales
Current Market Concentration (CON_t)	**Two Alternative Measures:** (1) The Herfindahl-Hirschman Index (2) The GRS Index
Lagged Capital Intensity (KIR_{t-1})	Ratio of capital employed to industry sales in the current year
Current Import-Export Ratio ($IMEX_t$)	Ratio of current imports to current exports
Lagged Selling Intensity ($SELL_{t-1}$)	Ratio of total selling (i.e., sum to advertising, marketing and distribution) related expenditure to industry sales in the current year
Lagged Technology Intensity ($TECH_{-1}$)	Ratio of expenditure on in-house R&D and foreign technology purchase to industry sales in the previous year
Lagged Vertical Integration (VI_{t-1})	**Two Alternative Measures:** (1) Ratio of value added to value of output in the current year (2) Ratio of inventory of output to sales in the current year
Additional Instruments	
Growth of the Industry ($GROWTH_t$)	Trend growth rate of industry sales over a period of last five years with the year under reference being the starting year
Lagged Mergers and Acquisitions (MA_{t-1})	Natural logarithm of total number of mergers and acquisitions during the last three years excluding the year under reference

Such dynamic panel data estimation techniques uncover the joint effects of the explanatory variables on the dependent variable while controlling for potential bias due to endogeneity of the explanatory variables including the lagged dependent variable[16]. In addition, presence of autocorrelation problem and validity of instruments are tested by applying the Arellano-Bond (1991) test for auto-covariance and the Sargan test (1958) of over-identifying restrictions respectively.

Generally, such models are estimated by applying Arellano-Bond (1991) dynamic panel data estimation techniques. However, a potential weakness of the Arellano–Bond (1991) dynamic panel data estimator (known as the difference GMM) is the assumption that the necessary instruments are based on lagged values of the instrumented variable(s) and hence are 'internal', though the estimators allow for inclusion of external instruments as well. But, the lagged levels are often poor instruments for first differenced variables, especially if the variables are close to a random walk (Arellano and Bover, 1995; Blundell and Bond, 1998). In the system GMM, as propounded by Arellano and Bover (1995) and Blundell and Bond (1998), the estimators include lagged levels as well as lagged differences. Thus, the Arellano-Bover/Blundell-Bond estimators augment the Arellano-Bond estimators by making an additional assumption, that the first differences of instruments are uncorrelated with the fixed effects (Roodman, 2006). Such introduction of more instruments improves efficiency of the estimators considerably.

Further, the Arellano and Bond estimator can perform poorly if the autoregressive parameters are too large or the ratio of the variance of the panel-level effect to the variance of idiosyncratic error is too large. Under such circumstances, the system GMM estimators use additional moment conditions and hence are likely to give better results, especially for panel datasets with many cross-sectional units but only a few time points. This method assumes that there is no autocorrelation in the idiosyncratic errors and requires the initial condition that the panel-level effects be uncorrelated with the first difference of the first observation of the dependent variable.

[16] Since industry is the unit of observation in the present context, endogeneity problem is unlikely to be acute as it normally is when firm or the line of business is the unit of observation (Salinger et al., 1990).

In order to overcome these limitations, the present paper applies the method of the system GMM as propounded by Arellano and Bover (1995) and Blundell and Bond (1998). Further, both one-step and two-step estimators are used. The two-step estimators are used for testing specification and overall significance of the estimated model as they yield standard errors that are asymptotically robust to both heteroscedasticity and autocorrelation. On the other hand, inferences on individual coefficients are based on one-step estimator as their asymptotic robust standard errors are unbiased and reliable. It may be noted that, in case of one-step estimators, the Sargan test over-rejects the null hypothesis of over-identifying restrictions, whereas the asymptotic standard errors of the two-step estimators can be severely downward biased in small samples (Arellano and Bond 1991; Blundell and Bond 1998). Hence, we use both the one-step and two-step estimators to test significance of the overall model and the individual coefficients respectively.

In the present model, inclusion of one-year lagged value of dependent variable as one of the explanatory variables accounts for the dynamic effects[17]. Two-year lagged values of the dependent variable and one-year lagged values of the predetermined variables are used as the instruments to control the endogeneity problem. In addition, growth and M&A are used as additional instruments to reduce such bias further. Besides, variance inflation factors (VIF) are computed to examine if the estimated models suffer from severe multicollinearity problem. Since the present study uses a balanced panel dataset of 49 industries over a period of 8 years but with many missing values, Fisher-type panel data unit root test is carried out to examine if the variables used in regression analysis are non-stationary. The test is based on the null hypothesis that that all panels contain a unit root again the alternative hypothesis is that at least one of the panels is stationary. Both the Augmented Dickey-Fuller (ADF) and Phillips–Perron (PP) unit-root tests have been carried out to ensure consistency.

Following Choi (2001), two methods have been applied to carry out the tests, viz., Inverse χ^2, and Modified Inverse χ^2. Since the mean of different variables at industry level is unlikely to be zero, the drift component is included. While the trend component is added and the cross sectional means are removed through demeaning in Philips-Perron unit-root test, drift is

[17]The use of such dynamic models is favoured, especially, for panels that have a large number of cross-sectional units with a small number of time periods, as we have in the present case. This is so because their estimation methods do not require larger time periods to obtain consistent parameter estimates.

considered in case of the Augmented Dickey-Fuller (ADF) test. A lag length of 2 years is selected by using the Newey and West's (1994) plug-in procedure (i.e., the nearest integer of $4*(T/100)^{2/9}$ with T being the time length of the panels).

5. Regression Results and Discussion

Table 2 presents the summary statistics of the variables used in regression analysis. The partial correlation coefficients between the dependent and the independent variables are given in Table 3. It is found that, the degree of partial association differs across the alternative measures of vertical integration as well as market concentration. Notably, vertical integration measured as the ratio of value added to sales is found to have statistically significant (partial) positive correlation with market power. But, the correlation coefficient is very low (and also not statistically significant) when the ratio of inventory of final goods to sales is considered as the measure of vertical integration[18].

The results of panel unit root tests are reported in Table 4. In case of the ratio of imports to exports (IMEX), and mergers and acquisitions (M&A), the test statistics of the Augmented Dickey-Fuller unit-root test are based on one-year lags. On the other hand, the test statistics for capital intensity (KIR) and the ratio of inventory of final goods to sales (INVT) in Phillips-Perron test are estimated without demeaning. It is found that none of the variables used in the regressions analysis suffers from the problem of unit root (as all the test statistics are statistically significant). Thus, all the variables included in regression analysis are stationary in nature.

[18]It is also found that values of variance inflation factors (VIFs) are very low. This suggests that there is no severe multicollinearity problem in the envisaged relationships.

Table 2: Summary Statistics of Variables Used in Regression Analysis					
Variable	Number of Observations	Mean	Standard Deviation	Minimum	Maximum
PCM_t	386	0.315	0.104	0.014	0.597
MSZ_t	392	10.985	1.225	6.649	13.600
GRS_t	392	0.310	0.190	0.060	0.863
HHI_t	392	0.190	0.166	0.017	0.802
KIR_{t-1}	392	0.869	0.387	0.252	3.074
$IMEX_t$	339	0.907	2.524	0.001	19.416
$SELL_{t-1}$	388	0.062	0.037	0.006	0.181
$TECH_{t-1}$	302	0.035	0.061	0.003	0.655
VA_VO_{t-1}	389	0.372	0.146	0.022	0.851
$INVT_{t-1}$	380	0.477	3.241	0.000	36.759
$GROWTH_t$	392	13.759	8.085	-16.325	50.309
$M\&A_{t-1}$	380	1.918	0.964	0.000	4.625

Table 5 and 6 report the regression results of the envisaged model with the ratio of value added to value of output and the ratio of inventory of final goods to sales being the alternative measures of vertical integration. Further, regression results with the HHI and the GRS Index as the alternative measures of market concentration are also reported in these tables. It is found that, in all the cases, the Wald-χ^2 statistics are significant. This means that all the estimated models are statistically significant. Further, since the Sargan test statistics are not statistically significant, the estimated models do not suffer from the problem of over identification of restrictions in any of the models. In addition, the Arellano-Bond test for autocorrelation suggests that there is no autocorrelation problem of second order, as the respective test statistics are not statistically significant.

Table 3: Partial Correlation Coefficients				
Variable	Ratio of Value Added to Value of Output as Measure of Vertical Integration		Ratio of Inventory of Output to Sales as Measure of Vertical Integration	
	HHI as Measure of Market Concentration	GRS as Measure of Market Concentration	HHI as Measure of Market Concentration	GRS as Measure of Market Concentration
MSZ_t	-0.09	-0.09	-0.28**	-0.27**
CON_t	0.15**	0.18**	0.10	0.14**
KIR_{t-1}	0.10	0.12*	0.22**	0.23**
$IMEX_t$	-0.08	-0.08	-0.16**	-0.17**
$SELL_{t-1}$	0.37**	0.37**	0.54**	0.54**
$TECH_{t-1}$	0.11*	0.11*	-0.02	-0.01
VI_{t-1}	0.48**	0.48**	0.01	0.01

Note: **statistically significant at 5 percent; *statistically significant at 1 percent

As mentioned earlier, we use the one-step estimates for examining statistical significance of the individual coefficients. It is found that, for all the models, the coefficients of lagged market power, current market size, lagged selling efforts, and lagged technology intensity are statistically significant. This means that variations in firms' market power across different industries of Indian manufacturing sector are caused by these factors. However, while the coefficients of lagged market power and lagged selling intensity are positive, those of current market size and lagged technology intensity are negative. This means that market power is higher or increases in industries that had greater market power or larger spending on advertising, marketing and distribution related strategies in the past. On the other hand, the industries with larger market at present or more spending on technology in the past can experience decline in market power. Importantly, sign and statistical significance of the individual coefficients are consistent across alternatives measures of vertical integration as well as market concentration. This suggest for robustness of the econometric results.

Table 4: Results of Fisher-Type Panel Unit Root Tests				
Variable	Based on Augmented Dickey-Fuller Tests		Based on Phillips-Perron Tests	
	Inverse χ^2	Modified Inverse χ^2	Inverse χ^2	Modified Inverse χ^2
PCM_t	201.20	8.29	189.33	6.52
MSZ_t	189.81	6.56	130.30	2.31
HHI_t	154.22	4.02	184.53	6.18
GRS_t	177.89	5.71	257.51	11.39
KIR_{t-1}	191.71	6.69	196.12[2]	7.01[2]
$IMEX_t$	157.70[1]	6.14[1]	306.46	16.13
$SELL_{t-1}$	176.02	5.77	286.17	13.44
$TECH_{t-1}$	129.41	5.78	166.12	6.57
VA_VO_{t-1}	202.47	7.68	179.87	5.85
$INVT_{t-1}$	612.24	37.80	265.16[2]	12.21[2]
$GROWTH_t$	189.67	6.55	271.22	12.37
$M\&A_{t-1}$	180.54[1]	6.75[1]	303.59	14.69

Note: [1]Based on one-year lag; [2]Based on non-removal of cross sectional means

Notably, in none of the models, the coefficient of vertical integration is statistically significant implying that such a business strategy does not cause any significant change in firms' market power at industry level. There is other evidence (e.g., Bhuyan, 2005) of no significant impact of vertical integration on market power. However, this is contradictory to the finding of Martin (1994) that vertical integration enhances oligopolistic coordination and market power. This is so possibly due to balancing of influence of diverse forces. On the one hand, larger extent of vertical integration is expected to enhance market power through greater access to input and/or output markets and creation of entry barriers. On the other hand, vertical integration also facilitates diffusion of innovation outcomes and distribution of the expenses across a wide range of products that are linked.

It is also found that technology intensity lowers firms' market power and this is consistent with the findings of Delorme et al (2002). While this may largely be due to the gestation lag and the problem of amortization in recognizing future benefits, it is also possible that technology strategies, especially in-house R&D efforts have failed in reaping the desired outcomes for the firms, particularly in respect of creating entry barriers. However, such inverse relationship between technology intensity and market power is to some extent contradictory with Kambhampati and Parikh (2003) and Mishra (2008). While Kambhampati and Parikh (2003) found a statistically significant positive relationship between in-house

R&D and profit margin at firm level, Mishra (2008) found no statistically significant relationship between the two[19].

Table 5: Regression Results with Ratio of Value Added to Value of Output as Measure of Vertical Integration								
Variable	HHI as Measure of Market Concentration				GRS as Measure of Market Concentration			
	Two-Step Estimates		One-Step Estimates		Two-Step Estimates		One-Step Estimates	
	Coeff.	z-Statistic	Coeff.	z-Statistic	Coeff.	z-Statistic	Coeff.	z-Statistic
Intercept	0.17085	4.05	0.23511	1.64	0.17438	4.60	0.22931	1.59
PCM_{t-1}	0.70651	17.90	0.70826	5.01**	0.69494	16.46	0.69721	5.04**
MSZ_t	-0.01492	-3.68	-0.02187	-1.77*	-0.01544	-4.18	-0.02174	-1.74*
CON_t	0.06859	2.34	0.11142	0.92	0.05944	2.45	0.09777	0.97
KIR_{t-1}	0.00972	1.28	0.00919	0.43	0.00837	1.05	0.00812	0.38
$IMEX_t$	-0.00030	-0.30	-0.00020	-0.11	-0.00036	-0.36	-0.00025	-0.13
$SELL_{t-1}$	0.64641	4.79	0.64523	1.97**	0.63317	4.54	0.63633	1.98**
$TECH_{t-1}$	-0.03599	-5.24	-0.04055	-1.74*	-0.03434	-4.14	-0.04037	-1.67*
VI_{t-1}	0.07430	2.19	0.09262	0.81	0.07941	2.12	0.09361	0.82
Wald–Chi^2		2521.0**		294.4**		2638.3**		288.4**
Sargan Test for Over-Identification of Restrictions		21.36 (0.26)				21.69 (0.25)		
Arellano Bond Test for AR (1)		-2.01 (0.04)		-1.80 (0.07)		-2.01 (0.04)		-1.84 (0.04)
Arellano Bond Test for AR (2)		-0.20 (0.84)		-0.20 (0.84)		-0.20 (0.84)		-0.18 (0.86)
Number of Observations		231		231		231		231

Note: (1) **statistically significant at 5 percent; *statistically significant at 10 percent

(2) Figures in parentheses indicate the level of significance of the corresponding test statistic.

(3) For one-step estimates, the z-statistics are computed using heteroscedasticity corrected robust standard errors.

[19]These contradictions may largely be due to model specification and period of analysis. For example, while both Kambhampati and Parikh (2003) and Mishra (2008) have added majority of the variables as the independent variables like the present paper, impact of vertical integration is not controlled in either of these two studies. Hence, inclusion of vertical integration in the present paper makes marked departure from nay of the existing studies and this is reflected in the findings. Further, while Kambhampati and Parikh (2003) and Mishra (2008) focussed in the 1990s and applied Arellano-Bond (1991) dynamic panel data estimation techniques, the present paper covers the decade of 2000s and applies the system GMM as propounded by Arellano and Bover (1995) and Blundell and Bond (1998). Such differences in period of coverage and estimation techniques might have bearings on the findings of the present paper vis-a-vis the earlier studies.

The statistically significant but positive coefficient of selling intensity suggests that greater efforts towards advertising, marketing and distribution result in higher market power. This is so possibly because greater selling intensity through advertising helps in raising market power by creating brand image, differentiating products and services from the rivals and creating entry barriers. There is some evidence of anti-competitive effects of advertising, especially through creation of entry barriers (Shephard and Shepherd, 2004). But expenditures on promoting the products or expanding distribution networks also result in development of related complementary assets. Hence, average market power of firms is likely to be higher in industries where selling intensity is larger. There is evidence of better financial performance following increases in expenditure on distribution and marketing related activities (Majumdar, 1997). Similarly, Martin (1993) and Bhuyan (2005) found statistically significant positive relationship between advertising intensity and market power. Increase in market concentration has also been observed following firms' advertising efforts (e.g. Comanor and Wilson, 1974; Martin, 1979; Shepherd, 1982; Das et al.1993).

Table 6: Regression Results with the Ratio of Inventory of Output to Sales as Measure of Vertical Integration								
Variable	HHI as Measure of Market Concentration				GRS as Measure of Market Concentration			
	Two-Step Estimates		One-Step Estimates		Two-Step Estimates		One-Step Estimates	
	Coeff.	z-Statistic	Coeff.	z-Statistic	Coeff.	z-Statistic	Coeff.	z-Statistic
Intercept	0.22539	5.14	0.29277	2.02**	0.22104	5.36	0.28832	1.99**
PCM_{t-1}	0.74480	28.49	0.77303	8.34**	0.74016	28.94	0.76323	8.63**
MSZ_t	-0.01980	-4.48	-0.02716	-2.13**	-0.01978	-4.70	-0.02721	-2.11**
CON_t	0.06559	2.05	0.10935	0.84	0.05751	2.19	0.09707	0.89
KIR_{t-1}	0.01360	1.89	0.01699	0.74	0.01288	1.80	0.01618	0.71
$IMEX_t$	-0.00084	-1.67	-0.00098	-0.91	-0.00096	-1.92	-0.00106	-0.98
$SELL_{t-1}$	0.83401	5.95	0.80578	2.19**	0.85325	6.13	0.80271	2.18**
$TECH_{t-1}$	-0.05525	-10.26	-0.05847	-3.16**	-0.05417	-9.76	-0.05885	-3.24**
VI_{t-1}	0.00001	0.13	0.00008	0.48	-0.00002	-0.15	0.00006	0.36
Wald–Chi^2		2038.1**		286.0**		1811.1**		267.3**
Sargan Test for Over-Identification of Restrictions		20.29 (0.32)				19.72 (0.35)		
Arellano Bond Test for AR (1)		-1.94 (0.05)		-1.83 (0.07)		-1.95 (0.05)		-1.87 (0.06)
Arellano Bond Test for AR (2)		-0.16 (0.87)		-0.16 (0.87)		-1.17 (0.87)		-0.14 (0.89)
Number of Observations		228		228		228		228

Note: (1) **statistically significant at 5 percent

(2) Figures in parentheses indicate the level of significance of the corresponding test statistic.

(3) For one-step estimates, the z-statistics are computed using heteroscedasticity corrected robust standard errors.

Our results suggest that capital intensity does not cause any significant influence on market power. This is consistent with Mishra (2008), but contradictory to the findings of Ornstein (1975), Liebowitz (1982), Domowitz et al (1986) and Martin (1988) and Bhandari (2010). While, according to Bhandari (2010), capital intensity causes negative impact on price-cost margin, Ornstein (1975), Liebowitz (1982), Domowitz et al (1986) and Martin (1988) found a positive impact on the same. It is argued that high capital intensity can cause large sunk costs that create entry barrier and thereby give rise to monopoly profit (McDonald, 1999).

The negative and significant coefficient of market size is probably not surprising. It is expected that larger market can influence market power in three possible ways. First, larger market can create opportunities for the existing firms to expand their business and, thereby achieve greater efficiency through economies of large-scale operations (Kambhapati, 1996). Secondly, larger markets can also induce new players to enter into the industry. This can reduce the degree of seller's concentration and hence market power (Ghose, 1975). Finally, larger market may create additional pressure on inputs and thereby raise their prices (Goldar and Aggarwal, 2004). The impact of market size on market power, therefore, depends on how these diverse forces empirically dominate each other. Apparently, the efficiency gains and entry (or the threat of potential entry) seem to have kept the market power in check.

It is also found that market concentration does not have any significant impact on market power. This is consistent with Mishra (2008), but contradictory to the positive relationship between the two as it is found in many of the existing studies (e.g., Scherer and Ross, 1990; Martin 1993; Kambhampati, 1996; Rao, 2001; Goldar and Agarwal, 2004). As mentioned earlier, such contradictions may largely be due to model specification, period of analysis and estimation techniques applied. It is also possible that the strategies towards creating entry barriers have failed and new firms have entered into the market. Besides, in addition to the degree of seller's concentration, market power at industry level also depends on price elasticity of demand and strategic conjectures of firms. Probably, a detailed firm level analysis would provide better insights in this regard.

Importantly, the paper finds that the coefficient of the ratio imports to exports is not statistically significant. This is so possibly because greater exports indicate enhanced competitiveness, whereas higher import intensity raises competitive pressures. It is possible that competitive pressures from imports force domestic firms to explore international market through exports. Hence, when exports are encouraged and imports are liberalized simultaneously, the combined effects of imports and exports may leave market power largely unchanged. This has important implications for trade policies and their complementarities with competition policy.

6. Summary and Conclusions:

In the context of decline in vertical integration and increase in outsourcing of manufacturing jobs during the last two and half decades of economic reforms, the present paper is an attempt to examine how such 'vertical disintegration' affected market power of firms in major industries of Indian manufacturing sector and understand the implications of such strategic changes for competition policy. The paper applies the system GMM approach to estimation of dynamic panel data models as propounded by Arellano and Bover (1995) and Blundell and Bond (1998) for a panel data set of 49 industries for the period 2003-04 to 2010-11. It is found that vertical integration does not cause any significant impact on market power in a dynamic set up. Instead, average market power of firms in an industry is influenced by its lagged value, size of the market, and selling and technology related efforts. While selling intensity has positive impact on market power, the impact of market size and technology intensity is negative. Notably, like vertical integration, market concentration, import to export ratio, and capital intensity do not have any significant impact on market power.

The findings of the present raise some important issues relating to policies and regulations of M&A, international trade and intellectual property rights. First, what should be the regulatory approach to M&A, particularly when they are not necessarily anti-competitive? This is very important considering that neither market concentration nor vertical integration has any significant impact of market power. Instead, integration of (weaker) firms through M&A may enhance competitiveness and restrict emergence of market power.

Second, given that efforts towards technology development reduce market power, what should be policy and regulatory approach to encourage in-house R&D and technology import? Making (R&D) and buying (licensing) seems to be mechanisms to meet competition or enhance rivalry in various industries resulting in lower market power. It needs to be emphasized that technology intensity in Indian manufacturing sector is still very low and M&A and inward FDI are considered as alternative routes of sourcing technology (Basant and Mishra, 2016). Besides, there is little empirical evidence that stronger intellectual property rights stimulate local innovation (Branstetter, 2004). These aspects should be addressed while designing policies for technology development as it has important implications for market competition.

Admittedly, our findings are tentative and robust conclusions in this regard require further exploration. While the present paper focuses on industry level analysis and thus can capture impact on the average firm in an industry, the issue of market power or efficiency can be addressed more directly at the firm level. Furthermore, a firm level analysis can also help in controlling strategic conjectures following vertical integration. This is very important as strategic conjectures are integral part of market power in oligopoly.

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