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THE MARKET VALUATION OF INNOVATION: THE CASE OF INDIAN MANUFACTURING

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Abstract

We revisit the relationship between market value and innovation in the context of manufacturing firms in India, using data for 2001-2010. In a milieu where most firms do not patent, the concern was whether 'small' innovations would be valued by the stock market. Interestingly, we find that the market places greater value on the relatively innovative firms, though the magnitude of this premium is much smaller than that for developed economies. Further, the market value-innovativeness relationship varies substantially across industry groups, surprisingly having the smallest magnitude for the science-based industries. This variation could be explained by the profit expectation and profit risk associated with the different industries.

1. Motivation

Today innovation is considered to be the prime motive force behind economic growth. Firms spend millions worth of scare resources on innovation, and it makes eminent sense to want to know whether the market values innovating firms differently from the non-innovating ones. Of course, innovative activity tends to be highly risky by its very nature, and may not set the cash registers ringing for long periods. The market need not, however, wait for the innovative activity of firms to result in higher profits before placing a value on such activity. It could, alternatively, value innovative activity in terms of the present discounted value of the expected profits that such activity is likely to generate (Griliches 1981). While there is persuasive evidence that developed country stock markets do value innovative activity by firms, can we expect the same in the context of less developed economies? A major reason for this incredulity is the fact, that the predominant share of intellectual capital appears to be generated in a handful of developed economies, whether measured in terms of the inputs into innovation (such as research and development expenditure) or in terms of the outputs of innovation (such as product patents). .

Nevertheless, the literature does recognize the existence of some innovative activity in a few developing countries, even though this may manifest itself primarily in the form of process patents, or utility models, or even smaller innovations which may not qualify for formal protection of any sort. Although these innovations may be small in the larger scheme of things, they appear to have value insofar as they contribute to raising firm productivity and profitability. In view of these facts, therefore, questions about the stock market's responsiveness become as relevant in the developing country context.as they have historically been in the context of developed economies. Thus, are more innovative firms valued more highly than less innovative ones, ceteris paribus? Is the market valuation responsive to the quality of innovation? Does the relationship between firm market value and innovativeness vary across industries, and if so, for which ones is it relatively important? Is the variation in the firm market value–innovativeness relationship across industries, if any, related to variations in economic performance across these industries? This study purports to explore the nexus between the private stock market value of firms and their innovative activities, in the context of manufacturing industries in the BRIC economy of India.

The received literature on the market valuation of the intangible assets of the firm has been informative on a number of counts. Griliches (1981), using US data, reports that a dollar increase in R&D raises market value of the firm by about $2 in the long run. Bloom and Van Reenen (2000) confirm these findings with UK data, finding that patents have a significant (immediate) impact on firm market value, such that doubling the citation-weighted patent stock raises firm value (per unit of physical capital) by about 43%. Hall, Jaffe and Trajtenberg (2005) are also in agreement, though they report a smaller increase of about 25% with a doubling of the (normalized) stock of knowledge capital. Further, studies show that the stock market valuation differs considerably across industries (Greenhalgh and Rogers 2006), and that the market may well value intangible assets more than a firm's tangible assets (Hall 1993). An exception to these studies appears to be that of Hall and Oriani (2006) who report only a weak relationship for the market valuation of intangible assets in Italy. It is striking, however, that the predominant bulk of the empirical evidence relates to the US, and a little to some other European economies. Do the same conclusions apply to less developed countries as well, at least those where firms are engaged in some innovative activity and the stock market is functional? In view of the recent trends by developed country multinationals, to increasingly locate production and innovation in certain developing countries, these are questions that might be of interest to developed country entities as well.

This study contributes to the literature by broad-basing the evidence on the nexus between market valuation and firm-level intangible assets, by focusing on the BRIC economy of India. We use data for a recent time period when growth has been on the up, and the economy has apparently displayed numerous signs of higher productivity (see Topalova and Khandelwal 2005; and the references therein), and innovativeness (The Economist 2010). This performance inevitably leads to the question whether the higher productivity and innovativeness have been reflected in the domestic stock market movements during this period. What distinguishes our context from those in the received literature is precisely the fact that while the firms may have been 'innovative', they have still not displayed a strong innovative performance as reflected by patents, which makes it far from obvious that the stock market would place any differential value on such innovation as there might have been. Second, we prefer not to follow the literature in using patents counts – raw or citation-weighted – in studying this relationship, because few Indian firms take out patents, especially product patents. Despite that, it may be the case that these firms are indeed innovative, although those innovations may be 'small' and not different enough from the state of the art to merit formal protection in the form of patents of any sort. In fact, these innovations would not even be reflected in terms of 'utility model' certificates, simply because India never had such a system in place. Therefore, to allow for the possibility of these 'small' innovations, we prefer to represent innovativeness in terms of the 'knowledge capital' generated by the research and development investment of firms (see below for details). Third, we study how the variation in the market value-innovation relationship across industries may be linked to the variation in expected profitability and the riskiness of profits across these industries.

Using data for the period 2001-2010 for a large sample of 380 Indian firms in the manufacturing sector, we find that despite a milieu where most firms do not obtain patents or even utility model certificates, the stock market places greater value on the relatively innovative firms, ceteris paribus. Further, the market appears to be discerning about the 'quality' of innovation as well. The relationship between firm market value and innovation varies substantially across the different industry groups; and, surprisingly, this 'multiplier' is the smallest for the science-based group of industries which are amongst the most innovative. Further investigation reveals that the variation in the market valuation-innovativeness 'multiplier' across industries can be explained by variations in the expected profit and profit risk that stock market investors/speculators associate with different industries.

The detailed analysis is presented in the following sections. Section 2 develops the relationship to be estimated. Section 3 details the data set and explains the computation of the model variables. Section 4 discusses the basic empirical results. Sections 5 and 6 report the results of various robustness checks. Section 7 examines the heterogeneity of the relationship across industry groups. Section 8 studies whether this variation across industries is explained by variations in expected firm/industry performance. Finally, section 9 rounds off with the major conclusions.

2. The Proposed Hypothesis

On the premise that the innovative activity of firms leads to the generation of 'knowledge capital', we propose to measure the private value of firm innovation in terms of the marginal effect of a unit change in knowledge capital on the capitalized market value of a firm. Following Griliches (1981) and Hall (1993) we make the reasonable hypothesis, that in any given period the market values a firm for what it owns, namely its physical capital, 'knowledge capital', and 'other intangible capital'. The notion of physical capital is well-defined (plant, equipment, inventories, etc.) and does not require further elaboration. Knowledge capital refers to the stock of knowhow embodied in the ideas, innovations, and inventions that a firm has title to; where this entitlement may be explicit as in the case of ownership of patents for instance, or else implicit as with unpatented matter. 'Other intangible capital' refers to factors such as reputation capital, which are too amorphous to be easily conceptualised.

In addition to the magnitudes of these capital stocks, the market's valuation of a firm would also be swayed by the quality of the capital stocks; just as the market value of a consignment of apples would depend both on their quantity as well as their quality. Although the quality of all three types of capital may differ across firms and over time, one would expect this to be particularly true of the stock of knowledge capital, in part because of the stochastic nature of the innovation process. For instance, some R&D investment might result in very small innovations, whereas other R&D investment might generate major breakthroughs. Even though the stock of knowledge capital generated in both these cases may be of similar magnitude, the quality of the capital stock would be a whole lot higher in the latter case.

Thus, the market value of a firm (V) may be expressed as a function of its stocks of physical capital (K_P), knowledge capital (K_K), and other intangible capital (K_{OI}), as well as the quality of its capital stocks (S), according to the relation

$$V = p(K_P + \beta K_K + \gamma K_{OI} + \delta S)^{\sigma} \tag{1}$$

where p is the market premium of the firm's stock value over its replacement cost of capital, β is the shadow price of the knowledge capital, γ is the shadow price of the 'other intangible capital', δ is the shadow price of the quality of capital, and σ is the scale factor in this valuation relation. Although one could have considered three different quality variables corresponding to the three different stocks of capital, we preferred to be circumspect in our modelling, knowing the data limitations. Taking logarithms and subtracting $ln\ K_P$ from both sides, this relationship may be rewritten as

$$\ln\left(\frac{V}{K_P}\right) = \ln(p) + \sigma \ln(K_P + \beta K_K + \gamma K_{OI} + \delta S) - \ln K_P \tag{2}$$

or

$$\ln\left(\frac{V}{K_P}\right) = \ln(p) + \sigma \ln\left[K_P\left(1 + \beta\frac{K_K}{K_P} + \gamma\frac{K_{OI}}{K_P} + \delta\frac{S}{K_P}\right)\right] - \ln K_P \tag{3}$$

or

$$\ln\left(\frac{V}{K_P}\right) = \ln(p) + \rho \ln K_P + \sigma \ln\left(1 + \beta\frac{K_K}{K_P} + \gamma\frac{K_{OI}}{K_P} + \delta\frac{S}{K_P}\right) \tag{4}$$

subject to the condition that $\rho = \sigma - 1$. If the market premium p is thought of as being partly systematically determined by market forces, and partly randomly determined by forces beyond the control of the players in the market, the above equation may be restated as

$$\ln\left(\frac{V}{K_P}\right) = \ln(p) + \rho \ln K_P + \sigma \ln\left(1 + \beta\frac{K_K}{K_P} + \gamma\frac{K_{OI}}{K_P} + \delta\frac{S}{K_P}\right) + \epsilon \tag{5}$$

Allowing for firm fixed effects and year fixed effects in the context of firm-level panel data (as we shall use), the estimating equation corresponding to the above specification is

$$\ln\left(\frac{V}{K_P}\right)_{it} = \rho \ln(K_P)_{it} + \sigma \ln\left[1 + \beta\left(\frac{K_K}{K_P}\right)_{it} + \gamma\left(\frac{K_{OI}}{K_P}\right)_{it} + \delta\left(\frac{S}{K_P}\right)_{it}\right] + \alpha_i + \mu_t + \epsilon_{it} \tag{6}$$

where α_i signifies firm-specific 'time constant' factors such as (possibly) tax rates, μ_t references factors that affect the sample firms similarly but may vary over time such as the 'depth' of stock markets, and ϵ_{it} is the stochastic error term.

Given the twin simplifying claims that $\sigma = 1$, and that $ln(1 + x) \approx x$ when x is 'small',[1] as in the received literature reviewed earlier, the model spelt out above yields the alternative estimating equation

$$\ln\left(\frac{V}{K_P}\right)_{it} \approx \beta\left(\frac{K_K}{K_P}\right)_{it} + \gamma\left(\frac{K_{OI}}{K_P}\right)_{it} + \delta\left(\frac{S}{K_P}\right)_{it} + \alpha_i + \mu_t + \epsilon_{it} \qquad (7)$$

To appreciate the difference between estimating equations (6) and (7), note that the implied elasticities of firm market value with respect to knowledge capital ($\partial \ln V / \partial \ln K_K$) are $\sigma\beta K_K/(K_P + \beta K_K + \gamma K_{OI} + \delta S)$ and $\beta K_K/K_P$, respectively. Thus, if in fact σ is found to be close to unity, one would expect specification (7) to yield upwardly biased estimates of the change in the capitalized market value of a firm as a result of a change in the stock of its knowledge capital. But if σ differs from unity, the elasticity estimate from (7) could be upwardly or downwardly biased.[2]

To render estimating equations (6) and (7) estimable, we need to be able to measure 'knowledge capital', 'other intangible capital', and the overall 'quality of capital'. Researchers have attempted to capture knowledge capital either in terms of the inputs into the innovation process – namely, research and development investment – and/or in terms of the output of the innovation process – namely, patents (and other intellectual property) that firms acquire based on the innovation (Hall and MacGarvie 2010, Greenhalgh and Rogers 2006, Hall, Jaffe and Trajtenberg 2005, Bloom and Van Reenen 2000, Blundell et al. 1999, Cockburn and Griliches 1988). We find the former approach more appropriate in the context of a less developed country such as India, where few firms own patents. The research and development investment that firms undertake indicates some innovative potential, even though the innovations that result therefrom may not be major enough to merit a patent or other formal protection. In fact, in countries such as India which has never had a system of 'utility models', unlike others such as Germany and Japan, these 'smaller' innovations cannot obtain even this weaker form of protection. Despite that fact, the resulting innovations may have positive implications for the production activities of firms. In view of these arguments, we eschew measurement of firm innovation in terms of patents and other intellectual property resulting from innovative activity, and prefer to measure it in terms of constructs based on the inputs into such activity, namely research and development investment. How exactly we use R&D data to construct this variable is explained in the ensuing section (see sub-section 3.1 below).

We propose to measure the stock of 'other intangible capital' as the sum of 'other intangible assets' owned by a firm (such as licenses, quota entitlements, franchises, marketing rights, brands etc.) and the stock of reputation capital generated by its advertising expenditure. Again, how exactly we create the latter component given a firm's flow of advertising expenditure is explained in the next section (see sub-section 3.2 below).

The quality aspect of capital, specifically knowledge capital, has mostly been captured in terms of patent citations. Citation weights are found to considerably improve non-weighted patent-based measures of knowledge capital, even though such weights may not accurately reflect the relative significance of different patents, just as citations of refereed journal articles may not correctly reflect their relative importance in a given field. What appears to make such measures particularly inappropriate in the less developed country context such as that of India, is that few firms file patents at all, making patent citations irrelevant to most firms. A much larger percentage does undertake R&D investment, however, so that if we are to proxy the quality of the 'small' innovations that result therefrom, we would have to look beyond patent citations. As a first approximation, we represent the quality of capital (S) by the post-tax profit of firms, for better quality capital (or that associated with ‘meaningful’ innovations from the production viewpoint) should increase profit more than poorer quality capital (or that associated with no innovations or else innovations that are not practically useful); after all, ‘the proof of the pudding is in the eating’.

3. The Data Set and Variables

The data set pertains to a large sample of firms drawn from the ‘Prowess’ database, sold by the Centre for Monitoring Indian Economy (CMIE 2012). The data pertain to firms traded on the Bombay and National Stock Exchanges of the country. Only firms for which data were available for the regressors physical capital and knowledge capital for the ten-year period 2001-2010 were retained. This left us with data on 380 firms for the period 2001-2010, or 3800 observations.[3] To remove/minimize the influence of outliers, observations with a market value to physical capital ratio exceeding 20 or a debt to assets ratio exceeding 5 were then dropped (Hall and Oriani 2006),[4] which left us with a sample of 3551 observations relating to 378 firms, with an average of 9.4 years of data for each firm. These firms were spread across 22 manufacturing industries (mostly) at the broad 2-digit and (some at the) 3-digit levels of the National Industrial Classification (NIC). These industries are automobile ancillaries, automobiles, cement, chemicals, (other) construction material, (other) consumer goods, domestic appliances, drugs and pharmaceuticals, electrical machinery, electronics, food and agricultural products, gems and jewellery, glass and glassware, leather products, metals and metal products, non-electrical machinery, paper and paper products, personal care, petroleum products, plastic products, rubber products, and textiles and textile products. These broad industry groups comprised 122 industries at the relatively finer 5-digit level, which we eschew naming individually for want of space.

The market value of firms was computed as the sum of equity and (the book value of) debt. Physical capital was measured in terms of the book value of net fixed assets. The quality of capital was computed as post-tax profits deflated by the (industry-specific) wholesale price index for output. The regressors ‘knowledge capital’ and ‘other intangible capital’ were computed as explained below.

3.1 *Computing the stock of ‘knowledge capital’*

We construct the stock of knowledge capital from the flow of R&D expenditure using the perpetual inventory relation (Hall 1990)

$$K_{Kt} = (1-\theta)K_{K(t-1)} + RD_t \tag{8}$$

where K_K is the stock of knowledge capital, *RD* is research and development investment, θ is the rate of depreciation of knowledge capital, and *t* is the time subscript. To employ this relation, we need to resolve a number of issues. First, it is very difficult to conjecture an appropriate rate of depreciation for knowledge capital, and we follow the literature in employing a rate of 15% per annum and, alternatively, 30% per annum for a robustness check. Second, if there are only one or two missing values in the R&D series for a firm, we interpolate these, since even a single missing value for R&D for a firm will cause all the associated stocks to be missing. Third, to derive the value of the stock in the ‘first’ period, we divide the R&D investment in that period by the sum of the rate of depreciation of knowledge capital and the pre-sample rate of growth of R&D. Given the paucity of R&D data, we employ the sample period R&D data (along with the few pre-sample observations that are available for some firms), to proxy the pre-sample rate of growth of R&D. This is found to range between approximately 1.6% per annum and 2.6% per annum across the 22 broad industry groups that the sample firms belong to (compared to the 8% per annum that Hall

(1990) suggests for the U.S.). Having computed the value of the stock in the 'first' period, we then employ equation (8) to derive the complete series.

3.2 *Computing 'other intangible capital'*

The stock of 'other intangible capital' (K_{OI}) is even more problematic to measure, given its amorphous nature. We attempt to capture it in terms of the sum of the stocks of 'other intangible assets' (K_{OIA}) owned by the firm (such as licenses, quota entitlements, franchises, marketing rights, brands, etc.) and the stock of reputation capital (K_R) generated by its advertising expenditure. To estimate the latter component, we again employ the perpetual inventory relation

$$K_{Rt} = (1 - \pi)K_{R(t-1)} + A_t \qquad (9)$$

where K_R is the stock of 'reputation capital', A is advertising expenditure, π is the rate of depreciation of 'reputation capital', and t is the time subscript. In consonance with the previous sub-section, we take π to be 15% per annum, and employ the sample period rate of growth of advertising expenditure in lieu of its pre-sample rate of growth. The latter is found to range between 1.7% per annum and 2.4% per annum across the 22 industry groups. Having derived the 'first' period stock of reputation capital (using the same methodology as that outlined in the previous sub-section for knowledge capital), we then derive the reputation capital series for each firm in the sample using equation (9). Adding the estimates of the stock of reputation capital so derived to the stock of 'other intangible assets' owned by firms, we obtain estimates of the stock of other intangible capital, that is $K_{OI} = K_{OIA} + K_R$.

Summary statistics for each of the variables are presented in Table 1. It is very difficult to put these statistics in perspective by comparing their magnitudes across countries, because one would be comparing physical capital of rather different kinds and vintages, knowledge capital with very different implications for raising productivity, stock markets with hugely varying depths and levels of development, and more. Nevertheless, some comparison might be helpful, for which we use the recent study of Hall and Oriani (2006). We find the so-called Tobin's average q (V/K_P) to be 4.5 on average, which is much larger than the magnitudes reported by Hall and Oriani (2006) for the UK, France, Germany and Italy, and even larger than that for the US. The ratio of knowledge capital to physical capital (K_K/K_P) is small, averaging 0.12, as one would expect for a country where firms do not invest a whole lot in R&D. It is no surprise then, that this figure is only about one-fourth or one-third that for the US, Germany and France, although it is about the same as that for the UK. The mean ratio of other intangible capital to physical capital (K_{OI}/K_P) is fairly high at 0.25, exceeding those for the US, UK, Germany, France and Italy, although the category of 'other intangible capital' is a mixed bag, and this comparison should be taken with reticence. The real profits to physical capital ratio (S/K_P) is found to average merely 0.001, but no equivalent figures for other countries are reported by Hall and Oriani (2006), because they do not employ this variable in their analysis.

That the variables in question have highly skewed distributions becomes evident from considering their median values. At 3.26, the median value of Tobin's average q is a whole lot smaller than its mean. The median ratio of the stock of knowledge capital to physical capital is a mere 0.05, and that of the stock of other intangible capital to physical capital even smaller at 0.01. The median value of the ratio of real profits to physical capital is similarly much smaller than its mean value. The correlation matrix suggests a positive association between market value and the intangible capital variables, while discounting the possibility of any significant collinearity between the regressors.

4. Market Value and Intangible Assets: Empirical Results

4.1 *The Nonlinear Specification*

We first present the estimation results using the nonlinear specification (6), where the parameter estimates are derived using nonlinear least squares. The pooled OLS and firm-level fixed effects results are reported in Table 2. All regressions allow for year fixed effects, and report robust standard errors. The null hypothesis that all slopes are simultaneously zero is strongly rejected for all regressions. Commencing with the pooled OLS regressions, column (1) reveals that the (normalised) stock of knowledge capital (K_K/K_P) has a strongly significant positive effect on (normalised) market value. Inclusion of the other intangible capital variable (K_{OI}/K_P) in the column (2) regression, and the real profit variable (S/K_P) in the column (3) regression, leaves the earlier result unchanged. In addition, both the added regressors are also found to have a strong positive effect on (normalised) market value.

One might argue that the sample firms differ from each other in a number of respects, especially firms belonging to different industries. A parsimonious way to control for these differences would be to include firm-level fixed effects in the estimated regressions, as is true of the results reported in columns (4), (5) and (6). The Heckman test appears to unambiguously favour the fixed-effects specification. Once again, we note that the (normalised) stock of knowledge capital (K_K/K_P) has a strong positive effect on (normalised) market value, and that this result remains unchanged as we add the variables representing other intangible capital (K_{OI}/K_P) and real profit (S/K_P). In addition, these latter two variables are themselves strongly positively associated with market value. The coefficient of the knowledge capital variable settles around 0.58 in the 'full' regression of column (6), with a corresponding elasticity at the means of 0.04, The coefficient of 'other intangible capital' is only about one-third as large at 0.20, but with a corresponding elasticity that is also about 0.04. The normalized profit variable also has a strong positive effect on the dependent variable, although we only have limited interest in this effect. The scale parameter σ turns out to be about 0.8, which is significantly less than the figure of unity assumed in much of the literature. This indicates a plausible decreasing returns to scale relationship between market value and increments in all the regressors taken together.

4.2 *The Linear Specification*

The regression results of the linear specification (7) are presented in Table 3. The first three columns report the pooled OLS results, and the last three the fixed effects results. In all the regressions the knowledge capital variable exhibits a strong positive influence on the dependent variable. Again, the Hausman test appears to strongly support the fixed-effects specification. Focusing on the fixed-effects 'full' regression of column (6), we find that not only is the coefficient of the knowledge capital variable (0.48) sufficiently different from the corresponding coefficient in the nonlinear specification (0.58 in column 6 of Table 2), all the other results are substantially downwardly biased as well. This bias stems from two sources – first, the fact that specification (7) presumes $\sigma = 1$, when in fact it is about 0.8 as we found in the previous section; and second, the simplification underlying specification (7) that $\ln(1 + x) \approx x$, where $x = \beta\left(\frac{K_K}{K_P}\right)_{it} + \gamma\left(\frac{K_{OI}}{K_P}\right)_{it} + \delta\left(\frac{S}{K_P}\right)_{it}$ in our specific context. Using the coefficient values reported in Table 2, column (6), and the regressor mean values reported in Table 1, we find that $x = 0.165$, so that $\ln(1 + x) = 0.153$ for our sample of firms, a difference of about 7.5%. In brief, therefore, it does not appear advisable to make the simplifying assumptions underlying the linear specification (7), but rather to rely on the results of the nonlinear specification.

5. Market Value and Intangible Assets: Robustness check

As a robustness check, we compute alternative measures of the stocks of knowledge capital (K_K'/K_P) and other intangible capital (K_{OI}'/K_P), allowing for a 30% per annum rate of depreciation instead of the earlier 15% per annum. The results are reported in Table 4, and we find that qualitatively they are no different from those discussed in the previous section. Further, even from the quantitative viewpoint, we find the elasticities to be much the same as before. Thus, comparing the preferred fixed-effects nonlinear estimates of Table 4, column (3)[5] with those of Table 2, column (6), we note that the elasticities at the means are 0.05 versus 0.04 for knowledge capital, 0.04 in both cases for other intangible capital, and 0.03 in both cases for real profits. The same holds for a comparison of the elasticities at the median levels of the variables. Of course, this is what one would expect given the high correlation of 0.98 between K_K/K_P and K'_K/K_P, and the correlation of 0.99 between K_{OI}/K_P and (K'_{OI}/K_P). Given that our earlier results are robust to the changes proposed in this section, we revert to our earlier definitions of the knowledge capital and other intangible capital variables.

6. Market Value and Intangible Assets: Correcting for Endogeneity

A problem with estimating the relationship between firm innovation and market value can be that the treatment variable may be endogenous; it may be the case that innovation is undertaken with the realisation that it will influence the stock market valuation of the firm. What weakens this criticism in our case is the fact that the dependent variable is an end-of-period stock, whereas knowledge capital, and other intangible capital are stocks that accumulate within the period, as a result of the flows of R&D, advertising and other expenditures (see also Greenhalgh and Rogers 2006 who point this out for their data as well). Nevertheless, to get around this infernal problem, we re-estimate the relationship using lagged values of the regressors; in other words, we work with the weaker assertion that the regressors in earlier periods are pre-determined, and are not likely to have been influenced by future market value considerations given the proverbial volatility of stock markets.

Table 5 reports the fixed effects nonlinear estimation results, which we consider relatively preferable, as well as the fixed effects results using the linear specification for comparison purposes. All regressions use regressors lagged one period, and we find that the results are qualitatively no different from those reported earlier in section 4. In fact, the coefficient of knowledge capital and other intangible capital from the ‘full’ nonlinear specification of column (3) is about the same as that from column (6), Table 2; namely, about 0.6 and 0.2, respectively. Therefore, there does not appear to be any substantive advantage in using lagged regressors in the estimation exercises.

6.1 *Economic Significance*

The elasticity estimates pertaining to knowledge capital are consistent across the alternative nonlinear, fixed effects specifications estimated, as is evident from Table 2 column (6), Table 4 column (3), and Table 5 column (3). The magnitude of the estimates is rather small, however, being around 0.5 at the regressor means. This implies that a doubling of the knowledge capital stock (per unit of physical capital) would lead to an increase in market value by only about 5%. Compare this with the 43% figure reported by Bloom and Van Reenen (2000) for the UK, 25% reported by Hall, Jaffee and Trajtenberg (2005) for the US, and 24%, 22% and 18% for France, Germany and Italy, respectively, reported by Hall and Oriani (2006). A possible explanation for this large difference could be precisely the fact that Indian firms do not conduct much ‘significant’ innovation; that which may not only be directly useful to the innovating firm but also be a potential source of income from licensing or sale of that technology, apart from its strategic benefits in blocking or leveraging the innovations of others. The minor nature of the innovation that is conducted induces only a small premium in the stock market valuation of the innovating firms.

7. Market Value and Intangible Assets: Sectoral Heterogeneity

There appears to be some value added in studying the issue of the market valuation of intangible assets at a more dis-aggregated level, for which we categorise our sample firms into Pavitt-groups (Pavitt 1984; Greenhalgh and Rogers 2006). In line with this typology, we classify the firms into one of four categories – (i) supplier dominated industries, (ii) production intensive (scale intensive) industries, (iii) production intensive specialised suppliers industries, and (iv) science-based industries. More specifically, category (i) comprises firms in the leather, textiles and textile products, rubber, and gems and jewellery industries. Category (ii) comprises firms in automobiles, cement, (other) construction material, (other) consumer goods, domestic appliances, food and agro-products, glass and glassware, metals and metal products, personal care, and paper and paper products industries. Category (iii) comprises firms in automobile ancillaries, and non-electrical machinery industries, while Category (iv) comprises firms in chemicals, drugs and pharmaceuticals, electrical machinery, electronics, petroleum products, and plastic products industries. The idea behind this typology is the contention that although firms vary in their technological trajectories, there is still sufficient basis to group them in a meaningful manner. This allows us to uncover any sectoral patterns that may exist in the data, with reference to the market value-intangible assets relationship that we are studying.

Table 6 presents only the fixed effects ‘full’ equation nonlinear estimation results, since we consider these to be relatively preferable. The regressions for all four groups of industries employ lagged regressors to control for endogeneity. To avoid repetition, we merely note that the results for each industry group are perfectly consistent with those reported in the earlier sections, as to sign and significance of the regressors. In addition, we find that the coefficient of knowledge capital varies substantially across the four industry groups, ranging from about two for group 1 to only about 0.1 for group 2. Similarly, the coefficient of other intangible capital also varies significantly across the four groups, from around unity for group 1 to about 0.1 for group 3.

8. Market Value and Intangible Assets: Profit Expectation and Profit Risk

More interesting than the heterogeneity of the market value-intangible assets 'multiplier' (for want of a better word), is the result that this coefficient of knowledge capital is the largest for group 1 and the smallest for group 4. Indeed, there appears to be some basis for claiming that this 'multiplier' or coefficient decreases more or less monotonically as we move from group 1 industries to group 4 industries.[6] This is interesting, because on the face of it, one would have expected just the converse, given that group 4 industries are the science-based industries that are associated with more innovative activity than the others. Given the differential levels of innovative activity across firms/industries, then, what are the factors that matter to the investors/speculators involved in the market valuation of that innovation?

To shed light on this question, we first estimate equation (6) for firms in each industry separately, allowing for firm and year fixed effects. Given the relatively smaller sample size at the individual industry level, we eschew using lagged regressors to save precious degrees of freedom. From the comparison of results in section 6 with section 4.1, we have already seen that this is not likely to be a serious omission. Despite this parsimony, we are unable to estimate equation (6) for the personal care, and gems and jewellery industries on account of insufficient observations. This exercise provides us with coefficients of the knowledge capital variable (or the 'multiplier' as we tentatively christened it above) for each of the remaining 20 industries in our data set. We would now like to study the factors that might explain the variation in this coefficient β across industries.

It stands to reason that the market valuation of a firm's innovative activity would ultimately depend upon the perceptions of the stock market investor/speculator about the firm's expected performance. Two elements of this expected performance that the market agents are likely to consider are the expected profits to be made from investing in the shares, and the riskiness of the expectation or profit risk.[7] As a first approximation, we proxy expected profits by lagged profits, and their riskiness by the deviation of actual from expected profits.[8] To make these measures functional, we consider lags of length one, two and three. Thus, with one lag, expected profits in period t would be the profits in period $t-1$ (variable EXP_PROFIT_1); with two lags, expected profits in period t would be the average of the profits in periods $t-1$ and $t-2$ (variable EXP_PROFIT_2); and with three lags, expected profits in period t would be the average of the profits in periods $t-1$, $t-2$ and $t-3$ (variable EXP_PROFIT_3). In all three cases, profit riskiness in period t would be the difference between the actual and expected profits in that period (that is, variables $PROFIT\_RISK\_1$, $PROFIT\_RISK\_2$ and $PROFIT\_RISK\_3$, respectively). After computing expected profit and profit risk for each firm for the period 2001-2010, we average across the firms and years in each of the 20 industries for which we had estimated coefficient β as described in the previous paragraph. This allows us to estimate the relationship

$$\beta_j = \omega_0 + \omega_1 EXP\_PROFIT\_K_j + \omega_2 PROFIT\_RISK\_K_j + \tau_j \qquad (10)$$

where subscript $j = 1, \ldots, 20$ indexes the industries in our new sample, and $K = 1, 2, 3$ indexes the alternative definitions of the two regressors.

The regression results are presented in Table 7, and it is evident that they are quite consistent across all three regressions. Therefore, for the sake of brevity, suffice it to note that both expected profit and profit risk have the expected signs, and are strongly significant in explaining the dependent variable – the 'market value multiplier' is smaller the lower the expected profit, and the higher the profit risk. The standardized coefficient of expected profit varies between 0.5 and 0.6 across the three regressions, whereas that of profit risk lies between –0.3 and –0.4, indicating that it makes little difference which definition of the two regressors we employ.

9. Conclusion

This paper revisits the relationship between market valuation and innovation in the context of manufacturing firms in India, using recent data for the period 2001 to 2010. In a milieu where most firms do not obtain patents, and cannot even obtain utility models, the concern was whether 'small' innovations would be visible to potential investors in the stock market. Interestingly, despite these mitigating aspects, we find that the stock market places greater value on the relatively innovative firms, ceteris paribus; even though the magnitude of this premium appears to be much smaller than that reported by studies on the developed countries. Furthermore, this relationship between firm market value and innovation was found to vary substantially across the different Pavitt industry groups; and, surprisingly, the market value-innovativeness 'multiplier' was the smallest for the science-based group of industries. Further investigation revealed, that the variation in this 'multiplier' across industries could be explained by the profit expectation and profit risk that the potential investors/speculators associated with the different industries.

References

Bloom, Nicholas and John Van Reenen, 2000, *Real Options, Patents, Productivity and Market Value: Evidence from a Panel of British Firms*, Institute for Fiscal Studies, WP 00/21.

Blundell, Richard, Rachel Griffith, and John Van Reenen, 1999, 'Market Share, Market Value and Innovation in a Panel of British Manufacturing Firms', *Review of Economic Studies*, 66(3), 529–554.

Cockburn, Iain, and Zvi Griliches, 1988, 'Industry Effects and Appropriability Measures in the Stock Market's Valuation of R&D and Patents', *American Economic Review*, 78(2), 419-423.

CMIE, 2012, Prowess: Release 4.11, <www.prowess.cmie.com>

Greenhalgh, Christine, and Mark Rogers, 2006, 'The Value of Innovation: The Interaction of Competition, R&D and IP', *Research Policy*, 35(4), 562-580.

Griliches, Zvi, 1981, 'Market Value, R&D, and Patents, *Economics Letters*, 7(2), 183-187.

Hall, Bronwyn H., 1990, *The Manufacturing System Master File: 1959-1987*, Working Paper no. 3366, National Bureau of Economic Research, Cambridge, Massachusetts.

Hall, Bronwyn H., 1993, 'The Stock Market's Valuation of R&D Investment During the 1980's. *American Economic Review*, 83(2), 259–264.

Hall, Bronwyn H., Adam Jaffe and Manuel Trajtenberg, 2000, 'Market Value and Patent Citations: A First Look', NBER Working Paper 7741.

Hall, Bronwyn H. and Megan MacGarvie, 2010, 'The Private Value of Software Patents', *Research Policy*, 39(7), 994-1009.

Hall, Bronwyn H. and Raffaele Oriani, 2006, Does the Market Value R&D Investment by European Firms? Evidence from a Panel of Manufacturing Firms in France, Germany and Italy, *International Journal of Industrial Organization*, 24(5), 971-993.

Jaffe, Adam B., 1986, 'Technological Opportunity and Spillovers of R&D: Evidence from Firms' Patents, Profits, and Market Value', *American Economic Review*, 76(5), 984–1001.

Pavitt, Keith, 1984, Sectoral Patterns of Technical Change: Towards a Taxonomy and a Theory, *Research Policy*, 13(6), 343-373.

The Economist, 2010, *The BRICs: The Trillion-Dollar Club*, 395(8678), April 17, 2010, 59-61.

Topalova, Petia and Amit Khandelwal, 2011, 'Trade Liberalization and Firm Productivity: The Case of India', *Review of Economics and Statistics*, 93(3), 995-1009.

Table 1: Sample Statistics of Variables – 2001-2010

Variable	Mean	Median	Standard Deviation	Minimum	Maximum
V/K_P	4.47	3.26	3.56	0.16	19.99
K_K/K_P †	0.12	0.05	0.20	0.00	2.74
K_{OI}/K_P †	0.25	0.01	0.77	0.00	13.86
S/K_P	0.0013	0.0008	0.004	–0.03	0.09

Correlation Matrix

	$\ln(V/K_P)$	K_K/K_P	K_{OI}/K_P	S/K_P
$\ln(V/K_P)$	1.00			
K_K/K_P †	0.30	1.00		
K_{OI}/K_P †	0.25	0.07	1.00	
S/K_P	0.30	0.14	0.12	1.00

Note: † Computations based on 15% depreciation rate (see text)

Table 2: Market Value and Firm IP Assets: Nonlinear Specification
Dependent Variable: ln (V/K_P)

	Pooled OLS Regressions			Fixed Effects Regressions		
Regressor	(1)	(2)	(3)	(4)	(5)	(6)
K_K/K_P	2.616***	2.555***	2.464***	0.782***	0.603***	0.584***
	(0.371)	(0.379)	(0.367)	(0.088)	(0.109)	(0.105)
	[0.18]	[0.16]	[0.16]	[0.06]	[0.05]	[0.04]
	{0.12}	{0.12}	{0.11}	{0.03}	{0.03}	{0.02}
K_{OI}/K_P		0.448***	0.385***		0.252***	0.202***
		(0.108)	(0.098)		(0.067)	(0.051)
		[0.07]	[0.06]		[0.05]	[0.04]
		{0.02}	{0.01}		{0.01}	{0.01}
S/K_P			69.546***			34.404***
			(11.433)			(5.664)
			[0.05]			[0.03]
			{0.05}			{0.02}
ln K_P	0.025*	0.025	0.032**	–0.195***	–0.144***	–0.123***
	(0.015)	(0.016)	(0.015)	(0.037)	(0.040)	(0.038)
Intercept	0.547***	0.519***	0.470	1.947***	1.540***	1.395***
	(0.112)	(0.127)	(0.125)	(0.236)	(0.234)	(0.225)
Scale parameter (σ)	1.025	1.025	1.032	0,805	0.856	0.816
N	3551	2587	2587	3551	2587	2587
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Firm fixed effects	No	No	No	Yes	Yes	Yes
Robust standard errors	Yes	Yes	Yes	Yes	Yes	Yes
P-value (all slopes 0)	0.000	0.000	0.000	0.000	0.000	0.000
$\bar{R}^2$	0.206	0.284	0.336	0.943	0.952	0.953
Hausman test p-value						0.000

Note: Robust standard error in parentheses; elasticity at the mean in square brackets; elasticity at the median in braces; ***, ** and * denote significance at the 1%, 5% and 10% levels, respectively, for a two-tail test.

Table 3: Market Value and Firm IP Assets: Linear Specification
Dependent Variable: ln (V/K_P)

	Pooled OLS Regressions			Fixed Effects Regressions		
Regressor	(1)	(2)	(3)	(4)	(5)	(6)
K_K/K_P	1.080***	1.250***	1.124***	0.516***	0.515***	0.482***
	(0.198)	(0.154)	(0.153)	(0.140)	(0.127)	(0.124)
	[0.13]	[0.14]	[0.13]	[0.06]	[0.06]	[0.06]
	{0.05}	{0.06}	{0.06}	{0.03}	{0.03}	{0.03}
K_{OI}/K_P		0.188***	0.169***		0.165***	0.147***
		(0.034)	(0.031)		(0.049)	(0.048)
		[0.06]	[0.06]		[0.06]	[0.05]
		{0.01}	{0.01}		{0.01}	{0.01}
S/K_P			39.831***			17.257***
			(11.106)			(5.174)
			[0.06]			[0.02]
			{0.03}			{0.01}
Intercept	0.812***	0.803***	0.798***	0.841***	0.824***	0.824***
	(0.034)	(0.040)	(0.040)	(0.025)	(0.032)	(0.031)
Scale parameter (σ)	1	1	1	1	1	1
N	3551	2587	2587	3551	2587	2587
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Firm fixed effects	No	No	No	Yes	Yes	Yes
Robust standard errors	Yes	Yes	Yes	Yes	Yes	Yes
P-value (all slopes 0)	0.000	0.000	0.000	0.000	0.000	0.000
$\bar{R}^2$	0.170	0.252	0.297	0.294	0.337	0.351
Hausman test p-value						0.000

Note: Robust standard error in parentheses; elasticity at the mean in square brackets; elasticity at the median in braces; ***, ** and * denote significance at the 1%, 5% and 10% levels, respectively, for a two-tail test. The scale parameter (σ) is 1 by assumption.

Table 4: Market Value and Firm IP Assets: Robustness Check – Assuming 30% Depreciation Rates
Dependent Variable: ln (V/K_P)

	Nonlinear Specification			Linear Specification		
	Fixed Effects Regressions			Fixed Effects Regressions		
Regressor	(1)	(2)	(3)	(4)	(5)	(6)
K'_K/K_P	1.120***	0.825***	0.734***	0.737***	0.622***	0.585***
	(0.139)	(0.147)	(0.127)	(0.146)	(0.158)	(0.155)
	[0.07]	[0.06]	[0.05]	[0.08]	[0.07]	[0.06]
	{0.04}	{0.03}	{0.03}	{0.03}	{0.03}	{0.03}
K'_{OI}/K_P		0.261***	0.205***		0.211***	0.184***
		(0.052)	(0.041)		(0.051)	(0.051)
		[0.04]	[0.03]		[0.06]	[0.05]
		{0.01}	{0.01}		{0.01}	{0.01}
S/K_P			34.424***			16.795***
			(6.055)			(5.142)
			[0.03]			[0.02]
			{0.02}			{0.01}
ln K_P	–0.186***	–0.142***	–0.120***			
	(0.035)	(0.016)	(0.038)			
Intercept	1.858***	1.538***	1.374***	0.832***	0.838***	0.838***
	(0.208)	(0.230)	(0.221)	(0.024)	(0.031)	(0.030)
Scale parameter (σ)	0.814	0.858	0.880	1	1	1
N	3551	2587	2587	3551	2587	2587
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Firm fixed effects	No	No	No	Yes	Yes	Yes
Robust standard errors	Yes	Yes	Yes	Yes	Yes	Yes
P-value (all slopes 0)	0.000	0.000	0.000	0.000	0.000	0.000
$\bar{R}^2$	0.943	0.952	0.953	0.299	0.339	0.352

Note: Robust standard error in parentheses; elasticity at the mean in square brackets; elasticity at the median in braces; ***, ** and * denote significance at the 1%, 5% and 10% levels, respectively, for a two-tail test. In the linear specification, the scale parameter (σ) is 1 by assumption.

Table 5: Market Value and Firm IP Assets: Robustness Check – Lagged Regressors
Dependent Variable: ln (V/K_P)

	Nonlinear Specification			Linear Specification		
	Fixed Effects Regressions			Fixed Effects Regressions		
Regressor	(1)	(2)	(3)	(4)	(5)	(6)
$(K_K/K_P)_{t-1}$	0.328***	0.256***	0.630***	0.290***	0.261†	0.254†
	(0.040)	(0.040)	(0.100)	(0.083)	(0.179)	(0.183)
	[0.03]	[0.02]	[0.05]	[0.03]	[0.03]	[0.03]
	{0.01}	{0.01}	{0.03}	{0.01}	{0.01}	{0.01}
$(K_{OI}/K_P)_{t-1}$		0.207***	0.234***		0.127*	0.115*
		(0.032)	(0.034)		(0.070)	(0.069)
		[0.04]	[0.05]		[0.04]	[0.04]
		{0.01}	{0.01}		{0.01}	{0.01}
$(S/K_P)_{t-1}$			24.681***			15.521**
			(4.737)			(7.499)
			[0.02]			[0.02]
			{0.02}			{0.01}
$(\ln K_P)_{t-1}$	–0.150***	–0.107***	–0.081*			
	(0.038)	(0.048)	(0.049)			
Intercept	2.103***	1.638***	1.451***	0.835***	0.803***	0.800***
	(0.235)	(0.163)	(0.141)	(0.024)	(0.039)	(0.039)
Scale parameter (σ)	0.850	0.893	0.919	1	1	1
N	3133	2198	2198	3133	2243	2243
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Firm fixed effects	No	No	No	Yes	Yes	Yes
Robust standard errors	Yes	Yes	Yes	Yes	Yes	Yes
P-value (all slopes 0)	0.000	0.000	0.000	0.000	0.000	0.000
$\bar{R}^2$	0.945	0.955	0.955	0.258	0.301	0.308

Note: Robust standard error in parentheses; elasticity at the mean in square brackets; elasticity at the median in braces; ***, ** and * denote significance at the 1%, 5% and 10% levels, respectively, for a two-tail test; whereas † denotes significance at the 10% level using a one-tail test. In the linear specification, the scale parameter (σ) is 1 by assumption.

Table 6: Market Value and Firm IP Assets: Results by 'Pavitt' Industry Groups
Dependent Variable: ln (V/K_P)

	Nonlinear Specification			
	Fixed Effects Regressions			
	Group 1	Group 2	Group 3	Group 4
Regressor	(1)	(2)	(3)	(4)
$(K_K/K_P)_{t-1}$	2.022**	0.124***	0.714***	0.365***
	(0.781)	(0.042)	(0.265)	(0.081)
	[0.06]	[0.01]	[0.06]	[0.04]
	{0.04}	{0.003}	{0.05}	{0.02}
$(K_{OI}/K_P)_{t-1}$	0.966**	0.366***	0.113*	0.175***
	(0.395)	(0.105)	(0.062)	(0.041)
	[0.14]	[0.09]	[0.01]	[0.04]
	{0.03}	{0.02}	{0.01}	{0.01}
$(S/K_P)_{t-1}$	0.150***	34.049***	26.551***	10.195**
	(0.004)	(7.953)	(9.449)	(3.992)
	[0.0001]	[0.02]	[0.02]	[0.01]
	{0.0001}	{0.02}	{0.02}	{0.01}
$(\ln K_P)_{t-1}$	0.189***	–0.098***	–0.233**	–0.013***
	(0.015)	(0.030)	(0.103)	(0.030)
Intercept	–0.468***	1.635***	2.157***	0.958***
	(0.152)	(0.227)	(0.712)	(0.173)
Scale parameter (σ)	1.189	0.902	0.767	0.987
N	196	608	448	946
Year fixed effects	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes	Yes
Robust standard errors	Yes	Yes	Yes	Yes
P-value (all slopes 0)	0.000	0.000	0.000	0.000
$\bar{R}^2$	0.796	0.950	0.959	0.958

Note: Robust standard error in parentheses; elasticity at the mean in square brackets; elasticity at the median in braces; ***, ** and * denote significance at the 1%, 5% and 10% levels, respectively, for a two-tail test.

Table 7: Market Value 'Multiplier' and Firm/Industry Expected Performance
Dependent Variable: β (i.e. coefficient of K_K/K_P)

Reressor	(1)	(2)	(3)
EXP_PROFIT_1	0.329^{***}		
	(0.067)		
$PROFIT\_RISK\_1$	-3.141^{**}		
	(1.340)		
EXP_PROFIT_2		0.403^{***}	
		(0.071)	
$PROFIT\_RISK\_2$		-2.406^{**}	
		(0.958)	
EXP_PROFIT_3			0.409^{***}
			(0.055)
$PROFIT\_RISK\_3$			-1.886^{**}
			(0.668)
N	20	20	20
Robust standard errors	Yes	Yes	Yes
P-value (all slopes 0)	0.001	0.000	0.000
$\bar{R}^2$	0.018	0.026	0.034

Note: Robust standard error in parentheses; ***, ** and * denote significance at the 1%, 5% and 10% levels, respectively, for a two-tail test.

Endnotes

[1] The approximation $ln(1 + x) \approx x$ holds true only for $|x| \leq 0.1$, and is quite close for $|x| \leq 0.2$.

[2] From the policy perspective total elasticities would serve better than partial elasticities, for they would include not just the direct effect of a change in knowledge capital on market value, but the indirect effects as well. For instance, an increase in the stock of knowledge capital may lead to a reduction in physical capital insofar as it raises the efficiency of use of physical capital. If this indirect effect dominates the direct effect of the first round increase in knowledge capital, the 'total effect' may be a decline in market value. Alternatively, an increase in the stock of knowledge capital may lead to an increase in the stock of reputation capital, and the 'total effect' would be a larger increase in market value than in the absence of the indirect effect. Incorporating such indirect effects, however, would require a more elaborate model that allows for interactions between the different types of capital stock, and that is beyond the scope of this paper.

[3] As section 3.1 explains, the knowledge capital variable was constructed using R&D data. Though we started off with R&D data on 380 firms for the period 2000-2010, the first observation was lost in constructing the knowledge capital variable, leaving us with data for 2001-2010.

[4] Varying these thresholds did not change the results qualitatively – the signs and significance of the variables of interest remained unchanged.

[5] As before, the fixed effects estimates from the *linear* specification in column (6) of Table 4 are biased, and hence not discussed in this section. The reasons for the bias are the same as those specified above – the presumption that $\sigma = 1$ when in fact it is about 0.8-0.9, and the simplification that $\ln(1 + x) \approx x$, where $x = \beta \left(\frac{K_K}{K_P}\right)_{it} + \gamma \left(\frac{K_{OI}}{K_P}\right)_{it} + \delta \left(\frac{S}{K_P}\right)_{it} = 0.184$ (using

the coefficient values in Table 4, column 3, and the regressor mean values in Table 1), which is about 8.2% larger than $\ln(1+x) = 0.169$.

[6] While the same observation holds for the coefficient of other intangible capital as well, we are not really interested in this, because other intangible capital is related to advertising and customer service expenditures rather than R&D expenditure and innovation.

[7] At a conceptual level, expectations about firm/industry performance may be predicated on expectations about the ease with which profits can be appropriated, which researchers have proxied by variables such as profit persistence, market share, etc. For an illuminating discussion on these issues see Greenhalgh and Rogers (2006). We feel, however, that it is more plausible to talk in terms of stock market agents having expectations about firm/industry performance rather than about the factors that this performance may depend upon.

[8] Profit in this context is defined as profit after tax deflated by the industry-specific wholesale price index number.