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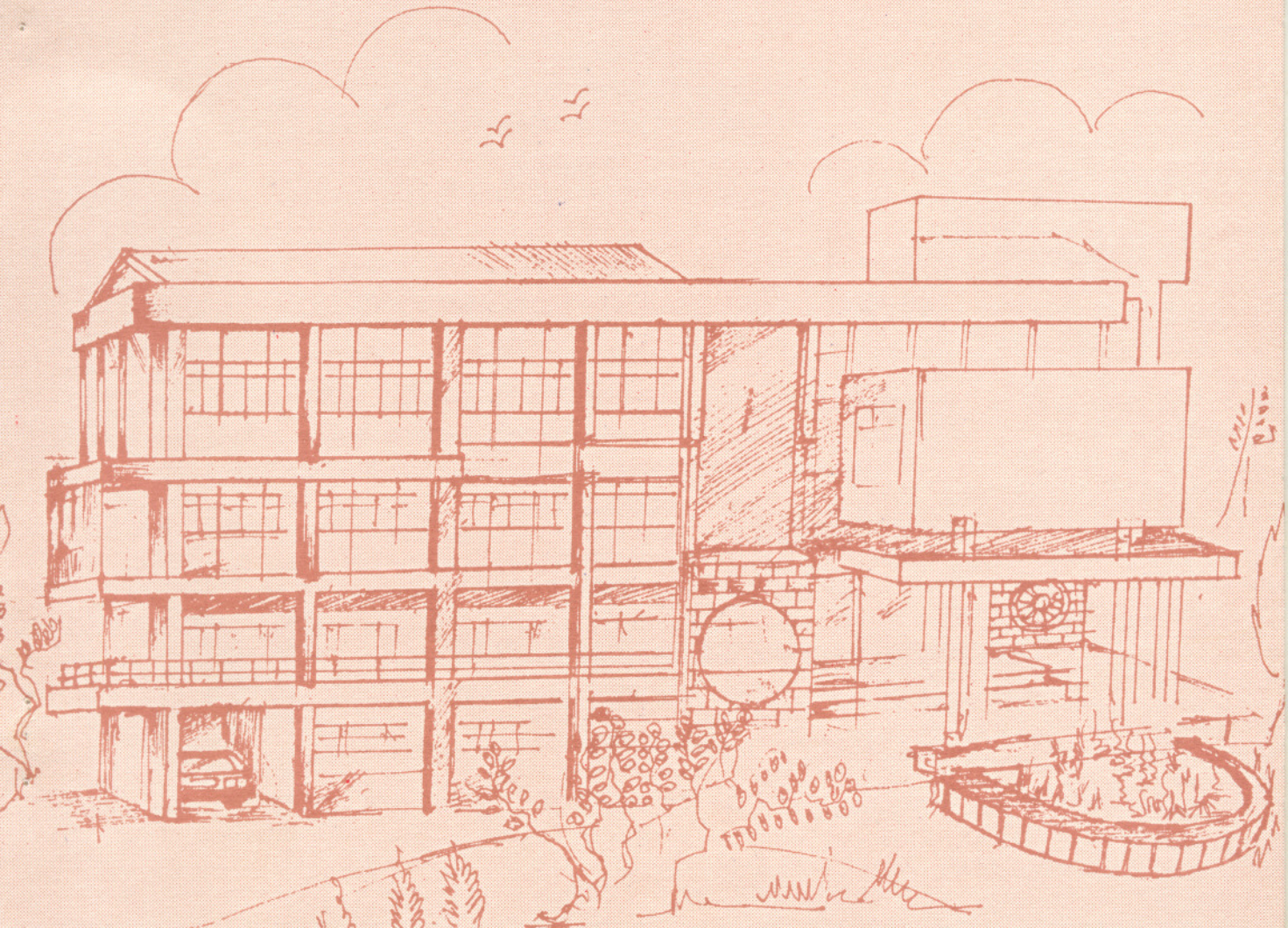
Technological Progress of Small & Medium Enterprises (SME) – Missing the Trees for the Woods



Technological Progress of Small & Medium Enterprises (SME) – Missing the Trees for the Woods

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A

Working Paper

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Abstract

This paper attempts to understand the concepts of technological progress, assessment of technological progress and whether the macro-view of technological progress is meaningful and insightful, in the context of SME[†]s. It is argued that the heterogeneity of this sector is multi-dimensional. The need to differentiate between embodied and disembodied technological progress is stressed. The paper contends that the multidimensional diversity of the SME sector and the conceptual clarity on technological progress has not informed the discussion on this topic. It is concluded that attempts to characterize the technological progress of SMEs has resulted in clichéd statements, naïve prescriptions and hollow insights. In the quest for the over-arching 'sectoral view' of the 'SME woods', the 'trees' have been overlooked, in exchange for spurious generalizations.

INTRODUCTION

History has shown that modern economic growth has been inspired by a rapid and persistent up-gradation of technology and scientific know-how. It is estimated that from one-third to one-half of the growth experienced by the industrially advanced countries has come from technological progress. Thus, technology has emerged as the principal driving force for long-term economic growth. Economic growth results both from slow and steady improvements in technology and from knowledge embodied in physical and human capital as well as from the "breakthrough"

inventions (Bimal Jalan, 1998).A study conducted in the SME sector in Karnataka (Bala et al, 2002) reveals a symbiotic relationship between R&D, Labor and Capital in increasing the Value of Output using regression analysis conducted on R&D –oriented and non-R&D oriented SMEs. These three factors (R&D , Labor & Capital) seem to drive as much as 55% of the Value of Output . When R&D is not in place, Labor and Capital appear to drive only to the extent of less than 30%.

In the context of Small & Medium Enterprises (SME), it is bemoaned that the lack of competitiveness is due to obsolete *technology*, among other factors. It is also generally understood that most SME entrepreneurs are not even aware of the need to modernize and upgrade their technology and are unable to locate the source of appropriate and affordable technology. Thus, SMEs operate with outdated technologies with a wide gap between indigenous and foreign technologies (Basith & Sekhri, 2001).

[†] In this paper SSI and SME have been used interchangeably

Large scale modernization and technological upgradation are offered as the twin prescriptions for improving the competitiveness of SMEs.In fact low labor productivity is supposed to be due to low 'levels' of technology , in turn suppressing the real income of labor(Juneja, 2001). Transfer of technology (TOT) is viewed as the mechanism for operationalizing the twin prescription. Hence policies that support flow of technology are expected to create a conducive environment. However, it is also recognized (though in a general context but also applies to SMEs) that in spite of the massive flow of technology developing countries are yet to develop strong indigenous technological capability , due to lack of Technological Capability(TC) to absorb imported technology (Bischoff, 2001).

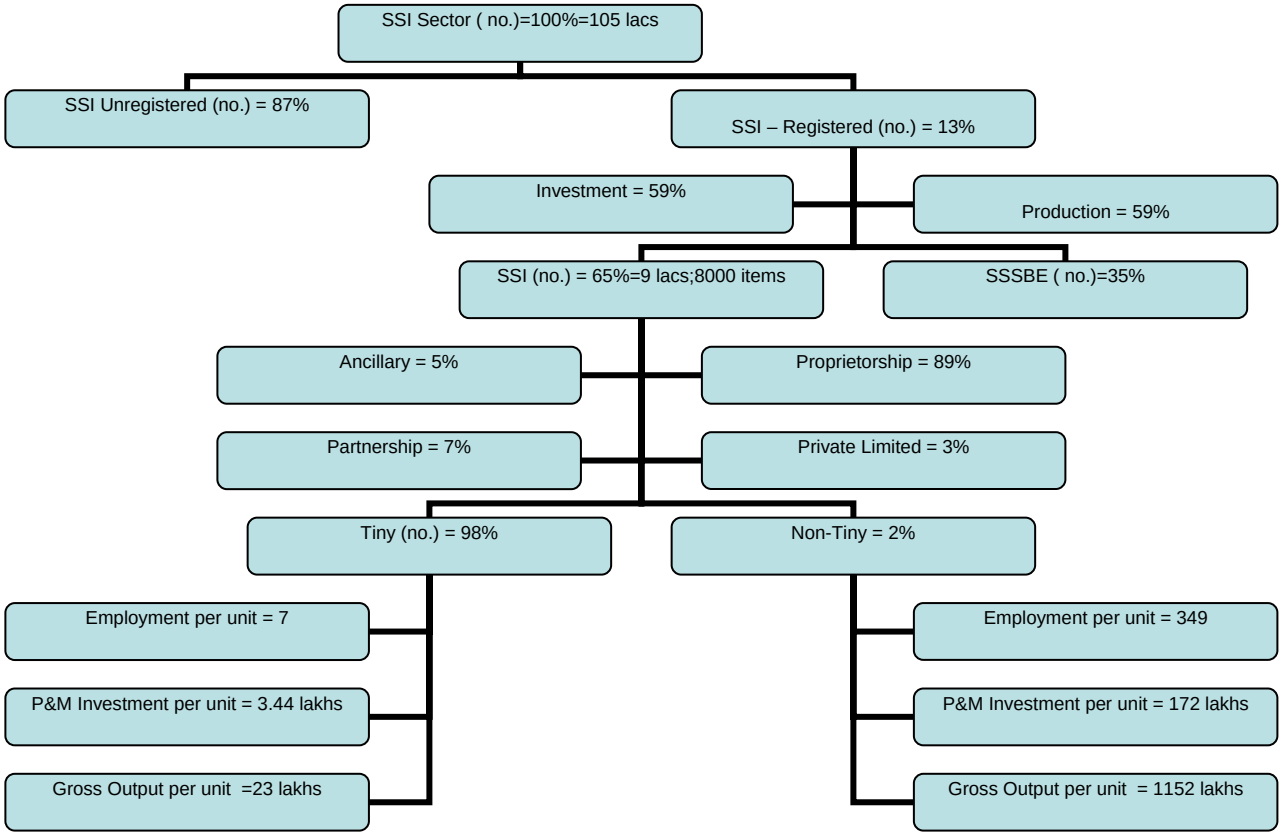
An understanding of the problems and prescriptions calls attention to two issues – what are the characteristics of SME sector? How do we understand 'technology' especially in the context of SMEs? What do we mean by technological progress and technological capability? Is technological up-gradation a panacea for the professed ills of SMEs? Can we draw useful generalizations and provide inputs for policy formulation based on the study of the SME sector as a whole?

SME – a definitional conundrum

The challenge, the confusion and obfuscation begins with the definition of this sector itself. There are diverse bases (input or output based) for defining this sector which is country-specific and sometimes even sector-specific (manufacturing vs. service) – no. of employees, investment in plant & machinery, annual sales turnover and combinations of these. To confound the confusion there are variations in the adoption of break points (to draw the lines dividing, tiny, small and medium) too! So far we have only examined the *statistical* definition. The economic definition typically points to three market and behavioral characteristics – small market share, "managed in a personalized way" and independence. This results in drawing distinctions such as 'little business' and 'larger small firms in which the owner acts more fully as a manager' (Atkins & Lowe,1997). Researchers engaged in the SME sector, therefore, have difficulty with regard to issues of validity and reliability, not to speak about generalizability. According to Noteboom (2002), the definition and statistical demarcation of SME is a subject of perennial but seldom fruitful debate. He suggests a 'pragmatic' approach – take a simple definition, based on one's perspective and purpose of study, which is statistically workable and theoretically offers no more than ball-park accuracy.

SME 'Woods' – Diversity, without Unity

There are primarily two broad dimensions of diversity one can discern with regard to the SME sector – Statistical and Behavioral. The statistical diversity is best illustrated with the facts and figures based on the latest census (3rd Census) of this sector. This has been depicted as follows:



It may be noted that this chart does not include the 'medium scale' sub-sector since the same is yet to be officially defined and declared. If done, it would only add to the diversity! One needs to superimpose on this picture of statistical diversity, the variations arising on account of the behavioral dimension. These variations are caused by two main factors – conditions which *allow* diversity and the *sources* of diversity (Noteboom, 2002). Factors which allow diversity are the a) Conditions of ownership, b) Capital Market for funds and c) Governmental regulations, all of which allow for variations resulting in substantial diversity. The sources of diversity are the so-called 'push '(discontent with the present job) and 'pull'(power , freedom , independence , riches) factors – arising out of the variance in the motives, goals and background of the entrepreneur. All these add up to a complex tapestry characterizing the diversity of the SME sector.

SME - Growth, Technology & Strategy Orientation

A Dutch survey of 380 entrepreneurs revealed that only 20% were oriented towards expansion and growth. Another survey conducted in Australia indicates that only 10% conformed to the type of efficient manager and effective entrepreneur. Yet another Dutch study points to the low level of 'dynamism' in this sector – only 18% use external information (Noteboom, 2002). This means that only 10% - 20% of the so-called entrepreneurs conform to the ideal of the 'Schumpeterian hero' who uses 'creative destruction' as the driving force!

No wonder that only 1% of the entrepreneurs reach an employment level of 100 persons over 15 long years (O'Farrell, 1984). In fact, attempts have been made to conceptualize the differences between an Entrepreneur and Manager, on the one hand and an Entrepreneurial venture and a Small Business, on the other hand. The following conceptualization has been offered by Carland et. al. (2002):

- An Entrepreneurial venture is one which engages in at least in one of Schumpeter's[1] four or five categories of behavior – the principal goal is growth and profitability through innovative strategic practices
- An Entrepreneur is an individual who establishes and manages the business for the principal purpose of growth and profitability whose characteristic behavior is innovative and will employ strategic management practices in the business

Miller (1983) stated that "In general theorists would not call a firm entrepreneurial if it changed its technology or product line … simply by directly imitating competitors while refusing to take any risks. Some proactive-ness would be essential as well. By the same token, risk-taking firms which are highly leveraged financially are not necessarily entrepreneurial. They must also engage in product market or technological innovations ". The defining and distinguishing characteristics of an entrepreneurial posture are risk-taking, innovative and proactive.

Strategic orientation represents the willingness to take on high-risk projects with high returns, being bold and aggressive in pursuing opportunities and initiating actions to which competitors respond and frequently first-to-market with product offerings (Covin & Slevin , 2002). In support of this orientation E firms *characteristically* emphasize technological leadership and R&D (Khandwalla, 1977).

From the foregoing discussion, it can be concluded that SME sector, as a whole, can hardly be *assumed* to be seeking growth and profitability, reflecting in a strategic orientation towards the market place emphasizing technological progress or development.

1 - Schumpeter suggested five categories of innovative strategic behavior viz.Introduction of new goods, new methods of production, opening of new markets, and opening of new sources of supply Industrial reorganization

Technology & Technological capability – a conceptualization

Most of the definitions of technology refer to 'knowledge, skills or capabilities 'as the central characteristic (Dodgson, 2000; Narayanan, 2001; Burgelman et al, 2004) of technology, manifesting in material artifacts such as tools, products and process. Basant & Chandra (2002) conceptualize technology as consisting of three interrelated components viz. three Ps – Product, Process and Practice. They believe that Indian firms should focus on process and practices, rather than on products, in order to remain competitive. Technological capability lies in the ability to handle technology and cope with technological changes and the ability to absorb and build on technologies. Indigenous Technological Capability (ITC) is the bedrock of technological progress – creating necessary conditions for absorption and adaptation of technologies from outside. ITC encompasses selection of most appropriate technologies, installation of equipment or production lines, mastering of technology (i.e. ability to assimilate, operate, maintain and repair), adaptation of the technology to suit specific production conditions and local resources, further development of technology as a result of incremental innovations and replication of technologies by conducting basic research and radical innovations to bring in new products (Bischoff, 2001). Five constituent elements of technological Capability have been suggested: pre-investment choice, project execution, plant operation, technological improvement and technology transfer (Lall Sanjay, 1987). It should be clear from the above discussion that Technological Progress is, therefore, reflected in the degree to which ITC is built up through mainly R&D efforts, either formal or informal. In the context of SMEs these efforts are mainly informal in nature.

Technological Progress versus Technical Efficiency

The concept of Value-Addition is extensible to the macro-economy level. The growth of the economy is closely related to the factor - productivity of its labor – measured as the value-added per person. It is well established that the growth in labor productivity has been driven mainly by technological progress, in the developed economies. As much as 80% of the growth in productivity in US has been attributed to technological progress. Thus, technology is the main engine of economic growth. The Growth Accounting literature offers another measure of technological progress - Total Factor Productivity Growth (TFPG) (Tinbergen, 1942; Abramowitz, 1955; Solow, 1957; Griliches & Jorgenson, 1966). TFPG as a concept gained importance due to its ability to indicate the 'sustainability' of output growth or value addition, in the context of diminishing returns to growth in factor inputs such as labor and capital stocks. TFPG lends itself to applications at any level – economy as a whole, sectoral level, industry level or any disaggregate level within the industry.

TFPG, as a measure, is expected to capture both embodied and disembodied technological progress, notwithstanding the controversies surrounding this measure. Embodied technological change, in turn, seeks to capture effects due to learning by doing (experience) , advances in applied technology, managerial efficiency and industrial organization which transform into better methods and organization that improve the efficiency of both new and old factor inputs (Renuka , 2003). Embodied Technological change is supposed to represent the change in the Technical Efficiency (TE) – a movement towards the production frontier. On the other hand, Disembodied Technological Progress, as the term implies, is not something 'embodied' in the factor inputs and hence pertains to 'useful knowledge' created through R&D and innovations. This is supposed to represent the real technological progress from one frontier to another frontier of the production function. In view of the above discussion, Technical Efficiency would be a more appropriate measure of technological progress in the Indian context, in general and in the SME context, in particular. This would, in empirical terms, relate to the improvements in process and practice-related components of technology.

Considerable inter-industry differences were found and was estimated to lie in the range of (-)0.6 - (+)0.3 per cent per annum during the sixties and the seventies (Ahluwalia , 1991).This compares poorly with the estimate of TFPG for the G-7 countries for the period 1947-73 , which range from 1.4% for USA to 4% in the case of Japan (Barro & Sala-i- Martin, 1995). Nevertheless, some researchers found a positive turnaround in Indian TFPG since the early eighties. Estimates of TFPG for the Indian Manufacturing sector, before and after liberalization, have been reported by some researchers to have improved, while others have reported the reverse (Goldar , 2004). For the SME sector as a whole, a study conducted covering the pre-liberalization period, it was found to have been low (Subramanian, 1995). Interestingly, SMEs have been found to be high on static efficiency of capital, but poor on the dynamic efficiency – perhaps due to poor efforts at improving the productivity of capital through learning by doing, managerial efficiency, good manufacturing practices etc. Wide variations in the technical efficiency have been reported across various sectors within SME.

SME – Strategic Orientation

SMEs, due to their lower scale economies, have to be strategically more value-led than volume –led. This imposes additional compulsion to leverage technology to create better value through innovation. However, where the predictability of the environment is high and technological complexity is low, it is seen that the SMEs do not either need to engage in R&D (Bala et al ,2001) or do not adopt any

changes in technology , even when the investment capacity , technology/training facility , loan availability , labor / technical manpower availability , incentives / tax concessions and Infrastructure are very favorable and supportive (Vasudev Rao , 2003). However, for the SME sector as a whole, the environment, post-liberalization, has been far from being predictable and simple, with de-reservation, dismantling of tariff and non-tariff restrictions etc. SME sector has very clearly demonstrated its resilience in the face of LPG forces to register a performance far superior than the Large Scale sector (SIDBI, 2001). If we consider the factory sector of SMEs it is all the more dramatic – this sector has done better post LPG on all parameters!

% CAGR

	SSI Factory	LSI Factory	Total
No. of units			
80- 89	0.68	6.07	1.26
90-98	3.78	6.14	3.00
Net Value Added			
80- 89	6.52	8.18	7.88
90-98	16.91	6.93	8.72
Fixed Capital(depreciated value)			
80- 89	-0.31	0.65	0.64
90-98	8.00	-1.21	-0.51
Invested Capital (Fixed + Working capital)			
80-89	-0.19	0.63	0.55
90-98	6.03	-1.11	-0.28
Employment			
80-89	0.65	0.57	0.60
90-98	8.10	-0.87	2.83

One can draw the following inferences:

1. The number of units in the SSI Factory sector has grown much faster during post-liberalization as compared to pre-liberalization
2. Net Value added has grown 2 ½ times as fast during the post-liberalization vis-à-vis pre-liberalization. LSI has seen a drop in its growth rate
3. Fixed Capital has shown a substantial positive growth (a sign of investment in technology?)
4. But Capital Intensity has remained stagnant (does it mean that the technology has not displaced labor , since employment has also grown at the same rate during 90-98 (@ 8.1% vs. 8% in Fixed Capital)
5. Employment in the SSI sector has grown dramatically during post-liberalization

How could SMEs, over nearly 15 years since LPG was set in motion, achieve resilience without having made technological progress, at least in the embodied form? More sharply , **What do these indicate? What is the technological underpinning of this robust growth? Has there been any change in the technological dimension of SMEs between pre and post LPG?**

Search for answers to these questions is terribly constrained by lack of reliable time-series data in our country. However, we shall attempt to piece together some evidence to explain this paradox of poor technological progress of the SMEs and the resilience exhibited by the sector post LPG. Towards This we shall turn to an understanding of the role of R&D – informal R&D in technological progress of SMEs.

Informal R&D – Driver of Embodied Technological Progress & Capability

R&D is another much hyped and hence misunderstood term! While it can lead towards 'breakthrough' inventions and innovations, representing progress of the 'disembodied' kind, it has to be understood in the Indian context, more so in the SME context. The objectives and achievements of R& D, clearly and consistently point towards enhancing competitiveness through improvement in quality, reduced rejection and increased output (Bala et al , 2002). Hence, it is more of the incremental Arrowian 'learning-by-doing' kind. Lest this be misunderstood as 'low-end' or worse still as unimportant, it is to be noted that technology development (disembodied kind) has never flourished in the absence of technical capability (Rosenberg, 82). The author has not come across any study based on Growth Accounting models on this sector, post LPG. However, the earlier discussion based on the SSI-factory sector (Annual Report, SIDBI, 2001), points towards a substantial spurt in

capital investment (-0.31% for the period, 80-89 vs. 8% for the period, 90-98), capital intensity remaining unchanged. This is indicative of adoption of modern machines and processes and hence represents a change in the quality of capital stock pointing towards an embodied technological progress. This could also be understood as a leading indicator of the potential for disembodied technological progress, in the long-run (Renuka, 2003). If R&D activities of the SME sector is used as an indicator of technological progress, then based on a study conducted in Karnataka (Bala Subrahmanyam et al , 2002) , it is reported that 52% of the units engage in R&D , though informal. Also, competition and technological change have been declared as the major reasons for undertaking R&D by a majority of units. While this is a cross-sectional study and hence does not enable a pre vs. post LPG comparison, such an emphatic stress on competitiveness could be interpreted as an unmistakable stamp of environmental compulsion due to LPG. Another survey conducted in the coastal belt of Karnataka, though less emphatic, reveals a high degree of awareness about the role of technology - as much as 84% of the respondents agreed that technology would provide a distinct competitive edge and the majority of the owner-managers were also engaged in techno-managerial roles (Vasudev & Nagabrahmam, 2001). As discussed earlier, Growth Accounting literature also supplies useful notions on technology, by decomposing TFPG into Technical Efficiency (TE) and Technological Progress. These correspond to Embodied and Disembodied Technology, respectively. Strategy literature provides yet another perspective through two important schools of thought viz. Resource –based view and Product-Market view (Burgelman et al, 2001). This furnishes the crucial link between internal capability and the external environment. This is captured in the term 'capability vector' which embraces the magnitude (internal) and direction (external) (Ramesh & Sankaran, 2003). In the general SME context, especially in the Indian-context, it is far more meaningful to address Embodied Technology and its progress than Disembodied Technology which is of the 'frontier-pushing' kind.

Painting the Technological Progress with a single brush – Missing the Trees for the Woods

To paint the technological progress of SME sector with a single brush would be naïve, given the heterogeneity of the SME sector in India both statistically and behaviorally. As discussed the 3rd census of the SSIs is quite revealing in this regard. Only 13% of the units are registered, out of this 98% are categorized as 'Tiny' with an average investment in P&M of Rs.3.4 lakhs, average employment of 7 persons, yielding a gross output of Rs.23 lakhs per annum per unit. Arguably, technological progress is not the main area of concern for these enterprises. Additionally, the variation in the behavioral dimension – whether a small business or an entrepreneurial venture, also determine whether growth and technological progress would receive the attention. The Karnataka

study cited earlier (Bala et al , 2002) reveals the variations in R&D Intensity across industries such as food, chemicals, Rubber & Plastics, Non-metallic, metal products and machinery & equipment.

CONCLUSION

Popular perception and the prescriptions offered for the technological ills of SMEs have overlooked the statistical and behavioral diversity of this sector. This has resulted in vacuous generalizations. This has been confounded by a simplistic conceptualization of technological progress as a movement on the frontier of the production function. It is not widely recognized that technological progress is constituted of two components – embodied (technical efficiency) and disembodied (mostly driven by radical R&D). In the Indian context, in general, and in the SME context, in particular, technical efficiency is the most appropriate measure or indicator of technological progress. Technological capability is developed through improvements in the process and practice components of technology and not merely by investing in sophisticated capital equipment. Clichéd prescription of 'technology up-gradation' is quite meaningless. Hence, the heterogeneity coupled with a simplistic view of technological progress renders any attempt at an 'over-arching' sectoral view as an exercise akin to reporting on the average depth of the ocean! Growth Accounting or Productivity literature recognized that the quantitative empirical investigation needs to be complemented with more comprehensive qualitative discussion provided by surveys and interviews at the disaggregated (sector or industry) or even firm-level (Renuka, 2003). In view of this, it is rather futile and facile to prescribe technology up-gradation as the wholesale panacea for the so-called technological backwardness of SMEs. Unless the purpose and the perspective of the study clearly determine which part of the SME sector is or should be the *focus*, reliability, validity and the generalizability of inferences would suffer enormously. Evidence presented in this paper suggests that we should be developing theories which better describe the heterogeneity of the sector. We should be seeking to analyze the development within the cluster of firms, rather than seeking generalized overarching theories for all firms **(**Birley & Westhead , 1990).

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