CHAPTER XI

DETERMINANTS OF SOFTWARE

EXPORT—A QUANTITATIVE ASSESSMENT

The firm-level performance of the software industry has been considered in the former Chapter, separately for domestic and export segments. Pursuant to this, the present Chapter enquires into the determinants of India’s software export. Part 1 relates the hypothesised determinants for the export orientation. Part 2 presents the model specification, data set and estimation procedure. Part 3 throws light on the empirical findings and the implications emanating therefrom.

The review and analysis so far have established that India’s software activity is predominated by export. This dominance is so pronounced that India’s software industry has been practically termed as software export industry. Accordingly, it is most appropriate to have an appreciation of the determinants of India’s software export. This would enable us to arrive at the areas calling for more of thrust or policy changes. Based on the literature review as well as the study so far, it is hypothesised that the export orientation of Indian software industry is determined by the unit labour cost of production, size of the firm, foreign tie-ups, advertising intensity, technology import, R&D intensity as well as age of the firm. For ascertaining the relative importance of the role played by these determinants of software export, a regression model has been formulated in what follows. At first, these determinants have been discussed in detail.

11.1.1 Unit Labour Cost

Software industry is highly manpower or knowledge-intensive. In fact, labour or manpower is the key resource going into the production of software. It is widely held that the cost of skilled labour is quite low in India as compared to that in many other countries. This along with its easy availability has been highlighted as the most important dimension of the India Advantage in software development. The manpower advantages, especially low cost, have made India the most preferred source for software
outsourcing or onsite development, among the leading nations of the world. In fact, India’s software boom has been greatly linked to the manpower resource. (Heeks, R., 1992; Schwar, 1989, ps.60-61; Singhal & Rogers, 1989, ps.203-4; Singh & Nandini, 1999; Joseph, K.J., 2001, p.17). It has also to be kept in view that manpower-based custom software form the substantial majority of India’s software development, especially export. Hence, manpower cost is expected to play an important role in India’s software export. Since it is low-cost manpower that is supposed to propel India’s software export, the anticipation is that there should be a strong and negative correlation between unit labour cost and software export. For this analysis, unit labour cost (ULC) has been defined as the percentage of wages paid by the firm to its sales volume.

11.1.2 Size

The export marketing literature in general has treated firm size as a proxy for the essential firm resources required to venture into the international markets. According to theory, the size of a firm is expected to impact positively on its export performance. (Kumar & Sidharth, 1994; Aggarwal, A., 2001; and Bonaccorsi A., (1992) for a survey). This would be through the possible economies of scale that can impart cost advantages in production, R&D, and marketing efforts. Larger firms would be better placed to obtain information on overseas markets as well as to cross over the uncertainties that may crop up there.

As regards software industry, there are divergent views on the role of firm size in software development. There is literature arguing that size or scale economies do not hold significance in software development, and accordingly there are no entry barriers for firms. However, there are also analysts emphasizing that economies of scale really matter and are significant in software production. In this connection, it may also be kept in view that this is one industry characterised by high level of concentration, nationally as well as globally. It is only a few firms that dominate the production and export of software in India. Internationally also, only a few players are leading the show. (Kumar, N., 2000, p.21; Kopetz, H., 1995, ps.298-301; Henry, P.S., 1989; Correa, C.M., 1995; ESC, 2000).

So, presumably, for being major global players in software or to be successful in software export, size matters, and scale economies are of relevance. This is especially so since the investments are mainly initial in both production as well as marketing, and the marginal
costs are insignificant. For this analysis, it is predicted that firm size (SIZE) will have a positive and strong impact on the volume of software export. SIZE has been defined in Rupee terms (crores) in terms of the sales achieved by the firms.

It is also expected that the relationship between firm size and export performance is non-linear. This is based on the mixed findings about firm size-export behaviour, discussed above. This non-linearity is also observed between the firm size and export behaviour in various other industries. (Kumar & Sidharthan, 1994). It has been argued that exporting may be beyond the capacity of too small an enterprise. On the other hand, very large oligopolistic enterprises enjoying better access to the domestic market, may not feel compelled to export. Hence, an inverted ‘U’ shaped relationship is possible. In the present study, this possibility shall be examined by including along with firm size (SIZE) its quadratic term SIZE².

### 11.1.3 Foreign Dummy

The theoretical literature point out that MNE associated firms are likely to exhibit more of export orientation. This would be because they are better exposed to more competitive technology, better management techniques as well as marketing skills in a globalised world. Moreover, they could be better placed to tap international markets than purely Indian owned firms in view of their easier access to the information and marketing networks of their partners abroad. (Aggarwal, A., 2001, p.6; Kumar & Sidharthan, 1994; Dunning, J.H., (1993) for a survey of literature).

As already explained, several foreign interests have entered the Indian software sector. Almost all major foreign companies are now present in this field. Some of these are fully foreign-owned, whereas several others are having foreign collaboration. Interestingly, majority of these collaborations are financial rather than technical, with equity participation of varying extent. One characteristic of the Indian software exporting companies is their preference for a tie-up with some leading IT company abroad. The prevailing notion is that this is highly essential to penetrate foreign markets. (Lakha, S., 1990, p.54, & 1994, ps. 399-404; BICP, 1989, p.64; Mukhi & Chellam, 1988). A foreign company would greatly cater to the marketing requirements of the Indian firm, and meet other requirements of exporting like brand image, recognition abroad, etc. They could have better access to information about foreign markets and consumer preferences and
the marketing and distribution networking abroad could enable faster response in terms of installation and after-sales service. All these would enhance their probability to export and to perform better overseas. For a purely domestic firm this collection of information on new markets involve considerable financial and other costs as compared to firms with foreign ownership and so exhibit lower propensity to export. Hence, the variable is predicted to have a positive and significant bearing on the Indian software export. This dummy variable related to foreign ownership or MNE association in India’s software industry (FD) has been given the value of ‘1’ wherever the equity participation is not less than 25%, and otherwise ‘0’.

11.1.4 Age

Age of any industrial production unit matters in their production and overall performance. This is because over the years the various parameters enabling the production process, viz., capital accumulation, skill and expertise, technology intensity, etc., and other intangible assets like brand image and goodwill look up. This may be especially so for the software industry which is knowledge or skill-intensive. As knowledge acquisition is an accumulative process, the old and experienced software units in India are expected to perform better and export more, as compared to start-ups. Even abroad also, the software giants are units well established in the field. Hence, this variable is posited to have positive correlation with export. The age (AGE) of the firm has been determined in terms of number of years with respect to its date of incorporation. The relationship between age and export behaviour is presumed to be non-linear. This is based on the general industry experience, and particularly for software industry where the thrust is on skill and knowledge. A pattern similar to the relationship between size and export is anticipated. To capture this possibility, the quadratic term of age (AGE$^2$) has also been included along with it.

11.1.5 Advertising Intensity

Enterprises who lay emphasis on advertising and sales promotion are likely to perform better than others in international markets. The reason given by analysts is that while building brands and trade names, these enterprises will have to perforce maintain quality which would greatly contribute to sustained export effort. Hence, a positive
relationship is forecast between advertisement intensity (ADS) and export behaviour. (Kumar & Sidharthan, 1994).

As regards software business, marketing is supposed to be critical. This is especially so in the IT-advanced countries. Available literature bring out that several of the established units spent more on marketing than in production. (Schware, R., 1987, p.1258; Correa, C.M., 1995, ps.173-4). In the software industry, marketing efforts are mainly on advertising. Hence, the advertisement intensity of firms has been used to capture the impact of marketing on software export. The variable should normally show positively significant impact on software export. However, in the Indian context, the anticipation is that the variable would be positively correlated but without significance. This has to be explained in terms of the nature of India's software export which is mainly custom software and not products and packages. This may not require any high order of marketing or advertisement. The variable advertisement intensity (ADS) has been defined as the percentage of advertisement expenditure of firms to their sales.

11.1.6 Technology Import

Technology is postulated to explain inter-firm variation in export behavior as it can significantly determine their international competitiveness, and boost up productivity and product quality. Import of technology is one of the most important sources of knowledge acquisition by enterprises in developing countries. (Aggarwal, A., 2001, p.8). As regards software industry, of late, the role of technology has been increasing in its production process. Automation has begun to invade several stages and processes of software production, with increasing application of software tools. This is considerably boosting the efficiency of software majors in developed countries. In the absence of capability for technology creation, Indian software firms are heavily dependent on technology import. Most of the leading exporters are having foreign tie-ups, and several of them are having foreign equity participation of varying extent. Hence, the chances and probability of exposure to the advanced software tools and techniques are more. Technological payments, viz., royalties and technical fees paid abroad, as a percentage of sales have been used as a proxy for the firm’s propensity to import technology (TECHIMP) from abroad. This variable is expected to positively impact software export but not significantly as the dominant portion of India’s software export is services and not products.
11.1.7 R&D Intensity

It is now widely held in industrial studies that technology acquisition from overseas sources per se does not lead to competitive advantages of firms either automatically or equally. Improvements in international competitiveness come to the firm through the requisite absorption of this technology and the resultant development capabilities. This is brought in through R&D activity. Software production is one area where technology moves very fast. Change is the order of the day. Moreover, as the industry is knowledge-intensive, the role of R&D is critical through enhancing firm-specific knowledge like better quality, innovative design and marketing. The variable should be interacting positively with software development and export. However, the impact may be devoid of significance in the Indian situation, since, by and large, Indian software units are weak on R&D as compared to their counterparts abroad, and the nature of software production (mainly custom software) also do not give scope for R&D efforts to express themselves adequately. (Aggarwal, A., 2001, p.9; Lall, S., 1992; Hanna, N.K., 1991, ps.17-18; Singh & Nandini, 1999; Chaudhuri, D.D., 1995; Kumar, N., 2000, ps. 33-34; Parthasarathy & Joseph, 2001; Schware, R., 1992; Dharmadhikari, V.K., 1988).

The variable (RDS) has been measured as the percentage of expenditure incurred on in-house R&D laboratories and equipment with respect to firms' sales.

11.2.1 Model Specification

\[
\text{EXPORT} = f(\text{ULC, SIZE, SIZE}^2, \text{FD, AGE, AGE}^2, \text{ADS, TECHIMP, RDS})
\]

\[
\text{EXPORT} = f(\cdot), \text{if export} > 0
\]

\[
= 0 \text{ otherwise}\] Tobit Model

where, \text{EXPORT} – Export Intensity (measured as the % of export to sales of the firm)

\text{ULC} – Unit Labour Cost (defined as the percentage of wages paid by the firm to its sales volume)

\text{SIZE} – Size of the Firm (defined in Rupee terms (crores) in terms of the sales achieved by the firms.

\text{FD} – Foreign Dummy (given the value of '1' wherever the equity participation is not less than 25%, and otherwise '0').

\text{AGE} – Age of the Firm (determined in terms of number of years with respect to its date of incorporation)
ADS – Advertising Intensity (defined as the percentage of advertisement expenditure of firms to their sales)

TECHIMP – Technology Import (proxied by technological payments made abroad)

RDS – R&D Intensity (measured as the percentage of expenditure incurred on in-house R&D laboratories and equipment with respect to firms’ sales)

The export behaviour of a firm is basically governed by two important decisions: whether to export or not and, if yes, how much to export. This categorises the industry firms into two: exporting and non-exporting. The first of the aforesaid questions also boils down to estimating the export probability and the second one to estimating export intensity. Correspondingly, the export competitiveness variable, export intensity, acquires the value of zero for the non-exporting firms and the actual export level as a share of sales for the exporting firms. In a situation where the value of dependent variable is not observed for several cases, the obvious choice is to employ a Tobit model which takes account of both the probability of a firm to export and the extent of export. A simple OLS estimation will produce biased results as it ignores the censoring nature of dependent variable. (Mc Donald and Moffitt, 1980).

The study has also estimated the Logit model to examine explicitly the probability effect on export behaviour. The idea is to examine whether there exists some independent variables which have differential performance with respect to only the probability of exporting vis-à-vis the total effect of export behaviour. (i.e., intensity plus probability). For comparative purpose, the study has also provided the OLS estimation of export intensity, but limited to only the exporting firms. This may facilitate interpreting the marginal effects for exporting firms, but are subject to the said bias of sample selection, i.e., bias arising on account of concentrating only on exporting firms.

11.2.2 Data Set

The firm level data pertaining to this study have been sourced from the Prowess database maintained by CMIE. The model has been estimated by the pooled Tobit regression for a sample of 199 firms with 732 observations unbalancedly spread over the period 1990-91 to 1999-2000. There are 417 observations related to exporting firms and
315 observations with non-exporters. As indicated above, the study has also resorted to Logit as well as OLS estimation of the data, as given in the Appendix (Table III). This is only for comparative purposes, as Tabit model is superior to both these approaches.

11.2.3 Estimation Procedure

The Tobit model has been estimated with maximum likelihood robust standard errors. STATA-- the statistical package used for the estimation purpose-- produces robust standard errors using the Huber-White estimators which can effectively deal with problems of not meeting the classical regression assumptions, such as non-normality and heteroscedasticity. The dataset has also been tested for multicollinearity between the independent variables using the criterion of Variance Inflating Factor (VIF) and Condition Index (CI). It was observed that there is collinearity between the original variable and its squared term in the case of Age and Size. Therefore, the method of ‘Centering’ has been used in the case of both these variables, i.e., instead of the original variable, its deviation form mean has been used in the estimation. It may also be noted that 100% export-oriented firms have been excluded from the analysis. These firms are basically based in export-processing zones or otherwise bound by export scheme framework, and are legally bound to wholly channelise their output for export. Therefore, for these firms institutional factors are the determinants of their export behaviour rather than firm-specific characteristics.

11.3 EMPIRICAL FINDINGS

The results are given in the Table XI.1 below. The estimated Tobit model is statistically significant, as indicated by the high value of Wald chi2 (721.04). Thus, taken together the independent variables are explaining the variation in dependent variable to a statistically significant extent. The performance of individual independent variables in the export performance of Indian software enterprises is discussed below.
### Table No. XI.1- Pooled Tobit Estimation of Export Behaviour of Indian Software Enterprises

<table>
<thead>
<tr>
<th>Independent variables</th>
<th>Coefficient (Robust Z)</th>
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<tbody>
<tr>
<td>Unit Labour Cost (%)</td>
<td>2.524214*** (2.085)</td>
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<tr>
<td>SIZE</td>
<td>0.7222225*** (3.771)</td>
</tr>
<tr>
<td>SIZE²</td>
<td>-0.0000283*** (-2.820)</td>
</tr>
<tr>
<td>Foreign dummy</td>
<td>40.64802*** (8.828)</td>
</tr>
<tr>
<td>AGE</td>
<td>1.170759*** (3.676)</td>
</tr>
<tr>
<td>AGE²</td>
<td>-0.0152224** (-2.307)</td>
</tr>
<tr>
<td>Advertising intensity (%)</td>
<td>-1.802584*** (-4.122)</td>
</tr>
<tr>
<td>Technology import (%)</td>
<td>9.393545*** (7.589)</td>
</tr>
<tr>
<td>R&amp;D intensity (%)</td>
<td>0.0192241*** (13.634)</td>
</tr>
<tr>
<td>Constant</td>
<td>5.387306* (1.662)</td>
</tr>
</tbody>
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| Wald chi2(9)               | 721.04 |
| Prob > chi2                | 0.0000 |
| Log likelihood             | -2439.3791 |
| Number of obs              | 732 |
| Obs. with exporters        | 417 |
| Obs. With non-exports      | 315 |

**Note:** ***-significant at 1 % level; **-significant at 5% level; *-significant at 10 % level.

The variable of unit labour cost has turned out as positive and significant. However, the expectation was that the variable should be exhibiting a significantly negative correlation. While explaining this, it has to be borne in mind that the unit labour cost or salary goes up with rise in the skill base of people, i.e., skill and salary are positively correlated. Any increase in skill should certainly contribute to more of efficiency in software development, but necessitate salary hikes also. Low cost labour can only comprise low skill categories which most probably denote ‘bodysmashing’ with limited earnings. This points to the need for laying more of thrust on high skill manpower as well as high-end software activities. Another probable explanation could be the increasing demand, indigenous and overseas, for software personnel and the resultant scarcities. To find the right skill and talent set and thereafter to retain them is really a problem for the software
firms, which has to be essentially tackled through the offer of higher wages and other compensation. This has been steadily pushing up salary levels. At the same time, software exports have been registering increases year after year. All these lead to the situation of increasing exports co-existing with increasing unit labour cost.

Size has turned out to be positive and significant, as expected. Indeed, software is a peculiar industry where scale economies and lack of entry barriers could coexist. Economies of scale really matter, despite the thrust of Indian software export being more on services than products and packages. This is since the bigger-sized units could be in a better position to distribute out the per unit establishment and other incidental costs of making even software services export, and to achieve cost gains while utilizing the basic resources required. So, some consolidation of the industry may result in improvements in overall competitiveness. This is also substantiating the argument in Chapter VIII that size has to be increased to enhance credibility in the overseas markets. SIZE\(^2\) also is significant with a negative sign, suggesting that firm size–export behaviour relationship in the Indian software industry is inverted U–shaped. Therefore, very large firms enjoying an oligopolistic hold in the domestic market may be generally less inclined to export than other firms. Other things being equal, increases in firm size increases the export orientation but after a threshold, size has a negative impact.

As forecasted, the age of software exporting units impact on their export volumes positively and significantly. Its positive coefficient is statistically significant at 1 percent level. This strongly supports the hypotheses that older firms in the industry have the competitive advantages of greater knowledge and experience in exporting vis-à-vis start-ups. AGE\(^2\) is also significant, similar to the position in respect of SIZE\(^2\), and leading us to similar conclusions.

However, the foreign dummy has turned out to be not only positive, but highly significant beyond expectation. Indian affiliates of MNEs are performing better than their local counterparts in software export. The foreign tie-ups are really helping India’s software export endeavours. It seems the arrangements or association with international companies, at least in the initial stages, really take care of marketing, sales and distribution abroad. Giving further encouragement to MNEs for entering the country for
undertaking export-oriented software manufacturing by leveraging the India advantages in software would be desirable.

As against expectation, the correlation between advertising intensity and software export, has come out as negative which has to be taken as counter-intuitive. This is also significant at 1 percent level. Whereas, globally the impact has been taken as strikingly positive. The probable explanation could be the nature of India’s software export, viz., services. It could practically be termed as ‘software services export’. This variant of export may not warrant that sort or intensity of advertising as for products and packages, and hence any substantial spending on advertisement could work out as wasteful expenditure with a negative correlation.

As regards the technology indicators, viz., technology import and R&D intensity, both are positive and significant at 1 percent level. In software industry which is knowledge and technology-intensive, technology acquisition really matters. Use of latest software development tools and techniques may enhance productivity and efficiency, even in the context of software services which is the mainstay of India’s software export. In the absence of indigenous technology creation, its import could fill the void. The present increasing number of foreign collaborations could be a possible avenue for this. The thrust should be laid not only on financial collaborations, but also technical. However, care should be taken to import technology suiting the industry requirements in the Indian context, and to avoid repetitive import of technology. The significance of R&D intensity is going against its hypothesized insignificance. So, the industry being knowledge-intensive, even in the context of software services, there is adequate scope for the application of R&D not only in terms of building local capabilities but also for strengthening export competitiveness. This could be by way of innovative designs, software quality, improved marketing initiatives, etc. As R&D is empirically observed to enhance the export orientation of Indian software enterprises, more of policy emphasis is called for to boost up their R&D efforts. This is particularly so when technology import is also enhancing export intensity, and greater R&D is imperative to enable technology adoption and assimilation.

The empirical evidence on the performance of independent variables as per the Logit and OLS estimations, are as follows (ref. Table III of Appendix): the labour cost is
positively affecting the export performance of exporting firms (OLS estimation) but is not observed to be significant for non-exporting firms to export. The variables of firm Size and Age tend to induce non-exporters to start exporting (Logit estimation), but are not effective or useful for increasing the export activity of exporting firms (OLS). Interestingly, these two variables as observed in the case of Tobit estimation, have non-linear effect on the export orientation of Indian software firms, as represented by the inverted ‘U’ shaped relationship. The variable FD is significantly positive in both Logit as well as OLS estimation. Foreign affiliation lends a critical edge to the Indian software industry in entering as well as performing well in overseas markets. Advertisement intensity, as already seen from Tobit results and for the reasons cited therein, is observed to have a negative effect on the export behaviour of firms both with regard to probability as well as intensity. Findings related to technology import suggest that the Indian firms who had access to foreign technology have exported, indicating success perfectly. This variable is also critical in the export success of exporting firms. Firms’ indigenous R&D efforts or innovations, although do not have a significant effect in the case of export probability (Logit), really contributes in promoting the export intensity of exporting firms (OLS). So, the findings under Logit and OLS estimations are more or less following the broad directions under the Tobit estimation, except for the differences with regard to significance.

On the whole, the software export model (Tobit) presented above throws light on the listed variables as significant determinants of export in the industry. Foreign tie-ups have emerged as highly significant and support the industry view that this is indispensable to access and succeed in the global software market. The labour cost has not emerged with its expected significance or direction because of the reasons mentioned earlier. As against the case of IT-advanced or mature economies, the advertising intensity has not acquired the expected significance/direction in the Indian situation, mainly because of the nature of production, viz., custom software or services and not products and packages. This is contrary to the pattern in developed counties where products and packages have emerged as the leading component of software production, and reveals the lack of India’s software maturity despite all the software boom. Technology and R&D intensities could really play a role in improving the country’s software export prospects, and calls for greater emphasis. This could also enable India’s switchover from services to packages in the long run. The policy directions and thrust have to keep these in view.