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ABSTRACT

Mauritius is an outlier in Sub-Saharan Africa for its impressive manufactured export performance based on garments since the adoption of market-oriented policies in the early 1980s. Little, however, is known about the role played by internal technological factors on the exporting behaviour of enterprises of different size classes in the Mauritian garment industry. Using recent methodological developments in the literature on industrial technological capabilities, this paper explores this issue by constructing a technology index and conducting econometric analysis on factors affecting enterprise-level technological development and export performance in a sample of Mauritian garment enterprises. The econometric results show that firm size, technical manpower, training expenditures and external technical assistance are positively related to the technology index. This confirms that investments in human capital and seeking information, both facilitated by size, improve technological performance. This is strengthened by the fact that the technology index and foreign ownership have positive and statistically significant effects on export performance of each firm. The technology index is a robust tool of empirical research and can be used to analyse the technological record of enterprises in adjusting developing countries.

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1. INTRODUCTION

Mauritius is an outlier in Sub-Saharan Africa for its impressive industrial performance. During the last two decades or so, the Mauritian economy underwent a remarkable transformation from a mono-crop sugar producer to become one of the leading exporter of manufactures in Sub-Saharan Africa. The share of manufacturing in GDP in Mauritius nearly doubled between 1980 and 1998 (from 15% to 25%).[1] The engine of industrial growth was manufactured exports (primarily garments), which grew at 14.8% per year during 1980-1998. By 1998, the country's value of manufactured exports per head (US$ 1,094) was the highest in Sub-Saharan Africa. This striking performance has lead some to regard Mauritius as an economic miracle in paradise (ILO, 1999). Its success in exporting garments is attributed to the adoption of a more market-oriented development strategy since the early 1980s, which emphasised trade liberalisation and attracting foreign investment through export processing zones and attractive investment incentives; reasonable macroeconomic stability in terms of low inflation and a competitive real exchange rate; a business-friendly economic environment with a bureaucrats keen to get things done and a low level corruption; a pool of cheap, literate, bilingual labour (English and French speaking); preferential access into the European Union market as a signatory of the Lomé Convention and close proximity to the untapped African market; and a high degree of political stability.[2]

In contract with the attention paid to macro aspects, there are hardly any studies on micro-economic aspects of the export record in Mauritius during the period of market-oriented economic policies. Information on the part played by internal technological factors on the exporting behaviour of Mauritian enterprises is particularly patchy. Enterprise-level technology issues are attracting increasing interest in the literature on economic development. A distinct body of research has begun to examine the nature of industrial technological development in market-oriented developing economies (Katz, 1987; Lall, 1992; Bell and Pavitt, 1993; Pietrobelli, 1997; Wignaraja, 1998; Romijn 1999; Metcalfe, forthcoming). This research suggests that industrial technological development should not be viewed as a process that can be promoted easily and quickly by investing in new equipment or buying imported technology. It requires conscious investments by firms in their own technological capability. Technological capability being defined here as the skills, knowledge and experience that enterprises need to

[1] Calculated from World Bank, *World Development Indicators 2000*.
[2] See Woldekidan (1994), WTO (1995), Milner and Mckay (1996), ILO (1999) and UNCTAD (2000).

operate imported technology efficiently. This research also found that enterprises in newly industrialising economies (NIEs) in East Asia had built up relatively good technological capabilities in a spectrum of industries compared to international standards and that this was a major factor in their rapid export growth and technological upgrading (Pack and Westphal, 1986; Hobday, 1995; Aw and Batra, 1998; Ernst, Ganiatsos and Mytelka, ed. 1998). The few available studies on Mauritius indicate that firms in the garment industry acquired technological capabilities, which enabled them to produce for international markets (World Bank 1994; Dubois *et al.* 1995; Lamusse, 1995). However, little is known about the nature of technological learning in large firms and small and medium enterprises (SMEs) and the firm-level influences on this process. There is also a lack of statistical confirmation of the relationship between capability building and export performance. Consequently, much of the literature on Mauritius has only been able to provide a limited picture on the dynamics of enterprise performance during the period of market-oriented policies.

In order to remedy these gaps, this paper attempts to shed light on the relationship between firm size and the acquisition of technological capabilities in Mauritius. Using cross-section data for the late 1990s, it constructs a technology index for a sample of 40 Mauritian enterprises in the garment industry and econometrically analyses its firm-level determinants (including firm size, ownership, employment of technical manpower, investments in enterprise training and use of external technical assistance).[3] It goes on to examine the influence of the technology index in an econometric analysis of firm-level export performance. Section 2 surveys recent literature on technological capabilities in developing countries focussing on econometric work on firm size and technology development. Section 3 briefly discusses the experience of market-oriented policies and SME development in Mauritius. Section 4 examines the nature of technological development in SMEs and large firms in the Mauritian sample. Section 5 presents the econometric results and section 6 concludes.

An SME is defined here as a firm with 100 or less employees while those with over 100 employees are taken as large firms. According to this definition, there are 19 SMEs and 21 large firms in the sample of 40 Mauritian enterprises. Moreover, 13 firms have some proportion of foreign equity and 27 were exporting some proportion of their sales.

[3] The enterprise data for this paper was collected during fieldwork in Mauritius in 1996 and 1998 in the course of studies on national competitiveness strategy and SME exports (see Lall and Wignaraja, 1998; Wignaraja and O'Neil, 1999).

2. TECHNOLOGICAL CAPABILITIES IN DEVELOPING COUNTRIES: A REVIEW OF RECENT LITERATURE

2.1 General Findings

A common perception in the literature is that the successful accumulation of technology in a given developing country can be encouraged by a smooth inflow of new information, ensuring conducive macro-economic conditions and increasing expenditures on education. These factors have a role to play but, on their own, are insufficient to ensure a continuous process of domestic technological development in developing countries. A relatively recent development in the literature is the emphasis on manufacturing enterprises as the main actors in the process of accumulating technological capabilities. The capability literature emphasises the notion that enterprises have to undertake conscious investments to convert imported technologies into productive use.[4] New technologies have a large tacit element (i.e., person embodied information which is difficult to articulate) that can only be acquired through experience and deliberate investments in various inputs (e.g. training, information search, engineering activities and research and development). Five features of the process of building firm-level technological capabilities in developing countries are particularly relevant to this study:

The process of acquiring technological capabilities is unpredictable (Lall, 1992; Metcalfe, forthcoming). Investments in technological capabilities, like financial investments, carry considerable risk and the outcome is uncertain. Firms face technical difficulties and financial uncertainties especially in research activities. Moreover, rarely can firms insure against failure in capability building. The implications of fundamental uncertainty are clear: the reality cannot be fully modelled and the direction of change never achieves equilibrium.

Capability building is an incremental and cumulative process (Bell and Pavitt, 1993; Hobday, 1995; Aw and Batra, 1998). Enterprises rarely develop a diverse range of capabilities simultaneously. Nor do they make jumps into completely new areas of technology. Instead, they process in an incremental manner by building on past investments in technological capabilities and typically move from simpler to more technological complex activities.

Capability building involves close cooperation between organisations (Lall *et al.* 1994; Mytelka and Farinelli, 2000). Firms rarely acquire capabilities in isolation. When attempting to absorb imported technologies, they interact and exchange technical inputs with other firms (e.g.

[4] See Pack and Westphal (1986), Katz (1987), Lall (1992), Bell and Pavit (1993), Ernst, Ganiatsos and Mytelka (ed. 1998) and Metcalfe (forthcoming).

competitors, suppliers and buyers of output) and support institutions (e.g. technology institutions, training bodies and SME service providers) in a national innovation system. Hence, interaction and interdependence between organisations (i.e. collective learning) in a national innovation system is a fundamental characteristic of capability building.

Success in acquiring firm-level technological capabilities can spillover into industrial success (Pack and Westphal, 1986; Katrak, 1986; Ernst, Ganiatsos and Mytelka, ed. 1998). Differences in the efficiency with which firm-level capabilities are created are themselves a major source of differences in comparative advantage between countries.

Capability building is affected by a host of national policy and institutional factors (Katz, 1987; Lall, 1992; Westphal, 2001; Metcalfe, forthcoming). Firm-level learning can be stimulated by the trade, industrial and macroeconomic regime well as supported by institutions of different kinds (including those providing industrial finance, training and information and technological support). Prominent among the factors that have a positive influence on capability building are: macroeconomic stability, outward-oriented trade and investment policies, ample supplies of general and technical manpower, ready access to industrial finance and comprehensive support from technology institutions.

Bulk of the empirical work on technological capabilities in developing countries has been based on case studies of enterprises in particular industries.[5] These detailed studies of individual firms and groups of firms have shed valuable insights into the nature of technological activities in developing countries, the utility of different learning mechanisms and factors affecting firm-level capability building. A significant contribution by the case study research is to suggest ways of classifying the technical functions performed by manufacturing enterprises to assimilate imported technology. One of the most elaborate taxonomies of technological capabilities is the one proposed by Lall (1992), which breaks them down into investment, production and linkages as follows:

Investment is represented by project execution activities including feasibility studies, equipment search, assessment of equipment, employee training during start-up and involvement of the firm in detailed engineering.

Production is sub-divided into process technology and product technology. Process technology includes quality control, maintenance, plant layout, inventory control, and various

[5] See Katz (1987) for a survey of early studies in Latin America and Bell and Pavitt (1993) for studies on other developing countries. Recent examples include: Lall *et al*. (1994) on food processing, wood working, textiles and garments and metal working in Ghana; Hobday (1995) on the electronics industry in East Asia; Pietrobelli (1997) on food processing and other industries in Chile; Wangwe (ed.1995) on food processing, wood working and metal working in several African economies including Mauritius, Kenya and Tanzania.

improvements in equipment and processes. Product technology covers copying imports (or buyers), improving existing products, introducing new products and licensing product technology.

Linkages are considered under supplier firm linkages, subcontracting linkages and linkages with institutions that provide trouble-shooting, testing, training and product design assistance.

The advantage of this framework over other approaches is that it provides a clear continuum of technical functions from the time new technology enters a given firm to when it exits to other firms and institutions. Furthermore, as this framework has been successfully used in past empirical work on technological capabilities in developing countries, it will be also used here to examine firm-level technological development in Mauritius.[6]

2.2 Econometric Analysis of a Technology Index

One major challenges facing researchers working on technological capabilities is to summarise inter-firm differences in capabilities. It is convenient to develop a simple summary measure to permit statistical analysis of the influences on capability acquisition. Recently, some studies have begun to rank the technological capabilities of individual firms and attempt statistical analysis of their determinants.[7] The ranking integrates objective and subjective information into measures of enterprises' capacity to set up, operate and transfer technology. To create an enterprise score, the information in these indicators is converted into a summary measure of capabilities. The typical approach adopted by this literature is highlight the various technical functions performed by enterprises to manage imported technology and award a given firm a score for each technical activity indicating its level of technical competence in that activity. An overall capability score is obtained for a given firm by taking an average of the scores for the different technical functions.

Some qualifications should be noted on the interpretation of the firm-level capability scores.

First, the estimates contain an element of subjectivity, which can lead to bias in the absolute values of the technological capability scores. However, this may not matter much for the purpose at hand — inter-firm comparisons of the relative values of the technological capability scores. As Westphal *et al.* (1990) explain in the context of their study of Thailand:

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[6] See, for instance, Lall *et al.* (1994) on Ghana; Biggs et al. (1995) on Kenya, Zimbabwe and Ghana; and Pietrobelli (1997) on Chile and Wignaraja (1998) on Sri Lanka.

[7] The pioneering work on this subject is Westphal *et al.* (1990) on Thailand. Subsequent work includes SRI International (1992) on Indonesia, Gosen (1995) on Mexico, Deraniyagala (1995) and Wignaraja (1998) on Sri Lanka, Romijn (1999) on Pakistan, Deraniyagla and Semboja (1999) on Tanzania, Wignaraja and Ikiara (1999) on Kenya, Latsch and Robinson (1999) on Zimbabwe.

..the capability scores are biased estimates with respect to the measurement of capabilities cum capacities *per se*. The degree of bias depends on the respective weights placed on capability and sophistication in the researcher' scoring. Unfortunately, it is not possible to state these weights. However, the bias that is present in the absolute values of the scores does not necessarily affect the relative values obtained when the scores are considered in comparison to one another. Intra-firm comparisons (across capabilities for one firm) and inter-firm comparisons (across firms for one capability) are biased with respect to indicating differences in capabilities cum capacities only to the extent that sophistication levels differ intra and inter-firm respectively. Since most of the analysis is concerned with relative values, it is possible that the bias has minimal consequences for the analysis (Westphal *et al.*, 1990, pp. 87 and 91).

Second, the weights attached are subjective, with all activities given equal weights by averaging.

Cross-section econometric work on the determinants of technological capabilities (hence, a technology index for short) reports some interesting findings particularly in regard to the relationship between firm size and the technology index in five developing economies which had adopted market-oriented policies (Thailand, Pakistan, Sri Lanka, Tanzania and Kenya).[8] OLS regressions were run relating technology indices to particular characteristics of enterprises. In relation to firm size, these studies have attempted to test the hypothesis that there is a positive relationship between the technology index and this variable. The positive relationship is based on the argument that the returns from capability acquisition are higher where a firm has a larger volume of sales to spread the fixed costs of capability acquisition and large firms can have more specialised technical manpower. Moreover, it is argued that capital market imperfections confer an advantage on large firms in securing finance for risky technological activities and size is correlated with the availability and stability of funds.

The earliest study by Westphal *et al.* (1990) included firm size as one of four variables (the others being ownership, market orientation and incentives given by the Board of Investment) determining different technology indices for a sample of 100 Thai electronics, biotechnology and materials technology enterprises. In a regression of a production technology index, he found that the firm size coefficient was significant at the 10 per cent level and positive.

Using a sample of 46 engineering firms in Tanzania, Deraniyagala and Semboja (1999) attempted to estimate the influence of several firm-level characteristics (firm size, foreign equity, firm age, entrepreneur’s education level and a skill index) on a production-based technology index. Interestingly, they found that firm size and foreign equity were not significant. Of the other explanatory variables, entrepreneur's education level and the skill index were significant (5 per cent level) and positive while firm age was also significant (5 per cent level) but negative in sign.

Wignaraja (1998) tested an overall technology index and one for production only against several firm-level characteristics (including firm size, foreign equity, technical manpower and technology imports) in a sample of 27 garment and engineering enterprises in Sri Lanka. In both regressions, firm size turned out to be significant (5 per cent level) and positive while technical manpower and technology imports were also significant (1 per cent level) and positive.[9]

Using a sample of 41 Kenyan garment and engineering enterprises, Wignaraja and Ikiara (1999) regressed an overall technology index against firm size, foreign equity, entrepreneur's education level, technical manpower and employee training. They report that firm size, foreign equity and entrepreneur's education were all significant (5 per cent level) and positive.

Finally, in a departure from the studies mentioned above, Romijn (1999) conducted econometric work using technology indices based on the manufacturing complexity of products on a sample of 100 engineering firms in Pakistan. In her best two regressions, firm size turns up as significant (1 per cent level) and positive. Among the other explanatory variables, external technical assistance and improvements made to products are both significant (1 per cent level and positive while search for information had a positive sign but was significant at the 5 per cent level. Surprisingly, entrepreneurs' education level and firm age were not significant.

Thus, the handful of econometric studies seem to provide some empirical support for the hypothesis that firm size is positively associated with the acquisition of technological capabilities. Entrepreneur's education level, technical manpower, external technical assistance and foreign equity also show up as important determinants of capability building in some studies. Building on earlier econometric work, the remainder of this paper further explores the relationship between firm size and technological capabilities through firm studies in the garment sector in Mauritius.

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[8] Lall *et al.* (1994) on Ghana and Latsch and Robinson (1999) on Zimbabwe also attempt to relate inter-firm differences in capabilities to firm characteristics (including firm size) using T-tests and rank correlation measures.

[9] In neither the Sri Lanka study nor the Kenya study did the industry dummy variable turnout to be significant.

3. MARKET-ORIENTED POLICIES AND ENTERPRISE PERFORMANCE IN MAURITIUS

3.1 Trade and Industrial Regime

In terms of its trade, industrial and macroeconomic regime; Mauritius is an outlier from other African developing economies. Unlike many African developing economies, the country did not subscribe to the prevailing orthodoxy of inward-oriented, state dominated development strategies of the 1960s and 1970s that emphasised stringent import substitution coupled with heavy state intervention in the economy. Instead in the 1970s, Mauritius followed a mixed trade policy of import substitution coupled with incentives for exports through the Export Processing Zone (EPZ).[10] These two trade regimes co-existed, influencing enterprises producing for the small home market and those producing for export. In the early 1980s, Mauritius introduced a stronger market-oriented stance to its economic policy. As a part of a structural adjustment loan agreement with the World Bank, Mauritius embarked on a process of trade liberalisation and industrial adjustment in 1983.

Three distinct phases of trade liberalisation and industrial reforms can be identified since the mid-1980s, each with a different rate of reform and coverage.

The first episode, between 1983-85, consisted of the rapid elimination of most quantitative restrictions on imports and their replacement by tariffs. Existing incentives for exporting -- granted via the EPZ since 1970 -- were maintained. Moreover, macroeconomic stability (low inflation and competitive exchange rates) became an explicit policy objective. Despite these early reforms, the domestic manufacturing sector remained relatively highly protected and restricted by a plethora of bureaucratic regulations.

The second, between 1986-1993, tried to gradually reduce the dispersion of effective protection among industries and to promote exports more vigorously by providing exporters with overseas marketing support, preferential interest rates on development loans and tax concessions. Export and investment promotion was greatly strengthened by the creation of the Mauritius Export Development and Investment Authority (MEDIA) in 1985. Emphasis was also placed on maintaining macroeconomic and price stability. There were also cuts in bureaucratic procedures affecting imports, exports and foreign exchange. The net result of these reforms was that the economy became more outward-oriented and private-sector focussed than in the past.

[10] Woldekidan (1994), Milner and McKay (1996), Lall and Wignaraja (1998) and UNCTAD (2000).

The third episode, from 1994 to date, cut protection further by reducing import tariffs and attempted to develop new areas of comparative advantage. In 1995, the number of tariff bands were reduced and the maximum import tariff rates was cut. New institutions were also established to promote new high skill exports (e.g. the Mauritius Productivity and Competitiveness Council was created in 2000).

By the mid-1990s, Mauritius had become considerably more open and market-friendly than in the past and is one of the most liberal regimes Africa. By the mid-1990s, substantial progress was made in reducing tariffs and non-tariff barriers to imports in Mauritius. One indication of greater openness is that the average tariff for manufacturing fell from 86.2% in 1980 to 30.1% in 1994. [11] The main changes include: quantitative restrictions have been mostly eliminated and the few that remain are largely on health, sanitary and security grounds; there are few import prohibitions (with the exception of commodities such as second hand motor vehicle spares and explosives); the level of nominal tariffs has fallen as well as its dispersion (the number of rate bands were cut from 60 to 8 and the maximum rates were reduced); there are no local content programmes to assist local suppliers; and public procurement policies are minimal.

Progress in achieving an open, market-friendly policy regime, however, was not matched by similar reforms in the human resource base and the technology support system for industry.[12] Mauritius has a good record in educational investment that is reflected in a relatively good base of primary and secondary educated manpower by regional standards – in 1993, its primary enrolment ratio was 106% while its secondary enrolment ratio was 59%. This primary and secondary level education base provided a pool of literate (bilingual), trainable workers for the industrial sector in Mauritius. However, the country suffers from a severe shortage of tertiary-level manpower, particularly in technical subjects (e.g. mathematics and computer science, engineering and natural science), which is needed for technological sophisticated industries in the future. University enrolments in these technical subjects were tiny in relation to its population (only 0.04% in 1991 compared with 0.56% for Singapore and 1.5% for Taiwan). Moreover, teacher quality, materials and equipment were often poor with a mismatch between the skills produced by tertiary-level institutions and those needed by industry.

Mauritius has a reasonable technology support system for industry with several institutions involved in providing metrology, standards and quality services; productivity improvement; SME extension services; training; and diffusion of technologies.[13] It has been improved in recent years, particularly the Mauritius Standards Bureau and the diffusion system (the

[11] WTO (1996).
[12] Bheenick and Hanoomanjee (1988); Lall and Wignaraja (1998).
[13] This assessment of the technology support system in Mauritius is drawn from Lall and Wignaraja (1998).

Technology Diffusion Scheme) as a part of a World Bank competitiveness project. The productivity improvement agency for export firms (the Export Processing Zone Development Agency) was doing a good job while the SME agency was also doing useful work but seemed inadequate in terms of what was needed to transform SMEs into efficient sub-contractors and make them export-oriented. The institutions in general were inadequate in terms of size, financial resources and technical manpower to respond to the technical challenges facing the industrial sector. Moreover, there were some functions that no institution was filling – the most prominent among these being research, development and design – productivity improvement and SME extension services needed to be expanded significantly.

3.2 Performance of Large Firms and SMEs

The transformation of the Mauritian economy over the last three decades from a low productivity, subsistence base to a producer of labour-intensive manufactures for export is a remarkable developmental achievement. It has built up a significant base of export-related skills, information and institutions, far ahead of neighbouring countries in Africa and is regarded by some as a candidate for newly industrialising economy (NIE) status in the 21st century. Its manufactured exports grew at 14.8 per cent during 1980-1998 compared with 8.1 per cent for South Africa, 9.0 per cent for Zimbabwe, 4.8 per cent for Kenya and 10.2 per cent for the Ivory Coast, 6.6 per for Nigeria and 1.7 per cent for Uganda.[14] By 1998, its manufactured exports per head ($1,094) were the highest in Africa and among the highest in the developing world. The bulk of manufactured growth in Mauritius during this period can be attributed to a single export item -- garments (which account for over 82 per cent of total manufactured exports in 1998). The country's dependence on this item is greater than that of other garment dependent economies in South Asia (e.g. Sri Lanka and Bangladesh). To date, there is little evidence of diversification into other labour-intensive exports (e.g. toys and footwear) or industrial upgrading into more technologically sophisticated exports (e.g. electronics and engineering industries) that was witnessed in East Asian economies in the 1960s and 1970s. The high degree of dependence on garments makes the country vulnerable to competitive pressures from cheaper producers of garments (e.g. China and Vietnam) particularly after the expiry of the Multi-fibre Agreement in 2005.

[14] Calculated from World Bank, *World Development Indicators, 2000*. The same data source shows that the 1980-1998 manufactured export growth rates achieved by Mauritius were closer to East Asian levels. For instance, Singapore experienced manufactured export growth rates of 15.4 per cent, Taiwan of 11.6 per cent, Hong Kong of 15.7 per cent.

There is a dearth of information on the relative economic contribution or performance of large firms and SMEs in Mauritius. However, a recent study provides some insights:[15]

- there were 411 large firms and 5,320 SMEs in the manufacturing sector in Mauritius in 1997;
- SMEs account for 32.1 per cent of manufacturing employment in 1997 and large firms for the rest;
- SMEs account for manufactured exports worth only US$ 23.1 million and large firms for US$ 1.1 billion in 1997 (1.9 per cent and 98.1 per cent of total manufactured exports, respectively);
- SMEs made up only 1.1 per cent of clothing exports, the dominant industry, while large firms make up 99.9 per cent;
- In terms of labour productivity, SMEs were below large firms in most industries.

Mauritius abandoned its mixed trade policy in favour of a more liberalisation in the early 1980s. The trade and industrial reforms shifted incentives further towards exports and away from import substitution. Over the last two decades, the country witnessed rapid manufactured export growth based on garments. The available evidence indicates that there is a distinct pattern of manufactured export performance by firm size in Mauritius during the period. Large enterprises seem to account for most of the country's manufactured export dynamism while SMEs have hardly participated in exports. Micro-level analysis adds considerable insights into national export performance. In Sections 4 and 5, we examine the influence of firm-level technological behaviour and its determinants on the export record of large firms and SMEs in Mauritius.

[15] See Wignaraja and O'Neil (1999). Additional insights are provided by survey data. The De Chazal Du Mee (1998) survey of 40 Mauritian SMEs found that only 7 were engaged in export sales (mostly towards the regional African market) and they conclude that SMEs were weak exporters relative to large firms.

4. TECHNOLOGICAL CAPABILITIES IN THE MAURITIAN SAMPLE

This section examines the nature of industrial technological development in large firms and SMEs during the market-oriented period in Mauritius in an attempt to link this to the export record. The analysis is based on the concept of a firm-level technology index (TI), which has been successfully used in other technology studies in developing countries (see Section 2.2).

The 40 firm garment sample used in the analysis is fairly evenly distributed between firms of different size clases – there are 19 SMEs (<100 employees) and 21 large firms (>100 employees). The average number of employees for the large firms was 536 employees compared with 38 employees for the SMEs. Four 4 micro-enterprises with less than 10 employees each are also included in the SME category.

There is a high propensity to export among the sample enterprises and 27 enterprises were exporting some proportion of their sales (10 enterprises export 100% of their sales). However, large firms were more export-oriented than SMEs (the two groups had average export to sales ratios of 75.8% and 12.3%, respectively).

There are only 13 enterprises with some proportion of foreign equity and hence the sample mostly consists of local firms.

4.1 Computing the Technology Index

The TI used for this study of Mauritian garment enterprises is a variant of those used by Wignaraja (1998) for Sri Lankan enterprises and Wignaraja and Ikiara (1999) for Kenyan enterprises. The TI used here and in the Sri Lankan and Kenyan studies draws on the three-fold classification of firm-level technological capabilities into investment, production and linkages activities developed by Lall (1992). In line with previous work, this study uses information on technical functions performed within a given industrial enterprise to compute a TI (essentially, a summary technology score) for each of the 40 garment firms in the Mauritian sample. The TI scoring system for the Mauritian firms (given in Appendix Table A1) consists of two sets of technical functions: production and linkages.[16]

[16] A lack of data on investment functions performed by the Mauritian sample enterprises meant that investment capabilities could not be incorporated into the technology index. As achievements in investment capabilities are likely to be closely correlated with those on production and linkage capabilities, this is not expected to affect a given firms technology ranking.

The larger category, production, is represented by ten separate technical activities, which range from common process engineering tasks (like measurement of internal reject rates and ISO 9000 quality management status) to product engineering tasks (like copying existing products, improving existing products and introducing new products). Productivity improvement, a key industrial engineering activity, is also included under this heading.

The other category in the TI scoring system, linkages, is represented by two technical activities. It highlights technology transfer via two kinds of inter-firm relationships: those with sub-contractors and those with overseas buyers of output.

Each of the twelve technical activities can be graded according to different levels (0, 1 and 2) to represent different levels of competence within that function. Thus, a given firm is ranked out of a total capability score of 24 and the result is normalised to give a value between 0 and 1.

4.2 Findings for Large Firms and SMEs

Table 1 shows the frequency distribution of the overall capability scores for the 40 garment firms in the Mauritian sample. The TI scores will be used both as a dependent variable and an independent variable in econometric analysis in Section 5.

Table 1: Frequency Distribution of Technology Index (TI) for All Firms

TI class	**No. of firms**	**% of total firms**
0.0-0.20	14	35.0
0.21-0.40	10	25.0
0.41-0.60	9	22.5
0.61-0.80	6	15.0
0.81-1.00	1	2.5
Total	40	100

The data suggest that there is a wide variation in TI scores between garment firms. Only one firm has a score in excess of 0.81, another six have scores in excess of 0.61 and the remainder have scores well below that of the best garment firms. This seems to suggest that some Mauritian garment firms have quite good technological capabilities, which are probably on par with international best practice in the garment industry, but there is also a long tail of underperformance in the sample. This technological capability gap is linked to firm size.

Table 2 shows the overall TI scores for the 21 large garment firms (>100 employees) and the 19 SMEs (<100 employees) in the Mauritian sample. It also shows scores, by firm size, for the main sub-categories of the TI (namely individual scores for process engineering, product engineering and linkages).[17] Table A1 indicates that there are 6 categories of technical functions under process engineering and a score for this is obtained by ranking firms out of 12. Similarly, a score for product engineering can be computed by ranking firms out of 6 and one for linkages by ranking out of 4. Size class scores are obtained by averaging the requisite enterprise scores.

Table 2: Average TI Scores for Large Firms and SMEs				
Size category (a)	**TI score**	**Process engineering score**	**Product engineering score**	**Linkages score**
21 Large Firms	0.51	0.53	0.37	0.40
19 SMEs	0.17	0.20	0.23	0.04
(a) SMEs have <100 employees, large firms have >100 employees.				

The data on the overall TI scores suggest that there is a striking difference in the level of technological development between large garment firms and SMEs in Mauritius. Large garment firms record an average TI score (0.51), which is three times higher than that for SMEs (0.17). A closer examination of the disaggregate scores for process engineering, product engineering and linkages sheds light on the nature of technological activities and achievements in large firms and SMEs.

Much of the technology gap between size classes is due to differences in process engineering capabilities. Large firms have an average *process engineering score* (0.53), which is more than double that for SMEs (0.20). In part, this reflects the fact that large firms have much better quality management capabilities than SMEs. For instance, the available evidence from our sample show that large firms (2.6%) typically record lower average internal reject rates for their main product than SMEs (3.9%).[18] Furthermore, more large firms than SMEs had moved into comprehensive quality management by adopting ISO 9000 quality management standards to enhance their export competitiveness -- 4 large firms had been certified to ISO 9000 standards and another 4 were in the process of being certified but none of the SMEs had received certification and only 2 SMEs were being certified. Most SMEs rely on final inspection of goods at the end of a line rather than a comprehensive quality management system. In some cases, the entrepreneur does *ad hoc* checks on finished goods and reject rates are not recorded.

[17] As industrial engineering only had one technical function listed, it was decided not to compute a separate score for this activity.

[18] World Bank (1994) argues that quality management in Mauritius "needs dramatic improvement". It found that average reject rates in Mauritius are around three times higher than in developed countries, despite use of considerable numbers of quality control personnel on the line. It also found that few firms have good systems that would prevent defects from arising.

The majority of SMEs were not aware of the existence of the ISO 9000 system and its many advantages including the improvement of quality, more rapid productivity growth and increasing the attractiveness to overseas buyers of output.

Moreover, large firms seemed to have better maintenance capabilities than SMEs. Nearly all the large firms had a regular routine for maintenance and serving of equipment, a maintenance shop and specialised maintenance manpower. Some large firms also brought in foreign maintenance staff where required (for instance, for major repair work on computer aided design systems). With some exceptions, SMEs did seem to conduct routine maintenance of their equipment and tended to undertake repairs only when equipment broke down. SMEs also tended to rely on contract maintenance staff hired from the local market and lacked in-house maintenance shops and specialised maintenance manpower.[19]

Large firms were also more active than SMEs in ensuring that relevant equipment were properly calibrated, that local raw materials were substituted for imports where possible and that equipment was regularly upgraded through purchases of new machines and technologies.[20]

In the case of *product engineering scores*, a somewhat smaller gap between large firms (0.37) and SMEs (0.23) is indicated by the data. This is slightly deceptive as our firm-level interviews indicated that there is considerable variation in the emphasis paid to product technology in the sample firms.

At one end, are large firms that typically receive new products and designs from foreign buyers of output and periodic visits to international trade fairs. On the whole, therefore, large firms are making garments in line with international trends and market demand. A core of large enterprises have also tried to create independent design capabilities by hiring trained designers, investing in computer aided design (CAD) systems and formulating strategies for interaction with a range of foreign buyers. The enterprise survey showed that 13 large garment enterprises

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World Bank (1994) concluded that the spread of ISO 9000 accredited quality management systems should be encouraged in Mauritius.

[19] Dubois *et al.* (1995) report that local firms (particularly SMEs) lack the ability to undertake major maintenance and cite the following reasons for this: unavailability of qualified manpower and serving equipment for undertaking major maintenance work; maintenance crews being more oriented towards routine maintenance; few people being involved in the maintenance department, poor maintenance planning; and inadequate status being allocated to the role of maintenance in the organisation.

[20] World Bank (1994) noted that a number of medium and large Mauritian firms have adopted computer aided design and manufacturing. Computer aided cutting is rare since it is much more expensive; however, some large firms have made the necessary investment; wider application of this technology is, however, needed if quality is to be raised in general. The study also commented that some large firms have also adopted into computerised sewing and stitching in order to reduce labour costs, cut defects and realise more complex designs. Meanwhile, the bulk of Mauritian firms (particularly SMEs) rely on outdated basic sewing machines.

had full-time designers (some of them even had qualified overseas) compared with only 6 SMEs (many of the designers in the SMEs lacked formal design qualifications).[21]

On the other, are SMEs which tend to copy imports or rely on local sources of information for product information and designs. A high proportion of products from SMEs cater to consumer tastes in the local/regional markets and are not in line with international trends. Relatively few SMEs were engaged in long-term marketing relationships with foreign buyers of output or had made the effort to try to develop independent design capabilities.

Finally, large firms (0.40) have better *linkages scores* than SMEs (0.04). There are limited contract-based intra-firm technological transfers in Mauritius either through subcontracting relationships or buyer-seller relationships with foreign buyers of output. To the extent that these occur, large firms (and, to a lesser extent, medium firms) are involved in exchanges of information, skills and technology. The lack of linkages involving small firms seems to be related to weaknesses in their price, quality and delivery performance.[22]

Next, we attempt to explain the factors affecting firm-level technological behaviour and explore the link with firm-level export performance.

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[21] The acquisition of design capabilities in some large local firms is impressive. One large local garment firm had set up a fully-equipped design centre with the latest CAD facilities from Japan and employed two overseas trained designers and 10 assistants. The firm said that it was able to offer several styles of a particular garment for foreign buyers to choose from. This was by no means an insolated case. Another large local garment firm had a CAD system and a nine-strong in-house design team. Such design capabilities seem to put Mauritius garment firms ahead of rival garment exporters in competitors like Sri Lanka, Bangladesh and Vietnam.

[22] The interviews shed some light on this issues. Two large garment MNC affiliates said that they had subcontracted orders to SMEs previously, but finding that the quality of output was below international standards (and the SMEs were unable to meet tight deadlines) had stopped subcontracting to SMEs altogether. Similarly, one large local garment firm reported that the quality of subcontractors output was very irregular; it rejects 20 per cent of its subcontractors' output on an average order.

5. ECONOMETRIC RESULTS

This section presents the results of two kinds of econometric analysis for the Mauritian sample using cross-section data for the late 1990s: (a) an investigation of the determinants of the technology index (TI); and (b) an investigation of the determinants of firm-level export performance. A T-test was also conducted on the means of various characteristics of large firms and SMEs to shed further light on the technological and exporting behaviour of the two enterprise groups.

5.1 Factors Affecting the Technology Index

The present investigation tests for the influence of firm size, ownership, age in production, engineering and technical manpower, employee training and external technical assistance on TI.

The full linear model is:

$TI = b_0 + b_1\ SIZE + b_2\ FE + b_3\ AGE + b_4\ ET + b_5\ TB + b_6\ EXTA$

The independent variables are as follows:

SIZE: total employment. This is expected to be positively correlated with TI. The returns from capability acquisition are higher where a firm has a larger volume of sales to spread the fixed costs of capability acquisition and larger firms can have more specialised manpower. Moreover, capital market imperfections confer an advantage on large firms in securing finance for technological activities, and size is correlated with the availability and stability of funds.

FE: the share of foreign equity. This is expected to have a positive relationship with TI. There are two possible reasons for this. Foreign affiliates are better placed to acquire technological capabilities because of their ready access to the "ownership advantages (e.g. technologies, skills and marketing know-how) of their parent corporations. Moreover, foreign affiliates may have a lengthy learning experience having been in production for several decades and may have accumulated technological capabilities that new local firms might lack.

AGE: age in production. This is expected to have a positive sign because years of accumulated production experience can capture "learning by doing" amongst other things.

ET: the share of engineers and technicians in employment. We can expect this to have a positive relationship with TI. Engineers and technicians can exert a significant influence on the process of building technological capabilities even in simple industries like garments through new quality management methods, equipment maintenance and upgrading, productivity improvement, training and minor adaptations to process technologies (e.g. energy saving measures).

TB: expenditure on employee training as a percentage of sales. This is expected to have a positive sign. Explicit employee training is crucial during enterprise start-up for creating the requisite capabilities to use new production technologies. As technologies evolve, a continuous process of training and re-training is needed to supply the technical and managerial skills needed by new process and product innovations.

EXTA: number of times a firm has used an external technical consultant or local technology institution during a three-year period.[23] Long-term relationships with individuals and institutions that provide training, technical information and technical services can be a valuable input into the acquisition of technological capabilities. Such linkages enable exchange of information, skills and technologies and can directly contribute to improvements in productive efficiency as well as diffusion of technologies throughout the industry.

Using these variables, we ran five different econometric investigations. We started with a simple model consisting of SIZE, FE and AGE to explain TI. Then we ran separate models by adding the remaining explanatory variables (ET, TB and EXTA) one by one to the simple model. Finally, we ran a model with only the significant explanatory variables from the previous models. The results from these econometric investigations are shown in Table 3. The results are fairly stable across the five models. Following testing for multicollinearity and heteroscedasticity, we consider the results of equations (4) and (5).[24] The former has all the available explanatory variables while the latter has only the statistically significant explanatory variables.

The adjusted R^2 (0.53) in equation (4) is reasonable for a cross-section study based on a small sample. Of the six explanatory variables, four are significant (one at the 1% level, 2 at the 5% level and one at the 10% level) and have the expected sign. Firm size, engineering and technical manpower, employee training and external technical assistance have a positive and significant relationship with TI. The positive sign on the firm size variable suggests that both explanations for the firm size effect are valid. The positive sign on the engineering and technical manpower variable indicates that technical manpower plays a fundamental role in the acquisition of firm-level technological capabilities. The positive sign on the employee-training variable suggests that formal in-house training programmes and on-the job training are important for both the

[23] Expenditure on external technical assistance as a percentage of sales is a better measure of external technical assistance than the one used here but the data were not available from the Mauritian firms.

acquisition of initial capabilities and for upgrading them as new technologies emerge. The positive sign on external technical assistance indicates that technical information and services provided by technical consultants and technology institutions enhance firm-level technological capability building.

TABLE 3: REGRESSION ESTIMATES (DEPENDENT VARIABLE: TECHNOLOGY INDEX, TI)					
Variable	(1)	(2)	(3)	(4)	(5)
Constant	0.278	0.204	0.178	0.153	0.193
	(4.40)***	(3.15)***	(2.99)***	(2.57)**	(5.48)***
SIZE	0.210E-3	0.193E-3	0.172E-3	0.158E-3	0.175E-3
	(3.64)***	(3.59)***	(3.50)***	(3.25)***	(4.05)***
FE	0.511E-3	0.658E-3	0.509E-3	0.394E-3	
	(0.60)	(0.82)	(0.70)	(0.56)	
AGE	-0.157E-4	0.001	0.001	0.003	
	(-0.003)	(0.28)	(0.32)	(0.75)	
ET		0.066	0.058	0.052	0.050
		(2.64)**	(2.57)**	(2.29)**	(2.25)**
TB			0.236	0.232	0.184
			(2.91)***	(2.08)**	(2.21)**
EXTA				0.008	0.007
				(1.77)*	(1.74)*
Adjusted R-squared	0.29	0.39	0.49	0.53	0.55
F-statistics	6.35***	7.29***	8.78***	8.30***	12.68***
Number of firms	40	40	40	40	40
Notes: T-statistics in brackets. Significance levels for T and F-Statistics = * 10% level, ** 5% level, *** 1% level.					

The lack of significance on foreign ownership might reflect the fact that there are too few majority foreign owned firms in the Mauritian sample for this effect to show up. Age in production has no significance.

Equation (5) produces somewhat better results than equation (4). There is a small improvement in both the adjusted R^2 (from 0.53 to 0.55) and the F-statistic (from 8.30 to 12.68). There is also some improvement in the significance of two of the explanatory variables.

[24] Correlation analysis suggests the absence of multicollinearity amongst the explanatory variables in equations (4) and (5). Using the White Test, we reject the hypothesis of heteroscedasticity in equations (4) and (5).

The econometric analysis suggested that firm size was an important determinant of TI. Some characteristics of large firms and SMEs were analysed in order to provide more insights on this issue. Table 4 shows the findings of a T-test on the means of some characteristics of the two groups:

- Large firms have significantly higher levels of technological capabilities than SMEs (the means for the technology indices are 0.51 and 0.17, respectively).
- The share of exports in sales is significantly higher in large firms (the means are 75.7 per cent and 12.3 per cent, respectively).
- Large firms have significantly higher foreign equity than SMEs (the means are 43.1 per cent and 5.1 per cent, respectively).
- There is a significant difference between the training expenditures of the two groups (the means are 0.27 per cent of sales for large firms and 0.08 per cent for SMEs).
- There is a significant difference in the use of external technical assistance between the two groups (the mean usage for the three-year period is 6.7 and 1.3, respectively).
- Age in production and engineering and technical manpower do not show up as significantly different between the two groups.

TABLE 4: T-TEST TO COMPARE THE MEANS OF LARGE FIRMS AND SMES (A)

	Technology index	Share of exports in sales (%)	% of Foreign equity	Age in production (years)	Engineers and technicians (% of employment)	Training expenditure (% of sales)	External technical assistance (nos. of times used in past 3 years)
LARGE FIRMS							
Observations	21	21	21	21	21	21	21
Mean	0.51	75.7	43.1	10.3	1.20	0.27	6.7
SMEs							
Observations	19	19	19	19	19	19	19
Mean	0.17	12.3	5.1	10.4	0.62	0.08	1.3
T-Statistic	6.9**	6.7**	3.4**	-0.06	1.6	1.9*	2.7*

Notes: (a) SMEs have <100 employees, large firms have >100 employees. ** significance at 5% level, * significance at 10% level.

5.2 Factors Affecting Firm-Level Export Performance

The econometric analysis of firm-level export performance here is based on a tradition of work carried out in other developing countries. This literature suggests that firm-level export performance is influenced by factors like skills, ownership, technology and firm size.[25] There is no previous work on Mauritian manufacturing enterprises.

The linear model is as follows:

$$EXSH = b_0 + b_1\,FE + b_2\,SIZE + b_3\,AGE + b_4\,TI + b_5\,ET$$

The independent variables are:

FE, the share of foreign equity, is expected to have a positive influence on export performance. Access to the marketing connections and know-how of their parent companies as well as accumulated learning experience of production and exporting make foreign affiliates better placed to tap international markets than local firms.

SIZE, total employment. This is expected to have a positive sign because exporting allows large firms, particularly in small economies, to exploit economies of scale in production by relieving the disadvantage of the small home market.

AGE, age in production, is expected to have a positive sign. Accumulated experience of different kinds (including performing repetitive technological tasks) is a means to improving firm-level production efficiency and hence export performance.

TI, the technology index, is expected be positively associated with export performance because the process of acquiring technological capabilities in enterprises is not just a simple function of years of experience but more the outcome of conscious investments in creating skills and information.

ET, the share of engineers and technicians in employment. As higher levels of technical manpower are likely to give firms a competitive advantage in exporting, this is expected to have a positive effect on export performance.

Four separate econometric models were run to attempt to explain firm-level export performance using these variables and the results are shown in Table 5. Following diagnostic testing, we

[25] There is a growing econometric literature on firm-level export performance in developing countries. Recent examples include: Wilmore (1992) on Brazil; Kumar and Siddarhathan (1993) on India; and Wignaraja (1998) on Sri Lanka.

consider the results of equation (2) that contains the full model and equation (4) that contains only the significant variables from previous models.[26]

TABLE 5: REGRESSION ESTIMATES (DEPENDENT VARIABLE: EXPORT SHARES, EXSH)				
Variable	(1)	(2)	(3)	(4)
Constant	21.840	1.472	-0.372	0.389
	(1.69)*	(0.11)	(0.41)	(0.97)
FE	0.463	0.397	0.394	0.383
	(2.90)***	(2.80)***	(2.99)***	(2.97)***
SIZE	0.170	-0.002		
	(1.59)	(-0.20)		
AGE	-0.111	-0.240		
	(-0.12)	(-0.30)		
ET	8.856	2.256	2.590	
	(1.77)*	(0.47)	(0.56)	
TI		99.841	95.511	100.929
		(3.36)***	(3.90)***	(4.53)***
Adjusted R-squared	0.31	0.47	0.49	0.51
F-statistics	5.41***	7.85***	13.74***	20.84***
Number of firms	40	40	40	40
Notes: T-statistics in brackets. Significance levels for T and F-Statistics = * 10% level, ** 5% level, *** 1% level.				

The adjusted R^2 (0.47) in equation (2) is reasonable for a cross-section model. Moreover, two of the five independent variables are significant at the 1 per cent level and have the expected sign. The fact that TI is significant and positive is a notable finding that emphasises the fact conscious investments in skills and information contribute to export performance at firm level. Furthermore, the positive sign on the foreign ownership variable indicates that both explanations for the ownership effect are valid. Meanwhile, firm size, technical manpower and age in production show no significance. Further work is needed to find explanations for these results.

Equation (4) produces better results than equation (2). The R^2 and F-statistics increase to 0.51 and 20.84, respectively and there is an increase in the significance of both explanatory variables.

[26] Correlation analysis suggests the absence of multicollinearity in equations (2) and (4). Using the White Test, we reject the hypothesis of heteroscedasticity in equations (2) and (4).

6. CONCLUSIONS

Drawing on the recent literature on technological development in developing countries, this paper has attempted to provide some evidence on the relationship between firm size and the acquisition of technological capabilities in Mauritius. Following a decade of import substitution and export promotion via EPZs, the country began strongly emphasising market-oriented policies in the early 1980s. By the mid-1990s, Mauritius had become considerably more open and market-friendly than in the past and is today one of most liberal regimes in Africa. Since the 1980s, Mauritius has witnessed double-digit manufactured export growth (particularly in garments), which has resulted in a per capita manufactured export value (US$ 1,094) that is far ahead of other African countries. While this is a considerable industrial achievement, the available evidence suggests that bulk of this export growth has come from large firms and that SMEs have played little active part in this process.

Micro-level evidence from a sample of 40 garment enterprises suggests that the trends in export performance by firm size are related to the acquisition of technological capabilities. Large firms seem to have acquired the requisite competitive capabilities to produce to the high standards of price, quality and delivery demanded by major foreign buyers of output. However, technological capabilities in SMEs lag behind the achievements of large garment firms. Quality control and quality management systems are insufficient. Few SMEs have preventative systems for equipment maintenance. Their capacity to copy, adapt and design new products is weak. They make little use of contractual technology imports and have few relations with foreign technical consultants.

Using information from the sample enterprises, we constructed a technology index in an attempt to quantify inter-firm differences in technological capabilities and conduct econometric analysis. The econometric analysis of the determinants of the technology index and export performance in Mauritius produced some interesting results. The econometric analysis of the determinants of the technology index in Mauritius showed that firm size, technical manpower, employee training and external technical assistance had a significant and positive effect whereas firm age and foreign equity were not significant. A simple T-test was conducted to highlight differences between large firms and SMEs. This analysis indicated that when compared with large firms, SMEs had lower levels of technological capabilities, were less export-oriented, had less foreign equity, conducted less employee training and made less use of external technical assistance.

The econometric analysis of the determinants of firm-level export performance indicated that foreign equity and the technology index were significant and positively associated with export shares. Meanwhile, firm size, firm age and technical manpower were not significant.

These results confirm the usefulness of recent attempts in the literature to quantify enterprise-level technological capabilities in developing countries. By providing new conceptual tools and analytical methods, this new strand of econometric research on technological capabilities nicely complements previous work based on detailed technology case studies of individual enterprises. Further work will lead to refinement of the technology index presented here, the collection of larger enterprise data sets and the use of more sophisticated econometric methods such as simultaneous equation models.

One final thought: the research on Mauritian garment enterprises re-affirms the case for policy support to improve the competitiveness of SMEs in market-oriented developing economies. Insertion into existing marketing relationships between large local firms and foreign buyers are increasingly recognised as a powerful mechanism for accessing overseas markets and new production technologies and capabilities. In this vein, it is necessary for upgrading in the Mauritian garment industry for SMEs to be incorporated into effective clusters around the large enterprises. This may partly occur spontaneously over time but policy policies can also induce the process of clustering. The experience of developed and developing countries suggests that supplier linkage programmes and focussed business development services (training, productivity improvement, quality management and technical information) are useful ways of connecting SMEs into clusters and improving their technological capabilities (see Altenburg and Meyer-Stamer, 1999; Mytelka and Farinelli, 2000).

Table A1: Technological Capability Scoring Scales for Mauritius Sample

Production Capabilities:						Linkages Capabilities:	
Process Engineering:		Product Engineering:		Industrial Engineering:			
INTERNAL DEFECT RATES:		COPYING:		PROD.VITY IMPROVEMENT		SUBCONTRACTING LINKAGES:	
No measurement	0	none	0	none	0	none	0
high (>2%)	1	ad-hoc	1	some	1	ad-hoc technology transfer	1
low (<2%)	2	systematic	2	systematic	2	systematic technology transfer	2
ISO 9000 STATUS		IMPROVING EXISTING PRODUCTS:				SYSTEMATIC RECEIPT OF TECH.	
no accreditation	0	none	0			FROM BUYERS	
ISO 9000 in-progress	1	some	1			none	0
ISO 9000 obtained	2	considerable	2			ad-hoc technology transfer	1
MAINTENANCE AWARENESS:		INTRODUCING NEW PRODUCTS IN-HOUSE				systematic technology transfer	2
None	0	none	0				
only repair when breakdown	1	some	1				
preventive system	2	considerable	2				
CALIBRATION of EQUIPMENT (b):							
None	0						
Little	1						
Frequently	2						
SUBSTITUTION OF LOCAL R.M.:							
None	0						
Little	1						
A lot	2						
BUY NEW EQUIPMENT:							
None	0						
Little	1						
A lot	2						

Table A2: Correlation Matrix

	TI	SIZE	FE	AGE	EXSH	ET	TB	EXTA
TI	1							
SIZE	0.58	1.00						
FE	0.31	0.40	1.00					
AGE	0.08	0.15	-0.06	1.00				
EXSH	0.65	0.43	0.52	-0.02	1.00			
ET	0.37	0.08	-0.02	-0.08	0.25	1.00		
TB	0.48	0.20	0.14	0.01	0.37	0.12	1.00	
EXTA	0.51	0.25	0.23	-0.20	0.31	0.24	0.43	1

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