
Introduction

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The notion of interactive learning has become a persistent theme in the studies of innovation and innovation systems. Learning is now widely recognised as an important factor in understanding the growth of a firm because firms innovate within a network of other actors or components. Firms also interact within boundaries that define their productive engagements. The components of a system consist of institutions and organisations, both of which are embedded conceptually and in practice within each other. As Edquist (2001,p.227) states: “Interactions and interdependence is one of the most important characteristics of the Systems of Innovation (SI) approach...” The nature of interactions, however, is complex and defined by the nature of knowledge exchange. It is also established a priori by the rules, the forces of history (path-dependence) and the capacity for action or inaction on the part of the actors involved.

The capability for engaging other actors within systems is an important complementary asset to a firm's internal capabilities in its efforts to gain access to and process a whole range of knowledge external to it. Interactions between organisations and firms take several forms. First, inter-firm flows of knowledge and skills through the movement of skilled staff from one firm to another. These flows include sub-contracting (manufacturing and trade types), joint ventures, franchises and supplier-customer relations. These diverse forms of interaction constitute important channels of flows in advanced and developing economies (Pavitt, 1984; von Hippel, 1988). Second, firm-institution interaction in which public agencies such as technology development centres (of different varieties across countries) and public R&D laboratories are among the most prominent in developing countries. The mandate of these agencies and laboratories, in broad terms, is to assist firms in process and product adaptations and also assist them in gaining comparative advantage through utilising natural resources. In theory, this mode of interaction enables support institutions to provide firms with what otherwise will be expensive information (regarding processes, products and competitors) to attenuate testing and quality control costs, which small firms in particular are unable to internalise. In addition to promoting learning, interactive collaborations contribute to significant measures in building technological capability in firms, (Lundvall, 1988; 1992). In other words, information and knowledge flows involve autonomous firm-level efforts such as technical and managerial training, hiring of local and foreign consultants and deepening relationships with clients, machinery suppliers and raw materials suppliers. These different channels of knowledge flows, when properly organised, constitute important learning avenues for firms. In sum a poorly developed SI may result from a situation of little learning, ineffective learning and complete absence of learning when there is lack of dynamic complementarities (Malerba, 1992).

In spite of the considerable work done in understanding interactive learning, much of the studies are devoted to understand the conditions of advanced industrial countries. This special issue is devoted to bridging this gap. The papers present original studies from Latin America, Asia and Africa. They contain rich and heterogeneous analyses that encompass a variety of agents such as universities, firms and infrastructure service providers.

The paper by Lall and Pietrobelli employs the concept of National Technology System that builds upon, but differs in important respects, from the concept of National Innovation Systems to explain the poor competitiveness of Sub-Saharan Africa (SSA). The paper explains by employing microeconomic evidence on scientific and technological infrastructure supporting industry in a sample of Sub-Saharan African countries. It concludes that, like several other studies, in spite of liberalisation and openness, weak industrial infrastructure continues to slow progress in the African industry.

For instance, the paper states that the supply of modern skills is inadequate and the physical infrastructure is weak and often deteriorating. This paper calls attention to these often neglected aspects of dynamic technology systems that are taken for granted in more advanced economies.

Part of the reason for the slow progress of the African industry is that industrialisation is a relatively recent process in the region, but then the strengthening of the national technology system is a long and costly process. It entails the gradual building of institutions, changing of attitudes, creating new links and networks and, inevitably,

having substantial resources over a lengthy period. Technology systems thrive in a conducive social, political and economic setting in which enterprises, governments and institutions plan and implement long-term strategies.

The authors suggest principles for policy, namely, technology strategy formulation and coordinating and planning the technology system. Technology strategy formulation in the region is not grounded in the kind of institutional mechanism found in dynamic Asian developing countries.

The second principle is that African countries develop more robust coordinating and planning of the technology system because the national system is highly fragmented in African countries. Fragmentation means that partial objectives are pursued without reference to national goals because of the atomistic behaviour of the actors.

The second paper by Figueredo *et al.* provides detailed empirical evidence on the globalisation of innovative activities and the role of technological infrastructure in the context of a large industrialising economy. It draws upon primary data from 11 research and technological institutes. An important contribution of the paper is the systematic study of two components of the innovation system, which are infrastructure and services in a large developing country. The following are the key findings:

- Brazil, as a typical late-industrialising country, still has some structural problems such as a certain lack of convergence in terms of public policy. However, huge efforts have been made to foster a more dynamic performance particularly in terms of human resources development and in the search for more stable funding and regulatory laws such as the Informatics Law.
- The globalisation of innovative capabilities has meant far deeper involvement of multinationals with R&D activities by their own or in conjunction with local technological infrastructures such as national research and technological institutes. This has been brought about for the following reasons:
 - a the diversity of the local and regional markets requiring specific products
 - b the practice of multinationals in providing technical support for local commercial operations.

However, the Brazilian technological infrastructure (especially R&D institutes) has played a complementary but substantial role in the dissemination of their R&D activities locally.

- At another level, globalisation has redefined the nature of interaction with local universities and research centres. Their researchers foster greater involvement with actors external to the country. For instance previously under-utilised, highly qualified human resources are being engaged through the use of incentives and subsidies offered by the Brazilian government (such as the tax reduction through the Informatics Law). This has stimulated multinationals R&D partnerships in Brazil. The successful institutes have been able to interact fruitfully with the technological infrastructure and generate demand not only for human resource management but also for joint research with local institutions.
- Contrary to conventional wisdom, empirical data in this study indicate that local public and private research and technological institutes have strengthened and consolidated their linkages with firms including multinationals and other components of the technological infrastructure.

This study makes a methodological contribution by applying a novel framework to the issues of globalisation of innovative capabilities and the role of technological infrastructure, which are represented here by research and technological institutes. The application of this framework to study other industrial context settings may contribute in deepening the understanding of the process of technological development not only in Brazil but also in other industrialising contexts.

The paper by Rajah Rasiah develops further the technological capabilities framework for studying the differences in technological intensities between foreign and local auto parts, electronics and textile and garment firms in Indonesia. The study concludes that foreign firms enjoy higher export incidence, process technology and R&D intensities than local firms in all three industries. The econometric results show a strong relationship between export-incidence and overall technological, Human Resources (HR) and process technology intensities. Foreign ownership was not only statistically significant. Its coefficient positive in the overall sample of the HR regression, except for export-incidence, was also higher in the foreign firms' sample.

Rasiah's paper shows that in spite of the financial and political crisis that may have created technological asymmetries by ownership, foreign firms generally enjoy higher technological capabilities. These results show strong potential for local firms – either through supplier relations, demonstration effect or transfer of tacit knowledge embodied in human capital – to benefit from the operations of foreign firms. Foreign firms' exposure to export markets also offers strong potential for the development of external market and domestic backward linkages for local firms. The sequencing of government focus in attracting FDI and stimulating learning and innovation must account for the fact that export-manufacturing firms develop at the bottom of the technology ladder where firms are embedded in weak National Innovation Systems (NIS). Foreign firms act as an important vehicle to penetrate export markets and to relocate production knowledge.

The paper recommends that the Indonesian government will have to harness foreign-local firm synergies by creating and strengthening institutions and systemic links. Doing so will stimulate learning and upgrading in the three industries. This is a considerable challenge given the weak macroeconomic situation that has prevailed following the financial and political crisis of 1997–1998.

The paper by Eric and Wood examines innovation in different segments of South Africa's wine industry and the extent to which it is being effectively supported by networking and knowledge exchange. They argue that it was ill-prepared for the highly competitive, brand-conscious consumer markets it encountered on re-entry into international markets. The wine marketing expertise was concentrated among small independent wine producers and a few large wholesalers. Most producers have significantly improved quality and product ranges, but they are weak in the area of marketing.

The South African wine industry has undergone significant changes over the past decade. This success has been most evident in the production of bottled wines and in the substantial increase in export volumes, albeit from a low base. By comparison with other New World producers, growth in export value has been less than impressive. South African producers have had limited success in the export of quality wines.

The authors suggest that the most critical constraint on performance on the industry is not in the technical or research areas, not in production or in winemaking, but in marketing. The marketing constraint is being alleviated by the following:

- through the growing capacities of WOSA, an effective organisation which has gained considerable legitimacy across the industry
- the rise of new brand-focused wine wholesalers that have developed close relations with a number of producers
- growing networking and sharing of knowledge of export markets between some local producers at least.

However, the impact of these developments has been uneven. As a group cooperatives obviously lack marketing expertise. The cooperatives in our sample have achieved limited success with brand development as well as in their marketing partnerships.

The authors conclude that strengthening the South African wine brand lies with an increase in the number and strength of top South African wine brands. It will, for instance, require the development of international brand management expertise among wholesalers and cooperatives. There appears to be considerable scope for investment in improving marketing capacities and training in marketing of wine producers. Attention certainly needs to be given to technical support and technological research, particularly in the extent of these activities. Gains from any further advancement of technological and innovation capacities in the industry, however, will depend critically on accompanying changes in marketing capacities.

Oyelaran-Oyeyinka's paper examines the dynamics of inter-firm collaboration of two Small and Medium Enterprise (SME) footwear clusters in southeastern Nigeria in response to local and global competition. The two clusters specialise in footwear production but are structurally distinct. The paper posits that the clusters' different structural attributes and internal technological capabilities will lead to differential responses to external pressures.

Three factors tend to explain the sustained response of the footwear clusters in the face of fluctuating aggregate economic conditions brought about by the economic reforms that started in the mid-1980s. First, the clusters have deep roots in historical craft production and are strongly embedded in the social milieu producing in the early stages for the low-end local consumers. They are gradually moving into markets beyond the southeast of Nigeria. The trigger provided by the economic structural adjustment seems to have stimulated the break more forcefully into the regional market with relatively better quality products. Second, changed cost conditions, while contributing to higher product cost, locally favoured exports. The third factor relates to the incidence of a predominant homogeneous ethnic group that has encouraged the sustenance of a pooled skill market with which knowledge has been kept within specialised geographic clusters.

The central question the paper asks is whether and how firms in clusters *learn to collaborate* when confronted with competitive pressures from within and outside the geographic boundaries of the clusters. Collaboration among enterprises has grown over time induced in the main by competitive forces. However, these are largely informal but relatively stable ties. The paper found that performance correlated with the measures of performance such as net profit and production output.

In the last paper, Rajah Rasiah and Yeo Lin argue that the simultaneous influence of markets, government and trust was critical in driving learning and innovation in Taiwan's information hardware industry. Instead of the focus on just markets or government in past works, the authors provide a powerful case in this paper to make the point that all three modes of governance interacted simultaneously to synergise each others role in the development of the information hardware industry in Taiwan.

Using empirical evidence from a careful scrutiny of the learning processes that were begun originally from the operations of local small firms and large multinationals and subsequently government instruments to stimulate innovation activities (especially R&D-based and the shift to designing and original brand name activities), the paper builds a dynamic picture of the catalysts that helped Taiwanese firms negotiate the daunting currents of competition to participate in high volume low margin contract manufacturing, global service provision, original design manufacturing and original brand manufacturing.

The paper argues that the neo-classical image of Taiwan as an island of thousands of small firms entering and exiting markets on the basis of relative price changes is inaccurate. Government policy to create and coordinate institutional support, and trust-loyalty to reduce market and government failures were important in driving learning and innovation in firms. In fact, rapid technical change and increased differentiation and division of labour in IH value chains drove firms to eventually specialise horizontally. Increased specialisation was met with increasing rather than reducing size distribution of firms in Taiwan especially after 1997.

Three major reasons are advanced to explain the rise in the size of IH firms in Taiwan, which began in the late 1980s but increased strongly after 1997:

- 1 The increasing demand for quality and reliability shifted contract manufacturing to larger OEM producers who were able to upgrade and undertake horizontal integration.
- 2 Rising production costs domestically and the emergence of low cost sites abroad (especially China) forced Taiwanese firms to shift operations to higher value added activities that included new product development.
- 3 Rising production costs pushed some firms into OBM activities, which *inter alia* required heavy investment into brand and image building, and opening of distribution and customer support outlets abroad.

The conclusions of the paper send a strong message to evolutionary economists to consider adding trust (social capital) as a major pillar in strengthening learning and innovation in firms and regions.

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