The co-evolution of technology and entrepreneurship: lessons for development from India and Korea

Gita Surie*

Department of Management and Decision Sciences,
School of Business, Adelphi University, USA
E-mail: surie@adelphi.edu
*Corresponding author

Mariano Torras

Department of Finance and Economics,
School of Business, Adelphi University, USA
E-mail: torras@adelphi.edu

Abstract: While technology and entrepreneurship are independently viewed as critical factors in firm survival and competitiveness, how entrepreneurial capabilities evolve in the context of technology absorption and contribute to development is less well understood. This paper develops a conceptual framework for understanding how technology and entrepreneurship co-evolve and contribute to the emergence of new ventures and development. Two case studies of the steel industry in India and South Korea illustrate the framework and provide lessons for fostering development in emerging economies and low growth regions of industrialised countries.

Keywords: technological innovation; entrepreneurship; economic development.

Reference to this paper should be made as follows: Surie, G. and Torras, M. (2007) 'The co-evolution of technology and entrepreneurship: lessons for development from India and Korea', *Int. J. Technoentrepreneurship*, Vol. 1, No. 2, pp.183–206.

Biographical notes: Gita Surie (Assistant Professor, Adelphi University and Senior Fellow, The Wharton School of the University of Pennsylvania) is pursuing research in technology and innovation, entrepreneurship, and multinational corporations. She received her PhD from the Wharton School of the University of Pennsylvania.

Mariano Torras (Associate Professor, Adelphi University) is pursuing research in ecological economics, development, institutional economics, and political economy. He focuses on well-being assessment, environmental and natural resource accounting, as well as on historical institutional dynamics and how they bear on redistributive success. He received his PhD from the University of Massachusetts, Amherst.

1 Introduction

Technological innovation and national competitiveness have attracted great interest in both academic and business communities during the past two decades. Historical evidence points to the importance of technology adoption and diffusion for developing nation states (Licht, 1995). Similarly, early research recognised the importance of entrepreneurship (Harbison, 1956; Knight, 1964) and led to studies on the characteristics of entrepreneurs (de Kets Vries, 1977; McGrath and MacMillan, 2000), their impact on performance, environments and cultures influencing entrepreneurship (Covin and Slevin, 1988; Shane et al., 1995; Shane and Venkataraman, 1996), as well as new firm entry, survival and growth (Santarelli and Vivarelli, 2007). This literature does not address the question of *how* entrepreneurial capabilities evolve in the context of technology absorption. In contrast, the literature on economic development and growth, while focusing on industrialisation through technologies yielding increasing returns (Murphy et al., 1989; Rosenstein-Rodan, 1943; Krugman, 1991), leaves unexamined the importance of entrepreneurial capabilities in facilitating local innovation and development.

In addition, entrepreneurship has largely been studied from the perspective of large firms, mature markets, and well-developed institutions in industrialised countries. Thus, only entrepreneurial combinations (Schumpeter, 1934) that are new to the world (Nelson and Pack, 1999) are regarded as innovations. However, in developing countries lacking institutional structures, perfect markets, new technologies, and where information is costly (Stiglitz, 1986), a broader concept of innovation is called for: one that involves learning by adapting new technology to the domestic environment and creating combinations that are new to the country (Nelson and Pack, 1999; Dahlman and Westphal, 1981).

Moreover, despite recognition of the paucity of entrepreneurial capabilities in developing countries (Brimmer, 1955; Leff, 1979; Papanek, 1962) there is little mainstream research in recent years (an exception is Sonko, 1994) examining the role of the state in fostering entrepreneurship (Nelson, 1987).[1] Also, while the big push literature points to the need for industrialising many sectors simultaneously to stimulate development (Rosenstein-Rodan, 1944; Murphy et al., 1989) it does not examine how entrepreneurial capability, essential for development, itself evolves in the context of technology assimilation.

Finally, earlier research assumed that technological innovation occurs mainly in industrialised countries (Vernon, [1966] 1979). The emergence of new multinationals from South Korea, China and India suggests that this assumption is incorrect, and that these firms have evolved innovations based on unique features of their economic and institutional environment (Guillen, 2001). Therefore, this paper aims to address these gaps in past research by examining the following research questions:

- How do entrepreneurship and technological innovation co-evolve in emerging economies?
- What are the implications for development?

Emerging economies provide a natural setting in which to study these questions. We present a conceptual framework that delineates *how* entrepreneurship capabilities evolve in the context of technological innovation using evolutionary and dynamic capabilities perspectives (Nelson and Winter, 2002). The framework is relevant to newly industrialising economies and potentially useful for revitalising slow growth regions in developed countries. Case studies of two firms, one each from Korea and India, illustrate our framework.

The paper is organised as follows. Section 1 outlines prior research. Section 2 presents the conceptual framework. Section 3 presents the case studies. Sections 4 and 5 present the discussion and conclusion.

2 Prior research

We focus on relevant research pertaining to technology transfer, development and entrepreneurship in emerging economies, particularly Korea and India.

2.1 Entrepreneurship, technology transfer and development

Past research on technology transfer, development and entrepreneurship in emerging economies can be summarised as follows. First, the technology transfer literature focuses on technology and emphasises issues such as new technology adoption by recipients of foreign technology, and the impact of modes of adoption and government policies on technology assimilation (Desai, 1988; Lall, 1987). Although growth requires an entrepreneurial response to technology adoption (Nelson and Pack, 1999), how entrepreneurial capabilities evolve via technology absorption is not examined.

Second, in the presence of inadequate markets and institutions in developing economies, entrepreneurial activity consists of building channels of input supply and marketing output, a role fulfilled by industrial groups (Leff, 1979).

Third, in emerging economies, state involvement in industrial development is critical, whether through export and market oriented policies in Korea and Taiwan (Kuznets, 1985; Sharma, 1993) by investing in strategic sectors and modernisation. The nature of intervention and incentives are important to direct entrepreneurial capabilities into productive rather than rent-seeking activities (Baumol, 1990). Successful interventions include the case of Korea (1948–1960), when the state devised structural supports for the cotton industry, mediated relations with foreign suppliers, and insulated the local market from competition to promote concentration and growth (McNamara, 1992). Similarly, government policies that discouraged a labour movement helped to build small scale entrepreneurship by encouraging participation in industrial work in Taiwan (Stites, 1985). In contrast, a regulatory state in India stifled entrepreneurship and slowed economic growth (Sharma, 1993).

Fourth, research on development suggests that industrialisation is achieved by investing in multiple sectors simultaneously (Murphy et al., 1989; Rosenstein-Rodan, 1943; 1944; Young, 1928). Also, growth is a result of investment in technologies yielding increasing returns (Krugman, 1991; Arthur, 1989; Romer, 1986).

Fifth, research on national innovation systems (Nelson, 1993) corroborates North's (1990) insight that appropriate institutions are essential for economic development.[2] Thus, Korea's industrial success is attributed to the development of a skilled workforce through educational investments and the building of scientific infrastructure through the repatriation of scientists and engineers (Choi, 1999).[3] Comparisons of Korea with historical evidence on the development of Sweden in the early 19th century (Chang and Kozul-Wright, 1994) also support the importance of government investment in education.

However, the assumption that capital or investment in technology automatically leads to industrialisation and growth may not be accurate as technology transfer is not costless (Teece, 1986) and information and markets are imperfect (Stiglitz, 1986, 1989).

A major impediment to industrialisation in developing economies is the scarcity of entrepreneurial capabilities to take advantage of opportunities presented by new industries (Lewis, 1970), to prevent a brain drain and support rising educational attainment (Nelson and Pack, 1999). As Stiglitz notes:

> "development represents a far more fundamental transformation of society, including a change in preferences and attitudes, an acceptance of change and an abandonment of many traditional ways of thinking." Stiglitz (2004, p.24)

This research does not focus on how entrepreneurial capabilities emerge by adapting and implementing technology.[4]

2.2 Entrepreneurship and innovation

The entrepreneurial process varies across nations because of region and context-specific opportunities for exploitation, resource availability and appropriability (Baker et al., 2005). However, past research focused on industrialised countries (Santarelli and Vivarelli, 2007) and innovation in mature industrial environments which involves using not only new technologies but also innovative organisational models (Baldwin and Clark, 2000). Consequently, this research emphasised incentives for entrepreneurship given the assumption of an abundant supply of entrepreneurs in industrialised societies (Hoselitz, 1952).

In contrast, research on emerging economies has focused on how to augment entrepreneurship since, historically, the supply of entrepreneurs in developing countries has been small or lacking (Leff, 1979; Papanek, 1962; Bar-el and Felsenstein, 1990).[5] Early examples of entrepreneurs in Korea and India – Kim Yon-su and Jamshetji Tata (McNamara, 1988; Misra, 2000) suggest that such individuals achieve success despite obstacles. Brimmer (1955) suggests that during the early 19th century, despite opportunities for entrepreneurship in India, production methods in cotton textiles were backward and business leadership was lacking as few Indian businessmen could adopt new forms of production. Similarly, modern technology was not pursued in China or India until a critical number of indigenous entrepreneurs was present in 1870 (Swamy, 1979). In both countries the first factories were established in the textile industry. Government patronage provided loans to start these enterprises although capital was obtained from private sources. However, the British administration in India was unwilling to invest in basic industries, and in so doing created obstacles for Indian entrepreneurship in cotton textiles and steel. In China, the response to Western technology was muted because the government was initially negative and defense oriented; later, development was vitiated by bureaucracy and absence of good leadership.

The presence of a large entrepreneurial class is associated with aggregate indicators such as GNP per capita, savings, price stability, a large export market and a decreasing agricultural sector (Bell, 1969). A rising entrepreneurial group is, thus, associated with economic incentives, an outward looking development pattern, and open trade policy, all found – though in varying degrees – in Malaysia, Thailand and the Philippines.

Murphy et al. (1991) suggest that allocating talent to entrepreneurship is good for growth while allocation to rent seeking is bad. Their study of 91 countries shows that enrolment in engineering is positively related to growth while enrolments in law is not.[6] Also, entrepreneurship in India is spurred by government support of developmental financial institutions (George and Prabhu, 2000) or impeded by culture and values (Morris, 1967).

Thus, entrepreneurship in emerging economies is linked with macro-economic and/or socio-cultural factors rather than with capabilities and innovation. In general, technology users in developing countries are viewed as passive recipients of technology (Vernon, [1966] 1979) despite recognition that adapting technology involves innovation (Dahlman and Westphal, 1981; Lall, 1987). Therefore, this paper focuses on *how* fostering technological innovation generates entrepreneurial capabilities. A framework linking technology and entrepreneurship with development is outlined below.

3 The co-evolution of entrepreneurship and technology in emerging economies: a knowledge-based framework

The analytical framework in this section:

- highlights the importance of technology and innovation in entrepreneurship
- yields insights for new venture emergence in emerging economies
- links the evolution of entrepreneurship with the stages of development.

3.1 Technological innovation and entrepreneurship

Technology and entrepreneurship are complementary and necessary for economic development. Technology is defined as consisting of knowledge of various types and embodied in artifacts and people (Hall and Johnson, 1970). Technological innovations are specific combinations of knowledge that have market value and can be categorised according to their impact (radical vs. incremental; Henderson and Clark, 1990), ease of use, and replicability (Winter, 1987). Technology encompasses both technical and complementary knowledge. Zahra et al. (2003) note that intangible technological resources play an important part in the internationalisation of new ventures.

However, the mere presence of technology does not guarantee economic development. Successful technology absorption and use requires managerial capabilities (Nelson and Pack, 1999; Nelson, 1993; Lall, 1987; Enos and Park, 1988); commercialisation requires integrating capabilities derived from internal and external sources (Zahra and Nielsen, 2002), and catalysing innovation requires entrepreneurship. For simplicity, the terms ‘entrepreneurs’ and ‘entrepreneurial capabilities’ are used interchangeably. Since the entrepreneur need not be an individual (Duvall and Freeman, 1983 note the existence of state entrepreneurship in industrialising countries), entrepreneurial capabilities are embodied in diverse roles and activities.

Entrepreneurs in developing countries catalyse innovation by articulating a vision, assuming risk, garnering resources and motivating teams to create value (Gupta et al., 2004). Their problem solving efforts are directed towards three arenas:

- new technologies that yield products or services to suit local conditions (for example, beneficiation technologies in the steel industry to improve the quality of inputs such as coke; indigenously designed small earthmoving equipment for the local market)[7]
- new organising principles for manufacturing to accommodate new technologies (for example, the development of modular organisational design and information technology to facilitate flexibility in manufacturing new hydraulic equipment instead of mechanical equipment[8]
- new markets for products and services (for example, for intermediate components and services such as business information services and contract research (Nelson and Pack, 1999)).[9,10]

3.2 New venture emergence

Entrepreneurs also play an important role in new venture creation. Entrepreneurial capabilities evolve dynamically in developing countries as a result of learning via technology transfer.[11] Learning is social and occurs within a community through interaction with experts and involvement in tasks relevant to the community. Gaining expertise involves mastering increasingly complex tasks, autonomous problem solving, a shift in identity, and the assumption of a central role in the community (Wenger, 1998).

The need for learning when acquiring technology necessitates the creation of such epistemic communities to replicate the knowledge of experts. Thus, involvement in technology transfer catalyses the emergence of new ventures. For example, Korea's attempts to industrialise led to the acquisition of technology and the emergence of new industries (Enos and Park, 1988; Ungson et al., 1997). Similarly, industrialisation in India can be attributed to technology acquisition efforts (Lall, 1985). While we do not dispute the need for investment in technology (Murphy et al., 1989; Romer, 1986), learning must occur for new opportunities to be systematically taken advantage of over time. Successive attempts to acquire and adapt new technology to the local environment enable entrepreneurial firms to evolve and grow (Nelson and Pack, 1999). Moreover, the diffusion of abstract knowledge (Arora and Gambardella, 1994) and availability of new Information and Communication Technologies (ICTs) simplifies the replication of knowledge (Cohendet and Steinmueller, 2000) and promotes rapid technology diffusion, thereby allowing developing country firms to participate in global markets (Surie, 2007).[12] ICTs also facilitate adoption of flexible organisational designs, enabling firms with capabilities and aspirations to expand operations and participate in the knowledge economy. Every wave of technology acquisition by an emerging economy also serves to reorganise it by increasing specialisation and diversification. Consequently, new opportunities emerge for entrepreneurs, giving rise to new ventures.

3.3 Entrepreneurship and the stages of development

Based on the theory of learning (Wenger, 1998) and of diffusion of capabilities (Surie, 1996) outlined in the previous section we suggest that the evolution of entrepreneurship corresponds with four stages of economic development in emerging economies (Table 1 outlines the stages in detail). The state of entrepreneurial capabilities is different at each stage and different learning strategies are used. We do not suggest that each stage has a fixed duration or that evolution is linear;[13] rather that there are specific configurations at each stage, evident even in the history of industrialised countries (for a model of entrepreneurship dynamics and development see Figure 1).

Stage 1: New economy formation

While modernisation may precede the creation of a new nation, independence often coincides with the desire to accelerate industrialisation as the new nation seeks to establish itself in the modern world (Westphal et al. 1985; Lall, 1987; Chang and Kozul-Wright, 1994). During this stage, new institutions are formed and the basic infrastructure and institutions required for modernisation are established (Kuznets, 1985; Nelson, 1993; Lim, 1999; Chang and Kozul-Wright, 1994). Examples of modernisation planning include the Korean and Indian Five Year Plans (Chang and Kozul-Wright, 1994; Lall, 1985) and China's Four Modernisations (Volti, 1982). Modernisation requires investment in new industrial technologies in multiple sectors yielding increasing returns (Murphy et al., 1989; Arthur, 1989), and skilled manpower to transform the economy by shifting the surplus from agriculture, the strongest sector, to technology and infrastructure (Burmeister, 1990; Murphy et al., 1989; Rosenstein-Rodan, 1943, 1944; Lewis, 1970).

The government undertakes entrepreneurship to reduce dependence on foreign capital (Freeman and Duvall, 1984) through public sector participation in education, infrastructure, and selected strategic industries. However, a few entrepreneurs are permitted to participate in industry and start ventures based on new technology (Ungson et al., 1997) as, for example, in the industrialisation of Japan, Korea, and India. Technology must be sought externally because it is not available domestically.

Stage II: Technology recipients

This stage is marked by a continued emphasis on technology transfer from industrialised countries. Investments in capital intensive manufacturing industries such as steel, textiles, automobiles, trucks, heavy manufacturing equipment, and computers are aimed at building self-sufficiency and local capabilities (Enos and Park, 1988; Lall, 1987; Heeks, 1996). Entrepreneurial roles remain the purview of the government and key industrialists. Internal markets are small and managerial skills insufficiently developed (Dahlman and Westphal, 1981). Consequently, government continues to dominate and maintain control via enterprises that function as incubators for developing new capabilities. The main emphasis is on learning how to manufacture (an early stage in developing technological capabilities; Desai, 1988).

Stage III: Technology adaptors

Adapting technology to meet local market demands takes precedence during this stage. Also, markets for new products are created, manufacturing excellence is developed, and local capabilities are deepened. Indigenous production increases and manufacturing-related services emerge (Lall, 1987; Heeks, 1996). Entrepreneurship is diffused in response to new opportunities created by increased demand domestically and private sector participation rises. Further learning occurs through benchmarking and implementing best practices such as the quality movement in both large and small-scale industries (Nagpal and Gyani, 2005). Similarly, the realisation that achieving global competitiveness requires shifting from import substitution to building a world class industrial base (Ungson et al., 1997) leads companies to accelerate capability replication and seek expertise by forging alliances with foreign multinationals.[14] Leading firms begin to emphasise exports and build overseas networks.

Table 1 The evolution of entrepreneurship and economic development

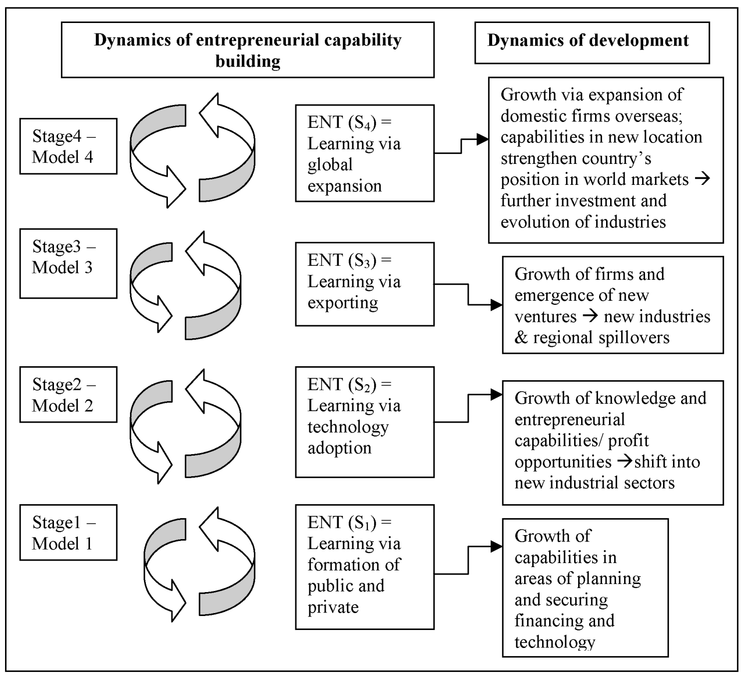
	Evolution of economy			
Dimension of entrepreneurship and innovation	*Stage 1: New economy formation 1950s–1960s**	*Stage 2: Industrialisation I technology recipients 1970s**	*Stage 3: Industrialisation II technology adaptors 1980s**	*Stage 4: Post-Industrial global innovators 1990s–2000 →**
Entrepreneurial role	Government assumes role of entrepreneur funds education	Government assumes role of entrepreneur: funds education and infrastructure Private sector begins investing in manufacturing	Private sector assumes greater role in entrepreneurship: focuses on technology intensive industries Government devolves responsibility by privatising some industrial sectors and higher education	Entrepreneurship more widely dispersed and shared by government and industry
State of institutions	Ground work for educational systems and infrastructure laid	Educational and legal systems transplanted from west Government manages banking Transportation and infrastructure	Existing institutions evolve to adapt to local context	Private sector participation in institution building – new institutions emerge to facilitate market creation. i.e., venture capital, new industry associations
Leading sectors	Agriculture	New growth industries: Manufacturing – steel, textiles Industrialisation of agriculture	Emphasis on strategic industries such as computers and information technology	Knowledge intensive industries – software, biotech and services
Intensity of knowledge and technology in inputs	Highly labour intensive; low levels of technology	Increasing capital intensity	Capital and knowledge intensity of inputs increases	Integration of knowledge, labour and capital intensity
Skill levels	Low technological skills; managerial skills scarce	Higher levels of technological skills required; managerial skills increase but not widespread	Technological and managerial skills not well diffused	Larger number of skilled workers available; managerial skills more diffused
Organisation form and structure	Functional hierarchies	Multi-product firms – M-form	Multi-product firms – M-form and networks	H-form – organisations; Use of multiple org. models and ecologies

*Timelines used are for illustrative purposes only (e.g., Sweden's development followed similar stages but occurred a century earlier; Chang and Kozul-Wright, 1994).

Stage IV: Global innovators

During this stage, there is further emphasis on integration with the world economy and raising quality in leading industrial sectors. Access to the information highway and new technologies of communication and coordination accelerates learning and enables the rise of knowledge-based industries. Firms begin to interact as participants, not only as buyers of technology but also as suppliers of intermediate products and services. Participation in the global economy fuels the expansion of domestic firms overseas and leads to the emergence of new multinationals operating in a new location of technological excellence (Cantwell, 1989).

Figure 1 Dynamics of entrepreneurial capability building and development



4 Case studies

This section outlines the evolution of entrepreneurial capabilities through technology acquisition and capability building in the steel industry. The iron and steel industry was selected because it is a key industry in developing economies that supplies basic materials for other manufacturing industries and crucial inputs into all forms of industrial development (Enos and Park, 1988; Lall, 1987). Two cases in the steel industry were examined using the four-stage framework outlined above in two emerging economies: Korea and India. For each case we outline the historical context of the industry; we then focus on the technology recipient,[15] technology adaptor and global innovator stages. The Korean firm was selected because it was the first and largest steel company in Korea and although initially state-owned, was later privatised. The Indian firm, TISCO, was selected because it was a strong performer unlike the state-owned firms. Data were obtained from archival and published sources, from company annual reports and websites, and the World Development Indicators (2006) database of the World Bank. In the case of the Indian firm, TISCO, primary data were also obtained from interviews, observations, participation in meetings, workshops, and teaching executives at a leading Indian business school as part of a larger in-depth study on capability building in Indian firms conducted during 1993–1996 and 2000–2003 (Surie, 1996, 2007). Table 2 summarises the evolution of two steel firms: POSCO (Korea) and TISCO (India).[16]

Table 2 Evolution of POSCO and TISCO from 1950s–2000

Firm	*Stage 1 new economy formation*	*Stage 2 Industrialisation I: technology recipients*	*Stage 3 Industrialisation II: technology adaptors*	*Stage 4 Post-industrial: global innovators*
POSCO	1950s–1960s Government assumes entrepreneurial role: Five year plans; investments in education; universal primary education achieved by 1960s POSCO founded in 1968 (a State-owned enterprise)	1970s Entry into strategic industries: steel, chemicals, etc. Substantial investments in infrastructure by government – harbour facilities, water supply systems, roads Construction of POSCO in 1970 Major products – steel for structural purposes; by 1975 POSCO had learned the technology of high carbon steel	1980s Further expansion and links between academia and industry Pohang University of Science and Technology (1986) and R&D centre for Industrial Science and Technology	1990s–2000 → In 1992, ultra-modern steelworks constructed connecting iron-making, steel-making and rolling. Among top steel companies in the world by 1998. Privatised in 2000 and recognised as globally integrated world-class multinational company focused on R&D and innovation, and expert services
TISCO	1950s–1960s Five year plans; Import substitution regime TISCO	1970s Capacity reserved chiefly for public sector TISCO acquired foreign technology via experts and equipment	1980s Continued threat of nationalisation; TISCO had developed some R&D capacity in coal beneficiation, maintenance and some modernisation Government permitted growth of two consulting firms (one public and one private) that focused on the steel industry	1990s–2000 → Modernisation via import of a blast furnace and installation of cold rolling mill facilities in 1990s with help of foreign consultants; TISCO took control of technology transfer and institutionalised learning By 2000, new organisation in place. New businesses and international markets pursued based on higher level capabilities; production of higher value added steel products and entry into new innovation and R&D intensive businesses

4.1 The Korean economy

Devastated by war, the Korean economy experienced tremendous change from the beginning of the 1960s during its metamorphosis into a modern industrial country. In 1962, the Republic of Korea promulgated its first economic development plan projecting rapid economic growth; five subsequent plans were equally ambitious. Exports and vigorous investment contributed to the rapid growth of the economy. Only about 3.5% of GNP was exported in 1962; by 1986 exports increased to about 29% and by 1991 to 38%. Early on, education received a relatively large share of total investment (with aid from the USA) and Korea achieved nearly universal adult literacy, universal primary education, and enrolment rates grew rapidly at all levels above the primary level by 1960. The rate of investment as a fraction of GNP was low in the 1960s. Throughout the decade, resources were allocated to industries with relatively low capital intensity. But the Sixth plan focused on industries producing capital goods. During the 1970s, the rate of growth of fixed investment (12.7% annually) outpaced GNP growth (8% annually). Over the 30 years from 1962–1991, the ratio of gross investment to GNP rose from 0.10 to 0.32. By 1999, value added in industry as a percentage of GDP was 35.9% (Enos and Park, 1988).

By the beginning of the 1970s, the Korean government realised the need for backward integration into heavy industry and began to attract Japan's fading industries such as the chemical, petrochemical, and iron and steel industries. The government stipulated that firms should be internationally competitive in scale and cost, entrepreneurs would be expected to provide capital for at least 40% of the total investment, and established rules for selecting suppliers of technology and foreign loans (Enos and Park, 1988) Thus, the government played a key role in industrialisation by directing the allocation of resources to entrepreneurship. Among the many challenges entrepreneurs faced in initiating such projects were:

- lack of capital which had to be borrowed from overseas
- lack of technology which necessitated acquisition from external sources
- lack of skilled workers and managerial capabilities in the local environment
- political risk which could result in policy changes such as nationalisation of industries or strict government control.

Only the largest firms (*chaebol*) and the government could participate because of the capital required. As capabilities strengthened government began to promote entrepreneurship further in the mid-1990s by providing more opportunities for financing to small and medium sized firms. In addition, some *chaebol* also began to reduce delays in payments to small firms,[17] providing them with more financial stability (Ungson et al., 1997). The government also offered incentives to Korean and foreign firms willing to invest in the new industries and granted tax privileges for a five year period.[18] The government also made substantial investments in harbour facilities, water supply systems and roads for these industrial complexes (Enos and Park, 1988).

Korea acquired technology mainly through licensing rather than through foreign direct investment to build local capabilities. We focus on the case of the Pohang Iron and Steel Company Ltd. (POSCO) (Westphal et al., 1985), which began as a government owned enterprise because of the size of investment (initially $5.8 million) but was later privatised, to highlight the role played by the government in incubating technological capabilities.

POSCO was founded in 1968 as a government-owned steel company and the first integrated iron and steel mill with a modern, large-scale, continuous production system of iron and steel making and rolling. POSCO went through three stages of expansion. Construction of the plant began in 1970 with a capacity of 1030 thousand metric tons per year of crude steel. In the first stage of expansion, completed in May 1976, steel capacity was increased to 2,600 thousand tons; in the second, completed in December 1978, to 5, 500 thousand tons, and in the third, completed in 1981, to 8,500 thousand tons. In 2004, POSCO was the world's 5th largest producer of crude steel. As the decision to shift to new technologies was outlined in the previous section, we focus on how POSCO graduated from a technology recipient to a technology adaptor, and became a global innovator (Enos and Park, 1988).

Technology recipient. Entrepreneurial ventures in developing countries face the challenges of a shortage of capital for financing large scale projects and lack of technology. Consequently, a consortium named Korea International Steel Associates (KISA) was formed to raise capital for the project. It consisted of seven members from four countries: Koppers, Blaw Knox and Westinghouse Electric International from the USA, DEMAG and Siemens from West Germany; Societa Italiana Impianti from Italy; and Wellman Steel Works Engineering from England. France joined in later instead of Japan. However, the consortium was dissolved in 1969 because of its inability to raise funds. Subsequently, agreements were signed with the Japanese for loans totalling $123 million and all major technology and facilities (Enos and Park, 1988). The Japanese contract specified the provision of help with planning and consulting, purchasing and construction, planning and execution of the construction and construction management system, and on-site assistance for start up and operation.

Enos and Park (1988) document the challenges faced during construction of the first stage facilities, such as delays in the laying of concrete, necessitating two month long emergency works to compensate. However, POSCO's employees worked round the clock and their efforts to learn built capabilities and established a tradition of early project completion. Initially, the major products of POSCO were hot rolled steel such as KSD 3501, HRSI and KSD 3503 used for structural purposes; high tensile steel was developed in 1975.

Technology adaptor. As local engineers learned from the effort to absorb the technology, reliance on foreign technical assistance was reduced. By 1981, POSCO depended solely on the Japan Group for the master engineering plan. Also, the Pohang University of Science and Technology (1986) and a R&D centre for Industrial Science and Technology were established to build science and technology capabilities and disseminate skills by forging links between academia and industry.

Emphasis on learning continued and POSCO engineers succeeded in absorbing the technology of making high carbon steel and producing high tension steel of 55 Kg/mm^2. Higher value-added products such as cold rolling coils and sheet, galvanised coils and sheet, as well as low-sulphur clean sheet and steel plate were included and further expansions were undertaken in the 1980s (Enos and Park, 1988). A strategy of exporting to other developing countries strengthened capabilities and helped to finance growth.

Global innovator. From 1993 onwards, POSCO entered the global market by obtaining ISO 9002 certification, and listing on the New York, London and Korean Stock Exchanges. In 1999 the company began to globalise operations by launching corporate-wide process innovation and Six Sigma initiatives to cultivate a continuous improvement culture. Information technology was also used to streamline operations (for example, via an enterprise portal) and implement activity based management. The company was privatised in 2000. Post 2000, the company achieved ISO/TS16949 certification for its cold rolled steel quality management system in 2003 without reliance on external specialists. The company also focused on knowledge management through continuing education, R&D efforts (in 2002, R&D investment CAGR was 12%; R&D as a percentage of sales was 1.4%; source DTI Publications (2002), government of UK), collaborations with the Pohang Institute of Science and Technology (POSTECH), the University of Pittsburgh, and by establishing a Graduate Institute of Ferrous Technology at POSTECH in 2006. In 2006 POSCO was ranked third among global steel producers by the International Steel Institute. Similar developments in other manufacturing sectors (for example, automotives, electronic goods and semiconductors) have led to successful participation by Korean firms in global high technology markets indicating that building entrepreneurial capabilities by adapting to increasing returns technologies helps to catalyse development (Murphy et al., 1989).

4.2 The Indian economy

From the late 1950s, the Indian government pursued an industrial strategy directed towards conserving foreign exchange, producing heavy capital and intermediate goods domestically, building a science and technology infrastructure, and maintaining national ownership of industrial enterprises with a leading role for the public sector. The scale and capital intensity of the steel industry ensured that the only large integrated steel plants established after 1950 were government-owned – Steel Authority of India (SAIL) – with the exception of one private company, the Tata Iron and Steel Company (TISCO). India faced the same difficulties as Korea in obtaining financing. Consequently, all the Indian public sector plants were turnkey plants gifted by Russia, UK and West Germany and the best technology was not necessarily transferred. Both public and private sector projects faced challenges. SAIL was burdened with difficulties in transferring technology, poor engineering, failure to take account of local raw material characteristics (coal and ore were available but of poor quality), low capacity utilisation, price controls, and poor management which contributed to its lacklustre performance, overall. TISCO faced similar difficulties in obtaining quality inputs. Moreover, the government allowed only limited capacity expansion (from 1.3 m tons to 2.0 m tons in the late 1950s) and modernisation of its aging facilities was possible only in 1983, partly because of the threat of nationalisation and partly because price controls held back profitability (Lall, 1985).

In contrast to the industrial policy followed by Korea which favoured large enterprises, Indian industrial policy focused on encouraging small enterprises while containing the growth of large private enterprises. Consequently, India's progress was slow in comparison with other developing countries in the 1960s and 1970s. India's manufacturing value added was $15.6 billion (in 1975 dollars, World Development Report, 1982) compared with $40.3 billion for Brazil, $23.4 for Mexico, $11.2 billion for Argentina, $10 billion for South Korea and $12.8 billion for Yugoslavia (Lall, 1985).

Value added as a percentage of GDP in 1999 was 25.9% as opposed to Korea's 35.9%, and it remained 26.6% in India with Korea at 34.6% in 2003 (World Development Indicators, 2006).

From 1974 on the Indian government required foreign owned affiliates to dilute their shareholding to 40% as a result of which about 60 companies closed operations in India. No foreign firms were permitted to enter strategic industries (such as computer hardware) and foreign firms were not permitted to undertake turnkey work until the 1980s, leading to reliance on domestic consultants and licensing to gain access to foreign technologies (Lall, 1985).

These regulations were designed to protect indigenous technologies, to reduce royalty rates and the life of the agreement and ensure that technology was absorbed fully, and to permit the licensee to sublicense the technology locally. Existing Indian producers (including government owned enterprises), were protected regardless of efficiency, and the market was insulated from external competition (Lall, 1985) whereas Korean incentives to export resulted in earlier attempts to adjust to global standards and markets.

However, low reliance on foreign technologies, together with efforts to boost indigenous R&D and local enterprise, 'protected' technological learning (Lall, 1985). While India was not a major exporter of capital goods among newly industrialising countries in 1978, the total value of product exports in this category was $421 million compared to $1.4 billion for Brazil, and $1.5 billion for South Korea. However, if exports of technology are considered per se, or accompanied by the sale of capital goods, India was among the leaders, in terms of value of exports and the range and complexity of technologies. Additionally, the departure of foreign computer firms created opportunities for new firms in business information services and software (Heeks, 1996).

Economic liberalisation was accelerated by India's financial crisis in 1991. Foreign competitors were once again permitted, leading Indian firms to forge joint ventures, license or import new technologies to enhance their competitiveness. By the end of the 1990s, some leading Indian firms had expanded overseas emerging as new multinationals. Capability building in various sectors such as trucks, heavy equipment, chemicals and computer hardware led to an expansion of each sector, creating further demand for skills, suggesting that a virtuous cycle is initiated by adopting increasing returns technologies (Murphy et al., 1989; Arthur, 1989). The government continued to promote industry and entrepreneurship by easing regulations (Sinha, 2003). The case of TISCO is outlined below.

Tata Iron and Steel Company (TISCO)

In 1981–1982, India produced 1.3 million tons of pig iron and 8.8 million tons of mild steel and was the 16th largest steel producer in the world. There were six integrated steel plants, one in the private sector. We focus on TISCO, the largest private integrated steel producer and consistently the best performer in the steel industry because of efforts to indigenise technology, build its own capabilities in maintenance, and backward integration into manufacturing of equipment and R&D (Lall, 1987). We outline TISCO's transformation from a technology recipient to a technology adaptor and finally, to a global innovator.

Technology recipient. TISCO was founded by Jamshetji Tata in 1907 with technology from USA (Lala, 1981). The steel industry was granted tariff protection by the British government from 1924 till 1941. In the 1950s and 1960s, Indian steel was much cheaper than imported steels.

The import-substituting regime instituted by the 1960s reserved all future steel capacity for the public sector. Therefore, TISCO faced several challenges: the company had to achieve 'satisfactory' performance in order to continue its existence and avoid nationalisation. Price controls restrained local prices and reduced profitability; imports were permitted only when necessary to make up for shortfalls (Lall, 1987).

TISCO, like SAIL also had problems with raw materials but overcame these challenges by retaining its own collieries and installing washing and blending facilities to alleviate the high ash content of coal used in steel production (Lall, 1987). Also, instead of relying on foreign equity or foreign licenses, TISCO obtained foreign technology in the form of individually recruited experts and equipment. Through efforts to absorb technology over 70 years of existence, the firm had built up a team of dedicated managers and technologists as well as a cohesive and skilled labour force.

Technology adaptor. To compensate for difficulties in maintaining equipment and the scarcity of foreign exchange for spare parts, TISCO developed capabilities in project execution, as demonstrated by the establishment of its 'Growth Shop' which began as a maintenance facility for imported machinery and manufacturing spares. Likewise, to solve production inefficiencies resulting from poor raw materials, process engineering capabilities were developed by making improvements in the raw material and coke oven areas. Also, to substitute expensive imported materials with local materials, TISCO continued to introduce new steels developed from in-house R&D, a practice followed since the 1920s. Managing input costs was critical, particularly, since government price controls prevented firms from capitalising on a monopoly position. Other capabilities were developed in industrial engineering such as quality control, productivity monitoring, and cost evaluation (Lall, 1987). In 1983, TISCO launched its first expansion in almost 30 years and began modernisation (Lall, 1987).

TISCO modernised further in the 1990s by importing a new state-of-the-art blast furnace which was installed mainly by local engineers (with the help of local and foreign technical consultants) organised as a cross-functional team and learning was transferred to other divisions of the organisation and to suppliers. As in the case of POSCO, the blast furnace project team worked overtime to meet completion deadlines. By the late 1990s, the company focused on quality through continuous improvement, obtaining ISO certification and benchmarking progress against other global players.

Global innovator. In 2000, a new cold rolling mill was installed using the same procedure; concurrently, an internal reorganisation to match new technology and enhance capabilities throughout the value chain was accomplished with the help of strategy consultants McKinsey and Company. Consequently, there was increased emphasis on value-added products, accelerating innovation through R&D, and patenting. The firm then began globalising via exports, overseas expansion, acquisition, and diversification into information technology based industries.[19] TISCO was ranked the fifth largest steel producer in the world by the International Iron and Steel Institute in 2006. In 2007 TISCO completed the acquisition of a steel company in the UK. Thus, despite facing a difficult regulatory environment until the 1980s, TISCO emerged as a leader. At each stage of its evolution, new capabilities built through technology acquisition increased demand for new products and skills and led to the emergence of ancillary industries serving other heavy industries. An example is the manufacture of bearings for trucks, cars and trains (lending credence to research on increasing returns technologies (Murphy et al., 1989; Arthur, 1989). Figures 2 and 3 provide macro-economic indicators showing the shift from agriculture to industry, manufacturing, and services.

Figure 2 India: sectoral trends

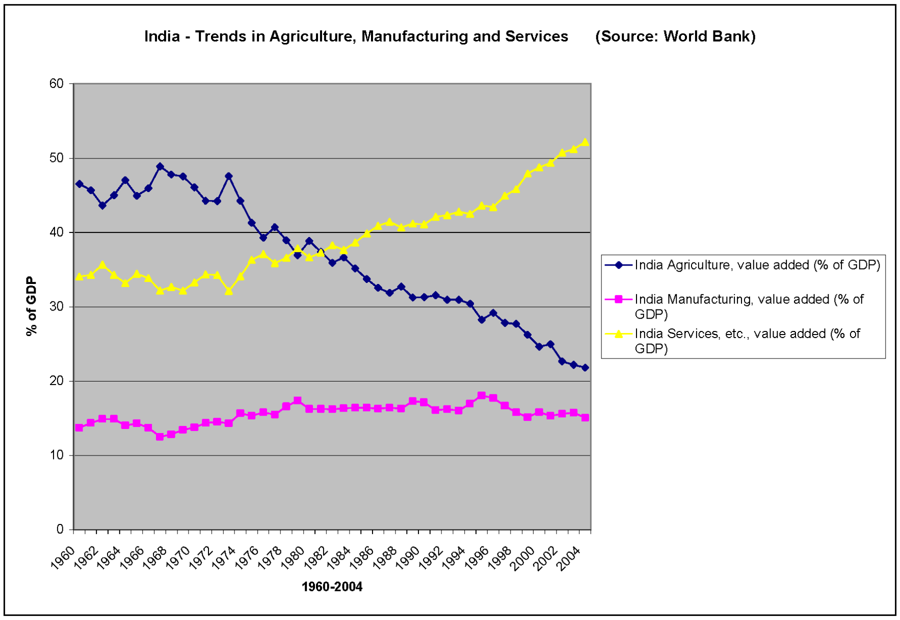
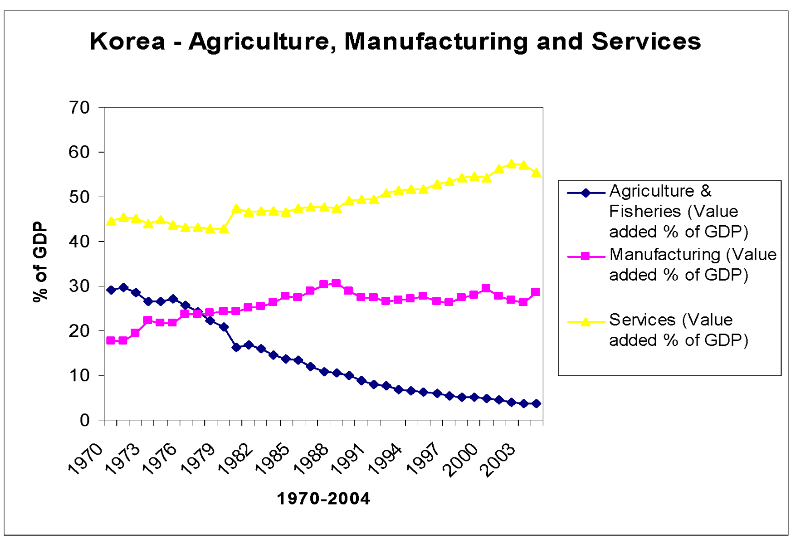


Figure 3 Korea: sectoral trends



5 Discussion

This paper suggests that technology acquisition is inextricably linked with the development and diffusion of entrepreneurial capabilities in developing countries and provides support from case studies of the stages outlined above.[20] In Korea, the steel industry was developed entirely by the public sector with the government assuming the role of entrepreneur (Duvall and Freeman, 1983). In contrast, the expansion of the Indian steel industry was inhibited by government policies that regulated prices and threatened nationalisation, but import substitution policies helped to build indigenous capabilities. Both countries used technology acquisition to foster entrepreneurship. While the timeframe and speed of evolution differed, firms in both countries followed a similar trajectory of technological development. Although TISCO was established in 1907, the regulatory environment impeded its expansion and entry into the global economy until the 1990s. POSCO evolved more rapidly because newer technologies were adopted at the outset in the 1970s while TISCO began modernisation only in the 1980s and was able to catch up in the 1990s.

Other industries follow a similar evolutionary path, suggesting that the framework is more widely applicable. For example, the Indian software industry emerged to provide services to the domestic computer hardware industry (Heeks, 1996) and software firms gained global experience by interacting with international clients (Surie, 2007). Similarly, government investments in science and technology institutions led to the emergence of the biotechnology industry in India in the 1990s, attracting multinational corporations seeking low cost research capabilities. By the late 1990s, the Indian government had privatised some public companies, increasing entrepreneurial activity in many sectors, including education. Thus, despite late entry into the global economy, India is increasingly recognised as an important location for knowledge based industries. The success of leading firms also wrought cultural transformation, generating interest in entrepreneurship as a career of choice (Stiglitz, 2004).

Examples in other countries include the evolution of entrepreneurial and technological capabilities in aircraft manufacturing by EMBRAER (Empresa Braziliera de Aeronáutica, S.A.), founded in 1960 in Brazil, and now a leading manufacturer of commercial and defense aircraft (Nelson, 1993). Similarly, the early history of Japanese industrial evolution also suggests that entrepreneurship and technological innovation co-evolved in the automobile industry (see Pascale, 1984 for details on the evolution of Honda; Nelson, 1960).

Limitations

Since the paper deals with the emergence of entrepreneurial capabilities via technological learning, a limitation is that it does not consider the impact of changes in exchange rates, trade regulations, or financial and macro-economic policies. Nevertheless, exchange rate stabilisation through macro-economic policies or an open trade regime in the absence of capability building is not sufficient to trigger entrepreneurship and development (Stiglitz, 2004; Baumol, 1990). For example, as the Indian case shows, despite facing a similar financial and trade regime TISCO performed better than SAIL, the public sector organisation, because of its own R&D efforts; it also acted entrepreneurially by manufacturing, domestically, components that could not be imported (Lall, 1987). Finally, the success of specific sectors such as the aircraft industry in Brazil and the early history of industrialised countries like Britain, the USA (Licht, 1995) and Japan (Nelson, 1960) suggest support for this framework.

6 Conclusion

6.1 Implications for development

In conclusion, our research has implications for the development of emerging economies.

- Entrepreneurial capabilities are not built in a vacuum, but rather, in the context of learning via technology acquisition, as evidenced by the evolution of both Korean and Indian firms. Hence, establishment of rules to stimulate investment in new technology and learning can help to initiate development.
- Appropriate government incentives and regulations are required to shape the industrial context and promote entrepreneurship in sunrise industries. While import substitution policies helped foster technical capabilities in India, inattention to incentives for global competitiveness and exports initially slowed expansion and entrepreneurship in the Indian steel industry.
- Diffusing entrepreneurship involves expanding markets by achieving quality standards through benchmarking global leaders. The presence of competition appears to have spurred benchmarking and continuous innovation initiatives to raise quality both in the Korean and Indian firms suggesting that incentives to do so must be in place in developing countries to overcome a perception of low quality.
- Entrepreneurship is fostered by reorganising to match technology. Both Korean and Indian firms implemented change successfully by adopting modes of organisation to match new technology at each stage of evolution, enabling them to reallocate and use resources more effectively. Reorganisation is especially critical in emerging economies with scarce resources and skills.
- The development of new entrepreneurial and technological capabilities triggers a virtuous cycle of learning, innovation, expansion and cultural transformation (Murphy et al., 1989; Arthur, 1989; Stiglitz, 2004) in emerging economies. New industries evolve by shifting resources from older industries as observed for both countries in Figures 2 and 3.

6.2 Implications for practice

Future practice can be informed by the insights presented above. First, this research provides a template for the growth and development of new firms by nurturing entrepreneurship through new technology implementation. By innovating to take advantage of environmental conditions, benchmarking quality and cost against global leaders, and continuously raising capabilities and aspirations, leaders of new firms can help to enhance performance and achieve global competitiveness. Second, this template can also be used by firms to stimulate entrepreneurship and innovation in low-growth regions of industrialised countries. Third, this research has implications for public policy. Policy makers can enact incentives to create new locations of excellence by fostering entrepreneurship in regions where it is lacking and by focusing on firms with the greatest potential for success in strategic industries. For example, the establishment of 'scientific parks' and incentives for new industries in industrialised and developing countries in areas where no such capabilities exist suggest that capabilities need to be nurtured.

6.3 Future research

Future research could validate the framework using data from other countries by studying the evolution of entrepreneurship in other sectors such as education, finance, and healthcare and by examining the impact of capability building in firms and industries on outward FDI flows from developing countries. Research could also study the impact of capability building strategies in new industrial regions in the USA such as Raleigh-Durham, North Carolina and Austin, Texas, and Maryland or similar regions in Europe. Other interesting questions include investigating the impact of increased entrepreneurship on:

- the nature of industry evolution
- performance differences between regions and nations
- education, health, quality of life, and nature of society.

Acknowledgements

We thank Christine Shaw, Young J. Zoh for the Korean data, and Francois Therin, Grenoble Ecole de Management for organising the workshop at the Academy of Management where some of these ideas were first presented, and reviewers at the European Academy of Management.

References

Arora, A. and Gambardella, A. (1994) 'The changing technology of technological change: general and abstract knowledge and the division of innovative labour', *Research Policy*, Vol. 23, pp.523–532.

Arthur, W.B. (1989) 'Competing technologies, increasing returns, and lock-in by historical events', *The Economic Journal*, Vol. 99, No. 394, pp.116–131.

Baker, T., Gedajlovic, E. and Lubatkin, M. (2005) 'A framework for comparing entrepreneurship processes across nations', *Journal of International Business Studies*, Vol. 36, pp.492–504.

Baldwin, C.Y. and Clark, K.B. (2000) *Design Rules*, MIT Press, Cambridge, MA.

Bar-el, R. and Felsenstein, D. (1990) 'Entrepreneurship and rural industrialisation: comparing urban and rural patterns of locational choice in Israel', *World Development*, Vol. 18, No. 2, February, pp.257–267.

Baumol, W.J. (1990) 'Entrepreneurship: productive, unproductive and destructive', *Journal of Political Economy*, Vol. 98, No. 5, Part 1, pp.893–921.

Bell, P.F. (1969) 'A quantitative study of entrepreneurship and its determinants in Asia', *The Canadian Journal of Economics*, Vol. 2, No. 2, pp.288–298.

Brimmer, A.F. (1955) 'The setting of entrepreneurship in India', *The Quarterly Journal of Economics*, Vol. 69, No. 4, pp.553–576.

Burmeister, L.L. (1990) 'South Korea's rural development dilemma: trade pressures and agricultural sector adjustment', *Asian Survey*, Vol. 30, No. 7, pp.711–723.

Cantwell, J. (1989) *Technological Innovation and Multinational Corporations*, Basil Blackwell, New York.

Chang, J-J. and Kozul-Wright, R. (1994) 'Organizing development: comparing the national systems of entrepreneurship in Sweden and South Korea', *The Journal of Development Studies*, Vol. 30, No. 3, pp.859–891.

Choi, H. (1999) 'Shifting human resources in South Korean science and technology', *Comparative Education Review*, Vol. 43, No. 2, pp.212–232.

Cohendet, P. and Steinmueller, W.E. (2000) 'The codification of knowledge: a conceptual and empirical exploration', *Industrial and Corporate Change*, Vol. 9, No. 2, June, p.195.

Covin, J.G. and Slevin, D.P. (1988) 'The influence of organization structure on the utility of an entrepreneurial top management style', *Journal of Management Studies*, Vol. 25, No. 3, pp.217–259.

Dahlman, C.J. and Westphal, L.E. (1981) 'The meaning of technological mastery in relation to transfer of technology', *Annals of American Political and Social Science*, Vol. 458, Technology Transfer: New Issues, New Analysis, November, pp.12–26.

de Kets Vries, M. (1977) 'The entrepreneurial personality', *Journal of Management Studies*, Vol. 14, pp.34–57.

Desai, A. (Ed.) (1988) *Technology Absorption in Indian Industry*, Wiley Eastern, New Delhi.

DTI Publications (2002) *The 2003 R&D Scoreboard*, Department of Trade and Industry, Government of UK, http://www.innovation.gov.uk/rd_scoreboard/downloads/2003_rd_scoreboard_analysis.pdf.

Duvall, R.D. and Freeman, J.R. (1983) 'The techno-bureaucratic elite and the entrepreneurial state in dependent industrialization', *The American Political Science Review*, Vol. 77, No. 3, pp.569–587.

Enos, J. and Park, W.H. (1988) *The Adoption and Diffusion of Imported Technology: The Case of Korea*, Croom Helm, New York.

Freeman, J.R. and Duvall, R.D. (1984) 'International economic relations and the entrepreneurial state', *Economic Development and Cultural Change*, Vol. 32, No. 2, pp.373–400.

George, G. and Prabhu, G.N. (2000) 'Developmental financial institutions as catalysts of entrepreneurship in emerging economies', *Academy of Management Review*, Vol. 25, No. 3, pp.620–629.

Guillen, M.F. (2001) *The Limits of Convergence*, Princeton University Press, Princeton, NJ.

Gupta, V., MacMillan, I.C. and Surie, G. (2004) 'Entrepreneurial leadership: developing and measuring a cross-cultural construct', *Journal of Business Venturing*, Vol. 19, pp.241–260.

Hall, G.R. and Johnson, R.E. (1970) 'Transfers of United States aerospace technology to Japan', in Vernon, R (Ed.): *The Technology Factor in International Trade*, National Bureau of Economic Research, Columbia University Press, New York.

Harbison, F. (1956) 'Entrepreneurial organization as a factor in economic development', *The Quarterly Journal of Economics*, Vol. 70, No. 3, pp.364–379.

Heeks, R. (1996) *India's Software Industry: State Policy, Liberalization and Industrial Development*, Sage Publications, Thousand Oaks, California.

Henderson, R. and Clark, K. (1990) 'Architectural innovation: the reconfiguration of existing product technologies and the failure of established firms', *Administrative Science Quarterly*, Vol. 35, pp.9–30.

Hoselitz, B.F. (1952) 'Entrepreneurship and economic growth', *American Journal of Economics and Sociology*, *The Psychological Approach to the Social Sciences*, Vol. 12, No. 1, pp.97–110.

Knight, F. (1964) *Risk, Uncertainty and Profit*, Houghton Mifflin Company, Boston.

Krugman, P. (1991) 'Increasing returns and economic geography', *The Journal of Political Economy*, Vol. 99, No. 3, pp.483–499.

Kuznets, P.W. (1985) 'Government and economic strategy in contemporary South Korea', *Pacific Affairs*, Vol. 58, No. 1, pp.44–67.

Lala, R.M. (1981) *The Creation of Wealth*, IBH Publishing Company, Mumbai, India.

Lall, S. (1987) *Learning to Industrialize: The Acquisition of Technological Capability by India*, MacMillan Press, Hampshire.

Lall, S., (1985) 'Trade in technology by a slowly industrializing country: India', in Rosenberg, N. and Frischtak, C. (Eds.): *International Technology Transfer*, Praeger, New York, pp.45–76.

Leff, N.H. (1979) 'Entrepreneurship and economic development: the problem revisited', *Journal of Economic Literature*, Vol. 17, No. 1, pp.45–64.

Lewis, W.A. (1970) *The Theory of Economic Growth*, Harper Torchbooks, New York.

Licht, W. (1995) *Industrializing America*, John Hopkins University Press, Baltimore.

Lim, T.C. (1999) 'The origins of societal power in South Korea: understanding the physical and human legacies of Japanese colonialism', *Modern Asian Studies*, Vol. 33, No. 3, pp.603–633.

McGrath, R.G. and MacMillan, I.C. (2000) *The Entrepreneurial Mindset: Strategies for Continually Creating Opportunity in an Age of Uncertainty*, Harvard Business School Press, Boston, MA.

McNamara, D.L. (1988) 'Entrepreneurship in colonial Korea: Kim Yôn-su', *Modern Asian Studies*, Vol. 22, No. 1, pp.165–177.

McNamara, D.L. (1992) 'State and concentration in Korea's first republic, 1948–60', *Modern Asian Studies*, Vol. 26, No. 4, pp.701–718.

Misra, A.M. (2000) 'Business culture' and entrepreneurship in British India, 1860–1950', *Modern Asian Studies*, Vol. 34, No. 2, pp.333–348.

Morris, D.M. (1967) 'Values as an obstacle to economic growth in South Asia: an historical survey', *The Journal of Economic History*, *The Tasks of Economic History*, Vol. 27, No. 4, (December) pp.588–607.

Murphy, K.M., Schleifer, A. and Vishny, R.W. (1989) 'Industrialization and the big push', *Journal of Political Economy*, Vol. 97, No. 5, pp.1003–1026.

Murphy, K.M., Schleifer, A. and Vishny, R.W. (1991) 'The allocation of talent: implications for growth', *The Quarterly Journal of Economics*, Vol. 106, No. 2, pp.503–530.

Nagpal, S. and Gyani, G. (2005) 'Setting standards to achieve global competitiveness Indian experience', *Confederation of Indian Industry and Quality Council of India*.

Nelson, R. (Ed.) (1993) *National Innovation Systems: A Comparative Analysis*, Oxford University Press, New York.

Nelson, R.R. (1960) 'Growth models and the escape from the low-level equilibrium trap: the case of Japan', *Economic Development and Cultural Change*, Vol. 8, No. 4, Part 1, July, pp.378–388.

Nelson, R.R. (1987) 'Roles of government in a mixed economy', *Journal of Policy Analysis and Management*, *Privatization: Theory and Practice*, Vol. 6, No. 4, pp.541–557.

Nelson, R.R. and Pack, H. (1999) 'The Asian miracle and modern growth theory', *The Economic Journal*, Vol. 109, No. 457, pp.416–436.

Nelson, R.R. and Winter, S.G. (2002) 'Evolutionary theorizing in economics', *The Journal of Economic Perspectives*, Vol. 16, No. 2, pp.23–46.

North, D. (1990) *Institutions, Institutional Change, and Economic Performance*, Cambridge University Press, New York.

Papanek, G.F. (1962) 'The development of entrepreneurship', *The American Economic Review*', Vol. 52, No. 2, May, *Papers and Proceedings of the Seventy-Fourth Annual Meeting of the American Economic Association*, pp.46–58.

Pascale, R.T. (1984) 'Perspectives on strategy: the real story behind Honda's success', *California Management Review*, Vol. XXIV, No. 3, pp.47–72.

Romer, P.M. (1986) 'Increasing returns and long-run growth', *The Journal of Political Economy*, Vol. 94, No. 5, pp.1002–1037.

Rosenstein-Rodan, P.N. (1943) 'Problems of industrialization of eastern and south-eastern Europe', *The Economic Journal*, Vol. 53, Nos. 210–211, pp.202–211.

Rosenstein-Rodan, P.N. (1944) 'The international development of economically backward areas', *International Affairs*, Vol. 20, No. 2, pp.157–165.

Santarelli, E. and Vivarelli, M. (2007) 'Entrepreneurship and the process of firms' entry, survival and growth', *Industrial and Corporate Change*, Vol. 16, No. 3, pp.455–488.

Schumpeter, J.A. (1934) *The Theory of Economic Development, an Inquiry into Profits, Capital, Credit, Interest, and the Business Cycle*, Translated from the German by Redvers Opie, Harvard University Press, Mass, Cambridge.

Shane, S.A. and Venkataraman, S. (1996) 'Renegade and national championing strategies', *Journal of Management*, Vol. 21, pp.931–952.

Shane, S.A., Venkataraman, S. and MacMillan, I.C. (1995) 'Cultural differences in innovation championing strategies', *Journal of Management*, Vol. 21, pp.931–952.

Sharma, S.D. (1993) 'Markets and states in development: India's reformers and the east Asian experience', *Asian Survey*, Vol. 33, No. 9, pp.894–904.

Sinha, D. (2003) 'The rise of entrepreneurship in India', in Richter, F. and Banerjee, P. (Eds.): *The Knowledge Economy in India*, Palgrave MacMillan, New York, pp.149–162.

Sonko, K.N.M. (1994) 'A tale of two enterprises: Swaziland's lessons for privatization', *World Development*, Vol. 22, No. 7, pp.1083–1096.

Stiglitz, J.E. (1986) 'The new development economics', *World Development*, Vol. 14, No. 2, pp.257–265.

Stiglitz, J.E. (1989) 'Markets, market failures, and development, American economic review', *Papers and Proceedings of the Hundred and First Annual Meeting of the American Economic Association*, Vol. 79, No. 2 pp.197–203.

Stiglitz, J.E. (2004) 'Information and the change in the paradigm in economics, part 2', *The American Economist*, Vol. 48, No. 1, pp.17–49.

Stites, R.W. (1985) 'Industrial work as an entrepreneurial strategy', *Modern China*, Vol. 11, No. 2, pp.227–246.

Surie, G. (1996) *Building Capabilities Through International Transfers of Technology*, PhD Dissertation, The Wharton School, University of Pennsylvania, Philadelphia, PA, USA.

Surie, G. (2007) *Knowledge, Organizational Evolution and Market Creation: The Globalization of Indian Firms, Forthcoming*, Edward Elgar, Northampton, MA.

Swamy, S. (1979) 'The response to economic challenge: a comparative economic history of China and India, 1870–1952', *The Quarterly Journal of Economics*, Vol. 93, No. 1, pp.25–46.

Teece, D.J. (1986) *The Multinational Corporation and the Resource Cost of International Technology Transfer*, Cambridge, Ballinger.

Ungson, G.R., Steers, R.M. and Park, S. (1997) *Korean Enterprise: The Quest for Globalization*, Harvard Business School Press, Boston, MA.

Vernon, R. ([1966] 1979) 'The product cycle hypothesis in a new international environment', *Oxford Bulletin of Economics and Statistics*, Vol. 41, No. 4, November, pp255–267.

Volti, R. (1982) *Technology, Politics, and Society in China*, Westview Press, Boulder, Colo.

Wenger, E. (1998) *Communities of Practice: Learning, Meaning, and Identity*, Cambridge University Press, New York.

Westphal, L.E., Kim, L. and Dahlman, C. (1985) 'Reflections on the republic of Korea's acquisition of technological capability', in Rosenberg, N. and Frischtak, C. (Eds.): *International Technology Transfer*, Praeger, New York, pp.167–221.

Winter, S. (1987) 'Knowledge and competence as strategic assets', in Teece, D.J, (Ed.): *The Competitive Challenge*, Ballinger, Cambridge, MA, pp.159–184.

World Development Indicators (2006) *Country Data from WDI Database*, World Bank, Washington DC.

Young, A.A. (1928) 'Increasing returns and economic progress', *The Economic Journal*, Vol. 38, No. 152, pp.527–542.

Zahra, S.A. and Nielsen, A.P. (2002) 'Sources of capabilities, integration and technology commercialization', *Strategic Management Journal*, Vol. 23, pp.377–398.

Zahra, S., Brett, A., Matherne, P. and Julie, M.C. (2003) 'Technological resource leveraging and the internationalization of new ventures', *Journal of International Entrepreneurship*, Vol. 1, pp.163–186.

Notes

[1]One reason is that standard neoclassical theory does not indicate a role for state intervention; in contrast, Nelson (1987) suggests that the role of the government may be important in supporting industrial R&D and the education of poor children. Likewise, Stiglitz (2004) notes the importance of government intervention.

[2]See also Stiglitz (2004).

[3]Korea is unique in that three-fourths of foreign educated students return home after university.

[4]An exception is Santarelli and Vivarelli (2007) who discuss the literature on new firm formation, survival and growth in a survey article; however, their research also focuses on developed rather than emerging economies.

[5]Bar-el and Felsenstein (1990) suggest that the industrialisation of rural areas can be encouraged by stimulating entrepreneurship in such regions.

[6]While all engineers may not become entrepreneurs, Nelson (1987) points to the role of the indigenous science community in technology transfer and adaptation, as well as to development in less developed countries.

[7]Surie (1996) provides details of adaptations Indian firms must make to adjust manufacturing to local conditions in the steel and earthmoving equipment industries.

[8]Surie (1996) also outlines organisational changes firms must make to adjust to new manufacturing technologies.

[9]Along with Nelson and Pack (1999) and Westphal et al. (1985) we argue that the adaptation of technology to suit a new environment constitutes innovation as it requires effort and involves Knightian uncertainty and risk (Nelson and Pack, 1999); hence, the technology need not be new to the world to constitute an innovation. The same applies for adaptations of organising principles and markets.

[10]See Surie (2007) for a discussion of how capabilities were developed in new industries such as software and biotechnology in India.

[11]This includes domestic innovation; see footnote 9 above.

[12]While protection of domestic markets may be warranted in the initial stages, overprotection may stifle development. Moreover, domestic firms with internal capabilities that do expose themselves to international competition are likely to increase competitiveness by paying attention to and adopting international standards (Nelson and Pack, 1999).

[13]We use the stages as device to communicate about evolution dynamics and changes over time. Firms may stagnate at a particular state if learning at that stage does not occur or competitive conditions are not favourable.

[14]While some developing countries have flourished as 'open economies', others have floundered. Similarly there is a variation in the performance of industrialised countries tracked by ISI (Information Society Index). While the norm appears to be limited competitiveness irrespective of 'openness', we emphasise that stronger performance in a global economy requires capability building.

[15]As the firm is a technology recipient from the start of its formation, we begin from the technology recipient stage and focus on the problems of the new venture together with capability building.

[16]The use of the case study approach is very different from approaches used for large sample studies. The cases are offered as an illustration of the framework, *not* as proof. Cases are used to provide a richer understanding of the context and historical detail (Arthur (1989) has suggested that history matters because of path dependence, particularly in evolutionary theorising (Nelson and Winter, 2002). In particular, as each country goes through the industrialisation process facing a different set of context conditions, case studies allow us to examine these in more detail than a large sample study. However, the elaboration of particular situations in detail precludes us from 'measuring' significance since that is not a goal of this approach.

[17]Earlier, a strategy followed by the chaebol was to delay payments to small firms to maintain flexibility and competitiveness in global markets, thus shifting the risk to the small business sector.

[18]This suggests that government was setting the ground rules for encouraging entrepreneurship in new industries (Baumol, 1990).

[19]This information is based on company interviews conducted with the strategic management team by the author.

[20]In our cases, we have started from the technology recipient stage as the preceding sections outlines government involvement in new venture formation. While these stages are borne out in the cases provided in this paper, additional research using cases and data from other countries would confirm whether these are more universally applicable.