Asian Journal of Technology Innovation 13, 2 (2005)

National Embeddedness of Economic Activities: Industrial and Technology Policy in Korea and Taiwan

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Summary

This paper adopts an embeddedness perspective and discusses rationales for government intervention in relation to economic development. Looking at East Asian experiences with industrial and technology policy the paper examines the general requirements, specific areas of focus and appropriate techniques for industrial and technology policy. Eight generic policy requirements are identified, viz. government capacity; monitoring and adjustment; policy sequencing; incremental upgrading; progressive market reliance; performance-orientation; selectivity; and flexibility.

Key words: national embeddedness, industrial and technology policy, national innovation systems, technological capabilities, Korea, Taiwan.

1. Introduction

Firms do not emerge and succeed individually but in the context of wider institutional environments, which are often malleable by policy. Indeed, work in a range of disciplines informs us of the ways in which economic activities are embedded in and shaped by socially devised structures.

There are two different sides to embeddedness: one is embeddedness as a basic ontological fact of economic life; the other is the utilitarian side of embeddedness as a source of increased economic performance. With respect to the latter there is strong evidence that institutionally rich domestic regimes capable of supplementing or superseding the logic of markets and hierarchies may help firms prevail over competitors based in institutionally impoverished market and

hierarchy-driven governance systems.

In this paper we explore the concept of embeddedness in the context of industrial and technology policy. More specifically, we enquire about what the general requirements and specific focus areas of successful industrial and technology policy are and how these might best be pursued. First, we outline a small selection of theoretical approaches that recognise the embeddedness of economic life. Second, we discuss how the acceptance of the national embeddedness of economic activities was translated into highly successful industrial and technology policies in Korea and Taiwan.

2. Approaches to National Embeddedness

Scholars from such different fields as economic history, industrial organisation, political science, management and business administration, geography, economic sociology, and development studies have recognised the importance of conceptualising economic activity as being fundamentally embedded in various social and institutional structures. However, rather than being a unified body of work studies of embeddedness are various, casual and sometimes contradictory.

Economic sociologists tend to address embeddedness at a fundamental social level (Granovetter, 1985; Granovetter and Swedberg, 1992; Smelser and Swedberg, 1994) and argue that economic actions should be understood in the context of the ongoing system of social relations in which they are embedded. According to Granovetter (1985), for instance, trade associations, interlocking directorates, extra-economic social activities, trust-based and enduring buyer-seller relationships and long-term and stable subcontracting relationships are institutional manifestations of such ongoing systems of social relations.

In this paper we approach embeddedness as a source of increased performance and outline a selection of approaches, which elaborate on the relationship between economic performance and the national institutional set-up. Among the literature dealing specifically with the national embeddedness of economic activities, we discuss the *national systems of innovation* approach, Lall's two concepts of *national technological capabilities* and *industrial technology development* and Whitley's *business systems* approach.[1)]

The national systems of innovation (NSI) approach can be seen as a sub-approach within

1) In this section we will confine ourselves to outlining the approaches. For a critical discussion of each of them, see Gammeltoft (2001).

a broader neo-Schumpeterian tradition, which has flourished since the 1970s. The neo-Schumpeterian literature presents two analytically distinct lines of enquiry: one elaborates on the work of Schumpeter and deals with the role of technology as the force underlying and shaping long-run economic development (e.g., Freeman, 1982; Dosi et al., 1988; Nelson and Winter, 1982). Interest here is in the dynamics of technological change, the inherent characteristics of technology, innovation, and firms and the focus is on radical innovations with the potential to transform companies and economies at large.

The other line of enquiry, the NSI approach, focuses more on the institutional context in which technological development takes place and the factors that impede or promote it (e.g., Freeman, 1987; Lundvall, 1992; Nelson, 1993).[2] It is more policy oriented, operates with a wider conception of innovation and emphasises incremental innovation and diffusion. National system of innovation has usefully been defined as 'that set of distinct institutions which jointly and individually contribute to the development and diffusion of new technologies and which provides the framework within which governments form and implement policies to influence the innovation process' (Metcalfe, 1995).

Lundvall (1992) furthermore proposes a narrow and a broad definition. The narrow definition includes organisations and institutions involved in searching and exploring (e.g., R&D departments, technological institutes and universities), whereas the broad definition includes 'all parts and aspects of the economic structure and the institutional set-up affecting learning as well as searching and exploring - the production system, the marketing system and the system of finance' (p. 12). Lundvall stresses that the way the different elements interact is as important as their individual characteristics.

Innovation and change require learning, which is considered an interactive and socially embedded process that must be considered in its institutional and cultural context. A particularly important part of that context is the modern nation state. Change and learning do not come about only, or even predominantly, through purposive activities such as R&D. They also take place as part of every-day activities within and between firms. Within firms, experience from everyday activities determines the direction of innovation and produces the necessary knowledge.

Lall (1992) introduced the notion of national technological capabilities, which is closely related to that of the NSI. National technological capabilities (NTC) underpin the productivity, growth and trade performances of countries and entail the interplay between capabilities, incentives and institutions. The capabilities of a country define the best that can be achieved, and incentives

2) For a discussion on the nature and antecedents of the NSI approach, see Sornn-Friese (2000).

guide the use of capabilities. Both operate within and are influenced by an institutional set-up.[3] Capabilities encompass physical investment, human capital and technological effort, which are strongly interlinked: investments are useless if the appropriate human capital is not developed, and so is the formation of formal skills without conscious (technological) efforts to utilise them. National technological effort comprises efforts of firms to assimilate and improve upon technology, supported by a technological infrastructure that provides information, standards, basic scientific knowledge and diverse facilities.

Incentives arising from market forces and from institutional and government functioning affect the pace of capital and skills accumulation; the types of capital purchased and skills learned; and the extent to which existing endowments are exploited in production. Needless to say, government policies are central in shaping incentives, but may do so either positively as when remedying structural and market failures, or negatively as when interventions are poorly conceived or implemented.

At the firm-level, technological capabilities are developed through a process of industrial technology development (ITD), which in turns consists of 1) the incentive structure facing firms; 2) the availability of suitable skills; 3) the availability of technical information and support services; 4) finance for ITD investments; and 5) governmental technology policy (Lall 1993). There are possible market failures and government remedies associated with each of these components, which lead to the specific role and form of government intervention. Lall (1992) maintains that competition is the most basic incentive affecting capability development but adds that government intervention is necessary in a range of areas. If a country chooses to rely on foreign investors for all difficult technological work, the learning process will be curtailed and industrialisation remain in less dynamic paths (Lall, 1993). If the source of market failure lies outside the firm (e.g., lack of skills, infrastructure, institutions) intervention to protect the firm will likely be ineffective. Intervention may improve resource allocation if failures arise from firms' own lack of investment in capability development. But under such circumstances, subsidies are preferable to tariffs due to lower consumption costs, even though more difficult to administer.

Whitley (1992; 1999) is also concerned with what might be dubbed the national embeddedness of economic activities. His research on business systems deals with how economic activities are organised, controlled and coordinated differently in different institutional contexts, resulting

3) Even though this makes institutions central to the formation of NTC, Lall merely notes that they encompass the legal framework, industrial institutions, training institutions and technology institutions without being more specific. The NSI approach may complement the literature on NTC in this respect.

in a variety of 'capitalisms'. By reference to variations in particular societal institutions, he seeks to explain how and why different ways of organising capitalist economies have developed and continue to be distinct. To compare and contrast different systems of economic coordination and control he seeks to develop a broad framework that can be used to 'identify the critical processes by which they become established, reproduced, and changed as relatively integrated and distinctive business systems' (Whitley, 1999, p. 15). Such an approach can potentially bring more detail to the study of the embeddedness, while remaining abstract enough to be broadly applicable.

Economic activities and relationships are considered socially constituted and institutionally variable so that agents, competition, and outcomes vary between societal contexts. Consequently, the approach dissolves the conventional market-hierarchy dichotomy and shows that firms and markets refer to different institutional entities in different societies, depending on how economic activities are conducted and organised. The nature of firms as quasi-autonomous agents, their internal structures and their interdependencies interrelate and differ significantly between institutional contexts (Whitley, 1992). Authoritative coordination may penetrate unequally within firms as well as span different firms (e.g., through cartels, profit-pooling associations, business groups, interfirm networks, and the like). Business systems are distinguished on the basis of the organisation of ownership and control, particularly the relationship between owners and managers, and vertical and horizontal integration of production; interfirm relationships such as forms of coordination with suppliers, customers, and competitors; and employer-employee relationships in firms (e.g., adversarial versus collaborative).

Business systems, then, are distinctive patterns of economic organization that vary in their degree and mode of authoritative coordination and in the organization and interconnections between owners, managers, experts, and other employees. Differences in the nature of relationships between five broad kinds of agents are particularly important in contrasting business systems: a) providers and users of capital, b) customers and suppliers, c) competitors, d) firms in different sectors, and e) employers and different kinds of employees. Relationships vary in their extent of organizational integration and in whether they are accomplished primarily through ownership-based hierarchies, formal agreements, personal obligations, informal commitments or otherwise. (Whitley, 1999:33).

Institutions may be more or less coherent, integrated, and mutually reinforcing. If more so, distinctive business systems will develop. If less so, competing principles of economic organisation may co-exist.[4] The most important institutions are those associated with the state and its policies; the financial system; the labour market; and trust and authority relations.

3. Industrial and Technology Policy

This section discusses rationales for government intervention in relation to economic development. Are there general policy requirements? Which specific areas are candidates for intervention and which techniques may be applied? These questions will be probed through the lens of the East Asian experiences.

The activism of various East Asian states has been amply documented in the literature. But while state interventions have apparently not seriously impeded economic development, it is next to impossible to document the effect of such intervention,and a vivid dispute has flourished around the issue.

The need for government intervention in the presence of certain market failures is generally accepted. More contested is the need for broader government activism to bring various markets and actors operating in them into existence and guide their development. There is also a general consensus as to the significance of macroeconomic stability, human resource development, high savings and investment rates, and export orientation, but if we consider government policies and programmes targeted more specifically at industrial and technological advance, we enter highly contested grounds. Much of this debate is phrased in terms of industrial and technology policy.[5)]

Evolutionary economists and authors within the capability tradition convincingly argue that the complexities of technological development go far beyond the generally accepted market failures. Even if one accepts that interventions are justified in order to remedy information failures and coordination problems between whatever activities may already be present in an economy, technological advancegoes beyond this and depends on uncertain, long-term, complex, cumulative and path-dependent learning processes of a diverse range of economic actors.

In mature and developed economies, marginalist preoccupations with attaining productive efficiency (i.e., appropriate composition of inputs given relative scarcities and prices) and allocative efficiency (i.e., appropriate allocation across activities) may to a wide extent be warranted. Dynamic investment and growth processes, on the other hand, are fundamentally different and associated with complicated structural problems. Agents, markets, and prices may be absent, weak and inadequate and highly variable and contingent on the specific course of the development process.

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4) Japan and Germany, for instance, are taken to represent more coherent and distinct business systems than the U.S.

5) Here we simply consider science and technology policy as narrower than, and properly contained within, industrial policy.

The distribution of resources between different activities in firms and between different firms, sectors and even countries needs to take account of linkage and spill-over effects, social benefits and learning costs and effects. Different benefits may be associated with different sectors or technologies at different points in time; the viability of a sector may depend on a wider cluster of activities (Porter, 1990); and clustering may require learning processes to be collective and coordinated between firms (Lall and Teubal, 1998). If one accepts that fundamental differences exist between processes of dynamic growth and static allocation, this strongly influences the extent and type of policy intervention conceivable.

A prominent theme within the debate on industrial policy is whether interventions should be functional or selective. *Selective interventions* are directed towards specific industries or clusters, generic technologies, regions, or even firms (Amsden, 1989; Wade, 1990; Pack and Westphal, 1986; Lall, 1996) and includes the creation of particular types of skills, institutions to promote particular technologies believed to be strategic, the financing of mission oriented research, the granting of infant industry protection or subsidies, the channelling of local or foreign investments into particular activities or negotiating with and regulating international investment and technology transfers. *Functional interventions* (World Bank, 1993), on the other hand, are more general and include human resource development, general infrastructure provision, export promotion, openness to international technology flows and so on. Selective interventions are far more complicated to accomplish since they need to be highly context specific and evolve over time. Moreover, the different paths taken by the East Asian NICs suggest that there is no single package of interventions that will ensure success.

Experience shows that government bureaucracy should be sufficiently capable to devise policies and carry them out; that policies need to be continuously monitored and adjusted; that policy focus in a given area should gradually shift from technology search, acquisition, and assimilation to indigenous improvements and innovation; that targeted activities should only deviate incrementally from the existing capability base; that targeted activities can gradually be performed with greater reliance on markets; that support should be tied to performance requirements; that policies should be truly selective; and that policies should be wide and flexible. We will expand on these points in the following.

Government support for technological activities is contingent on sufficient government capacities in policy formulation and implementation and on socio-political issues related to the economy in question. History is littered with examples of governments intervening in counterproductive ways retarding technological development, efficiency, export growth and structural change (Lall, 1992; World Bank, 1991), and Lall (1992) recognises that few governments possess the capacities

to intervene on the scale it has been done in Korea. In the absence of such capacities, broader functional interventions at a subsectoral level may be preferable, leaving it to market forces to sort out the best enterprises and technologies. On the other hand, if selective interventions can be as beneficial as some believe, an alternative course of action would be to initiate efforts to enhance government capacity. The effectiveness of government interventions depend on adequate administrative and organisational capacities and the acquisition of these capacities is subject to the same uncertainties, learning costs and economies and so on as those associated with manufacturing technology.

Policies should be continuously monitored and government able to respond in an effective and timely manner. Pack and Westphal (1986) assert that 'selective intervention can bring successful results only to the degree that it entails successive implementation and reformulation of detailed strategy through the accumulation of information relevant to judging progress toward an unambiguous objective' (p. 103). It has also been suggested that there are significant positive externalities associated with the information gathering during the course of monitoring from which private industry may benefit.

Since late industrialisers tend to advance from replication of mature products and technologies towards indigenous adaptation, improvement and innovation, there is obviously a sequencing to interventions: at an early stage, focus is most appropriately placed on the acquisition and assimilation of proven technologies, and techniques such as capital goods imports, learning-by-doing and reverse engineering are to a large extent sufficient. Later, indigenous development efforts become more relevant to maintain competitiveness in the face of rising local costs and increasing competition from low wage locations, more reluctant technology transfer from developed country competitors, pressures to tighten intellectual property (IP) protection and possibly protectionist counter measures in advanced markets.

Since most learning is cumulative and incremental interventions are more likely to succeed if they support activities that have a base in existing skills and knowledge in a country. New technological leaps must be modest, based on realistic assessments of what is feasibly attainable within reasonable periods of time.

Government intervention is more needed in the early stages of an industry's development and can subsequently be scaled down. The most significant feature of Korean, Taiwanese, and Japanese industrial policy, according to Pack and Westphal (1986), is a dual policy regime between industries in which the countries already had comparative advantage and those in which they did not. In the former case, industries were subject to a neutral incentive regime. In the latter case, various forms of selective interventions were applied (e.g. credit rationing and

preferences, import quotas and tariffs, licensing controls, tax preference on income from exporting and other tax inducements). The development of distinctly new capabilities for existing or new industries was only attempted in a few areas at a time, while at the same time the use of already existing capabilities was left to market forces operating in response to largely neutral incentives.

The East Asian experiences show that promotion and protection should be limited, combined with competition in the domestic market, include a phasing-down schedule and be conditional upon performance requirements such as exports and productivity.

To avoid spreading scarce resources too thinly, selectivity is at the heart of industrial policy. An appropriate balance between reliance on imported technology and local efforts needs to be struck, and only certain areas, sectors and activities promoted.

Finally, overly specific and narrow policies are inherently risky: if investments were associated with large sunk costs or specific assets, the costs of becoming locked into an inappropriate development path would be considerable. This implies that strategies should be based on wide search, variety, experimentation and some slack and redundancy. Flexibility becomes a quality in its own right.

4. Industrial and Technology Policy in Korea and Taiwan

Below we consider four broad areas of industrial policy in Korea and Taiwan and the techniques associated with them: the creation and nurturing of markets and agents, industrial organisation, the institutional infrastructure, and the regulatory framework.

Regardless of the disputes over the efficacy of industrial policy, it remains a well-documented fact that the Asian states have all pursued activist policies (with the possible exception of Hong Kong), although the extent and specific instruments have varied: the Southeast Asian countries have been more uniformly open towards trade and investment and have had less interventionist policy-orientations. Korea and Taiwan have applied a combination of export promotion and import-substitution, protection of local markets and government procurement to stimulate local enterprises. Korea has been the most interventionist, utilising subsidised credit, duty-free imports for exporters, export targets, tax incentives, government-business deliberation councils and contests among its policies. Taiwan has focused particularly on supporting R&D and technological development and forging linkages between domestic and foreign-invested companies. Both countries, and particularly Korea, have also pursued technology transfer more aggressively than

the Southeast Asian states (e.g., through requirements of local content and the forging of local linkages). Korea is renowned for shunning foreign direct investment (FDI) and preferring license agreements and capital goods imports. Even in Hong Kong, which is otherwise known for its laissez-faire policy approach, government has intervened through the allocation of export licenses and public housing projects and more recently by approval of a US$18 million technology upgrade program (Das, 1998).

With respect to industrial organisation, economic activities have become organised in qualitatively different ways in different Asian societies (Whitley, 1992). The NIEs, except Singapore, relied to wide extent on domestic firms for technological upgrading, whereas the ASEAN-4 have relied on foreign subsidiaries and provided incentives to attract them. Due to the absence of a domestic entrepreneurial base, the Korean government has been very actively involved in the economy ever since independence and a few giant *chaebol* under government supervision and guidance have been the institutional vehicle of accumulation. Taiwan's industrial structure is characterised by a large number of small, family-owned businesses, and in Singapore and the ASEAN-4, TNCs and foreign/domestic joint ventures are particularly prominent.

4.1. Markets and Agents [6)]

Markets are institutionally constituted and vary between contexts. Both markets and the economic agents operating in them may need to be created and nurtured. The Korean government's promotion of the chaebol is a prominent case in point. The large domestic business groups were a means to economise on limited local entrepreneurial and financial resources and to internalise deficient markets for capital, skills, information, and entrepreneurship. Their size allowed economies of scale to be attained and they were used to enter strategic industries. In Korea, by design, a symbiotic relationship between government and the chaebol was created in which government was able to generate investment opportunities and the chaebol subsequently responded to them. Government led the market, as Wade (1990) has put it.

At an early stage, an industry's activities may be confined to assembly of imported parts and components on the basis of foreign technology and know-how. Once assembly activities reach sufficient scale, and as technical, organisational and managerial learning progress a broader range of related and specialised activities may be undertaken locally. If assembly industries are locally owned and managed, the capabilities necessary to branch into new activities may

6) Unless otherwise stated, the country evidence from Korea and Taiwan relies predominantly on Wade (1990). Amsden (1989, 1997), and Evans (1995).

be acquired largely through the assembly activity; if they are foreign owned and managed, more of the capabilities must be acquired elsewhere. Specialised technological agents such as engineering firms, intermediate-goods producers, and capital goods suppliers may act as repositories of technological capabilities and diffuse technology between firms. Flows through such intermediaries are often far more important than those directly between competing firms (Dahlman et al., 1987). Close interactions between these agents and their customers also ensure the development of local capabilities that match local needs. To nurture such complementary activities, government may set specific targets for machinery, parts and raw materials that should be localised and offer tax incentives, preferential financing, loan guarantees and R&D subsidies to those who develop them. In Korea, some local activities were supported by law ruling that projects should be given to local firms, possibly with foreign minority partners if possible, and quantitative import restrictions, import licensing, domestic content and other techniques were used to promote the development of local capital goods industries. Besides promoting specific agents, government may also encourage companies to enter particular technologically demanding areas, e.g., by means of protection or targeted credit, or targeting specific activities in firms such as R&D or training.

Countries frequently target particular infant industries for certain periods. One reason is that advance in various base industries such as information technology, new materials and biotechnology may influence strength in downstream industries, so that countries cannot afford to let these sectors be exclusively controlled by foreign firms. A converse argument is that demand from strong downstream industries may be necessary to develop upstream component industries. More generally, technological linkages between firms may require that whole groups of activities be promoted as infant industries, since this will allow learning processes in individual companies to be coordinated. Furthermore, some groups of activities may be more beneficial to an economy than others at a given level of development.

Lall (1993) observes that successful infant industry promotion in Korea targeted sectors with significant externalities and linkage potentials. Interventions were not directed at isolated products or technologies but based on a broader plan taking their interrelationships into account. More specifically, he finds that 1) targeted industries must realistically be able to reach world class efficiency in the foreseeable future; 2) only a few infants should be promoted at any given time due to scarcity of resources; 3) performance requirements, such as exports, must be made to avoid promotion leading to complacency rather than upgrading; and 4) complementarities to the industry (finance, skill base and supporting industries) must be dealt with concurrently. Complacency of protected firms, which would be contradictory to the purpose of protection, is a real risk but can be addressed by limiting protection, imposing performance requirements

or enforcing early entry into export markets while maintaining domestic protection.

Public enterprisesare common in activities where social benefits outweigh private benefits (e.g., in capital and technology intensive areas, and areas considered nationally strategic). Beyond the capabilities developed in these enterprises themselves, technology may be diffused into the private sector through the linkages they form and through labour mobility. In Korea, the government announced procurement plans under which contracts were granted based on cost and quality considerations. Such contracts induced activities in particular areas and at the same time provided secure income to companies in the process of undertaking risky investments in other areas, such as semiconductors. In Taiwan, public enterprises were used to enter particularly difficult or capital-intensive activities. Public procurement policies and localisation schemes may be applied to initiate local production of goods, intermediate goods and production equipment.

4.2. Industrial Organization

There may also be a role for government in shaping the way agents interact and the way industrial activities are organised. As a production system develops, more and more advanced activities will be undertaken locally and linkages between activities become more complex. In some instances, externalities, inability to appropriate the benefits or information or coordination failures lead firms to not initiate otherwise socially beneficial activities. Government may need to encourage the establishment and use of various supporting industries. Based on case studies of fifteen countries, Nelson (1996) finds that many countries encourage cooperation between private firms in R&D. Pack and Westphal (1986) address the issue that previously transferred technology may be incompletely mastered and productivity reduced due to insufficient diffusion of knowledge about production engineering, inadequate product specialisation among firms making similar products, and an insufficient extent of subcontracting. They assess that actively promoting increasing technical efficiency can lead to benefits in the range from 30 to 50 percent of existing production. The absence of subcontractingis likely to result in different firms internalising the same activity, all operating below full utilisation. The advantages of specialisation may be foregone if too many firms produce the same product, a risk that may be reduced by government intervention (e.g. by encouraging rationalisation cartels among private industries). In the later stages of Korean industrialisation various curbs were placed on the chaebol to avoid collusive practices and excessive vertical and horizontal integration. Government also responded to an imbalance between large and small business sectors and promoted small and medium industries(SMIs), particularly technology-based firms. Export processing zones and industrial districts have been

important in providing companies with physical and institutional infrastructure and facilitating cooperation between foreign and local companies, and among local companies themselves.

4.3. Institutional Infrastructure

The institutional infrastructure may function as a means for accumulation of capabilities and a channel through which information and manpower can diffuse between firms. Here we consider human resource development, the science and technology (S&T) infrastructure, industrial extension, government-business deliberation and finance as part of the institutional infrastructure. Heavy investment in human resourcesin general and technical training in particular is usually highlighted as one of the most important prerequisites for the rapid economic development in East Asian countries. Obviously, the composition and level of skills required varies as industrialisation proceeds. The overseas training and hiring of returnees are also frequently cited as important. Nelson (1996) finds that the education of the workforce is one of the factors that has the most profound impact on innovation, and more specifically that a major determinant of the success of infant industry protection programmes is the quality of the education and training system and the extent to which it provides firms with the strong skills needed to make it on their own. On this basis, policy recommendations may be to encourage industrial training by subsidies to or levies on firms; to increase enrolment rates with a focus on technical fields; to gear training to emerging technological needs; and to get industry involved in the management of training and education institutions.

A well developed local S&T infrastructurecan induce the choice of socially appropriate techniques, improve the terms of technology imports and stimulate capability development in local productive enterprises and specialised technological agents. Nelson (1996) finds that the relationship between public R&D efforts and industrial success differs from case to case, but generally benefits seem to depend on tight linkages between the public programmes and the industry involved, linkages between specific firms or groups of firms and specific laboratories, research programmes or individuals. Government laboratories may spearhead the development of new technologies, but policies directed at the diffusion and application of technology, bringing industries up to world practice or spreading knowledge about new developments, can generally be more effective than the subsidisation of major breakthroughs. Since individual companies may not be able to appropriate the benefits of information gathering related to technology acquisition and absorption, and since such gathering is associated with large fixed costs, government may induce industry-wide efforts, possibly with some compulsion to curb free riding.

In Korea, public research institutions played an important role in identifying technology sources and disseminating information to local firms, strengthening their bargaining position. In Taiwan, they were active in importing technologies and diffusing them into small and medium-sized enterprises (SMEs). Experienced researchers also migrated from public institutions into nascent corporate R&D centres. Studies suggest that the main economic benefit from research activities is not the formal output as such but the resulting supply of scientists and engineers, their skills and network engagements (Bell and Pavitt, 1993). Public research institutions played a limited role in the early stages of Korean industrialisation, but their importance increased as manufacturers moved into less mature technologies. At this stage, various agencies were established to help industries acquire technology: 1) a technology transfer centre provided information regarding alternative technologies available abroad and assisted in preparation of contracts; 2) technical information centres collected and disseminated scientific technical information; 3) technical extension service agencies assisted firms in improving product quality, training, factory automation, and so on; and 4) public R&D institutes undertook joint research with industries and supplied information on technology sources, which enhanced the bargaining position of local firms. As domestic demand rose, a number of specialised research institutes spun off from *Korea Advanced Institute of Science and Technology* (KAIST) and pioneered new products and processes and adapted and improved foreign technologies in areas such as shipbuilding, marine resources, electronics, telecommunications, energy, machinery, chemicals and standardisation.[7)]

The rationales for more mundane industrial extension services are the same as those for the more specialised activities related to science and technology. A well-functioning metrology, standards, testing and quality assurance (MSTQ) system is central to the upgrading of local firms and to facilitating local cooperation and international marketability. In Taiwan, an electronics working group was formed in the mid-1960s to assist companies in areas such as marketing, coordinating production with the demands of foreign buyers, procurement, training, quality improvement and accelerating bureaucratic approval procedures. In Korea, the setting of industrial standards increased the local diffusion of technology (Kim and Dahlman, 1992).

It has been argued that so-called government-business deliberation councils contributed significantly to the economic success of some of the East Asian countries (World Bank, 1993).

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7) A problem with publicly provided R&D and extension services is that they are often supply-driven, do not correspond to industry needs, and are of inadequate quality. Various mechanisms can be applied to secure the relevance and reach of such efforts (e.g., requiring them to be more demand-driven, requiring that part of the budget is covered by fees; conducting joint public-private projects; securing private sector input in management and operations; and conducting applied technological work rather than basic science).

These are forums that bring together various stakeholders (government, business, labour, consumers, academia, and the press) to discuss policy and market trends, exchange information in general, and formulate visions for future development. The organisation of industries into associations was particularly encouraged in Japan and made these kinds of deliberations more efficient. Additionally, industry associations can support their constituencies in various ways, strengthen intra-industry cooperation and provide services for their members.

Owing to the inherent uncertain and long-term nature of scientific and technological activities, financeposes a special problem. Anglo-Saxon market-based financial systems are usually taken to favour short-term profit-oriented investments, whereas in credit-based financial systems, often associated with Germany and Japan, creditors tend to be more engaged in long-term growth-oriented investments and there are closer associations between financial institutions and firms (Whitley, 1999). In Korea, the government established various funds aimed at supporting activities such as technological development, small technology start-ups, R&D, equipment modernisation and plant automation. It also took steps to create financial institutions specifically catering to the needs of new technology-based firms and to establish a venture capital industry, primarily based on public firms. Even though financial market interventions were common in the East Asian NICs, they are risky and less feasible today, but if properly targeted and monitored a case for such interventions can still be made (Lall, 1998).

4.4. Regulatory Framework

Various features of the regulatory framework bear on technological development. Here we consider regulations related to technology transfer, the encouragement of export activities, competition, foreign investment, intellectual property rights protection and development plans.

Government may intervene to increase technology transfer or improve the terms under which it is conducted. By providing subsidies and fiscal incentives for local involvement it may stimulate the participation of local agents in the transfer and absorption of imported technological packages. An alternative strategy is to guide or subsidise transnational corporations (TNCs) to enter targeted activities or conduct R&D locally. Today, FDI restrictions are less feasible, and an alternative strategy is to lure TNCs to conduct higher value-added activities locally through large investments in training and education and in upgrading of local suppliers, infrastructure and supporting institutions. Developing country licensees are often disadvantaged vis-à-visforeign licensors. They may not be aware of alternative suppliers, let alone be able to assess the commercial value of a license, possibly resulting in higher licensing fees or overly restrictive agreements (e.g.,

restrictions on local adaptations, requirements that the licensee informs the licensor about adaptations, or export restrictions). Governments may impose limits on royalty payments or achieve favourable changes in the terms of licensing agreements (e.g., through information dissemination or through their ability to control the access of licensors to the domestic market).

Korea's restrictive policies towards FDI and foreign licenses induced companies to acquire foreign technology in the form of capital goods and turnkey plants. A slight overvaluation of the local currency and tariff exemptions on imported capital goods facilitated these forms of transfers. At a certain point in the early 1980s Korean government relaxed its policy on FDI and foreign licenses to facilitate advanced technology transfers, which were only possible if foreign partners could retain control. In Taiwan, the *Electronics Research and Service Organisation* (ERSO) licensed technology from abroad and subsequently sub-licensed it to local firms to avoid price-raising competition among them.[8)]

Another commonly recognised factor behind the economic growth of East Asian countries is their early push towards exports, which imposed incentives upon firms for upgrading efficiency and provided them various learning opportunities. Nelson (1996) finds that effective innovation depends on whether the package of fiscal, monetary, and trade policies encourages exporting and, more specifically, that the extent to which firms quickly tried to compete on world markets was a major determinant of the success of infant industry protection programmes. From early on the Korean government pushed and pulled companies to compete in export markets so as to obtain scale economies. This also imposed strict cost and quality requirements on the exporters, which directed them to acquire, master, adapt and develop technology. Export activities also brought companies in contact with foreign OEM buyers from whom technology was transferred in the process of securing processes and products in accordance with buyer requirements. Korea applied export subsidies and suasion to push companies to export and compensate for an overvalued exchange rate and protected domestic market. While export subsidies are inapplicable in the current international commercial climate, various forms of institutional support may be considered to attain export orientation.

In Korea and Taiwan, firms were not only required to compete in export markets. While the domestic market was protected from foreign imports and investments, this was combined with fierce domestic competition. Competition in the domestic market was gradually increased along with the liberalisation of imports and foreign investments. This increased the pressure

8) The publicly owned ERSO was set up in 1974 with the purpose of acquiring semiconductor design and production capability by recruiting a foreign partner to help develop and commercialise the technology.

on local firms to compete on the basis of innovation. A special non-market competitive mechanism discussed in the World Bank's *Miracle Study* was the conduction of contests. In Korea and Japan, firms were encouraged to cooperate and the number of competing firms was kept down to be able to attain scale. Instead of having a large number of independent firms compete in markets, contests were instrumental in avoiding inefficiency and collusion: firms were required to compete for government-controlled scarce resources, particularly credit, foreign exchange, licenses to initiate or expand activities and import protection. These favours were then granted according to export performance and international competitiveness. Thus, the East Asian experience suggests that it is important to combine protection with competition to prevent inefficient allocation of resources and to curb rent-seeking.

Foreign direct investment is an important source of technology and finance, but there are risks inherent to relying too heavily on foreign technology, and industrial policy consequently needs to distinguish between enterprise ownership: TNCs can bring definite advantages to industrialisation processes with the capital, skills, technology, and market access they command, but since they tend to exploit static comparative advantages and retain advanced activities elsewhere, interventions may be needed to lure them into deepening local production and conducting more dynamic and complex activities locally. This might take the form of changing incentives to encourage local technological activity or restricting foreign entry and encouraging and supporting local companies to develop R&D and other technological capabilities themselves. In the short-term and to the individual company, simple import or licensing may appear cheaper, even though there may be long-term advantages associated with the adaptation of imported equipment, and even though the cost of such efforts is likely to decline as firms gradually learn how to perform them. Technological efforts on the part of firms can reduce the cost of technology imports, increase the ability to exploit new technological opportunities, and reduce dependence on imports. In Korea and Taiwan, restrictions on FDI were used as part of a strategy to build local capabilities. Although emerging industries did have to rely on foreign component parts, machinery, know-how, local entrepreneurial and managerial talent were nurtured. This, however, requires a considerable base of human resources and entrepreneurial talent to ensure that local efforts can actually substitute for technology imports.

At the early stages of development, lenient intellectual property right lawsfacilitate local imitation of foreign products and processes, but later on when local companies themselves become able to undertake development work, lax laws may discourage local development efforts. More strict laws, on the other hand, make it imperative for firms to acquire foreign technology or step up their own R&D. Accordingly, one could envision systems of flexible and variable protection,

contingent on the industry or activity in question and its state of development as being developmentally superior. But today, governments have less leeway in this respect: intellectual property right protection with respect to patents, copyright and brand-name laws is more diligently pursued globally through the World Trade Organization (WTO).

Governments commonly formulate development plansrelated to technological development and establish special bodies to devise them and oversee their implementation. The plans typically reflect ambitions to shift from a low to a high technology growth path by taking on more complex industrial activities, increasing local value added in production and design, increasing local innovative activities and so on. Besides determining areas of direct government activism, such plans constitute part of the incentive structure influencing the direction and intensity of private efforts. The plans commonly set growth targets, specify promoted activities, identify areas particularly suitable for local development or for joint local/foreign development, and coordinate efforts between different activities or sectors. In both Korea and Taiwan development plans were developed specifically for the electronics industry. As early as 1967 the Korean government created a *Ministry of Science and Technology*, which was intended to coordinate the technology-related activities of other ministries, but the line ministries largely ignored it. In 1973 they also formed a *National Council for Science and Technology*, but it never functioned. Later on, a body was established to advise the government on science and technology issues.

5. Conclusions

The paper argued that while firms constitute the core of developed economies and are a main vehicle for economic activities, growth and technological development, an exclusive focus on firms is inadequate when dealing more broadly with industrial dynamics. Our central contention was that economic activities should be considered in association with the wider (national) institutional context in which they are embedded (Gammeltoft, 2003). We presented three theoretical approaches sharing the common feature of shedding light on the various ways in which economic activities are embedded. We proceeded to discuss the issue of industrial and technology policy and formulated a number of generic requirements for such policies: 1) a strong and capable government; 2) continual monitoring and adjustment of policies; 3) a gradual upgrading of activities, e.g. from assimilation to innovation; 4) an (only) incremental upgrade from the existing capability base; 5) progressively more reliance on markets; 6) imposition of performance requirements; 7) true selectivity to avoid spreading scarce resources too thinly; and 8) wide and flexible policies.

Finally, we identified a set of specific areas in which industrial and technology policies may be and have been applied with particular reference to the East Asian cases. Table 1 summarises which specific entities and issues the various approaches took into account.

Table 1 : Main Entities Addressed in the Approaches to National Embeddedness

	Business systems	NSI	ITD	Industrial policy
General policies (incentives)	Dominance of the state and its willingness to share risks with private owners; state antagonism to collective intermediaries; extent of formal regulation of markets	Policies towards competition and intellectual property rights	Macroeconomic policies; foreign and domestic competition	Competition
Technology policies		Policies towards industrial innovation	Technology imports; FDI; promotion of local R&D; other interventions to strengthen ITD	Technology transfer; export push; FDI regime; IP protection; development plans; government-business deliberation
Labour and skills	Strength of public training system and state-employer-union collaboration; strength of independent labour unions and certified labour organisations; centralisation of bargaining	Education and training system (including quality and attitudes instilled) Labour-management relations	Skills: worker and supervision, technical, engineering, design and development, scientific and basic research, managerial, organisational, marketing	HR development
Information and technical support		Level and organisation of R&D activities and sources of its funding; roles of universities	Knowledge of the need and promotion of ITD; access to external information; standards, metrology, testing facilities; technical extension services; contract research, design, training; information services on technical sources and trends; basic research support; access to technological information worldwide	S&T infrastructure; industrial extension
Economic agents				Capable firms; specialised technological agents; infant industries; public enterprises
Industrial organisation		Organisational characteristics of important firms and industries; firm-internal R&D labs; user-producer interaction		Supporting industries; subcontracting; SMIs; inter-firm cooperation (e.g. in R&D); rationalisation
Finance	Market vs. credit-based financial system	Institutional set-up of the financial sector	Availability of R&D finance at appropriate rates and in sufficient quantity; equity-sharing finance for innovators; special finance for SMEs	Finance

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